Challenges and Promising Solutions for Improving the Use of Geospatial Data for PEPFAR Decision Making

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USAID
FROM THE AMERICAN PEOPLE

PEPFAR

MEASURE Evaluation

ACKNOWLEDGMENTS

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ABBREVIATIONS

CDC	United States Centers for Disease Control and Prevention
DHS	Demographic and Health Surveys
GIS	geographic information systems
NGO	nongovernmental organization
OGAC	Office of the Global AIDS Coordinator
PEPFAR	U.S. President's Emergency Plan for AIDS Relief
PLHIV	people living with HIV
USAID	United States Agency for International Development

INTRODUCTION

To promote and improve the use of geospatial data by the U.S. President's Emergency Plan for AIDS Relief (PEFPAR) implementing partners, MEASURE Evaluation—funded by the United States Agency for International Development (USAID) and PEPFAR—convened a meeting of the Geographic Information Systems (GIS) Working Group in Washington, DC, on June 23, 2016. The group has been meeting at least annually since the year 2000, giving GIS specialists and users a regular opportunity to share their experiences with spatial data and platforms, and to keep up to date on recent developments in GIS technology and its uses for global public health. Over the years, several springboard discussions from these meetings have resulted in publications and have also led to further collaborative work within the project.

This year, 31 participants from 15 organizations attended the one-day meeting: statisticians, GIS specialists, program managers, and health advocates from the USAID, the United States Centers for Disease Control and Prevention (CDC), the Office of the Global AIDS Coordinator (OGAC), and a number of nongovernmental organizations (NGOs).

Their agenda focused on the role and uses of spatial data, because these data are playing a larger and larger role in PEPFAR's decision making. With the availability of these data, analytical tools now allow users to pair other datasets with spatial data to create visual data representations, such as maps and overlays, that can help focus HIV programs "on the right things, in the right place, at the right time" in order to achieve PEPFAR's goal of an AIDS-free generation. For example, PEPFAR partners can now use GIS in order to understand better the availability of HIV services (for example, site client loads—the number of clients attending a given site). By allowing decision makers to view data about the services in the context of where sites are located and clients' travel distances (and difficulties) to access services, GIS can also improve access to HIV services.

MEASURE Evaluation set the following objectives for the meeting:

1. Share examples of state-of-the-art use of geospatial tools and data.
2. Identify factors that affect spatial data quality as well as potential strategies to mitigate poor-quality spatial data.
3. Identify common questions and challenges that could be addressed with spatial data products.
4. Consider potentially valuable spatial analytical methods to support PEPFAR decision making.
5. Share information on selected spatial data issues, such as confidentiality and data ownership.

Contributions of Spatial Data to Global Health Programs

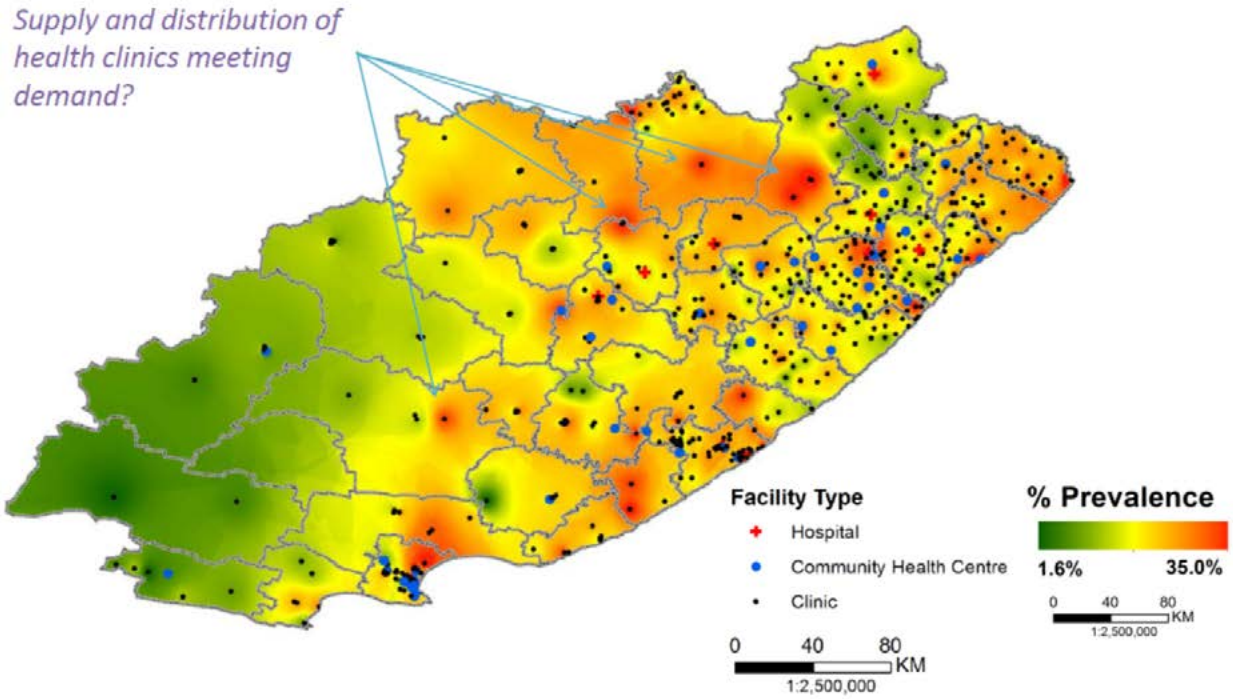
Carrie Stokes, chief geographer of USAID and director of USAID's GeoCenter, gave the morning's keynote address. She underscored the importance as well as challenges of using geographic data to inform decision making in all aspects of HIV and other global health programs. She shared several examples to illustrate the use of spatial data: crowdsourcing work with OpenStreetMap; "story mapping" during the Ebola crisis; mapping travel times to access care in Malawi; and the Sylhet stunting/food consumption study, which was also able to disaggregate data by gender. (Follow the embedded hyperlinks to learn more about these.)

Geographic data can be analyzed in all aspects of a program cycle to convey information to help decision makers understand the data better and make more informed decisions. However, basic data literacy is often lacking, and addressing that requires an upfront investment in an expanded suite of training that focuses on data and analytics and visualization. Also, policies are being revised to ensure clear expectations from partners in terms of data collection and submission, to ensure that data are collected and reported in standard ways.

This report shares the presentations and group exercise outputs from this meeting, organized around the following topics (see Appendix 1 for the meeting agenda):

1. Data quality
2. Data use
3. Data analysis

An expert speaker introduced each topic, which was followed by group exercises. For each exercise, groups of five or six participants explored issues related to the topic. Later in the day, participants were able to do a "gallery stroll" to review the posters that the groups created in response to the questions for each exercise. During the gallery stroll, participants placed "thumbs up" stickers on the responses they felt were the most relevant or important.



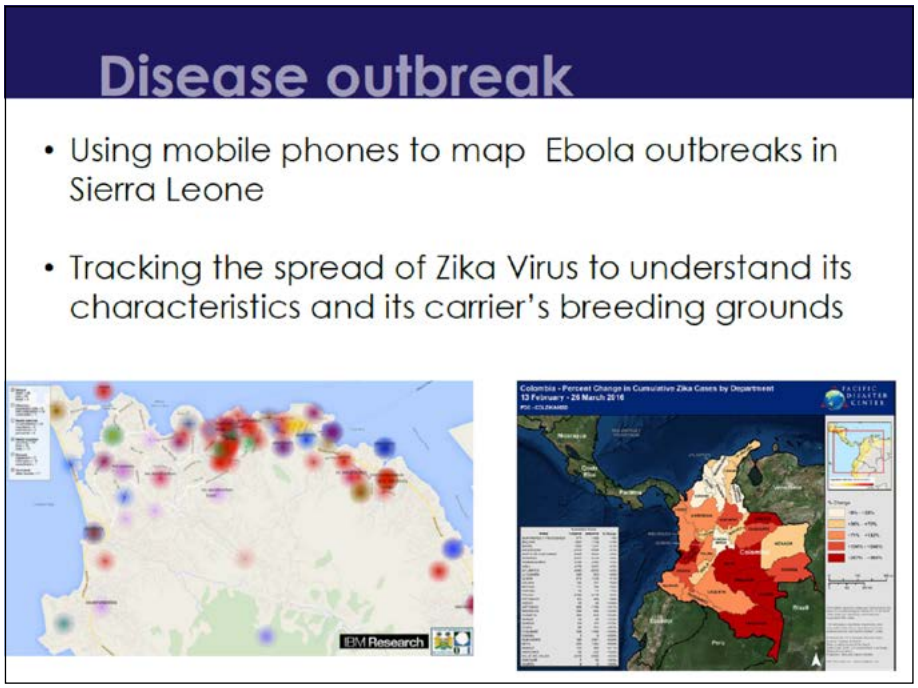
Estimated HIV Prevalence in Eastern Cape, South Africa 2014
From Spencer Intro Presentation #1

SPATIAL DATA QUALITY

Useful output from geospatial data analysis requires good-quality data and a shared understanding of what "good data quality" means. Other key issues around the quality of spatial data are understanding the factors that affect spatial data quality and identifying promising strategies to ensure good spatial data quality. Nathan Heard, GIS lead at OGAC) and in the Office of Global Health Diplomacy, U.S. Department of State, introduced the data quality topic with a presentation on "PEPFAR's Experience in Moving towards Spatial Data Governance." He spoke first about the requirements for suitable quality data, aligned with the purpose of the analysis. For example, when mapping health facilities or medical stores, do you need data that are accurate to within 100 meters or to within one meter? Also, further standardization of geographic units is needed in terms of the areas being reported (e.g., subdistrict versus local government area). As for spatial data quality in PEPFAR, data governance and data management policy are important in terms of specifying the processes, regulations, and requirements for spatial

data as well as the roles and responsibilities of PEPFAR's partners to manage these data. Overall, clear data governance and a strong communications effort will motivate people to adopt and use a standard set of geospatial data. This will also allow data to track and agree with other platforms, such as OpenStreetMap and Google Maps.

Heard also reported that OGAC is receiving requests for maps from PEPFAR teams but doesn't know how the teams are using these maps—or should be using them—to inform decision making. Quality issues with the available geospatial data are also a concern and need to be identified and corrected to improve the use of these data. Current geospatial datasets include duplicate location data for some sites; for other sites, the longitude and latitude data have been incorrectly transposed (which places some sites out in the ocean!). Some data have problems as simple as missing negative signs. Identifying and correcting these errors is necessary for geospatial data to be useful.



Maps as a Tool for Data Use

Group Exercise #1

For the session on data quality, each group of participants received the following two questions:

- What are three key barriers to spatial data quality?
- What are three solutions or mitigating factors?

After discussions, several common barriers to spatial data quality emerged. The barriers or factors that participants felt most strongly affected spatial data quality were these:

- Lack of a data management culture (This is often due to inadequate staff expertise and/or funding, or a culture where data management is not appropriately valued by senior staff or not supported by clear data policies and guidance.)
- Lack of unique identifiers for all geographic levels (e.g., region, district, subdistrict, facilities)
- Imprecise national and subnational boundaries that either are unknown or disputed
- Weak ground-level capacity for conducting data collection and training
- Lack of agreed-upon spatial data standards, such as borders, naming conventions, data characteristics, and ethical issues for collecting data

To address many of these barriers, participants felt that a more robust data management culture was needed, which requires building the capacity of staff in the field and at headquarters. It will also require funding. Data quality suffers from lack of demand, which would improve with capacity building and a culture that promotes the use of data. Improved access to data tools and promotion of success stories using spatial data could also make a difference.

SPATIAL DATA USE

It is important to understand the ways that PEPFAR partners are currently using the geospatial data as well as the potential uses of geospatial data. Other important questions are whether the availability of spatial data *is* or *isn't* changing decision making, who is using spatial data products, and for what purpose?

Isabel Brodsky, data use advisor, and Andrea Vazzano, technical health advisor, both at Palladium, presented "Maps as a Tool for Data Use: Considerations for Improvement." Brodsky and Vazzano related that many spatial data use issues are similar across data use in general, but some are specific to spatial data. As spatial data become increasingly available, several improvements are needed, such as improved master facility lists, more geocoded data, increased mobile phone accessibility to data, and better methods for collecting and mapping data.

For PEPFAR partners, spatial data have a number of important potential uses:

- Spatial data can be especially useful in PEPFAR 3.0 to inform decisions about how to reallocate decreasing donor resources (see the scenario below).

- For commodities distribution and tracking, mapping can help track the movement of commodities, monitor the time for commodities to reach health facilities, and estimate when stock outs will occur. In the LEAD project, conducted in Tanzania by IMA World Health, maps of the locations of machines to test CD4 counts, overlaid with travel distances and times, were used to explain the low use of CD4 machines at some sites.

- Spatial data are also important for mapping the progression of disease outbreaks in as close to real time as possible. For example, with the Ebola outbreak, some NGOs used disease progression maps to advocate more funding.

A specific factor that influences the use or nonuse of spatial data in decision making may be how timely and current the data are. If there's a large time lag between spatial data availability and the time of decision, then the data are less valuable. If there are not enough data available for an informed decision, data may not be used at all. If there's low demand for spatial data from the end users, then the data may not be collected in a timely way, or valued. This, of course, is part of building a culture of data use that demands good quality data. Another factor that influences whether spatial data are used is how clear or complex the visualization (e.g., map or graphic) is, how well it communicates the intended analysis, and how easy it is to create.

Group Exercise Session #2

For this exercise, each group received the following scenario to discuss:

> *You're the GIS specialist serving a PEPFAR country team. The team has to make decisions about prioritization of sites. The objective is to provide resources to those sites that can best advance progress on 90-90-90 goals. This means some sites with low volume may see support withdrawn in favor of high volume sites. However, if low volume sites see unilateral withdrawal of support it may lead to increased HIV prevalence if clients have no other sites nearby.*

1. *What are the questions that you would ask to help you make this decision?*
2. *How would you visualize the answers to those questions?*

3. *What challenges do you foresee in doing this? How would you overcome those challenges?*
4. *What steps could you take to foster the sustainability of this process?*

Participants came up with the following examples of potential questions that could help decision makers prioritize sites to best reach the 90-90-90 goals, which PEPFAR has adopted:

- What are the demographics of each area, such as locations of key populations and HIV prevalence rates?
- What level of access does the population have to services (distances between population centers and service sites and availability of transportation)? Do seasonal constraints (winter or rainy season) or topology constraints hinder access?
- Who are the stakeholders in the area and what are their capabilities and level of engagement to provide services?
- What types of services will be provided?
- What are the definitions of "high volume" and "low volume"?
- What makes some areas low-volume (access, demographics, culture)?
- Are other resources available in high-volume areas to absorb some of the demand? Are referral systems in place?
- Are any supply chain or cost-effectiveness issues or budget constraints affecting volume?

To help decision makers visualize the answers to the above questions, participants recommended:

- Developing indicators to map progress toward the 90-90-90 goals and determining what else would help to reach them, such as a cost-benefit analysis for each site
- Creating dashboards for aggregated, time-series, and broad-context data
- Creating custom maps or visual aids to support specific programmatic decision-making needs

Summarizing the challenges to presenting geospatial data, participants said:

- Local stakeholders must prioritize data collection and use.
- Scenario modeling can be a useful tool for visualizing data.
- Program managers need to assess what data are available versus what data they need to make decisions.
- User-friendly software would encourage the production and use of spatial data.

Discussing how to sustain data use, participants made the following points:

- Advocacy encouraging stakeholders to use spatial data makes sense only if the stakeholders have the capacity to collect, analyze, and use these data to aid their decision making.

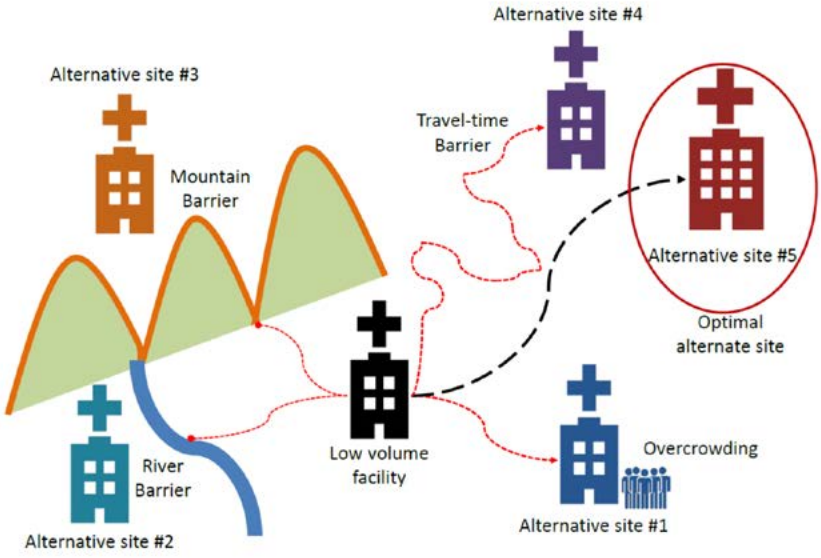
- Actively engaging potential users at the local level to define parameters will help with user buy-in and encourage use of this type of data, reinforcing a culture of data use and potentially sustaining data's use in future decision making.

SPATIAL DATA ANALYSIS

When using geospatial data to analyze a given scenario, several questions must be asked. Clara R. Burgert-Brucker, senior geospatial advisor with the Demographic Health Survey (DHS) program at ICF International, presented "Beyond Dots on a Map: Spatially Modeled Surfaces of DHS Data." She posed these questions: What is the "just right" level for decentralized decision making? What is the best way to combine data, such as overlaying data on environmental behaviors with maps of health facilities? What is the best way to use external data sources along with DHS data sources? (In this case, she said, using data from different sources requires some type of standardization and validation.)

Spatial models of urban areas are limited, according to Burgert-Brucker, because urban areas tend to be quite heterogeneous, and spatial data models tend to make them appear more homogenous than they really are. How do we work with data at the scale of five kilometer squares, for example? Do we reaggregate the data up for larger areas such as districts, livelihood zones, or catchment areas when doing analyses, such as comparing intervention versus nonintervention areas? With geospatial models, how do we communicate uncertainty with a map and what level of error are decision makers comfortable with? It is impossible to recreate DHS regions and national estimates by aggregating 5 kilometer x 5 kilometer squares. Also, using spatial data to create comparisons across time is challenging, owing to the different levels of accuracy of DHS over time and the reliability of covariates DHS used in the past.

John Spencer, senior GIS technical specialist at MEASURE Evaluation, presented "Geospatial Targeting for HIV Programs Using Modelbuilder." He posed the hypothetical situation of a USAID mission doing its country operational planning: How could the mission use GIS to understand implications for PEPFAR support of sites when deciding how to best allocate funding? A simple tool to support decision making around the funding of sites is to look at the number of patients receiving care, comparing low-volume sites to high-volume sites. But those data give a decision maker only part of the picture. By looking at the sites visually, on a map overlaid with geographic features, transportation routes, and the locations of patients who need HIV care, a decision maker can determine if closing some sites could put an undue burden on some clients' access to care. GIS analysis of travel time across road networks can provide a more realistic model of patient behavior than a simpler Euclidean geometry calculation, with its straight-line distances between communities with HIV clients and health sites. Distances alone do not tell the whole story of how geographic



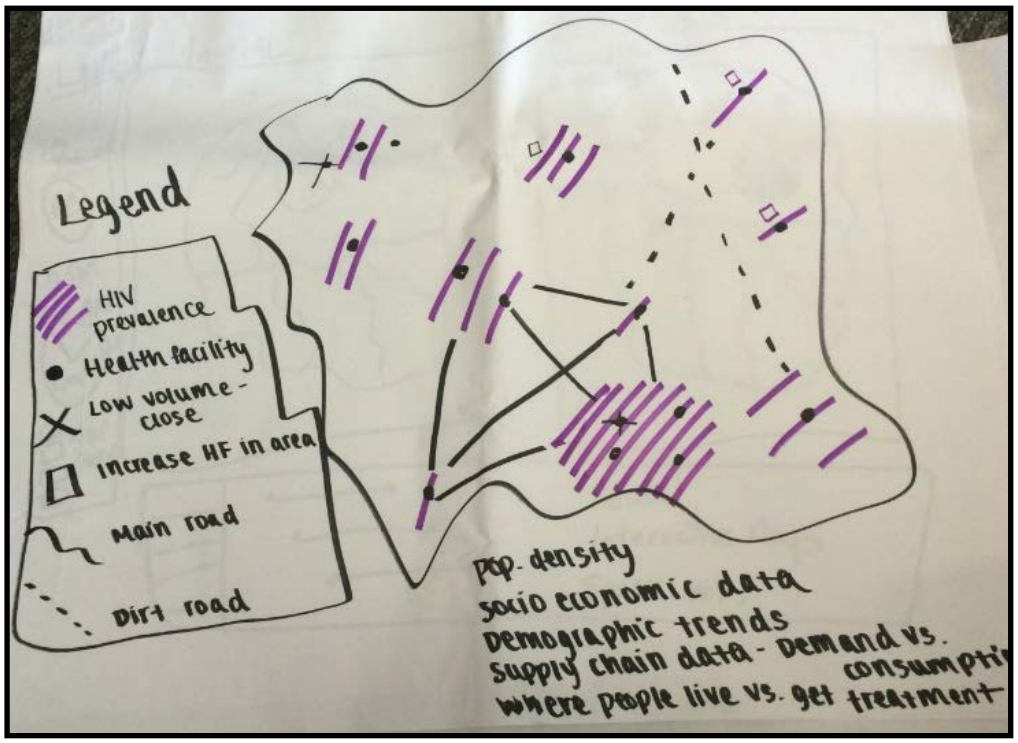
From *Geospatial Targeting for HIV Programs Using Modelbuilder.* When modeling to compare low-volume to high-volume sites for program allocation, the underlying geographic features should be taken into account.

features or a lack of road systems between points may hinder travel. Geography matters, and incorporating it into the PEPFAR decision making process can result in a more robust analysis.

Group Exercise Session #3

Participants were asked to consider the earlier scenario—looking at how to use spatial data to reallocate PEPFAR funds—and sketch what an ideal map using these data to inform such a decision would look like. Participants were also asked to list the data elements that each of these "ideal" maps should contain.

Map 1:



Map 1 presents data to show where HIV prevalence is high, accurate locations of the health facilities, information about health facility capacity, and an accurate network analysis of the transportation system to show how easy or difficult it is for clients to access health services.

Data elements for Map 1:

- HIV prevalence
- Health facility locations
- Information on health facility capacity
- Main roads
- Dirt roads
- Other possible data could include:
    - Population density

- Socioeconomic data
- Demographic trends
- Supply chain data: demand versus consumption
- Where people live versus where they get treatment

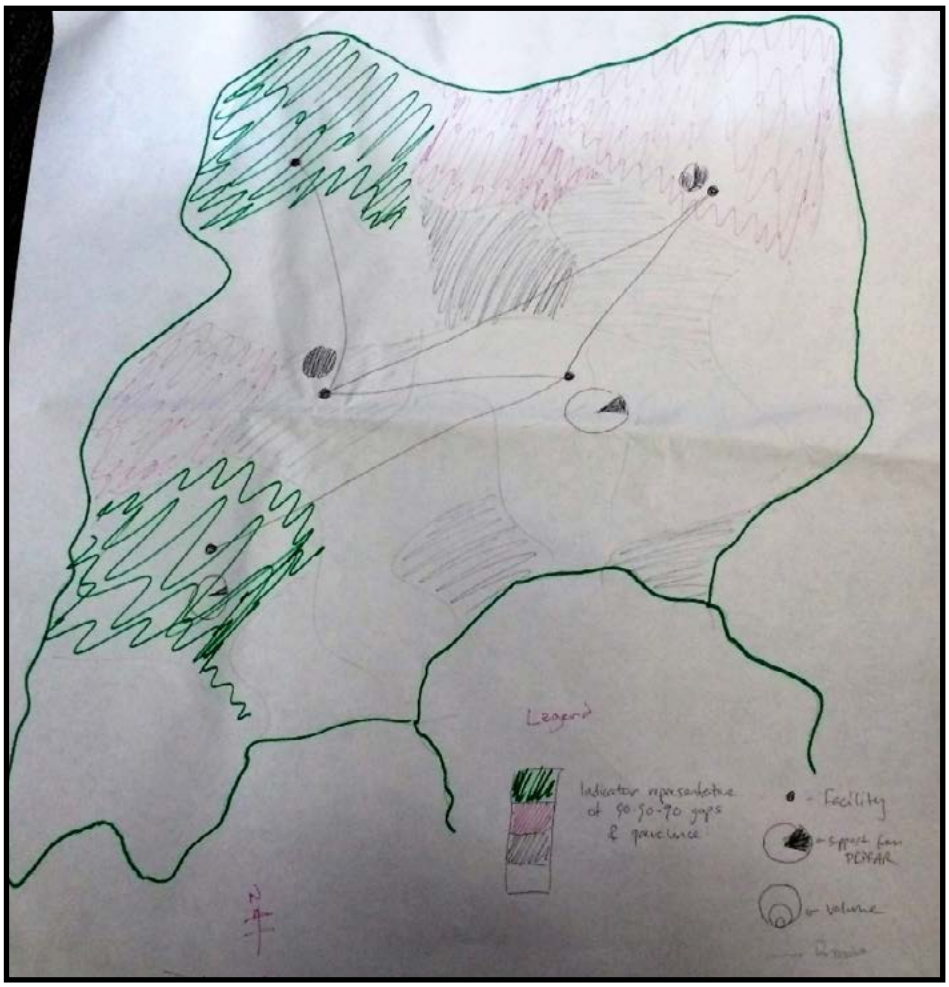
Map 2:

Map 2 displays potential "before" and "after" scenarios to model how changing the funding allocation to a site could affect the number of people treated. The map also displays a network analysis of the road systems and the current capacity of a site versus how reallocation would allow it to reach full capacity.

Data elements for Map 2:

- Site volume
- Satellite data
- ART capacity for each site
- HIV prevalence
- Network analysis

Map 3:

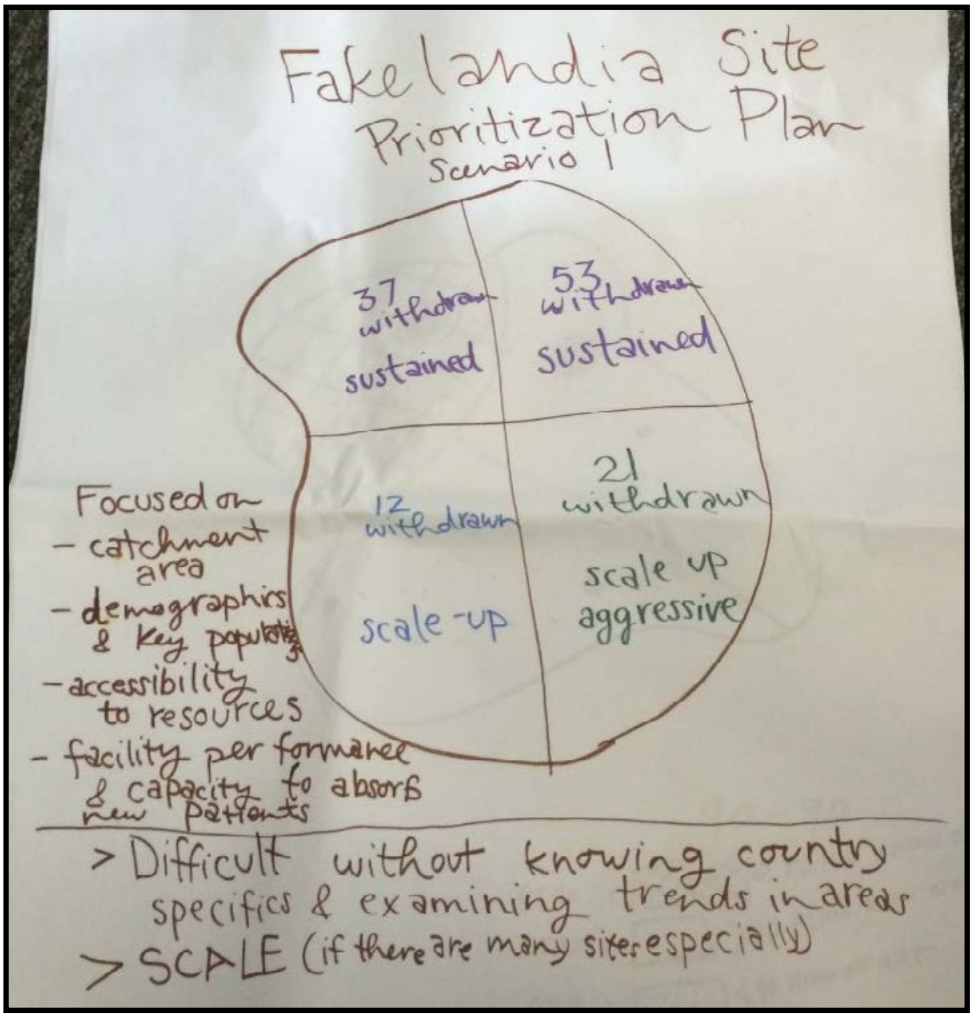


Map 3 focuses on comparing PEPFAR support, by displaying both HIV prevalence and health site volume to create a "low-medium-high" area map. The map also displays the 90-90-90 indicators and identifies potential gaps or problem areas that need to be addressed.

Data elements for Map 3:

- Selected 90-90-90 indicators
- 90-90-90 gaps
- HIV prevalence
- Site volume
- Percentage of PEPFAR support at each site

Map 4:

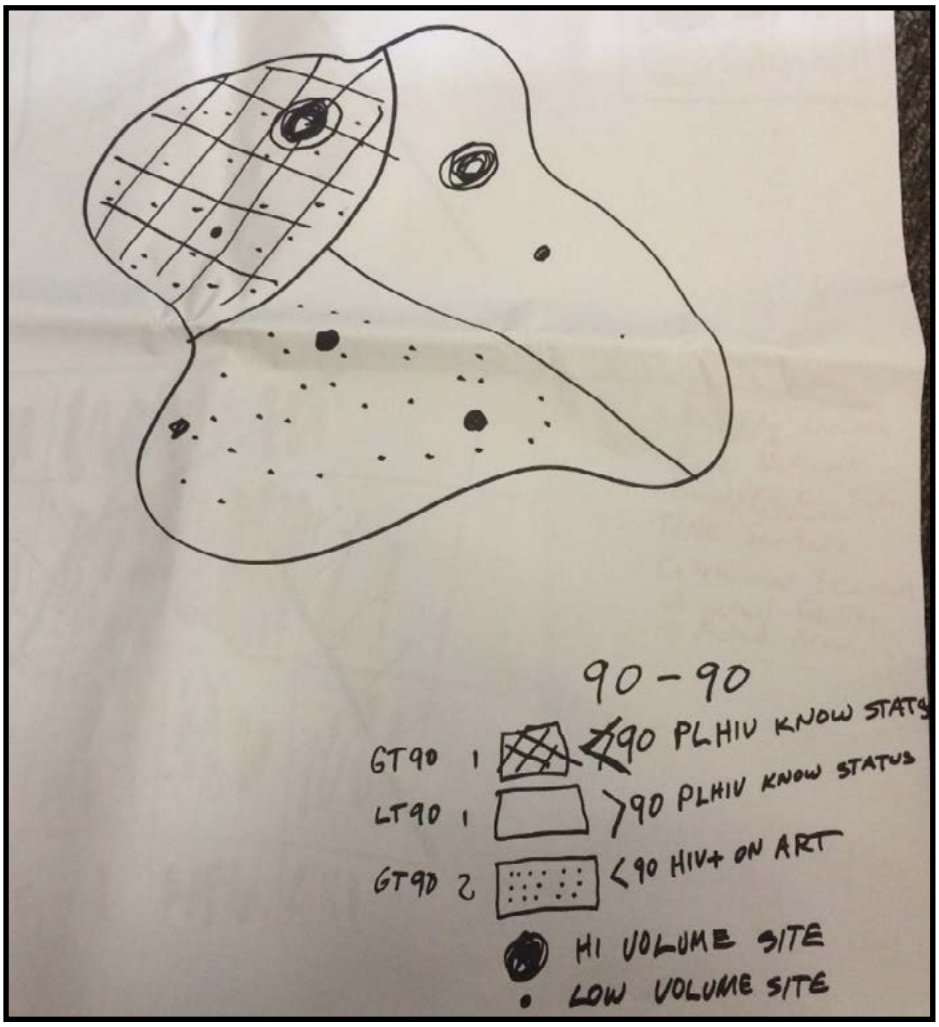


The group who created Map 4 proposed creating a series of maps for four different scenarios involving different levels of scale-up or scale-down for various health sites. A key difference in this map is that this group is proposing the creation of "catchment areas" for each facility and then looking at the potential effects on 90-90-90 goals according to the choices made for funding levels for each area.

Data elements for Map 4:

- Catchment area and number of sites
- Demographics and key populations
- Access to resources
- Facility performance and capacity to absorb new patients

Map 5:

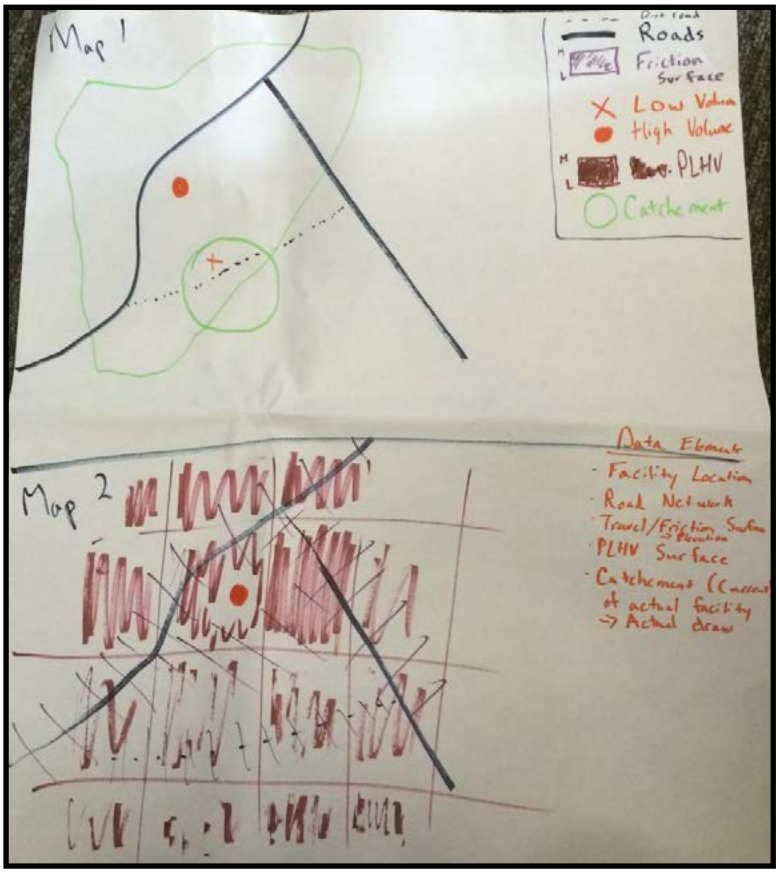


Map 5 proposes a simplified map based on the volume of clients at each health site and the location of each site in comparison to reported HIV status for each area (less than or greater than 90 percent for the particular goal). The map overlays areas where less than 90 percent of PLHIV are on ART, which allows the reader to compare two of the 90-90-90 goals on this one map and see how it varies by location.

Data elements for Map 5:

- Areas where more than 90% of PLHIV know their status
- Areas where less than 90% of PLHIV know their status
- Areas where less than 90% of PLHIV are on ART
- High-volume sites
- Low-volume sites

Map 6:



The group who created Map 6 proposes looking at various data elements in two different formats—vector and raster data—which would allow for the use of a number of different spatial analysis techniques. Presumably, by comparing the size and location of catchment areas for health sites (which could consider both the potential volume of each site and the underlying demographics of the entire area) and then analyzing the road network distances, it would be possible to highlight areas that overlap in coverage. With this knowledge, decision makers could identify and potentially close or scale back redundant locations.

Data elements for Map 6:

- Facility locations
- Low- and high-volume facilities
- Road network
- Travel characteristics: paved and unpaved roads
- Number and location of PLHIV
- Catchment areas

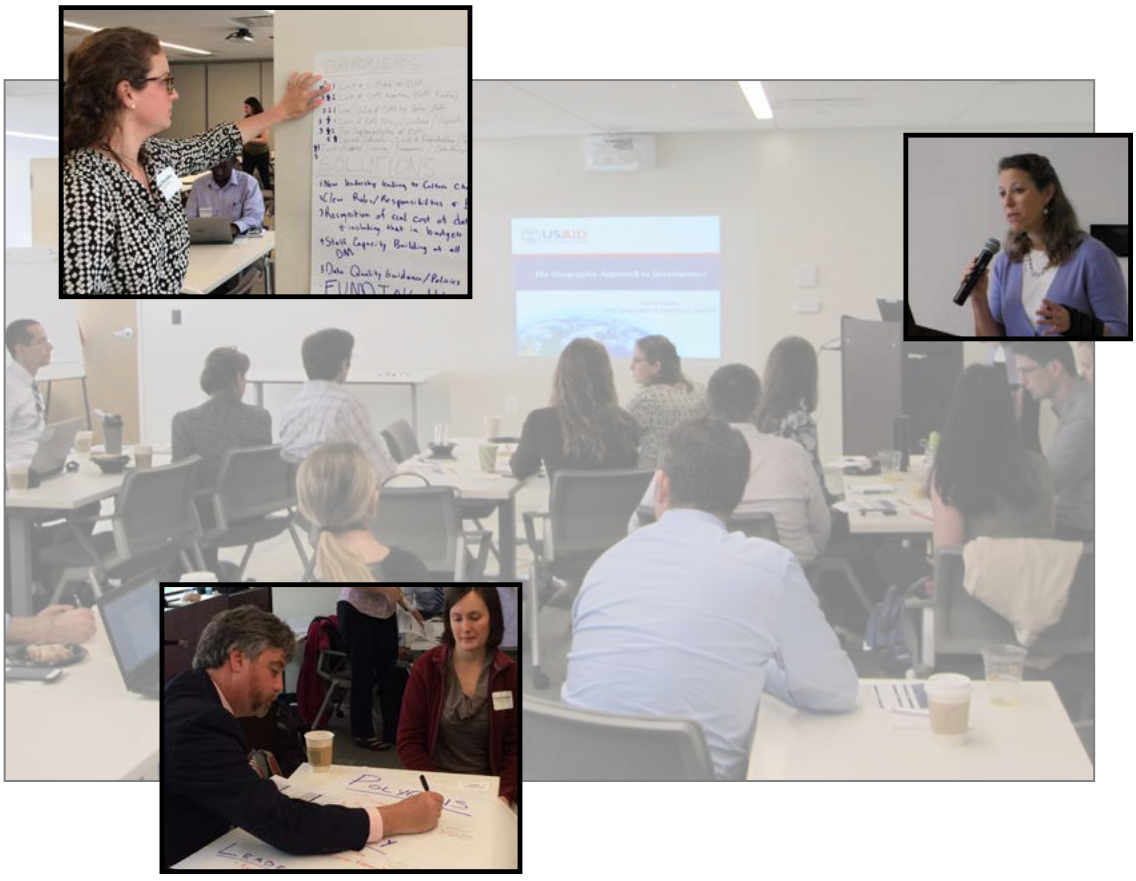
Summary of The "Ideal" Map Exercise

It is clear from examining the maps produced by the group exercises that no single "perfect map" can be developed. Each group identified different data elements and different ways to present the data based upon their experiences and understanding of the data product needed. The implication of this for PEPFAR is that even if the underlying data were collected in a standardized way, there would likely be variability in the maps produced by field teams. If PEPFAR would like to see standardized maps, they will need to offer guidance on what the maps should look like.

OTHER CONSIDERATIONS WITH SPATIAL DATA

John Spencer ended the meeting with a reality check, reminding participants about several important issues surrounding the collection and use of spatial data that they had not explicitly addressed, such as data confidentiality, data ownership, and data security. Confidentiality matters, because the act of collecting data can potentially put groups at legal or physical risk. Thus, data collectors and users must make key populations' privacy and safety a high priority. Data ownership requires clear policies and procedures for who can access the data, what is acceptable use of the data, and who bears responsibility for updating the data. Data security entails protecting spatial data from unauthorized access and use.

The ability to use geospatial data offers exciting new options for visually presenting PEPFAR data overlaid with maps at select granularity, at national, subnational or facility levels. The GIS Working Group encourages PEPFAR partners to learn more about the use of spatial data to create compelling visuals to support their data analyses.



APPENDIX 1

MEASURE Evaluation

USAID FROM THE AMERICAN PEOPLE

MEASURE Evaluation

GIS Working Group Annual Meeting

AGENDA

June 23, 2016
Palladium, 1331 Pennsylvania Ave NW, 6th floor

Meeting objectives: By the end of the meeting participants will have:

1) Seen examples of state of the art use of geospatial tools and data
2) Identified factors that affect spatial data quality and potential strategies to mitigate bad spatial data
3) Identified common questions being asked in support of PEPFAR decision making, who is asking them and the role for spatial data products
4) Identified potentially valuable spatial analytical methods that can support PEPFAR decision making
5) Learned about other relevant spatial data issues such as confidentiality, data ownership, etc.

Pre-Meeting

8:30 am to 9:00 am	Registration and Reception, Breakfast

Opening

9:00 am to 9:15 am	Welcome **John Spencer,** *Senior GIS Technical Specialist, MEASURE Evaluation, UNC*
9:15 am to 9:30 am	Participant introductions
9:30 am to 9:45 am	Keynote address **Carrie Stokes,** *Chief Geographer and Director of the GeoCenter, USAID*

Data Quality

Objective of this block:

- Identify what "data quality" means in terms of spatial data
- Identify the key issues around data quality
- Develop list of factors that affect data quality (in either a positive or negative way) and identify possible solutions or strategies that have proven successful

Outcomes:

- List of factors affecting spatial data quality and possible solution and/or elements contributing to high or low quality spatial data

9:45 am to 10:05 am	"PEPFAR's experience in moving towards spatial data governance" **Nathan Heard, DSc.,** *GIS Lead, Office of the Global AIDS Coordinator and Health Diplomacy, US Department of State*
10:05 am to 10:30 am	**Group work** "What are 3 key barriers to spatial data quality?"
10:30 am to 11:00 am	**Group work** "List either one potential solution or one mitigating factor for each barrier"
11:00 am to 11:20 am	*Coffee Break/gallery walk*
11:20 am to 11:30 am	Summary by moderator of gallery and comments from audience

Data Use

Objective of this block:

- Identify how the availability of spatial data is or isn't changing decision making
- Who is using spatial data products? For what purpose?

Outcomes:

- List of factors affecting spatial data quality and possible solution and/or elements contributing to high or low quality spatial data

11:30 am to 11:50 am	"Maps as a Tool for Data Use: Considerations for Improvement" **Isabel Brodsky**, *Data Use Advisor*, and **Andrea Vazzano**, *Technical Health Advisor, Palladium*
11:50 am to 12:30 pm	**Group work** Tara Nutley, Senior Technical Advisor, MEASURE Evaluation, Palladium, Moderator
12:30 pm to 1:30 pm	*Lunch/Gallery Walk*
1:30 pm to 1:40 pm	**Moderator summarizes data use exercise results** Group questions/comments

Data Analysis

Objective of this block:

- Present types of analysis are possible with the growing spatial data infrastructure
  - Analysis suitable in low capacity environments
  - Analysis possible in high capacity environments
- Demonstrate what is required from a data/capacity standpoint for this type of analysis
- Are there stakeholders beyond the usual suspects that can employ or benefit from analysis
- Identify what some "ideal" maps look like?

Outcomes:

- Examples of data analysis opportunities to support global health; PEPFAR specific analysis examples including data requirements, technical requirements, etc.

1:40 pm to 2:00 pm	"Is supply of clinic-based services meeting demand? Spatial data challenges" **Mark Janko,** *PhD Candidate and Predoctoral Trainee, Departments of Biostatistics and Geography, University of North Carolina at Chapel Hill*
2:00 pm to 2:20 pm	"Beyond Dots on a Map: Spatially Modeled Surfaces of DHS Data" **Clara R. Burgert-Brucker,** *Senior Geospatial Advisor at the DHS Program, ICFI*
2:20 pm to 2:40 pm	**Group work** "What would the ideal map look like?"
2:40 pm to 3:15 pm	**Review of group work** and group discussion

For your consideration

Objective of this block:

- Present important information that requires consideration but are cross cutting with spatial data
- Identify any things that were "missed" relevant to the use of geospatial tools in global health and/or relevant resources

Outcomes:

- List of resources or contacts about relevant topics and materials

3:15 pm to 3:30 pm	**"Reality check"** **John Spencer**, *Senior GIS Technical Specialist, MEASURE Evaluation, UNC*
3:30 pm to 3:45 pm	**Group work:** "What did we miss?" - "What do you know that others may benefit from?" - Topics for future meetings – Provide resources or contact information
3:45 pm to 3:50 pm	**Review of group work** and any last minute questions/comments from attendees
3:50 pm to 4:00 pm	• Summary of day's work • Next steps

Meeting End

APPENDIX 2

Name	Position	Organization
Aaron Dixon	Statistician	US Census Bureau
Abraham Agadew	GIS Specialist	CDC
Akin Atobatele	FSN Fellow, M&E Manager	USAID
Alan George	Tech Advisor, Supply Chain	MSH
Altin Ilirjani	Senior Data Strategist	GBH, USAID
Ana Djapovic Scholl	Senior M&E Advisor	Office of HIV/AIDS, USAID
Becky Wilkes*	GIS Specialist	MEASURE Evaluation, UNC
Brian Bakker	GeoCenter Program Manager	USAID/GDL/GeoCenter
Carrie Stokes*	Chief Geographer, Director of GeoCenter	USAID
Clara Burgert-Brucker*	Senior Geospatial Advisor	ICF International/DHS program
Gina Sarfaty	Geospatial Specialist	Office of HIV/AIDS, USAID
Isabel Brodsky*	Data Use Advisor	Palladium Group
Jennifer Majer	M&E Officer	Action Against Hunger
Jim Tobias	Senior GIS Developer	CDC Global AIDS Program
John Spencer*	Senior Technical Specialist, GIS	MEASURE Evaluation, UNC
Julianna Kuhn	GIS Analyst	LAB/USAID
Katherine Wikrent	Data Science Fellow	Development Gateway
Matt Pagan	GIS Research Assistant	ICFI/DHS Program
Michael Mwebaze	HMIS Developer	MEASURE Evaluation, JSI
Mike Edwards	Biostatistician, Sr. Advisor	MEASURE Evaluation, JSI
Nate Heard*	Health Analyst	OGAC, Dept. of State
Patrick Gault	Senior Geospatial Analyst	GeoCenter, USAID
Robert Leddy	Geographer	US Census Bureau
Samuel Estabrook	Spatial Data Manager	Blue Raster/ICFI/DHS
Sarah Unninayar	Technical Advisor, Program Systems	Pathfinder International
Senad Handanagic	Public Health Worker	New to US & GIS
Simon Conesa	Senior Technical Advisor	MSH
Steven Peck	VP of M&E	ACDI/VOCA
Tara Nutley*	Senior Technical Specialist	MEASURE Evaluation, Palladium
Tim Essam	Data Scientist	USAID
Trinadh Dontamsetti	Health Geographic Analyst	ICF International/DHS program

* Indicates facilitator and/or presenter

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