

# How Geographic Information Systems Can Sharpen HIV Program Planning

Data are essential to a well-functioning health system. At present, an explosion in the quantity of data has prompted an increasing emphasis on how this information can advance global health. Over the past decade, low- and medium-income countries have made great strides in developing strong data infrastructures, and global health professionals have been working to expand human capacity for analysis and use of data.

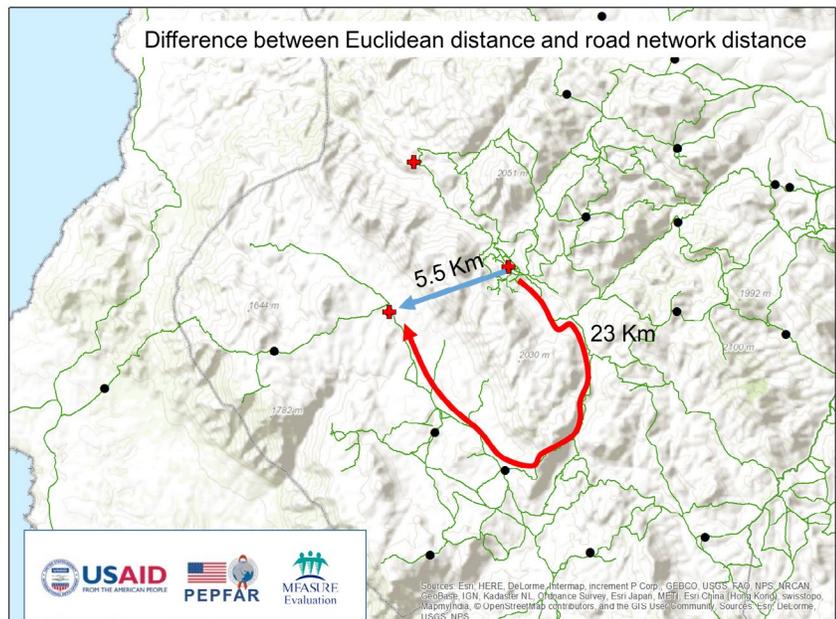
Within this burgeoning data “tsunami,” as some have termed it, are rich streams of data on the populations at risk and in need of HIV treatment, the services being provided, and the context in which these both exist. Many of these data streams have a geographic component. A geographic information system (GIS) can make use of the geographic data to produce analysis that can better locate services and ensure they reach populations in need.

GIS synthesizes data from many sources, such as health surveys, routine health information systems (RHIS), or census data, and links them using a common geography. It offers the opportunity to bring together data sources that may not have been connected before, resulting in a richer picture of the context in which HIV programs operate.

MEASURE Evaluation—a project funded by the United States Agency for International Development (USAID) and the United States President’s Emergency Plan for AIDS Relief (PEPFAR)—believes GIS has a big role to play in **strengthening health information systems (HIS)** and **improving monitoring and evaluation (M&E)**. We are breaking new ground with research on the uses of GIS in these areas to guide decision making on health policy, resource allocation, priorities, and programs. A high priority is research to benefit PEPFAR-supported HIV country programs.

MEASURE Evaluation is exploring and promoting the use of GIS to improve HIS in the following ways:

- Identifying best practices
- Developing tools that facilitate the management, analysis, and communication of data using geospatial contexts
- Improving M&E



In Tanzania, MEASURE Evaluation’s GIS team has used spatial analysis to assess service areas for HIV program sites. The traditional approach calculated service areas based on a Euclidean (straight-line) distance calculation between sites. However, in cases where there are barriers, such as a mountain between the population in need and the site, Euclidean calculations can produce a distorted picture of access. The simple act of considering road networks can mean that sites that seemed to be only five kilometers apart, based on Euclidean measurements, are now known to be actually more than four times that distance, when road networks are considered.

- Publishing research
- Providing technical assistance

Linking data through a GIS can eliminate blind spots in the understanding of the supply of health services and the demand for those services. Powerful spatial analysis techniques can then be used to illuminate HIV programs by calculating service areas, modeling accessibility of those services to populations, or identifying areas of high risk or unmet needs. Maps, charts, and other data products that GIS tools generate capture intuitive, powerful evidence that can be tailored to audiences at national, district, or facility levels, to spur thinking and discussion.

As countries strive to meet PEPFAR and other global development goals, GIS tools can provide sophisticated analysis of the burden of disease and distribution of resources. GIS analysis can support efforts by a country or program to improve the use of health

data, and thus enhance the ability of program managers or policymakers to see and address health challenges. With the advent of DHIS 2 software and other eHealth systems, facility and district health data have become increasingly available in digital formats, more and more of them interoperable. GIS can examine a mix of PEPFAR reporting data and other available data—including cost data and links among facility-based and community-based programs—to identify service gaps and add value to all aspects of planning a country’s HIV response, through data triangulation and other synthesis tools.

Country decision makers and program managers can use GIS to accomplish four essential tasks:

- **Improving efficiency**, by identifying gaps or overlapping services
- **Identifying equity gaps**, where geographic barriers or inadequate services result in unequal access to good-quality care
- **Supporting M&E**, by mapping patterns—including areas where morbidity or mortality are unusually high, indicating that programs are lacking or ineffective
- **Layering data**, such as demographics, economic status, transport options, and land-use patterns, to improve understanding of health contexts and vulnerabilities

In Tanzania, for example, GIS has helped the health ministry to scale up HIV prevention and treatment. In West Africa, GIS continues to be used to coordinate the public health response to the Ebola virus. Uganda has used GIS to identify gaps in obstetric care.

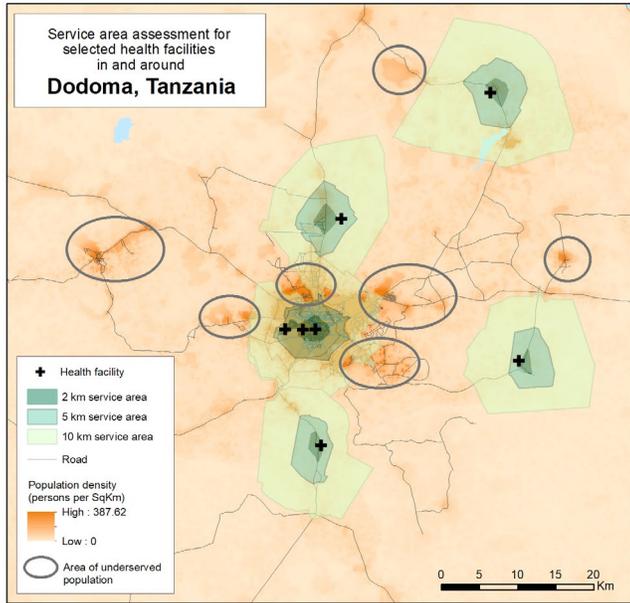
MEASURE Evaluation is using GIS data to provide countries everywhere with a more robust picture of HIV issues and opportunities. MEASURE Evaluation also can **train country staff to use GIS tools** to create their own maps. Our GIS specialists have conducted workshops and created the following training materials that can help:

- Presentations and white papers explaining the “how” and “why” of using a GIS and introducing the fundamentals of using spatial data are available here:
  - ♦ <http://www.measureevaluation.org/resources/publications/ms-11-41a>
  - ♦ <http://www.measureevaluation.org/resources/publications/ms-14-88> <http://www.measureevaluation.org/resources/publications/sr-17-142>
- Publications on more advanced sampling and geospatial analysis considerations are available here:

- ♦ <http://www.measureevaluation.org/resources/publications/sr-17-143>
- ♦ <http://www.measureevaluation.org/resources/publications/ms-14-95-en>
- ♦ <http://www.measureevaluation.org/resources/publications/ws-16-128>
- Handouts specifically about the collection of spatial data, including information about projections and geographic positioning systems (GPS) are available here:
  - ♦ [http://www.measureevaluation.org/resources/training/capacity-building-resources/geographic-information-systems-mapping-and-analysis-of-spatial-data/tools-tips/FS1383\\_GPScoordinates\\_Dec2013.pdf](http://www.measureevaluation.org/resources/training/capacity-building-resources/geographic-information-systems-mapping-and-analysis-of-spatial-data/tools-tips/FS1383_GPScoordinates_Dec2013.pdf)
  - ♦ [http://www.measureevaluation.org/resources/training/capacity-building-resources/geographic-information-systems-mapping-and-analysis-of-spatial-data/spatial-data-fundamentals/UTMcoordinatesystemAfrica\\_Jan2013.pdf](http://www.measureevaluation.org/resources/training/capacity-building-resources/geographic-information-systems-mapping-and-analysis-of-spatial-data/spatial-data-fundamentals/UTMcoordinatesystemAfrica_Jan2013.pdf)
- eLearning courses: “Geographic Approaches to Global Health” (available at <http://www.measureevaluation.org/resources/publications/ms-12-56>) and “GIS Techniques for M&E of HIV/AIDS and Related Programs” (available at <http://www.measureevaluation.org/resources/publications/ms-15-106>)
- Interactive introductory mini-tutorials: “GIS Step-by-Step” (available at <http://www.measureevaluation.org/resources/training/online-courses-and-resources/non-certificate-courses-and-mini-tutorials/gis-step-by-step-tutorials/>)

Furthermore, MEASURE Evaluation can help planners frame data in many geographic contexts, to integrate health and ancillary information. If migration is typical within a country, or if seasonal variations, such as rainy seasons, have a negative impact on programs, MEASURE Evaluation can help planners map that reality. Program managers can align human resources data with the number of patients visiting each facility, identify facilities that are overburdened or have extra capacity, and include topography or road networks as data elements.

This map of the Dodoma region, in Tanzania, on the next page is an example of the results of such an exercise. Combining road network data with facility locations shows areas (in green) within relatively easy reach of those facilities. This information, along with population data (darker orange shows greater population density), reveals areas with higher populations that are being



underserved. These areas are circled on the map. Seeing this, planners can determine specific places that might benefit from the addition of new health facilities.

GIS also makes it possible to show relationships among adjoining areas and may reveal, for example, a heightened risk of disease in one area that is adjacent to a second area with a high prevalence of disease. Similarly, GIS can call attention to an area that lies along a migratory route frequented by people who live in an area with a high prevalence of disease.

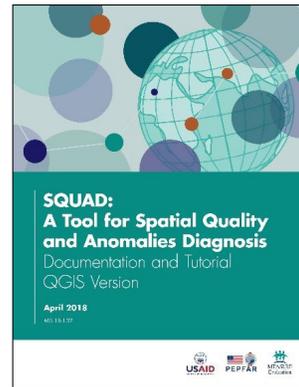
GIS specialists at MEASURE Evaluation have created tools that can help with these tasks:

- Service area assessment tools: <http://www.measureevaluation.org/resources/publications/sr-14-109>, <http://www.measureevaluation.org/resources/publications/ja-13-167>
- Data quality assessment tools: <http://www.measureevaluation.org/resources/tools/geographic-information-systems/squad-tool>
- Priorities for Local AIDS Control Effort (PLACE) survey mapping tool: <http://www.measureevaluation.org/resources/tools/hiv-aids/place/the-place-mapping-tool-a-plugin-for-qgis>

The number of opportunities for GIS tools to strengthen health systems continues to grow rapidly, owing in part to trends in geographic data: higher density of information and increased availability of geographic identifiers. These trends are pushed by commitments to build strong HIS foundations and advances in technology, such as smart phones and satellite imagery on one end and sophisticated, GIS software on the other. At the same time, more and more people know how to use GIS tools. For all these reasons, MEASURE Evaluation’s work in GIS for HIV program planning is helping countries meet PEPFAR and other global development goals.

## Two Useful GIS Tools from MEASURE Evaluation

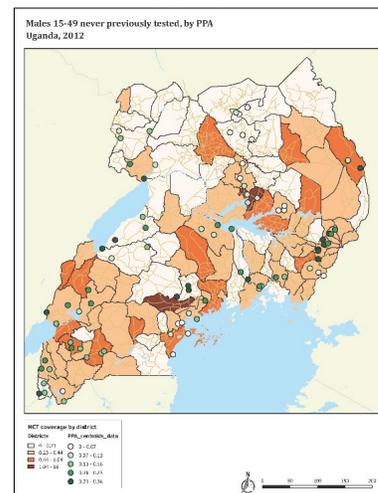
### SQUAD Tool



The Spatial Quality and Anomalies Diagnosis (SQUAD) tool is a way to assess the quality of large point-based data sets rapidly. It makes possible in a short period what would otherwise take a skilled GIS technician days or weeks to accomplish. The tool is particularly useful for assessing master facility lists, both to identify problems with the data and point a

way forward to fixing them. It is available for use with ArcGIS and QGIS (popular free and open-source GIS programs) and comes with complete documentation and a tutorial data set.

### PLACE Mapping Tool



This map is an example of the output—a fully formatted, printable map—of the PLACE mapping tool. This tool walks nongeographers through the steps needed to determine where HIV incidence and transmission rates are high, to help a country determine areas of high priority for HIV prevention efforts. The tool works inside QGIS and comes

with complete documentation and sample tutorial data.

## About **MEASURE** Evaluation



Wayne Hoover, MEASURE Evaluation

MEASURE Evaluation, funded by the United States Agency for International Development (USAID), has a global mandate to help countries strengthen their health information systems (HIS). HIS are the backbone of all aspects of a country's health sector—from

strategic planning and policymaking to delivering services at health facilities. The project's objective is to enable countries to generate high-quality health information at local, national, and global levels.

MEASURE Evaluation also helps countries improve their capacity for rigorous evaluation to determine what programs work and to identify HIS strengthening interventions that are effective. The project provides in-country resources, such as offices and staff, and short-term technical assistance where USAID might request support. The project works across the full range of disease- and service-specific health sectors: HIV, malaria, tuberculosis, maternal and child health, family planning, nutrition, water and sanitation, and infectious diseases.

MEASURE Evaluation's history has been one of collaborative effort, with tailored responses to individual USAID mission needs, as well as integration of crosscutting USAID priorities such as gender, country ownership, and system sustainability. MEASURE Evaluation is implemented by the Carolina Population Center at the University of North Carolina at Chapel Hill, in partnership with John Snow, Inc., ICF International, Management Sciences for Health, Palladium, and Tulane University.

### MEASURE Evaluation's Services

To learn more about our capabilities visit: [www.measureevaluation.org](http://www.measureevaluation.org), email: [measure@unc.edu](mailto:measure@unc.edu). Jason B Smith, PhD, Director for Health Systems Strengthening, John Spencer, Senior GIS Technical Specialist

To access all of the project's capabilities statements, visit: <http://www.measureevaluation.org/about/services/capacity-statements>. To access MEASURE Evaluation resources, country governments should contact their local USAID mission. The mission, in turn, can contact the USAID AOR for MEASURE Evaluation, Kristen Wares ([kwares@usaid.gov](mailto:kwares@usaid.gov)).