Identifying Populations at Greatest Risk of Infection – Geographic Hotspots and Key Populations

Report and recommendations from a meeting of the UNAIDS Reference Group on Estimates, Modeling and Projections held in Geneva, Switzerland, 25-26 July 2013

Introduction

The Joint United Nations Programme on HIV/AIDS (UNAIDS) *Reference Group on Estimates, Modelling and Projections* exists to provide impartial scientific advice to UNAIDS, the World Health Organization (WHO) and other partner organizations on global estimates and projections of the prevalence, incidence and impact of HIV/AIDS. The Reference Group acts as an 'open cohort' of epidemiologists, demographers, statisticians, and public health experts. It is able to provide timely advice and also address ongoing concerns through both *ad hoc* and regular meetings. The group is coordinated by a secretariat based in the Department of Infectious Disease Epidemiology, Imperial College London.

Meeting objectives

The main objectives of this consultation are to:

1. Discuss and advise whether and how a more granular representation of prevalence, incidence and risk at different administrative levels could better convey the need for programming in line with the nature of the local epidemic.
2. Discuss and advise how improvements can be made in the analysis and presentation of the manifold higher risk of infection of key populations compared to the rest of the population in different parts of the world, in view of triggering action, and in view of changing epidemic trends.
3. Discuss and assess the potential impact of applying geographical data analysis to improve programme efficiency.

Three main outcomes will be developed following the meeting:

1. Meeting report
2. Concept paper
3. Material for UNAIDS World AIDS Day report

Approach

The meeting featured presentations combined with group discussion to generate consensus recommendations. The meeting agenda is included in Appendix I and the list of participants is included in Appendix II.

The recommendations drafted at Reference Group meetings give UNAIDS and WHO guidance on how best to produce estimates of HIV/AIDS, provides an opportunity to review current approaches and also helps to identify information needs (earlier reports are published on the Reference Group website www.epidem.org). This transparent process aims to allow the statistics and reports published by UNAIDS and WHO to be informed by impartial, scientific peer review.

Framework for discussions

Meeting discussions were framed by the UNAIDS Deputy Executive Director, Luiz Loures, and by CDC Division of Global HIV/AIDS (DGHA) Director, Debbie Birx, who emphasized the importance of ensuring that available data are adapted to address challenges in the AIDS response, facilitating a focus on results through intensified interventions, particularly for key populations in areas with high HIV prevalence. This will include further disaggregation of both epidemiological and service data by geographic location and population group. District-level epidemiological data within high prevalence areas can inform focused programming, while disaggregated data from low prevalence areas can shed light on what is working. There was a call to be more innovative in how data is collected and in the methods used to define and input data into models, as well as to integrate geographical data into models. Models should be sensitive to variable levels of ART coverage geographically rather than always using the mean.

Mark Dybul, Executive Director of the Global Fund, reflected on the power of maps to initiate high-level dialogue in countries, with clear and adequate messaging, and drive policy. Community engagement is essential in order to reach those people who have not yet been reached and to increase retention in programmes. A more refined approach to epidemiology is being implemented by the Global Fund in their replenishment strategies. Although care and treatment and basic prevention should be provided everywhere, high transmission in small pockets should be controlled with intensive prevention efforts. There is an opportunity to reduce incidence using focused approaches that can fundamentally change the course of the epidemic and save millions of lives. Resources are available to fund these efforts. Consensus is required to avoid inaction.

Maps also serve a key function in terms of coordinating between implementing partners as well as globally among donors. Mapping of policies and for accountability (i.e. travel restrictions, criminalization of HIV transmission, funding levels) is also powerful.

How can the wealth of within-country data available be used best to inform programming? There is urgency in identifying rapid implementation approaches to apply geospatial analysis and mapping to inform resource allocation and programming, as well as to promote data availability best suited to this approach, including producing actionable information at relevant geographical units.

Final meeting recommendations:

The following recommendations on how to improve the availability and use of geographic and other novel analyses and presentations of data to guide efficient and effective programming were developed on the basis of discussions during the meeting, and specifically around a series of key questions distributed to participants in the agenda (see Appendix I).

1. *Data availability, needs and analyses*

- Collect and share geocoded data for ANC / PMTCT, facilities, programme data routinely
    - Explore possibility of establishing a global repository for this information
        - Data ownership issues and security implications
    - Think through data needed for models and what the “optimal” data collection would be
        - Do we need more specific data at health facility level?
        - Data on incidence, viral load and case reporting by geo code needed

    - Revisit experience and lessons learned from previous work (i.e. working group from WHO)
    - Coverage data
- Capture uncertainty (of data sources and indicators) in maps, in order to provide this information to policy makers
- Improve quality and availability of data
    - Data on incidence
    - Improve standards and protocols in countries
    - Improve size estimates data
    - Population based surveys are the main source of information for geospatial analyses, but are of limited availability for concentrated epidemic countries
        - Still considered useful to conduct geo-spatial and hotspots analyses in concentrated epidemics for prioritization
    - Identify data collection methods to complement data from population based surveys in order to collect data on hidden populations, particularly for concentrated epidemics.
- Explore possibility of refining AIS sampling to be more specific
- Create one prevalence surface using a standardized methodology, with a surface of uncertainty
- Investment framework cases need to be more granular, with greater specificity at lower geographic levels
- Research the cost of data needed and best methods for data collection (i.e. are prevalence and incidence data needed?)
- Use available data (i.e. sentinel surveillance data) to identify hotspots and complement with other methodologies such as PLACE
- Possibly identify and fund an organization to coordinate efforts and support countries to explore data availability, needs and geographical analysis

2. *Use of GIS analyses*

- In the short term:
    - Articulate the strengths and weaknesses of different spatial analyses approaches in reference to well-defined programmatic use cases.
        - Possible priority use cases: geographic targeting; coordination of donor community; validated method for sub-provincial prevalence estimates; demographic-epidemiologic data integration at district level (size estimation); service catchment area modeling for gap analysis.
        - Determine the right interval for the spatial analyses discussed
    - Prioritization and resource allocation exercises framed and informed by geography
    - Better integration of geography into HIS, M&E and reporting on community-based services
- Some spatial data/maps require advance training (advanced geostatistics in R) while others might be created through use of the PLACE method downloaded from the Internet. Entry level free and open-source GIS is QGIS.
- What methods to pursue? How to pursue?
    - Use case dictates method: simpler is better
    - Right tool matched with the right data with the right analysis at the right scale
    - Analyze possibility of reaching consensus on methods to use

3. *How to achieve greater impact through geographical information*

- Establish a collaborative multi-disciplinary taskforce with definite timelines to develop a short, medium and long-term strategy.
  - Conduct a regional meeting with countries that have available data to apply geospatial analysis
    - Potentially identify a small set of interested countries with available data and try various methods to see what can be done and how useful the analysis is for countries.
- Identification of hotspots must be accompanied by a corresponding service delivery model and intensified funding to make a difference.
- Accelerate the adoption of geo-spatial data for decision making through advocacy, using the examples of countries with experience in this type of analysis.
- Evaluate what has been done before
  - Validate predictions developed from modeling/mapping approaches
- Establish partnerships with communities
- Develop guidelines for this process
- Build capacity of countries (local organizations, MoH) to generate and apply the geo-spatial information
- Monitor the impact of this form of analysis and develop advocacy piece based on results
  - Identify cases of countries where geospatial analyses have already been applied and their impact on resource allocation and policy
- Align to country needs
- Align sampling domains/maps to administrative and political units

Country experiences with mapping hotspots

Hotspots mapping approaches have been applied in several countries/regions. Results have been used to inform programming to varying degrees.

India: An abundance of data have recently become available from various sources, including routine surveillance (HSS, ANC, STD), behavioural/biological surveys (at state and sub-district level), mapping data (size estimates) and routine programme data (PMTCT, ART, prevention). The geographical unit of data collection has co-evolved (from national to state to district to sub-district level) with the response across several national planning cycles and informed progressive prioritization at two levels: macro level (national and sub-national levels) annually and micro level (typologies and hotspots within populations/geography) routinely. Decision-making has been decentralized from national to state level. A simple algorithm based on prevalence in ANC and among female sex workers was defined to prioritize resource allocation, initially based on prevalence data and now integrating data on risk behaviours and population size estimates. A system of empowering and training staff to use data available was established.

Kenya: Regional data are available on HIV prevalence, also among key populations (small area estimates), and service uptake (i.e. male circumcision). There is considerable geographic heterogeneity in prevalence across the country. Regional HIV prevalence data have shown that the Nyanza region has almost double the HIV prevalence of the rest of the country, and the lowest level of male circumcision. Other available data sources include DHS, AIS, and population size estimates. Data are used to target interventions to areas with the highest HIV burden in strategic planning, but further data use is limited (for example to inform condom distribution). There is scope to map HIV transmission patterns across the country, using birth and death registrations further to inform programming, and using available data to model the impact of interventions.

Brazil: Information systems are all linked at the national level by patient name (notifiable disease information system, control system for lab tests, medicines logistics control system, mortality). The system contains information on all persons who have had at least 1 visit in the public health system. It also includes all people receiving ARVs, as these are only provided by the public system. Data available have been used to generate maps of the spatial distribution of cumulative AIDS cases, incidence rate, MSM, PLWHIV linked to care in public health facilities, and viral load. Such mapping has shown, for example, that the majority of AIDS cases reported in Brazil are in fewer than 10% of the country's 5,570 municipalities. Reporting at all geographic levels is encouraged through incentives – in order for the state and municipality to receive funding for CD4 and viral load exams, they need to have reported data. Based on this information, it has been possible to map the spatial distribution of HIV cases, found to be concentrated in the south-east, and service provision. It has also been possible to estimate the cascade of care at national level, and will be further estimated at state and municipality level. Issues around data completeness are expected when the cascade of care is further disaggregated by age and sex. Civil society engagement has been imperative for data collection efforts, particularly among key populations.

Namibia: In the City of Windhoek incident HIV cases and services were mapped illustrating the majority of new cases were centered in informal settlement areas towards the North of Windhoek which was not in alignment with provision of services. This analysis exercise was complemented by participatory assessments including PLWHIV and sex workers to identify meeting sites that could be approached by prevention interventions. Results were used to inform strategic and operational planning for the City of Windhoek, which focused on expanding services to informal settlements. Pilot interventions were then implemented in these areas.

KwaZulu Natal, South Africa: Analysis based on an ongoing dynamic open cohort in a 400 square km area of KwaZulu Natal. Since 2000 routine data collection has been conducted among this population (births, deaths, migration, other socio-demographic variables), with annual population based HIV surveillance since 2003. All individual-based data are geo-located. Spatial analytic techniques applied are kernel smoothing and spatial cluster detection using Kulldorff spatial scan statistics. Data were not interpolated (as all individuals are included), but clusters were super-imposed. Four types of geographical analysis have been conducted with cohort data:

- HIV outcomes: Revealed heterogeneous distribution of HIV prevalence and incidence, even in generalized epidemic context, and spatial clustering of new HIV infections. Distinct topographic boundaries at high level of spatial resolution reflect the importance of scale when conducting spatial analyses. Analyses suggest there is value in targeted HIV prevention approaches even in a high HIV prevalence population within a generalized epidemic.
- Sexual risk behaviours: Mapping of community level sexual partnership patterns (number of lifetime partners and concurrent partnerships) showed that a high prevalence of concurrency was not associated with increased risk of HIV acquisition, and that prevention messages targeting the reduction of multiple partnerships, irrespective of whether they overlap in time, are needed.
- ART coverage and risk of HIV acquisition: ART coverage was mapped within the study area illustrating that the protective effect of expanding ART coverage reaches maximum levels once almost complete coverage under treatment initiation guidelines (350 CD4) is reached.
- Population viral load: Viral loads were mapped to assess if they are randomly distributed or if there is clustering in certain areas. Mapping highlighted known areas of high incidence, which

suggests population viral load may be useful as a community-level index of transmission potential.

Mapping key populations

Various hotspots mapping approaches focusing on key populations have also been applied in various countries and regions.

The Crane Survey in **Kampala, Uganda** has been ongoing since 2008. Interviews are conducted with men who have sex with men (MSM), sex workers (SW), and people who inject drugs (PWID) to map meeting venues, with the purpose of targeting prevention interventions. Clusters of sex work were observed, indicating agreement among survey respondents. Geographic overlap of high risk behavior was found. Interviewees are identified through RDS. Google Earth offline software is used for mapping. Data use agreements are established with potential users. Advantages of this method include having an accurate background map and being able to reach many respondents with limited investment of time. However, it is entirely dependent on descriptions provided by respondents and their ability to adequately read a map.

Bio-behavioural surveys and spatial mapping were used to track the IDU epidemic in **St. Petersburg, Russia**, between 2002 and 2008, with participation of 900 people who used injecting drugs. PWID were recruited and tested for HIV. Cases were found to be concentrated in small areas of the city. Incident cases were co-localized with high prevalence neighborhoods. The epidemic spread to other areas of the city between 2002 and 2008. Comparing the course of the epidemic among PWIDs in St. Petersburg, Vancouver and New York, it was found that in order for harm reduction and other prevention services to be most effective in reversing the epidemic, they must be aligned with the location of PWID.

The HIV epidemic among PWID and MSM has been emerging in **MENA** over the last 10 years. Epidemics are concentrated among key populations and geographically clustered. While data from bio-behavioral surveys are available, the surveys are scattered across geography and time and are mostly focused in urban settings (with the exception of Pakistan and Iran). There is a lack of repeated population-based surveys with HIV biomarkers and GIS data in this region, but other potential data sources exist which could inform mapping: HIV testing data (HIV testing is mandatory in many MENA countries for various processes, for example to have a driver's license in Syria) and case reporting. Pakistan has experience mapping sites where MSW gather.

Geographic mapping of key populations to determine location and estimated population size is being implemented by the Karnataka Health Promotion Trust in **India** as a first phase in M&E interventions for prioritization.

Availability of human resources and CD4 technology as well as need for such services were mapped In **Mozambique**. Resources were found not to be in the places where they were needed. Based on this information it was possible to realign the allocation of resources with impact.

The PLACE (Priorities for Local AIDS Control Programmes) method, based on the proximate determinants framework, aims to map priority prevention areas by working collaboratively with stakeholders at the national level as key informants to identify geographic areas where new infections are most likely to occur, focusing on where to reach people with high rates of new sexual partnerships and sharing needles. Maps are then used to develop action plans to address prevention gaps. PLACE has been implemented in many countries and seeks to also be useful to the community, with surveys and mapping considered a first part of services provided. A point system is used to score districts and identify the priority districts to focus on. PLACE can be implemented rapidly, for example, data collection in Uganda took approximately 10 days per district. The methodology developed is straightforward and can be implemented independently. The estimated cost of implementing PLACE in 25 districts in Uganda was USD 800,000. In Angola, PSI is using PLACE data to inform condom distribution.

The District Health Information System (DHIS) was adopted in **Kenya** in 2010 and rolled-out throughout the country in 2011. Data is reported by primary health facilities through paper-based forms, which are entered into DHIS at the district level. Facility level data is summarized when transmitted to the district level due to the data transmission tools, limiting scope for utilization of individual-level data. All health facilities in Kenya are reporting through the DHIS. DHIS data have been used to identify regional variations in PMTCT uptake.

Mapping methodologies

Various methods for mapping hotspots were presented, which produced varying results. Even for a given method, the use of different methodological assumptions resulted in different results. This leads to the question of whether a consistent and validated methodology is needed to identify hotspots.

Spatial clustering detection was used to identify the location of areas with higher or lower numbers of HIV infections than expected under the null hypothesis of spatial randomness (a concentration of HIV infections that can't be explained by chance), using SaTScan and ArcGIS software. DHS data from 20 countries in Sub-Saharan Africa were included. Clustering was found in all but two SSA countries, suggesting a clustered transmission in the region. Strength of clustering was estimated using the relative risk of HIV infection within the cluster compared to outside the cluster. This analysis found that the fraction of the population with high prevalence clusters increased with national HIV prevalence. It was also found that the higher the national prevalence, the smaller the difference in prevalence between clusters and non-clusters. An analysis of the temporal evolution of prevalence found that even where national HIV prevalence is declining, HIV prevalence in clusters with high prevalence either did not decline or increased. Use of the results of this analysis to inform planning is most advanced in South Africa.

Spatial clustering detection, combined with kernel smoothing, has been used within the framework of the Africa Center longitudinal cohort study which started HIV surveillance in 2003, to quantify the spatial variation in incidence and identify clusters within the study area. Incidence data are directly measured in the cohort study - all people within the age group in the study area are eligible for HIV testing. Annual surveillance rounds are conducted and risk behaviours and service uptake are mapped. Total number of lifetime partners, HIV prevalence, ART coverage and distance to transport routes were found to be individual predictors of HIV incidence.

Interpolation between sampling locations and to map spatial patterns of HIV prevalence at sub-regional level is required as available data may be at different geographic levels, aggregated, available only for a limited number of years or have other limitations, including related to sampling.

The following recommendations for creating interpolated layers using DHS data were determined by a Measure consultative meeting:

- Essential that every interpolated layer comes with a corresponding layer mapping the uncertainty of the interpolated estimates.
- Inclusion of globally available covariates (i.e. roads, environment, population) should be considered.
- Approach used should be reproducible and accessible (i.e. code sharing).
- Approach used should strive to create a standardized map for each country that is easily comparable between countries instead of the “best” map for any specific country.
- Re-call time frame of indicator influences the usefulness of interpolated data layer (i.e. last 2 years, last 12 months, last 2 weeks)

DHS data were used to estimate an HIV prevalence surface, irrespective of administrative divisions, showing spatial variations in the epidemic. **Kernel Density Estimation (KDE)** was used to construct an HIV prevalence surface from a scatter plot. Each DHS cluster is represented on the surface with a dot. A circle is drawn around each dot so that the number of persons surveyed within the circle is at least equal to a fixed number. An intensity surface is generated for each cluster with a bandwidth depending on the radius and a height proportional to the number of observations. The smoothing adapts to the spatial distribution of the clusters. There is no automatic way to choose the smoothing parameter – estimates are made using different values and the one that best corresponds to the expected results is subjectively selected.

In another approach, countries were divided into polygons of N - polygons of equal DHS sample sizes (based on the number of individuals tested). Prevalence curves were then modeled for each polygon of N. Prevalence modeled for the center of each polygon were used as input to create an interpolation surface using **ordinary kriging**. HIV prevalence across African countries at a sub-regional level was mapped to evaluate geospatial methods to interpolate between sampling locations and develop a method to map the spatial patterns of HIV prevalence at sub-regional level. Kriging was found to be the best method to interpolate.

To determine how best to incorporate geographical heterogeneity into mathematical models, the optimal geographical unit for mapping/modeling was assessed through the development of approaches to combine available spatial data on both determinants of risk and burden of infection into mathematical models. The unit used needs to capture heterogeneity (which is unlikely to match administrative boundaries), must be appropriate for the level of data aggregation and the research question, and must align with model assumptions. The optimal unit was found to be the minimum spatial unit, which is informed by the availability of data, or expert opinion. Thiessen polygons used to interpolate are aggregated using the AZTool into minimum spatial units.

Various mapping methods exist. The need for consensus on the approach to use and external validation of these methods was identified. Uncertainty estimates need to be presented alongside maps produced. Scaling-up and deploying methodologies proposed in a cost-effective way is considered a challenge.

Other applications of spatial mapping using DHS data include underweight children in SSA, risk of anemia, food security, poverty alleviation, and the link between different infections (i.e. HIV and malaria). GIS methods were used to link and triangulate various data sources for a prospective evaluation of family planning services in Nigeria, Kenya, Senegal, and India.

Using information on epidemic heterogeneities in resource allocation

A geographic prioritization approach can produce cost efficiencies while improving health outcomes. This approach was investigated in Kenya, whereby a health production function (showing the optimal intervention combination for a given level of spending) was produced for each of the 47 counties in Kenya. These showed differences in scale and gradient and the level at which further spending doesn't buy much more health. It is this heterogeneity which is exploited to obtain efficiency gains in resource allocation. The order in which interventions are implemented is largely the same, but there are important differences across counties. For the same amount of spending the impact can be increased by prioritizing geographically.

Data availability

Opportunities:

- DHS was identified as a key source of data for mapping hotspots, with over 90 countries having implemented over 250 surveys since 1984. Maps can be made using DHS data on StatCompiler. Elements to consider in the use of DHS data are:
    - Displacement of GPS data (on average of 2.5 km) to protect households from identification, with potential impact on analysis related to distance to services.
    - DHS seeks standardization and comparability across countries and time, which may not reflect the best data available at a specific time for a country.
    - Estimate errors and guidance to users on data manipulation that has occurred need to be considered.
- Other data sources for mapping include:
    - Health facility data
        - Census
        - Surveys
        - Surveillance
        - Routine information systems
    - Outreach and community based services
    - Population surveys
- Even partial data is useful to inform decision-making.
- Triangulation of data from various sources and data sets contributes to analysis as well as partially overcomes limitations of individual data sources. It is also a form of incorporating data quality checks in the analysis.
- Tools for data generation and use should be simple, cheap and user-friendly.
- Institutionalization of data generation and collection processes, as well as instances of analysis, is key. Integrating this approach in national planning cycles is an opportunity for institutionalization.
- Tight links between GIS and HIS, for example use of common coding or less ideally standardized naming conventions, are useful to produce maps of service data.

Challenges:

- DHS is not a geographic sample and is not powered to detect changes over time
- There may be significant risks for key and vulnerable populations in identifying "hotspots", such as targeting of meeting areas by police. Careful messaging and use/dissemination of hotspots data is needed.

- Need to define who the maps are for. Different audiences may require different types of maps.
- Also need to define what maps will be used for. The data (i.e. HIV prevalence, number of PLWHIV) that are chosen for mapping may lead to different rankings/prioritization of countries/regions.
- To be effective, data tools must be available and useful to the people implementing interventions on the ground. Training and empowerment in the use of data tools is crucial.
- A potential risk arises from only prioritizing actions where data are available.
- Mapping the extent of community-based services, as they may be more diffused than public services.
- Promoting maintaining the HIV response a priority at regional levels in countries following decentralization of decision-making.
- Sub-national boundaries changing over time

Specific data issues were identified:

- Comparability over time
- Comparability across countries (rather than a single 'best' map for each country, better to have comparable maps across countries)
- Consistent sites
- Important to show uncertainty (due to interpolation and indicator); how to capture and layer on a map
- Age-specific analyses
- Data needs for models
- How to link data sources together
- Ensuring consistent, complete and timely reporting from various administrative levels
- Limitations of each individual data source
- Increased cost of generating data at lower administrative/geographic levels. However the risk of not doing so may increase long-term costs.

Specific challenges around the use of DHS data were also identified:

- Larger samples, or oversampling high and low prevalence areas. The number of geographic domains is highly dependent on available funding. Good precision at lower levels requires larger samples, increasing costs.
- Low population areas are less likely to be sampled, potentially leading to missing clusters.
- Bringing together sampling based on different indicators (i.e. DHS, AIDS surveys).
- Consistent sites: interpretation of temporal trends with changing sampling areas.
- A challenge to measure service uptake. For example, there are concerns around the validity of self-reported data such as HIV status.
- Displacement – can it be removed?
- Including biomarkers in DHS: Low levels of concordance found between rapid and laboratory HIV tests. To use ARV biomarkers would need to apply assays for each type of ARV per person as well as skilled laboratory technicians, which could become costly.

Appendix I: Meeting Agenda

Meeting Agenda: Identifying Populations at Greatest Risk of Infection - Geographic Hotspots & Key Populations

Location: Geneva, Switzerland: UNAIDS Headquarters, Kofi Annan Conference Centre

Dates: 25-26 July 2013

Thursday, July 25th

Start	Duration	Subject	Speaker
Opening Session - Opening remarks and introductions (Chair: Tim Hallett)			
900	10	Opening remarks	Luiz Loures, UNAIDS
910	10	Opening remarks -- CDC perspective	Debbie Birx, *CDC*
920	10	Meeting aim, objectives and outcomes	Peter Ghys, *UNAIDS*
930	10	Introductions	ALL
Session 1 - Country presentations and discussions on data availability (Chair: Luiz Loures)			
940	15	Zimbabwe	Elizabeth Gonese, *CDC Zimbabwe presented by Wolfgang Hladik*
955	15	India	Sema Sgaier, *BMGF*
1010	10	Questions	ALL
1020	*20*	*Coffee break*	-
1040	15	Kenya	Peter Cherutich, *Kenya NASCOP*
1055	15	Brazil	Ana Roberta Pati Pascom, *MOH Brazil*
1110	10	** Questions **	
1120	40	**** Group discussion ****	ALL
1200	*60*	*Lunch*	-
Session 2 - Use of GIS methodology to represent epidemiological differentials (Chair: Luiz Loures)			
1300	15	DHS GPS data use and limitations	Clara Burgert, *ICF International*
1315	15	Combining survey and surveillance data to discribe within-country epidemiological heterogeneity	Sarah-Jane Anderson, *Imperial College London*
1330	15	Detecting areas of high HIV prevalence in sub-Saharan Africa using DHS data	Laith Abu-Raddad, *Weill Cornell Medical College, Qatar*
1345	10	** Questions **	ALL
1355	15	Methods used to capture heterogeneity within Africa Centre data	Frank Tanser, *Univ of KwaZulu-Natal*

1410	15	Methods used for mapping HIV	Joseph Larmarange, *CEPED*
1425	15	Methods for using GIS, examples from applications outside HIV	Livia Montana, *UNC Chapel Hill*
1440	10	** Questions **	ALL
1450	25	**** Group discussion ****	ALL
1515	*25*	*Coffee break*	-
Session 3 - Discussion on key populations (Chair: John Stover)			
1540	15	MSM	Wolfgang Hladik, *CDC*
1555	15	IDU	Robert Heimer, *Yale University*
1610	15	Emerging HIV epidemics and key populations in Middle East and North Africa	Laith Abu-Raddad, *Weill Cornell Medical College, Qatar*
1625	15	** Questions **	ALL
1640	15	Using evidence from geographic clustering of risk to improve HIV prevention programmes for key populations: Lessons learned from the PLACE method	Sharon Weir, *UNC Chapel Hill*
1655	15	Bio-behavioural mapping of key populations and changing trends over time	Senthil Kumar, *Karnataka Health Promotion Trust*
1710	15	Lifetime risk of HIV infection among key population groups	Amanda Chorley, *LSHTM*
1725	10	** Questions **	ALL
1735	40	**** Group discussion ****	ALL
1815		Close	-

Friday, July 26th

Start	Duration	Subject	Speaker
Opening Session			
800	15	Synthesis of Day 1, objectives for Day 2	Tim Hallett, *Imperial College London*
Session 4 - Service uptake and impact (Chair: Debbie Birx)			
815	15	Measure DHS: Different patterns of service uptake	Joy Fishel, *ICF International*
830	15	DHIS country example: Rwanda	Eric Remera, *Rwanda Biomedical Council* (TBC)
845	10	DHIS country example: Kenya	Peter Cherutich, *Kenya NASCOP*
855	15	Prioritising geographic areas on the basis of expected impact of Investment Framework programming in Kenya and Mozambique	Tim Hallett, *Imperial College London*
910	20	** Questions **	ALL
930	10	From data to action in Namibia - the example of Windhoek	Henk van Renterghem, *UNAIDS Namibia*
940	10	Efficiencies of geographically focused interventions	Swarup Sarkar, *UNITAID*
950	15	Mapping service provision to enhance programme planning	Nathan Heard, *OGAC*

1005	20	** Questions **	ALL
1025	*20*	*Coffee break*	-
1045	15	Perspectives from The Global Fund -- How should this information be use?	Mark Dybul, *The Global Fund*
1100	15	Human rights and equity considerations in relation to prioritising services for geographic hotspots and key populations	Joe Amon, *Human Rights Watch*
1115	60	**** Group discussion ****	ALL
1215	*60*	*Lunch*	-
Session 5 - Discussion and recommendations (Chair Tim Hallett)			
1315	120	**Plenary discussion:** Defining recommendations on how to improve the availability and use of geographic and other novel analyses and presentations of data to guide efficient and effective programming. Key questions for consideration include: 1. Data availability, needs, analyses - *What information is available, what can be done now with this information?* - *What data collection/collation are needed to strengthen in the short term?* - *Implications and considerations for survey design (DHS, AIS, others)?* - *Where do we want to be in the medium-long term?* Rapporteur: Mary Mahy 2. Use of GIS analyses - *Which methods to pursue? How to pursue?* - *What is required to evolve/respond to the needs of geo-spatial analyses?* - *What are the skills needed?* - *Where do we want to be in the medium-long term?* Rapporteur: Nathan Heard 3. How to achieve greater impact through the use of geographical information - *How does this information get used and inform decision making?* - *What have been the challenges/limitations encountered?* - *What are the associated political dimensions for in-country application?* - *What can we learn from the experiences from other diseases?* Rapporteur: Peter Cherutich	
1515	30	**Next steps, final remarks**	Luiz Loures, Peter Ghys, Tim Hallett
1545		Close	

Appendix II: List of Participants

1	Mark Dybul	*Global Fund*
2	Ade Fakoya	*Global Fund*
3	Debbie Birx	*US CDC*
4	Wolfgang Hladik	*US CDC*
5	Nathan Heard	*Office of the US Global AIDS Coordinator*
6	Richard Needle	*PEPFAR*
7	Gundo Weiler	*WHO*
8	Txema Garcia Calleja	*WHO*
9	Sema Sgaier	*The Bill and Melinda Gates Foundation*
10	Johannes van Dam	*FHI 360*
11	Swarup Sarkar	*UNITAID*
12	Joy Fishel	*ICF International, MEASURE DHS*
13	Clara Burgert	*ICF International*
14	John Stover	*Futures Institute*
15	Tim Hallett	*Imperial College London*
16	Sarah-Jane Anderson	*Imperial College London*
17	Ide Cremin	*Imperial College London*
18	Livia Montana	*UNC Chapel Hill*
19	Sharon Weir	*UNC Chapel Hill*
20	Laith Abu-Raddad	*Weill Cornell Medical College, Qatar*
21	Frank Tanser	*Africa Center, University of KwaZulu-Natal*
22	Peter Cherutich	*Kenya NASCOP*
23	Joseph Larmarange	*CEPED Paris*
24	Amanda Chorley	*London School of Hygiene & Tropical Medicine*
25	Ana Roberta Pati Pascom	*MoH Brazil*
26	Joe Amon	*Human Rights Watch*
27	Robert Heimer	*Yale School of Public Health*
30	Senthil Kumar	*Karnataka Health Promotion Trust*
31	Khangelani Zuma	*HSRC, South Africa*
32	Teymur Noori	*European Centre for Disease Prevention and Control*

UNAIDS PARTICIPANTS

1 Luiz Loures
2 Peter Ghys
3 Mary Mahy
4 Keith Sabin
5 Victoria Bendaud
6 Eleanor Gouws
7 Henning Mikkelsen

8 Karl Dehne
9 Peter Godfrey-Fausset
10 Catherine Sozi
11 Henk van Renterghem
12 Mbulawa Mugabe
13 Marjorie Opuni
14 Annemarie Hou
15 Sophie Barton-Knott
16 Richard Burzinski
17 Helena Nygren-Kruge
18 Fodé Simaga
19 Michael Hahn
20 Rubén Mayorga