DIGITAL AND DATA BRIEFS

Interoperability

In the last five years, the global digital health community has increasingly advocated for interoperability, or the ability to share data across various systems and platforms, within health information systems. It is embedded in the WHO Digital Health Strategy, the Principles for Digital Development, the Principles of Donor Alignment for Digital Health, and the USAID Digital Strategy.

USAID DIGITAL STRATEGY

To maximize the impact of taxpayer dollars, USAID will strive to further optimize our policies and procurement processes for the digital age, so that USAID-funded programming uses systems designed for **interoperability**, reusability, and sustainability across sectors.

PRINCIPLES OF DIGITAL DEVELOPMENT

Identify and use open data and **interoperability** standards

Develop modular, **interoperable** approaches instead of those that stand alone

WHO DIGITAL HEALTH STRATEGY

Digital health should be developed with principles of transparency, accessibility, scalability, replicability, **interoperability**, privacy, security, and confidentiality.

PRINCIPLES OF DONOR ALIGNMENT FOR DIGITAL HEALTH

Donors will invest in scalable, sustainable, accessible, and **interoperable**, and evidence-based digital health global goods that meet country priorities.

However, the value of interoperability is not broadly understood in the global public health sector. While there is a growing consensus around the importance of interoperability amongst digital health practitioners, more evidence is needed to demonstrate the value of investments targeted at increasing the interoperability of health and other data. More evidence is also needed to illustrate how interoperability contributes to health system strengthening and improved health outcomes.

This brief provides a definition of interoperability and includes a spotlight on Tanzania where peer-reviewed research and gray literature have demonstrated a positive impact on maternal, neonatal, and child health (MNCH) services. In addition, it provides actionable lessons and references for further learning relevant for MNCH and other health areas, and in other countries.

Developed from the growing literature related to interoperability, this brief utilizes the definition of interoperability provided by the forthcoming Digital Implementation Investment Guide:

Interoperability is the ability of different applications to access, exchange, integrate, and use data in a coordinated manner through the use of shared application interfaces and standards, within and across organizational, regional, and national boundaries, to provide timely and seamless portability of information and optimize health outcomes.

Interoperability in the context of maternal, neonatal and child health

Many MNCH programs rely on data found in multiple information systems. For example, using data about postpartum hemorrhage case load across facilities with data about the availability of skilled human resources can support decision making about the allocation of midwives to facilities. These data typically exist in independent information systems, so through interoperability, they can be combined to support health system managers in their decision-making process.

Similarly, the prospects of safe and successful delivery of a baby can be enhanced by at least three information systems:

1) A **human resource system** so that a skilled birth attendant is available at the facility.
2) A **logistic management information system** so that the birth attendant has the necessary equipment for a safe delivery.
3) An **individual health record** of the mother available at the primary facility so that the birth attendant knows the mother's history, understands potential risks of complications, and can document key information about the birth to inform future visits. This same record, available at a referral facility should a higher-level of care be needed, provides the referral facility immediate access to the mother's health record. An individual health record can also inform and capture antenatal care services that are provided.

Interoperability enables new kinds of information use. Through the implementation of data standards, technology standards, protocols for data exchange, and other mechanisms, data are more easily shared across different digital platforms. This allows data collected in one system to be available in a parallel system – reducing the time and cost of data entry, increasing the availability and quality of data, and creating new opportunities for analytics, visualization, and data-led action. For more examples of how interoperability can support MNCH programs, a USAID-funded compendium of examples in Uganda can be found here.

The consequences of deploying non-interoperable systems

When health information systems are not interoperable, they can interfere with health system performance. Data collection and entry in redundant systems distracts health workers from patient care and can reduce health worker motivation. Manual transcription between systems is error-prone and can reduce the quality and reliability of information entered into health information systems. Data may be erroneously recorded differently in each system, opportunities to identify errors are reduced, and the ability to rapidly draw insights from multiple systems is reduced. Data management needs also increase with multiple standalone systems that each require oversight. Multi-system analytics require multiple, parallel, often manual processes to reconcile different data definitions, clean data, and then combine, validate, and interpret data. The staff time required to do manual data management and cleaning across systems can be very burdensome, costly, and distract from providing care. Errors across systems can be magnified, reducing trust in the information produced and ultimately preventing the use of data in decision-making.

The negative impact of non-interoperable systems on health system performance directly impact the quality, timeliness, and availability of care—leading to adverse and avoidable health outcomes. If postpartum hemorrhage case load is not linked to human resource data, some mothers may be left without a skilled birth attendant to provide emergency care in cases of PPH.

SPOTLIGHT ON TANZANIA

How interoperability improved access to health workers and reduced stockouts of vaccines

In 2015, the Government of Tanzania rolled out a package of digital interventions to address key challenges in their immunization program, including improving immunization coverage and reducing stockouts.

A baseline survey revealed that 496 children (out of a target population of approximately 8,000) were unaccounted for in the northern district of Meru, suggesting incorrect documentation and subsequently inaccurate data and immunization coverage estimates. In addition, monthly stockouts persisted overall at roughly 7%, with some specific vaccines stocked out more than 10% of the time, despite supervisory attention to reducing vaccine stockouts.

The Government used a suite of five interoperable information systems—both new and existing—as well as adaptive management strategies (e.g. peer learning, co-creation of data outputs and data use strategies, alerts) to improve the use of these systems:

Electronic immunization registry

Confidential, individual-based information system that contains data on vaccine doses administered. This type of system allows monitoring of vaccination coverage by individual, vaccine, dose, age, target group, and geographic area.

Health facility registry

Reference repository of unique identification of health facilities or service delivery points, including name, location, type, status, and services provided.

Health information system

System for managing and analyzing pre-aggregated service delivery data reported from health facilities. More sophisticated health management information systems might include a data warehouse compiling data from multiple systems and covering not only service delivery, but also human resources, commodities, equipment and infrastructure, financial data, supervisory data, and also include client- or transactional-level data.

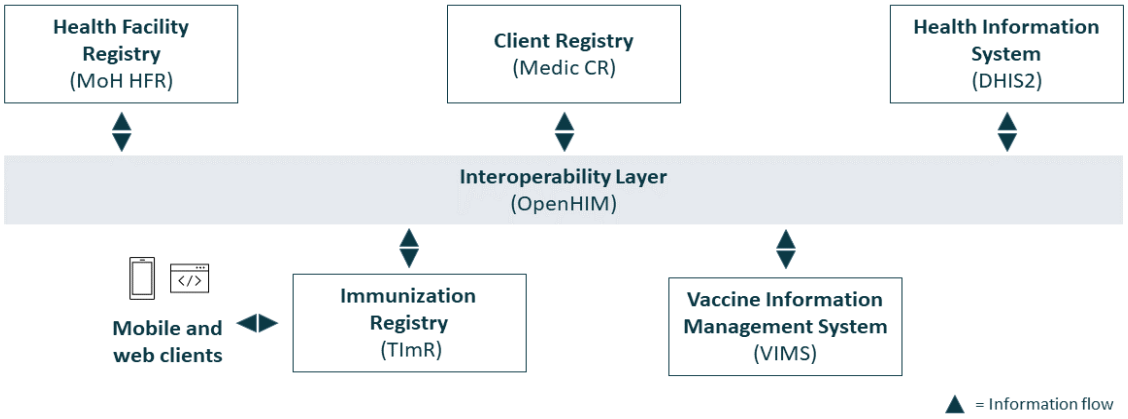
Logistics management information system

Integrated platform for end-to-end management of all health commodity supply chain data. In some cases, logistics management information systems are used to track maintenance and operational status of cold chain equipment and infrastructure.

Client registry

Reference repository of identification data on individuals who are accessing health services.

An interoperability layer connects these systems to support data exchange. Because these systems were intentionally designed to be interoperable, health workers only have to enter information once, and that information is automatically available in the other systems and to other potential data users (i.e. district health officers). For example, the connection between the logistics information system and vaccine information management system shares data during stock reporting and distribution and can prevent stock outs.



The five interoperable information systems, and the adaptive management interventions accompanying them, led to meaningful change in the health system. Improvements were seen in health system outcomes including a reduction in vaccine stockout rates, and a reduction in time spent on data entry by frontline health workers.

A peer-reviewed study, published in *Vaccine*, found that vaccine stockouts reduced overall by 70% ($p < 0.01$), with the largest effect sizes for Diphtheria-Tetanus-Pertussis-containing-vaccine (80% reduction; $p < 0.01$), Measles Rubella vaccine (89% reduction; $p < 0.01$) and Oral Polio Vaccine (83% reduction; $p < 0.01$). Further analysis revealed that these effects were not immediate; the longer the health workers had with the system, the larger the effect size and the fewer the stockouts. Fewer stockouts reduce the number of children who miss a vaccination. It also results in cost savings to the system as there are fewer emergency stock replenishment trips from facilities to the district vaccine store to collect vaccines.

The five interoperable information systems contributed to a 70% reduction in vaccine stockouts.

In addition, health workers self-reported that they would spend 41% less time registering and updating each child when the legacy paper-based immunization registry was fully replaced. For those health workers involved in immunization service delivery, this adds up to saving more than 70 hours of time each year. Tanzania's national health workforce includes approximately 50,000 individuals that could save time with increased interoperability. That impact is equivalent to adding an additional 3.5 million health worker hours—the equivalent of more than 1,500 full-time health workers per year—back into the system at zero additional cost.

It is important to note that completeness levels of the stock data did not improve as anticipated in this study. One potential reason is that the majority of facilities evaluated were required to use this new system *in addition to* the legacy system rather than *fully replacing* the legacy system, which led to an overall increase in workload rather than the decrease experienced by facilities that fully transitioned.

Other potential reasons include infrastructure challenges, ongoing training requirements due to staff turnover, hardware/software maintenance challenges, and/or low attention from supervisors. Since the publication of the studies (listed at the end of this document) on Tanzania, the country has committed to fully transition to an interoperable, paperless system in its immunization program; this will yield important learning opportunities in the coming two years.

Actionable Insights

Tanzania's experience deploying an interoperable set of information systems yielded important lessons that can be applied in many contexts where MNCH and other programs are considering investments in information systems and are wondering about the value of interoperability.

Interoperability leads to service delivery improvements.

Interoperable health information systems can reduce stockouts and enable better monitoring of vaccine coverage, including the possibility of identifying children missed and ensuring vaccines given at different facilities are tracked for a single child. Greater visibility into current stock levels and future stock needs can ensure facilities have the appropriate supplies available. Data can inform services at the point of care (e.g. what vaccines should be provided during a facility visit) and can help identify gaps in care. And time saved by reducing the data entry burden on frontline health workers can be spent on patient care.

Interoperability creates financial and human resource efficiencies.

By automating administrative data management tasks, interoperability frees health workers from time-consuming, duplicative data management activities and/or removes the cost of hiring and paying salaries to full-time data entry clerks. In addition, improved stock management can reduce the number of emergency replenishment trips which saves both time and transportation costs. As evidenced in Tanzania, an up-front investment in interoperability can refocus scarce health worker resources and add millions of hours toward clinical care provision.

Interoperability must be part of a package of interventions.

Interoperability is most effective when (1) it is deployed within a well-designed digital architecture; (2) it is nested into a set of activities targeting time-savings and service delivery improvements; and (3) it is designed with consideration to the end user. Digitalization is notoriously difficult to do well; almost all studies linking digital systems to health impact include adaptive management support as part of the digital system rollout.

The benefits of interoperability increase as duplicative systems are phased out.

Interoperability is most efficient when it replaces duplicative and burdensome parts of the health information system. Otherwise, the time burden on health workers increases with entry into two systems: often digital and paper-based. As interoperability is applied more broadly within health systems, countries must also create a roadmap for its digitalization, including the removal or re-design of the paper portion of the information system.

The value of interoperability is realized over time.

As shown in Tanzania, improvements were realized within a year of deployment. However, change is not instant—the workforce must first learn and adopt any new information system, which can take a few months. Then, they must derive enough value from the system so that they work to keep the data correct and up to date. With quality data in a system they value, health workers then begin to use the data to improve service delivery. This creates a reinforcing cycle of improvement between data collection and use. The change management process can take a year or longer, depending on the timeline to going paperless. Ongoing reinforcement may also be needed to promote continued use of the systems over the long-term.

Resources & Further Reading

BID Initiative Resources

Tanzania Midline and Endline M&E Report

This report presents the evaluation findings from Arusha Region and Tanga Region based on data collected between 2015 and 2018.

Journal Articles

Three Waves of Data Use Among Health Workers

Werner L, Seymour D, Puta C, Gilbert S. Three Waves of Data Use Among Health Workers: The Experience of the Better Immunization Data Initiative in Tanzania and Zambia. *Glob Health Sci Pract*. 2019;7(3):447-456. Published 2019 Sep 26. doi:10.9745/GHSP-D-19-00024.

The impact of an integrated electronic immunization registry and logistics management information system on vaccine availability in three regions in Tanzania

Gilbert S, Bulula N, Yohana E, Thompson J, Beylerian E, Werner L, Shearer J. The impact of an integrated electronic immunization registry and logistics management information system on vaccine availability in three regions in Tanzania: A pre-post and time-series analysis. *Vaccine* 2020; 38(3):562-569. Published 2019 November 7. doi:10.1016/j.vaccine.2019.10.059.

Other Resources

Health Information Systems Interoperability Maturity Toolkit

MEASURE Evaluation

Enabling and Expanding the Scope of Public Health Decision Making in Uganda to Reduce Maternal Mortality: Concept Note and Use Case

Kumar, M., Kim, T. E., Millar, E., Ongechi, K. S., & Weiss, W. Enabling and Expanding the Scope of Public Health Decision Making in Uganda to Reduce Maternal Mortality: Concept Note and Use Case. Chapel Hill, NC, USA; MEASURE Evaluation, University of North Carolina.

LEGO Lessons for COVID-19: Making data click

PATH

Mtenga, H. and Mwanyika, H. (2020). [Interviews and program communications].

Digital Square brings partners together to improve how the global community designs, uses, and pays for digital health tools and approaches. By strengthening the coordination among digital health stakeholders, Digital Square reorients the market to better match tools and approaches to the needs of countries and communities.

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