Estimating the size of populations at risk of acquiring HIV in settings with high HIV incidence

A User's Guide to the 'SHIPP Tool' for Population Size Estimation

February 2024

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Part I. Introduction

1. Purpose of the User Guide

This User Guide was created to assist national and district-level HIV programmers in estimating the size of populations at different levels of HIV risk. The Guide accompanies a newly-developed Excel-based tool that offers an easy-to-use approach to generate population size estimates that reflect both background HIV incidence and reported behavioural risk for males and females aged 15 to 49 years. By linking district-level estimates on HIV incidence and behavioural data for the first time, the new Sub-national HIV Estimates in Priority Populations tool (the 'SHIPP Tool') can be used to prioritise districts and sub-populations for HIV prevention programmes and to ensure such programmes are adequately resourced and tailored to the local risk composition.

The UNAIDS Global AIDS Strategy 2021-2026 sets prevention targets based on a combination of age, sex, location and behavioural factors, as does the UNAIDS 2016 Guidance on HIV Prevention among Adolescent Girls and Young Women. The SHIPP Tool provides HIV risk and population size estimates disaggregated by these 4 factors – age, sex, location and sexual behaviour categories – to enable detailed HIV prevention planning. As shown in Figure 1, analyses by Howes et al[1] demonstrate there is efficiency gained from using a risk-stratification approach. Specifically, going beyond geographic prioritisation, to further stratify by behavioural risk, can help to reduce the numbers needed to reach by about ten percentage points, for example, reaching 5% rather than 15% of 15-24yr-old females in order to find half the new cases of HIV in a country.

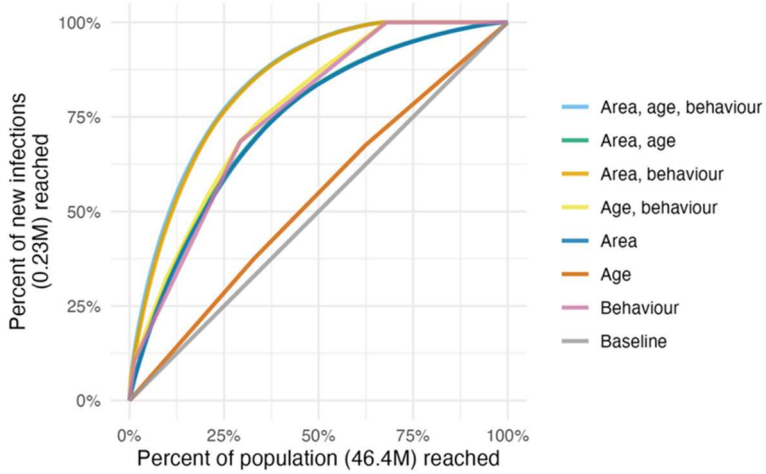


Figure 1. Percentage of new infections reached across all 13 countries, taking a variety of risk stratification approaches, against the percentage of at-risk population required to be reached [Source: Howes et al 2023]

[1] Howes et al., 2023. Spatio-temporal estimates of HIV risk group proportions for AGYW across 13 countries. *PLOS Global Public Health.*

The estimates in the SHIPP Tool can serve as denominators for the number of people who should receive differentiated HIV prevention packages (by this we mean combination prevention packages that are differentiated by level of risk). For example, by estimating the numbers of adolescent girls and young women aged 15-19, 20-24, and 25-29 years in each sexual behavioural category, within each district, country teams can allocate HIV prevention packages and resources, targeting the geographical areas with the largest numbers of young women in high-risk categories. This information can also help HIV prevention programmers determine how they will distribute service packages both geographically and by behavioural risk, guided by the UNAIDS 2020 *Decision-making Aide for Investments into HIV Prevention Programmes among Adolescent Girls and Young Women*.

To aid this process, this User's Guide will demonstrate and explain each step required to produce district-level differentiated risk estimates and to interpret the results and implications for delivering appropriate HIV prevention packages to those who need them most.

While the SHIPP Tool helps to estimate the size of priority populations for HIV prevention, and identifies where such groups are concentrated, it does not provide the means by which individuals in different behavioural risk categories can be identified. Various strategies for reaching such priority populations are discussed at the end of this Guide.

Short Summary: What is the SHIPP Tool?

The SHIPP Tool was developed by UNAIDS and partners to better understand HIV incidence of priority groups at sub-national level. The Tool disaggregates HIV incidence and population sizes by age group, sex, location and sexual behaviour risk. The tool distinguishes four sexual behaviour categories:

Not sexually active
Sexually active, one cohabiting partner
Non-regular sexual partner(s)
Key populations

The SHIPP Tool draws from a combination of survey data and mathematical model outputs from 34 countries in eastern and southern Africa, specifically: Angola, Benin, Burundi, Burkina Faso, Botswana, Cameroon, Central African Republic, Chad, Congo, Cote d'Ivoire, Democratic Republic of the Congo, Eswatini, Ethiopia, Gabon, Ghana, Guinea, Gambia, Kenya, Lesotho, Liberia, Malawi, Mali, Mozambique, Namibia, Niger, Rwanda, Senegal, Sierra Leone, South Africa, Tanzania, Togo, Uganda, Zambia and Zimbabwe.

The Tool is pre-populated with the latest Spectrum and Naomi estimates and uses estimates of the prevalence of behaviours from the most recent Demographic Health Surveys (DHS) and/or AIDS Indicator Surveys and/or Population-based HIV Impact Assessment (PHIA) surveys in each country (by district and age group). In the case of the Democratic Republic of Congo, the most recent Multiple Cluster Indicator Survey (MICS) has been used.

UNAIDS will update the tool as part of the annual HIV estimates process that starts every October. For questions, please send an email to: estimates@unaids.org

2. Who is this User Guide for?

This User Guide (the 'Guide', for short) is intended for users of the Excel-based Population Size Estimation tool. This includes experts in HIV strategic information, programme managers, service providers and policy makers involved in planning for HIV prevention within their respective countries and districts.

In using the SHIPP Tool and Guide together, programme managers and strategic information experts will be able to produce, analyze and use population size estimates to plan HIV prevention programmes. This can help teams to align country programming efforts with global targets and guidance. Also, those involved in reporting and monitoring coverage of priority populations with intensified support may be able to leverage the population estimates in tracking implementation, although the estimates produced can only be taken as indicative denominators rather than exact figures. (Users should be aware of the limitations of the SHIPP Tool and the estimates it generates, and limitations are discussed below in Section 10.)

3. Data Inputs: What are the data sources used in the population size estimation tool?

The SHIPP Tool is pre-populated with relevant data for the following 34 Global Fund priority countries:

- Angola
- Benin
- Botswana
- Burundi
- Burkina Faso
- Cameroon
- Central African Republic
- Chad
- Congo
- Cote d'Ivoire
- DRC
- eSwatini
- Ethiopia
- Gabon
- Ghana
- Guinea
- Gambia
- Kenya
- Lesotho
- Liberia
- Malawi
- Mali
- Mozambique
- Namibia
- Niger
- Rwanda
- Senegal
- Sierra Leone
- South Africa
- Tanzania
- Togo
- Uganda
- Zambia
- Zimbabwe

The population size estimates in the SHIPP Tool are generated from a combination of survey data and statistical model outputs. A complete list of all the datasets used to generate the population size estimates in the Tool is provided in the Excel booklet itself, and a brief summary follows here.

For estimates of HIV incidence at a district level by age (in 5-year age bands), the SHIPP Tool draws on the Naomi small-area estimation model[2]. Background HIV incidence in each district is classified into the following four levels – "low", "moderate", "high" and "very high" – as specified in the Global AIDS Strategy 2021-2026 and shown in Table 1. In the Naomi model, population estimates by sex and age group are drawn from district population projections produced by national statistical offices, household censuses, or global population data products such as the Gridded Population of the World or the WorldPop projects.

[2] https://onlinelibrary.wiley.com/doi/10.1002/jia2.25788

Table 1: HIV incidence categories defined in the Global AIDS Strategy 2021-2026

District-level HIV incidence	
HIV incidence rate (annual cases per 100 person-years)	**HIV incidence category thresholds**
< 0.3	Low
0.3-0.9	Moderate
1.0-2.9	High
>3.0	Very High

The HIV-related behavioural risk categories employed by the model in the SHIPP Tool are based on sexual behaviour and relationship status and are listed in Table 2. They follow the logic of targets in the Global AIDS Strategy 2021-2026, which distinguish low and high-risk sexual behaviour and, in addition, five key populations[3]. For the first three categories, the SHIPP Tool estimates the prevalence of these behaviours using geospatial data (survey cluster locations) from large-scale population-based surveys such as the Demographic Health Surveys (DHS) and/or AIDS Indicator Surveys and/or Population-based HIV Impact Assessment (PHIA) surveys and/or Multiple Indicator Cluster Surveys (MICS) in each country, to fit spatially smoothed district-level models (see Annex 1 for further details). Men and women's behavioural data are fitted separately.

Table 2: Categories of risk in relation to sexual behaviour and key populations

Sexual behaviour categories	Behavioural risk definition
No sexual risk	Not sexually active. (respondent reports no sex in the past 12 months).
One cohabiting partner	Sexually active with one cohabiting partner (one regular partner). (respondent reports sex with one marital or cohabiting partner in the past 12 months)
Non-regular sexual partner/s	Sexually active with at least one non-regular sexual partner (non-cohabiting, non-marital) or two or more partners (of any type). (respondent reports sex with at least one non-regular partner [neither marital nor cohabiting] or 2+ sexual partners [any partner type] in the past 12 months).
Key populations	
Females	Women who sell sex. (further details below).
Males	Gay men and other men who have sex with men. Men who use injection drugs. (further details below).

Estimates in the highest-risk behavioural categories for 'key populations' are derived from an existing small-area estimation model4, which outputs population size proportions and HIV prevalence estimates for female sex workers (FSWs), men who have sex with men (MSM) and

[3] UNAIDS considers **gay men and other men who have sex with men, sex workers, transgender people, people who inject drugs, and prisoners and other incarcerated people** as the five main key population groups that are particularly vulnerable to HIV and frequently lack adequate access to services. https://www.unaids.org/en/topic/key-populations

[4] Stevens O, Sabin K, Anderson R, Garcia SA, Willis K, Rao A, et al. Population size, HIV prevalence, and antiretroviral therapy coverage among key populations in sub-Saharan Africa: collation and synthesis of survey data 2010-2023. medRxiv. 2023:2022.07.27.22278071.

people who inject drugs (PWID). Briefly, this approach synthesized all available KP data and matched the geography by name and corresponding population (i.e. women for FSW, men for MSM and PWID) and fits a small-area estimation model to this data. The KP model assumes that rural KP population size estimates are approximately 60% that of urban KP estimates. The approach fits a second small-area estimation model to estimate HIV prevalence in KPs using age-location-year matched HIV prevalence estimates in the general population to predict HIV prevalence in KPs. KP estimates are at the admin-1 level and assumed to be uniform across all districts within an admin-1 unit. Note that admin-1 can vary by country and can refer to "province", "district", "municipality" or "county".

Table 3 summarises the risk ratio used in the SHIPP Tool to estimate HIV incidence for each behavioural group. The HIV risk for those who have non regular partner/s and those among the key population categories is relative to the group reporting one regular sex partner in the past 12 months.

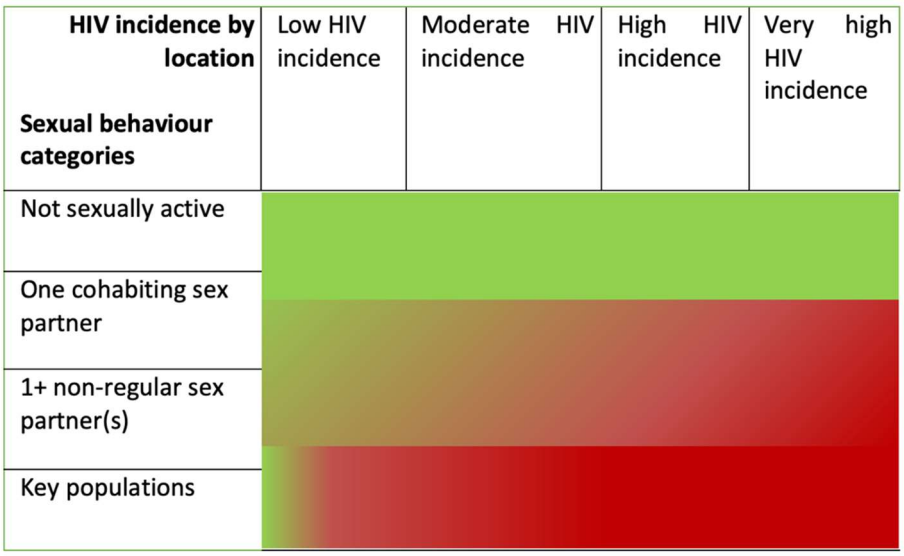
Table 3. Risk ratios used to estimate HIV incidence for each behavioural risk group

Sexual behaviour category	**HIV risk ratio used to generate HIV incidence estimates** (relative to the reference category)	
Not sexually active	0	
Sexually active with 1 cohabiting partner	1 (Reference category)	
Sexually active with non-regular sexual partner(s)	Females* 1.72 (15-24 yrs) 2.10 (25-49 yrs)	Males* 1.89 (15-24 yrs) 2.10(25-49 yrs)
Females in key populations - Women who sell sex **	**District-level HIV incidence^**	**HIV risk ratio ±** (relative to 'Low risk' group above)
	3.0%+	3
	1.0-2.99%	4
	0.3-0.99%	7
	0.1-0.3%	11
	<0.1%	17
Males in key populations - Men who have sex with men - Men who inject drugs ^^	2.5-250 (MSM) 2.5-55 (MWID)	

** These relative risk assumptions are based on analyses of risk factors for incident HIV infection from studies in sub-Saharan Africa by Slaymaker et al CROI 2020; Jia et al JIAS 2022; Ssempijja et al JAIDS 2022; Hoffman et al JAIDS 2022*
^ These HIV incidence categories are drawn from the UNAIDS Global AIDS Strategy 2021-2026
± See Annex 1 (Frequently Asked Questions) for more information on the relationship between HIV risk and district-level HIV incidence for female sex workers. Values are interpolated between these points for a smooth non-linear relationship between population-level incidence and risk ratio.
*** The relative risk assumptions for women in key populations are from an analysis by Jones & Anderson et al medRxiv (https://www.medrxiv.org/content/10.1101/2023.10.17.23297108v2.full.pdf)*
^^The relative risk assumptions for men in key populations are from Stevens et al medRxiv (Admin 1 KP prevalence estimates relative to general population prevalence) and Stannah et al medRxiv 2022 (systematic review & meta regression)

Figure 2 illustrates the relationship between behavioural risk categories and HIV incidence levels by location. The colour coding is illustrative of how HIV incidence is expected to be distributed with green representing no or very low HIV incidence and red very high HIV incidence. It shows that the same sexual behaviours (like having multiple sexual partners) do not confer the same risk of HIV infection everywhere. Rather, as the background level of HIV incidence increases, the risk of HIV infection associated with sexual behaviours also increases.

Figure 2: Combining HIV incidence estimates by location and behavioural factors



By considering HIV incidence disaggregated by age, sex, geography and behaviour, the tool mirrors the detailed HIV prevention targets in the Global AIDS Strategy. It is also important to interpret risk in the context of social and economic vulnerabilities and inequalities, particularly those shown to increase HIV risk. As the estimation Tool expands in successive versions, some 'structural' factors (such as education level, orphan status, early marriage) can be incorporated into the estimates for further granularity. Until then, locally available data can be considered alongside the spreadsheet estimates. Considering structural vulnerabilities is further addressed in Section 9 and Annex 1.

ACTIVITY:

Try this quiz[5] to test your learning from Part 1. (To play the interactive quiz, you will be prompted to login or sign up for a free Kahoot account)

For deeper understanding of the data sources and models used to generate the SHIPP Tool estimates, please see Annex 1 for Frequently Asked Questions. Also, a slide deck on the model development is available on the UNAIDS HIV Tools website, here: https://hivtools.unaids.org/

[5] If the link above does not work, copy and paste this pathway onto your internet browser: https://create.kahoot.it/share/pse-tool-quiz-data- inputs/ed19b5f7-1789-4ed3-90be-52adef0fb08a

Part II. How to use the population size estimation tool

4. Getting prepared

For the best use of the SHIPP Tool, it is advisable to form a working group that will generate and review the estimates and discuss interpretation and implications. Alternatively, an existing group may be well placed to guide this work. The working group can set out in advance:

- The specific aims for using the SHIPP Tool in your context, e.g., to identify the geographic areas with the largest priority populations and allocate resources proportionally to offer differentiated HIV prevention packages
- The estimates and visual outputs that will be most useful to achieve your aims
- The process and timeline for reviewing and interpreting the estimates
- How the estimates will be used to inform decisions and responsibilities in your setting

The working group should ideally consist of a mix of stakeholders including strategic information experts, prevention programme managers, service providers, government technical leads, civil society, community and academia.

5. Data Outputs: What estimates does the SHIPP Tool produce?

The spreadsheet generates two types of estimates: population sizes and new HIV infections expressed both as a number (of new cases) and an HIV incidence rate (new cases per 100 person-years). These are presented by age, sex, place and the behavioural risk categories listed in Table 2 above (the '4D' disaggregation). More specifically, the Tool produces population size and HIV incidence estimates separately for females and males aged 15-49 years (in 5-year age bands), and further disaggregated by behavioural risk categories both nationally and by district.

These estimates are organised as follows:

- **Population size** with the size of population sub-groups presented as a *number (n; population size)* of HIV-negative individuals and as *a proportion (%)* of the total population
- Estimated **new HIV infections** as the *number (n) of new HIV cases* per year and the *proportion* these new cases contribute to all new infections per year in a given group.
- The annual **HIV incidence rate** (*new HIV infections* per 100 person-years) estimated for sub-group. These cells are colour-coded as follows to reflect categories of HIV incidence:
  - green for no new HIV cases
  - pale green for a low incidence rate (<0.3 per 100py)
  - yellow for moderate incidence (0.3-0.99 per 100py)
  - pink for high incidence (1-2.99 per 100py)
  - dark orange for a very high incidence rate (>=3 per 100py)
- The **total population estimates per HIV incidence category.** This combines the above population size and HIV incidence estimates to calculate the approximate number of people in each HIV risk category. These estimates can be used as **denominators** or the number in need of prevention packages based on their HIV risk category.

These outputs are explained further and demonstrated in the next section (Step-by-step approach). Note that cells will say "N/A" when there are no data available to produce the required estimates. The 'Information' comment will say "Value Not Available Error".

6. Step-by-step approach to generate outputs

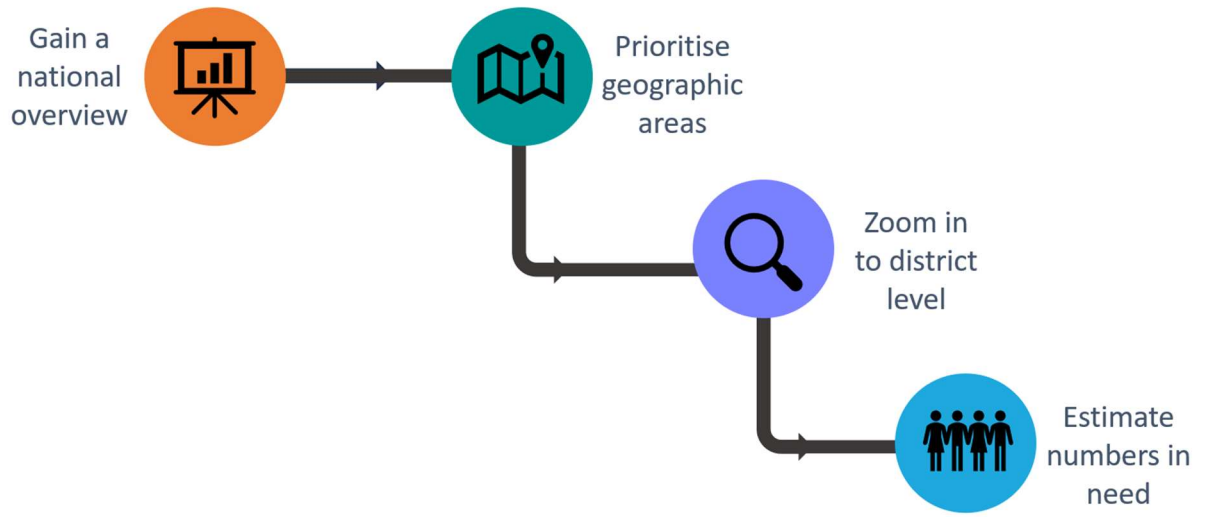
First: Download and familiarize yourself with the SHIPP Tool spreadsheet

The SHIPP Tool, version 28 December 2023, can be downloaded from the UNAIDS HIV Tools website here https://hivtools.unaids.org The full tool with all countries is approximately 70MB.

After opening the Tool, you can use the tabs running along the bottom to navigate. The first tab, entitled 'Category descriptions' includes helpful reminders of the definitions and categories used throughout the Tool. This includes the thresholds for HIV incidence levels, definitions of sexual behaviour risk categories and the HIV risk ratios applied to different behavioural groups. The second tab, 'Model Inputs' includes the latest quarter and year of Naomi estimates and the latest surveys used for sexual behaviour estimates for each country.

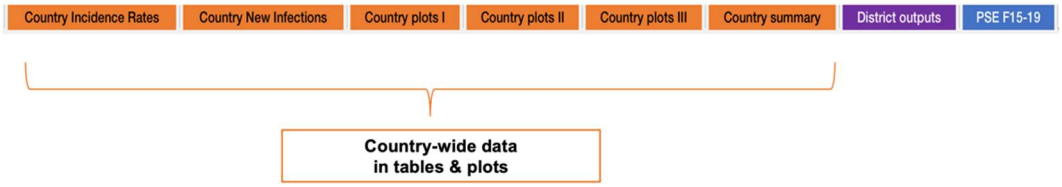
Users can scan through each tab to view how the data are organised in the Tool. Here, we suggest a user pathway that can help users explore the main features and estimates generated by the Tool. It is not the only way to interact with the Tool but it is a useful way to become acquainted with the Tool, its features, and how they can help you make priorities for HIV prevention programming. We include some hands-on exercises to demonstrate the features, so it is a good idea to have the SHIPP Tool open as you use this Guide.

A user pathway to explore and apply the SHIPP Tool features and estimates



Step 1: Gain a national overview of HIV risk composition in your country

The first series of orange tabs summarise data at the national level, in a variety of ways.



The first two orange tabs offer a complete summary of HIV infections for all districts in a country. Specifically, they summarise HIV incidence rates and new HIV infections, respectively, by sex, age group, and behavioural group, across all districts. These tabs are useful for scanning all data in a country to identify patterns (by age, sex, behaviour) and hotspots (by district). You can start to see which sub-populations experience the highest HIV rates and infections, and in which districts.

All sheets are protected in the workbook. To unprotect them, go to the 'Review' option on the Excel menu and select 'unprotect sheet'. When prompted, type in the password psetool2023.

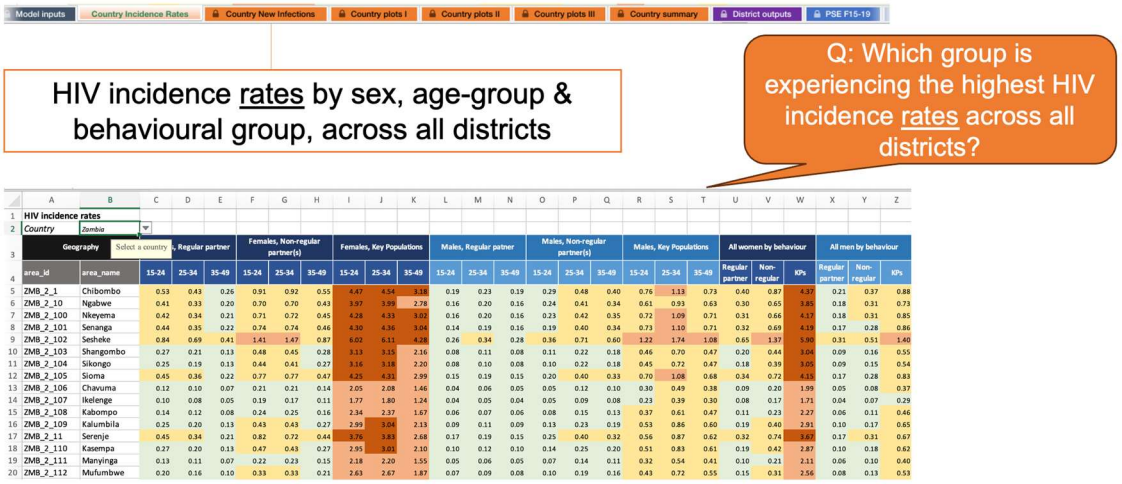
Try this yourself with the Country Incidence Rates tab

In cell B2, use the pull-down menu to select the country of your choice. The spreadsheet will automatically populate with HIV incidence rates. Each row summarises data for one district (or another sub-national unit like 'county', as applicable). Along the columns, HIV incidence rates are summarised separately by sex (females and males), sexual behaviour groups, and age group (15-24, 25-34, 35-49). The cells are colour-coded to reflect categories of HIV incidence, as summarised in this table.

Colour coding used for HIV incidence categories
No HIV risk
Low HIV incidence: <0.3
Moderate HIV incidence: 0.3 - 0.99
High HIV incidence: 1.0 - 2.99
Very high: 3.0 +

Scan the HIV incidence rates to identify patterns, for example:

- Which population groups experience the highest HIV incidence rates across most districts?
- How would you report the highest HIV incidence rate you see?
- Which groups experience the lowest HIV incidence rates?
- Which district experiences the highest HIV incidence rates, across most sub-groups?
- Select another country and see how patterns differ.

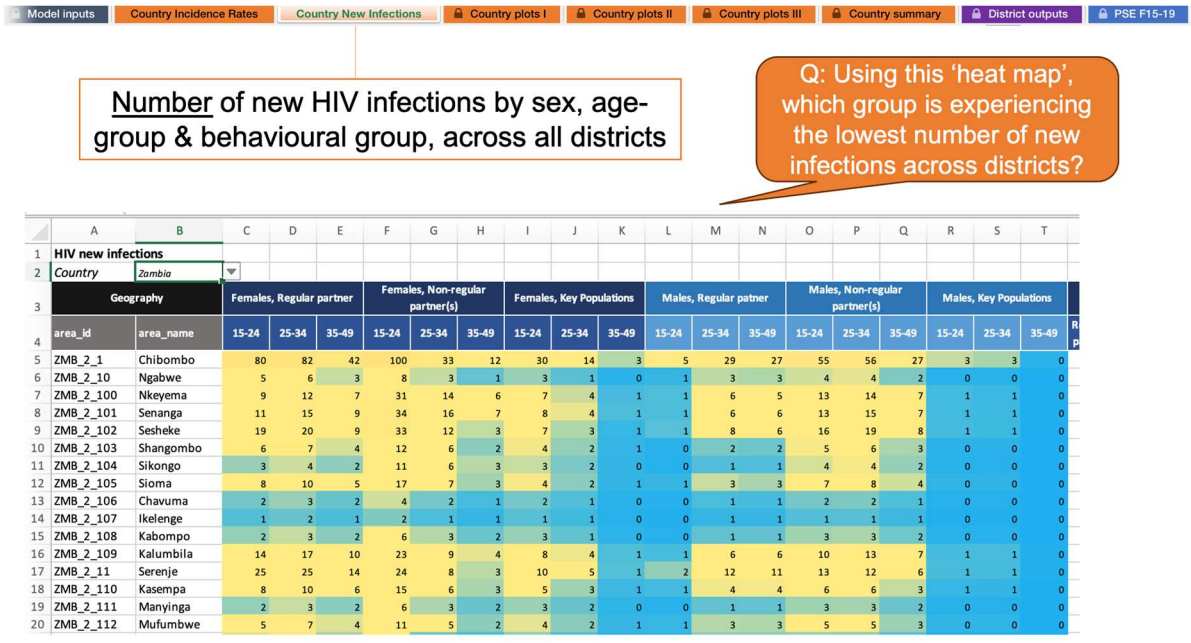


Try this yourself with the Country New Infections tab

In cell B2, use the pull-down menu to select the country of your choice. The spreadsheet will automatically populate with estimated numbers of new HIV infections. The table is colour-coded with a 'heat map' in which cells with the highest numbers have a 'warm' colour like orange and red while cells with the lowest numbers have a 'cold' colour like blue.

Scan the numbers to identify patterns, for example:

- Which population groups experience the highest number of new infections?
- Which groups experience the lowest number of new infections?
- Which district experiences the highest numbers of new infections? And the lowest?
- Select another country and see how patterns differ.



The orange tab entitled 'Country plots I' presents a national summary of HIV incidence rates and new infections across all districts, averaged across the country,

Try this yourself with the Country plots I tab

First, select your country of choice by clicking on the large green box at the top, Row 1. A pull-down menu will appear next to this box; click on the menu to see a list of countries. Scroll through the list and select the country of your choice. Alternatively, type the country name directly into the green box.

Try this: use pull-down menu to select Zambia

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	**National population size estimation**					**Zambia**							
2		ZMB			Women's national HIV incidence	Select country	rate	ZMB			Men's national HIV incidence level:		Low
4		Adolescent girls and women by level of HIV risk						Adolescent boys and men by level of HIV risk					
5		No sex	One regular partner	Non-regular partner(s)	KPs	All	WLHIV	No sex	One regular partner	Non-regular partner(s)	KPs	All	MLHIV
6	**Population in % of total**												
7	15-49	26.8	53.4	18.4	1.3	100.0	13.9	29.8	37.2	37.5	0.9	100.0	7.7
8	15-24	42.8	31.4	24.0	1.8	100.0	4.3	51.2	7.4	41.0	1.1	100.0	2.2
9	25-49	13.3	72.0	13.7	1.0	100.0	20.6	11.7	62.4	34.6	0.7	100.0	11.5
10	15-19	60.5	14.0	23.8	1.6	100.0	2.5	67.3	0.6	31.0	0.9	100.0	1.7
11	20-24	20.9	52.9	24.3	1.9	100.0	6.5	31.3	15.9	53.3	1.5	100.0	2.9
12	25-34	11.1	72.0	15.6	1.3	100.0	15.6	12.9	54.6	40.4	1.1	100.0	6.3
13	35-49	15.9	72.0	11.5	0.5	100.0	25.7	10.3	71.6	27.7	0.2	100.0	16.9
14	**Population sizes**												
15	15-49	1,138,604	2,268,534	782,826	56,248	4,930,369	684,157	1,264,580	1,581,160	1,592,736	37,646	4,848,713	372,592
16	15-24	832,179	610,522	466,573	34,046	2,031,655	88,335	995,341	144,359	796,287	22,326	2,002,998	44,685
17	25-49	306,425	1,658,012	316,253	22,202	2,898,714	595,822	269,239	1,436,801	796,449	15,320	2,845,716	327,907
18	15-19	650,468	150,624	255,789	17,676	1,102,355	27,798	723,427	6,585	333,145	9,681	1,090,980	18,141
19	20-24	181,711	459,898	210,784	16,370	929,300	60,537	271,914	137,774	463,142	12,644	912,018	26,544
20	25-34	138,010	896,923	194,215	16,686	1,475,947	230,112	160,580	679,848	503,599	13,147	1,448,899	91,725
21	35-49	168,415	761,089	122,038	5,515	1,422,767	365,710	108,659	756,953	292,850	2,173	1,396,816	236,182
22	**Estimated annual new HIV infections**												
23	15-49	0	8,867	7,254	2,335	18,456	0	0	3,128	5,996	328	9,453	0
24	15-24	0	3,348	4,854	1,456	9,659	0	0	268	2,362	165	2,796	0
25	25-49	0	5,519	2,400	879	8,798	0	0	2,860	3,634	163	6,657	0
26	15-19	0	907	2,810	670	4,388	0	0	6	576	28	610	0
27	20-24	0	2,441	2,044	786	5,271	0	0	263	1,787	137	2,186	0
28	25-34	0	3,669	1,756	715	6,140	0	0	1,519	2,475	147	4,140	0
29	35-49	0	1,850	644	164	2,657	0	0	1,341	1,159	16	2,517	0
30	**Contribution to all new HIV infections in age group**												
31	15-49	-	48	39	13	100	-	-	33	63	3	100	-
32	15-24	-	35	50	15	100	-	-	10	84	6	100	-
33	25-49	-	63	27	10	100	-		43	55	2	100	
34	15-19	-	21	64	15	100	-	-	1	94	5	100	-
35	20-24	-	46	39	15	100	-	-	12	82	6	100	-
36	25-34	-	60	29	12	100	-	-	37	60	4	100	-
37	35-49	-	70	24	6	100	-		53	46	1	100	
38	**Estimated HIV incidence rates**												
39	15-49	0.00	0.39	0.93	4.15	0.43	0.00	0.00	0.20	0.38	0.87	0.21	0.00
40	15-24	0.00	0.55	1.04	4.28	0.50	0.00	0.00	0.19	0.30	0.74	0.14	0.00
41	25-49	0.00	0.33	0.76	3.96	0.38	0.00	0.00	0.20	0.46	1.06	0.26	0.00
42	15-19	0.00	0.60	1.10	3.79	0.41	0.00	0.00	0.09	0.17	0.29	0.06	0.00
43	20-24	0.00	0.53	0.97	4.80	0.61	0.00	0.00	0.19	0.39	1.08	0.25	0.00
44	25-34	0.00	0.41	0.90	4.28	0.49	0.00	0.00	0.22	0.49	1.12	0.31	0.00
45	35-49	0.00	0.24	0.53	2.97	0.25	0.00	0.00	0.18	0.40	0.74	0.22	0.00

In the above example, we have selected Zambia and the table automatically populates with the following estimates:

- The **population size** of each sub-group is presented as a proportion (%) of the total population [in Rows 7-13] and as a number (population size) [in Rows 15-21].
- **New HIV infections** are estimated as the number of new HIV cases per year [in Rows 23-29] and the proportion these new cases contribute to all new HIV infections per year [in Rows 31-37].
- The **annual HIV incidence rate** (new HIV infections per 100 person-years; PY) is estimated for sub-group [in Rows 39-45], where they are colour-coded to reflect the categories of HIV incidence described above.

Using the data for Zambia in Country plots I, try the following short and long exercises to become more familiar with the estimates.

Short exercise

Country Plots I

With Country Plots I, use national-level summaries to find:

1. Approximately how many **15-24yr females** are in Zambia?
   - Of those, approximately how many are living with HIV?
   - And approximately how many are HIV-negative?
2. Approximately how many **15-24yr males** are in Zambia?
   - Of those, approximately how many are living with HIV?
   - And approximately how many are HIV-negative?

Short exercise

Did you find the answers?

Country Plots I

With Country Plots I, use national-level summaries to find:

1. Approximately how many **15-24yr females** are in Zambia? 2,031,655
   - Of those, approximately how many are living with HIV? 88,335
   - And approximately how many are HIV-negative? 1,943,320

2. Approximately how many **15-24yr males** are in Zambia? 2,002,998
   - Of those, approximately how many are living with HIV? 44,685
   - And approximately how many are HIV-negative? 1,958,313

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	**National population size estimation**				**Zambia**								
2		ZMB			**Women's national HIV incidence level:** Select country		**ate**	ZMB			**Men's national HIV incidence level:**		**Low**
4		**Adolescent girls and women by level of HIV risk**						**Adolescent boys and men by level of HIV risk**					
5		**No sex**	**One regular partner**	**Non-regular partner(s)**	**KPs**	**All**	**WLHIV**	**No sex**	**One regular partner**	**Non-regular partner(s)**	**KPs**	**All**	**MLHIV**
6	**Population in % of total**												
7	15-49	26.8	53.4	18.4	1.3	100.0	13.9	29.8	37.2	37.5	0.9	100.0	7.7
8	15-24	42.8	31.4	24.0	1.8	100.0	4.3	51.2	7.4	41.0	1.1	100.0	2.2
9	25-49	13.3	72.0	13.7	1.0	100.0	20.6	11.7	62.4	34.6	0.7	100.0	11.5
10	15-19	60.5	14.0	23.8	1.6	100.0	2.5	67.3	0.6	31.0	0.9	100.0	1.7
11	20-24	20.9	52.9	24.3	1.9	100.0	6.5	31.3	15.9	53.3	1.5	100.0	2.9
12	25-34	11.1	72.0	15.6	1.3	100.0	15.6	12.9	54.6	40.4	1.1	100.0	6.3
13	35-49	15.9	72.0	11.5	0.5	100.0	25.7	10.3	71.6	27.7	0.2	100.0	16.9
14	**Population sizes**												
15	15-49	1,138,604	2,268,534	782,826	56,248	4,930,369	684,157	1,264,580	1,581,160	1,592,736	37,646	4,848,713	372,592
16	15-24	832,179	610,522	466,573	34,046	2,031,655	88,335	995,341	144,359	796,287	22,326	2,002,998	44,685
17	25-49	306,425	1,658,012	316,253	22,202	2,898,714	595,822	269,239	1,436,801	796,449	15,320	2,845,716	327,907
18	15-19	650,468	150,624	255,789	17,676	1,102,355	27,798	723,427	6,585	333,145	9,681	1,090,980	18,141
19	20-24	181,711	459,898	210,784	16,370	929,300	60,537	271,914	137,774	463,142	12,644	912,018	26,544
20	25-34	138,010	896,923	194,215	16,686	1,475,947	230,112	160,580	679,848	503,599	13,147	1,448,899	91,725
21	35-49	168,415	761,089	122,038	5,515	1,422,767	365,710	108,659	756,953	292,850	2,173	1,396,816	236,182
22	**Estimated annual new HIV infections**												
23	15-49	0	8,867	7,254	2,335	18,456	0	0	3,128	5,996	328	9,453	0
24	15-24	0	3,348	4,854	1,456	9,659	0	0	268	2,362	165	2,796	0
25	25-49	0	5,519	2,400	879	8,798	0	0	2,860	3,634	163	6,657	0
26	15-19	0	907	2,810	670	4,388	0	0	6	576	28	610	0
27	20-24	0	2,441	2,044	786	5,271	0	0	263	1,787	137	2,186	0
28	25-34	0	3,669	1,756	715	6,140	0	0	1,519	2,475	147	4,140	0
29	35-49	0	1,850	644	164	2,657	0	0	1,341	1,159	16	2,517	0

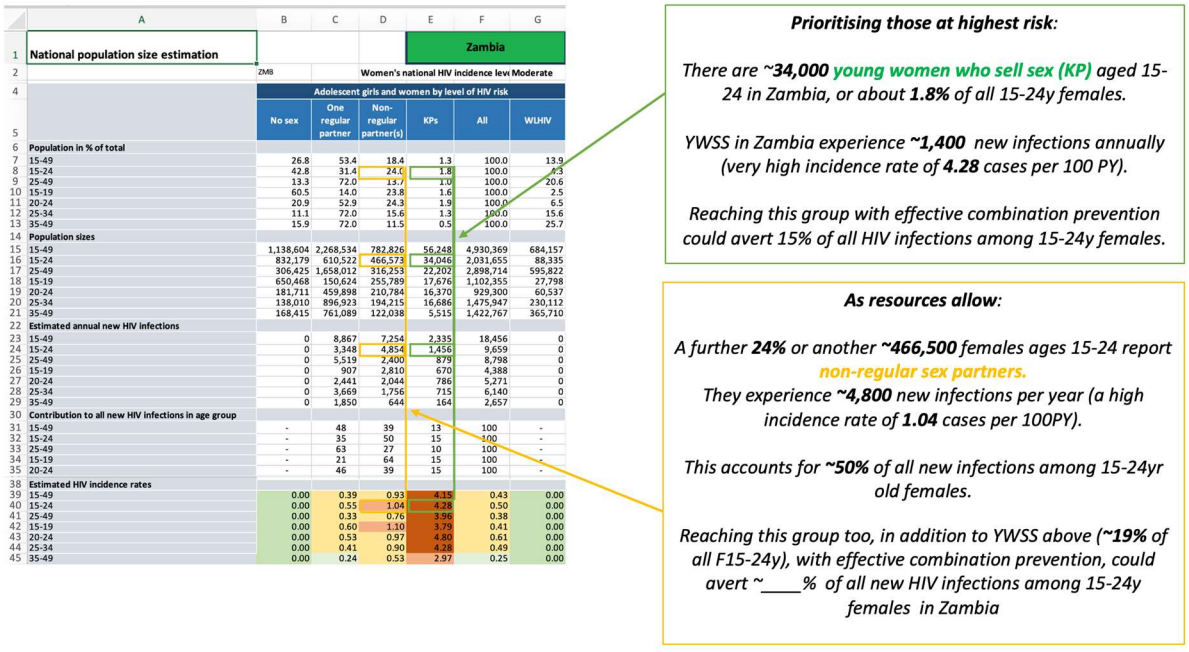
Longer exercise: Can you find these national level summaries…?

In Zambia, among 15-24 year-olds who are not living with HIV	Females (N=1,943,320)	Males (N=1,958,313)
What is the estimated HIV incidence rate? And how could you classify this level of HIV risk?		
What proportion of the population (of HIV-negative 15-24yr olds) are in the '**key population**' group?		
What is the HIV incidence rate among females in key population groups?		
What proportion of all new HIV infections among 15-24 yr-old females are among key populations?		
What proportion of the population report a '**non-regular sexual partner**'?		
What is the HIV incidence rate among females with non-regular sexual partner(s)?		
Which behavioural group accounts for the highest number of new HIV infections among 15-24 yr-olds? Why?		

Did you find the answers?

In Zambia, among 15-24 year-olds who are not living with HIV	Females (N=1,943,320)	Males (N=1,958,313)
What is the estimated HIV incidence rate? And how could you classify this level of HIV risk?	0.50 per 100PY 'moderate'	0.14 100PY 'low'
What proportion of the population (of HIV-negative 15-24yr olds) are in the '**key population**' group?	1.8% (FSW)	1.1% (MSM, MID)
What is the HIV incidence rate among females in key population groups?	4.28 per 100PY 'very high'	0.74 per 100PY 'moderate'
What proportion of all new HIV infections among 15-24 yr-old females are among key populations?	15%	6%
What proportion of the population report a '**non-regular sexual partner**'?	24%	41%
What is the HIV incidence rate among females with non-regular sexual partner(s)?	1.04 per 100PY 'high'	0.30 per 100PY 'low'
Which behavioural group accounts for the highest number of new HIV infections among 15-24 yr-olds? Why? *Larger population size for those with non-regular partners compared to young people KPs*	Non-regular partners (4,854)	Non-regular partners (2,362)

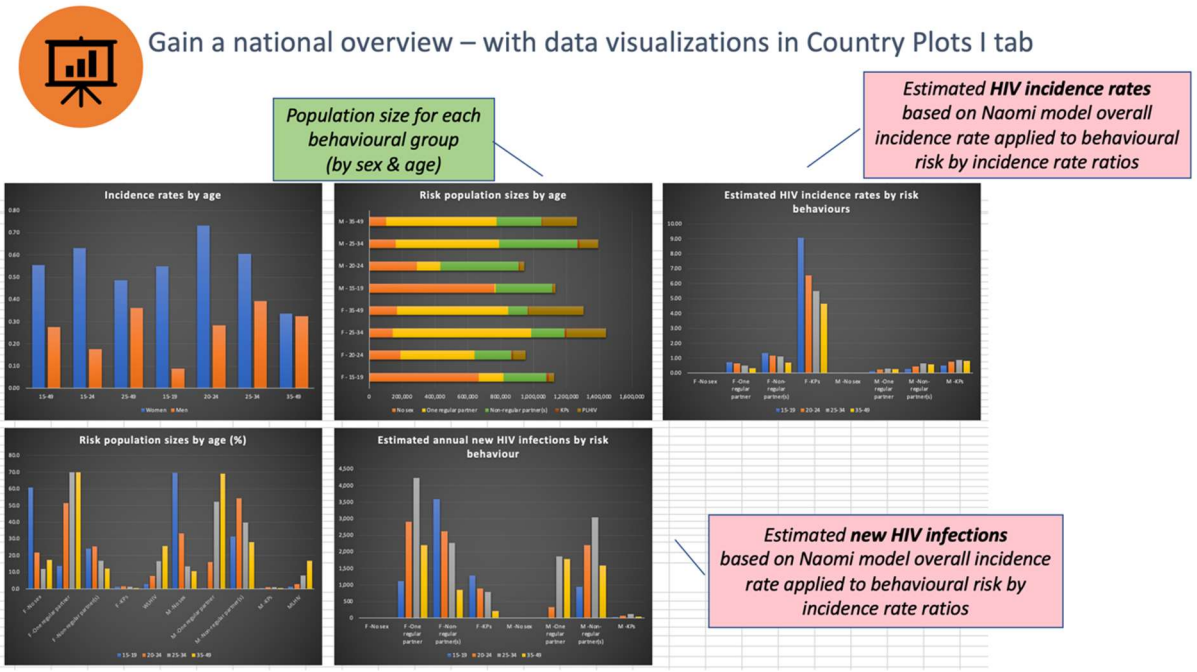
In the below example, we show how you can interpret these estimates and start to build a picture and narrative about the size of populations at highest HIV risk. See if you can fill in the blank at the end.



	A	B	C	D	E	F	G
1	National population size estimation				Zambia		
2		ZMB			Women's national HIV incidence level: Moderate		
4		Adolescent girls and women by level of HIV risk					
5		No sex	One regular partner	Non-regular partner(s)	KPs	All	WLHIV
6	Population in % of total						
7	15-49	26.8	53.4	18.4	1.3	100.0	13.9
8	15-24	42.8	31.4	24.0	1.8	100.0	6.3
9	25-49	13.3	72.0	13.7	1.0	100.0	20.6
10	15-19	60.5	14.0	23.8	1.6	100.0	2.5
11	20-24	20.9	52.9	24.3	1.9	100.0	6.5
12	25-34	11.1	72.0	15.6	1.3	100.0	15.6
13	35-49	15.9	72.0	11.5	0.5	100.0	25.7
14	Population sizes						
15	15-49	1,138,604	2,268,534	782,826	56,248	4,930,369	684,157
16	15-24	832,179	610,522	466,573	34,046	2,031,655	88,335
17	25-49	306,425	1,658,012	316,253	22,202	2,898,714	595,822
18	15-19	650,468	150,624	255,789	17,676	1,102,355	27,798
19	20-24	181,711	459,898	210,784	16,370	929,300	60,537
20	25-34	138,010	896,923	194,215	16,686	1,475,947	230,112
21	35-49	168,415	761,089	122,038	5,515	1,422,767	365,710
22	Estimated annual new HIV infections						
23	15-49	0	8,867	7,254	2,335	18,456	0
24	15-24	0	3,348	4,854	1,456	9,659	0
25	25-49	0	5,519	2,400	879	8,798	0
26	15-19	0	907	2,810	670	4,388	0
27	20-24	0	2,441	2,044	786	5,271	0
28	25-34	0	3,669	1,756	715	6,140	0
29	35-49	0	1,850	644	164	2,657	0
30	Contribution to all new HIV infections in age group						
31	15-49	-	48	39	13	100	-
32	15-24	-	35	50	15	100	-
33	25-49	-	63	27	10	100	-
34	15-19	-	21	64	15	100	-
35	20-24	-	46	39	15	100	-
38	Estimated HIV incidence rates						
39	15-49	0.00	0.39	0.93	4.15	0.43	0.00
40	15-24	0.00	0.55	1.04	4.28	0.50	0.00
41	25-49	0.00	0.33	0.76	3.96	0.38	0.00
42	15-19	0.00	0.60	1.10	3.79	0.41	0.00
43	20-24	0.00	0.53	0.97	4.80	0.61	0.00
44	25-34	0.00	0.41	0.90	4.28	0.49	0.00
45	35-49	0.00	0.24	0.53	2.97	0.25	0.00

The Country Plots I tab also presents estimates visually in the form of five bar charts, see example below. The first chart presents national-level incidence rates by age and sex (top, left). This is followed by two charts presenting the distribution of behavioural risk categories, summarised as a proportion [bottom, left] and number [top, middle] of people in each behavioural category, separately by age and sex. HIV incidence estimates are presented as rates [top, right] and new

infections [bottom, middle], disaggregated by age, sex and behavioural group (with the latter generated through incidence rate ratios described in Part 1 applied to Naomi model estimates).



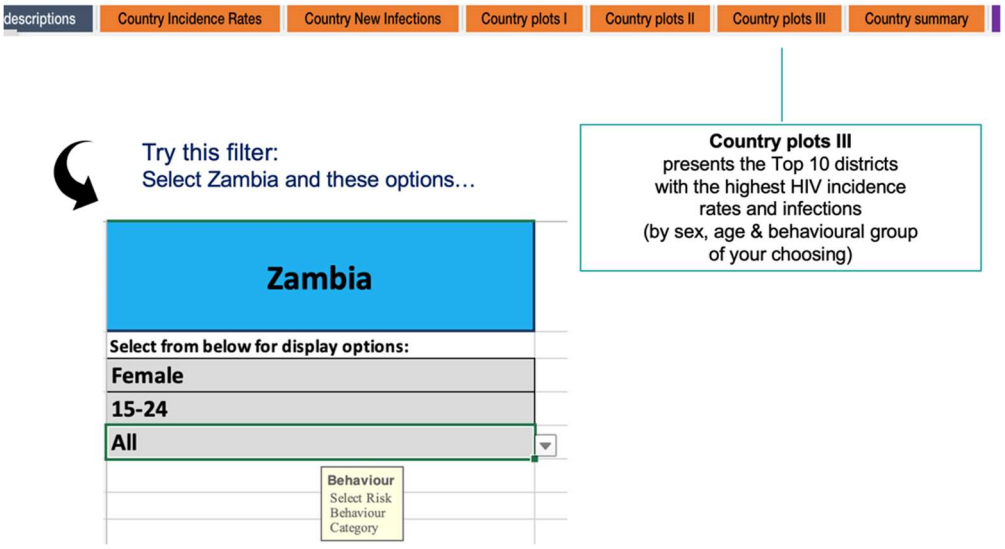
Step 2: Prioritise geographic areas (districts)

The Tool can help you to see variation in HIV risk profiles in order to prioritise districts for programme planning. As shown above, we can scan rates and numbers of infections across districts in the first two orange tabs, to explore this variation. In addition, the Tool can rank districts in order of highest incidence rates and numbers. The **Country Plots III** tab ranks the 'top 10' districts according to the sex, age group, and behavioural risk group of your choice.

Using insights gained from Step 1 to select a priority sub-population, the Country plots III tab will generate plots ranking the top 10 districts according to: (1) the highest HIV incidence rates; and (2) the largest number of new HIV infections in this sub-population.

Try this yourself with the Country plots III tab

In Step 1 above, we observed that HIV incidence in Zambia was highest among adolescent girls and young women (with the highest rates among key populations of young females and highest numbers of infections among young females with non-regular partners). To identify districts to prioritise for prevention with young females, try the below example to rank districts by selecting females aged 15-24 years in Zambia.



This selection will generate the following district rankings.

From the above output, you will see that the district rankings (by HIV incidence rate and by HIV infections) are not the same.

- **Q**: Why do you think the ranking of Top 10 districts differs in the first and second list?
- **A**: The districts with the highest HIV incidence rates are not always the most populous districts. Some may be in rural, dispersed, less populous areas. A third plot generated in Country plots III ranks the districts by the size of the HIV-negative population (in our example, it ranks districts with the highest concentration of females aged 15-24 years who are HIV-negative). Large population sizes can drive large numbers of new infections, even if HIV incidence rates are not very high. This shows us that it is important to consider both the rates and numbers of new HIV infections, to identify priority districts.

Step 3: 'Zoom in' to understand HIV risk composition at the district level (one district at a time)

Once you have prioritised geographic areas, the purple 'District outputs' tab allows you to generate district-level summaries of all estimates, in both tabular and graphical formats. This is useful for programme and resource planning at the individual district level (or other sub-national unit such as 'county', depending on the country).

Try this yourself with the **District outputs** tab

Using insights gained from district ranking in Step 2, choose a district that you have designated as a priority for HIV prevention, on the basis of both HIV incidence rates and numbers of new HIV infections. First, select your country of choice from the drop-down menu in the large green box at the top right. Next, select the district of your choice from the blue box at the top left. This will automatically populate the spreadsheet with estimates and data plots for this district.

In the below example we have selected Kisumu county in Kenya. (This is a district in the Top 10 for both HIV incidence rates and new infections, based on the rankings generated in Country Plots III) As you can see, the table summarises estimates in the same format as the national level summaries explored above.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	**District population size estimation**	**Kenya**				**Kisumu**							
2		KEN_2_42		Women's district HIV inc						Men's district HIV incidence level:			Low
4		Adolescent girls and women by lev						Adolescent boys and men by level of HIV risk					
5		No sex	One regular partner	Non-regular partner(s)	KPs			No sex	One regular partner	Non-regular partner(s)	KPs	All	MLHIV
6	**Population in % of total**												
7	15-49	26.3	46.8	25.7	1.2		17.5	31.5	31.8	35.6	1.1	100.0	8.9
8	15-24	44.5	27.9	26.1	1.5		5.4	53.5	6.0	38.9	1.5	100.0	2.7
9	25-49	10.3	63.3	25.4	1.0		25.9	12.6	53.9	32.7	0.8	100.0	13.6
10	15-19	66.9	11.3	20.5	1.3		3.9	74.5	0.5	23.9	1.1	100.0	2.6
11	20-24	20.1	46.0	32.1	1.7		6.9	32.7	11.5	53.9	1.9	100.0	2.7
12	25-34	9.3	62.6	26.8	1.3		19.8	13.9	47.0	37.8	1.2	100.0	8.6
13	35-49	11.7	64.4	23.4	0.5	100.0	32.7	10.9	63.4	25.5	0.2	100.0	19.8
14	**Population sizes**												
15	15-49	73,240	130,205	71,532	3,388	337,446	59,080	90,452	91,269	102,111	3,292	315,151	28,026
16	15-24	57,944	36,320	33,927	1,954	137,545	7,400	70,933	7,923	51,591	2,024	136,122	3,651
17	25-49	15,296	93,885	37,605	1,435	199,901	51,680	19,519	83,346	50,520	1,268	179,029	24,375
18	15-19	45,466	7,698	13,946	873	70,779	2,796	49,214	306	15,759	750	67,805	1,777
19	20-24	12,478	28,622	19,981	1,080	66,766	4,604	21,719	7,617	35,832	1,274	68,316	1,874
20	25-34	7,911	53,242	22,820	1,113	106,059	20,973	12,479	42,247	33,994	1,108	98,226	8,399
21	35-49	7,385	40,643	14,784	322	93,842	30,707	7,040	41,099	16,527	160	80,803	15,977
22	**Estimated annual new HIV infections**												
23	15-49	0	297	399	112	808	0	0	114	266	26	406	0
24	15-24	0	134	259	70	463	0	0	11	125	15	151	0
25	25-49	0	163	140	42	345	0	0	103	141	11	255	0
26	15-19	0	51	160	31	243	0	0	0	30	2	33	0
27	20-24	0	82	99	38	220	0	0	11	95	13	118	0
28	25-34	0	104	94	34	233	0	0	63	107	10	179	0
29	35-49	0	59	45	8	112	0	0	40	35	1	75	0
30	**Contribution to all new HIV infections in age group**												
31	15-49	-	37	49	14	100	-	-	28	66	6	100	-
32	15-24	-	29	56	15	100	-	-	7	83	10	100	-
33	25-49	-	47	40	12	100	-	-	40	55	4	100	-
34	15-19	-	21	66	13	100	-	-	1	92	7	100	-
35	20-24	-	37	45	18	100	-	-	9	80	11	100	-
36	25-34	-	45	41	15	100	-	-	35	59	5	100	-
37	35-49	-	53	40	7	100	-	-	53	46	1	100	-
38	**Estimated HIV incidence rates**												
39	15-49	0.00	0.23	0.56	3.30	0.29	0.00	0.00	0.12	0.26	0.78	0.14	0.00
40	15-24	0.00	0.37	0.76	3.57	0.36	0.00	0.00	0.14	0.24	0.76	0.11	0.00
41	25-49	0.00	0.17	0.37	2.93	0.23	0.00	0.00	0.12	0.28	0.83	0.16	0.00
42	15-19	0.00	0.67	1.15	3.59	0.36	0.00	0.00	0.10	0.19	0.32	0.05	0.00
43	20-24	0.00	0.29	0.49	3.56	0.35	0.00	0.00	0.14	0.26	1.01	0.18	0.00
44	25-34	0.00	0.20	0.41	3.09	0.27	0.00	0.00	0.15	0.31	0.89	0.20	0.00
45	35-49	0.00	0.14	0.31	2.40	0.18	0.00	0.00	0.10	0.21	0.42	0.12	0.00
46													
47	**Population sizes per HIV incidence category**	**AGYW 15-24**						**ABYM 15-24**					
48	**Categories**	**No sex**	**One regular**	**Non-regulai**	**KPs**	**Total**		**No sex**	**One regular p:**	**Non-regular p**	**KPs**	**Total**	
49	Low HIV Incidence	57,944	28,622	0	0	86,567		70,933	7,923	51,591	0	130,447	
50	Moderate HIV Incidence	0	7,698	19,981	0	27,679		0	0	0	750	750	
51	High HIV Incidence	0	0	13,946	0	13,946		0	0	0	1,274	1,274	
52	Very high HIV Incidence	0	0	0	1,954	1,954		0	0	0	0	0	
53	Total	57,944	36,320	33,927	1,954	130,145		70,933	7,923	51,591	2,024	132,471	
54													
55	**Population sizes per HIV incidence category**	**Women 25-49**						**Men 25-49**					
56	**Categories**	**No sex**	**One regular**	**Non-regulai**	**KPs**	**Total**		**No sex**	**One regular p:**	**Non-regular p**	**KPs**	**Total**	
57	Low HIV Incidence	15,296	93,885	6,929	0	116,110		19,519	83,346	16,527	7	119,399	
58	Moderate HIV Incidence	0	0	30,675	0	30,675		0	0	33,994	1,261	35,255	
59	High HIV Incidence	0	0	0	683	683		0	0	0	0	0	
60	Very high HIV Incidence	0	0	0	752	752		0	0	0	0	0	
61	Total	15,296	93,885	37,605	1,435	148,220		19,519	83,346	50,520	1,268	154,654	

Bomet
Kakamega
Vihiga
Bungoma
Busia
Siaya
Kisumu
Homa Bay
Migori
Kisii
Nyamira
Nairobi (County)

Short exercise

District outputs

With the Districts outputs tab, use district-level summaries in the table & plots to find:

1. Among females in Kisumu, Kenya, which sub-group experiences the highest HIV incidence rate? How would you describe this rate? How many new infections are estimated per year in this sub-group?
   - …
   - …
   - …
2. Among males in Kisumu, Kenya, which sub-group experiences the highest HIV incidence rate? How would you describe this rate? How many new infections are estimated per year in this sub-group?
   - …
   - …
   - …

Did you find the answers?

Short exercise

District outputs

With the Districts outputs tab, use district-level summaries in the table & plots to find:

1. Among <u>females</u> in Kisumu, Kenya, which sub-group experiences the highest HIV incidence rate? How would you describe this rate? How many new infections are estimated per year in this sub-group?
   - Females aged 15-19 years in 'key populations' (young women who sell sex)
   - The incidence rate is approximately 3.59 new infections per 100 person-years; this is a 'very high' level
   - The estimated number of new HIV infections among 15-19y females in key populations is ~31 per year
2. Among <u>males</u> in Kisumu, Kenya, which sub-group experiences the highest HIV incidence rate? How would you describe this rate? How many new infections are estimated per year in this sub-group?
   - Males aged 20-24 years in 'key populations' (MSM and men who inject drugs)
   - The rate is approximately 1.01 new infections per 100 person-years; this is 'moderate'
   - The estimated number of new infections among 20-24y males in key populations is ~13 per year

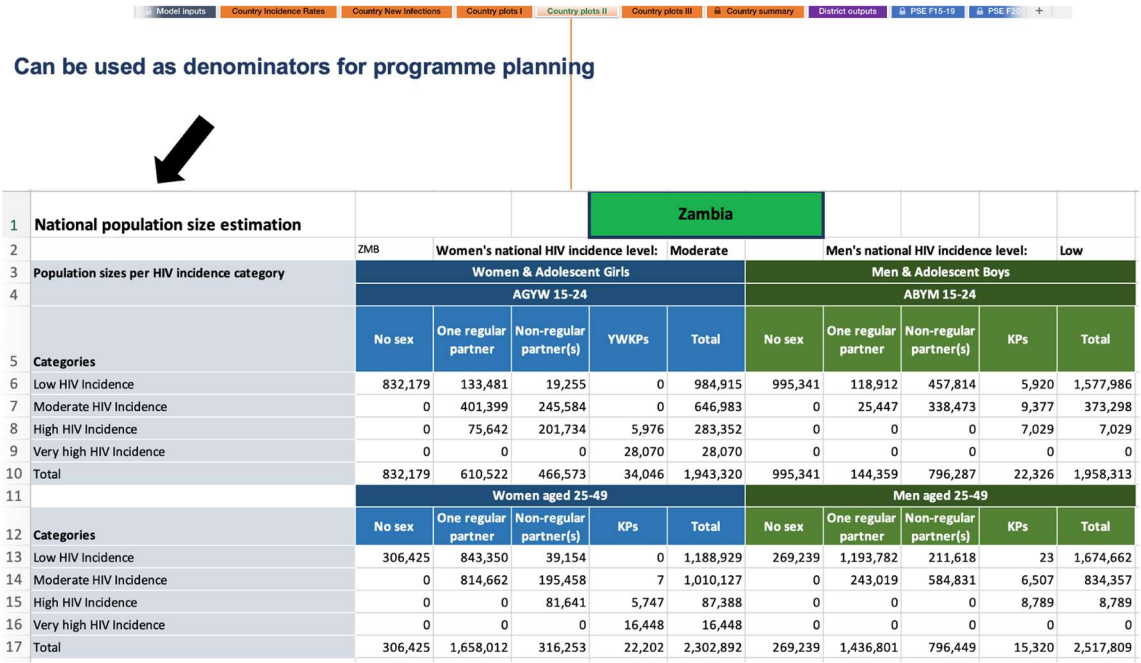
Step 4: Estimate numbers in need

The SHIPP Tool adds up population sizes in each HIV incidence category. This generates population size estimates that can serve as denominators for differentiated HIV prevention planning, for example:

- The estimated number of people at 'high' and 'very high' HIV risk and in need of intensive HIV prevention programming. These may include PrEP, STI diagnoses and treatment, and economic empowerment strategies. (Programming strategies are discussed further in Part III below.)
- The estimated number of people in need of a basic minimum package of comprehensive HIV prevention strategies. These may include HIV testing, treatment and condom promotion, and are recommended for everyone regardless of HIV risk.

The Tool generates population size estimates at both national and district level. For national-level denominators, use Country plots II to select the country of your choice. For district-level denominators, use the District outputs tab [rows 47-61].

Try this yourself with the Country plots II tab



1	**National population size estimation**				**Zambia**					
2		ZMB	**Women's national HIV incidence level:**		**Moderate**			**Men's national HIV incidence level:**		**Low**
3	**Population sizes per HIV incidence category**	**Women & Adolescent Girls**					**Men & Adolescent Boys**			
4		**AGYW 15-24**					**ABYM 15-24**			
5	**Categories**	**No sex**	**One regular partner**	**Non-regular partner(s)**	**YWKPs**	**Total**	**No sex**	**One regular partner**	**Non-regular partner(s)**	**KPs**	**Total**
6	Low HIV Incidence	832,179	133,481	19,255	0	984,915	995,341	118,912	457,814	5,920	1,577,986
7	Moderate HIV Incidence	0	401,399	245,584	0	646,983	0	25,447	338,473	9,377	373,298
8	High HIV Incidence	0	75,642	201,734	5,976	283,352	0	0	0	7,029	7,029
9	Very high HIV Incidence	0	0	0	28,070	28,070	0	0	0	0	0
10	Total	832,179	610,522	466,573	34,046	1,943,320	995,341	144,359	796,287	22,326	1,958,313
11		**Women aged 25-49**					**Men aged 25-49**			
12	**Categories**	**No sex**	**One regular partner**	**Non-regular partner(s)**	**KPs**	**Total**	**No sex**	**One regular partner**	**Non-regular partner(s)**	**KPs**	**Total**
13	Low HIV Incidence	306,425	843,350	39,154	0	1,188,929	269,239	1,193,782	211,618	23	1,674,662
14	Moderate HIV Incidence	0	814,662	195,458	7	1,010,127	0	243,019	584,831	6,507	834,357
15	High HIV Incidence	0	0	81,641	5,747	87,388	0	0	0	8,789	8,789
16	Very high HIV Incidence	0	0	0	16,448	16,448	0	0	0	0	0
17	Total	306,425	1,658,012	316,253	22,202	2,302,892	269,239	1,436,801	796,449	15,320	2,517,809

Use the output from the above example to answer the following questions.

In Zambia, among 15-24 year-old young people (YP)…	Females	Males
How many YP should be reached with a basic minimum package of comprehensive HIV prevention strategies? *[Clue: this is recommended for everyone regardless of risk level]*		
How many YP are in a 'high' or 'very high' incidence category, and thus in need of intensive HIV prevention programming?		
How many YP may be in need of a 'key population' programme?		

Did you find the answers?

In Zambia, among 15-24 year-old young people (YP)…	Females	Males
How many YP should be reached with a basic minimum package of comprehensive HIV prevention strategies? [Clue: this is recommended for everyone regardless of risk level]	1,943,320	1,958,313
How many YP are in a 'high' or 'very high' incidence category, and thus in need of intensive HIV prevention programming?	High: 283,352 + Very high: 28,070	7,029 + 0
How many YP may be in need of a 'key population' programme?	34,046	22,326

1	**National population size estimation**				**Zambia**					
2		ZMB	**Women's national HIV incidence level:**		**Moderate**		**Men's national HIV incidence level:**			**Low**
3	**Population sizes per HIV incidence category**	**Women & Adolescent Girls**					**Men & Adolescent Boys**			
4		**AGYW 15-24**					**ABYM 15-24**			
5	**Categories**	**No sex**	**One regular partner**	**Non-regular partner(s)**	**YWKPs**	**Total**	**No sex**	**One regular partner**	**Non-regular partner(s)**	**KPs**	**Total**
6	Low HIV Incidence	832,179	133,481	19,255	0	984,915	995,341	118,912	457,814	5,920	1,577,986
7	Moderate HIV Incidence	0	401,399	245,584	0	646,983	0	25,447	338,473	9,377	373,298
8	High HIV Incidence	0	75,642	201,734	5,976	283,352	0	0	0	7,029	7,029
9	Very high HIV Incidence	0	0	0	28,070	28,070	0	0	0	0	0
10	Total	832,179	610,522	466,573	34,046	1,943,320	995,341	144,359	796,287	22,326	1,958,313

Finally, if you have identified a priority population group from the steps above, population size estimates are listed for sub-groups in the series of blue and green tabs which summarise all data in separate age & sex groupings.

For example, if you have identified females aged 15-24 as a priority population in your country, you can use the blue '**PSE F15-24**' tab for a complete list of population size estimates in all districts, in columns Z through AG. You can also view estimates for narrower 5-year age groups in '**PSE F15-19**' and '**PSE F20-24'**.

7. Troubleshooting

It is anticipated that country applications may lead to technical questions, problems and suggestions. Those might include how to consider additional data, how to deal with implausible results or simply technical issues when using or making adjustments to the file.

For technical support requests and related questions, please contact

- as a first entry point for all technical support, estimates@unaids.org
- for general questions and support, the technical focal point in the Global Prevention Coalition Secretariat: benediktc@unaids.org
- for any questions related to the NAOMI model estimates: wanyekii@unaids.org
- for any questions on the spreadsheet: krisher@pennstatehealth.psu.edu

8. Interpreting Results and Acknowledging Uncertainty

Neither the population size nor behavioural risk data will be static or exact (see Section 10 on Limitations). They will change over time, sometimes more quickly than new data are collected and added to the Tool. Also, as the HIV incidence estimates are based on assumptions about relative risks, the output should be considered indicative rather than precise enough for specific target-setting, e.g., they are not accurate enough to identify an exact number of individuals to find and enrol into services.

Outputs may be ambiguous, and there might be missing data and/or some gaps, depending on what was available in the dataset used to populate the spreadsheet. It is valuable to consider any recent studies that have been conducted and include other data on populations at risk of HIV within your context, in your interpretation and use of the estimates.

As an example with adolescent girls and young women, Table 4 illustrates structural vulnerabilities that are often associated with risk or – in the case of adolescents who are not yet sexually active – potential future risk. Structural vulnerabilities are important to consider in understanding the social context of behavioural risks and structural barriers affecting key populations, however, such factors are not yet incorporated within the estimation Tool.

Table 4: HIV-related risk in the context of structural vulnerabilities

Sexual behavioural category	Associated structural vulnerabilities
Not sexually active	Low access to secondary education, orphanhood, exposure to violence, household poverty, food insecurity
Sexually active with one cohabiting partner	+ Early sexual debut, early motherhood, sexual power imbalance, inter-personal violence and conflict, economic dependence on partner, spousal separation
Sexually active with at least one non-regular sexual partner(s) (non-cohabiting, non-marital) or two or more partners (of any type)	+ Alcohol, transactional sexual relationships, mobility
Young women who sell sex	Factors above + Stigma, discrimination, systematic exclusion from health and social services, criminalization, lack of legal protections, increased risk of violence

Existing programme data on numbers reached, numbers and proportions of adolescent girls and young women (in different behavioural categories) receiving existing services, and other routine data may also offer insights into who is being missed and where efforts need to be intensified and redirected (regardless of the estimated numbers).

It is important to note that the SHIPP Tool produces population size estimates of all people in need of HIV prevention services (in the given population). This is considered the denominator for a given population, and does not take existing programme coverage into account. In other words, the number of people *already* receiving HIV prevention services have not been deducted from the estimates. This is something that can be done with programmatic, clinical or research data specific to the context.

Part III. From data to programming

9. Using the population size estimates

In principle, HIV prevention services and tools should be made available universally. Where resources are limited, however, priorities can be made on the basis of risk, in particular for programme components that are more costly, such as interpersonal outreach, PrEP or social support interventions.

This section outlines strategies to use the estimates generated by the SHIPP Tool for such prioritisation, **focusing on adolescent girls and young women as an example**.

Once the estimated numbers of adolescent girls and young women stratified by risk have been produced, there are two ways to use the data for prioritisation and planning. The first approach is to review the data geographically in order *to identify districts* with a high concentration of young women likely to be at risk of contracting HIV. The second is to determine the specific service packages that should be offered *within any given district*, including the likely financial and human resources required to deliver them. These two approaches are addressed in turn.

1. *Geographic prioritisation*. Comparison between districts will highlight settings with greater need for intensified HIV prevention, e.g., the districts with the highest concentration of young women likely to be at risk of HIV infection. There will be some districts with overall low HIV incidence but with significant numbers of adolescent girls and young women reporting high risk behaviours. This could result from a large population size in general (such as in urban areas or larger districts) and/or location of numerous "hot spots" where high risk behaviour is concentrated, such as border towns. On the other hand, there may be districts with high background HIV incidence but relatively few numbers of adolescent girls and young women at risk, perhaps in rural, dispersed or sparsely populated areas. Combined with existing contextual information about demographic and socio-economic patterns of HIV transmission, the estimates can help select or confirm geographical allocation of programme efforts.
2. *Prioritisation within districts*. The Tool highlights how behavioural risk is distributed across adolescent girls and young women by age group, facilitating the planning of differentiated HIV prevention packages. Both the *2021-2026 Global AIDS Strategy* and *2016 UNAIDS Guidance on HIV Prevention among Adolescent Girls and Young Women* specify what intensified efforts should be added on top of a standard, comprehensive package of HIV prevention, based on increasing risk categories. The latter document is also accompanied by the *Decision-making Aide for Investments into HIV Prevention Programmes among Adolescent Girls and Young Women*, published in 2020. It specifies **that the following standard and comprehensive services should be made available to ALL adolescent girls and young women**, regardless of risk level or location:

Through general health, education and social development funding:

- Access to primary and secondary education
- School health programmes
- Comprehensive Sexuality Education (CSE) in both school and out-of-school settings
- Social support and empowerment of vulnerable adolescents
- Access to integrated sexual and reproductive health services delivered through youth-friendly systems

Through HIV response funding:

- Access to male and female condoms and lubricants
- Comprehensive HIV information
- Access to HIV testing and treatment services
- Post-exposure HIV prophylaxis and prevention of mother-to-child transmission of HIV within maternal and child health services
- Dedicated HIV prevention programmes for and with key populations (including young key populations) in line with available guidance

Specific additional HIV prevention components should be added differentiated by the district's combined location and population-based risk levels as follows:

HIV incidence generated by the spreadsheet (disaggregated by location & behaviour categories)	**HIV incidence risk category**	**Additional Core Package Components** (from *2021-2026 Global AIDS Strategy* and *2016 UNAIDS Guidance on HIV Prevention among Adolescent Girls and Young Women*)
< 0.3%	Low	N/A The standard package of services listed above are recommended for all adolescent girls and young women
0.3-0.99%	Moderate	The above plus… ● Risk assessment for STI/HIV and counselling and testing ● Active provider-initiated condom and lubricant promotion and provision
1.0-2.99%	High	The above plus… ● Dedicated school-based HIV prevention campaigns (knowledge, risk perception, methods, skills, GBV) linked to services in all schools/tertiary educational settings ● Community-based demand generation and outreach HIV prevention services ● STI diagnosis (including as indicator for HIV risk) and treatment ● HIV&STI service integration into family planning services ● Male partner testing (invitation letter + self-test) + ART referral ● Access to HIV pre-exposure prophylaxis (PrEP) ● Community-based active PrEP demand generation
>=3.0%	Very High	The above plus… ● Active promotion of PrEP services to all who are currently sexually active ● Structured interpersonal communication outreach using evidence-based curricula, e.g., SASA! ● Cash transfers, incentives, economic empowerment targeting most vulnerable adolescent girls and young women ● Social asset-building, safe spaces, parenting programmes, and mentoring targeting most vulnerable adolescent girls and young women ● Keep girls in school or provide education assistance targeting vulnerable adolescent girls and young women at high risk

The *2021-2026 Global AIDS Strategy* sets target coverage for each package component depending on risk level.

An important aspect of multi-component differentiated packages is the ability to "layer" services so that each adolescent girl and young woman receives a mix based on her individual needs and circumstances. Where different organisations are commissioned to offer various components in

the package, careful attention should be given to putting coordination mechanisms and referral systems in place to avoid patchy coverage. Lessons about different models of coordination have been learned from the DREAMS Partnership in diverse settings.[6]

The SHIPP Tool will be most useful if used as part of comprehensive situation and response analysis leading to strategic prioritization. Strategic decision-making needs to consider the very large differences in risk of acquiring HIV, which the Tool illustrates, but also adolescent girls' and young women's circumstances and contextual drivers of HIV risk (for example, those who are unemployed, out of school, orphaned, at risk of violence victimisation, in receipt of government welfare grants, or characteristics of male sexual partners) rather than sexual behaviours only.

Where the module for young women in the PrEP-Implementation[7] and target setting tools[8,9] has been used, it will be useful to compare findings. The PrEP implementation tool will provide more precise PrEP needs estimates, while this SHIPP Tool provides estimates that can be linked to a full set of HIV prevention activities.

Finally, it is essential that population size estimates and prioritization exercises are not used for targeting and labelling individual women. The Tool's purpose is to help estimate how many AGYW are at risk and should be prioritized in programme planning and resource allocation. Strategies for reaching priority populations are discussed in the next section.

Part IV. Reflections on use of the SHIPP Tool

10. Limitations

While the population size estimates described in this Guide can facilitate national and district-based planning, there are limitations that should be taken into consideration.

First, the SHIPP model relies on the accuracy and quality of the survey data that underpin its calculations, some of which may be out-of-date, especially where HIV incidence and behaviours change with time. Wherever possible, SHIPP estimates should be triangulated with other available data, including local knowledge from existing programmes and community representatives. For example, service providers reaching specific sub-populations of adolescent girls and young women (e.g., out-of-school girls or young sex workers) may have relevant, current data from local mapping exercises or clinic registers.

Second, the spreadsheet generates very specific numbers that can give a false sense of precision and accuracy. Programme implementers may be tempted to use these exact numbers as specific targets for service delivery and use them as denominators for calculating coverage of different service packages. While some monitoring with these estimates will be appropriate, it is important to consider population size figures as indicative rather than exact. They are estimates, based on a

[6] Chimbindi & Birdthistle, et al. Translating DREAMS into practice: Early lessons from implementation in six settings. *PLoS One* 2018. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0208243

[7] https://www.who.int/tools/prep-implementation-tool

[8] https://www.prepwatch.org/resource/prep-it/

[9] https://jointsiwg.unaids.org/wp-content/uploads/2022/01/3.-Using_the_PrEP-KP-tools.pdf

range of assumptions, and likely to be more useful for prioritistaion (relative comparisons between districts and sub-groups) rather than to monitor programme performance, for example, by a particular implementing organisation.

A third limitation of the SHIPP tool is its use of rigid behavioural risk categories, which may not accurately represent behaviour over time, particularly among young people. Social science research has consistently shown the diversity of sexual behaviour and its relationship to HIV, the dynamic nature of young people's behaviours and relationships (between the categories listed above), and how factors that shape sexual vulnerability change across time and between contexts. Furthermore, labelling individuals as "high" or "extremely high" risk can be stigmatising and reduce their willingness to engage with prevention services. This is particularly true in the case of young key populations, for example, females who sell or exchange sex but may not self-identify as part of the community of female sex workers, or men who have sex with men who may not self-identify as gay men.

Annex 1.

Frequently Asked Questions about the SHIPP Tool: data inputs, sources & modelling

Populations included/excluded

Q: Which key population groups are included in the SHIPP Tool estimates?

- For females, the SHIPP Tool includes women who sell sex (whether they do or do not identify as sex workers). Note this is **not** women who report transactional sex.
- For males: the SHIPP Tool includes men who have sex with men and men who inject drugs.

Q: Which key populations are not included in the SHIPP Tool, and why?

- Transgender women – due to lack of reliable data and small population size, particularly for spatially disaggregated estimates at 5-year age categories.
- Women who inject drugs – due to small population size. Based on the literature review of roughly 17 peer-reviewed studies, about 94% of the populations sampled were males. Therefore, in the SHIPP Tool we assume a 1:10 female to male ratio.
- Men in prisons.

Q: Why are estimates for 10-14 year olds not included? Aren't they a priority group for HIV prevention among adolescents, especially girls?

- Estimates for 10-14 year-olds have not been included in the SHIPP Tool due to the sparsity of sexual behaviour data for this age group. The main demographic and health surveys used in the Tool do not ask detailed sexual behaviour questions to children under age 15.
- However, the SHIPP Tool identifies areas in which HIV risk is high or very high among 15-19 year old girls; it would be advantageous to prioritise such areas with comprehensive prevention programmes for 10-14 year olds before their risk of HIV escalates and to reduce new infections among the next cohort of 15-19 year olds.
- (Note that the Naomi model estimates HIV prevalence for those under 15 years, based on data from sources such as routine testing, PMTCT and ART programmes).

Q: Why are some countries not included in the SHIPP Tool?

- The SHIPP Tool includes countries that have validated the Naomi model and have at least one household survey within the past 15 years.

Data Sources

Q: Do model estimates match the Modes of Transmission Model?

- At present, no.

Q: Do model estimates match the Key Population 'workbook' population sizes?

- Work is underway to be able to scale national KP population size estimates to the workbook, it is anticipated that during the estimates process, if a KP workbook is available, it will be used to scale national KP population sizes within the tool.

Q: What is the Naomi Model?

- Naomi is a Bayesian small-area estimation model, which estimates the number of people living with HIV (PLHIV), antiretroviral treatment (ART) coverage and unmet need, and

new HIV infections by district, or equivalent subnational administrative level. The model presents the data stratified by subnational administrative units, sex, and five-year age groups.

- For more information on the Naomi model, please see the article *Naomi: a new modelling tool for estimating HIV epidemic indicators at the district level in sub-Saharan Africa* by Eaton JW et al. Journal of the International AIDS Society 2021, 24(S5):e25788.
- The development of the data viewer for Naomi is led by UNAIDS, Avenir Health, Imperial College London and the UNAIDS Reference Group on Estimates, Models and Projections.
- You can find the data viewer here: https://naomi-spectrum.unaids.org/

Q: Should the estimate of new infections by district be similar to what we observe in Naomi?

- Yes, they should match exactly to what we observe in Naomi. Additionally, Naomi provides the following inputs to the SHIPP Tool: total population, HIV incidence, HIV prevalence, new infections and the number of people living with HIV (disaggregated by age, sex and district). The overall estimates by age, sex and district are identical to the Naomi model results.
- The addition the SHIPP tool makes is to integrate sexual behavioural data in order to further disaggregate HIV estimates by behavioural categories. This helps to identify priority sub-populations for differentiated HIV prevention (e.g., to plan the most intensive prevention for the highest risk groups).

Q: Why does the SHIPP Tool pool data from Naomi and not other models like Spectrum or Thembisa?

- The main reason that we are pulling data from the Naomi model is to have district-level estimates. The lowest level of geographical information for Thembisa (South Africa-specific) is provincial and for Spectrum (all countries) is national.
- Because the Naomi model is calibrated to the Thembisa model (in the case of South Africa) and to Spectrum (in the case of other countries), the estimates in the SHIPP Tool are also aligned with Thembisa and Spectrum.

Q: What is the data source for the population size estimates and HIV prevalence for Key Populations?

- The estimates come from the work of a team lead by Oli Stevens at Imperial College London and UNAIDS. They have synthesised available data on population sizes, HIV prevalence and ART coverage for KPs in sub-Saharan Africa to develop a small area estimation model to output KP estimates at an Admin-1 level (i.e., province, state, district or municipality, depending on the country; see next question).
- Available data used to build the model includes: The UNAIDS Global AIDS Monitoring & Key Population Atlas, the CDC Surveillance Database, the GFATM Surveillance Database, Peer-reviewed sources such as the Global.HIV and a systematic review by Degenhardt et al on people who inject drugs (PWID) systematic review.
- Based on the year and geography that the data were collected in, population size estimates are matched to a geography by name and corresponding population in order to obtain a baseline of general population size to compare to.
- Currently the model provides estimates for 3 KPs: FSW, MSM, and PWID.
- To estimate the population size, the Stevens et al model incorporates: an overall fixed effect for the study method category (i.e., empirical, PLACE, mapping, other); a random effect for the specific study method; an intrinsic conditional autoregressive (ICAR) spatial smoothing random effect at Admin-1 level and a study random effect (IID). Stevens et al's population size model specifically estimates urban proportions. When

there is no information for a particular area, data is borrowed from neighbouring areas, that is, they are spatially correlated between admin-1 neighbours.

- There is limited empirical data on the urban to rural KP ratio but it is widely held that the urban proportion of KPs is greater in urban areas. The assumption in Oli's model is that the KP size in rural areas is about 60% of what it is in urban areas.
- To estimate HIV prevalence, the Stevens et al model incorporates the following terms: a fixed effect to matched population prevalence for a given population group, year and admin-1; fixed effect for Region (e.g., west and central Africa vs, east and southern Africa); interaction between matched population HIV prevalence and region (to allow for the relationship between general population prevalence and KP prevalence to vary based on which region you are in); fixed effect for HIV status method (self-report vs laboratory) and a study random effect.

Q: What does Admin-1 level mean?

- Admin-1 level refers to the first level of spatial disaggregation in a country. It varies from country to country and can be: province, state, district or municipality.

Q: What is the data source for Key Population HIV incidence data?

- For FSW, the SHIPP Tool utilizes a systematic review of age and sex-matched HIV incidence estimates among FSW relative to the general population in Jones & Anderson et al medRxiv (https://www.medrxiv.org/content/10.1101/2023.10.17.23297108v2.full.pdf).
- For MSM and PWID, the SHIPP Tool utilizes the relative prevalence of HIV at an Admin-1 level in the Stevens et al modeling working described above to approximate relative incidence. These estimates are substantially lower for MSM than the relative incidence estimates calculated in a systematic review by Stannah et al medRxiv (https://www.medrxiv.org/content/10.1101/2022.11.14.22282329v1). UNAIDS analyses have found an inconsistency between empirical incidence and prevalence estimates among MSM, with empirical incidence estimates resulting in drastically higher HIV prevalence than is found in surveys of MSM. The hypotheses are that either empirical incidence estimates are increased due to the populations recruited in longitudinal incidence studies being substantially higher risk than most MSM, due to very young MSM experiencing a very short extremely high HIV risk period in their lives, or a further explanation. As a result, the SHIPP tool uses the prevalence ratio to approximate incidence rate ratio instead of empirical incidence estimates.

Q: How are HIV incidence rates by behaviour derived?

- The Model maintains the overall Naomi incidence rates and number of new infections in a given district and 5-year age group but pulls in literature estimates of incidence rate ratios by each of the behavioural categories to get estimates of HIV incidence rates by behaviours.
- The Model makes the assumption that the incidence rate ratios are the same across populations.

Q: Which behavioural surveys are included in the SHIPP Tool?

- Demographic Health Surveys (DHS), Population-based HIV Impact Assessment Surveys (PHIAs), the Botswana HIV/AIDS Impact Surveys, and Multiple Indicator Cluster Surveys (MICS).

Q: Where to find what survey data informs the Model?

- In the 'Model Inputs' tab of the SHIPP Tool.

Q: Why are multiple surveys listed in the table?

- This is a spatio-temporal model of sexual behaviour over time in a country. We find that there is relatively little change over time in sexual behaviour reporting, but we include multiple surveys to improve estimation. The year of each survey included is listed on the table in the 'Model Inputs' tab mentioned above.

Q: How reliable are the sexual behaviour data? How confidently can we interpret the estimates in each age group?

- The behavioural survey data may be subject to selection bias (if some groups are systematically excluded from participation) and to reporting bias (e.g., if there is under- or over-reporting of sexual behaviours, and these differ systematically by age, sex or geographic area).
- The SHIPP Tool does not account for these biases. If data are available to quantify the extent of reporting biases by age, we may be able to adjust for this in future iterations of the Tool.

Q: Why aren't other known behavioural risk factors included in the model, like condom use or condomless sex? e.g., if somebody with multiple sex partners uses a condom, the HIV risk estimate should be lower.

- Currently, we are not using any questions on inconsistent condom use or transactional sex from behavioural surveys. While this would add an additional feature, this represents an additional layer of complexity that ultimately would be too great for the quality of the data available.
- There continue to be challenges with collecting reliable data on condom use (including problems with measurement definitions and social desirability bias). Also, consistent condom use is rare among those cohabiting, or in a relationship with a regular partner.

Q: How are missing data from behavioural surveys handled?

- Although the rates of missing data from the survey questions used is very low, the SHIPP Tool is currently ignoring any missing data and doing a complete case analysis.
- The analysis accounts for sampling weights, which accounts for survey non-response but does not account for non-response from within individual indicators. This is a limitation of the SHIPP Tool.

Q: Why aren't social and structural determinants of HIV risk included in the SHIPP estimates, e.g., educational level, orphan status, socio-economic status, experience of violence?

- The SHIPP Tool fits data for all countries in a single model, and the risk associated with social and structural determinants varies by context (it is not universal).
- Going forward, it may be possible to fit separate models for countries with strong data on the HIV risks associated with important social and structural factors.

Updates to the SHIPP Tool

Q: How often will estimates in the SHIPP tool be updated?

- Tool updates will be incorporated into the annual HIV estimation process coordinated by UNAIDS. They will be finalised as each country's Naomi estimates are finalised in the early months of the following year (Jan-April).
- For behavioural data, any new survey data will be pulled in advance of the estimates process around December of each year.

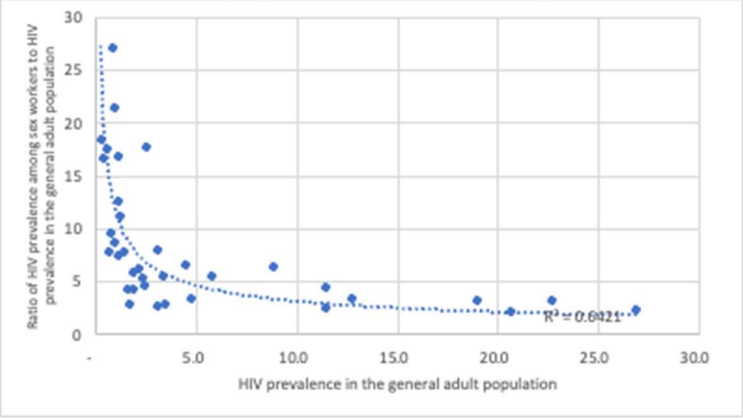
Q: How current are the estimates produced by the Tool?

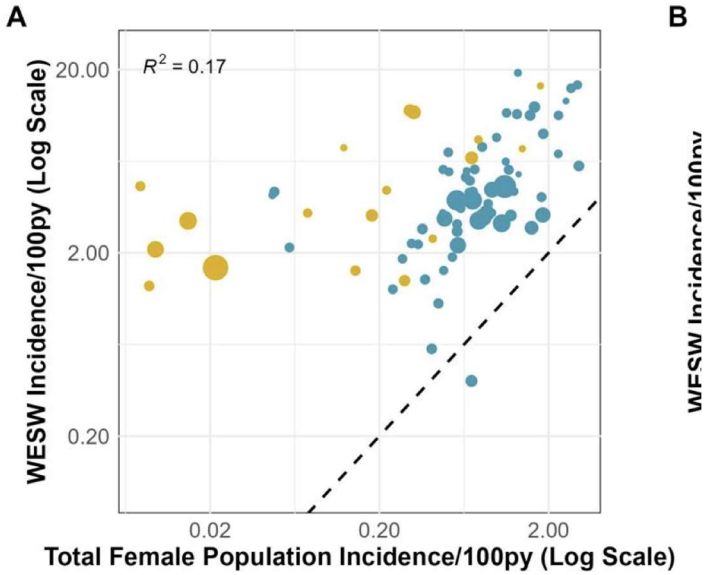
- The HIV incidence rates are drawn from the Naomi model, which is updated annually (see previous question)
- The behavioural data are drawn from the most recent surveys available, and more than one survey if possible (for spatio-temporal modelling). The data suggest that there is little change over time in the proportions of the general population reporting the sexual behaviours used in this Tool.

Data Interpretation

Q: In Table 3 of the User Guide, why does the HIV risk ratio for female sex workers increase as the district-level HIV incidence decreases? Shouldn't HIV risk increase where HIV is more common in the community?

- The risk ratio represents a relative measure; in this case, it is a comparison of HIV risk among sex workers and those who do not sell sex in the same geographic area. In areas where HIV prevalence is low in the general adult population, the HIV risk among sex workers will be very high compared to the risk among those who do not sell sex. With increasing levels of HIV in the general population, HIV risk increases for all sexually active groups and the risk among sex workers becomes comparatively less than that of non sex workers.
- This relationship is illustrated in the figures below (from Jones & Anderson et al MedRxiv (https://www.medrxiv.org/content/10.1101/2023.10.17.23297108v2.full.pdf)





Q: Is the category of "No Sex" adjusted for survivors of rape in geographic areas where prevalence of sexual violence may be high? We know that survivors of rape may report "no" to survey questions like "have you had sex in the last 12 months?" or "zero" to questions such as "how many sexual partners have you had in the last 12 months?".

- No. The SHIPP Tool is not currently adjusted for social stigma around reporting sexual activity to survey questions. Currently the SHIPP tool is outputting the estimates directly from the data, without adjusting to account for any potential differences on how the data is reported. However, this is something that the team of developers is exploring for future iterations of the tool.

Annex 2.

Reaching priority populations of adolescent girls and young women

The SHIPP Tool assists in estimating the number and concentration of HIV risk among adolescent girls and young women, but it does not provide the means by which individuals in different behavioural risk categories can be identified. Programmers will need to find locally appropriate ways of determining where and how to reach individuals to whom they intend to offer the different HIV prevention packages.

There are many approaches to conducting risk and vulnerability assessments, and tools that attempt to identify the highest risk individuals on a collective (based on structural or aggregated criteria) or individual (usually screening questionnaires) basis. These are not standardised nor well-evidenced. UNICEF conducted a recent review of over 40 tools and studies attempting to operationalise categories of sexual and reproductive health (including HIV) risk or vulnerability for adolescent girls and young women.[10] The review identified great diversity in approaches, but no standardised or universally applicable ways to reliably screen individuals into programmatic risk categories. A recent systematic review and meta-analysis analyzed risk scores predicting HIV incidence among adult heterosexual populations in sub-Saharan Africa. Younger age, non-cohabiting partner(s) and recent sexually transmitted infections were consistently identified as predicting future HIV infection.[11] The review concluded that both community HIV burden and individual factors should be considered to quantify HIV risk, while considering that HIV risk scores had only low-to-moderate predictive ability. The resulting uncertainties imply that risk differentiation can be useful for identifiying priority groups for intensified outreach and active demand generation but should not be used to deny access to specific services.

Individual screening tools can be stigmatising and feel invasive and judgmental to the people to whom they are administered, although less sensitive proxy behaviours can be used in place of questions about behaviours that are deemed sensitive. Open-ended, interview-style screening methods have also been recommended, which allow for required information about difficult topics like sexual behaviour and gender-based violence to be collected through a natural conversation. As individuals often move between risk levels over time, including moving back and forth from lower to higher risk, as their circumstances and partnerships change, any form of screening should be considered less of a "one time" measure and more of a continuous process.

Good local information and familiarity with HIV risk environments will prove critical in deciding the best platforms for delivery of prevention packages. These should build on successful models in place, including existing governmental and non-governmental services providing sexual and reproductive health and social care to adolescent girls and young women in different settings.

In all settings the SHIPP Tool will show that HIV incidence rates are particularly high among (young) key populations. It is therefore essential to ensure that dedicated programmes with (young) key populations are developed in line with existing implementation tools and guidelines.

[10] https://www.unicef.org/esa/media/9146/file/UNICEF-ESARO-AGYW-RV-Assessment-2021.pdf

[11] Jia KM, Eilerts H, Edun O, et al. Risk scores for predicting HIV incidence among adult heterosexual populations in sub-Saharan Africa: a systematic review and meta-analysis. J Int AIDS Soc. 2022;25(1):e25861. doi:10.1002/jia2.25861

Among adolescent girls and young women at highest risk are those engaged in transactional sex, or who self-identify as sex workers. In addition to having multiple sexual partners, they are often less able to negotiate condom use and can be difficult to engage with health services. There is a continuum of sexual exchange. Some adolescent girls and young women offer sex through a range of informal arrangements usually referred to as transactional sex, where there is an expectation of financial or material compensation but not necessarily an agreed price in advance of the sex taking place. When adolescent girls and young women rely on selling sex as their main source of income, they are considered part of Key Populations.[12] Some adolescent girls and young women who sell sex consider themselves to be sex workers while others do not, particularly if they are still transitioning from more diffuse forms of sexual exchange, although they are likely to experience similar risks. A recent study with young women who sell sex in Zimbabwe (aged 18-24 years) found little difference in behavioural risk for HIV among those who did or did not self-identify as professional sex workers. However, those who did not identify as sex workers were less engaged with HIV and other SRH services.[13]

There is usually a very steep rise in HIV incidence by age among young key populations.[14] There are particular challenges in engaging this group of adolescent girls and young women, as they may not be willing to disclose their involvement in selling sex among peer groups in general community settings but may also not feel comfortable attending targeted key population services. Delivering any package of services to adolescent girls and young women selling sex will thus require a two-pronged approach through which they can be identified and supported by both interventions designed for vulnerable adolescent girls and young women and services targeted at female sex workers.[15]

A combination of peer outreach and location-based approaches can help ensure adolescent girls and young women most in need of HIV prevention and treatment do not fall through the gaps. PLACE and Respondent Driven Sampling (RDS) are examples of location- and social network-based approaches used for recruitment into services.[16][17] Local organisations serving key populations may also have programmatic insights into where younger sex workers can be found and can extend their services accordingly, or partner with organisations focused on a broader category of vulnerable adolescent girls and young women to ensure they are reached with all the relevant package components.

In location-based approaches, outreach by specially trained workers from organisations already considered key population or youth "friendly" can help to identify and refer adolescent girls and

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[12] Girls under the age of 18 years who sell sex are defined as sexually exploited children in line with the UN Convention on the Rights of the Child.

[13] Hensen & Chabata, et al. HIV risk among young women who sell sex by whether they identify as sex workers: Analysis of respondent-driven sampling surveys, Zimbabwe, 2017. *JIAS* 2019. https://onlinelibrary.wiley.com/doi/10.1002/jia2.25410

[14] Birdthistle I, Tanton C, Tomita A, et al. Recent levels and trends in HIV incidence rates among adolescent girls and young women in 10 high-prevalence African countries: a systematic review and meta analysis. Lancet Global Health 2019: 7(11). [Table 2]

[15] Reference SWIT and the South Africa Sex Work Strategy South African National Sex Worker HIV Plan 2016 - 2019 FINAL Launch Copy... (2) (1).pdf (unfpa.org) regarding women who self identify as sex workers. Reference the UNAIDS transactional sex and HIV risk document for transactional sex programme approaches: Transactional sex and HIV risk: from analysis to action (unaids.org)

[16] Olawore O & Astatke H,et al. Peer recruitment strategies for female sex workers not engaged in HIV prevention and treatment services in Côte d'Ivoire: Program data analysis. *JMIR Public Health Surveill* 2020. doi: 10.2196/18000. PubMed PMID: 33001039

[17] Reference new paper in press with *JMIR Surveillance* comparing 2 methods of reaching young women who sell sex in Zimbabwe, by Chabata S et al

young women into services.[18] "Hotspot" locations that are known as sites where people look for casual or commercial sexual partners often have concentrations of YWSS regardless of whether they self-identify as sex workers. These can be entertainment venues, truck stops, bar and hotel areas, for example.

Peer referral is also an effective way to reach adolescent girls and young women who are "hidden" and do not already have good contact with services.[19] They are often more willing to take advice from those similar to themselves. A standardised approach to peer outreach and case management is Microplanning, where young peer educators identify, screen, and liaise with high risk adolescent girls and young women to link them to relevant services.[20] Key population-friendly outreach workers can also help YWSS overcome their anxiety about taking up referrals to other interventions for adolescent girls and young women such as educational subsidies and social protection.

Differentiated models of care[21] allow for more client-centred approaches and increase the number of services delivered in community settings by lay workers and peers. STI and HIV testing, and ART and PrEP distribution are being made available through lay health workers or peer outreach workers. HIV self-testing is increasingly available. Where services require trained health professional and/or specialised equipment, mobile clinics that visit "hotspot" locations at specified times may work well for mobile adolescent girls and young women. Static clinics to which adolescent girls and young women have to travel can be less popular, particularly where adolescent girls and young women worry that they will be identified by community or family members. If static clinics are the only viable option, using outreach workers to accompany YWSS may improve their willingness to attend.

Finally, internet and phone-based communication and services may be especially suitable for adolescent girls and young women, depending on rates of ownership of phones and other digital devices. As exposure to social media increases, and digital equity improves, there are new opportunities for engaging priority populations, including adolescents and young people.

[18] Reference the WHO recommendation on AFHS and the global standards:
https://www.who.int/publications-detail-redirect/9789240031593
https://apps.who.int/iris/handle/10665/183935

[19] WHO reference https://apps.who.int/iris/handle/10665/329993

[20] Reference the adapted microplanning approach trialled in Zimbabwe: https://pubmed.ncbi.nlm.nih.gov/35279215/

[21] WHO reference https://apps.who.int/iris/handle/10665/258506