DEFINING AND BUILDING

A DATA USE CULTURE

PATH

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INTRODUCTION

"The digital health community is on a journey to deliver health impact."[1]

Over the past decade, the use of information and communication technology (ICT) to improve health outcomes has multiplied in the global health sector. More recently, there has been an increasing emphasis on maturing away from a myriad of pilots and toward proven and scaled solutions. Now, ICTs are widely recognized as an essential and valuable tool for increasing access to and the quality of information and services.[2,3,4,5]

Interventions in how health care systems make decisions using technology will improve population health by getting the right information in the hands of people making decisions.

At PATH we believe the sector is moving into a new, more mature phase. The question at hand is no longer "should we use ICTs in global health?" but rather "how can we use ICTs to maximize health impact?" One of the primary benefits of ICTs is the improved ability to collect, analyze, and use data. But to do this well and sustainably requires fostering a data use culture.

In this paper, we explore two frameworks that PATH has developed to highlight the necessary components of a data use culture—at a national system or country level as well as at organization, facility, community, or individual levels. We also examine evidence gathered from data use success stories within and beyond the health sector and how a data use culture

influenced their outcomes. Finally, we present recommendations for how the digital health field can take local, regional, and global action to accelerate the rate at which countries and communities are designing and building their own data use cultures. This important action will lead to improved health systems and, ultimately, to healthier people.

1   Wilson K, Gertz B, Arenth B, Salisbury N. The Journey to Scale: Moving Together Past Digital Health Pilots. Seattle: PATH; 2014.

2   PATH. Data Use Partnership: The Journey to Better Data for Better Health in Tanzania. Seattle: PATH; 2016. Available at http://www.path.org/publications/detail. php?i=2734.

3   World Economic Forum. The Global Information Technology Report 2015: ICTs for Inclusive Growth. Geneva: World Economic Forum and INSEAD; 2015. Available at http://www3.weforum.org/docs/WEF_Global_IT_Report_2015.pdf.

4   Perceived value of applying Information Communication Technology to implement guidelines in developing countries; an online questionnaire study among public health workers. Online Journal of Public Health Informatics. 2014;6(2):e180. Available at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4235319/.

5   Simba DO. Application of ICT in strengthening health information systems in developing countries in the wake of globalization. African Health Sciences. 2004;4(3):194–198.

DATA USE CULTURE

Data sometimes defies gravity because it goes up, but doesn't come down. How do we empower health workers so that they can use this data?

— *Dr. Mpoki Ulizubisya, Permanent Secretary of Tanzania's Ministry of Health, Community Development, Gender, Elderly, and Children*

DATA USE CULTURE:
WHAT IS IT?

Defined simply, a data use culture describes the customs, dispositions, and behaviors of a particular group or organization to support and encourage the use of evidence, including facts, figures, and statistics, to inform their decision-making.

In practice, a data use culture is much more complex and encompassing. A sustainable and effective data use culture means that:

- People demand data—valuing, seeking out, and using timely, high-quality data as a standard way of doing business.

- People understand their role as data producers and users—collecting, analyzing, reporting, and applying data to inform decisions and increase the impact of their work.

- People are motivated and empowered to use and act on data.

- People use data to inform decision-making, even if the data highlight a lack of progress against stated goals.

- Managers support and encourage their staff to systematically collect, analyze, report, and use data transparently and in real- or near-time at every level.

- Organizations have, value, and adhere to established data collection and use policies.

- Organizations have data use champions at all levels, including in leadership roles.

- Organizations have interoperable systems that provide real- or near-time, relevant, accessible, and accurate data to staff at all levels.

Data use literature[2,6,7] notes several activities as being critical to the creation of a data use culture. Specifically:

- **DATA PRODUCTION:** Designing harmonized systems and processes that support timely, high-quality data collection for both clinical care and program management leads to data that are changed into actionable information at all levels of the health systems.

- **INFORMATION USE:** This consumable information can be further analyzed, comprehended, and employed by skilled decision-makers who take and promote evidence-based actions.

When both of these elements are in place, they fuel the need for even more information. In practice, systems and contextual factors act on these elements to accelerate and drive an increased demand for high-quality data, creating an improved data use culture. When a strong data use culture is present, the stage is set for improving health system outcomes, such as improved systems management, facility management, and patient management.

To foster the development and institutionalization of a data use culture, it is important to prioritize data use efforts and interventions at all levels of the health system—from national policy to the delivery of services. The interplay between these levels and stakeholders brings together dependencies that are necessary to enable timely, high-quality data to be generated, transformed into usable information, and then effectively acted on within the health system, ultimately leading to improved health system performance.

6   McElheran K, Brynjolfsson E. *The rise of data-driven decision making is real but uneven. Harvard Business Review. February 3, 2016. Available at https://hbr. org/2016/02/the-rise-of-data-driven-decision-making-is-real-but-uneven.*

7   Nutley T, Reynolds HW. *Improving the use of health data for health system strengthening. Global Health Action. 2013;6(1):20001. Available at http://www.tandfonline. com/doi/full/10.3402/gha.v6i0.20001.*

DATA USE CULTURE:
WHY IS IT IMPORTANT?

A major obstacle to accelerating health gains and optimizing the efficiency and effectiveness of health care delivery is that decision-makers at all levels of the health system are not using data at all times or in an optimal way to drive planning, performance management, and the delivery of services.

The use of timely, high-quality data is essential to strengthen health systems and provide health services efficiently.

However, many organizations and countries have deficiencies in both data production and information use, resulting in a broken data use cycle. These deficits result in limited use of evidence in population health decision-making and, consequently, suboptimal health systems performance. Countries and organizations can improve health outcomes by introducing interventions or technologies that put the right information at the right time in the hands of the right people so they can make better decisions.

Photo: PATH/ Gabe Bienczycki

DATA USE CULTURE:
HOW CAN IT BE STRENGTHENED?

A THEORY OF CHANGE FOR ACCELERATING DATA USE IN NATIONAL HEALTH SYSTEMS AND COUNTRIES

How is a national culture of data use established and sustained? In 2016, PATH and Vital Wave Consulting jointly developed a theory of change to illustrate how countries can stre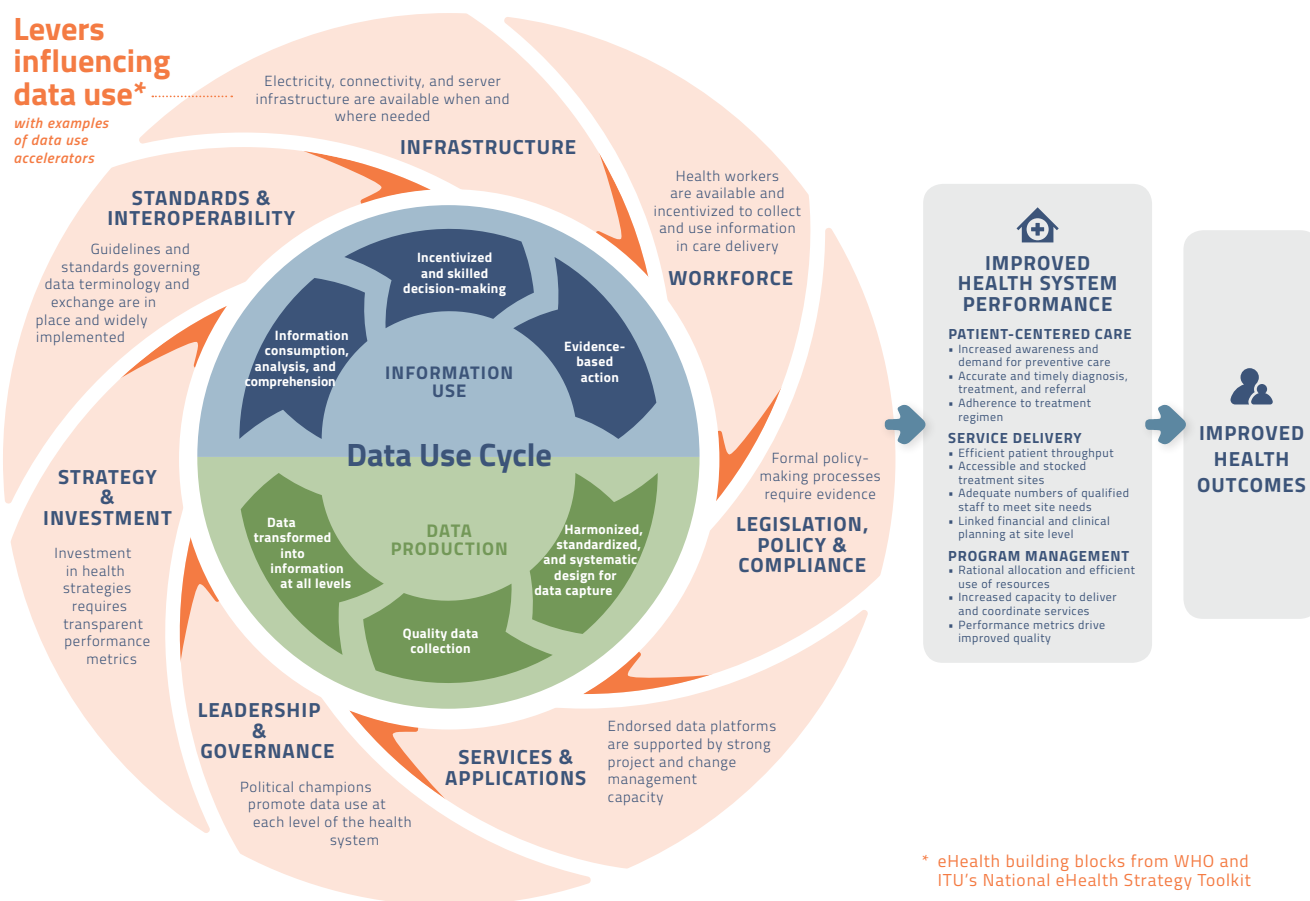ngthen national data systems and accelerate data use (see Figure 1). The principal hypothesis of the theory is that better data and regular data use will create a data use culture, leading to better decisions, an improved health system, and improved health outcomes.[8]

The eHealth building blocks from the World Health Organization (WHO) and International Telecommunication Union (ITU's) National eHealth Strategy Toolkit[9] provide a framework and categorization of the various factors that can act as "levers" to accelerate or hinder the cycle of data production and information use. The presence of these factors determines whether or not a particular environment fosters data use.

FIGURE 1

THEORY OF CHANGE FOR ACCELERATING DATA USE IN HEALTH SYSTEMS.

Levers influencing data use*
with examples of data use accelerators

INFRASTRUCTURE
Electricity, connectivity, and server infrastructure are available when and where needed

WORKFORCE
Health workers are available and incentivized to collect and use information in care delivery

STANDARDS & INTEROPERABILITY
Guidelines and standards governing data terminology and exchange are in place and widely implemented

STRATEGY & INVESTMENT
Investment in health strategies requires transparent performance metrics

LEADERSHIP & GOVERNANCE
Political champions promote data use at each level of the health system

SERVICES & APPLICATIONS
Endorsed data platforms are supported by strong project and change management capacity

LEGISLATION, POLICY & COMPLIANCE
Formal policy-making processes require evidence

Data Use Cycle

INFORMATION USE
- Incentivized and skilled decision-making
- Evidence-based action
- Harmonized, standardized, and systematic design for data capture
- Quality data collection
- Data transformed into information at all levels
- Information consumption, analysis, and comprehension

DATA PRODUCTION

IMPROVED HEALTH SYSTEM PERFORMANCE

PATIENT-CENTERED CARE
- Increased awareness and demand for preventive care
- Accurate and timely diagnosis, treatment, and referral
- Adherence to treatment regimen

SERVICE DELIVERY
- Efficient patient throughput
- Accessible and stocked treatment sites
- Adequate numbers of qualified staff to meet site needs
- Linked financial and clinical planning at site level

PROGRAM MANAGEMENT
- Rational allocation and efficient use of resources
- Increased capacity to deliver and coordinate services
- Performance metrics drive improved quality

IMPROVED HEALTH OUTCOMES

* eHealth building blocks from WHO and ITU's National eHealth Strategy Toolkit

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8   PATH. *Theory of Change for the Data Use Partnership*. Seattle: PATH, Vital Wave; 2016. Available at http://www.path.org/publications/files/DHS_theory_of_change_rptv2.pdf.

9   World Health Organization and International Telecommunication Union. *National eHealth Strategy Toolkit*. Geneva: WHO; 2012. Available at http://www.who.int/ehealth/publications/overview.pdf.

LEADERSHIP AND GOVERNANCE	• Political champions promote data use at each level of the health system. • Political commitment exists to support data systems and make evidence-based decisions. • Active intragovernmental convening bodies have the authority and resources to coordinate investments, regularly review data and data systems, and operationalize strategies. • Defined governance and management structures are in place to implement digital health strategies. • Invested and coordinated data use leaders exist at all levels of government and civil society.
STRATEGY AND INVESTMENT	• Data systems and data use strategies are published, accessible, activated, and budgeted and have transparent performance metrics—all aligned to global best practices. • Investments in health strategies require transparent performance metrics. • National strategies articulate the governmental data vision and are invested in by the government. • Dedicated in-country financing mechanisms are in place. • National budget is tied to health payments. • Donor investments are catalytic, coordinated, and driven by government priorities.
SERVICES AND APPLICATIONS	• Endorsed data platforms are supported by strong project and change management capacity with articulated business or financial models. • Point-of-service applications and administrative systems used by health workers are institutionalized throughout the health system. • Services and applications have user-centric designs and supported business systems are in place. • Institutionalized applications and services are in place for all eHealth building blocks.
STANDARDS AND INTEROPERABILITY	• Clear guidelines and standards are in place to govern data terminology and exchange, ICT connectivity, and data use. • Clear frameworks are harmonized, up to date, and endorsed across domains to measure health system performance, including national monitoring and evaluation frameworks, interoperability architecture, and technology standards. • A national digital health architecture is in place. • Active governing bodies are in place and meet regularly to manage and oversee adherence to health standards for ICT and data use. • Mechanisms are in place to ensure owners of data systems demonstrate plans for interoperability and compliance.
INFRASTRUCTURE	• Reasonable political stability, reliable electricity, minimum standard internet connectivity, and server infrastructure (with backup sources accessible when needed) are in place. • Health workers at all levels are able to access the tools they need to analyze and use data effectively. • Adequate technical support, ICT capacity, and maintenance systems exist locally. • Encryption tools and guidance are standardized and implemented to ensure data privacy and security.
LEGISLATION, POLICY, AND COMPLIANCE	• Formal policymaking processes require and are based on evidence and data. • Integrated processes exist to develop evidence-based policies across ministries. • Policymakers adopt comprehensive, evidence-based policies that strengthen digital health systems. • National legislation establishes an enabling digital environment. • Clearly published processes exist for auditing compliance, with penalties for noncompliance. • A national health plan establishes data use as a pillar.

| WORKFORCE	• An adequate number of health workers are available and incentivized to collect and use data for health care delivery. • Ongoing in-service capacity-building efforts are in place to enhance skills in data analytics, management, and use for service delivery as well as program planning and policymaking. • Decision-makers are trained and skilled in understanding and using data effectively. • Peer networking is leveraged to improve performance and support workers at all levels in all roles.

This framework focuses primarily at the national or country level, but the themes can be applied to other contexts. When these levers are "pushed" or invested in, they act as accelerators, improving and intensifying data production and information use, generating momentum in the cycle of data use, leading to an improved data use culture, and enabling evidence-based decisions that drive health system performance (see Figure 2). When there is suboptimal investment in one of these levers, the cycle of data use can decelerate.

FIGURE 2

COMPONENTS OF A DATA USE CULTURE

Data Production + Information Use	X	Levers	=	Data Use Culture, which leads to Improved Health System Performance
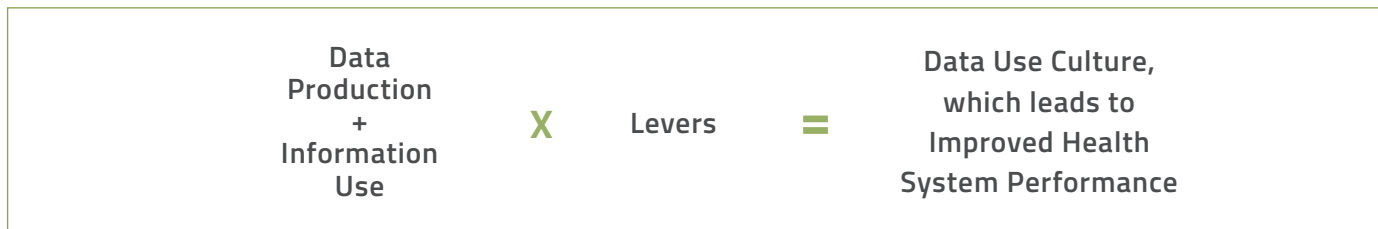
As this theory is applied, understanding how the levers interact and relate to each other and the context is critical, revealing potential barriers to success and opportunities for targeted system improvement. Key considerations include:

• **WEIGHTING**: What is the relative weight of each accelerator's impact on the data use cycle and health system performance? Which accelerators have funding and political support? Which are in danger?

• **PHASING**: Are there dependencies between the accelerators that suggest an optimal phasing or sequencing in different contexts? Should one accelerator be prioritized over the others?

• **INTERPLAY**: What is the potential multiplicative effect among the different accelerators?

• **CONTEXT**: Does the context (including health system maturity) make a difference in the impact these accelerators have on the data use cycle and health system performance? If so, how can the accelerators be structured to increase their positive impact?

By answering these questions, a tailored approach to fostering a national data use culture can be developed, accounting for specific resources, infrastructure, and capacity.

BEHAVIOR CHANGE FRAMEWORK FOR ENABLING DATA USE THROUGH INDIVIDUALS WITHIN COMMUNITIES, FACILITIES, AND ORGANIZATIONS

The theory of change discussed above identifies the key levers to strengthen a data use culture within a national health system context and outlines the data production and information use cycle required to achieve data use. The behavior change framework (see Figure 3) is complementary to the theory of change, explaining how the levers influence a set of individual actors within the health system who must change their behavior and increase their production and use of quality data.

These individuals interact with the data use cycle collecting, transforming, from analysis to reporting, and acting on data within communities, facilities, and organizations.

In the behavior change framework, the individual is at the center because culture change in the health system— at all levels from national policy to service delivery—starts with individual people. It is the individuals who work within the broader context of information system products, data management and use policies, evidence-based practices, and capacitated and motivated people.

To foster a data use culture, an organization needs to establish a collective understanding and expectation around the value of data and its role in decision-making. The behavioral shifts required to generate and sustain momentum around a data use culture require the contributions and actions of many individuals. The pathways to enable this individual change consist of five interrelated pathways: awareness of need, access to information, motivation to act, empowerment to act, and skills to use and improve quality.

FIGURE 3

A BEHAVIOR CHANGE FRAMEWORK FOR ENABLING DATA USE THROUGH INDIVIDUALS WITHIN COMMUNITIES, FACILITIES, AND ORGANIZATIONS.

DATA USE CULTURE: **WHAT AND WHY?**

The theory of change for accelerating data use in health systems and the behavior change framework for enabling data use through organizations, facilities, communities, and individuals are complementary.

We've discussed how the theory of change identifies key systems levers that can be acted upon to accelerate a data use culture within the context of a national health system while the behavior change framework identifies the individual and organizational enablers that allow for a data use culture to exist.

These two frameworks further complement each other in that the theory of change speaks to **WHAT** has to happen and be in place for an optimal data use culture to take root. The behavior change framework, on the other hand, speaks to **WHY** it can take root—namely, why individuals and their organizations enact critical data use responsibilities.

WHAT HAS TO HAPPEN TO OPTIMIZE A DATA USE CULTURE (FROM THEORY OF CHANGE)	**WHY INDIVIDUALS ENCOURAGE A DATA USE CULTURE** (FROM BEHAVIOR CHANGE FRAMEWORK)
• Tools are harmonized and systematically implemented. • High-quality data are collected. • Data are transformed into consumable information at all levels of the health system. • Information is consumed and analyzed at all levels. • Decisions are made based on these analyses. • Evidence-based decisions lead to action.	• Individuals see the need for data use. • They have access to information that they need. • They are motivated to act on that information. • They are empowered to act based on their analysis of that information. • And, they have the needed skills to use and improve the data.

Both the "what" and the "why" are critical in making sure that people at all levels are doing what is needed for data to be transformed from the collection of numbers or elements to evidence-driven action.

- **AWARENESS OF NEED:** To stimulate a growing demand for data, individuals need to have an awareness of the value of high-quality data to inform decisions and be aware that they are expected to use data and actively participate in the information cycle. The stimulus for their awareness may be intrinsic or extrinsic, but the premise that their respective role requires the application and use of data is fundamental to the process of cultivating a data use culture.

- **ACCESS TO INFORMATION:** Having access to usable information based on high-quality data is required for individuals to act on that information. The routinized process for availing information to decision-makers facilitates their ability to establish a practice of applying data for decision-making. Therefore, providing access to complete, accurate, and timely information is the goal of the data system.

- **MOTIVATION TO ACT:** To follow through on using data to inform decision-making, individuals must be motivated to do so. Much research and effort has been invested to further understand the drivers of individual motivation with regard to health workers and health systems. Motivation can come from extrinsic incentives, both financial and nonfinancial, or through harnessing intrinsic drivers, such as altruism and a care for the community. Motivation may differ significantly from one individual to the next, and from one day to the next. Nevertheless, working to incentivize health workers through the use of peer networks, data use champions, and other forms of recognition and performance management is important to stimulate motivation to use data.

- **EMPOWERMENT TO ACT:** The ability of individuals to feel empowered to act on the information they have access to is critical not only to the improvement of health service

delivery but also to their sustained motivation to use data. The facets of empowerment are directly linked to the formal policies, including job descriptions and the subsequent roles and responsibilities of the individual workers, as well as to the informal policies and practices that guide their day-to-day activities. As a result, activities supporting this pathway should enable individuals to thoroughly understand what their level of empowerment is, identify what decisions they have control over, and apply and act on information accordingly.

- **SKILLS TO USE AND IMPROVE QUALITY:** The capacity to synthesize information extracted from a data system and act on that information relates to an individual's ability to identify the relevant management questions, review and identify pertinent information for a specific question, interpret that information, and then develop conclusions and corresponding action items to address the question. The quality of decision-making is influenced by a number of factors, including performance support, experience, and the ability to monitor performance. Individuals must have the necessary capacity and organizational support relative to the decisions they are responsible for.

In addition to these well-marked individual pathways, building and strengthening a data use culture also requires an organization to adopt a holistic approach that includes information system products, data management policies, and evidence-based practices, as well as motivated people who have the necessary skills. The "Four Ps" are the organizational elements that need to be in place to support the individual pathways and help form a data use culture:

- **POLICIES** and the management structure surrounding data generation and use greatly affect the predominant culture around data use. Standing government policies and procedures often discourage program managers from applying their skills to interpret and report accurate information. The environment around information and reporting can be closely linked to funding and resource allocation, which can either stimulate or stymie accurate reporting and the application of data to health system service delivery. Moreover, the misalignment of policies is most often exacerbated at the subdistrict level, which is where much of the service delivery occurs. Depending on the congruency of governing policies, the implementation of policies can create conflicts or competing priorities. Therefore, clear and complementary policies are paramount to cultivate an environment that encourages and rewards data use and the application of evidence-based decision-making.

- **PRODUCTS** include modifying existing systems to stimulate new functionality, or they may involve new tools that enable users to collect, report, and analyze data more efficiently in real- or near-time. This includes improved paper-based solutions that lend themselves to gains in data quality and increased functionality that translate to improved data use. Products also include technology solutions, such as electronic medical records or registries, that are integrated into a national health information system at appropriate points of interaction to create a seamless and timely information system.

- **PRACTICES**, a complementary component of policymaking, involve the formal and informal activities that result in the operationalization of the policies. These practices help institutionalize the culture surrounding data use, whether for the benefit or to the detriment of data use. Performance management and support are integral to curating an enabling environment that can adequately support the proliferation of data use. The recognition of the deeper underlying importance of social norms and values in shaping how organizations evolve their practices to elevate and prioritize the use of data to become the expected standard needs to be consistently applied to all practices, both the formal and the informal ones.

- **PEOPLE**, the workforce that supports health service planning and delivery at all levels, are key to a resilient data use culture. In order for the data to be in the hands of the right individual, at the right time, the interconnectedness of the health system and those working within it needs to be aligned and working in concert. A strong data use culture reinforces the ability of the workforce to cumulatively apply data for decision-making, to have adequate staff levels and structure in place, to have sufficient capacity, and to facilitate the opportunity for the health workers to be analyzing data and applying relevant data for decision-making. The degree to which a health workforce is networked will influence how effectively and efficiently data are leveraged and used throughout the system.

DATA USE IN GLOBAL HEALTH

Data that people can't understand is just noise.
Data that people can understand and trust is knowledge.

— *Tim Trefen, Cofounder of Mixpanel, Inc.*

To understand how to utilize the frameworks above, it is important to examine the evidence behind their design and to put them in the context of real-life data use implementation situations. Below are examples of how two countries, Tanzania and Zambia, sought to strengthen data use through the Data Use Partnership and the BID Initiative.

DATA USE PARTNERSHIP

The government of Tanzania and development partners are calling for increased and improved investments in data systems and data use to strengthen their ability to make evidence-based decisions. Through the Data Use Partnership (DUP), the Bill & Melinda Gates Foundation provided funding for the government of Tanzania, supported by PATH, to develop a costed investment road map, building on previous assessments and existing work.

A core team consisting of the Ministry of Health, Community Development, Gender, Elderly and Children; the President's Office Regional Administration and Local Government; and PATH worked closely together to review existing literature, interview stakeholders, discuss findings, and formulate and cost 17 investment recommendations totaling $74 million prioritized by the government of Tanzania to improve health system performance through better data use.

DATA USE PARTNERSHIP IN TANZANIA:
AN INVESTMENT ROAD MAP

The government of Tanzania is striving to move the country to middle-income status and achieve the Sustainable Development Goals. Tanzania has achieved several health-related Millennium Development Goals; however, others remain unattained. Routine access to and use of high-quality data can play a pivotal role in supporting the attainment of these goals by increasing quality and reach of health care while reducing cost.

Stakeholders in Tanzania almost universally acknowledge the role data can play in improving health systems and, ultimately, health outcomes. At the national level, government agencies and partners are currently working to implement more than 120 health-related data systems and a range of data use initiatives, with little coordination or visibility between systems. At the primary care level, health care workers often lack data management and data use skills. And at all levels of the health system, variability in data quality and data standardization results in low incentives for health workers to use data to inform health system and health care decisions (see Figure 4). To address these challenges, the government of Tanzania has prioritized improvements to its health information systems and efforts to build a culture of data use.

The government of Tanzania wants to use high-quality, well-managed data to guide health policies, practices, and resource allocations. With directed investment, these are attainable goals and will lead to positive outcomes at every level of the health system:

- **HEALTH WORKERS** will have the data to better deliver services, track and manage supplies, and treat patients.
- **ADMINISTRATORS** will be able to target supplies and staff to the areas that need them most.

- **POLICYMAKERS** will be empowered to make informed budgeting and planning choices and to hold implementers accountable for monitoring, evaluation, and reporting.

To determine what investments should be made to strengthen data systems and data use in Tanzania, the DUP team supported the government in conducting a landscape and gap analysis to inform the development, prioritization, and costing of a set of investment recommendations (see Figure 5). The Tanzanian government's leadership and participation with the DUP team in the analysis process was critical to ensuring advocates for strengthening data use were vocal at the national level of the health sector. Below is a discussion of what was learned during the analysis as it applies to the theory of change described earlier and the resulting investment recommendations (see Figure 2).

10   AbouZahr C, Adjei S, Kanchanachitra C. From data to policy: good practices and cautionary tales. Lancet. 2007;369(9566):1039–1046. Article is part of the Lancet Health Statistics Series. Available at http://www.thelancet.com/pdfs/journals/lancet/PIIS0140-6736(07)60463-2.pdf.

FIGURE 4

DATA NEEDS AT DIFFERENT LEVELS OF THE HEALTH SYSTEM.[10]

CURRENT FINDINGS AROUND THE LEVERS FOR CHANGE

The landscape and gap analysis for the Data Use Partnership demonstrated that each of the seven levers of the theory of change are essential to building a culture of data use, though the first three listed below (leadership and governance, standards and interoperability, and workforce) have the greatest influence on the data use cycle in the current Tanzanian context.

Leadership and governance: At the highest level of the government, the president's office, there is vocal commitment to data use, transparency, and accountability for ensuring efficient use of public resources for high-quality public service. With the president as a champion and enthusiastic leadership at the ministry level, the political will is there; the key to success lies in institutionalizing and governing data use. Improved coordination of investments and integration and governance of data and data systems are government priorities. The data use investment road map provides a clear, specific, and costed plan to guide future investments.[2]

Standards and interoperability: The ability to pull data from different sources and convert it into actionable information is critical to enabling people to make data-driven decisions.[8] Similarly, it is essential to draw on what data the current system can produce and to enhance that function through better programming and funding.[11] Many good data services and applications have been designed and implemented; better integration and use of data systems and the information they can produce is now the focus. Services and applications are often designed and implemented without a coherent, overarching architecture and underlying standards.

Health workers have to know which data systems to use for which purposes, sometimes requiring entering the same data into multiple systems. Gaps in integration of systems make it challenging to get a comprehensive, aggregated view of the population's health and tailor policies and resource decisions accordingly. There are different systems for tracking different diseases and no unique patient identification, so it is difficult for health workers to understand the patient's medical history and provide appropriate, high-quality health services.

Workforce: The local market for hardware and the availability of skilled software developers is rapidly improving. Meanwhile, Tanzania's health sector has had challenges tracking and managing the allocation and retention of skilled health workers, resulting in some areas of the country lacking the skilled personnel they need. Using health workforce data could solve this, but accessing high-quality data in a usable format is a gap. Tanzania has built a culture of data collection, but quality of the data collected and use of that data remains a significant challenge. It is not enough to have the data; effective analysis to inform decisions is what ultimately improves the outcomes of decisions. Training for health workers in data systems and use is becoming more prevalent but is still limited. Health workers need more training in how to use data collection tools and how to assess the quality of data collected. It must be clear what the value of the data is at all levels of the health system. Through our stakeholder interviews, PATH heard that the value of the data and the importance of accurate data collection is not always well understood at the point of data collection and that data are transmitted up to high levels without much feedback.

Strategy and investment: The government has already established or is close to finalizing clear and thorough strategies to guide priorities in data systems and use (e.g., the Health Sector Strategic Plan IV,[12] National eHealth Strategy,[13] the draft Monitoring and Evaluation and Data Dissemination and Use strategies). There is significant investment already and interest in increasing investments in the implementation of these strategies from the government and its partners.

Legislation, policy, and compliance: As mentioned above, Tanzania has developed and formalized government strategies and policies around the use of ICTs and the data they produce. One of the key challenges the country faces is implementation and enforcement of those strategies and policies. This is caused by limited resources available for implementation and enforcement and limited awareness by the agencies, organizations, and people of the policies and how to comply with them.

11   Walpole M, McGeoch M, Bubb P, Brummitt N. Using Data for Decision-Making: From observations to indicators and other policy tools. In: Walters M, Scholes RJ, eds. The GEO Handbook on Biodiversity Observation Networks. Pretoria, South Africa: Springer International Publishing; 2017. doi:10.1007/978-3-319-27288-7_12.

12   Tanzania Ministry of Health and Social Welfare. Health Sector Strategic Plan IV (July 2015-June 2020). Available at http://www.tzdpg.or.tz/fileadmin/documents/dpg_internal/dpg_working_groups_clusters/cluster_2/health/Key_Sector_Documents/Induction_Pack/Final_HSSP_IV_Vs1.0_260815.pdf.

13   Tanzania Ministry of Health and Social Welfare. Tanzania National eHealth Strategy 2013–2018. Available at http://www.who.int/goe/policies/countries/tza_ehealth.pdf.

Infrastructure: Significant investments in telecommunications infrastructure are already underway from the private sector (e.g., Halotel). ICT innovation and development is increasingly occurring locally in Tanzania and the region—in the Silicon Savannah—not just in places like Silicon Valley.

Services and applications: As part of the Silicon Savannah, Tanzania has experienced a rapid growth in the number of ICT pilots and deployments, many in the health sector (see Figure 5).[2] Often these are developed and funded by external, international organizations. In a now crowded ecosystem of ICTs, Tanzania's health sector is trying to improve coordination of the data systems themselves, along with access to the data they produce.

TANZANIA'S EXISTING ECOSYSTEM
OF HEALTH DATA SYSTEMS IS CROWDED AND FRAGMENTED [2]
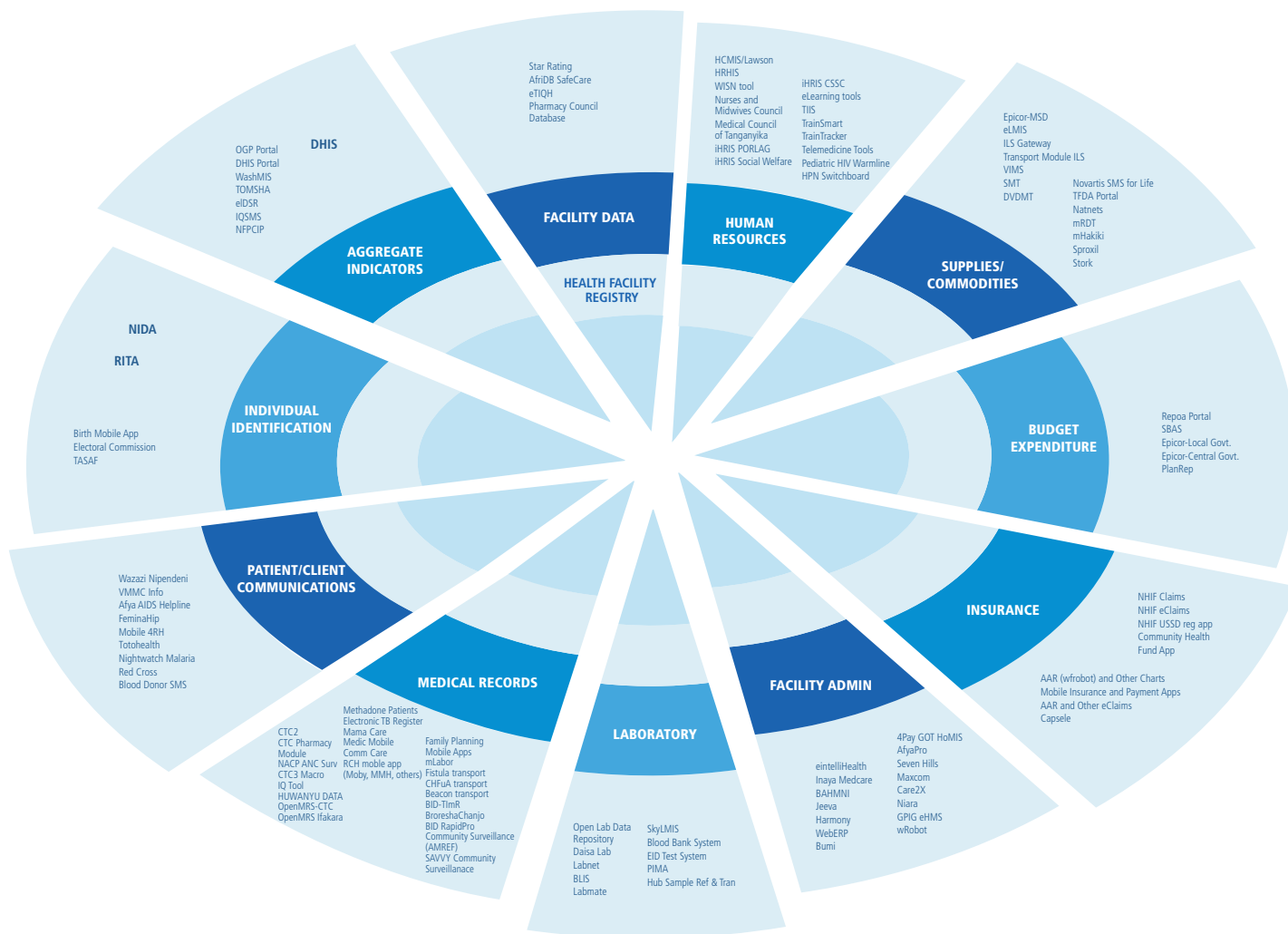
NOTE: The full list of defined acronyms in this graphic are available on pages 114-116 of Data Use Partnership: The Journey to Better Data for Better Health available at: http://www.path.org/publications/detail.php?i=2734.

FIGURE 6

TANZANIA'S DATA SYSTEMS AND USE INVESTMENT ROAD MAP.

ROAD MAP: THE JOURNEY

With these priority investments, Tanzania will be able to effectively use data to improve health.

Years 1 2 3 4 5 6

Enhance government coordination of data systems and use initiatives
$220,000

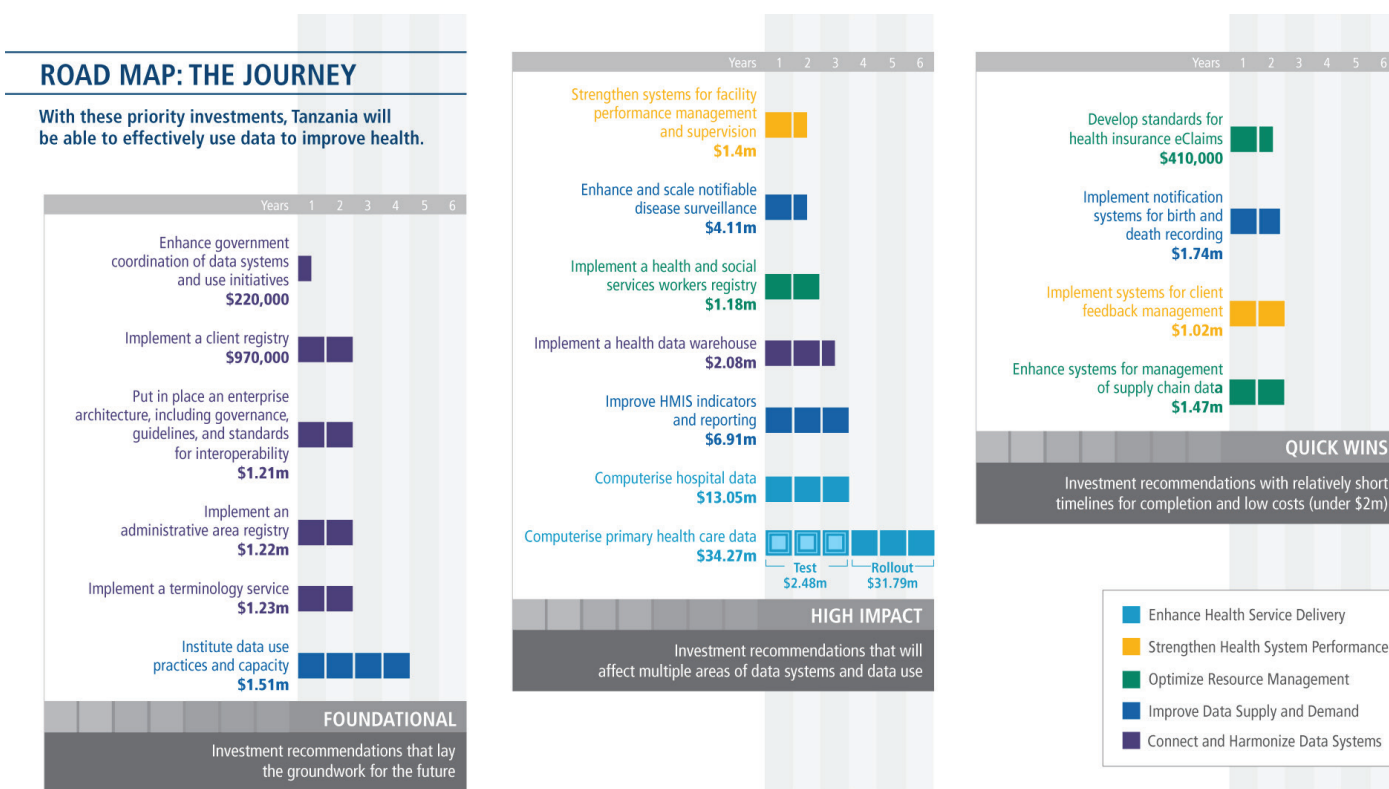Implement a client registry
$970,000

Put in place an enterprise architecture, including governance, guidelines, and standards for interoperability
$1.21m

Implement an administrative area registry
$1.22m

Implement a terminology service
$1.23m

Institute data use practices and capacity
$1.51m

FOUNDATIONAL
Investment recommendations that lay the groundwork for the future

Years 1 2 3 4 5 6

Strengthen systems for facility performance management and supervision
$1.4m

Enhance and scale notifiable disease surveillance
$4.11m

Implement a health and social services workers registry
$1.18m

Implement a health data warehouse
$2.08m

Improve HMIS indicators and reporting
$6.91m

Computerise hospital data
$13.05m

Computerise primary health care data
$34.27m

Test $2.48m   Rollout $31.79m

HIGH IMPACT
Investment recommendations that will affect multiple areas of data systems and data use

Years 1 2 3 4 5 6

Develop standards for health insurance eClaims
$410,000

Implement notification systems for birth and death recording
$1.74m

Implement systems for client feedback management
$1.02m

Enhance systems for management of supply chain data
$1.47m

QUICK WINS
Investment recommendations with relatively short timelines for completion and low costs (under $2m)

■ Enhance Health Service Delivery
■ Strengthen Health System Performance
■ Optimize Resource Management
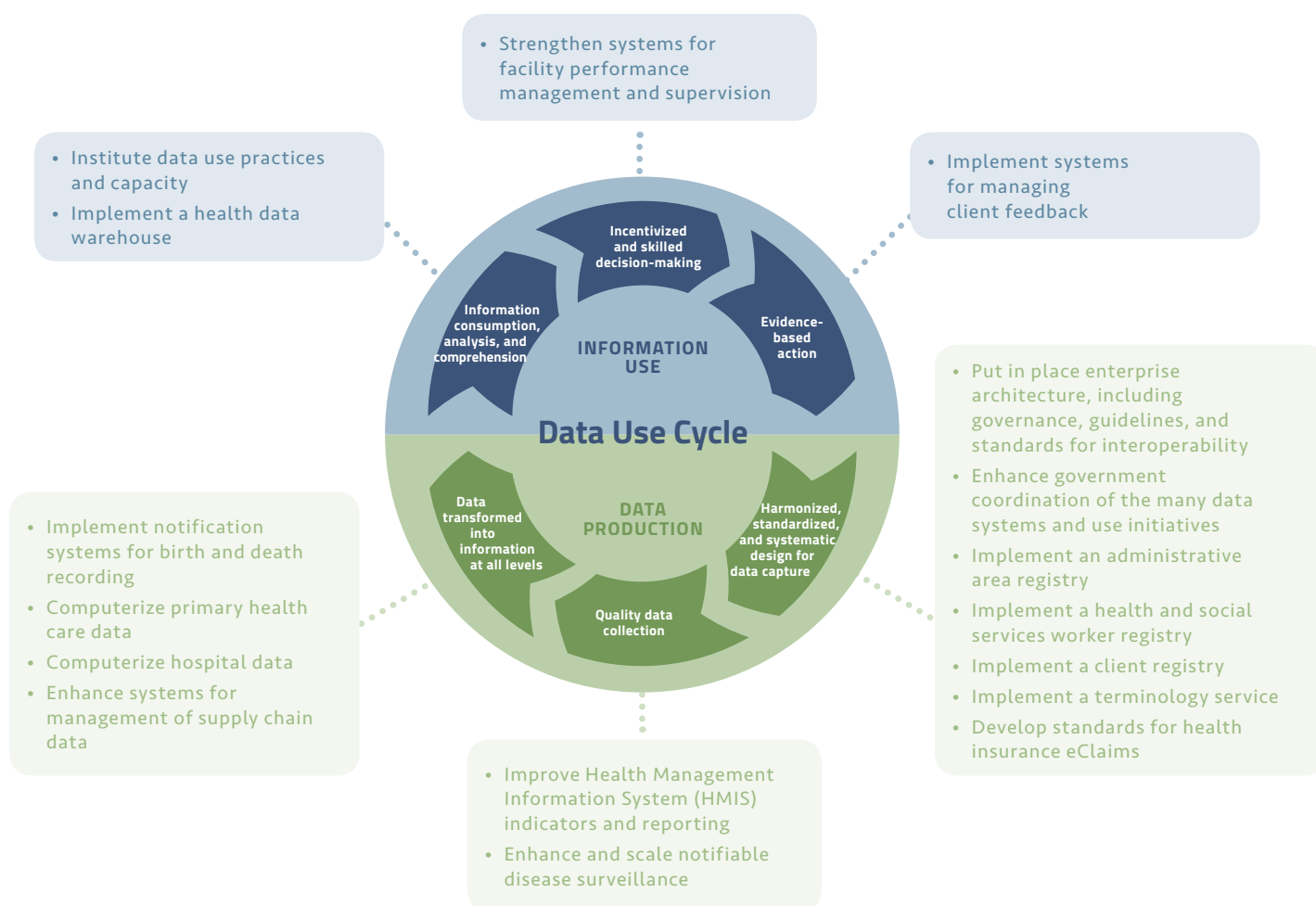■ Improve Data Supply and Demand
■ Connect and Harmonize Data Systems

INVESTMENT RECOMMENDATIONS

After conducting the landscape and gap analysis, the DUP team compiled 38 potential investments to strengthen a culture of effective data use that the government of Tanzania then further consolidated and prioritized. Below are the 17 investment recommendations that resulted from this process, divided into three categories: foundational, high-impact, and quick-win (see Figure 6).[2]

The investment recommendations include components from multiple levers of change. For example, any investment recommendation involving the deployment of a data system will adhere to standards and include documentation of the system (for maintenance and future enhancements) and training for users.

At this phase, Tanzania should focus primarily on strengthening data production—ensuring harmonized, standardized, and systematic design for data capture; high-quality data collection; data transformed into information at all levels; and incentivized and skilled decision-making (see Figure 7). These elements are necessary before a full and effective data use cycle, and culture, are possible.

FIGURE 7

- Strengthen systems for facility performance management and supervision

- Institute data use practices and capacity
- Implement a health data warehouse

- Implement systems for managing client feedback

Data Use Cycle

INFORMATION USE
- Incentivized and skilled decision-making
- Information consumption, analysis, and comprehension
- Evidence-based action

DATA PRODUCTION
- Data transformed into information at all levels
- Harmonized, standardized, and systematic design for data capture
- Quality data collection

- Implement notification systems for birth and death recording
- Computerize primary health care data
- Computerize hospital data
- Enhance systems for management of supply chain data

- Put in place enterprise architecture, including governance, guidelines, and standards for interoperability
- Enhance government coordination of the many data systems and use initiatives
- Implement an administrative area registry
- Implement a health and social services worker registry
- Implement a client registry
- Implement a terminology service
- Develop standards for health insurance eClaims

- Improve Health Management Information System (HMIS) indicators and reporting
- Enhance and scale notifiable disease surveillance

The theory of change proved a valuable tool in developing the assessment framework used to determine the final investment recommendations. Its components ensured that the analysis and final recommendations were both deep and comprehensive and carefully designed to consider the complexities of Tanzania's health sector context as well as best practices in software development, data analysis, and change management.

The foundational investment recommendations are important to prioritize at the start of road map implementation. For example, the enterprise architecture investment recommendation is a prerequisite for other investments that focus on registries and new or enhanced data systems. While each investment recommendation promotes the growth of a data use culture throughout the health system, without the requisite infrastructure being built, there will be no foundation from which that culture can grow.

BID INITIATIVE
Better data. Better decisions. Better health.

BETTER IMMUNIZATION DATA FOR ALL

The BID Initiative is grounded in the belief that better data, plus better decisions, will lead to better health outcomes. Led by PATH and funded by the Bill & Melinda Gates Foundation, the vision of the BID Initiative is to empower countries to enhance immunization and overall health service delivery through improved data collection, quality, and use.

The BID Initiative began by working with the ministries of health in Tanzania and Zambia to:

- *Identify the key challenges these countries face with immunization program data quality and data use in their immunization program.*
- *Develop and implement a package of interventions to create an environment where reliable, easily accessed, and actionable data can be used to improve health outcomes.*
- *Disseminate the lessons learned, interventions, and tools to other countries and the global community.*

BID INITIATIVE:
A HOLISTIC APPROACH

The BID Initiative was designed to take a holistic approach to the development and institutionalization of a data use culture focused on information system products, data management policies, evidence-based practices, and capacitated and motivated people—at all levels of the health system. This design resulted in the development of the behavior change framework presented earlier. The individual pathways and organizational elements presented in this framework are illustrated below, using experiences gathered by BID Initiative teams in Zambia and Tanzania.

PATHWAYS TO A DATA USE CULTURE

Build an awareness of need—at all levels of the health system.
BID Initiative Zambia's first implementation milestone was to secure a Memorandum of Understanding (MOU) with the MOH to show its support and commitment to the implementation of the BID Initiative. The MOU signified that the MOH was aware of the need, and willing to partner, to improve data quality and use in immunization. It also acknowledged the need to review and update policies through the BID Initiative, reflecting the policy aspect of the data use conceptual framework.

The BID Initiative team then carried out assessment visits at national, provincial, district, and facility levels that confirmed many data quality and use challenges that the Expanded Programme on Immunization (EPI) faced. These assessments showed that the Zambia EPI routinely recorded immunization coverage rates ranging from 110 percent at facility level to below 75 percent at national level; that record keeping was incomplete, inaccurate, and late; and that there were facility stockouts with no corresponding stockouts at district level and upward. These challenges continued to build awareness of the need to improve data quality and use.

Once facility implementation started, an additional problem was identified: health care workers believed they were only collecting data for reporting—not

for use to address problems they face in their daily work like defaulter tracking, stock ordering, and vaccination outreach. Building this awareness of the usefulness of data among health workers was another necessary step in building a data use culture.

Create access to the right information at the right time.
The BID Initiative is introducing new systems to track vaccine delivery and vaccine stock information. At the facility level this means capturing actionable information about which children are receiving which vaccine doses at what time; at the district level this means having information about facility stock levels in order to proactively avoid stock outs.

These systems allow health care workers to use a tablet to look up a child when he or she comes to the clinic and easily see which vaccine doses the child is due for. All the information is saved in one place, even if that child received vaccinations at multiple health centers, and is easily accessed by any health worker. It also allows health workers to have access to data on which children may have missed a vaccine dose so they can take action and follow up with those children, through community leaders or outreach activities. Health care workers can also access stock information so they

know when to reorder supplies and vaccines based on forecasted needs. District authorities can also use these data to oversee activities at facilities within their district and determine where they may have pockets of low coverage so they can take action with the facilities to address gaps.

Motivate and empower individuals to act, and ensure they have the necessary skills and capacity to do so.
Data use practices mature over time as individuals become motivated and empowered and build the necessary capacity to be true data users.

In Zambia, regardless of the previously mentioned MOU, the various program officers within the national government were not sufficiently empowered to act to address data challenges. From an institutional level, there was fragmentation in decision-making. It was not clear who was mandated to make decisions in what area, and once those decisions were made, there was always the threat that another program officer from another unit would veto that decision if the decision was made in his or her absence. A MOH/BID technical working group (TWG) was created to address this challenge. The purpose of the TWG was to get all the relevant program officers in one place to debate issues and make final decisions.

The TWG also highlighted the need for the MOH to have a coordinated internal mechanism among the various units to address crosscutting issues in the implementation of BID and any other digital health interventions.

At subnational levels in Tanzania, health care workers often see their monthly reports as a top-down reporting activity and the final result of their data collection efforts, rather than information that they can use to make decisions about the immunization services they deliver. For example, some facilities had reports noting children who had missed vaccine doses but the facilities were not acting on them. Addressing this challenge requires changing the mentality that data are only for reporting. The BID team has recruited and trained district staff to be immunization mentors to model, encourage, and support health care workers at the facility level to improve the quality of their data and use it to inform their planning and decision-making. District-level engagement has been key to motivate and empower facility-level data use, and for the long-term ownership and support needed for a sustainable data use culture.

IDENTIFIED CHALLENGES AND PRESCRIBED SOLUTIONS

Immunization service delivery in sub-Saharan Africa is highly routinized, and most countries experience similar challenges in delivering the services. Working closely with the ministries of health in Tanzania and Zambia, the BID Initiative identified the following key challenges that were blocking those countries from improving the performance of their immunization programs and then developed three solutions to address them. Note that as the challenges are complex and multifaceted, the solutions are not singular, but rather they are a combination of synergistic interventions that include people, policies, practices, and products that work together.

CHALLENGES

- *Inaccurate or uncertain denominators for calculating immunization rates (e.g., not having a good understanding of the catchment population).*

- *Defaulter tracing (e.g., having difficulty identifying children who do not start immunization or who drop out).*

- *Vaccine stockouts due to lack of visibility into stock management and logistics.*

- *Inadequate data management and use capacity at all levels of the health system.*

PRESCRIBED SOLUTIONS

- *Developing and implementing immunization registries.*

- *Developing and implementing stock management tools into the immunization registries and practices.*

- *Creating a data use culture through a set of data use interventions.*

THE FOUR PS: POLICIES, PRODUCTS, PRACTICES, AND PEOPLE

Support country governments to develop **POLICIES** that outline a strategic vision and are aligned with country needs.

In Zambia, the BID Initiative actively participated in and supported the MOH in developing an eHealth strategy as well as in exploring digital health architectures that would best suit the country's existing and future digital health implementations.

In Tanzania, the introduction of the BID Initiative has played a major part in the government's effort to expand its cross-sectoral eGovernment initiative. It has also helped build stakeholder support and collaboration and a belief that digital solutions can be used to improve health care delivery.

These engagements have set the stage for the collaborative development of a singular, countrywide vision for digital health composed of many interoperable and linked interventions.

"A house is built with many walls going up at different times. We can't stop building one wall just to wait for another wall to be built by another person. Continue building and when that other person comes on board to build their wall, eventually all those separate walls will come together to form one house." —MOH Program Officer

Take the time to agree on and build a user-centered PRODUCT.

In Tanzania and Zambia, the BID Initiative introduced electronic immunization registries with incorporated supply chain and stock management tools. In Zambia, it took significant time to gain stakeholder agreement—at varying levels of the health system—on requirements and product design. Defining requirements was particularly challenging as there were already existing digital solutions in use and national-level stakeholders had to be convinced that these solutions didn't need to compete or be mutually exclusive.

Interoperability, as one of BID's core approaches, provided a practical solution for how different systems can collect and share data without burdening the person collecting or recording the data. At the EPI level, this concept was quickly accepted. "Collect once and use many times" was a mantra often repeated among EPI officers. The government of Zambia did eventually step in to support the creation of digital architectural standards that would be used by all partners, ensuring system interoperability. While the product requirements were designed in partnership with national-level stakeholders, it was important to ensure that stakeholders at all levels were engaged in the product design. At subnational levels in Zambia and Tanzania, the BID team formed User Advisory Groups (UAGs) composed of nurses, community health workers, and district and regional officials. The UAGs provided feedback on each stage of the product development, which has been essential to understand how the systems work in practice and how they can be best designed to meet the needs of users. Designing the right product can also facilitate the data use pathways by giving users access to the data they need and creating dashboards and reports that easily translate that data into useful information they can act on.

The importance of changing PRACTICES is often underestimated but is essential and must be encouraged.

Although it is necessary to get the product "right," arguably it is even more important to plan for the changes in the formal and informal practices to institutionalize a culture of data use. Examples of such practices include changing workflows within the facility to find optimal placement of digital solutions, shifting ownership of data and the people it represents from the district to the facility, or switching data collection practices from paper data systems to a digital system. These are practices that need to change to support the introduction of new policies and products—without changing the practices, a new product may not be used or leveraged to its full value.

Since the BID Initiative began, the team has focused on the importance of developing strong change management activities to encourage data use, but the challenge of creating this type of culture change—especially at scale— has often been underestimated or not recognized.

The BID team continues to work with local authorities at all levels to increase their involvement and ownership of the new systems. District authorities play an essential role in encouraging and sustaining practices at the facility level by holding health care workers accountable for using the new systems and following new practices, and regional authorities support the districts in carrying out this role. These individuals can also be a consistent resource in orienting new workers who rotate into the immunization department.

Connect PEOPLE to support change and build a more resilient health system.

The resiliency of the data use culture largely resides in the people who are managing day-to-day service delivery. The health system is made up of the relationships between individuals, and the degree to which they are connected will influence how effectively and efficiently data are leveraged and used throughout the system.

The BID Initiative has been successful in creating a more networked health workforce by introducing WhatsApp groups as a communication forum. Health care workers are encouraged to use the social network to share their experiences and help each other with their responsibilities related to immunization data, collection, and use. WhatsApp groups also give new staff a supportive network to engage with to better understand their role as data producers and users, which is particularly important as health workers transition into immunization service delivery.

We have seen great uptake of this intervention, with WhatsApp groups active in five districts in Tanzania and health care workers sending daily messages. Members have used the network to problem solve, share information about filling out the monthly immunization reports, and locate vaccine supplies at other facilities. For example, one facility was low on BCG syringes, so a worker messaged the WhatsApp group to seek surplus supplies to help avoid a potential stockout, resulting in a transfer of 300 syringes. In a stockout event that could have led to a child missing out on a lifesaving vaccine, these conversations empowered health workers to act to provide vaccinations, improving the health of children in their community.

FUTURE STATE

The BID Initiative has been working to create a data use culture in Tanzania and Zambia, in line with the principles laid out in the conceptual framework. Creating a culture shift of this magnitude takes time and sustained effort. The data use culture is expected to grow and be progressively entrenched, looking different from year to year until it reaches the stage of "that's how we do stuff around here."

WHAT DOES AN IMPROVED DATA USE CULTURE LOOK LIKE IN ONE YEAR?

Health care workers are able to:

- *Track children not completing their vaccination schedule and know their names and caregivers' phone numbers in case of an outbreak.*

- *Quickly mobilize stock because they know what stock is in which facility at any given time.*

- *Trace potential problem antigen batches via lot number.*

WHAT ABOUT FIVE YEARS AFTER THAT?

The benefits of a data use culture have spread:

- *Caregivers' records will be linked to their children's records, so important pieces of information (e.g., if a child was born protected from tetanus) are readily accessible.*

- *A child who is seen in an outpatient clinic with a potential adverse vaccine reaction or who has a potential reportable disease can be connected directly to the immunization registry.*

- *Stockouts will be reduced significantly, if not eliminated, and emergency restocks will be substantially reduced.*

- *Defaulter tracing will be much easier and more cost-effective.*

- *Health care workers will be consistently using the data they have to make better decisions about how best to deliver services.*

- *Countries across Africa will be working together to learn from each other's experience and will build solutions together.*

DATA USE
ACROSS SECTORS

What gets measured, gets managed.

— Peter Drucker, Management Consultant, Educator, and Author

Photo: PATH/Gabe Bienczycki

While we have focused on the health sector so far, improved data use for decision-making is a common goal. Learnings from successful data quality and use frameworks used in other sectors can be readily applied to the health data use ecosystem, and the levers in the theory of change can be adapted beyond health to other sectors and applications.

This cross-sectoral sharing can strengthen the health sector's resources and inform the promotion of an enabling environment that fosters effective health care decision-making.[14] Additionally, harmonizing standards for metrics with other health areas and sectors allows for greater, and faster, cross-sector planning. Below are examples of how data use has led to greater positive impact across sectors.

DATA USE THROUGH THE INSTITUTIONALIZATION OF BARCODES

The successful global institutionalization of barcodes is one example that demonstrates improved system performance and outcomes through the creation of a data use culture, starting with data production. Decades of effort ultimately led to more efficient delivery of goods and reduced costs driven, in part, by less waste and improved ability to meet demand through forecasting and planning.[15] More recently, traceability across the supply chain has increased safety through more efficient recalls. Data from all levels of the supply chain are used to monitor day-to-day performance and support evidence-based decision-making.

Grocers were a driver behind the original development of barcodes to meet a shared need for improved inventory management—such as tracking of on-hand product quantities—and to automate their processes. Before the adoption of barcodes, grocers did not have a common standard for uniquely identifying items to allow for quick store check outs or accurate tracking of inventory data. Grocery trade associations in the United States began to coordinate an effort to use barcodes to solve the need for automated data capture and improved inventory management. The associations established a committee to develop a standard, interindustry code to identify products using a machine-readable symbol.[16] Through a coordinated strategy, guidelines, and standards based on key principles, this effort ultimately led to the Universal Product Code (the UPC barcode).[15]

Looking to the levers from the theory of change, barcodes relied heavily on standards and interoperability,

14   Nutley T, Gnassou L, Traore M, Bosso AE, Mullen S. Moving data off the shelf and into action: an intervention to improve data-informed decision making in Cote d'Ivoire. Global Health Action. 2014;7(1):25035. doi:10.3402/gha.v7.25035.

15   Wilson K, Goertz B, Arenth B, Salisbury N. The Journey to Scale: Moving Together Past Digital Health Pilots. Seattle: PATH; 2014. Available at: http://www.path.org/publications/files/TS_dhs_journey_to_scale.pdf.

16   Sharma A, Thomas D. Looking backwards to look ahead: Lessons from barcode adoption for RFID adoption and implementation. Journal of Information Systems Applied Research. 2014;7(4):25–36. Available at http://jisar.org/2014-7/N4/JISARv7n4p25.html.

leadership and governance, and strategy and investment. Policies, regulations, and standards enabled barcodes to scale across industries; funding organizations and political leadership committed to coordinate and invest in these standards over the long term; and a coordinated strategy and shared investment facilitated the design, development, and institutionalization of the solution.

Learnings from the barcode example have since been applied to facilitate global adoption and use of new, complementary technologies, such as radio-frequency identification. Setting standards allows for easy adoption across the supply chain, as does interoperable scanning equipment available from multiple manufacturers. Additionally, as traceability across the supply chains advances, useful lessons are learned in how the private sector, organizations, and governments coordinate to selectively share information toward a common goal.[17]

In the health system, barcodes have had direct applications through tracking and managing stock of medications, vaccines, devices, and equipment throughout the supply chain, from manufacturing to patient receipt. In the area of patient management and care, they can be used for accurate patient identification from the time of admission, including traceability of specimens and, in the case of the United States, through to billing.

DATA USE IN DISASTER PREPAREDNESS AND RESPONSE

The ability to prepare and respond to weather-related and natural disasters illustrates some of the clearest examples of how effective and widespread data use can be used to solve an immediate need. Emergency response requires innovation to provide actionable and usable information to the right people to make informed decisions. Without an urgent need identified for the information use side of the data use cycle, the focus can be solely on data collection. In this situation, with the near-term goal solely based on storing data for a later date, momentum toward a data use culture will not be created and data quality can be low.

User feedback loops to improve data quality can rapidly fill information gaps. For example, geographic information and mapping data that lack local and regional detail can provide baseline data to be updated by users with current and more detailed information. Starting with satellite imagery, crowdsourced volunteers are quickly able to support first responders by enhancing the available maps of a disaster-hit region with content from the collaborative project OpenStreetMap, such as after the 2010 earthquake in Haiti and the 2015 earthquake in Nepal.[18,19]

Another tool that relies on feedback loops is the Trilogy Emergency Relief Application, developed by the

International Federation of Red Cross and Red Crescent Societies and Trilogy International Partners after the Haiti earthquake. The mobile phone application allows aid agencies and mobile phone users in disaster areas to interact and target recipients using location-based data and uses SMS to enable efficient delivery of services and resources.

One-way communications to push out official bulletins also still play a key role and can help provide early warning to those affected and for post-event communications. The wireless emergency alert system (WEA) under the US Federal Emergency Management Agency can be used to notify the public of imminent threatening emergencies (e.g., tornadoes, floods) and presidential alerts during national emergencies, in addition to other regional emergencies. Geotargeted SMS messages are sent to mobile phones in affected areas, which requires integrating SMS data with meteorological information identified by the US National Weather Service and rapid coordination with the US Federal Communications Commission and wireless service providers.

Methods of communication and tools range from top-down official communication methods to informal, unofficial channels.[20] For official channels, policy decisions are required to determine what information will be communicated (e.g., how to keep users from disregarding the messages due to

17 Adam BD, Holcomb R, Buser M, et al. Enhancing food safety, product quality, and value-added in food supply chains using whole-chain traceability. International Food and Agribusiness Management Review. 2016;19.

18 Soden R, Palen L. From crowdsourcing to community mapping: the post-earthquake work of OpenStreetMap Haiti. In COOP 2014—Proceedings of the 11th International Conference on the Design of Cooperative Systems, May 27–30, 2014. Nice, France: Springer International Publishing; 2014.

19 Palen L, Soden R, Anderson J, Barrenechea M. Success and scale in a data-producing organization: the socio-technical evolution of OpenStreetMap in response to humanitarian events. In Proceedings of the Special Interest Group on Computer-Human Interaction 2015. 4113–4122. Available at https://dl.acm.org/citation.cfm?doid=2702123.2702294.

20 Houston JB, Hawthorne J, Perreault MF, et al. Social media and disasters: a functional framework for social media use in disaster planning, response, and research. Disasters. 2015;39(1):1–22.

too many messages being received). Applications like the WEA also require policy updates over time as needs change and technologies advance, reflecting the need to adapt to stay relevant and useful to users.[21] Informally, existing social media platforms, such as Twitter and Facebook, have been adapted to meet a range of needs for use at the national, organizational, and individual levels.

Coupled with adoption by users, open data policies and procedures are needed to promote necessary data sharing, to allow for application of data to local and regional needs, and to ensure the same data can be used for multiple purposes. As with barcode usage, open data can allow scientists, private-sector companies, and others to innovate on the data.

DATA USE IN GLOBAL HEALTH SECURITY RESPONSES

In order to avoid the need for disaster response measures, leveraging a data use culture in proactive global health security efforts can effectively track outbreaks before they reach emergency levels, and if crises occur, effectively target health worker response. During efforts to respond to the 2014–2015 Ebola crisis in West Africa, effective information use ultimately helped mobilize the workforce and equipped users with information they could use to take evidence-based action. Data use was a necessity from the health system level to the individual level during the crisis, with a large number of different technologies being used to meet the significant information needs.[22]

One of the earliest identified needs was for ministries of health to be able to connect with the health workforce managing day-to-day service delivery and to receive real-time communications back from them. Large coverage gaps and mobile connectivity issues limited the usefulness of the data for coordination, contact tracing, and effective resource and service delivery. As one example to address this need, NetHope partnered to provide mobile satellite equipment and devices following a rapid assessment to identify the state of ICT in Liberia.[23,24] To mobilize health workers to areas with the greatest need and provide advance warning to prepare for incoming patients, more data was needed.[25]

A report published by US Agency for International Development (USAID) analyzed how efforts to collect and exchange extensive patient and caseload data were central to understanding the Ebola trajectory and formulating the operational response.[26] Health officials used case data to dispatch operational responders—such as contact tracers and burial teams. Data collected at the district and prefecture level were aggregated and transmitted to the national level where they became the basis for country-level situation reports that were used to inform high-level national and international discussions about the Ebola outbreak and response efforts.

With existing health information systems and mobile application services already in place, open standards facilitated the ease of interoperating these systems so that government and other stakeholders could develop fast, innovative solutions to harness digital technology in the response. For example, mHero was launched as a pilot in Liberia in November 2014 to connect IntraHealth's iHRIS and UNICEF's RapidPro so the MOH could share with and obtain real-time vital information from frontline health workers. mHero provided a much-needed platform to utilize systems already in use by government and partner organizations (e.g., iHRIS and RapidPro, with integration to DHIS2) and leveraged common standards of the Open Health Information Exchange architecture to quickly support rapid communication amid the crisis.

Improved communication facilitated more efficient and planned use of the limited treatment space available, helping contain the spread of the virus and reducing the need for additional treatment centers. By providing consumable information through a tool users were already familiar with and making it available across all levels of the health system, mHero fostered a data use culture and improved health outcomes.

21   Casteel MA, Downing JR. How individuals process NWS weather warning messages on their cell phones. Weather, Climate, and Society. 2013;5:254–265. Available at http://journals.ametsoc.org/doi/abs/10.1175/WCAS-D-12-00031.1.

22   United States Agency for International Development. Technical Brief: Use of Technology in the Ebola Response in West Africa. Washington, DC: USAID; 2014. Available at https://www.msh.org/sites/msh.org/files/technology_and_ebola_response_in_west_africa_technical_brief_final.pdf.

23   Communications equipment, connectivity solutions and crisis data mapping unified and enabled the Ebola effort in West Africa page. NetHope website. Available at https://nethope.org/project/emergency-response-ebola-outbreak/.

24   NetHope, USAID Global Broadband and Innovations Alliance, and USAID. Information and Communications Technology Response to the Ebola Crisis: Desk Review and Recommendations for Private Sector Engagement. Washington, DC: USAID, NetHope/GBI; 2014. Available at http:// solutionscenter.nethope.org/assets/collaterals/ USAID_LiberiaICTDeskReview_Final_Nov414.pdf.

25   Fast L, Waugaman A. Fighting Ebola With Information: Learning From Data and Information Flows in the West Africa Ebola Response. Washington, DC: USAID; 2016.

RECOMMENDED ACTIONS TO STRENGTHEN AND SUSTAIN A DATA USE CULTURE

The price of light is less than the cost of darkness.

— *Arthur C. Neilson, Market Researcher & Founder of ACNielsen*

The evidence and case studies presented here clearly show that supporting data use leads to improved health systems performance and better health outcomes.

We conclude this paper with a few recommended actions to create a strong and sustainable data use culture, for policymakers, funders, organizational leaders, and data users who also believe in the importance of data-driven decision-making and are seeking to build cultures of data use in their own work.

IDENTIFY CHAMPIONS

A data use culture requires someone on the inside to set the example, raise the bar, and inspire and mobilize others to use data for decision-making. These champions must have the vision, the influence, and the authority to transform how business is done.[26] To change behavior in an organization, leaders must communicate the change, model the new behavior themselves, and reinforce and encourage that change in others.[27] Data use champions can be supervisors who leverage existing hierarchies and reporting structures or influencers at any level.

ENGAGE USERS

Data users at all levels must feel "that they have a part to play in changing the situation" through their data use.[8] In developing products, policies, and practices, work directly with the people

(i.e., users) to guide what information is needed to support decision-making, in what format, and when. A user-driven process ensures the right solution is selected, developed, implemented, and used.

BUILD DATA USE SKILLS

Don't tie data use training to a particular tool; rather, look to build overall skills capacity and train on specific tools as they are introduced. Build an understanding of the importance of data use regardless of the level of sophistication of the paper or electronic data collection and analysis tools and systems that are in use.

INTEGRATE DATA USE IN POLICIES AND PRACTICES

Clearly articulate the value of using data in policies and practices so they empower health care workers at all levels to use data. Integrate data use

into roles and work plans; include it in job descriptions, training, performance reviews, incentive structures, and supervisory conversations; and mention it in national, regional, district, and facility policies.

LINK SYSTEMS

Project-specific and vertical systems are less likely to achieve buy-in from users and are therefore ultimately less sustainable. As data quality diminishes, momentum in the data use cycle decreases. Planning for interoperability from the outset and using open standards to link systems, making data more accessible and usable, will accelerate the creation of a data use culture.

26   Barton D, Court D. Three keys to building a data-driven strategy. *McKinsey Quarterly*. March 2013. Available at http://www.mckinsey.com/business-functions/ digital-mckinsey/our-insights/three-keys-to-building-a-data-driven-strategy.

27   Alsher P. Change leadership: The three actions needed by every sponsor [blog post]. *Implementation Management Associates*. March 2, 2017. Available at http://www. imaworldwide.com/blog/change-leadership-the-three-actions-needed-by-every-sponsor.

BE PATIENT AND PRIORITIZE

Creating or changing an organizational culture takes effort. New behaviors take time to develop and mature, requiring regular attention and encouragement. There will frequently be a greater demand for change—be it related to products, policies, practices, or people —than the resources to supply and support that change. Being targeted and intentional with investments of time, money, and effort to create a data use culture is essential. With complacency, a data use culture will fail; but with dedicated nurturing and support, it will grow.

It is increasingly clear that scaling ICT solutions and building a data use culture must be joined in order to achieve desired health outcomes.

The global health sector has made great strides in moving from pilots to scaled technologies. Now the digital health field must make similar progress in supporting countries and communities develop sustainable data use cultures as part of their journey to better health.

USING THE PRINCIPLES FOR DIGITAL DEVELOPMENT

Digital health efforts—large and small—that seek to improve evidence-based decision-making should follow guidelines known as the Principles for Digital Development (see Figure 8). These global principles were written by and for the global development community to help integrate "established best practices into technology-enabled programs."

While a data use culture is not dependent on digital technology, these principles are useful in thinking about how to create a sustainable culture of data use and they are rooted in the recommended actions. A strong data use culture can truly be achieved only in an environment that emphasizes principles such as evidence-based, user-centered, country-driven solutions collaboratively designed with humility, transparency, and commitment to the end goal of making people healthier.

FIGURE 8

PRINCIPLES FOR DIGITAL DEVELOPMENT

1 DESIGN WITH THE USER	**4** BUILD FOR SUSTAINABILITY	**7** REUSE AND IMPROVE
2 UNDERSTAND THE EXISTING ECOSYSTEM	**5** BE DATA DRIVEN	**8** ADDRESS PRIVACY AND SECURITY
3 DESIGN FOR SCALE	**6** USE OPEN: STANDARDS, DATA, SOURCE & INNOVATION	**9** BE COLLABORATIVE

Source: Principles for Digital Development at http://digitalprinciples.org