DEFINITION

Interoperability: "... the property that allows for the unrestricted sharing of resources between

different systems. This can refer to the ability to share data between different components or machines, both via software and hardware, or it can be defined as the exchange of information and resources between different computers through local area networks (LANs) or wide area networks (WANs). Broadly speaking, interoperability is the ability of two or more components or systems to exchange information and to use the information that has been exchanged" (Techopedia, available at http://www.techopedia. com/definition/631/interoperability). Pursuing this strategy can also involve first developing the standards to which the systems will adhere.

Integration: "...the process of linking together different computing systems and software applications physically or functionally to act as a coordinated whole. The system

integrator brings together discrete systems utilizing a variety of techniques such as computer networking, enterprise application integration, business process management or manual programming" (Wikipedia, available at: https://en.wikipedia.org/wiki/ System integration). Integration involves applying standards to coordinate and improve efficiencies between or among organizations, and often begins with an effort to achieve interoperability.

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Data interoperability and integration enable multiple systems to communicate with one another and exchange data. These strategies have long been part of efforts to strengthen national health information systems (1). Now, with the proliferation of electronic health information systems, they are being applied within global health information systems. MEASURE Evaluation—funded by the U.S. Agency for International Development (USAID) to strengthen health systems in low-resource settings—is working worldwide to improve the interoperability and integration of data systems. Our specific focus is on routine health information systems.

Both interoperability and integration rely heavily on a common framework of standards.

Systems that are interoperable can exchange data without transformation, because these systems adhere to the same standards; for example, they use the same file formats or communication protocols. The reference framework allows for both functional and semantic interoperability. Functional interoperability is information interchange: moving data from one system to another (2). Functional standards—for example, Statistical Data and Metadata eXchange-Health Domain (SDMX-HD) and Open Health Information Exchange (OpenHIE) protocols—provide a common structure so that data

can be moved from one system to another. Understanding and using the information being transferred are known as semantic interoperability. Standard vocabularies—for example, ICD10, SNOMED-CT, and LOINC provide classifications, names, and codes for disease, medical terms, and laboratory observations. These allow different systems to interpret the data exchanged in the same way.

Systems that cannot communicate directly must be integrated to connect,

Unifying information from systems that used to stand alone makes it much easier for program managers to answer questions about a health system as a whole

and that requires custom programming. Vertical integration is hierarchical within a single organization or system: that is, sharing data from the national level to subnational levels. Horizontal integration is across several organizations, health programs, and



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services: for example, sharing data among the World Health Organization, USAID, a health ministry, and other partners (3, p. 63). Integration can be achieved through technology-based solutions that tie one system to another: for example, using common identifiers such as the standard RxNorm for pharmaceuticals. Or it can be achieved simply by agreeing upon a common proprietary naming system, database structures, and hierarchies of data aggregation that facilitate access to multiple data sources and sharing them.

The illustration shows the relationship between integration





Braa and Sahay, 2012, page 61 (adapted)

and interoperability. Here, interoperability is the ability to exchange data between client medical records and the aggregate data warehouse, and between human resources records and the aggregate data warehouse. Distinct data systems are joined through this process. There is no interoperability between the medical records and human resources records, because data are not being transmitted between the medical records data store and the human resources data store. Data from these two systems are transformed and integrated in a third data store: the medical records data warehouse. In this example, client medical records and human resources records are "joined" and integrated in the aggregate data warehouse.

What Can Integration and Interoperability Do for Global Health Program Managers?

Interoperability in Sierra Leone. This country relies on an electronic medical record application called OpenMRS, which collects patients' data so that doctors and nurses can track their clients' health over time. Sierra Leone's data warehouse—DHIS 2—collects aggregated patient data and is important for national-, district-, and hospital-level management (3, p. 59). To link patientlevel and aggregated health data, the country adopted

SDMX-HD, which defines data structures and code lists. The use of SDMX-HD made OpenMRS and DHIS 2 interoperable, giving them a common language with which to exchange data. As a result, the scope of DHIS 2 expanded to include logistics management, human resources management, lab systems, health finances, and other patient-centric and operational areas (3, p. 59). Unifying information from systems that used to stand alone made it much easier for program managers to answer questions about the health system as a whole.

Integration in South Africa.

During apartheid, there were separate health systems (and with them, separate health information systems) for different racial groups. When apartheid ended, health

managers were faced with the challenge of unifying these separate systems, including creating a unified dataset. For this integration to be successful, a uniform and minimal set of data elements, with clear definitions to be reported by all health facilities, was negotiated by different health programs and services. These standards were hierarchical and flexible, so that they could be reported as needed at the national, district, and local levels. This effort gave the Department of Health a more accurate picture of the country's health situation. Ultimately, it led to the creation of a DHIS for South Africa-an open-source electronic information system that manages, houses, and reports facility data (3). Because partner health data systems are required to observe specific reporting standards, data sets are integrated in the DHIS 2 (which succeeded the DHIS), where they are managed and used by South Africa's Ministry of Health.



ALL ABOUT eHEALTH

Electronic health (eHealth) refers to the health sector's use of information and communication technologies (ICT), such as mobile phones, portable and handheld computers, Internet and cloudbased applications, open source software, and data warehouses. Advances in ICT have increased exponentially the amount of data that health information systems can collect, synthesize, and report. Expansion of these technologies in low- and middle-income countries (LMICs) promises to revolutionize the global health sector's response to these countries' most pressing health issues.

MEASURE Evaluation—funded by the U.S. Agency for International Development—seeks new ways to exploit such eHealth solutions as data dashboards and geospatial data analysis, as part of its mandate to strengthen health systems in low-resource settings. Even though health program managers in LMICs—as everywhere—are increasingly expected to use and invest in such strategies, many lack information about how the strategies work and how they can benefit the management of health programs.

To address this problem, we developed this glossary of eHealth strategies most likely to enhance data access, synthesis, and communication for health program managers at all levels of a health system who are eHealth novices. The list has been vetted and revised by an advisory group representing the World Health Organization, the Free University of Free Brussels/European Agency for Development and Health, the University of Oslo, the Public Health Foundation of India, and the National Institute of Public Health Mexico.

The complete set consists of fact sheets on the following eHealth strategies, in addition to this one:

- Dashboards
- Crowdsourcing
- Hackathons
- Open data
- Big data and data science
- Geospatial analysis
- App Competitions

In each fact sheet, you'll find the following information:

- eHealth strategies that have been used in health information system strengthening efforts to improve access to and synthesis, presentation, and communication of health data for program management
- How the strategies have been adapted (or not) from their application in resource-rich country settings to health programs in LMICs
- An example of the strategy for global health program management
- Links to additional resources for more in-depth details on the strategies

For more information on the examples discussed and other examples of interoperability and integration see:

http://www.mn.uio.no/ifi/english/research/networks/

hisp/integrated-health-information-architecture/ch-03.pdf

http://www.hissjournal.com/content/3/1/1

http://hufee.meraka.org.za/Hufeesite/staff/the-hufeegroup/paula-kotze-1/a-review-of-interoperability-standards-ine-health-and-imperatives-for-their-adoption-in-africa

For more information on MEASURE Evaluation, visit:

https://www.measureevaluation.org

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2. Techopedia. No date. "What Is Interoperability?" Available at: <u>http://www.techopedia.com/</u> <u>definition/631/interoperability</u>.

3. Braa, Jorn and Sahay, Sundeep. 2012. "Integration and Interoperability: Standardization is Key." Pp. 58–82, Integrated Health Information Architecture: Power to the Users. Design, Development and Use. New Delhi, India: Matrix Publishers. Available at: www.mn.uio.no/ ifi/english/research/networks/hisp/integrated-healthinformation-architecture.html.



MEASURE Evaluation is funded by the U.S. Agency for International Development (USAID) under terms of Cooperative Agreement AID-OAA-I-14-00004 and implemented by the Carolina Population Center, University of North Carolina at Chapel Hill in partnership with ICF International, John Snow, Inc., Management Sciences for Health, Palladium, and Tulane University. The views expressed in this presentation do not necessarily reflect the views of USAID or the United States government. FS-15-165f