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Creating HIV prevention cascades

Operational guidance on a tool
for monitoring programmes

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Summary

Over the past three decades, significant advances have been made in HIV prevention. Despite this progress, around 1.5 million people acquired HIV in 2020. To improve the effectiveness of prevention efforts, it is imperative that HIV prevention programmes remain focused on, are accessible to, and are accepted by, the people most at risk of acquiring the infection (primary prevention). In addition, it is important to prevent onward transmission of HIV (secondary prevention), for example by ensuring that people with HIV are on antiretroviral therapy and have undetectable viral loads. Progress in HIV prevention efforts should be monitored using methods that can provide timely and actionable information. The treatment cascade (or care continuum) is one method for monitoring progress in preventing secondary transmission, but no similar, uniform, framework currently exists for monitoring progress in the implementation of HIV primary prevention programmes or in HIV secondary prevention through condom and needle–syringe programmes (NSPs).

To date, a number of HIV prevention cascade approaches have been proposed; most of these approaches have included data for particular prevention methods and population groups in specific settings around the world. Nevertheless, there is a growing consensus that some degree of standardization is necessary to accurately measure and compare the success of prevention programmes and to monitor progress in meeting global HIV prevention targets. However, the complexities of HIV prevention—for example, heterogeneity in at-risk populations, periodicity of risk and overlapping risks and vulnerability for individuals and populations—make standardization a challenging task.

Recognizing these challenges, this publication provides guidance for developing HIV prevention cascades using a basic approach, but allowing for flexibility and country/area-specific adaptations, based on differences in service delivery and data collection. It is intended to assist national and subnational HIV prevention programme managers—from government entities and nongovernmental organizations/community-based organizations (NGOs/CBOs)—involved in the implementation, administration, monitoring and evaluation of HIV prevention programmes. Prevention cascades can be part of an overall strategic information plan to monitor progress in addressing the HIV epidemic nationally and globally and to strengthen programmes.

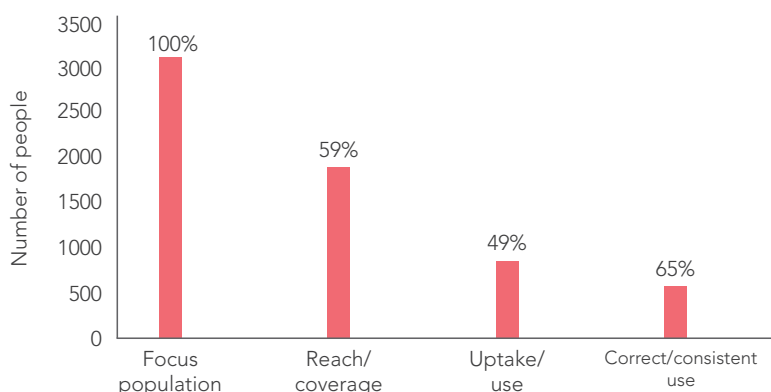
A basic cascade approach using existing data to demonstrate successes and gaps in HIV prevention programming is presented. This approach focuses on:

- Prevention of HIV using one or more well-defined prevention methods for a specific population at greatest risk of acquiring HIV.
- Use of routine data from HIV prevention programmes (both from government bodies and NGOs/CBOs), as well as survey data (a second choice if programme data are not available).
- Programme monitoring, including coverage and performance—that is, correct and consistent use of the method, not the impact on the incidence of HIV.
- Programme management, not research into the reasons for gaps and the effectiveness of solutions.

Where this basic approach reveals major gaps in programming, and it is feasible to do so, expanded cascade frameworks (not covered in this guidance) or other analytical tools may be used to understand the reasons for these gaps, identify relevant interventions and assess the potential impact of these interventions in reducing the incidence of HIV.

Figure 1 represents the basic cascade approach, monitoring the reach/coverage, uptake/use and correct/consistent use of one or a combination of prevention methods in specific populations (i.e. the focus population) and geographical areas at a specified point in time. The cascade presents the actual number of people included in each step. For the proportions displayed, the denominator of each successive step is derived from the former step. The exact calculation and definition of each of the cascade steps and potential data sources are discussed further in this report, as well as the interpretation and use of the basic approach.

Figure 1.
Basic HIV prevention cascade approach (illustrative*)
 (For the percentages, the denominator of each successive step is derived from the former)



* Cascades referred to as 'Illustrative' in this publication are not based on real data. They illustrate the logic of the cascade beyond specific contexts. However, context-specific examples are provided throughout this guide.

In addition, technical and country examples are presented for single prevention methods (condoms, oral pre-exposure prophylaxis, voluntary medical male circumcision, needle and syringe programme) for different populations, as well as for a combination of these prevention methods. The actual country examples make clear that the design of programmes, and hence the availability of data to populate HIV prevention cascades, varies across countries or subnational areas. Hence, this guidance is meant to be flexible to allow for necessary adaptations. In all cases, it is important that whenever a cascade is presented it is accompanied by a clear definition of what is measured, the limitations of the data and the denominator used.

Data sources from which HIV prevention cascades may be developed include population size estimates, routine programme data (preferred option) and behavioural surveys. Each of these sources has strengths and limitations. When conducting a prevention cascade analysis, it is important to have a good understanding of the

sources of data, how the data are reported, whether the quality of the data has been assessed (e.g. for completeness, accuracy and to ensure that there is no double counting) and any limitations the data may have, as this will determine the quality of the data and how the cascade should be interpreted. The goal should be to use the best data available, while continuing to look at ways to improve their quality—including adopting new methods that can improve the validity, completeness, timeliness and representativeness of the data—and to use the data that are available to improve programmes continuously.

Introduction

Over the past three decades, significant advances have been made in HIV prevention. Despite this progress, around 1.5 million people acquired HIV in 2020 (1). In that year, more than 65% of all new HIV infections were among key populations—sex workers, people who use/inject drugs, gay men and other men who have sex with men, transgender people and prisoners—and their partners (1). Furthermore, although new HIV infections among adolescent girls and young women (aged 15–24 years) declined between 2010 and 2020 globally, around 5000 become infected with HIV every week (2).

Prevention is one of the key components of the ambitious agenda set in 2021 by the global HIV community. In the *Political declaration on HIV and AIDS: ending inequalities and getting on track to end AIDS by 2030* (3), Member States committed to:

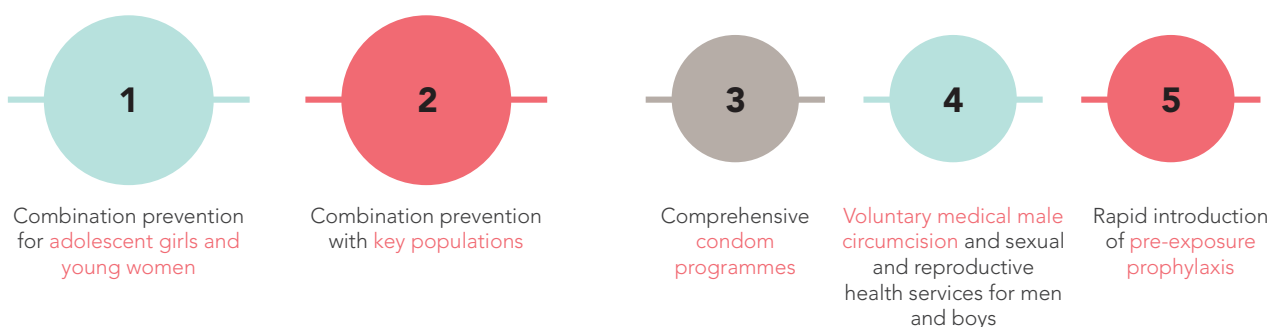
- Reducing annual new HIV infections to under 370 000.
- Reducing annual AIDS-related deaths to under 250 000.
- Eliminating all forms of HIV-related stigma and discrimination by 2025.

As part of the Declaration, Member States also “committed to prioritize HIV prevention and to ensure by 2025 that 95 per cent of people at risk of HIV infection, within all epidemiologically relevant groups, age groups and geographic settings, have access to and use appropriate, prioritized, person-centred and effective combination prevention options” (3). More detailed HIV prevention targets, organized by population and location, have been set in the *Global AIDS strategy 2021–2026—End inequalities. End AIDS* (4).

The Global HIV Prevention Coalition has identified five HIV prevention pillars (5) that need to be strengthened in national HIV prevention responses (Figure 2) and the progress is being monitored through global scorecards.

The Global HIV Prevention Roadmap also provides a results framework for HIV prevention defining results and targets at the level of impact (HIV incidence reduction), outcomes (people using prevention methods) and outputs (coverage and system changes). (5)

Figure 2.
The five pillars of combination HIV prevention (3)



Pillar 1 also includes male partners, while Pillar 5 covers all antiretroviral-based prevention methods: PrEP and HIV testing and treatment (95–95–95).

To improve the effectiveness of prevention efforts, HIV prevention programmes must remain focused on, are accessible to, and are accepted by the people most at risk of acquiring HIV (primary prevention). In addition, it is important to prevent onward transmission of HIV (secondary prevention), for example by ensuring that people with HIV are on antiretroviral therapy (ART) and have undetectable viral loads.

Progress in HIV prevention efforts should be monitored using methods that can provide timely and actionable information. The treatment cascade (or care continuum) is one method for monitoring progress in preventing secondary transmission, but no similar, uniform framework currently exists for monitoring progress in the implementation of HIV primary prevention programmes or in HIV secondary prevention through condom and needle–syringe programmes (NSPs). This is the objective of this publication.

It is important to recognize that HIV prevention programmes operate in social contexts that affect their ability to reach those most at risk and to provide appropriate services to them. Not only are individual HIV prevention services necessary, an enabling environment is needed for them to be adopted. This is particularly true for key populations which are marginalized and, in some cases, criminalized. Critical (or social) enablers include: decriminalization of same-sex sexual relationships, sex work and drug use; empowerment of at-risk populations through, for example, ensuring basic rights to education and livelihoods; and ensuring protections of legal and human rights for vulnerable groups. While prevention programme monitoring through a cascade approach cannot account for these enablers (or the lack thereof), it can provide data on gaps and opportunities that can draw attention to them. As such, prevention cascades should be seen as one part of an overall strategic information agenda to monitor progress in addressing the HIV epidemic nationally and globally (6).

Use of HIV prevention cascades

Cascades have proven to be powerful management and advocacy tools in areas such as HIV diagnosis and treatment and vertical transmission of HIV. Their appeal lies in their visual illustration of the coverage and impact of interventions in several sequential steps—from diagnosis to linkage to services to uptake of treatment (including retention and adherence) to health outcomes. Since coverage of all steps ideally should be 100%, any drop-offs in the cascade indicate losses in engagement and gaps in programme implementation that should be addressed.

Due to the success of HIV treatment and vertical transmission cascades in driving appropriate programming in those areas, there is increased interest in developing cascades for prevention programming. However, there are a few key differences between prevention cascades and the treatment cascade that make this a complicated undertaking, as shown in Table 1. These and other issues related to the challenges of devising HIV prevention cascades have been discussed elsewhere (7–9).

Table 1.

Key differences between treatment and prevention cascades (10–12)

	Treatment cascade	Prevention cascade
Core intervention.	Antiretroviral therapy (singular option).	Multiple interventions (each as a single intervention, but preferably in combination) with different frequencies (one-off voluntary medical male circumcision(VMMC), daily or non-daily oral PrEP, event driven (condoms, needles and syringes)) and with varying efficacy and acceptability/preference.
Population in need.	All people living with HIV.	PrEP, VMMC: at-risk HIV-negative people, e.g. living in a high incidence area and/or part of a population group at higher risk and/or with specific individual risk/vulnerability factors. Condoms, NSP: at-risk HIV-negative people and people living with HIV who have a high risk of transmitting HIV.
Intervention timing.	Always.	When at higher risk (individuals can move in and out of periods of risk over the course of time or life).

Despite the complexities involved in creating HIV prevention cascades, they have multiple (and sometimes overlapping) uses, including:

- Providing information on programme management and facilitating improvements by analysing bottlenecks.
- Assessing progress toward prevention goals (subnational, national and ultimately global).
- Generating research questions (e.g. investigating why there are gaps in coverage and uptake).
- Supporting advocacy for sustaining or expanding prevention services to ensure effectiveness.
- Providing transparency in how prevention funds are being spent and with what effect at the service provision level.

Prevention cascades are a tool for monitoring progress in HIV prevention programme implementation and should be complemented by other data analysis efforts to obtain a detailed understanding of the overall state of HIV prevention within a population.

Objective

To date, a number of HIV prevention cascade approaches have been proposed, with most including data for particular prevention methods and population groups in specific settings around the world (13–21). These approaches vary considerably in their design, data requirements and sources, methods for measurement and, hence, interpretation of results.

However, there is a growing consensus that some degree of standardization is necessary to accurately measure and compare the success of prevention programmes and to monitor progress in meeting global HIV prevention targets (7, 8). The advantage

of a generic approach is that it promotes comparability over time, across populations, between subgroups of a population, across geographical areas and between prevention methods. However, given the great variability in how prevention services are delivered and monitored across settings, populations, and prevention methods, standardization and comparability are difficult to achieve.

Recognizing these challenges, this publication provides guidance for developing HIV prevention cascades using a basic approach, but allowing for flexibility and country/area-specific adaptations, based on differences in service delivery and data collection. The goal is to help programme managers, implementers and other stakeholders acquire a better perspective on the performance of their prevention programmes and their intended results and use this information to improve the programme.

Development of this guide

Three consultations were particularly significant in the preparation of this guidance. In December 2016, an experts meeting with international policy-makers, researchers, programme implementers and funders was convened by UNAIDS in Geneva to review existing prevention cascade approaches and to make recommendations for the development of a uniform framework (22). This was followed by a stakeholder meeting and workshop convened by the Manicaland Centre for Public Health Research, Imperial College London (in association with UNAIDS, the Zimbabwe Ministry of Health and Child Care and the Zimbabwe National AIDS Council) in Harare, Zimbabwe, from 31 July to 2 August 2017 (23). Participants included international policy-makers, researchers, programme managers and monitoring and evaluation (M&E) specialists who discussed the characteristics of a generic prevention cascade and theoretical/analytical frameworks for interpreting prevention cascades.

A third meeting was convened by UNAIDS in May 2018 with a focus on the use and application of prevention cascades in different countries (24). Participants had practical experience understanding data availability for such cascades as well as knowledge about facilitators and the barriers to translating prevention cascades into practical use and programmatic guidance. The goal of that meeting was to reach a consensus on the key elements in a standard HIV prevention cascade approach that could be widely adopted and adapted, particularly by programme implementers and managers.

The guidance in this publication was developed by staff and consultants from UNAIDS and the Bill & Melinda Gates Foundation based on meetings, document reviews and inputs provided by technical experts and global development partner organizations. It is a 'living document' in the sense that it may be modified in the future on the basis of experience with the suggested approach in countries (as already has been done in Zimbabwe, based on a draft version of the current guidance) (25), as well as continued expert discussions about the prevention cascade framework's feasibility and usefulness.

Audience

This guidance is intended primarily for national and subnational HIV prevention programme managers (including implementing partner level managers) from government bodies and non-governmental organizations/community-based organizations (NGOs/CBOs) involved in the implementation, administration, monitoring and evaluation of HIV prevention programmes.

Scope

As noted above, creating HIV prevention cascades is complex. This publication provides managers with guidance on how to create basic HIV prevention cascades as a starting point to enhance their ability to monitor and improve their programming and to facilitate comparisons of programme effectiveness across sites.

This basic HIV prevention cascade approach focuses on programme management and monitoring and describes what is being provided and used by a population in need and where there are gaps, for the purpose of facilitating programme improvement. This, effectively, is the first step in a multistep process that would subsequently involve research to identify the individual and the social–structural causes of these gaps (barriers), the development and testing of appropriate interventions to address them and the evaluation of the impact (effectiveness) of prevention programs on reductions in HIV incidence. A few examples of more comprehensive prevention cascade approaches have been published elsewhere (7, 9, 13). These require data that, in many settings, may not be routinely collected by programmes or easily available from other sources. Where such data are available, employing a more complex cascade framework is recommended. Further explanations of core issues and models of HIV prevention cascades are presented elsewhere (8).

In June 2018, the World Health Organization (WHO) issued a *Cascade data use manual* (26), which includes a comprehensive introduction to the nature and uses of cascades and focuses on those assessing progress in HIV care and treatment. The current publication complements that manual by providing guidance for developing, interpreting and using cascades focused primarily on preventing HIV acquisition. As cascades dealing with the prevention of vertical transmission of HIV are already in use and covered in detail in existing guidance on treatment cascades, they are not included here.

Basic HIV prevention cascade

As mentioned previously, the purpose of this publication is to provide a framework for managers for creating simple and feasible HIV prevention cascades that can be used for national and subnational (including implementing partner level) programme monitoring and improvement related to different prevention methods for various populations. A basic cascade approach is presented as a standardized method for using existing data to demonstrate successes and gaps in HIV prevention programming. Note that since not all essential data may be readily available, the cascade might need to be slightly modified. Over time, consideration should be given to adapt data collection in order to continuously improve the prevention cascade.

Considerations for the basic approach

The basic HIV prevention cascade approach is based upon the following considerations:

- Historically, prevention programmes have been based on one or more well-defined prevention methods (e.g. condoms, pre-exposure prophylaxis (PrEP), voluntary medical male circumcision (VMMC), behaviour change communication) for each population. Increasingly, combination prevention programmes, packages, or platforms are being developed which could either be covered in separate cascades for the different package components or in one cascade combining two (or more) components.
- While prevention cascades theoretically can be based on either a prevention method or population group, in practice most will be a combination of these (e.g. condom use among female sex workers), because this is how most programming and monitoring occurs.
- Prevention programmes—and hence prevention cascades—should, to the extent possible, be focused on defined populations at greatest risk of acquiring HIV infection. The following point should also be considered:
 - Risk is neither fixed nor linear for all people, but HIV prevalence and incidence data and knowledge of environmental, behavioural and social–structural factors that elevate HIV risk in any population or setting should inform the determination of who is at greatest risk.
- The starting and ending points are key questions for all cascades:
 - For PrEP and VMMC, the basic framework starts with the estimated number of HIV-negative people who are at greatest risk of acquiring HIV infection. Although HIV testing services (HTSs) are at the core of the comprehensive package of HIV prevention services as an essential first step in enabling people to know their HIV status and as a critical entry point for HIV prevention, treatment and care services, the approach presented below does not start with HIV testing. HIV-negative status is implied in the first step as it needs to be confirmed before programme uptake.

- For condoms and needle–syringe programmes, people living with HIV or those with an unknown status are also included in the focus population, in addition to high risk HIV-negative people.
- Because the focus of the current guidance is on programme coverage and performance, the endpoint is correct/consistent use of the prevention methods and not HIV incidence, although correct/consistent use of the method should ultimately lead to a lowering of the number of new infections. The inclusion of infections averted (as an operationalization of reduced HIV incidence) as the final step in the cascade, while ideal, is not feasible in most programmatic settings. (For similar reasons, the widely accepted treatment cascade ends with viral suppression, not a direct measure of averted morbidity, mortality or onward transmission.)
- There are two ways to construct and interpret the proportions in prevention cascades (as there are for treatment cascades), depending on the denominator chosen (27). In one version, the denominator of the proportions for each of the steps remains the same (i.e. the total number of people at risk of HIV infection in a defined population, reflected in the first bar). In the other version, the denominator of the proportions of each successive step is derived from the former (i.e. for the second bar it will be the total number of people at risk of HIV infection (first bar); for the third bar it will be the total number in the second bar, etc.). Since this guidance is meant for programme managers, the second approach is recommended, as the goal is to determine whether the specific prevention strategies being provided to a focus population are reaching and being used effectively by the people who most need them. There may be circumstances in which it might only be possible to develop a cascade using one denominator throughout, such as when using broad population survey data. Furthermore, there may be circumstances where it might be more relevant to use one denominator throughout (in cases where the use/uptake of the intervention is mainly due to commodities provided outside a specific programme). In all instances, it is important that the description of the cascade is explicit about the denominator(s) used.
- Prevention cascades are based on measurable indicators. Ideally one data source—preferably programme data, though survey data can be used if programme data are not available, or data from one survey, which is available on a routine basis—should be used. However, a mix of currently available programme data (country defined)—can be used in one cascade. These data include indicators from international reporting (e.g. WHO (6)); the United States President’s Emergency Plan for AIDS Relief (PEPFAR) Monitoring, Evaluation and Reporting (MER) (28); UNAIDS Global AIDS Monitoring (GAM) (29); and survey data (e.g. Integrated Biological and Behavioural Surveys (IBBS) (30), Demographic Health Surveys (DHS) and AIDS Indicator Surveys (AIS) (31), Population-based HIV Impact Assessment (PHIA) (32) and Multiple Indicator Cluster Surveys (MICS)) (33). The limitation of using multiple sources is that it can produce conflicting results, which will affect the interpretation of data. Given this limitation:
 - Ideally, a country will have defined programme packages with associated indicators against which all implementers in the country report.
 - Where more granular underlying monitoring data exist, i.e. disaggregated by sex/gender, age and risk characteristics, different prevention cascades can be created which will allow comparisons of subgroups of the population.
 - A limited number of indicators is advised as a way to simplify cascade analysis, as long as it allows greater disaggregation and use of routine data for programme improvement.

- Based on the data available, cascades may either be cross-sectional or longitudinal. This guidance focuses on cross-sectional cascades, which are simpler and more commonly used. They measure the different steps at a specific point in time (based on programme or survey data) and can provide a snapshot of the status of a prevention programme across the population included in the cascade. Longitudinal cascades are better suited for prevention as they track the same individuals (cohort) at each step of the cascade over time, allowing monitoring of a cohort’s HIV prevention trajectory. If a strong individual-level reporting system is available, e.g. for PrEP, longitudinal prevention cascades can be developed (see Table 2 for a comparison of these two approaches).
 - Note that there are other prevention cascade formats, for instance one that looks at motivation and access in the second and third bars. Since this approach is fully survey based, it is not used here, though it could be useful for researchers and programme developers in acquiring an insight into the demand for and availability of HIV prevention services, the reasons for gaps and possible interventions (8, 9).
- Cascades should clearly cite the population and prevention method included, the geographical area and time period covered and the data source(s) used. This information should also include definitions of what is measured, the limitations in the data and the denominator used.
 - Cascades could be linked to national or subnational targets (e.g. comparable to the 95–95–95 targets).

Table 2.

Differences between cross-sectional and cohort cascades

	Cross-sectional cascade	Cohort cascade
Benefits	<ul style="list-style-type: none"> ▪ Shows status at a particular point in time. ▪ Provides a snapshot for programme managers. ▪ Provides an overview for monitoring programme progress. ▪ Wider data availability. ▪ Denominator often includes the total population of interest. 	<ul style="list-style-type: none"> ▪ Longitudinal representation makes for a truer continuum. ▪ Outcome is observed among those engaged. ▪ Can provide more granular information on cascade in subgroups of individuals included in the analysis, as more is known about them. ▪ Sensitive to programmatic change (across those stages captured in the cascade). ▪ Can provide more targeted action.
Limitations	<ul style="list-style-type: none"> ▪ Less sensitive to reflect impact of programmatic changes in real time. ▪ Estimations can be imprecise, final outcome can have small sample size. ▪ Draws on multiple data sources with definitional challenges. ▪ Reflects continuum as unidirectional. ▪ Does not provide feedback on client specific care continuum. ▪ May not distinguish important subgroups. 	<ul style="list-style-type: none"> ▪ Cohort data still less often available in routine systems. ▪ Cascade re-entry by cohort members may remain a data challenge unless personal identifiers are carried through.

Adapted from the World Bank Group, 2018 (34).

Table 3 summarizes the basic HIV prevention cascade approach and its areas of focus.

Table 3.

Scope basic HIV prevention cascade approach

Focuses on	Does not focus on
Use of routine data from HIV prevention programmes (both from governments and NGOs) as well as survey data (second choice if no programme data are available).	Use of data collected in research contexts.
Programme monitoring: coverage and performance.	Impact of the programme on HIV incidence.
Programme management.	Research into the reasons for gaps and effectiveness of solutions.

Basic HIV prevention cascade approach

The basic HIV prevention cascade approach recommended for use/adaptation was shown in Figure 1. This approach focuses on monitoring the reach/coverage, uptake and use of at least one prevention method in specific populations and geographical areas at a specified point in time. As detailed in Table 4, the development of the prevention cascade starts with a clear definition of each step (the numerator and denominator) and potential data sources. Illustrations for each of the steps for a particular prevention method (or combination of methods) can be found in the examples of cascades in the following sections.

Table 4.

Defining and measuring the cascade steps

Cascade step	Numerator	Denominator (% = Numerator ÷ Denominator)	Explanation	Potential data sources
Focus population	The size estimate of the total population of interest in a country or subnational area at a specified point in time.	100% The fraction is not applicable in this step.	For PrEP and VMMC cascades, the total focus population would be the number of those who are HIV uninfected, most at risk for HIV at the time of creating the cascade and in need of a particular prevention method or package of prevention methods. For condoms and NSPs, those who are HIV positive or have an unknown status are also included.	<ul style="list-style-type: none"> ▪ Population size estimates using a range of methods, including census, enumeration, behavioural surveillance, population surveys, programme mapping, capture–recapture method, multiplier method, network scale-up method and community informant and observation methods. When the focus population should include HIV negative individuals only, the estimate needs to be adjusted using the prevalence of HIV in the population. Furthermore, the focus population should ideally only include those most at risk and hence the estimate can be adjusted using data from an HIV risk assessment conducted in the population. ▪ Other options: programme size or coverage target.

Cascade step	Numerator	Denominator (% = Numerator ÷ Denominator)	Explanation	Potential data sources
Reach/coverage	Number of people in the focus population receiving one or more quality assured prevention methods in a specified timeframe according to national guidelines.	Number of people in the focus population (size estimation from the previous indicator).	Reach/coverage describes the extent to which a prevention method is delivered to the focus population, i.e. the extent to which those in need of a prevention method actually receive it (reflecting 'supply' and 'access' aspects).	Routine programme data that are able to discern distinct individuals met during the time period (preferred option); and/or behavioural surveillance data, e.g. IBBS, DHS, PHIA, AIS, MICS, polling booth surveys and small area surveys.
Uptake/use	Number of people reached/covered who used the prevention method(s) in a specified timeframe.	Number of people in the focus population receiving one or more prevention methods in a specified timeframe (numerator from the previous indicator).	Uptake/use refers to the action of taking up or making use of something that is available (reflects 'demand' aspects).	Routine programme data (preferred option), data from international reporting (e.g. WHO, MER, GAM) and behavioural surveillance data.
Correct/consistent use	Number of people who used the prevention method(s) who used it as prescribed/indicated in a specified timeframe.	Number of people reached/covered who took up/used the prevention method(s) in a specified timeframe (numerator from the previous indicator).	For prevention methods to be effective, they must be used as indicated ('adherence' and 'persistence' aspects). For condom use, the focus is on consistent use; for oral PrEP, the focus is on correct and consistent use.	Routine programme data (preferred option) and behavioural surveillance.

Interpreting and using the basic approach

The illustrative example of the basic cascade (Figure 1) can be interpreted as follows:

- First bar: The total focus group population (100%).
- Second bar: Just over half (59%) of the focus population is reached/covered by the prevention method(s).
- Third bar: About half (49%) of those who are reached/covered by the prevention method(s) are actually taking it up/using it.
- Fourth bar: Almost two-thirds (65%) of those who are taking it up/using it are correctly/consistently using the prevention method(s).
- The largest gap is in the uptake/use of the prevention methods.

A first step in interpreting the cascade is to ensure that what is being seen is plausible, given what is generally known about HIV prevention for this focus population. This step must take into account the quality of the data used to create the cascade and compare the results with other available data.

A next step would be to identify the gaps identified between the different cascade steps and investigate why they occur, e.g. are services being provided in all the catchment areas where the populations at risk are found? Are there sufficient prevention services/commodities available? Are the available prevention services/commodities accessible considering factors such as their geographical location, opening times, affordability and confidentiality? Are there barriers to providing, accessing or using the prevention method correctly/consistently? Are there factors influencing demand such as low risk perception, negative perceptions about the method, social norms and capacity to use, including social and practical skills? These questions can be answered by triangulating data from different sources. If such data do not exist, they may be obtained from qualitative and quantitative research (though this is beyond the scope of this guidance) (9, 14, 35). The results can also be compared with targets, over time, other geographical areas, or populations (if indicator definitions are similar). Cascades for subgroups within the focus population (based on sex/gender, age, risk characteristics) can be compared.

Finally, based on the reasons for the gaps, solutions should be sought and tested, e.g. ensuring government or NGO/CBO coverage of underserved areas, increasing the number of prevention services/commodities available, offering the prevention services/commodities in ways that make them more accessible (location, time) and removing any of the barriers to access or correct/consistent use. If resources and capacity are available, this could be extended to reviewing the intervention literature, developing and piloting prevention services/methods (36–38).

While these issues may seem straightforward, there are some that will affect the interpretation of the cascade. First, denominators may be difficult to measure at a particular point in time and likely will change over time. This might occur, for example, when individuals move in and out of PrEP programmes based on their changed level of risk. Should a government want to create a cascade, clear definitions of the denominator applicable to a particular point in time, together with available data sources and data limitations, will be critical. Second, capturing 'consistent use' may be difficult when the indicator data come from a source different than data in previous steps of the cascade and because of 'social desirability' bias. Transparency about this is essential to ensure valid interpretation. Third, and perhaps most significant, there may be other things going on in the environment, besides the prevention programme being monitored, that contribute to outcomes that might erroneously be attributed to that prevention programme. For example, people who inject drugs may obtain some sterile syringes from a particular HIV prevention programme, but they may also, simultaneously, be obtaining them from other sources in the community, such as pharmacies. Similarly, individuals may participate in a condom promotion programme, but may prefer condoms different from those provided in the programme and, therefore, obtain them elsewhere. In both of these examples, while the overall prevention outcome is one that is desired, it cannot necessarily be attributed to a particular programme.

Method-specific HIV prevention cascades

Although combination prevention is important, this section presents HIV prevention cascades focusing on single prevention methods (condoms, oral PrEP, VMMC, NSPs) due to challenges in creating combination prevention cascades. These cascades can be created for different populations and the approach can be modified to fit the programme or country context. Cascades can also be created for other prevention methods, e.g. the use of opioid substitution therapy (OST) by people who are dependent on opioids, or comprehensive sexuality education for adolescents. Theoretical examples of cascades for various prevention methods are presented, followed by examples showing how the basic approach has been adapted when using real programme or country data.

Example 1: Condom cascade approach

Condoms (and lubricants) are highly effective in preventing sexual transmission of HIV (and other sexually transmitted infections, as well as unintended pregnancies); the consistent and correct use of the male condom significantly reduces HIV during vaginal and anal sex (39). The importance of maintaining a focus on condom use is emphasized by the third UNAIDS HIV prevention pillar: “Strengthened national condom and related behavioural change programmes”.

A basic condom cascade approach is presented in Figure 3 and the operational definitions and suggested data sources for the cascade steps are presented in Table 5. This cascade is based largely on survey data, as no routine programme data are generally available and can be created for different populations (e.g. general population, key populations, or adolescent girls and young women) and adapted for the specific programme/country. For those engaging in high-risk sex, lubricants should also be used; lubricant use could be included in this cascade if data are available.

Figure 3.

The basic condom cascade approach (illustrative)

(For the percentages, the denominator of each successive step is derived from the former)

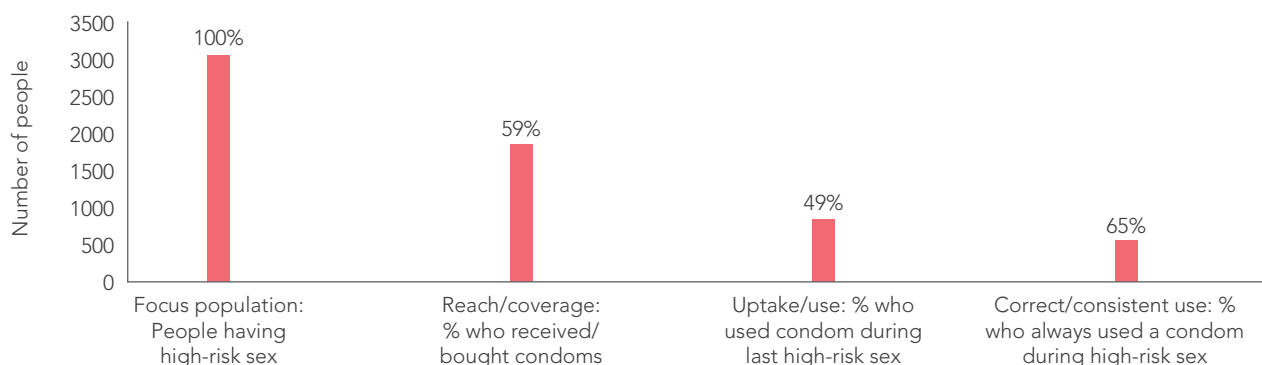


Table 5.

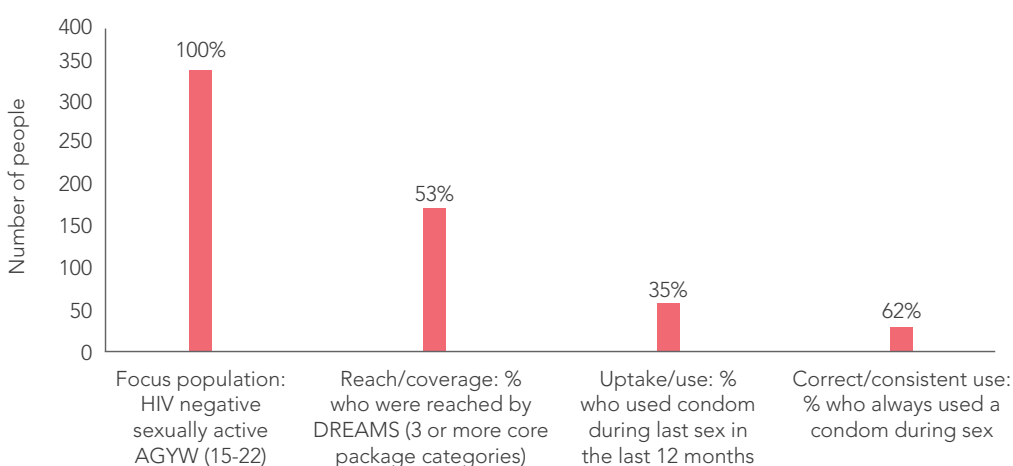
Operational definitions and data sources of the different steps in the basic condom cascade approach

Cascade step	Operational definition	Data sources
Focus population	<p>Total number of persons who had high-risk sex in a specified timeframe (e.g. in the past 12 months in a country or subnational area).</p> <p>The definition of 'high-risk sex' depends on the population of interest, e.g. those having sex with a non-marital, non-cohabiting (NMNC) partner; those having sex with multiple partners; those having a partner at high HIV risk, e.g. people who use/inject drugs; those paying for sex; those receiving cash, gifts, or favours for sex.</p>	<p>Preferred: size estimates (country or subnational area) of the population of interest (e.g. based on age and/or gender/sex and/or key or priority population membership). This estimate should be adjusted for high-risk sex status (using survey data).</p>
Reach/coverage	<p>The number and percentage of the focus population who received/bought condoms in, for example, the past 12 months. Or, the number and percentage of the focus population who indicated that, for example, they know a source for condoms or that it is easy to get a condom if they need one.</p>	<p>Preferred: the number of people reached with condoms.</p> <p>Possible: survey data.</p> <p>Depending on the population of interest, this can be covered by survey questions such as:</p> <ul style="list-style-type: none"> ▪ In the past 12 months, have you been given condoms for free? ▪ Do you know a formal source of condoms? ▪ If you wanted a condom, would it be easy for you to get one?
Uptake/use	<p>Of those who were reached/covered, the number and percentage who used a condom the last time they had high-risk sex.</p> <p>Note that condoms can be obtained through a specific programme, but also from other sources in the public and private sectors. Uptake/use can still be high, but it cannot necessarily be attributed to the condom programme.</p>	<p>Preferred: survey data.</p> <p>Depending on the population of interest, this can be covered by survey questions such as:</p> <ul style="list-style-type: none"> ▪ The last time you had sex with a non-marital, non-cohabiting partner, did you use a condom? ▪ The last time you paid for sex, did you use a condom? ▪ The last time you had sex with a client, did you use a condom? ▪ The last time you had anal sex with a male partner, did you use a condom? <p>Also:</p> <ul style="list-style-type: none"> ▪ WHO PR.1: percentage of people who used a condom during their last high-risk sex act in the last 12 months. ▪ GAM 3.18: the number or percentage of respondents who say they used a condom the last time they had sex with a non-marital, non-cohabiting partner, or those who have had sex with such a partner in the last 12 months; and GAM 3.6: condom use among key populations.
Correct/consistent use	<p>Of those who used condoms, the number and percentage who used a condom every time they had high-risk sex in, for example, the past month.</p> <p>Note that there can be social desirability bias, leading to overestimation of this proportion.</p>	<p>Preferred: survey data.</p> <p>This can be covered by a survey question such as: In the past month, how often did you use condoms with an NMNC partner?</p> <ul style="list-style-type: none"> ▪ Always ▪ Most of the time ▪ Sometimes ▪ Rarely ▪ Never

Figure 4 illustrates the basic condom cascade approach adapted for adolescent girls and young women in Nairobi, Kenya, based on DREAMS (Determined, Resilient, Empowered, AIDS-free, Mentored, and Safe) evaluation cohorts in the slum areas. Because DREAMS only enrolls HIV-negative adolescent girls and young women, they form the focus population. This focus population is not restricted only to those who had high-risk sex. Furthermore, the reach/coverage bar includes those who received three or more DREAMS core interventions, not those that specifically received condoms (although 62% of those included received a condom promotion intervention and condoms can also be obtained outside of the DREAMS programme). In this example, the largest gap is related to the use of condoms. However, there are large gaps for reach/coverage and consistent use as well. These findings were shared with PEPFAR, which considered them in the context of other findings (triangulation of evidence) to establish new priorities for DREAMS and for the next Country Operational Plan (2021).

Figure 4.

Condom cascade for the adolescent girls and young women (AGYW) cohort in Nairobi slums, 2019
(For the percentages, the denominator of each successive step is derived from the former)



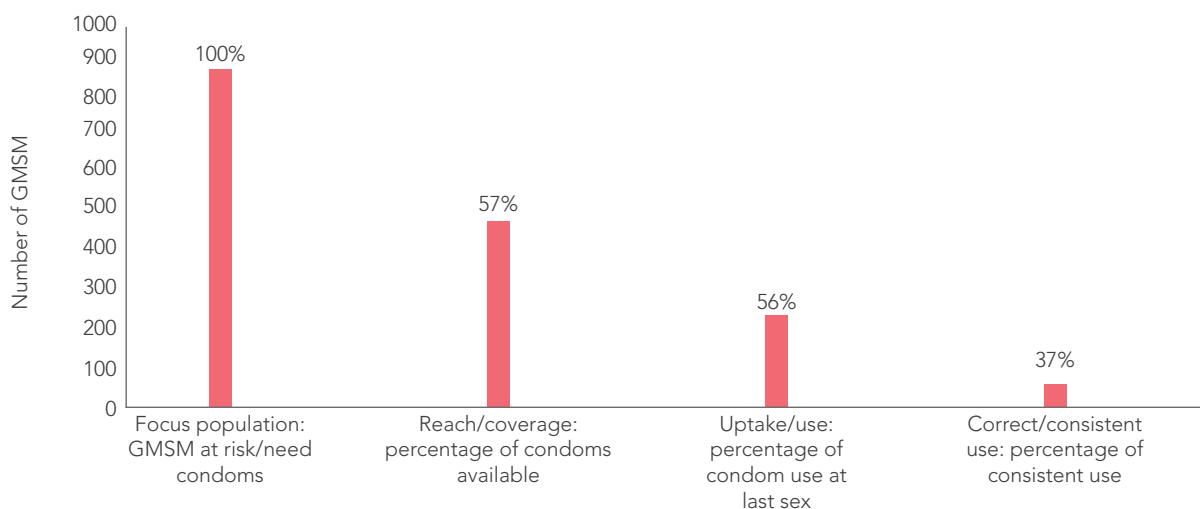
Source: London School of Hygiene and Tropical Medicine. Evaluation of DREAMS programme. Data provided by I. Birdthistle and S. Mulwa.

Figure 5 illustrates the basic condom cascade approach for gay men and other men who have sex with men included in a PLACE (Priorities for Local AIDS Control Efforts) assessment conducted in Angola in 2017 (40). In this example, the greatest gap for programme implementers is consistent use of condoms among those who are reached and decide to use condoms. However, there are also large gaps for reach/coverage and uptake/use.

This cascade was specifically created for a presentation at AIDS 2018, the 22nd International AIDS Conference held in Amsterdam in July 2018, to explore if data from PLACE studies could be used to construct prevention cascades. The broader programme in which this work took place was led by Linkages (funded by the United States Agency for International Development). The standard indicators used for Linkages programmes do not include the specific indicators needed to create this prevention cascade for Angola. Thus, while proving instructive as an exercise, this cascade likely has not informed programming in the country.

Figure 5.

Condom cascade for gay men and other men who have sex with men (GMSM) in Angola in 2017
(The denominator of each successive step is derived from the former)



Source: Adapted from Weir, 2018 (40).

An example of the analysis of potential reasons for gaps in (effective) condom use can be found in a study of young women who sell sex in Zimbabwe who were enrolled in an impact evaluation of the DREAMS programme (18).

Example 2: Pre-exposure prophylaxis cascade approach

Pre-exposure prophylaxis should be offered as a prevention choice for people at substantial¹ risk of HIV infection as part of combination HIV prevention approaches (as reflected in UNAIDS Pillar 5) (41). The use of PrEP may be prioritized for key populations, serodiscordant couples and other at-risk populations, such as adolescent girls and young women (and their male partners) at substantial risk of HIV in high prevalence locations. Countries or programmes may have additional eligibility criteria for PrEP, for example, people who have used post-exposure prophylaxis (PEP). Emerging evidence from clinical research on gay men and other men who have sex with men demonstrating that different dosing strategies (i.e. besides taking a pill once a day, every day) can be effective provides an opportunity to offer flexibility, choice and convenience to a wider range of individuals who can benefit from PrEP (42).

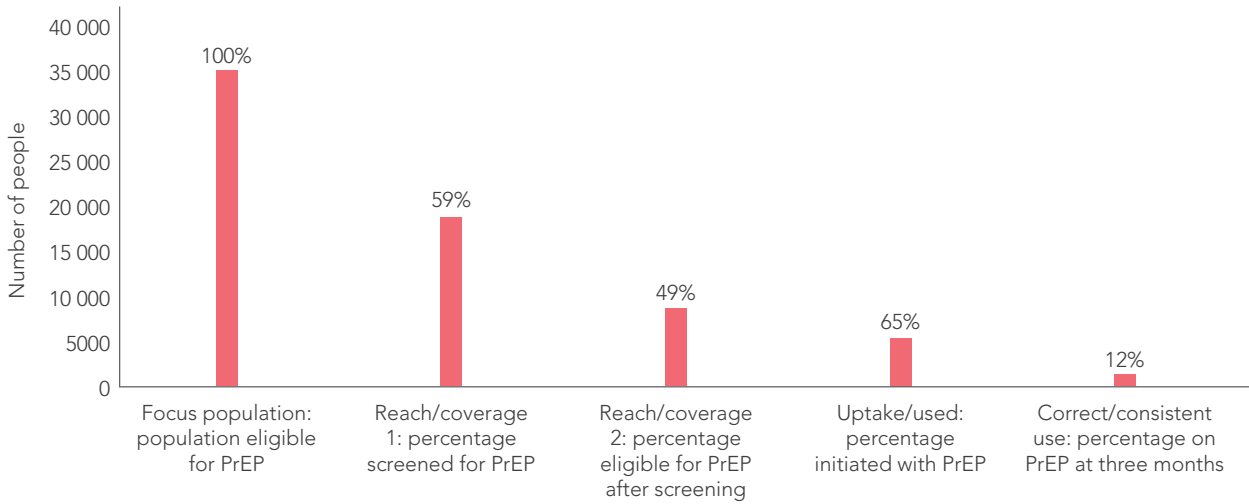
A basic PrEP cascade approach is presented in Figure 6. This cascade is based largely on programme data and can be created for any of the populations mentioned above to whom oral PrEP (the only ART-based prophylaxis that currently exists) may be offered and adapted to suit the specific programme or country context. The operational definitions and data sources for the different steps in the basic PrEP cascade (Table 6) are based on the monitoring and evaluation module of the WHO implementation tool for PrEP of HIV infection (43). Although this cascade only focuses on PrEP, it is part of a combination approach including, for example, condoms.

¹ 'Substantial' is defined as an incidence of HIV infection in the absence of PrEP which is sufficiently high (>3% incidence) to make offering PrEP potentially cost-effective and even cost-saving.

Figure 6.

Basic PrEP cascade approach (illustrative)

(For the percentages, the denominator of each successive step is derived from the former)



Florence Nakirija, Uganda. Credit: UNAIDS

Table 6.

Operational definitions and data sources for the different steps in the basic PrEP cascade approach

Cascade step	Operational definition	Data sources
Focus population	<p>Population eligible for PrEP at a specified point in time in a country or subnational area. Eligibility for starting PrEP will vary among countries and programmes based on national guidelines for PrEP. Eligibility should include at a minimum:</p> <ol style="list-style-type: none"> (1) HIV-negative status. (2) No signs and symptoms of acute HIV. (3) This criterion, whether an individual is at substantial risk for HIV and may benefit from PrEP, is contextual and should be based on national/programme guidelines. 	<p>Preferred: population size estimates (country or subnational area) of the total population to whom PrEP may be offered in a country or subnational area, adjusted for HIV status (i.e. HIV prevalence) to determine the eligible population.</p> <p>Other options:</p> <p>PrEP programme data: in this case, the cascade will only report on those reached and HIV tested by the PrEP programme.</p> <p>In the case of limited resources, the PrEP target could also potentially be used.</p>
Reach/coverage	<p>The reach/coverage bar for PrEP is split into two bars.</p> <p>Reach/coverage 1: the number and percentage of the focus population who were screened for PrEP in, for example, the past 12 months. This screening can include the assessment of whether an individual is at substantial risk for HIV (behavioural risk screening); and/or has no contraindications for PrEP use (medical assessment).</p> <p>Reach/coverage 2: the number and percentage of those screened for PrEP found to be eligible for PrEP.</p>	<p>Preferred: PrEP programme data.</p> <p>Possible: survey data.</p>
Uptake/use	<p>The number and percentage of those who were reached/covered (screened and found eligible) who initiated oral PrEP in, for example, the past 12 months.</p>	<p>Preferred: PrEP programme data.</p> <p>Options:</p> <p>WHO PR.3: number of people who initiated oral PrEP during the reporting period.</p> <p>GAM 3.15: number of people who received oral PrEP at least once during the reporting period (stratified by populations eligible for PrEP).</p> <p>MER PREP_NEW: number of individuals newly enrolled on oral PrEP to prevent HIV infection in the reporting period (disaggregated by populations eligible for PrEP).</p> <p>Possible: survey data, e.g. in the last six months have you taken PrEP?</p>
Correct/consistent use	<p>The number and percentage of those initiated on oral PrEP who have persisted on oral PrEP as prescribed for three consecutive months. Studies are ongoing on the optimal prescription regimen for the different populations—e.g. non-daily PrEP for gay men and other men who have sex with men—so this operational definition should be adapted accordingly for specific populations.</p> <p>Note that inconsistent use—especially when looking at long term use—might be due to a lack of adherence, but also can be due to the fact that an individual is no longer at substantial risk for HIV. With this cascade it must be kept in mind that individuals move in and out of the at-risk status.</p>	<p>Preferred: PrEP programme data.</p> <p>Possible: survey data, e.g. do you take PrEP daily as prescribed, or non-daily as prescribed?</p>

Note: If the PrEP programme records the data per individual over time (screened—eligible—initiated—continued), this could be a longitudinal cascade.

Figure 7 illustrates the basic PrEP cascade approach for adolescent girls and young women in sites in Kenya supported by Jilinde—a project rolling out PrEP in public health facilities—between February 2017 and September 2019. It is modified from the basic approach with respect to the focus population, including adolescent girls and young women who tested HIV-negative. Furthermore, the data are affected by the limitations of the national monitoring and evaluation system. For example, the data on the number of adolescent girls and young women testing negative, being screened and eligible are aggregated, which can lead to duplication due to repeated testing/screening. In addition, there are gaps in documentation of screening for PrEP eligibility. In this example, the key gaps for programmers are to ensure that those who are eligible for PrEP are assessed and that there is consistent use among those who take it up.

The Jilinde project team regularly summarizes and analyses the programme data using the cascade approach and the results are reviewed during the monthly, quarterly and annual programme and data review meetings. Table 7 summarizes the four main purposes of the cascade analysis for the project.

Figure 7.

PrEP cascade for adolescent girls and young women (AGYW), Kenya, 2017–2019. Data provided by D. Were, Jilinde Project (For the percentages, the denominator of each successive step is derived from the former)

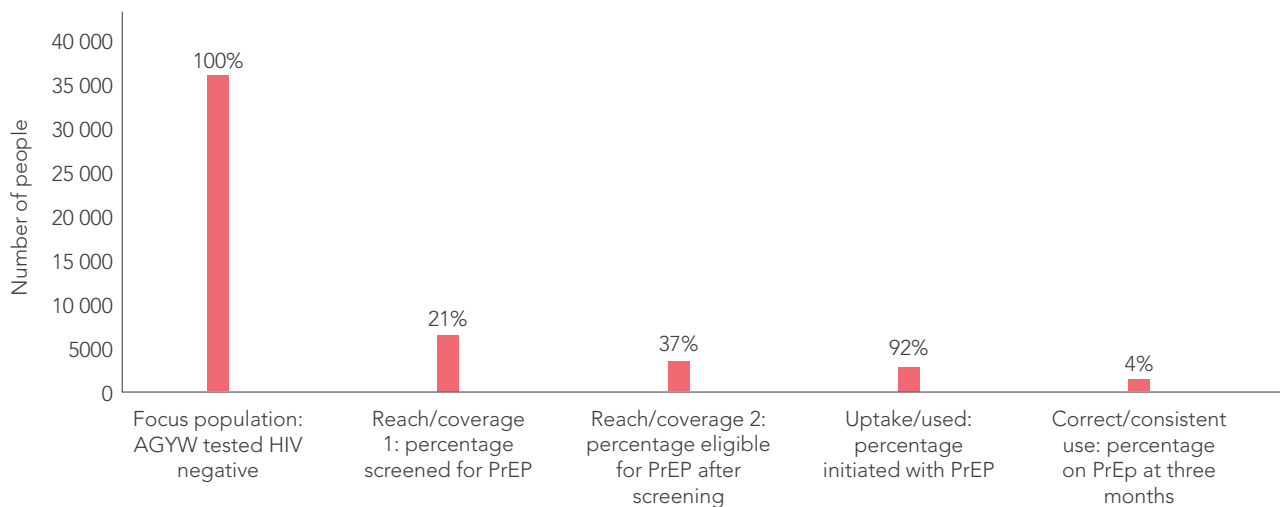


Table 7.

Purposes of the prevention cascade analysis.

Data provided by D. Were, Jilinde Project Kenya (19)

Identifying gaps	By analysing the cascade, the team continuously identified which elements of the programme were doing well and the missed opportunities that the team needed to address. For example, missed opportunities in screening for PrEP eligibility were highest for adolescent girls and young women (78%), followed by female sex workers (58%) and gay men and other men who have sex with men (45%). On the other hand missed opportunities for PrEP initiation were lowest among adolescent girls and young women (8%) compared with female sex workers (72%) and gay men and other men who have sex with men (75%). Furthermore, continuation rates were low across all populations at one month (ranging from 29% to 32%) and three months (6–8%).
Identifying research questions and hypotheses	Several gaps that the team noted in the cascade cannot be explained through routine programme data. Therefore, the team designed hypotheses and research questions based on the cascade, which the team studied to elicit answers on why the gaps in the cascade exist. For instance, the team designed studies to understand why there is low PrEP uptake among adolescent girls and young women and the reasons underpinning the low PrEP continuation. Stigma (self, by others) was found to negatively impact on both PrEP uptake and continuation among adolescent girls and young women, female sex workers and gay men and other men who have sex with men (43). Furthermore, intrinsic motivation, receiving a form of interpersonal social support and access to adequate information were predominant incentives for continuing on PrEP. Adolescent girls and young women identified product challenges (e.g. side effects, taking a pill every day) as the main drawbacks prompting discontinuation of PrEP.
Advocacy	Through regular review meetings of the data presented through the cascade, and findings from the implementation science studies to further understand the gaps in the cascade, the team packaged the evidence to inform advocacy efforts. For instance, to increase reach and coverage, the team supported the devolved (county) government in Migori in diversifying PrEP delivery channels that were initially restricted to comprehensive care centres/HIV treatment clinics. Through this successful advocacy effort, PrEP was diversified and is currently offered in family planning clinics, maternal and child health clinics, outpatient departments and through community delivery platforms such as outreach in safe spaces.
Course correction	The team has trained health care workers from the health facilities that are supported through quality improvement processes. Subsequently, each health facility designed quality improvement projects based on their facility specific cascade. The health providers in a given facility analysed their facility specific cascade and identified bottlenecks to service delivery during their monthly review meeting and subsequently instituted corrective actions. For instance, some facilities identified long arduous referral pathways as the challenge leading to low uptake and revised their referral pathways to ensure that PrEP is offered through a 'one stop shop' approach.

Another illustration of the basic PrEP cascade approach has been published using data from Princess PrEP, Thailand's largest key population-led PrEP programme (including cascades for gay men and other men who have sex with men and transgender women) in 2019 (20).

Example 3: Voluntary medical male circumcision cascade approach

Male circumcision was recommended by WHO and UNAIDS in 2007 as an HIV prevention method in settings of high HIV prevalence (reflected in UNAIDS Pillar 4) (44). VMMC does not provide full protection from the HIV infection, but it does contribute, along with other protective measures, to reducing the risk of HIV acquisition among adolescent boys and men. The population level impact of male circumcision will be greatest in settings where the prevalence of heterosexually transmitted HIV infection is high, the levels of male circumcision are low and populations at risk of HIV are large (such as countries or subnational areas). A population level impact of male circumcision on HIV transmission in such settings is not likely until a large proportion of men are circumcised, although benefit to the individual male is expected in the short term. In 2020, the updated WHO guidelines on VMMC recommended that it should continue to be promoted as an additional efficacious HIV prevention option within combination prevention for adolescents 15 years and older and adult men in settings with generalized epidemics to reduce the risk of heterosexually acquired HIV infection (45).

A basic VMMC cascade approach is presented in Figure 8. This cascade can be modified to be aligned with the programme/country context and can be created for different age groups (e.g. adolescents and adult men). The operational definitions and data sources of the different steps in the basic VMMC cascade are given in Table 8. Although this cascade only focuses on VMMC, as indicated above it should be combined with other protective measures, e.g. condoms. This cascade is based largely on programme data.

Figure 8.

Basic VMMC cascade approach (illustrative)

(For the percentages, the denominator of each successive step is derived from the former)

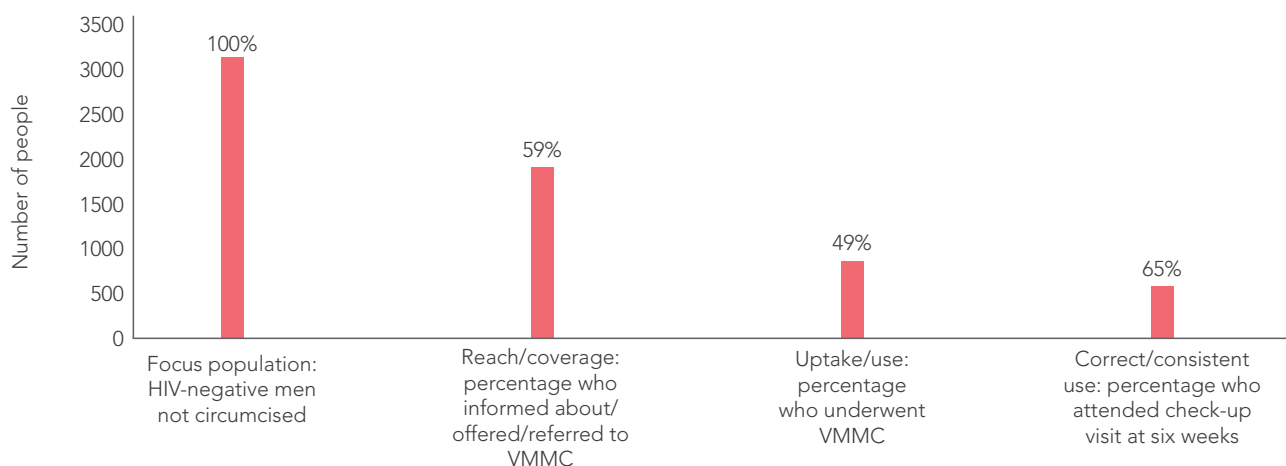


Table 8.

Operational definitions and data sources of the different steps in the basic VMMC cascade

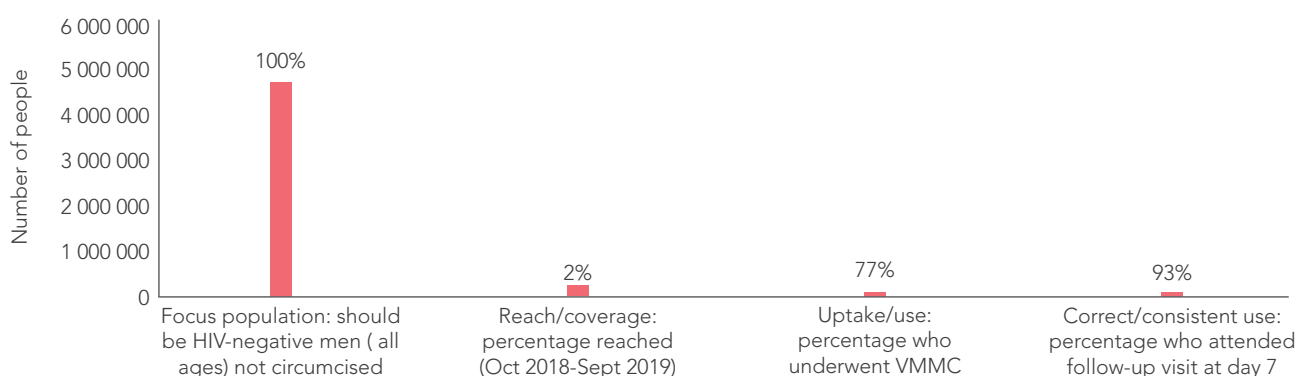
Cascade step	Operational definition	Data sources
Focus population	<p>Total number of HIV-negative men (in a specified priority group), not circumcised, at a specified point in time, in a high HIV prevalence country or subnational area.</p> <p>The age/risk group depends on who is prioritized by the country or programme, so this could be younger males (15–30 years).</p> <p>The focus population should only include men who have not undergone VMMC. If men are traditionally circumcised in a manner comparable to VMMC—e.g. when the complete foreskin is removed rather than a small cut—they can be excluded from the focus population. However, if the traditional circumcision is partial, i.e. the biological effectiveness is different from VMMC, these men should in principle undergo VMMC and hence be included in the focus population. This will be population/country dependent.</p>	<p>Population size estimates (country or subnational area), if possible adjusted for HIV status (using HIV prevalence), VMMC status (using VMMC prevalence) and priority group characteristics.</p> <p>In the case of limited resources, the VMMC target could also potentially be used.</p>
Reach/coverage	<p>The number and percentage of the focus population who were informed about VMMC, or who were offered/referred for VMMC, or who are planning to get circumcised, or who had access to VMMC in the past 12 months.</p>	<p>Preferred: VMMC programme data.</p> <p>Possible: survey data, e.g. are you planning to get circumcised?</p>
Uptake/use	<p>Of those who were reached/covered, the number or percentage who underwent VMMC according to the national standard in the past 12 months.</p> <p>In case there are no data for the reach/coverage indicator, it will be of the number and percentage of the focus population who underwent a VMMC.</p>	<p>Preferred: VMMC programme data.</p> <p>Options:</p> <p>WHO DfC.1: number of voluntary medical male circumcisions performed during the reporting period according to national standards.</p> <p>GAM 3.17: number of males circumcised during the past 12 months according to national standards.</p> <p>MER VMMC_CIRC: number of males circumcised as part of the VMMC for HIV prevention programme within the reporting period.</p> <p>Possible: survey data.</p>
Correct/consistent use	<p>Because VMMC is a one-time procedure, it is not easy to define this bar. However, because the efficacy of VMMC is associated with both the procedure and post-procedure practices, this step focuses on the number and percentage of males who underwent VMMC who returned for a routine follow-up visit at seven days after surgery or after device removal, or at six weeks (as recommended by WHO) (46).</p>	<p>Preferred: VMMC programme data.</p> <p>Possible: survey data.</p>

Figure 9 illustrates the basic VMCC cascade approach for men of all ages in Zimbabwe in 2018–2019. Reach was defined as being informed about VMMC by an interpersonal communication agent. Only a small proportion of HIV-negative uncircumcised men was informed about VMMC, but three-quarters of those who were underwent the procedure; follow-up after a week was high. The Population Services International Zimbabwe programme has used this cascade approach to assess programme leakages, to identify where gaps exist and to design solutions for them. For example, a study was set up to assess the effectiveness of human-centred design to shed light on demand creation on VMMC uptake in Zimbabwe.

An effort was made to also create this cascade at a national level, but one of the problems encountered was that data are collected on the number of follow-up visits and not on the number of circumcised men who attended a follow-up visit (47).

Figure 9.

VMMC cascade for men of all ages in Zimbabwe, 2018. Data provided by N. Taruberekera, Population Services International Zimbabwe
(For the percentages, the denominator of each successive step is derived from the former)



Example 4: Needle and syringe programme cascade approach

Providing access to and encouraging utilization of sterile needles and syringes for people who inject/use drugs (PWID) is considered to be a fundamental component of any comprehensive and effective HIV-prevention programme for this group. A variety of measures have been developed to improve access to and utilization of sterile injecting equipment, including needle–syringe programmes (48). Attempts to increase the availability of sterile injecting equipment should be accompanied by efforts to increase its utilization.

A basic needle–syringe programme cascade approach is presented in Figure 10 and the operational definitions and data sources of the different steps are given in Table 9. This cascade is based largely on programme data. The approach can be adapted to the context in the respective programme/country.

Figure 10.

Basic needle–syringe programme cascade approach (illustrative)

(For the percentages, the denominator of each successive step is derived from the former; PWID: persons who inject/use drugs)

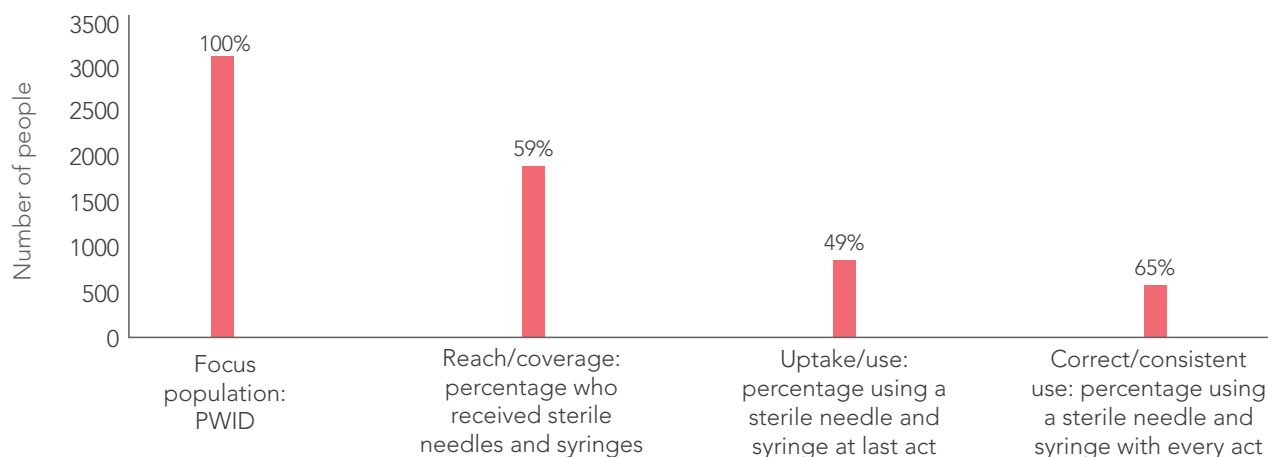


Table 9.

Operational definitions and data sources for the different steps in the basic needle–syringe programme cascade approach

Cascade step	Operational definition	Data sources
Focus population	The number of people who inject drugs who had injected in the past 12 months at a specified point in time in a country or subnational area (49).	Preferred: size estimates of people who inject drugs. In the case of limited resources, the NSP target could also potentially be used, but since these are usually 60% of the population, the cascade will be overestimating performance of the NSP.
Reach/coverage	The number and percentage of the focus population who received sterile needles and syringes at least once or knew where to obtain these in the past 12 months. In several countries needles and syringes can be purchased legally in pharmacies without a prescription—outside of the NSP programme—which affects the reach/coverage proportion.	Preferred: NSP data. Possible: survey data, for example: are sterile needles and syringes available when you need them? Or: have you received sterile needles or syringes free of charge? (50)
Uptake/use	Of those who were reached/covered, the number and percentage who used a sterile needle and syringe the last time they injected in the past 12 months. This implies that there are sufficient needles and syringes to cover injection acts. However, this is not the case for most programmes for people who inject drugs.	Preferred: NSP data. Options: WHO KP.4: number of survey respondents who used a sterile needle and syringe the last time they injected drugs (they should have injected drugs at least once at any time in the past month). GAM 3.8: number (or percentage) of people who inject drugs who report using sterile injecting equipment the last time they injected drugs. Possible: survey data.

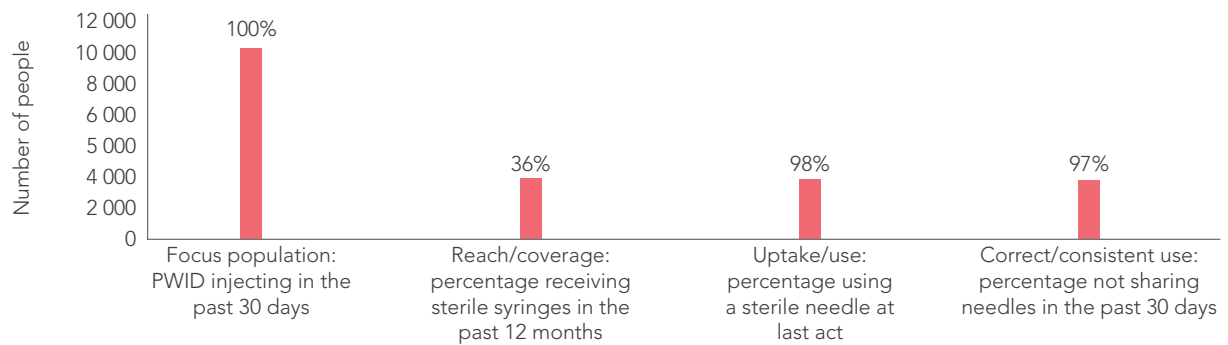
Correct/ consistent use	<p>Of those who took up or used sterile needles and syringes, the number and percentage who used a sterile needle and syringe with every act in the past month.</p> <p>There can be social desirability bias leading to overestimation of this proportion.</p>	<p>Preferred: NSP data</p> <p>Possible: survey data, for example: in the last month when you injected, how often did you use a new, sterile needle? By new sterile needle is meant a needle never used before by anyone:</p> <ul style="list-style-type: none"> ▪ Never ▪ Rarely ▪ Half of the time ▪ Most of the time ▪ Always
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Figure 11 presents an illustration of the basic needle–syringe programme cascade approach in Ukraine. It is not based on programme data, but on data from an IBBS conducted in 2017 and the last step has been modified to “not sharing needles in the past month” due to data availability. Note that based on this cascade, one would conclude that reach/coverage is very low, while (consistent) use is very high. However, in countries like Ukraine, where sterile syringes are cheap and openly sold in pharmacies, provision of syringes by a programme greatly underestimates the true coverage. In fact, 97% of all people who inject drugs (not only those who received sterile syringes) reported having used a sterile needle during the last injection act and 93% of all people who inject drugs reported not sharing needles in the past 30 days, although these percentages might be higher than in reality due to social desirability bias. Thus, the cascade approach could possibly be modified by removing the reach/coverage step or adding data in this step on receiving syringes outside the programme. On the other hand, low programme coverage might have implications for other prevention services besides needle provision, e.g. HIV testing and condom provision and hence it is important that the cascade includes information.

Although Ukraine used needle–syringe programme coverage data to define targets for the Global Fund to Fight AIDS, Tuberculosis and Malaria application in 2020, the cascade framework as a whole was not used for some of the reasons related to the limitations of the cascade mentioned above. First, people who inject drugs obtain syringes from sources other than needle–syringe programmes, and ‘effective use’ can be achieved without such programmes. Second, there is a strong self-report bias in ‘effective use’ which cannot be estimated and thus cannot measure progress. Third, a common view is that the only gap that should be addressed for HIV prevention for people who inject drugs is the lack of syringes/needles, i.e. there is no need to motivate people who inject drugs to use them. If they have enough sterile syringes/needles, they almost always use them, regardless of HIV risk considerations. Overall, a cascade whereby all the bars are expressed using the target population as the denominator might be more relevant for the needle–syringe programmes in Ukraine (21). Furthermore, additional data are needed for programme planning in addition to those captured in a cascade. For effective use, it is important to know whether those accessing needle–syringe programmes share syringes less frequently than people who inject drugs. It is also important to note that HIV can be transmitted not only through direct syringe sharing, but through other injection behaviours (back/front loading, container sharing, etc.), which should be addressed by prevention programmes through means other than provision of syringes and needles.

Figure 11.

Needle–syringe programme cascade for people who inject drugs in Ukraine, 2017
(For the percentages, the denominator of each successive step is derived from the former)



Source: Adapted from Varetska, 2019 (51), data provided by K. Dumchev, Ukrainian Institute on Public Health Policy

Another illustration of the basic needle–syringe programme cascade approach has been published (including a condom cascade for people who inject drugs) using data from the 2014 national bio-behavioural surveillance survey in the Islamic Republic of Iran (52).

HIV combination prevention cascades approach

Example: Key populations and adolescent girls and young women

Several HIV prevention methods have proved effective when used consistently, but no single prevention approach has the ability to stop the epidemic on its own (53). Combinations of prevention methods are needed to maximize the likelihood that one or more will be taken up and used effectively. Combination prevention packages comprise a range of biomedical, behavioural and structural approaches and should be tailored to specific key and priority populations.

All key populations, which by definition are at higher risk for acquiring HIV, should be reached by combination prevention programmes that are evidence informed and based on human rights. Comprehensive packages of prevention methods should include, as appropriate to the population, a mix of such measures as: comprehensive condom and lubricant programming; harm reduction interventions, in particular needle–syringe programmes and OST, for substance users; behavioural interventions; HTS and referral/linkage to HIV treatment if positive; oral PrEP and PEP; and VMMC (54).

For the priority population of adolescent girls and young women (and their male partners) at substantial risk of HIV (HIV incidence of about 3 per 100 person-years or higher) in high prevalence locations, particularly in Africa, combination prevention programmes are equally important (UNAIDS Pillar 1). The comprehensive packages should include condoms, social and behavioural change communication programmes, school-based prevention, gender-based violence prevention, oral PrEP and HTS and referral/linkage to HIV treatment and VMMC (55).

Combination prevention programmes can either be covered in separate cascades for the different package components (as discussed earlier) or in one cascade combining two (or more) components. It is quite difficult to devise cascades for multicomponent, combination prevention programmes in part because individuals may not be using all of the relevant prevention methods,

Thus, the basic combination cascade approach presented here (Figure 12) begins with defining the focus population, then assessing the provision (reach/coverage) of a package of prevention methods relevant to that population. In this example, two common prevention methods are included — condoms (with compatible lubricant if required) and oral PrEP. Uptake/use and correct and/or consistent use are assessed for *at least one* of the two effective prevention methods. More implementation research is needed to determine how best to capture and represent a combination prevention intervention that has more than two components.

The corresponding operational definitions and data sources for the cascade steps for the combination of condoms and PrEP are described in Table 10. This cascade is based largely on programme data. The approach can be adapted to the context in the respective programme/country. In addition to the example given, other cascade approaches can be created for key populations and adolescent girls and young women, including interventions that are part of the combination prevention package, for example comprehensive sexuality education and condoms for adolescent girls and young women, or condoms and needle–syringe programmes for people who inject drugs.

Figure 12.

Basic combination prevention cascade approach for key population (KP) and adolescent girls and young women (AGYW)—condoms and/or PrEP (illustrative)

(For the percentages, the denominator of each successive step is derived from the former)

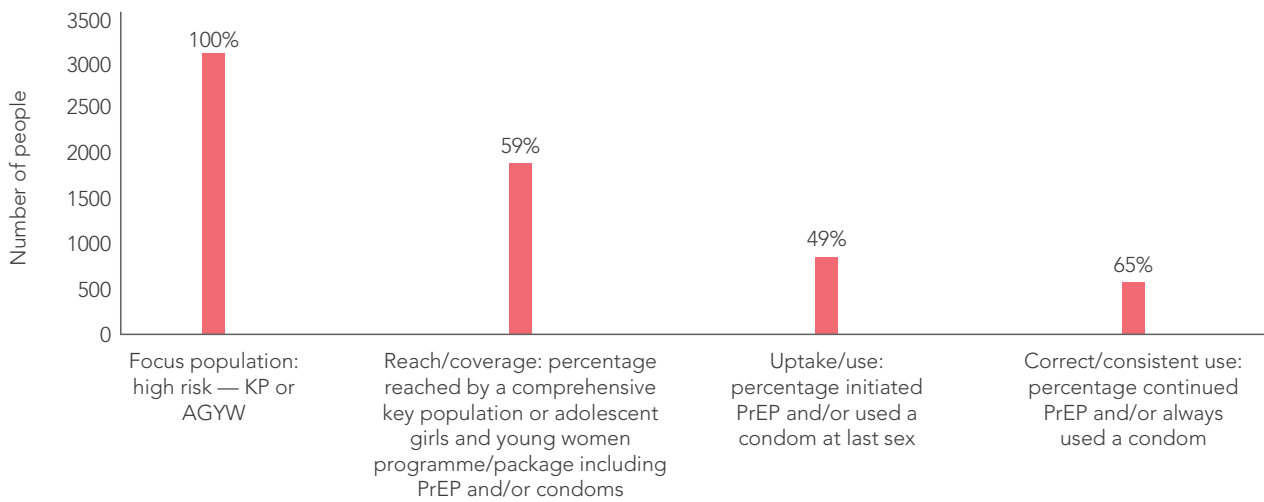


Table 10.

Operational definitions and data sources of the different steps in the basic combination prevention cascade approach for key populations and adolescent girls and young women

Cascade step	Operational definition	Data sources
Focus population	<p>The number of at-risk key population and adolescent girls and young women at a specified point in time, in a country or subnational area.</p> <p>At-risk will be contextual (depending on incidence and risk factors) and can differ between countries/programmes.</p> <p>If the combination prevention includes PrEP or VMMC, then only HIV-negative people should be included in the focus population. A cascade looking at condoms plus NSP will include people living with HIV and those with an unknown status besides HIV-negative people.</p>	<p>Preferred:</p> <p>Key populations: size estimates, if possible adjusted for HIV status (using HIV prevalence) and risk status (using survey data).</p> <p>Adolescent girls and young women: population size estimates, if possible adjusted for HIV status (using HIV prevalence) and risk status (using survey data).</p> <p>In the case of limited resources, the key population/ adolescent girls and young women programme coverage target could also potentially be used.</p>
Reach/coverage	<p>The number and percentage of the focus population that has been reached (e.g. at least four times in the past 12 months or as defined by the programme) by a key population/adolescent girls and young women programme/comprehensive package of prevention methods.</p> <p>For the purpose of this cascade, the package should include provision for condoms (and compatible lubricant) and offer of oral PrEP.</p>	<p>Preferred: key population or adolescent girls and young women programme data.</p> <p>Options:</p> <p>MER AGYW_PREV: numerator—Number of active DREAMS beneficiaries who have completed at least the DREAMS primary package of services/interventions as of the end of the reporting period</p> <p>WHO KP.1/GAM3.7: number of surveyed people in a key population who have received a defined, evidence-based package of HIV prevention interventions (consistent with WHO guidelines) within a defined timeframe.</p> <p>MER KP_PREV: numerator: number of key populations reached with individual and/or small group-level HIV prevention interventions designed for the target population (also GF KP-1).</p> <p>Possible: survey data—depending on the population of interest, this can be covered by questions such as:</p> <p>Adolescent girls and young women: have you taken part in any of the following HIV prevention programmes?</p> <p>Has a peer educator or outreach worker ever talked to you about HIV?</p> <p>The last time you met a peer educator or outreach worker, what items did you receive? When has a health-care provider last offered or discussed PrEP with you?</p>
Use/uptake	<p>Of those who were reached/covered, the number and percentage who used/took up an effective prevention method:</p> <p>Initiated oral PrEP, in the past 12 months and/or used a condom (and compatible lubricant) the last time they had high-risk sex, in the past 12 months.</p>	<p>Preferred: Key population or adolescent girls and young women programme data.</p> <p>Possible: survey data.</p> <p>For examples, see the data sources for the condom and PrEP cascades.</p>
Correct/consistent use	<p>Of those who used/took up an effective prevention method, the number and % who correctly/consistently used it:</p> <p>Continued on oral PrEP as prescribed for three consecutive months and/or used a condom (and compatible lubricant) every time they had high-risk sex, in the past month.</p>	<p>Preferred: key population or adolescent girls and young women programme data.</p> <p>Possible: survey data (for examples see the data sources for the condom and PrEP cascades.)</p>

No published or unpublished illustrations of the theoretical combination prevention cascade for adolescent girls and young women or key populations presented above could be found, underscoring the complexities of such cascades. When the editors of a 2020 special supplement of the *Journal of the International AIDS Society* on 'Data-driven HIV Prevention' called explicitly for submissions of examples of cascade analyses, nearly all papers received focused on single methods of prevention (7). The closest example of a 'combination' cascade in the literature is based on routine data from a female sex worker programme in Zimbabwe, but this largely includes single cascades on condom use and PrEP, with only one bar combining the two interventions ('covered by condoms or PrEP') (15). When conducting the country-level testing, both countries felt that it would be feasible to construct combination prevention cascades using programme data if programmatic monitoring was improved.

In addition, both Ghana and China, where the draft guidance was tested, suggested that a combination prevention cascade be developed focusing on overall programme performance and not specific prevention interventions. This cascade would start with the focus population, followed by those reached (once or more) with outreach services, e.g. in the past year (reach/coverage), followed by those taking up any clinical services, including routine services during the same period (uptake/use), followed by those taking up these services regularly, e.g. once or more in each quarter of the year (correct/consistent use).



Credit: Courtesy of School Rainbow, UNAIDS Asia Pacific

Data quality and improvement

Prevention cascades ideally should be based on one data source, but often a mix of data from different sources will be used in one cascade. Data used in cascades (whether for prevention or treatment) may not always be perfect. While this may make it difficult to construct a perfect cascade, the goal should be to use the best data available while continuing to look at ways to improve it and use the data that are available to improve programmes continuously.

When conducting a prevention cascade analysis, it is important to have a good understanding of the sources of data, how data are reported, whether the data quality has been assessed, e.g. for completeness, accuracy and double counting, and any limitations the data may have, as this will determine if the data can be used and, if so, how they should be interpreted. Recognizing and documenting the limitations of available data sources is important for accurately interpreting cascades.

As shown in the sample prevention cascades above, data sources from which HIV prevention cascades may be developed include population size estimates, routine programme data and behavioural surveys. Population size estimates of at-risk populations are used to determine the size of the focus population and hence are the denominator from which the next step in the cascade is derived. A problem can occur when no recent size estimates are available, no size estimates are available for the specific geographical area considered, or when no size estimates are available that are considered correct. Furthermore, prevention cascades require sample size estimates of those who are most at risk. This is particularly challenging for key populations, such as gay men and other men who have sex with men and people who use/inject drugs who often are hidden (56–58). Since each size estimation method has both strengths and limitations, it is important to apply multiple methods to generate multiple estimates and triangulate them to reach both a point estimate and a range. Different cascades could be created using different size estimates to examine the impact of this uncertainty on the next steps in the cascade.

Programme data are frequently collected (more frequently as survey data) and hence are the core of information on HIV prevention reach/coverage and (correct/consistent) use. However, the data that are needed to create prevention cascades may not in all cases be collected by the programme. Additionally, programme data often are difficult to disaggregate by key population, although it is a positive development that the different health information systems (such as DHIS2) are progressing to make provision for key population data.

Other developments which might be useful in this respect are the following:

- (1) *Key population trusted access platforms*. These are a foundation on which effective key population programmes are built, on which a range of community and clinic based interventions and services are provided. It is also a way of working with key population communities to establish trust and improve access to services involving close collaboration on programme design, implementation, monitoring and addressing critical enablers (59).
- (2) *Microplanning*. A microplan is a live (continually updated) tool that helps a peer outreach worker plan, prioritize and follow up on prevention services, based on the risk and vulnerability of each individual (60). Because the majority of prevention

programming for key populations in low and middle-income countries is externally funded by NGOs, the data collected are often reported to donors, rather than to national HIV programmes. While the cascades might be used by projects funded by donors, using the same indicators in reporting will allow governments to aggregate the data to assess prevention programming at the national level since scale and coverage are necessary not just within a project but for the country.

IBBS data provide specific population-level estimates for HIV-related risk factors and uptake of HIV prevention services. The benefits of behavioural surveillance are that it uses a consistent sampling methodology (aiming to limit selection bias and to ensure a representative sample), data collection methods and indicators to track trends in behaviour over time. However, this usually involves self-reporting, which may be influenced by social desirability bias or recall bias. Furthermore, population surveys, in general, are logistically complicated and expensive and, as a result, only conducted every couple of years.

Data that are available through surveys and not routine programme data could be collected by implementing routine programmatic survey methods. These include: frequent mini-surveys ('IBBS light'), polling booth surveys (61, 62) or computer assisted methods such as audio computer-assisted self-interviews (both methods are more anonymous than individual surveys) conducted either in clinics or the community to assess condom use. These can be validated with less frequent, more rigorous population based surveys every three–four years). Another option is small area surveys (63).

Other resources provide details on how best to collect the kinds of monitoring data that are included in HIV prevention cascades, as well as their strengths, biases and limitations (6, 26).

High quality data are important for all aspects of programming, not just cascades. While working with the data, efforts should be made to improve their quality, including adopting new methods that can increase their validity, completeness, timeliness and representativeness—all measures of high quality. For example, new ways to develop more comprehensive estimates should be explored, e.g. by making use of social media apps (64).

Another method that is beneficial for prevention cascades is the use of unique identifier codes (UICs). These are alphanumeric codes assigned to individuals to accurately track their interactions with service providers while enhancing their anonymity and confidentiality. In addition:

- UICs avoid double counting of individuals in the cascade. For example, if the same female sex worker regularly comes to collect PrEP, she will only be counted once as 'On PrEP'.
- A UIC can assess whether individuals make use of a comprehensive package of prevention services. For example, it is possible to see if adolescent girls and young women have accessed PrEP and/or condoms.
- Unique identifiers also facilitate the ability to follow people along the HIV prevention cascade and create longitudinal prevention cascades. It is even possible to assess the ultimate goal of keeping them HIV-negative. For example, are those gay men and other men who have sex with men who indicated they used condoms consistently and correctly still HIV-negative when tested again?

More information on developing, implementing and using UICs can be found in References (65–69).

Abbreviations

AGYW	adolescent girls and young women
AIS	AIDS Indicator Survey
ART	antiretroviral therapy
CBO	community based organization
DHS	Demographic Health Survey
DREAMS	Determined, Resilient, Empowered, AIDS-Free, Mentored, and Safe
FSW	female sex worker
GAM	Global AIDS Monitoring
GMSM	gay men and other men who have sex with men
HTS	HIV testing services
IBBS	Integrated Biological and Behavioural Survey
M&E	monitoring and evaluation
MER	Monitoring, Evaluation and Reporting
MICS	Multiple Indicator Cluster Surveys
NGO	nongovernmental organization
NMNC	non-marital, non-cohabiting (partner)
NSP	needle—syringe programme
OST	opioid substitution therapy
PEP	post-exposure prophylaxis
PEPFAR	President’s Emergency Plan for AIDS Relief (USA)
PHIA	Population-based HIV Impact Assessment
PLACE	Priorities for Local AIDS Control Efforts
PLHIV	people living with HIV
PMTCT	prevention of mother-to-child transmission of HIV
PrEP	pre-exposure prophylaxis
PWID	people who inject drugs
UIC	unique identifier code
VMMC	voluntary medical male circumcision

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