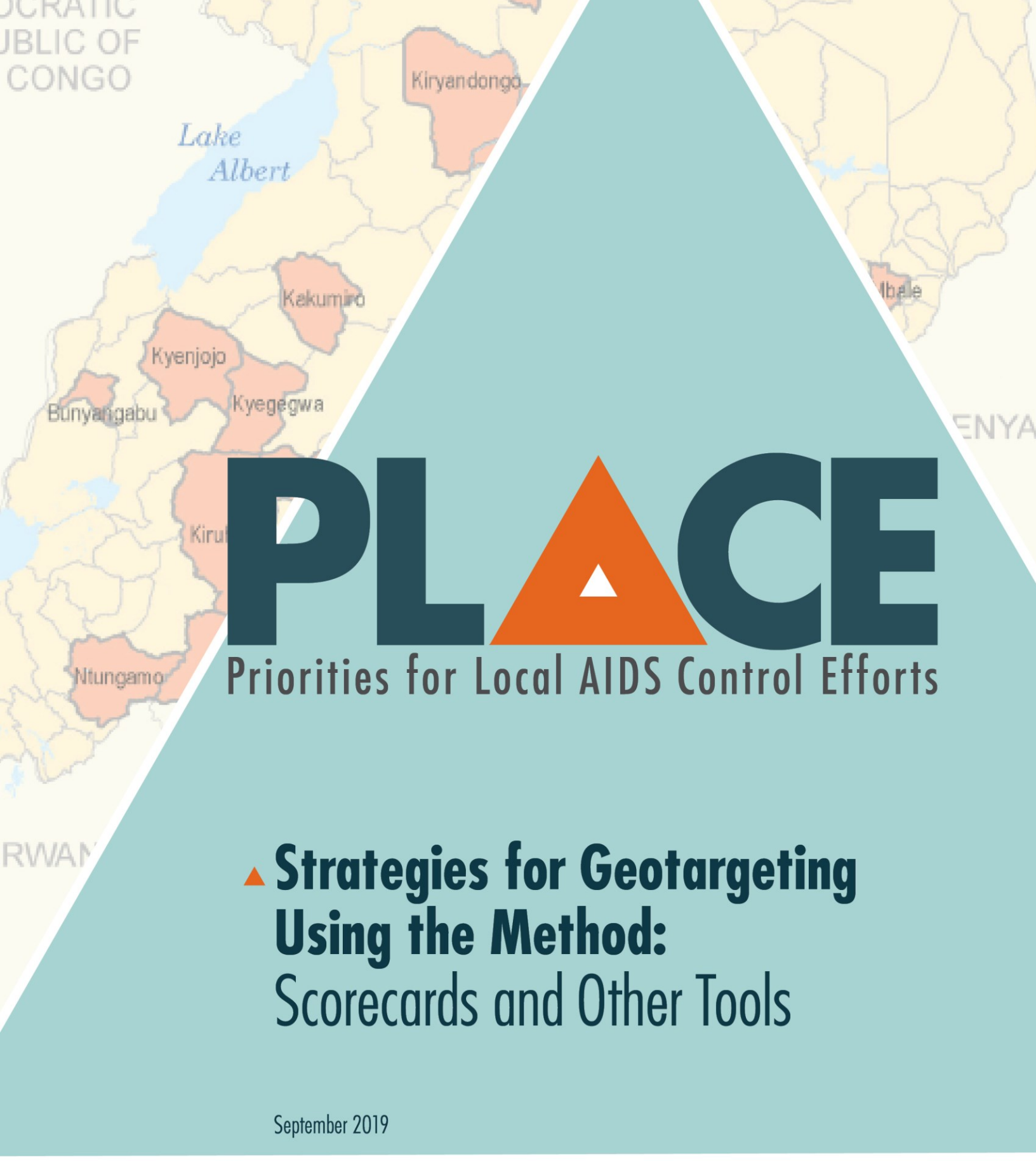

PLACE

Priorities for Local AIDS Control Efforts

Strategies for Geotargeting Using the Method: Scorecards and Other Tools

September 2019

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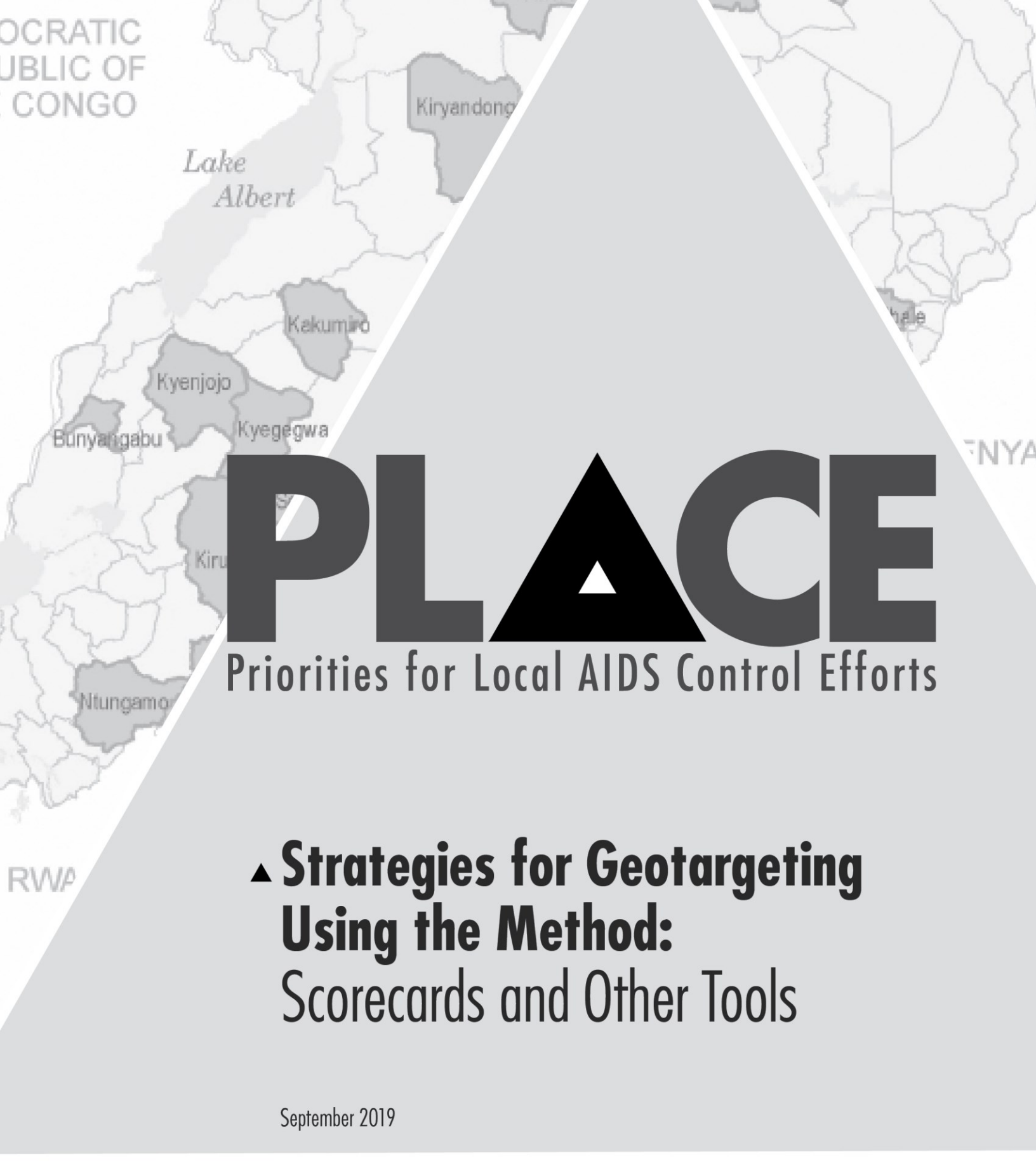

PLACE

Priorities for Local AIDS Control Efforts

▲ Strategies for Geotargeting Using the Method: Scorecards and Other Tools

September 2019

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FOREWORD

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ABBREVIATIONS

MEEPP	Monitoring and Evaluation of Emergency Plan Progress
PLACE	Priorities for Local AIDS Control Efforts
PMTCT	prevention of mother-to-child transmission
PPA	priority prevention area
UPHIA	Uganda Population-Based HIV Impact Assessment
USAID	United States Agency for International Development

BACKGROUND

HIV prevalence can vary greatly across geographic areas (Schaefer, et al., 2017; Tanser, Bärnighausen, Cooke, & Newell, 2009; Tanser, de Oliveira, Maheu-Giroux, & Bärnighausen, 2014; Chimoyi & Musenge, 2014), with few infections in some areas and many infections in others. In 2013, adult HIV prevalence averaged 4.7 percent across sub-Saharan Africa, but ranged from 0.2 percent in Bas-Congo, Democratic Republic of the Congo, to 27 percent in parts of Swaziland (now Eswatini) (McGillen, Anderson, Dybul, & Hallett, 2016). This uneven distribution of infection continues today.

Surveillance data have documented the existence of geographic core areas for sexually transmitted infections (Bernstein, Curriero, Jennings, Olthoff, Erbelding, & Zenilman, 2004; Blanchard, Moses, Greenaway, Orr, Hammond, & Brunham, 1998; Ellen, Hessol, Kohn, & Bolan, 1997; Jansen, et al., 2003), including for HIV. The identification of geographic core areas can inform an "upstream" public health response to reduce the spread of infection to other areas. A recent epidemiologic model (McGillen, Anderson, Dybul, & Hallett, 2016) showed that the combination of geographic targeting and programming for sex workers who have high rates of new sexual partnerships decreased HIV transmission in sub-Saharan Africa. The benefits of a focused, rather than a uniform, national approach have been demonstrated in Kenya, where models showed that a focused strategy would reduce the number of new infections by 40 percent over a 15-year period (Anderson, Cherutich, Kilonzo, Cremin, Fecht, Kimanga, et al., 2014).

Research on HIV interventions builds on experience and data from the Priorities for Local AIDS Control Efforts (PLACE) method to refine strategies for prioritizing geographic areas to find people who are the most likely to acquire and transmit HIV. 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)—developed the method over the years since 1999 to increase local capacity to understand the drivers of local HIV epidemics, identify gaps in services among those most likely to acquire and transmit HIV, and provide evidence to support tailored interventions to reduce HIV transmission. The current version of the PLACE Tool Kit is available here: https://www.measureevaluation.org/resources/tools/hiv-aids/place.

In the early years of PLACE implementation (early 2000s), subnational areas of high risk were called "high-transmission areas" and were identified based on discussions with stakeholders and local knowledge. Efforts were subsequently undertaken to formalize the identification of higher-risk areas. The current study—conducted by MEASURE Evaluation, a project funded by the United States Agency for International Development and United States President's Emergency Plan for AIDS Relief—builds on this work, in support of the global 90-90-90 goals for control of the epidemic.[1]

[1] By 2020, 90 percent of those who are HIV-positive will have been diagnosed, 90 percent of those diagnosed will be on antiretroviral therapy (ART), and 90 percent of those on ART will be virally suppressed (Joint United Nations Programme on HIV/AIDS [2014]).

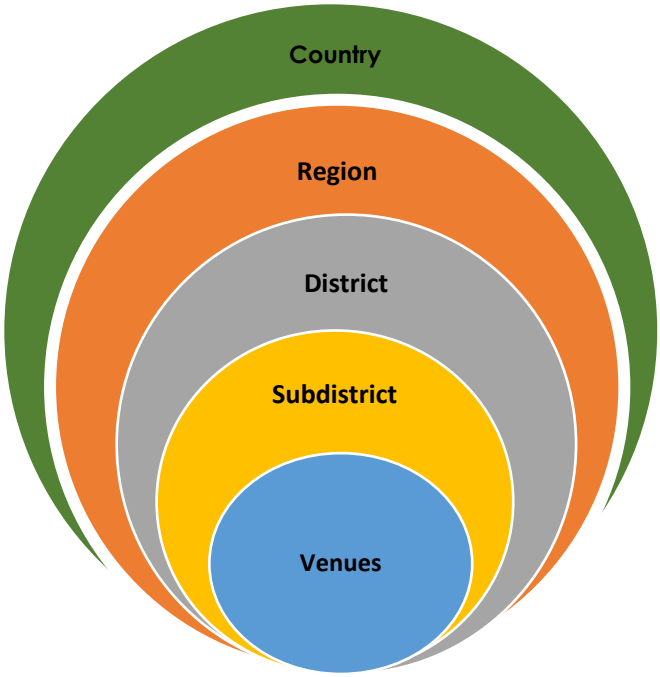
Statement of the Problem: The Granularity Challenge

Treatment for HIV is effective. Not only do people live longer, but also those who achieve viral suppression with treatment will not transmit the virus to others. Unfortunately, many people are still unaware of their positive status and not all people on treatment have achieved viral suppression. Reaching them requires finding geographic areas with clusters of people in the following categories:

1. Those who are HIV-positive but who do not know their status
2. Those who know their status but have not achieved viral suppression
3. Those whose behaviors put them at highest risk for acquiring HIV

The challenge is to identify geographic areas that provide a strategic level of granularity—areas that are not so small that HIV testing outreach would have a minimal effect on the epidemic, but also areas that are not so large that resources cannot be allocated cost-effectively. In a given country, four subnational levels of granularity can be considered, as shown in Figure 1.

Figure 1. Subnational levels that the PLACE method considers



The advantages and disadvantages of focuses on regional, district, and subdistrict areas are described below. This study did not investigate a focus on community social venues, such as bars and clubs.

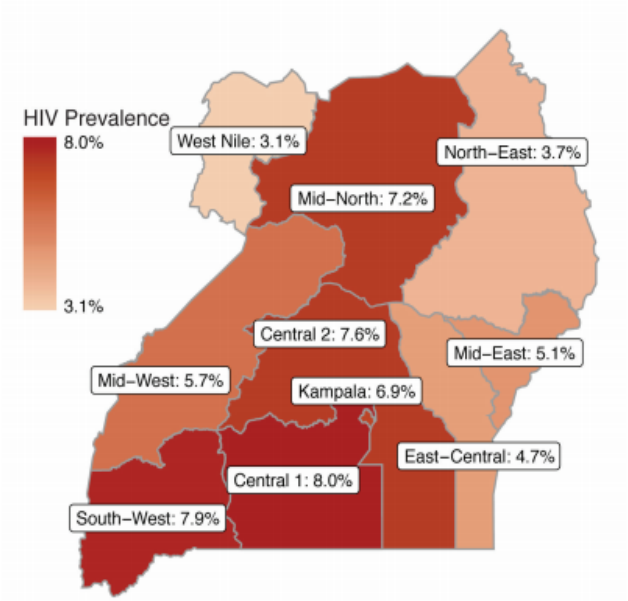
A Regional Focus

Large household surveys, such as the Uganda Population-Based HIV Impact Assessment (UPHIA) 2016–2017, provide regional estimates of HIV prevalence. Subnational comparisons at the regional level are useful for macro-understanding of the HIV epidemic in a country and for strategic planning at the national level. However, regional data do not provide sufficient granularity for focused program planning.

Figure 2. Example of a map showing variations in HIV prevalence in Uganda, by region

Among adults aged 15 to 64, the prevalence of HIV varied geographically across Uganda, ranging from 3.1% in West Nile region to 8.0% in Central 1 region.

Region	HIV Prevalence (%)	95% CI
Central 1	8.0	6.6-9.3
Central 2	7.6	6.1-9.0
Kampala	6.9	5.6-8.1
East-Central	4.7	4.0-5.4
Mid-East	5.1	4.0-6.2
North-East	3.7	3.0-4.4
West Nile	3.1	2.5-3.7
Mid-North	7.2	6.0-8.4
Mid-West	5.7	4.7-6.8
South-West	7.9	5.8-9.9
Total	6.2	5.8-6.7



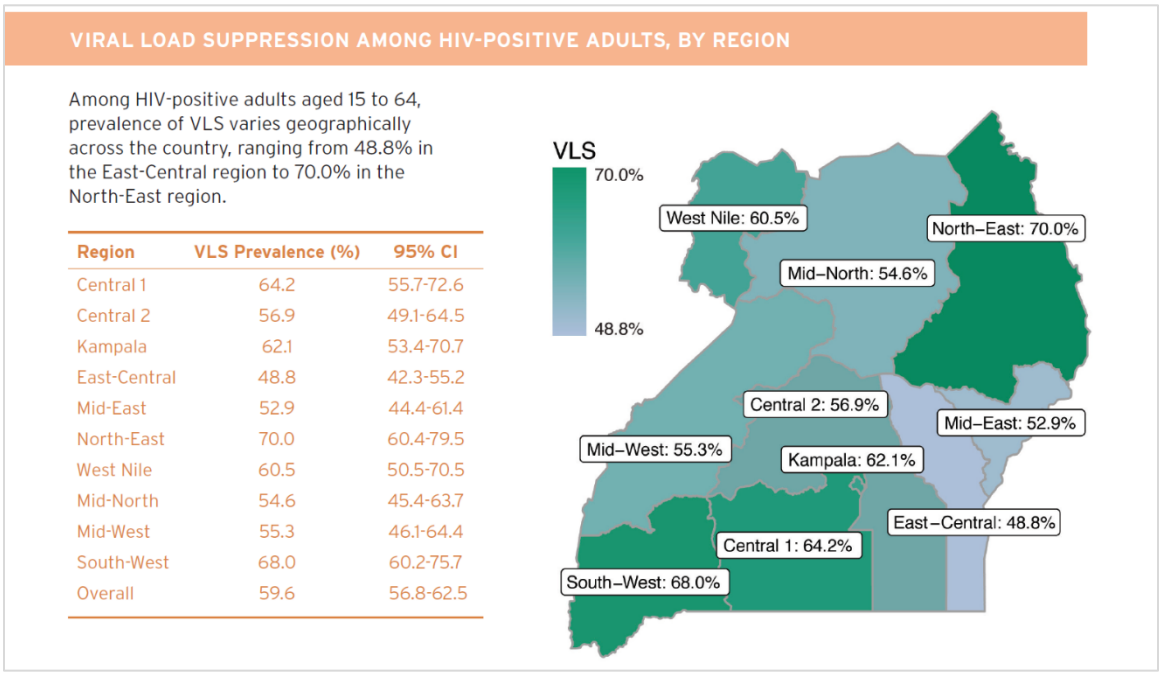
Source: Ministry of Health, Uganda, 2019

For example, the map in Figure 2 shows clearly the variability in HIV prevalence among adults ages 15 to 65 across Uganda's regions. Prevalence ranges from 3.1 percent in the West Nile Region to 8.0 percent in the Central 1 Region. Although the map depicts which regions carry the highest burden of HIV, it does not show variation in those regions. In each region, the prevalence varies significantly across districts and in subdistrict areas. It is possible that clusters of people with HIV are hidden in low-prevalence regions and even in low-prevalence districts. A reliance on regional maps can obscure the specific districts that should be reached. Moreover, by focusing on the percentage of people who are HIV-positive, a regional focus obscures the more important strategic information for programs, which is the absolute number of people who have the virus. Large population centers may have a lower prevalence of HIV but a higher burden of cases.

The map in Figure 3 shows the proportion of those who are HIV-positive who have achieved viral load suppression. It is not necessarily true that the regions with the greatest HIV prevalence have achieved the greatest success in terms of viral suppression. For example, one of the three regions with the lowest prevalence (East Central) has achieved only 48.8 percent viral suppression, which is lower than the national percentage (59.6%) (Ministry of Health, Uganda, 2019).

A reliance on regional maps of HIV prevalence or of viral suppression provides limited insight into where pockets of people who have HIV but are not on treatment may be hidden.

Figure 3. Viral load suppression among HIV-positive adults, by region



Source: Ministry of Health, Uganda, 2019

A District-Level Focus

Geographic areas, such as districts, that are smaller than regions have many advantages for HIV programming:

- Funding and resource mobilization often occur at the district level.
- Geographic boundaries of a district are known.
- Demographic and health data are often available.
- Spatial data for districts are often available.
- Service delivery often occurs at the district level.
- Public health accountability, including data tracking and surveillance, is often at the district level.

However, a district-level focus can have some disadvantages. Districts are often large and are not homogeneous. Moreover, there may be a geographic pocket, including an HIV transmission network, that could be missed with a district-level focus.

A Subdistrict-Level Focus

HIV is not constrained by political boundaries, whether national, regional, or district. The clustering of prevalent HIV infection reflects the size and characteristics of local sexual and/or needle-sharing networks and their access to treatment. Some networks may be large, stretching across continents, whereas others are small, and for the most, part local. Although sexual and needle-sharing networks are not directly observable, clues to the location of subdistrict areas with networks likely to sustain a higher incidence of HIV are available from a thoughtful review of demographic, epidemiologic, and contextual data.

Identifying local areas that are likely to have pockets of high HIV incidence is part of the planning process for implementing the PLACE method. For this scorecard work,[2] we use terminology borrowed from PLACE and from PLACE publications. We initially called areas that were likely to have pockets of high HIV incidence "high- transmission areas." Now we call them "priority prevention areas" (PPAs). The new term is less stigmatizing and brings attention to the role that these areas play in preventing onward transmission of HIV.

Box 1. Typology of PPAs

Urban and peri-urban areas where there is an economic draw for people:

1. Central business district
2. Truckstop/border crossing
3. Trading center
4. Area with a high concentration of illegal drugs

Areas with night life, massage, or street sex work:

5. Area with a concentration of bars and clubs
6. Area with a high concentration of massage parlors
7. Area with a high density of street sex workers

High density and poorly served areas:

8. Urban slums
9. Townships
10. Refugee camps

Areas with high male employment:

11. Construction site
12. Tea or farming estate
13. Fishing village
14. Mining operation
15. Military barracks or garrison

Over the past 20 years, researchers using the PLACE method have worked in many settings with local stakeholders to identify PPAs in districts. PPAs are subdistrict areas that are likely to contain clusters of people who have HIV but who have not achieved viral suppression. Box 1 provides a typology of PPAs. The advantages of focusing prevention services in such subdistrict areas are:

- People at risk in the area are often more homogeneous.
- The PPAs are smaller than districts.
- There may be more opportunities to reach the entire at-risk network in a more concentrated area using a variety of outreach strategies.

[2] See the section "Scorecard 1: Updated District-Level Scorecard" for an explanation of a PLACE scorecard and how it is used.

OBJECTIVES OF THIS STUDY

The goal of this study was to contribute to countries' and stakeholders' development of strategies to achieve epidemic control by identifying geographic core areas for untreated HIV.

In conducting this study, we examined existing district- and subdistrict-level strategies. We used data from Uganda to assess these strategies, including data from:

- The UPHIA 2016–2017 survey
- 2013 and 2018 Uganda PLACE studies conducted by MEASURE Evaluation (MEASURE Evaluation, 2014; MEASURE Evaluation, 2018)
- Program and surveillance data from Uganda shared by the United States Agency for International Development (USAID)

Our objectives were as follows:

1. Develop a district-level scorecard from the 2013 Uganda PLACE data (MEASURE Evaluation, 2014) using contextual indicators, and assess the scorecard's association with HIV prevalence among prevention of mother-to-child transmission (PMTCT) populations in the district.

Our aim was to assess whether a simplified scorecard that used only contextual factors was associated with HIV prevalence. In many settings, HIV prevalence at the district level may not be available. A scorecard that relies only on contextual factors may prove useful in some settings.

2. Map the subdistrict HIV cascade data from the men and women interviewed at social venues in more than 90 subdistrict areas investigated in 2013 using PLACE.

Our aim was to estimate the number of HIV-positive people unaware of their status and the number of HIV-positive people not on treatment to show the scope of the epidemic in subdistrict areas and the within-district variability in terms of the male-to-female ratio of knowing one's HIV status and treatment status. This will provide insight into whether there is value in subdistrict mapping for the first two bars of the 90-90-90 treatment cascade.

3. Develop a new subdistrict-level scorecard for the number of people with HIV but not suppressed.

The new scorecard used data from the 2018 PLACE study in Uganda to identify the characteristics of subdistrict areas that were likely to include people with the virus but not yet suppressed. This approach will provide a strategy for identifying where to find those who are HIV-positive but not yet suppressed in other districts.

The scorecards and maps such as those prepared in this study help countries improve their efforts to reach people who have HIV but who do not know their status, people have not yet achieved viral suppression, and people who are suitable candidates for pre-exposure prophylaxis.

SCORECARD 1: UPDATED DISTRICT-LEVEL SCORECARD

In 2013, the PLACE National Steering Committee in Uganda developed a scoring system to identify the districts that were likely to have higher HIV prevalence than others (MEASURE Evaluation, 2014). The scoring system included indicators from HIV prevalence data, Demographic and Health Survey data, population data, spatial data, and contextual information. Ten indicators were used to rank the districts by HIV risk on a scale of zero to 10, where zero represented the lowest risk score and 10 represented the maximum risk score. The method was recommended to countries through a series of workshops co-sponsored by the World Health Organization, UNAIDS, and the Global Fund to Fight HIV, Tuberculosis and Malaria.

Table 1 presents the 10 indicators and their data sources.

Table 1. Original scorecard indicators

	Type of Indicator	Definition of the Indicator	Source of the Data
1	Feasibility	2012 district HIV counseling and testing coverage. The cutoff was 30%. Districts with coverage >=30%=1, <30%=0. This indicator represented the ease of implementing the PLACE methodology, especially the testing and counseling component.	Monitoring and Evaluation of Emergency Plan Progress (MEEPP)
2	Burden	2012 district PMTCT HIV prevalence: >7.4%=1, <7.4%=0. This indicator represented the district HIV burden among women of reproductive age.	MEEPP
3	Incidence	Increase in PMTCT HIV prevalence from 2011 to 2012: >1% increase=1, <1% increase=0. This indicator represented the outcomes of PMTCT services in the district.	MEEPP
4	Contextual risk	Presence of a major transport route through or in the district increases the risk of HIV due to stopovers made by truck drivers. Presence=1, absence=0.	Uganda National Roads Authority website
5	Contextual risk	Presence of a fishing village in the district=1, absence=0. Fishing communities have higher HIV risk than the general population.	Uganda Fisheries Research Institute, Jinja, Uganda

	Type of Indicator	Definition of the Indicator	Source of the Data
6	Contextual risk	Presence of large mining operations=1, absence=0. Mining activity is associated with increased HIV acquisition and its spread.	Ministry of Energy and Mineral Development website
7	Contextual risk	Large military presence=1, absence=0. Presence of uniformed men in the community increases HIV risk.	Uganda People's Defence Force website
8	Contextual risk	More than one fishing village=1, one or no fishing village=0.	Uganda Fisheries Research Institute, Jinja, Uganda
9	Contextual risk	Presence of large cross border trade=1, absence=0.	Uganda National Roads Authority website
10	Contextual risk	District with municipality status or above=1, less than municipality status=0.	Ministry of Local Government, Uganda
		Total scores for each district, out of 10 indicators.	

The districts were grouped into three categories: high risk, medium risk, and low risk. For the 2013 PLACE study, we oversampled high-risk districts. The scorecard was used to select the districts for the PLACE study. High-scoring districts were oversampled relative to lower-scoring districts.

Figure 4 shows the distribution of districts, by HIV score.

Table 2 shows the distribution of district-level scores, by region. In each region, there were districts with high, medium, and low scores. This suggests a lack of homogeneity in the epidemic at the regional level. Focusing on those regions with the highest overall prevalence would miss districts with high prevalence that happened to be located in lower prevalence regions.

Figure 4. Distribution of districts, by HIV score

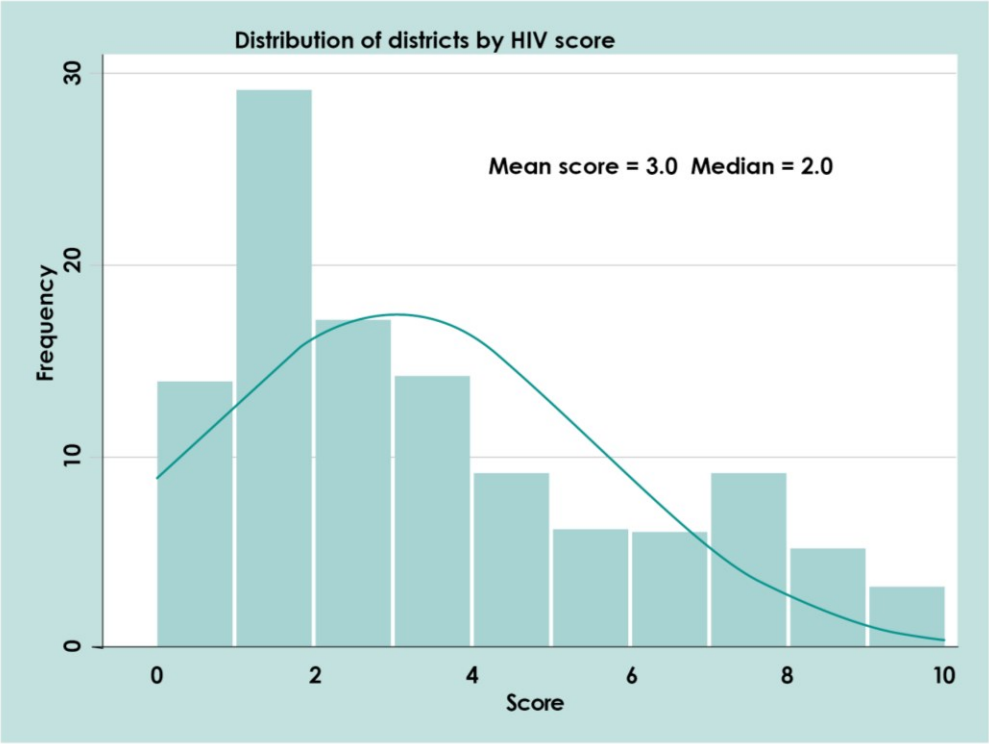


Table 2. Distribution of district-level scores, by region (HIV Scorecard 1: Updated District-Level Scorecard)

Region	High Score>=5	Medium Score= 2,3,4	Low Score < 2
Central	7	9	7
Eastern	6	13	13
Northern	4	8	18
Western	11	10	5

Updated 2013 District Scorecard Using Contextual Factors

As shown in Table 1, three types of indicators were used in 2013: indicators of the feasibility to implement PLACE, indicators of HIV burden or incidence, and indicators of contextual risk. We wanted to assess whether a simplified scorecard that used only contextual factors was associated with HIV prevalence among the PMTCT population. In many settings, HIV prevalence at the district level may not be available. Consequently, a scorecard that relies only on contextual factors may prove useful in some settings.

The updated district scorecard was based on the contextual indicators given in Table 1:

- Presence of a major transportation route
- Presence of a fishing village
- Presence of an additional fishing village
- Presence of a mining operation
- Presence of a military camp or barracks
- Presence of an international border
- Presence of a municipality

Updated District Scorecard 1 Results

The revised district scores ranged from zero to seven, reflecting the seven indicators in the scorecard. Among the districts:

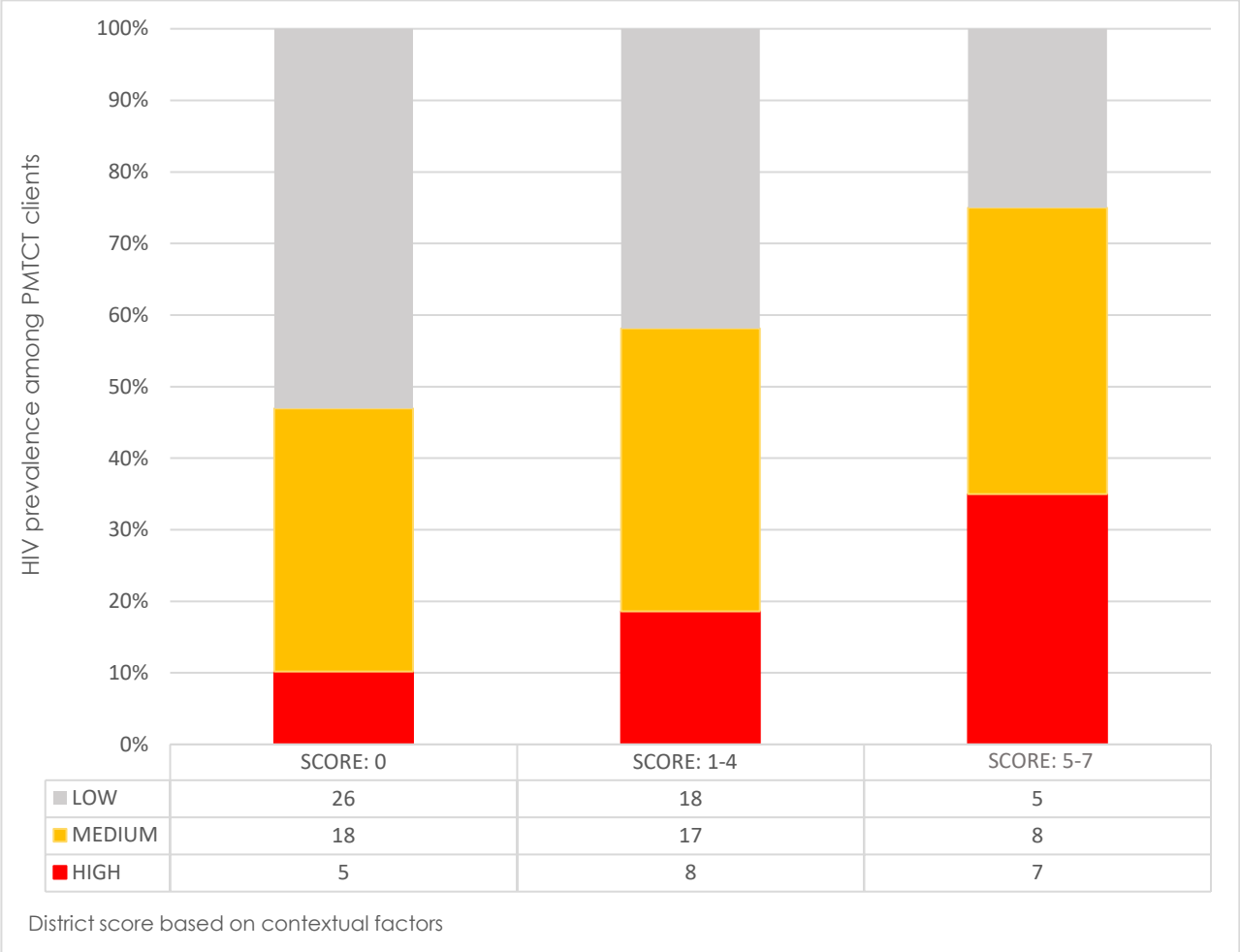
- 43 percent (49 districts) scored zero
- 38 percent (43 districts) scored one to four
- 18 percent (20 districts) scored five to seven

To assess the strength of the association between the contextual score and HIV prevalence among PMTCT women, we also stratified the districts by HIV prevalence among PMTCT women in the same proportion:

- 49 districts with HIV prevalence less than 5.77 percent were considered low prevalence.
- 43 districts with HIV prevalence greater than or equal to 5.77 percent and less than or equal to 9.68 percent were considered medium prevalence.
- 20 districts with HIV prevalence greater than 9.68 percent were considered high prevalence.

We then assessed whether the districts in the top 18 percent in terms of score were also likely to be in the top 18 percent in terms of HIV prevalence, and similarly for the other two groups. We found a fairly strong association between the revised district score and HIV prevalence among the PMTCT women. Thirty-five percent of the districts with a high score had high HIV prevalence among PMTCT women ($p=.02$).

Figure 5. HIV prevalence, by district score



Source: MEASURE Evaluation, 2014

Recommendations for the Updated District Scorecard 1

Such a district-level scorecard may be useful in settings where HIV prevalence is unknown and where an investigation is needed to assess HIV prevalence and the proportion of people who have achieved viral suppression. To implement Scorecard 1, the following steps should be taken:

- Convene a meeting of stakeholders knowledgeable about the country and the characteristics of the people who are HIV-positive.
- The stakeholders then review the generic PPA typology and adapt it based on known information.
- Based on these discussions, a simple district scoring system, such as that used in Uganda, is developed.
- All districts are scored. Those with the highest scores should be investigated first.

MAPPING THE NUMBER OF PEOPLE WHO HAVE HIV AND DO NOT KNOW THEIR STATUS

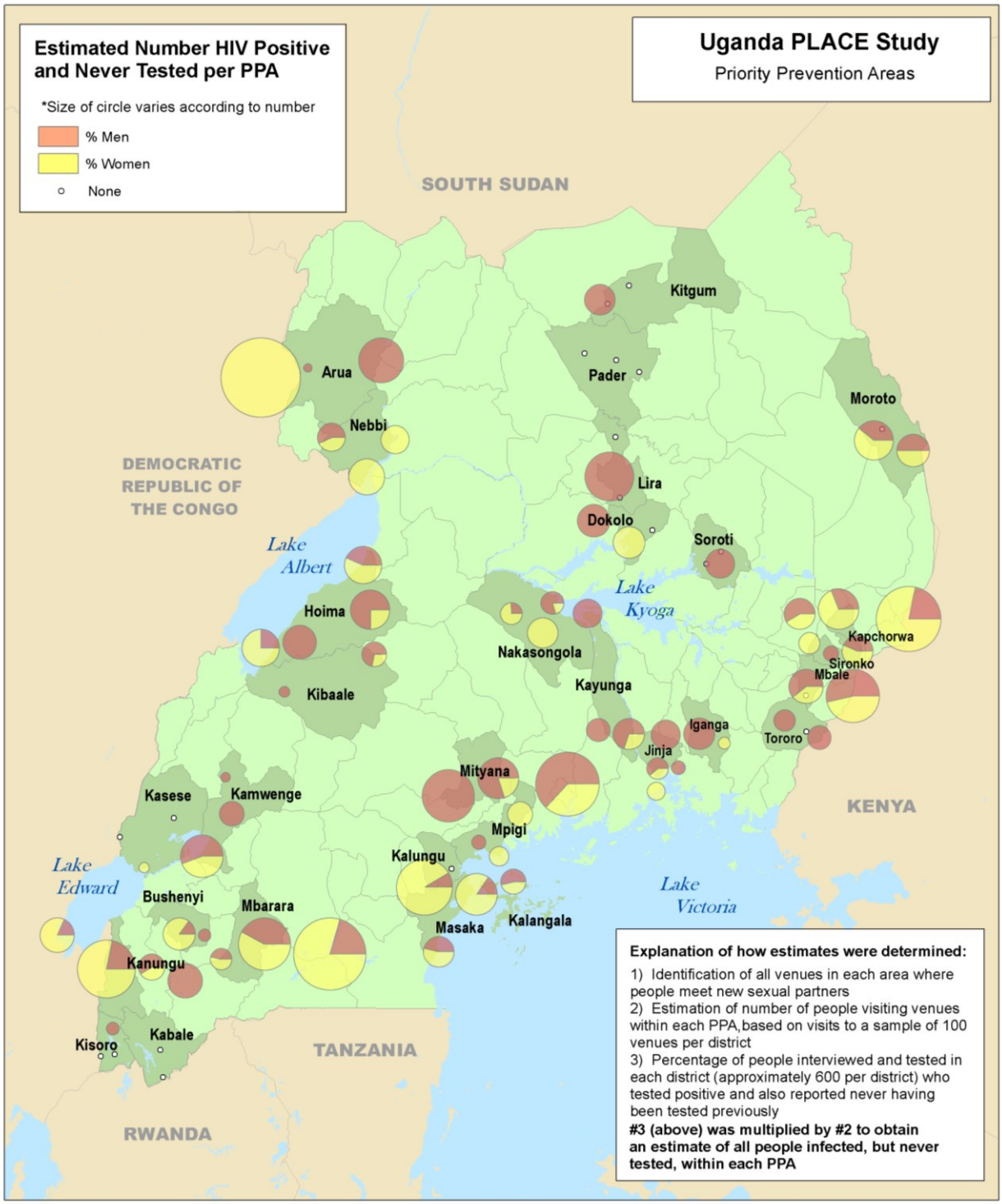
Using the 2013 PLACE data, we estimated the number of people attending PLACE venues who were HIV-positive but who had never been tested, and the proportion who were men and women (MEASURE Evaluation, 2014). This estimate did not include people who had HIV and had received at least one test with an HIV-negative result. Consequently, the estimates are probably significant underestimates of the number who were HIV-positive and did not know their status. A review of the maps (Figures 6 through 8) showed the following:

- In some subdistrict areas, there were many people who were HIV-positive and reported never having been tested. In several areas, there were more than 100 men or women who had not been tested.
- In some districts, there were PPAs with relatively few people who had never been tested and PPAs with more than 100 people who had never been tested.
- The male-to-female ratio among people who had HIV but had never been tested varied by PPA.

Recommendations

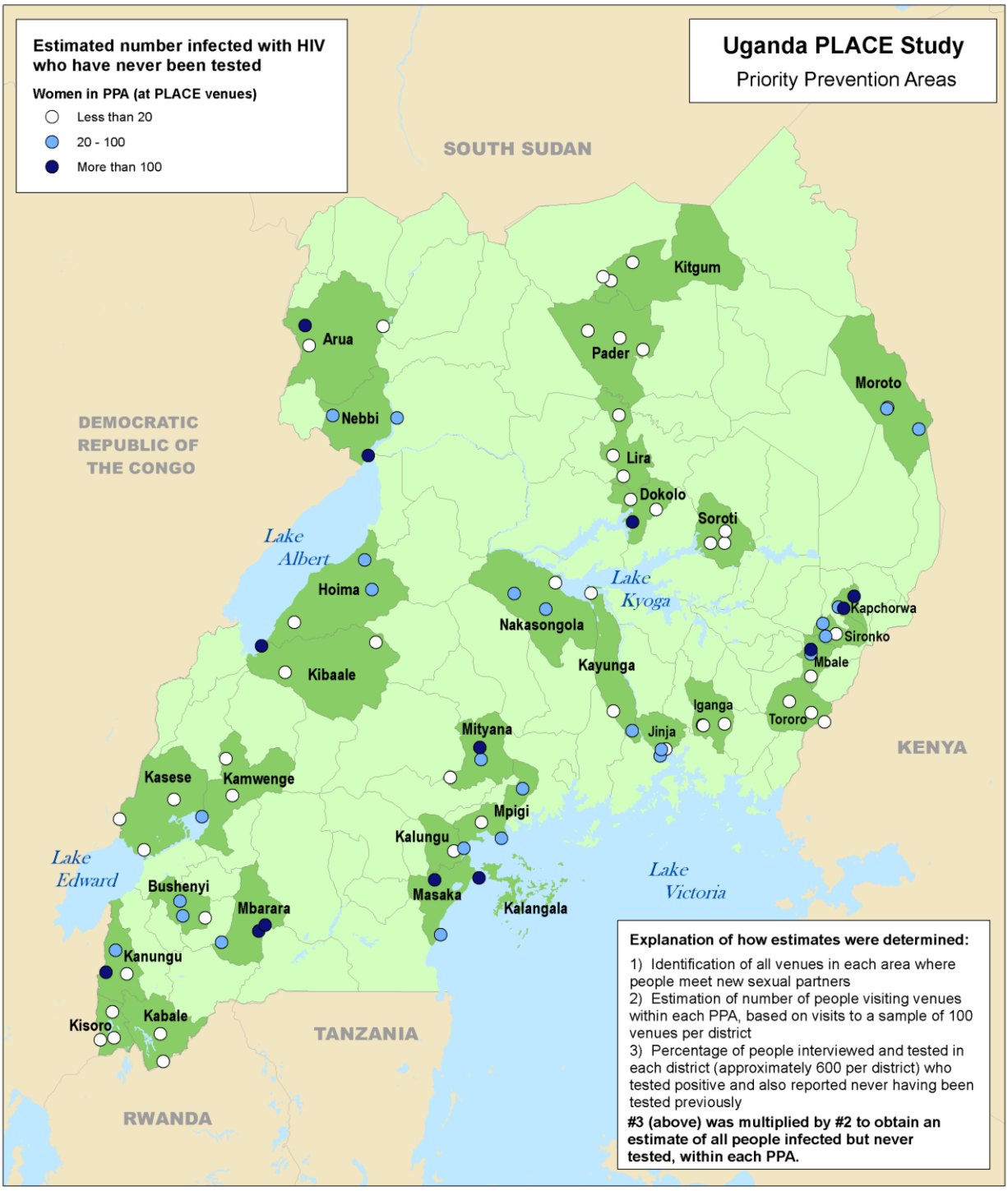
The subdistrict maps showed that HIV epidemics varied in the districts. Therefore, efforts to identify the PPAs would be a good strategy to find pockets of high HIV prevalence.

Figure 6. Estimated number of HIV-positive and never-tested people, per PPA



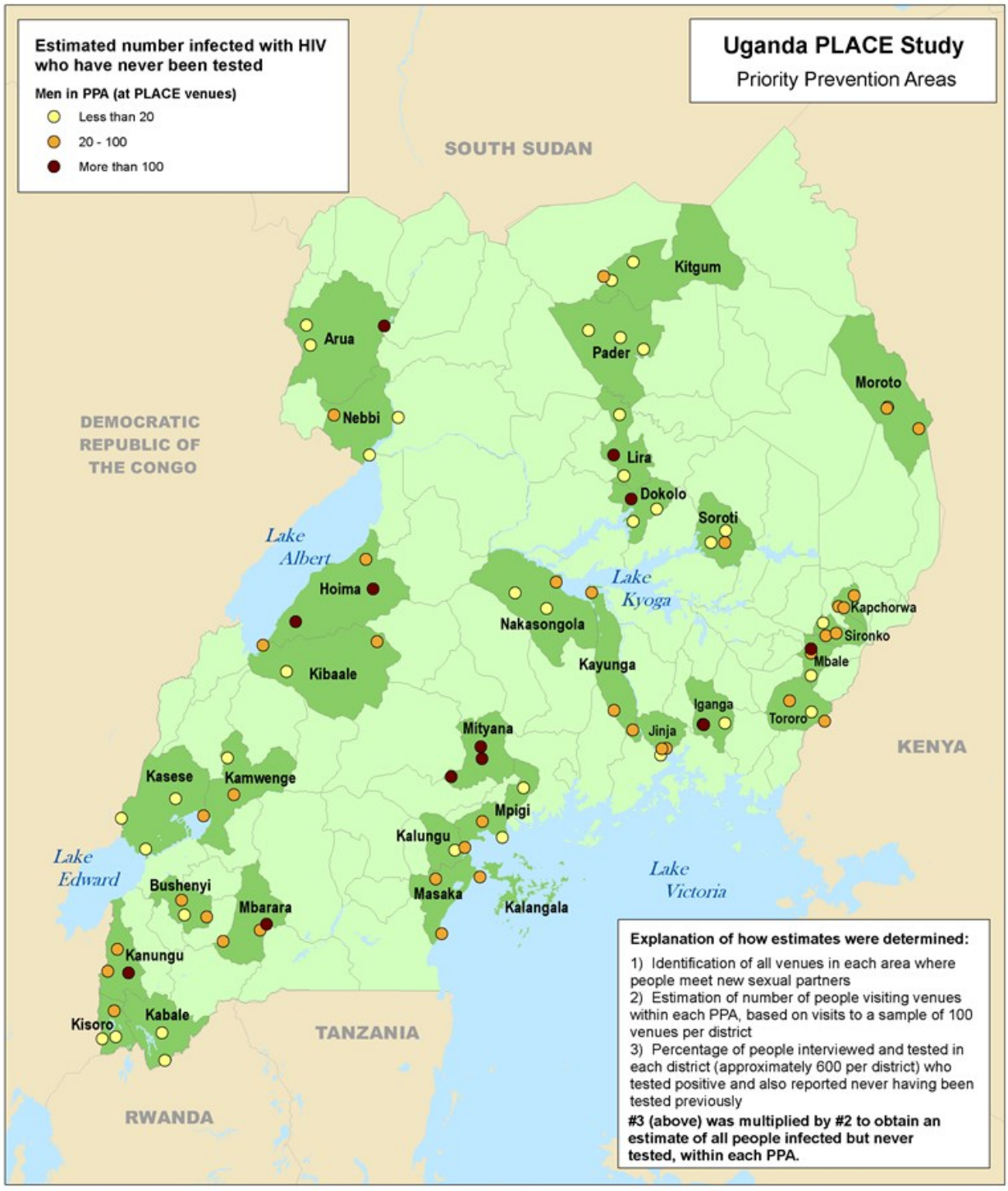
Source: MEASURE Evaluation, 2014

Figure 7. Estimated number of HIV-positive and never-tested women, per PPA



Source: MEASURE Evaluation, 2014

Figure 8. Estimated number of HIV-positive and never-tested men, per PPA



Source: MEASURE Evaluation, 2014

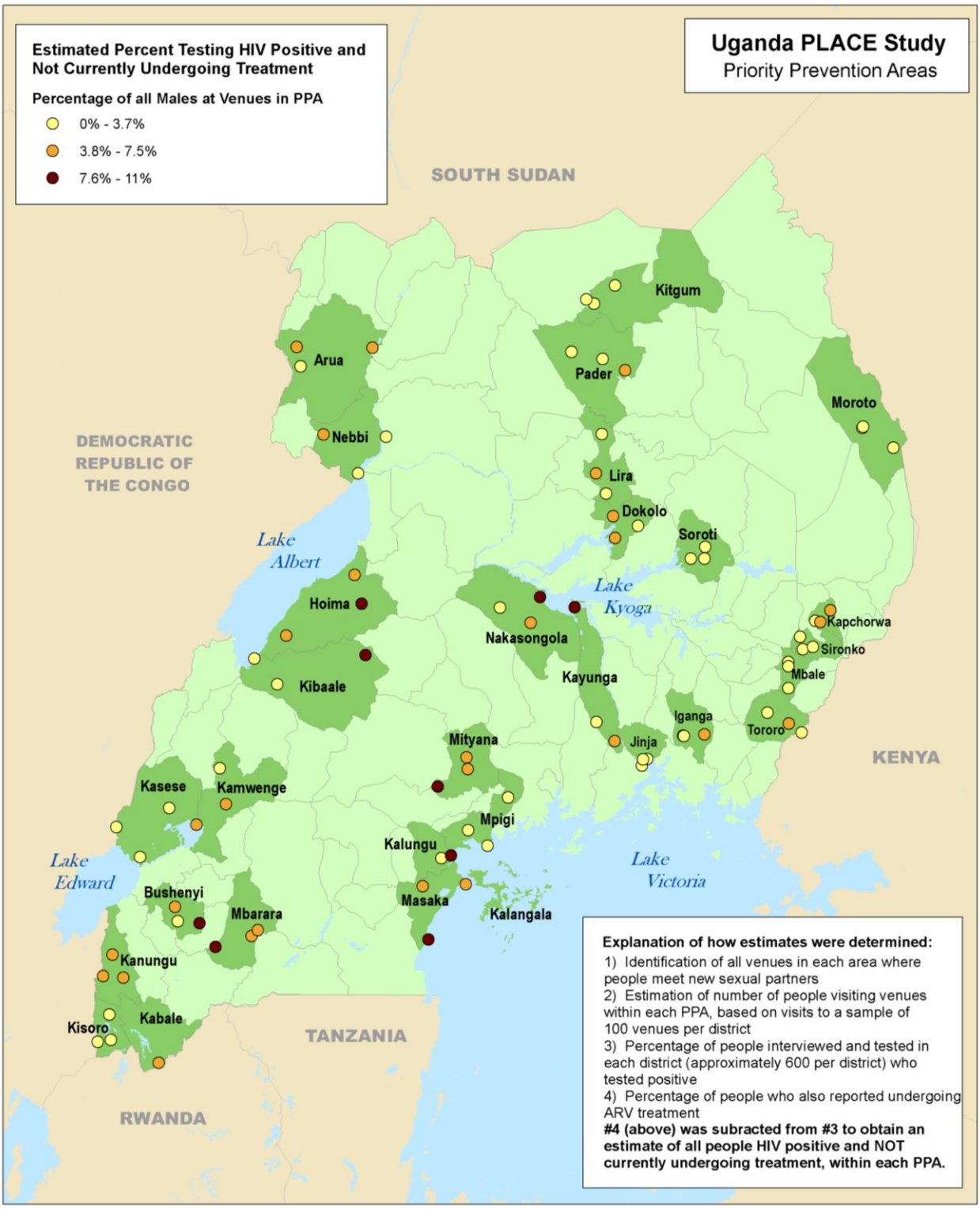
MAPPING UNTREATED HIV AT THE SUBDISTRICT LEVEL

We also estimated the percentage of men and women who were HIV-positive but were not on treatment. Figure 9 showed the percentage in 2013 of HIV-positive men who were not on treatment and visiting venues where people meet new sexual partners; Figure 10 showed the percentage of women meeting that description.

Recommendations

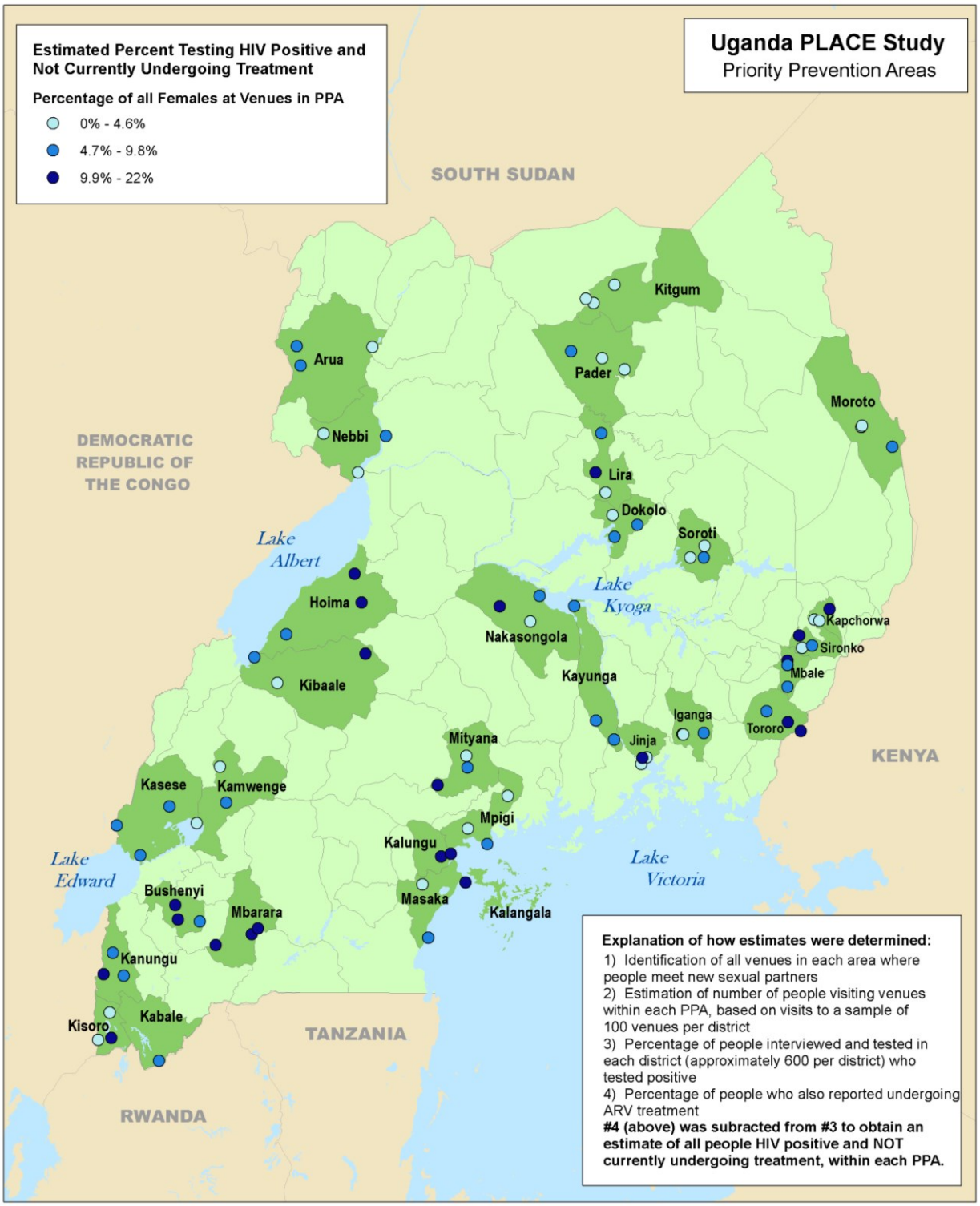
These subdistrict maps showed that there was a wide range in the percentages of people who had HIV but were not on treatment. These data could be used to guide efforts to provide outreach for testing and treatment.

Figure 9. Estimated percentage of HIV-positive men not on treatment, 2013



Source: MEASURE Evaluation, 2014

Figure 10. Estimated percentage of HIV-positive women not on treatment, 2013



Source: MEASURE Evaluation, 2014

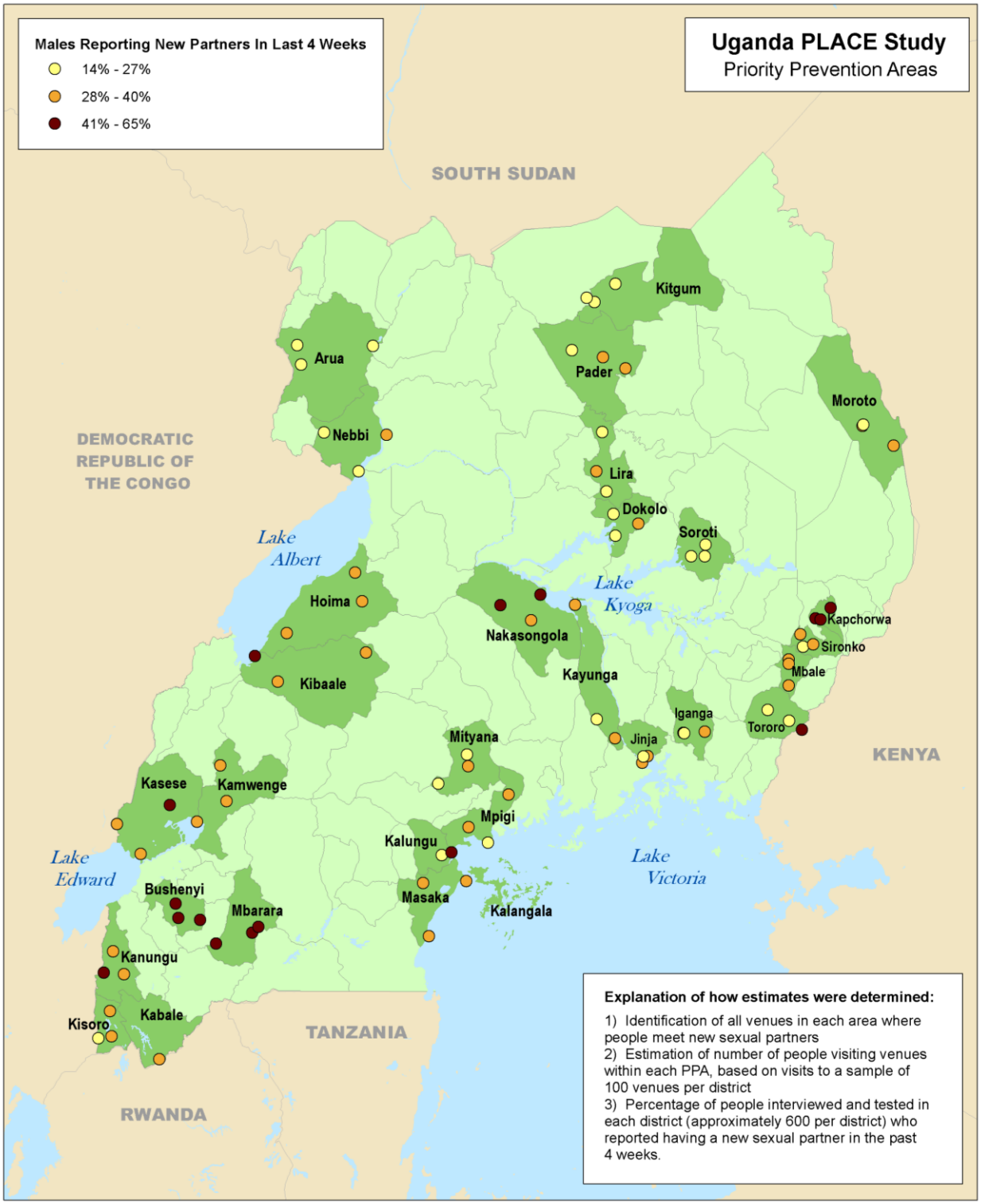
MAPPING THE PERCENTAGE OF PEOPLE WITH NEW SEXUAL PARTNERS AT THE SUBDISTRICT LEVEL

We also estimated the percentage of men and women who reported having a new sexual partner in the past four weeks, by PPA (Figures 11 and 12) (MEASURE Evaluation, 2014).

Recommendations

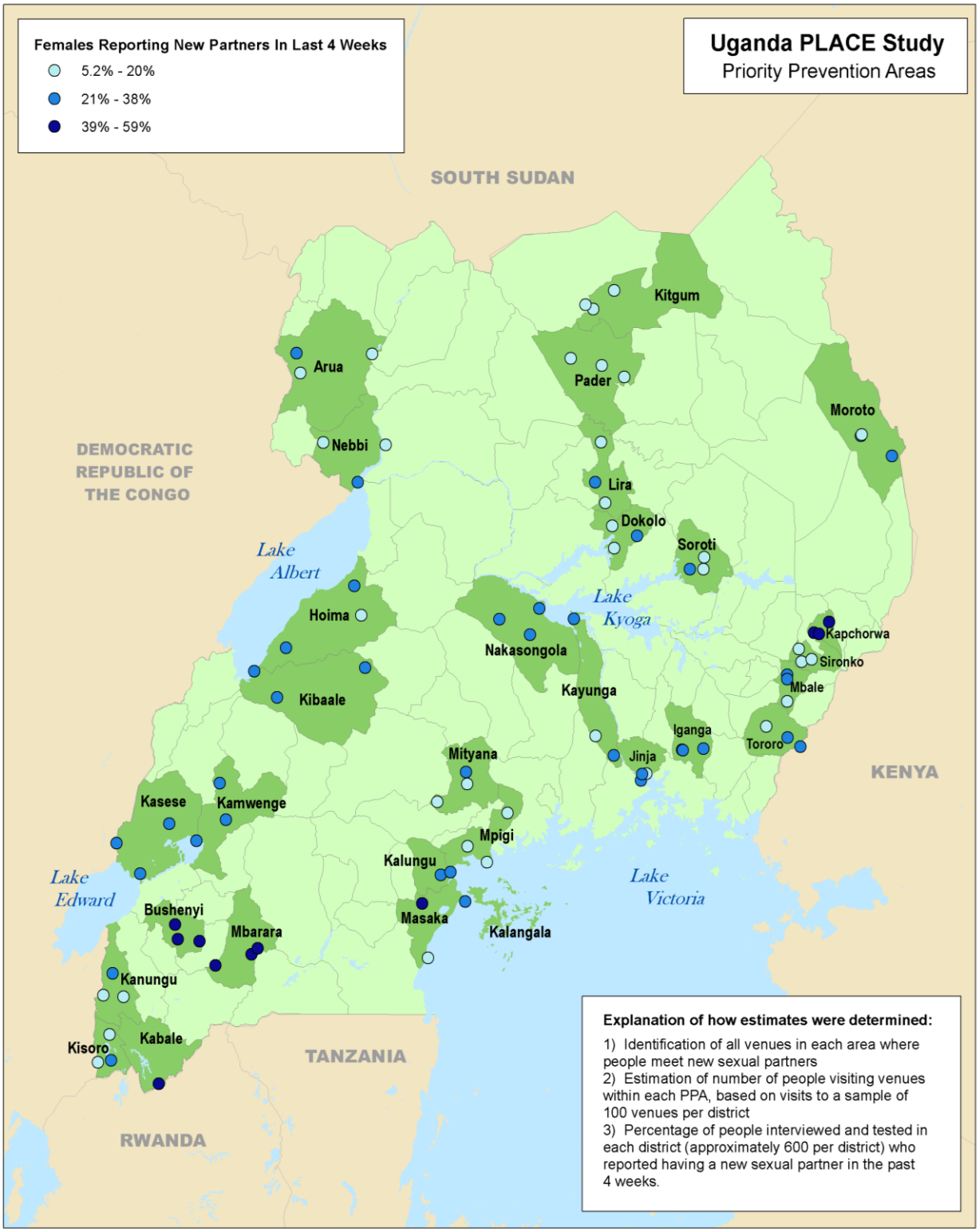
These subdistrict maps showed that there were many people who attended venues in PPAs who had a high rate of new sexual partnerships. If these people were HIV-positive but not on treatment, they were at risk of transmitting the virus to others. If they were not HIV-positive, they were at risk of acquiring the virus if they did not consistently use condoms. These maps can be used to advocate increased prevention programming and condom distribution.

Figure 11. Men reporting new partners in the past four weeks



Source: MEASURE Evaluation, 2014

Figure 12. Women reporting new partners in the past four weeks



Source: MEASURE Evaluation, 2014

MAPPING WHERE HIV IS NOT SUPPRESSED AT THE SUBNATIONAL LEVEL

In 2013, we recommended that local district stakeholders and HIV officials at the district level identify all PPAs, but select only three for mapping venues and implementing PLACE (MEASURE Evaluation, 2014). In 2018, we asked districts to identify *all* PPAs in the district and implement PLACE there (MEASURE Evaluation, 2018).

We estimated the number of people with HIV but not suppressed based on the weighted number of people in the PPA who had visited PLACE venues during the course of one week, who were tested for HIV at the venues during the PLACE interviews, and who provided a dried blood spot that was tested to estimate the viral load. The estimated number of men who were HIV-positive but not suppressed (12,250) shown in Table 3 was 22 percent of the estimated number of men in the 25 districts covered by the 2018 PLACE study who were HIV-positive but not on treatment (PEPFAR data provided by USAID, and not shown here).

Table 3. Estimates of the number of HIV-positive people not virally suppressed in 25 PLACE districts, based on interviews with men and women at PLACE venues in 201 PPAs in 2018

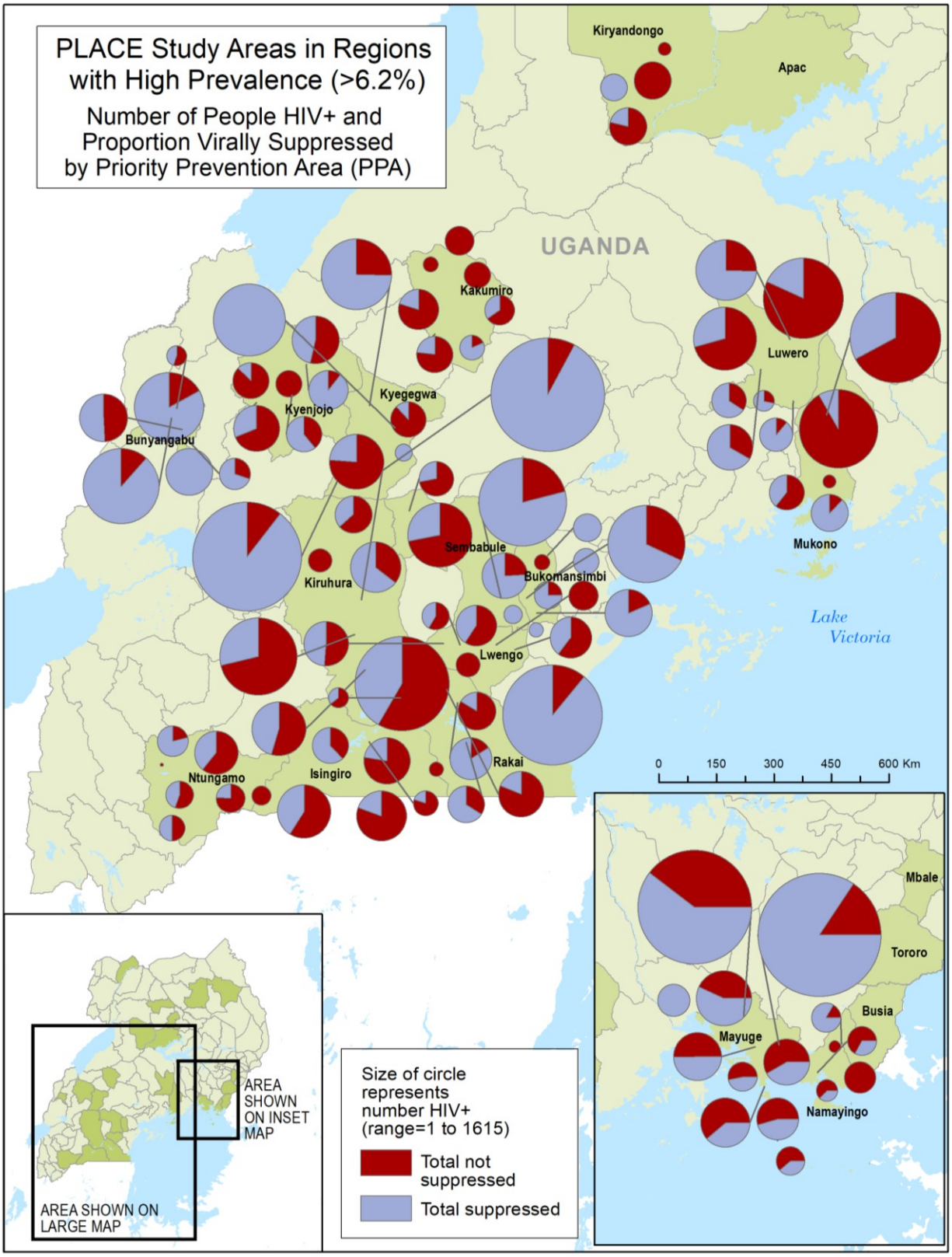
Men Interviewed at PLACE Venues					
Category	**All: Total Number**	**Number HIV-Negative**	**Number HIV-Positive**	**Number Not Suppressed**	**Percentage Not Suppressed**
Men					
Unweighted Sample	9484	9056	413	225	52.4%
Weighted	525,540	504,376	22,348	12,250	57.9%
Women					
Unweighted Sample	4431	4026	396	165	40.7%
Weighted	224,443	207,531	16,911	5700	35.0%
Transgender Women					
Unweighted	134	120	14	5	35.7%
Weighted	n/a	n/a	n/a	n/a	n/a

Maps showing the estimated number of people with HIV and the proportion of those who have not achieved viral suppression are provided on the next two pages. Figure 13 shows the proportion of HIV-positive people who were virally suppressed in high-prevalence regions, where the prevalence was greater than 6.2 percent according to the UPHIA survey. Figure 14 shows the same estimates for districts with lower prevalence.

Recommendations

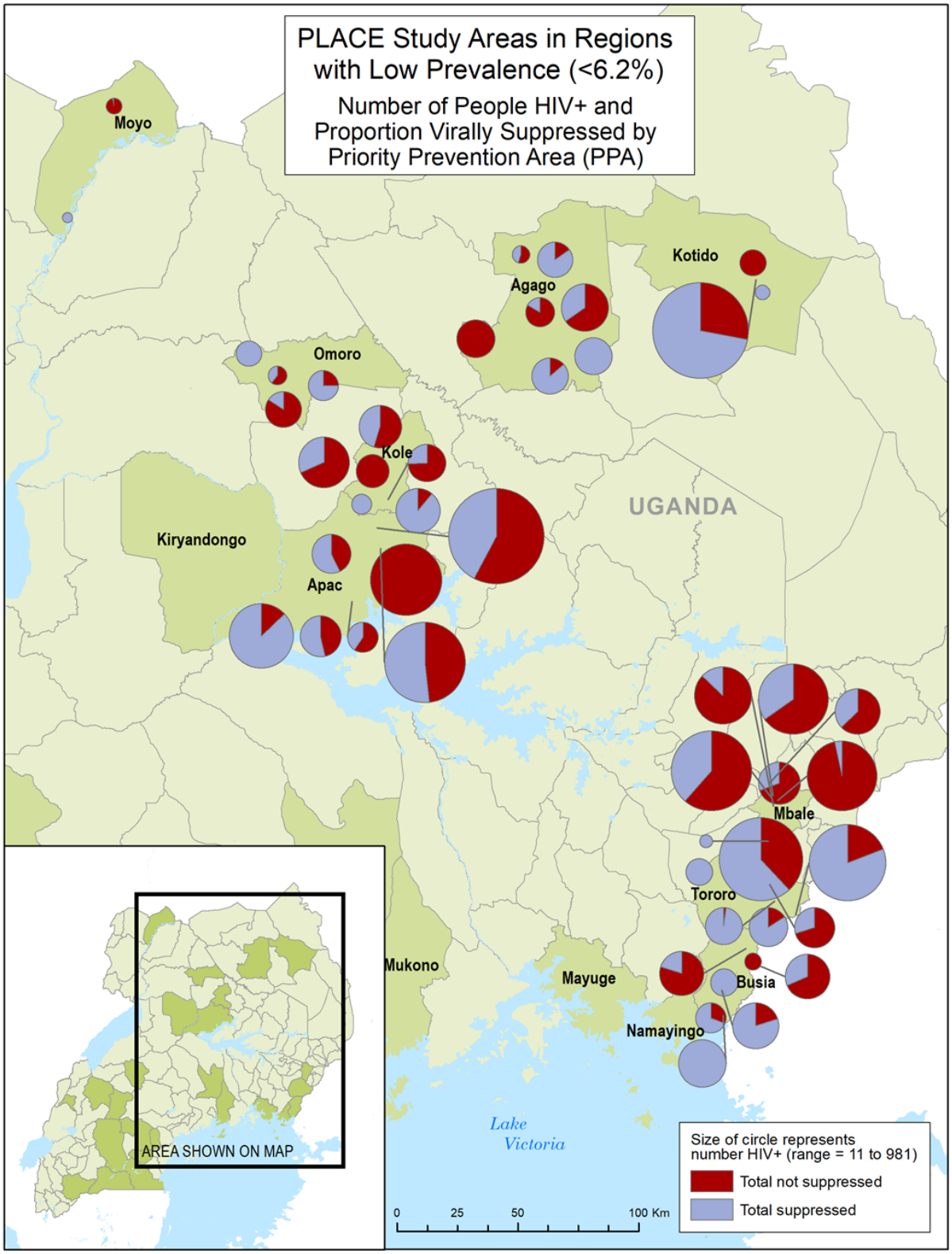
The maps showed that there was much work still to be done to engage people in care. Some PPAs in low-prevalence districts had an especially high percentage of people who were not yet suppressed. The maps suggested that efforts to improve access to treatment among people attending social venues could result in more people being put on effective treatment.

Figure 13. PLACE study areas in regions with high prevalence (>6.2%)



Source: MEASURE Evaluation, 2014

Figure 14. PLACE study areas in regions with low prevalence (<6.2%)



Source: MEASURE Evaluation, 2014

A NEW VIRAL SUPPRESSION SCORECARD AT THE SUBNATIONAL LEVEL

Using the 2018 PLACE data for Uganda (MEASURE Evaluation, 2018), each PPA was characterized by the following:

- Number of venues identified where people meet new sexual partners
- Urbanicity—that is, whether the area was in one of the following locations:
  - City
  - Municipality
  - Town council
  - Town board
- Whether the area contained a main or a secondary road

For each PPA in the 25 districts, we also estimated the following:

- Number of people with HIV
- Number of people with HIV and not suppressed, whether the region had a higher-than-average prevalence of HIV according to the most recent UPHIA survey (Regions 1, 2, 4, 9, and 10) or a lower prevalence (Regions 5, 6, 7, and 8).

We used a subprogram for logistic regression in SAS called *proc genmod* to estimate the percentage of people going to venues in PPAs with various characteristics (Appendix B).

The new scorecard is presented in Table 4. For each combination of contextual factors, we reported the percentage of people who went to venues who were HIV-positive and not virally suppressed. This percentage ranged from 1.74 percent for PPAs in rural areas with no main or secondary road, no lake, and lower-than average regional HIV prevalence, to 5.49 percent for PPAs in urban areas with no main or secondary road, no lake, and higher-than-average regional HIV prevalence.

Appendix A provides the estimates of the number of people with HIV and not suppressed among the venue-going population in each PPA.

Appendix B provides the SAS code.

Recommendations

This scorecard can be used to prioritize geographic areas at the PPA level using only contextual factors that are publicly available. It is a feasible and accessible tool for programs with limited resources to plan surveillance and outreach activities to reach the highest-yield areas.

Table 4. PPA-level scorecard

Contextual Factors*				Number of PPAs in Each Stratum of Contextual Factors	Estimated Percentage of Venue-Goers with HIV and Not Suppressed
Higher-than-Average Regional HIV Prevalence	On a Lake	Urban Area (City or Municipality)	Main or Secondary Road in Area	N	%
0	0	0	0	26	1.74
0	0	0	1	15	1.78
0	0	1	0	9	4.02
0	1	1	0	3	2.03
0	1	0	1	5	2.08
1	0	0	0	53	2.37
1	0	0	1	39	2.43
1	0	1	0	2	5.49
1	0	1	1	0	--
1	1	0	0	5	2.78
1	1	0	1	13	2.85

*Higher-than-average regional HIV prevalence was determined based on the 2016–2017 UPHIA (Ministry of Health, Uganda [2019]).

CONCLUSION

In this study, we explore several strategies for prioritizing geographic areas where the highest percentage of venue-goers in Uganda who were HIV-positive and were not virally suppressed could be reached. The district-level scorecard may be useful in settings where regional prevalence is unknown, and where a knowledgeable team of stakeholders is available to provide insight into the district-level contextual factors most associated with the high prevalence of HIV. The PPA-level scorecard, which identifies where HIV-positive people who are not suppressed can be found, may be useful in settings where a more granular geographic focus is needed and where some estimates of HIV prevalence at the regional or district level are already available.

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APPENDIX A. PPA-LEVEL DATA FROM THE 2018 UGANDA PLACE STUDY

Region	District	PPA Name	Number of PLACE Venues in the PPA	Number of People Interviewed and Tested	Estimated Number at Venues During One Week	HIV Prevalence Among Those Tested	Estimated Number of People at Venues with HIV	Estimated Number Who Were Not Suppressed	Number Suppressed	Percentage Suppressed
Central 1	Rakai	Kibaale Town Council	50	68	1736	8.1%	141	48	94	66.2%
Central 1	Rakai	Lwamagwa Town Council	47	105	4041	5.4%	219	178	41	18.8%
Central 1	Rakai	Lwentulege Town Council	39	78	4435	4.2%	186	30	156	83.8%
Central 1	Rakai	Kacheera/Lwanga Fishing Villages	59	74	7141	13.3%	949	554	395	41.6%
Central 1	Rakai	Rakai Town Board	27	30	834	4.6%	38	38	0	0.0%
Central 1	Rakai	Ntantamukye/Kamuli Trading Centers	62	70	2443	0.9%	21	21	0	0.0%
Central 1	Rakai	Lwanda Town Council	38	73	15486	6.9%	1063	117	947	89.0%
Central 1	Rakai	Ddwaniro/Buyamba Trading Centers	45	57	1873	8.2%	153	128	25	16.6%
Central 1	Sembabule	Sembabule Town Board	60	49	5879	.	.	0	.	.
Central 1	Sembabule	Lwemiyaga Trading Center	124	35	1495	8.6%	128	93	36	27.8%
Central 1	Sembabule	Ntuusi Fishing Village	110	121	6783	6.5%	438	314	123	28.2%
Central 1	Sembabule	Mateete Trading Center	109	132	7607	10.9%	826	174	652	78.9%
Central 1	Sembabule	Lwebitakuli Trading Center	87	40	2255	7.7%	174	103	71	41.0%
Central 1	Sembabule	Kikyusa Trading Center	90	158	7764	2.9%	223	54	170	75.9%
Central 1	Bukomansimbi	Bukomansimbi Town	43	122	5791	11.0%	635	203	432	68.1%
Central 1	Bukomansimbi	Kigangazi Market	42	58	1912	4.3%	83	0	83	100.0%

Region	District	PPA Name	Number of PLACE Venues in the PPA	Number of People Interviewed and Tested	Estimated Number at Venues During One Week	HIV Prevalence Among Those Tested	Estimated Number of People at Venues with HIV	Estimated Number Who Were Not Suppressed	Number Suppressed	Percentage Suppressed
Central 1	Bukomansimbi	Butenga Health Facility and Trading Center	34	58	1251	6.6%	82	20	62	75.9%
Central 1	Bukomansimbi	Kikuuta Trading Center	22	36	1001	.	.	0	.	.
Central 1	Bukomansimbi	Bulenge Trading Center	37	80	2968	0.9%	26	26	0	0.0%
Central 1	Bukomansimbi	Buyoga Coffee Farms	38	72	1811	13.2%	238	44	194	81.5%
Central 1	Bukomansimbi	Kiryamenvu Rural Area	23	36	856	8.3%	71	0	71	100.0%
Central 1	Bukomansimbi	Misanvu Trading Center	44	81	1985	1.8%	36	0	36	100.0%
Central 1	Lwengo	Lwengo Town Council	93	78	4902	1.8%	91	91	0	0.0%
Central 1	Lwengo	Lwengo Subcounty	110	33	1517	.	.	0	.	.
Central 1	Lwengo	Ndagwe Subcounty	93	66	4188	.	.	0	.	.
Central 1	Lwengo	Kinoni Town Council	130	99	4815	3.8%	181	109	72	40.0%
Central 1	Lwengo	Kyazanga Town Council	60	47	3026	2.6%	79	46	33	42.0%
Central 1	Lwengo	Kyanzanga Subcounty	76	62	3741	1.6%	60	60	0	0.0%
Central 1	Lwengo	Kingo Subcounty	56	62	3325	0.7%	22	0	22	100.0%
Central 1	Lwengo	Katovu Town Council	98	122	9006	2.3%	211	108	103	48.9%
Central 2	Luwero	Luwero Town Council	49	95	4729	8.9%	422	298	124	29.4%
Central 2	Luwero	Wobulenzi Town Council	61	77	2981	7.5%	222	74	148	66.8%
Central 2	Luwero	Kikyusa Trading Center	20	61	4913	8.0%	393	100	293	74.5%
Central 2	Luwero	Busiika/	26	34	1669	7.0%	117	13	104	88.8%

Region	District	PPA Name	Number of PLACE Venues in the PPA	Number of People Interviewed and Tested	Estimated Number at Venues During One Week	HIV Prevalence Among Those Tested	Estimated Number of People at Venues with HIV	Estimated Number Who Were Not Suppressed	Number Suppressed	Percentage Suppressed
		Wumba Trading Center								
Central 2	Luwero	Bombo Military Barracks	42	42	862	5.3%	46	13	33	71.4%
Central 2	Luwero	Zirobwe Trading Center	16	31	1357	.	.	0	.	.
Central 2	Luwero	Kanyanda Kaslasa Trading Center	56	51	2832	4.5%	126	43	83	65.9%
Central 2	Luwero	Kamira Trading Center	45	114	5254	13.1%	688	563	125	18.1%
Central 2	Mukono	Nakifuma Town Council	131	147	13837	6.3%	874	587	287	32.8%
Central 2	Mukono	Mpatta Fishing Village	76	83	9899	1.3%	132	80	52	39.4%
Central 2	Mukono	NamaWojjolo/ Namataba/ Mbalala Truck Stops	201	78	11571	5.7%	654	599	55	8.4%
Central 2	Mukono	Katosi Landing Site	74	62	3182	4.6%	146	18	128	87.5%
Central 2	Mukono	Seeta Trading Center	91	45	3447	.	.	0	.	.
Central 2	Mukono	Kalagi Town	154	55	2737	11.5%	314	314	0	0.0%
Central 2	Mukono	Kisoga Town	127	42	2178	0.8%	18	18	0	0.0%
East-Central	Mayuge	Bwonda Town Council	69	78	2390	10.8%	258	158	100	38.7%
East-Central	Mayuge	Magamaga Truck Stop	86	87	3726	2.9%	110	0	110	100.0%
East-Central	Mayuge	Mayuge Town Council	63	73	8234	16.7%	1376	544	832	60.5%
East-Central	Mayuge	Masolya Islands	43	39	794	23.5%	187	102	85	45.5%
East-Central	Mayuge	Musita/Lugolole/ Bulanga	115	96	4846	6.6%	322	139	183	56.8%
East-Central	Mayuge	Bugade Town Council	47	62	4613	5.3%	245	123	121	49.6%
East-Central	Mayuge	Bugoto/	100	107	6675	24.2%	1615	252	1363	84.4%

Region	District	PPA Name	Number of PLACE Venues in the PPA	Number of People Interviewed and Tested	Estimated Number at Venues During One Week	HIV Prevalence Among Those Tested	Estimated Number of People at Venues with HIV	Estimated Number Who Were Not Suppressed	Number Suppressed	Percentage Suppressed
		Kigandalo Trading Centers								
East-Central	Mayuge	Nango/ Bukagabo Trading Centers	43	31	859	10.5%	90	48	42	46.9%
East-Central	Namayingo	Namayingo Town Council	75	85	3425	2.7%	91	15	76	83.6%
East-Central	Namayingo	Banda Mine and Landing	86	73	4591	2.3%	104	104	0	0.0%
East-Central	Namayingo	Mutumba Fishing Sites	77	139	7185	1.2%	89	60	30	33.3%
East-Central	Namayingo	Buhemba Fishing Sites	83	57	2647	8.5%	224	131	94	41.8%
East-Central	Namayingo	Bukana Mine and Landing	45	111	6626	0.7%	48	30	18	37.5%
East-Central	Namayingo	Buyinja Gold Mining	75	35	3493	0.4%	15	15	0	0.0%
East-Central	Namayingo	Lolwe Island Fishing Site	56	56	1843	4.6%	85	52	33	38.6%
Mid-East	Busia	Sikuda-Tiira Gold Mine	33	101	6204	3.4%	209	166	42	20.3%
Mid-East	Busia	Eastern Division Busia	49	165	6063	0.5%	30	30	0	0.0%
Mid-East	Busia	Western Division Busia	47	63	1972	10.8%	213	146	67	31.4%
Mid-East	Busia	Lumino Trading Center	39	55	1839	4.4%	80	0	80	100.0%

Region	District	PPA Name	Number of PLACE Venues in the PPA	Number of People Interviewed and Tested	Estimated Number at Venues During One Week	HIV Prevalence Among Those Tested	Estimated Number of People at Venues with HIV	Estimated Number Who Were Not Suppressed	Number Suppressed	Percentage Suppressed
Mid-East	Busia	Majanji Fishing Community	33	95	3109	7.7%	240	0	240	100.0%
Mid-East	Busia	Masaba Subcounty	56	42	2229	10.1%	226	45	181	80.0%
Mid-East	Busia	Nalyowa Fishing Community	48	48	1742	5.6%	97	30	67	68.9%
Mid-East	Mbale	Busiu Town Council	102	77	4158	0.4%	18	0	18	100.0%
Mid-East	Mbale	Nakaloke/ Namunsi Town Councils	85	80	4211	5.2%	219	138	82	37.2%
Mid-East	Mbale	nauyo Bugema/ Musoto Town Council	96	63	6714	5.2%	349	303	45	13.0%
Mid-East	Mbale	Northern Division Mbale	76	77	7320	7.2%	524	341	182	34.8%
Mid-East	Mbale	Wanale Division Mbale	92	35	3244	16.2%	524	506	18	3.5%
Mid-East	Mbale	Industrial Division Mbale	171	113	6835	10.0%	686	422	264	38.5%
Mid-East	Mbale	Namanyoyi Makuduyi/ Namagumba Town Board	74	80	8468	2.2%	189	131	58	30.8%
Mid-East	Mbale	Jewa/Mile 6 Town Board	48	32	3515	.	.	0	.	.
Mid-East	Tororo	Tororo Municipal Council	114	59	3617	4.0%	146	3	143	98.0%
Mid-East	Tororo	Malaba Border Crossing	88	78	4136	15.1%	625	120	505	80.8%
Mid-East	Tororo	Osukuro Factories/Truck Stops	131	44	4155	3.9%	161	26	136	84.1%

Region	District	PPA Name	Number of PLACE Venues in the PPA	Number of People Interviewed and Tested	Estimated Number at Venues During One Week	HIV Prevalence Among Those Tested	Estimated Number of People at Venues with HIV	Estimated Number Who Were Not Suppressed	Number Suppressed	Percentage Suppressed
Mid-East	Tororo	Rubongi/Mukujju Factories/Markets	209	85	10292	1.7%	172	121	51	29.9%
Mid-East	Tororo	Nagongera/Paya Trading Centers	171	140	14230	0.5%	77	0	77	100.0%
Mid-East	Tororo	Molo/Merikit Trading Centers	148	138	14515	5.1%	742	283	458	61.8%
North-East	Kotido	Central Division Kotido Trading Center	82	194	7101	13.8%	981	274	707	72.1%
North-East	Kotido	Lokitelaebu Trading Center	52	42	1259	.	.	0	.	.
North-East	Kotido	Losakucha Market	44	70	9336	.	.	0	.	.
North-East	Kotido	Kacheri Town Council	55	91	4967	.	.	0	.	.
North-East	Kotido	Rengen Cattle Market	51	77	2608	2.8%	74	74	0	0.0%
North-East	Kotido	Panyangara Trading Center	42	56	1379	1.7%	23	0	23	100.0%
West Nile	Moyo	Moyo Town Council	77	145	2918	0.9%	27	26	1	3.7%
West Nile	Moyo	Metu Border Area	57	102	5631	.	.	0	.	.
West Nile	Moyo	Laropi Landing/ Ferry	49	122	5203	.	.	0	.	.
West Nile	Moyo	Obongi Landing/Trading Center	53	145	6196	0.2%	11	0	11	100.0%

Region	District	PPA Name	Number of PLACE Venues in the PPA	Number of People Interviewed and Tested	Estimated Number at Venues During One Week	HIV Prevalence Among Those Tested	Estimated Number of People at Venues with HIV	Estimated Number Who Were Not Suppressed	Number Suppressed	Percentage Suppressed
West Nile	Moyo	Lefori Rural Trading Center	36	32	558	.	.	0	.	.
Mid-North	Apac	Apac Municipality	45	100	2639	6.1%	161	69	92	57.0%
Mid-North	Apac	Aduku Town Council	53	99	6934	10.0%	692	333	358	51.8%
Mid-North	Apac	Inomo Social Spots	55	77	12176	8.0%	973	561	412	42.4%
Mid-North	Apac	Chawente Fishing Community	66	93	3390	2.9%	97	58	40	40.7%
Mid-North	Apac	Ayeu Fishing Community	63	65	3421	12.9%	441	57	385	87.1%
Mid-North	Apac	Wansolo Fishing Community	59	61	1772	10.1%	180	83	96	53.6%
Mid-North	Apac	Nambieso Fishing Village	72	69	12292	4.5%	549	549	0	0.0%
Mid-North	Agago	Lamiyo Barracks and Market	50	49	2667	5.7%	153	153	0	0.0%
Mid-North	Agago	Kalongo-Parabongo Market and Mines	99	46	1373	9.7%	133	20	113	84.7%
Mid-North	Agago	Patongo Town Council	82	97	3192	2.8%	90	75	15	16.2%
Mid-North	Agago	Adilang Trading Center	67	113	4023	3.6%	146	0	146	100.0%
Mid-North	Agago	Wol Town Council	82	64	6658	0.5%	33	18	15	44.4%
Mid-North	Agago	Kotomor Market	41	49	1420	9.9%	141	19	122	86.4%
Mid-North	Agago	Lapono Market	90	71	9549	2.5%	238	155	83	35.0%

Region	District	PPA Name	Number of PLACE Venues in the PPA	Number of People Interviewed and Tested	Estimated Number at Venues During One Week	HIV Prevalence Among Those Tested	Estimated Number of People at Venues with HIV	Estimated Number Who Were Not Suppressed	Number Suppressed	Percentage Suppressed
Mid-North	Kole	Corner Morlem Trading Center	54	63	3709	7.4%	275	188	87	31.6%
Mid-North	Kole	Bala Trading Center	106	116	4672	3.2%	151	112	39	25.8%
Mid-North	Kole	Akalo Trading Center	88	84	2262	9.2%	209	23	186	89.0%
Mid-North	Kole	Alito Trading Center	48	30	1306	1.8%	23	12	12	50.0%
Mid-North	Kole	Lwala Trading Center	87	99	3653	1.1%	42	0	42	100.0%
Mid-North	Kole	Aboke Trading Center	65	84	1903	6.2%	117	117	0	0.0%
Mid-North	Kole	Opeta Trading Center	65	84	4157	4.7%	194	106	88	45.3%
Mid-North	Omoro	Odek Subcounty	35	88	7251	.	.	0	.	.
Mid-North	Omoro	Ongako Subcounty	100	105	3260	2.1%	68	0	68	100.0%
Mid-North	Omoro	Omoro Town Council	53	104	4038	2.4%	97	24	72	74.9%
Mid-North	Omoro	Palenga Town Council	44	54	3253	1.1%	37	23	15	39.0%
Mid-North	Omoro	Bobi Subcounty	118	151	2886	4.8%	138	117	22	15.8%
Mid-West	Kyenjojo	Kyenjojo Town Council	66	94	3177	4.2%	133	52	82	61.3%
Mid-West	Kyenjojo	Kinyantale-Mbale Tea Estate	96	143	5302	4.3%	226	156	70	30.9%
Mid-West	Kyenjojo	Rugombe-Kagorogoro Trading Center	51	36	2953	4.7%	138	120	17	12.5%
Mid-West	Kyenjojo	Rwensinga Trading Center	66	41	1968	3.7%	74	74	0	0.0%
Mid-West	Kyenjojo	Katooke Town Council	49	91	4846	3.4%	164	17	146	89.5%

Region	District	PPA Name	Number of PLACE Venues in the PPA	Number of People Interviewed and Tested	Estimated Number at Venues During One Week	HIV Prevalence Among Those Tested	Estimated Number of People at Venues with HIV	Estimated Number Who Were Not Suppressed	Number Suppressed	Percentage Suppressed
Mid-West	Kyenjojo	Mabira-Kyamutunzi Trading Center	85	136	6020	4.0%	240	129	112	46.4%
Mid-West	Kiryandongo	Bweyale Town Council	60	46	1266	1.5%	18	18	0	0.0%
Mid-West	Kiryandongo	Masindi Port Trading Center	77	170	6891	2.2%	151	119	32	21.1%
Mid-West	Kiryandongo	Karuma Truck Stop	55	43	634	3.4%	21	19	2	10.3%
Mid-West	Kiryandongo	Kiryandongo Town Council	55	109	3709	4.0%	148	148	0	0.0%
Mid-West	Kiryandongo	Kapundo Trading Center	83	73	2537	.	.	0	.	.
Mid-West	Kiryandongo	Mutunda Trading Center	95	42	2365	.	.	0	.	.
Mid-West	Kiryandongo	Apodorwa Trading Center	61	58	2340	3.3%	76	0	76	100.0%
Mid-West	Kyegegwa	Kyegegwa Town Council	79	72	4602	12.0%	553	0	553	100.0%
Mid-West	Kyegegwa	Kyegegwa Subcounty	76	71	3602	3.7%	134	117.4	16.2	12.2%
Mid-West	Kyegegwa	Kakabara/ Gasani Towns	107	52	3478	15.3%	532	135.5	396.6	74.5%
Mid-West	Kyegegwa	Karwenyi/Izina Town Council	145	130	13665	10.0%	1373	107.2	1265.7	92.2%
Mid-West	Kyegegwa	Kazinga/Kyerisho Town Council	125	110	10630	11.9%	1267	132.5	1134.9	89.5%

Region	District	PPA Name	Number of PLACE Venues in the PPA	Number of People Interviewed and Tested	Estimated Number at Venues During One Week	HIV Prevalence Among Those Tested	Estimated Number of People at Venues with HIV	Estimated Number Who Were Not Suppressed	Number Suppressed	Percentage Suppressed
Mid-West	Kyegegwa	Bujubuli Town	121	71	4349	0.7%	32	0.0	32.5	100.0%
Mid-West	Bunjangabu	Kibiito Town Council	98	97	5181	4.7%	243	119.6	123.6	50.8%
Mid-West	Bunjangabu	Kibiito Subcounty	146	104	4700	2.2%	103	31.0	72.1	70.0%
Mid-West	Bunjangabu	Rwiimi Town and Subcounty	106	55	6126	3.8%	235	0.0	235.3	100.0%
Mid-West	Bunjangabu	Rubona Town Council	67	80	1965	2.1%	42	23.3	18.8	44.6%
Mid-West	Bunjangabu	Kisomoro Market	129	110	8977	6.8%	606	70.3	535.6	88.4%
Mid-West	Bunjangabu	Kyamukube Town Council	74	111	6554	7.8%	513	87.6	425.6	82.9%
Mid-West	Kakumiro	Rutooma Town Council	40	44	1441	.	.	0.0	.	.
Mid-West	Kakumiro	Kakumiro/Kibikko Town Council	73	78	1705	3.8%	65	11.8	53.2	81.8%
Mid-West	Kakumiro	Katikara Subcounty	26	42	1288	6.9%	89	89.3	0.0	0.0%
Mid-West	Kakumiro	Kikoora Town Council	36	35	920	2.7%	25	24.8	0.0	0.0%
Mid-West	Kakumiro	Kisengwe Subcounty	71	108	2836	4.9%	139	106.4	32.5	23.4%
Mid-West	Kakumiro	Munsaana Town Council	24	70	1687	5.6%	95	62.0	33.0	34.7%
Mid-West	Kakumiro	Kisiita/Mpasaana Town Council	59	108	3416	2.2%	74	73.9	0.0	0.0%
Mid-West	Kakumiro	Igayaza Town Council	50	115	2778	6.2%	173	137.8	35.0	20.3%
South-West	Ntungamo	Rubaare Truck Stop	73	101	3138	2.6%	81	45.5	35.8	44.1%
South-West	Ntungamo	Rwentobo Town Council	66	51	1658	4.2%	69	34.5	34.6	50.1%
South-West	Ntungamo	Ntungamo Municipality	65	106	4002	5.0%	199	121.1	77.9	39.1%
South-West	Ntungamo	Kitwe Town Council	63	65	2226	1.7%	39	38.9	0.0	0.0%
South-West	Ntungamo	Ruhaama Trading Center	55	81	2267	3.9%	88	67.4	20.8	23.6%

Region	District	PPA Name	Number of PLACE Venues in the PPA	Number of People Interviewed and Tested	Estimated Number at Venues During One Week	HIV Prevalence Among Those Tested	Estimated Number of People at Venues with HIV	Estimated Number Who Were Not Suppressed	Number Suppressed	Percentage Suppressed
South-West	Ntungamo	Rwashamaire Town Council	69	50	1028	0.1%	1	1.0	0.0	0.0%
South-West	Ntungamo	Kibatsi Town	66	86	2705	3.7%	100	20.8	79.6	79.3%
South-West	Isingiro	Bugango Border Post	33	105	4262	6.3%	268	215.7	52.1	19.5%
South-West	Isingiro	Kikagate Boder Post	32	79	3287	9.2%	301	177.1	123.7	41.1%
South-West	Isingiro	Isingiro Town Council	33	96	2289	6.0%	137	52.1	85.2	62.1%
South-West	Isingiro	Sangano Refugee Camp	38	94	2737	2.4%	65	52.1	13.0	20.0%
South-West	Isingiro	Rugaaga Market	40	160	6024	3.8%	231	179.4	52.1	22.5%
South-West	Kiruhura	Rushere/ Nyakasharara Town Councils	114	118	3559	8.9%	318	242.2	75.6	23.8%
South-West	Kiruhura	Rurambira Fishing Community	68	42	1327	3.2%	42	26.8	15.3	36.4%
South-West	Kiruhura	Kageti/Sanga Town Councils	90	108	4297	7.2%	308	168.4	139.8	45.4%
South-West	Kiruhura	Nkungu/Burunga Markets	63	50	2356	6.3%	148	94.0	53.6	36.3%
South-West	Kiruhura	Kazo Town Council	56	42	1630	3.6%	58	58.2	0.0	0.0%
South-West	Kiruhura	Kinoni Subcounty	60	84	4530	6.0%	272	96.5	175.8	64.6%
South-West	Kiruhura	Kikatsi Cattle Market	104	84	8740	7.3%	637	453.6	183.3	28.8%

APPENDIX B. SAS CODE AND OUTPUT

The following is the SAS code used to generate the estimates shown in Appendix A.

```
proc genmod data = all2;

model totalnotsuppressed = highreg onlake/*onborder*/city_municipality notmainorsecondaryroad
        / link=log dist=poisson
        offset=logsize ;
        estimate "results_high" highreg1/ exp;
        estimate "results_onlake" onlake1/ exp;
        estimate "results_city_municipality" city_municipality1/ exp;
        estimate "results_notmainorsecondaryroad" notmainorsecondaryroad1/ exp;

output out=predicted_countsHIGH p=predicted;
        /*exact onborder onlake / joint estimate;*/
run;

data predicted_countsHIGH_p; set predicted_countsHIGH;where pred = 1; prop = predicted/10000; run;

proc means data = predicted_countsHIGH_p nway; class highreg onlake city_municipality
        notmainorsecondaryroad;
        var prop; output out = scorebyvar mean = score; run;

data predicted_countsHIGH_obs; set predicted_countsHIGH; where pred ne 1; prop = predicted/totalsize;
run;
*output number following each combo ;

ods csv file = "C:\Users\sweir\OneDrive - University of North Carolina at Chapel Hill\D

Drive\Scorecard\score.csv";

proc print data = scorebyvar; run;
proc means data = predicted_countsHIGH_obs nway; class highreg onlake city_municipality
notmainorsecondaryroad; var prop; output out = scorebyvar mean = score; run;

ods csv close;
```

Algorithm converged.

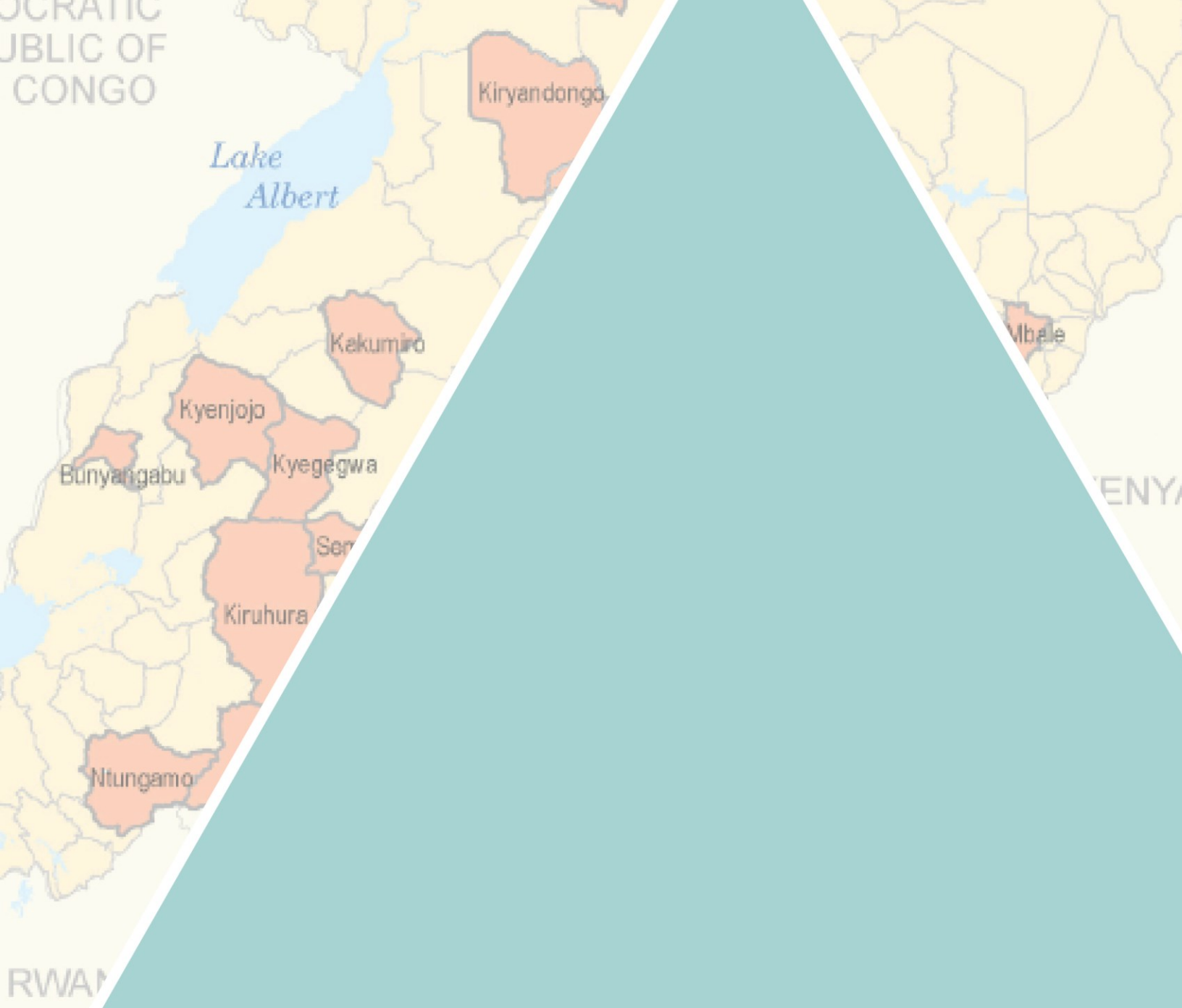
Analysis of Maximum Likelihood Parameter Estimates

Parameter	DF	Estimate	Standard Error	Wald 95% Confidence Limits		Wald Chi-Square	Pr > ChiSq
Intercept	1	-4.0536	0.0170	-4.0870	-4.0202	56618.1	<.0001
highreg	1	0.3122	0.0172	0.2785	0.3459	329.65	<.0001
onlake	1	0.1575	0.0208	0.1166	0.1983	57.06	<.0001
city_municipality	1	0.8387	0.0258	0.7881	0.8894	1053.44	<.0001
notmainorsecondaryro	1	0.0253	0.0164	-0.0069	0.0575	2.37	0.1236
Scale	0	1.0000	0.0000	1.0000	1.0000		

Note: The scale parameter was held fixed.

Contrast Estimate Results

Label	Mean Estimate	Mean Confidence Limits		L'Beta Estimate	Standard Error	Alpha	L'Beta Confidence Limits		Chi-Square	Pr > ChiSq
results_high	1.3664	1.3212	1.4133	0.3122	0.0172	0.05	0.2785	0.3459	329.65	<.0001
Exp(results_high)				1.3664	0.0235	0.05	1.3212	1.4133		
results_onlake	1.1705	1.1237	1.2193	0.1575	0.0208	0.05	0.1166	0.1983	57.06	<.0001
Exp(results_onlake)				1.1705	0.0244	0.05	1.1237	1.2193		
results_city_municipality	2.3134	2.1992	2.4336	0.8387	0.0258	0.05	0.7881	0.8894	1053.4	<.0001
Exp(results_city_municipality)				2.3134	0.0598	0.05	2.1992	2.4336		
results_notmainorsecondaryroad	1.0256	0.9931	1.0591	0.0253	0.0164	0.05	-0.0069	0.0575	2.37	0.1236
Exp(results_notmainorsecondaryroad)				1.0256	0.0168	0.05	0.9931	1.0591		



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