**Characterizing national denominators to represent key population program targets.**

A review and synthesis of published and unpublished key populations (KP) literature in Zambia was conducted to obtain direct population size estimates for female sex workers (FSW), gay men and other men who have sex with men (MSM), and transgender persons (TG). Direct size estimates obtained using multiplier methods (e.g., capture recapture, unique object, social event), stakeholder consensus (e.g., wisdom of the masses, expert opinion), and successive sampling population size estimation (SS-PSE) were used to generate proportions and predict indirect population size estimates for each KP. Updated data from a 2021 BBS were included in extrapolations, specifically MSM size estimates using SS-PSE and three-source capture recapture. Additionally, the following program data were used to assess key HIV indicators, including KP\_PREV and HTS\_TST (HTS\_TST\_POS and HTS\_TST\_NEG): (1) initial cut of data from DATIM (as of December 2021), USAID Open Doors program data (FY20), and Centers for Disease Control and Prevention program data (FY21).

To generate district-level FSW proportions, direct size estimates were divided by the total population of women 18 and older. Predicted proportions for FSW were generated using candidate linear regression models that included HIV prevalence and population density as covariates. The best fitting model was obtained using results from three model fit diagnostics: adjusted R-squared, leave one out cross validation (LOOCV) root mean squared error and mean absolute error. The best fitting model included HIV prevalence (among women) as a district-level covariate. Because the 95% confidence intervals for the predicted proportions were imprecise, additional linear regression models were fit to the lower and upper bound of the direct estimates allowing for a range of plausible size estimates for each district. Predicted proportions were multiplied by the overall number of women aged 15-49 and 15+ in each district to generate the size of FSW in Zambia. The district level estimates were extrapolated to provincial level estimates by averaging the district-level proportions for each province.

For MSM, proportions were generated by dividing the district-level direct estimates from the 2021 BBS by the total population of men 15-49 years. Predicted proportions were generated using simple and stratified imputation methods. For simple imputation, a constant average proportion was applied to all districts. For the stratified imputation, strata of population density of greater than or equal to 100/km2  and less than 100/km2  were generated and the average proportions in these strata were applied to the districts that belonged to the two categories. Size estimates for MSM were generated by multiplying the proportions by the overall population number of men aged 15-49 and 15+. The district level estimates were extrapolated to provincial level estimates by applying the summed estimates for MSM.

To generate district-level TG proportions, direct size estimates were divided by the total number of men and women 18 and older in the different districts to generate a proportion. Predicted proportions for TG were then imputed and applied to the total population aged 15-49 and 15+ in each district. For simple imputation, a constant average proportion was applied to all districts. In parallel with FSW estimates, the district level estimates for TG were extrapolated to provincial level estimates by averaging the district-level proportions for each province.

Results for the small area estimation of population sizes for FSW, MSM, and TG are presented in the accompanying MS Excel spreadsheets. The predicted proportion of FSW ranged from 3.2% in Lupoposhi and 1.07% in Mongu. The total number of FSW among women aged 15-49 in Zambia was estimated to be **81,539 (69,710-121,080**). The estimated sizes in districts ranged from 88 in Mwandi to 9,318 in Lusaka. Among women 15+, the total number of FSW was estimated to be **96,177 (82,336-142,726**). The estimated size in districts ranged from 113 in Mwandi to 10,262 in Lusaka.

The predicted proportion of MSM using simple imputation was 2.31% (1.50%-7.18%). The total number of MSM among men aged 15-49 was **107,318 (69,551-333,435)**. The size in the districts ranged from 160 in Ngabwe to 16,923 in Lusaka. The size of MSM among men aged 15+ **124,728 (80,834-387,528).** The size of MSM aged 15+ in the districts ranged from 196 in Ngabwe to 18,610 in Lusaka. For stratified imputation, the predicted proportion among districts with population density < 100/km2 was 3.02% (1.98%-18.57%) and the predicted proportion among districts with population density >= 100/km2 was 2.07% (1.34%-3.38%). The total number of MSM among men aged 15-49 was estimated to be **126,272 (82,321-637,642),** ranging from 210 in Ngabwe to 15,190 in Lusaka while among men aged 15+, the total number of MSM was estimated to be **147,243 (96,004-748,896)**, ranging from 256 in Ngabwe to 16,704 in Lusaka.

The predicted proportion of TG was 0.08% (0.06%-0.10%). The total number of TG persons among all persons aged 15-49 was estimated to be **7,687 (5,578-9,796)**, ranging from 11 in Ngabwe to 1,200 in Luska. Among all persons aged 15+ the total number of TG persons was estimated to be **8,975 (6,513-11,438),** ranging from 14 in Ngabwe to 1,320 in Lusaka.

These estimates may serve as a minimum benchmark for denominators for service provisions and resource allocations particularly in areas where no direct estimates exist for KP until underlying data collection processes to generate better direct size estimates are strengthened.