Program Science Handbook

Tools for optimizing equity and impact in public health programming

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Contributors

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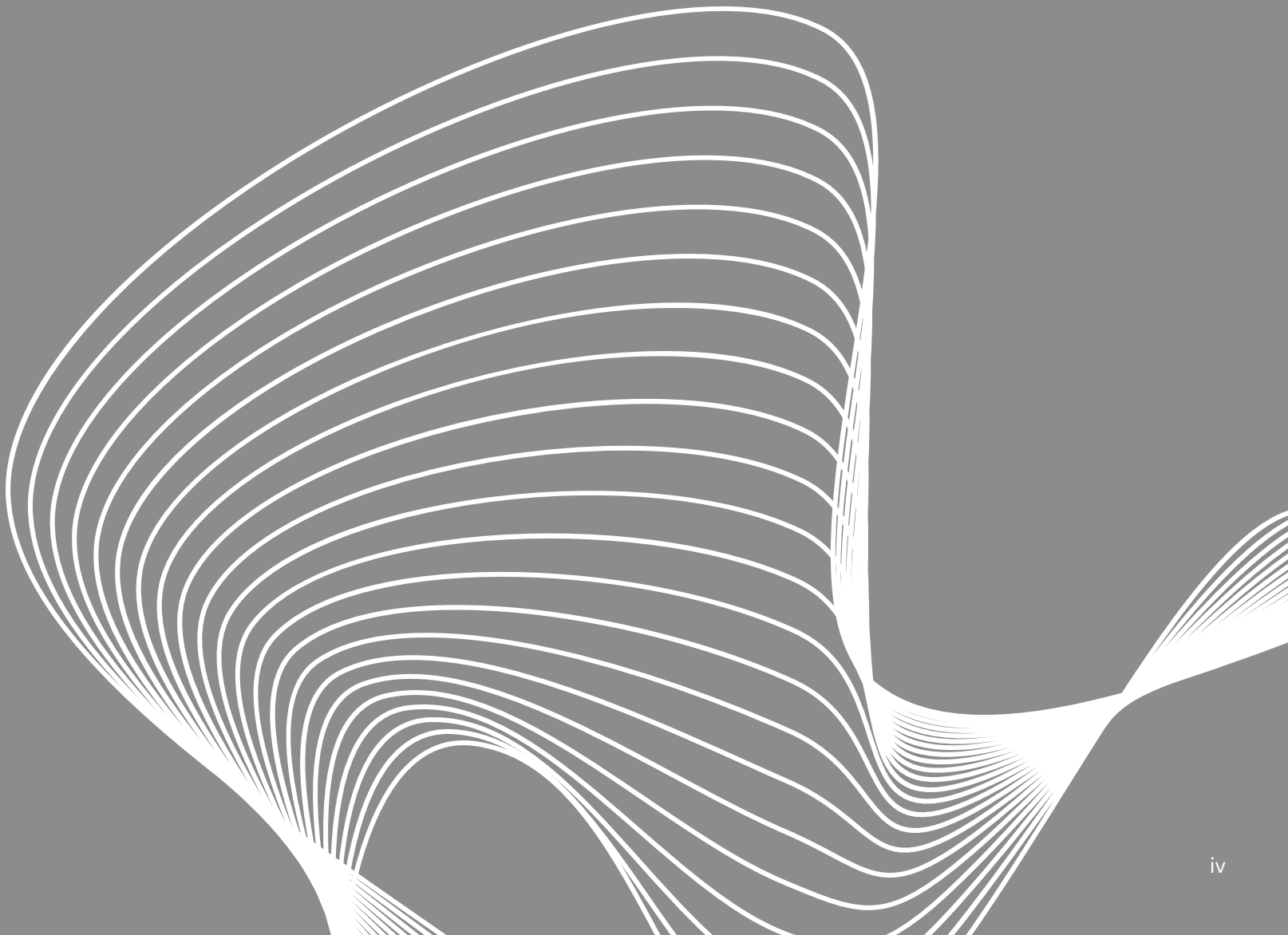


Acronyms

AI: Artificial Intelligence

AMETHIST: Adapted Microplanning to Eliminate Transmission of HIV in Sex Transactions

ART: Antiretroviral therapy

BBS: Biobehavioural surveys

CLM: Community-led monitoring

ePBS: Expanded polling booth surveys

EPCF: Effective Program Coverage Framework

EPP: Estimation and Projection Package

FGD: Focus group discussions

IBBS: Integrated biobehavioural surveys

ITPC: International Treatment Preparedness Coalition

KPSE: Key population size estimation

NACA: National Agency for the Control of AIDS (Nigeria)

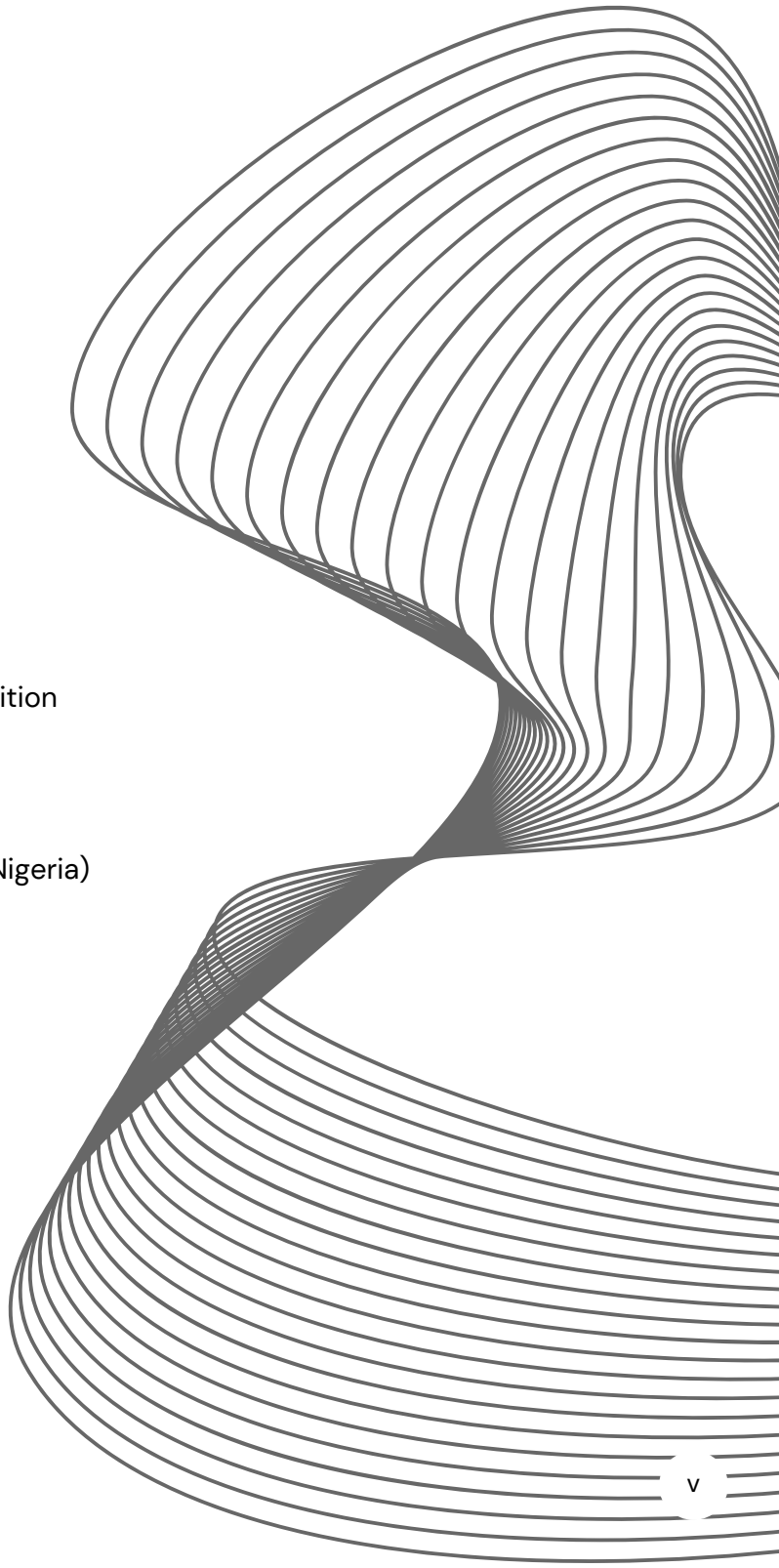
PBS: Polling booth surveys

PrEP: Pre-exposure prophylaxis

STI: Sexually transmitted infections

UIC: Unique identification codes

VMMC: Voluntary medical male circumcision



Introduction

Program Science is a public health approach that embeds scientific research within program design, implementation, monitoring, and management to improve population outcomes.[1,2] As a mechanism for generating evidence to inform ongoing improvements, Program Science helps programs remain responsive to changing local contexts and evolving epidemiological needs.[3] Program Science operates across three spheres: Strategic Planning (identifying priority populations, geographies, and epidemiological contexts), Program Implementation (selecting intervention packages and delivery platforms), and Program Management and Monitoring (tracking local epidemiology and program outputs, outcomes, and impact).[4]

The Effective Program Coverage Framework (EPCF) was developed using Program Science principles to strengthen the integration of research and learning into public health programming.[5] Although several step-by-step manuals exist for tools that facilitate a Program Science approach, no single resource shows how these tools can work together to maximize population impact and advance health equity. This handbook aims to address this gap by presenting *why*, *how*, and *when* various tools can be used to operationalize Program Science for HIV and other sexually transmitted infection (STI) programs.

Designed for program planners, implementers, academics, and community partners, this handbook emphasizes keeping interventions relevant and scalable through continuously assessing and adapting their implementation to the evolving needs of prioritized populations and geographies.[3] The handbook serves as a reference guide rather than a step-by-step, "how-to" manual, directing users to external resources for detailed methods where appropriate. Rather than cataloguing all Program Science tools, we focus on select methods across the three spheres of Program Science to illustrate how they work together to operationalize the approach holistically.

To date, Program Science has been most widely applied in HIV/STI programming, particularly in resource-constrained settings.[3] However, its principles are broadly applicable to other health areas and contexts,[6] including programs focused on chronic and other noncommunicable diseases. While the tools in this handbook strive to be adaptable beyond HIV/STI prevention, their scope reflects the current state of Program Science, which has been most extensively developed in these areas.

Program Science is a dynamic and evolving field that prioritizes the long-term sustainability of health programs.[5] Advances in applied methodologies, emerging technologies, and applications in other public health areas will continue to shape its growth. Therefore, this handbook is designed as a living document that may be updated to reflect new techniques and real-world applications.

The evolution of Program Science depends upon the collective efforts of researchers,

policymakers, program planners, implementers, and community partners. Looking ahead, this handbook serves as an invitation to continue building and advancing the field together.

Box I. Community-engaged research and learning processes

Program Science recognizes that the generation of knowledge and learning arises not only from formal research but also from the implementation and operation of programs themselves. Meaningful community engagement plays a vital role in this process, offering invaluable insights and enriching both the programs and the scientific understanding they support. Community-engaged research[7] involves collaborative partnerships between researchers and community members throughout the research process. According to Anderson et al. (2012), this approach emphasizes mutual respect, co-learning, and shared decision-making to ensure research is relevant and beneficial to the community. Community-engaged research is characterized by unique ethical complexities, such as power dynamics, informed consent, and cultural sensitivity, often requiring tailored ethics education that equips both researchers and community partners to navigate these challenges.

While community-engaged research and learning is often associated with qualitative methods due to its focus on dialogue and relationship-building, any type of research—qualitative, quantitative, or mixed methods—can adopt a community-engaged approach.

What defines community-engaged research and learning is not the methodology but the level of community involvement throughout the research process, from identifying research questions to disseminating and integrating findings.

For example, researchers can engage community members in designing surveys to ensure culturally appropriate language and relevant questions. Community partners might also assist in recruiting participants, interpreting statistical findings within the local context, and co-presenting results to stakeholders. This collaborative approach not only improves the quality and accuracy of the data but also fosters trust and ensures the research addresses community-identified priorities. Community-engaged processes can and have been employed across all Program Science spheres.

Spheres of Program Science

Program Science is defined by an iterative process[1–3] that derives research questions from programs,[8] generates new hypotheses, and reintegrates new knowledge to refine program strategies.[3] Theoretical and empirical evidence produced through program-embedded research and learning drives scientific inquiry, producing insights that are incorporated into programming to optimize service delivery and population-level impact.[3,4]

Program Science operates through three interrelated spheres that mirror the steps of a program cycle.[4]

- **Strategic Planning** informs decisions about program priorities and resource allocation, aligning with the local epidemic context—broadly, determining *where*, *what*, and *for whom* interventions should be delivered.
- **Program Implementation** guides decisions about service delivery locations and platforms, strategies for meaningful engagement with prioritized populations, and the optimal combination of interventions to meet their needs.
- **Program Management and Monitoring** generates robust evidence through an ongoing, iterative process that monitors program performance and outcomes, and guides program refinements in response to shifting epidemic patterns and evolving structural contexts.

Together, these spheres work to optimize three essential elements of a program's strategy: **populations** (including geography), **program components** (intervention packages), and **program platforms**. Within each sphere, various tools and approaches help generate and organize knowledge and program intelligence.

Complementing Implementation Science with Program Science

Implementation Science plays a critical role in translating evidence into real-world practice. It typically focuses on the early or discrete phases of implementing interventions—the "how-to" of adopting, integrating, and scaling interventions for effectiveness and fidelity. Program Science complements and extends this approach by explicitly addressing what happens after implementation. It embeds scientific inquiry across the entire program lifecycle, not only to determine which intervention packages should be implemented, but also to guide prioritization strategies that ensure the right populations and geographies at the right time. Program Science generates evidence to support programs in adapting and improving a program's component interventions as contexts evolve. This iterative, continuous process helps ensure that investments in new products, technologies, strategies, and implementation efforts remain responsive and optimized for population-level impact.

Effective Program Coverage Framework

Informed by two decades of operationalizing the Program Science approach, the EPCF enables programs to identify, quantify, and understand coverage gaps and assess their population-level impact.[2–5] The EPCF was developed in partnership with public health experts in HIV/STI, including community members, policymakers, program implementers, funders, and academics, to accelerate and improve the use of embedded research and learning, thereby maximizing program impact and advancing health equity.

As illustrated in the following figure,[5] the EPCF is a cyclical scheme rooted in Program Science and driven by the context in which public health programs operate. It begins with a program's goals and strategy, which inform required coverage targets for each program component and prioritized population. Additional dimensions of program coverage are then measured and monitored through the EPCF's coverage cascade. Coverage gaps are analyzed through routine program monitoring, with focused and embedded research as needed. The knowledge generated is considered through an equity lens to inform adjustments to the program strategy, restarting the cycle.

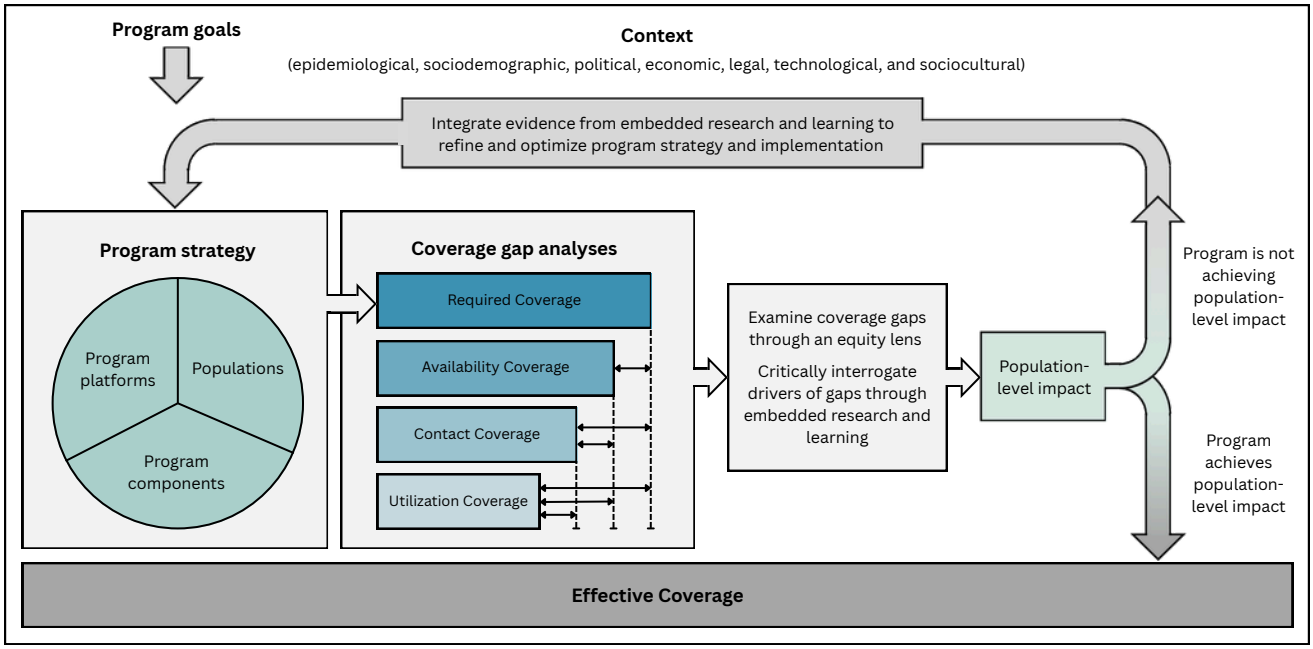


Figure 1. The Effective Program Coverage Framework

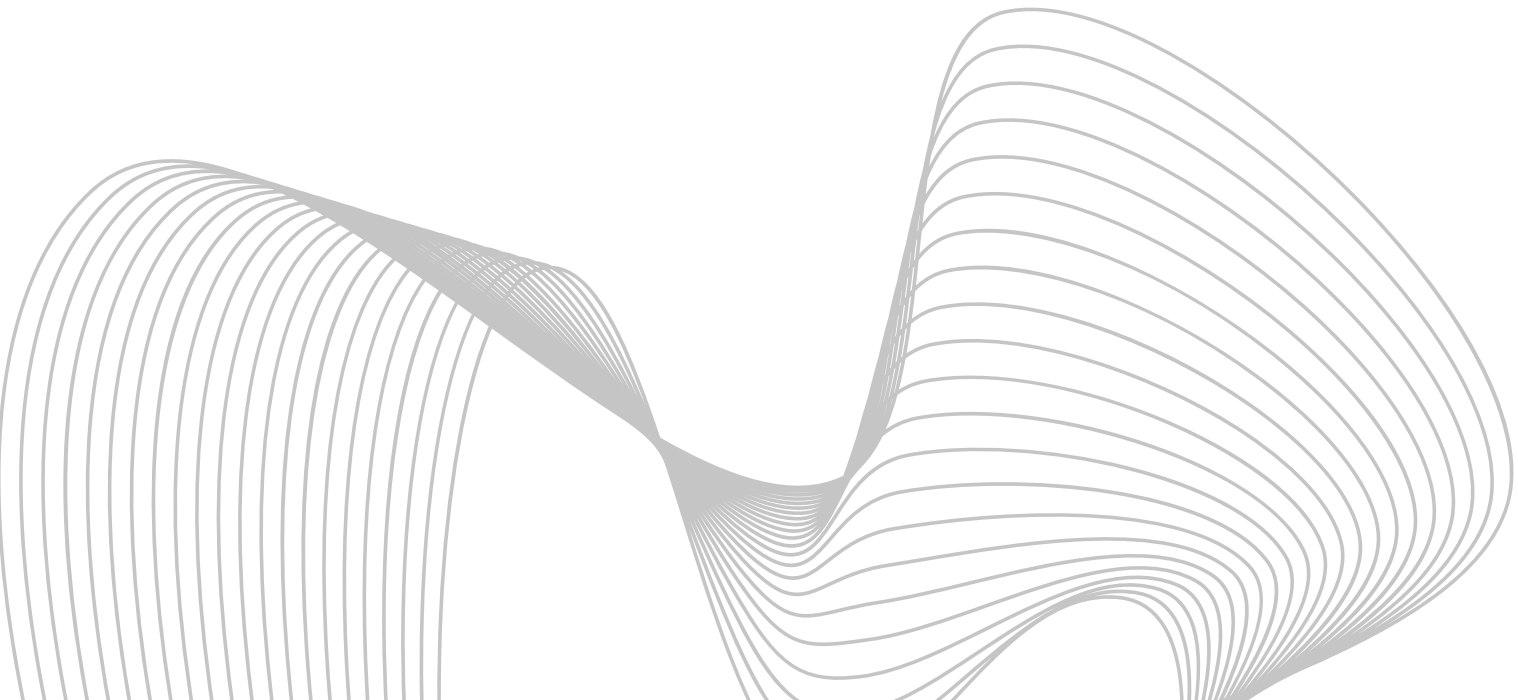
The EPCF depicts how a program's goals, strategy, and context influence each dimension of the coverage cascade. The context (e.g., epidemiological, sociodemographic, political, economic, legal, technological, and sociocultural factors) is central to all stages of program planning, implementation, scale-up, monitoring and management.[2,4,9,10] Context in the EPCF is treated as a dynamic construct that is continuously examined through embedded research and learning.

A **program's strategy** is essential for achieving its overarching public health goals and maximizing its impact. Identifying priority populations and subgroups is a crucial first step in tailoring program components to meet their specific needs in relation to the epidemic phase, local context, and available best practices and evidence. Program flexibility and adaptability are essential to accommodate the inevitable changes that both a program and the populations it serves will undergo over time. The core of a program's delivery platform is the interface between the service provider (virtual, outreach-based, or facility-based), the service provided, and the service user. Delivery mechanisms, strategies, and configurations must be designed to function effectively within this interface, at a scale that optimizes impact.

Required coverage is the first step in the EPCF's coverage cascade. It is a quantifiable metric defining which populations, in which geographies, and during what timeframes would most benefit from receiving services. It anchors all subsequent coverage steps and links program goals to measurable outcomes.[9] Other dimensions of program coverage (i.e., **availability**, **contact**, and **utilization**) are measured relative to the required coverage target, with each ideally reaching 100%. Generating coverage cascade estimates typically requires combining routine monitoring data with primary data collection guided by locally contextualized indicators and embedded learning agendas.

Once estimates are established, programs can identify and quantify **coverage gaps** through an equity lens.[11–15] Equity-focused analyses guide strategic prioritization and resource allocation, often by stratifying cascade data by geography and key sociodemographic characteristics.

After gaps are identified, embedded research is used to generate hypotheses about what drives inequalities across the cascade. Using diverse research methodologies to support rapid-cycle learning, new evidence and insights are fed back into the program to inform strategy and implementation adjustments, continuing the cycle of improvement toward maximizing a program's population-level impact.



Program Science Tools

The EPCF offers a structured approach to identifying programmatic needs, embedding research and learning within a program, and refining strategies to improve program impact and equity in outcomes at the population-level. Overlaying the three spheres of Program Science with the EPCF helps organize the tools used to support evidence-informed decision-making across the program cycle.

In the **Strategic Planning** sphere, the EPCF supports the development of a program's overarching strategy, including setting clear goals, identifying priority populations and geographies, and estimating required coverage. These foundational elements shape decisions about resource allocation and intervention design and selection. Tools that assess local epidemic context and establish reliable population denominators are critical for aligning a program's strategy with the needs for prioritized populations and enabling responsive, data-driven program implementation.

In the **Program Implementation** sphere, the EPCF provides a roadmap for monitoring service delivery through a coverage cascade. Here, tools are leveraged to assess whether services already exist (availability coverage), are accessed by those for whom they are intended (contact coverage), and are actively used (utilization coverage). These indicators help determine what services are needed, where, for whom, and how best to deliver them.

Once services are in place, tracking the coverage cascade generates data to identify coverage gaps and assess population-level impact. In the **Program Management and Monitoring** sphere, the EPCF captures the iterative process of data collection, synthesis, and interpretation. A range of tools, from national, population-based surveys to community-led monitoring (CLM), generate insights into barriers to access and inform adjustments to programs.

Throughout the cycle, the EPCF serves as a feedback mechanism, translating strategy into measurable targets and using learnings to refine and adapt programming. This embedded approach strengthens accountability and ensures that programs remain responsive to changing epidemic contexts and community needs.

This section of the handbook presents a curated selection of tools and approaches used across the three Program Science spheres. Each tool is accompanied by a description of its relevance, considerations for implementation, its contribution to knowledge generation, and an example of its real-world application. Where appropriate, readers are directed to external links for step-by-step guidance. These tools were selected for their flexibility and adaptability across diverse epidemic contexts. However, they represent only a portion of the broader and evolving toolkit for operationalizing a Program Science approach, which continues to grow through emerging innovations, applications, and shared learning across settings.

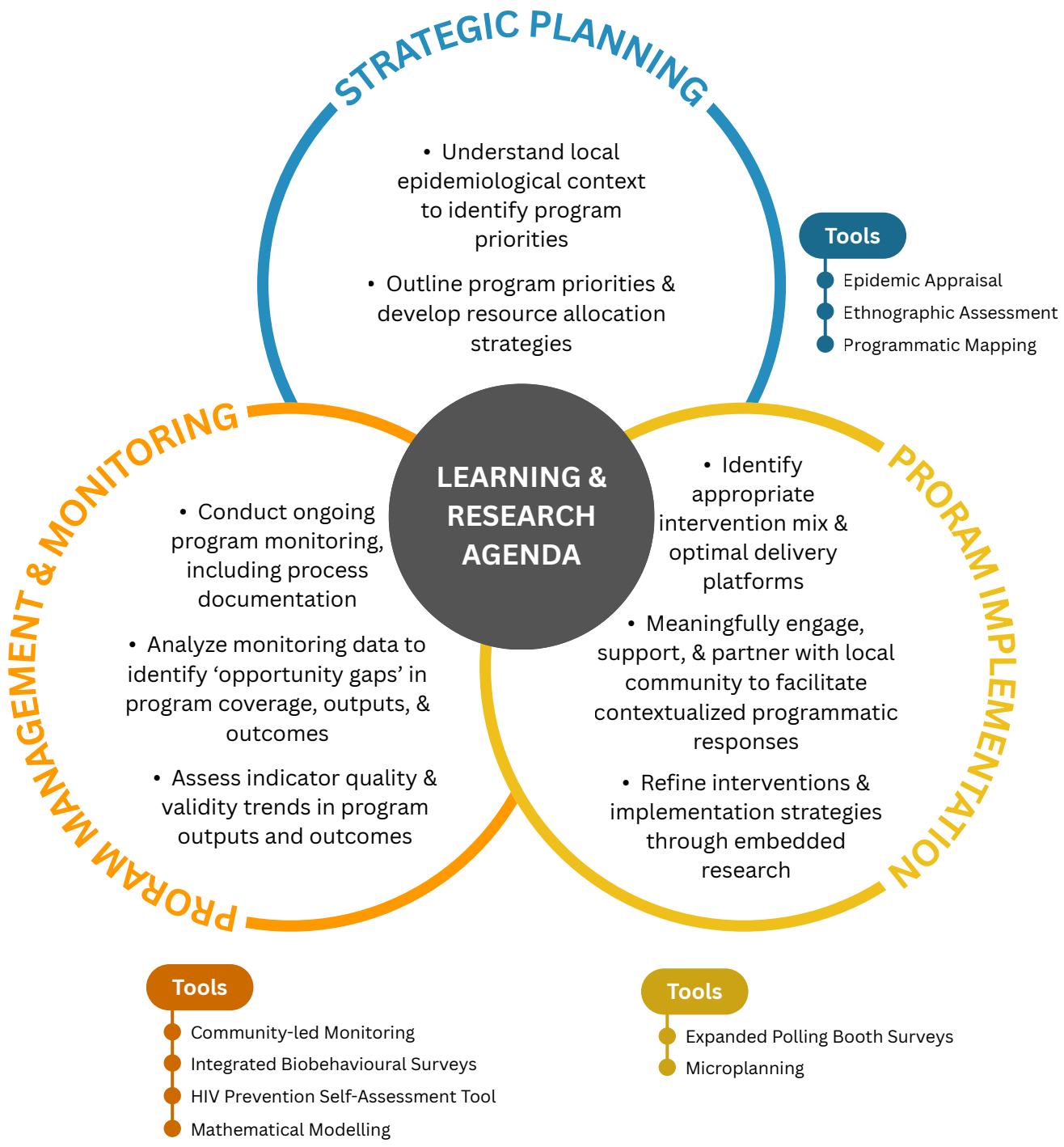


Figure 2. The Spheres of Program Science

Strategic Planning Sphere

Tools in the Strategic Planning sphere inform decisions about program priorities and resource allocation, ensuring alignment with the local epidemic context. These tools help determine the where, what, and for whom of interventions, facilitating a responsive approach to HIV/STI program planning.

Tool: Epidemic Appraisal

Why is this tool helpful for this sphere?

Current HIV guidance recommends that countries strategically scale up newer prevention interventions, such as long-acting oral pre-exposure prophylaxis (PrEP), alongside proven strategies like condom promotion, voluntary medical male circumcision (VMMC), and retention of people living with HIV on antiretroviral therapy (ART).[16] These services should be delivered efficiently and equitably to maximize coverage, reduce operational costs, and ensure sustainability.[17]

To adequately inform the development and continuous refinement of prevention programs, it is crucial to:

- understand evolving epidemiological dynamics at the national and subnational levels;
- identify population groups and locations with higher rates of HIV/STI acquisition and transmission;
- estimate population sizes; and
- characterize organizational typologies of key and prioritized populations.

The HIV epidemic appraisal tool generates evidence to identify *high-burden geographies*, derive their population sizes and prevalence, and assess existing program coverage. By characterizing heterogeneity and inequities in a given epidemiological context, the tool enables national and subnational governments to invest in sustainable strategies to reduce HIV incidence and prevalence.[18] It provides timely guidance on local transmission dynamics, epidemic drivers, and trajectories to support the targeted planning of interventions.

How does this tool generate knowledge for this sphere?

The HIV epidemic appraisal tool generates knowledge to address three specific objectives:

1. Geographic prioritization: To identify high-burden geographies by analyzing HIV prevalence and incidence at the local level.
2. Epidemic typology: To define epidemic typology by analyzing population size and HIV prevalence at the local level.
3. Program coverage gap analyses: To assess program coverage and coverage gaps by analyzing routine program monitoring data.

Priority geographies are established by obtaining the most recent information on HIV incidence and prevalence at the relevant jurisdictional level, and using data from several mathematical models (e.g., the Spectrum/Estimation and Projection Package [EPP],[19] Naomi [Network-based Approaches for Modeling HIV Incidence],[20] and Shiny90[21]) to generate national and subnational estimates.

Accurately characterizing **epidemic typologies** is an essential step in prioritizing population groups for HIV prevention. Through epidemic appraisal, this is done by analyzing three measures:

1. HIV prevalence in the general population
2. HIV prevalence among key populations
3. Density of key populations per 1000 adult males (age range to be defined as per data availability)

Meetings with partners and end-users of information generated through the epidemic appraisal can help build consensus and validate population size estimates. Based on the three measures, epidemic typologies can be categorized as concentrated, generalizing, or mixed, with each category requiring distinct program strategies.

The final component involves **program coverage gap analyses** using routine program monitoring data to identify geographies and populations where programs and services need to be scaled up to optimize coverage. The accuracy, completeness, and consistency of routine monitoring data used to measure program coverage gaps often vary across subnational units.[22]

The comprehensive picture of a regional epidemic, generated through the three steps of an epidemic appraisal approach, provides crucial evidence for developing a program strategy. Specific geographies are prioritized based on the relative incidence and density of prioritized populations, and local epidemics within those priority geographies are characterized by typology to inform the most effective program strategies for maximizing coverage and impact. Finally, routine monitoring data are used to conduct assessments of program coverage and to identify critical gaps.

Key Resources

- HIV Epidemic Appraisal in Kenya: A toolkit

Box II. Tailoring programmatic focus by epidemic typology

Concentrated epidemics are characterized by transmission primarily within key populations. In these settings, efforts should prioritize achieving high program coverage and impact among groups at elevated risk of localized transmission. Additional programmatic focuses may include supporting all people living with HIV across prioritized geographies to achieve viral suppression and ensuring that all individuals who are pregnant are routinely tested for HIV and linked to care if diagnosed. Prioritizing HIV testing and treatment during pregnancy in high-burden contexts is critical to preventing vertical transmission and can serve as a key entry point for reaching individuals and families with HIV services.

Mixed epidemics involve significant transmission within key populations alongside increasing transmission risk in the broader community, often shaped by social and structural factors that influence sexual networks and behaviours. In these contexts, programs must sustain focused interventions for key populations while expanding targeted services for other groups at elevated risk. These may include adolescents, young women, and young men (particularly in areas with historically low rates of male circumcision), as well as continued prioritization of HIV testing and treatment for pregnant individuals.

Generalizing epidemics are characterized by widespread community-level transmission, without substantial isolated contributions from distinct subpopulations. In these contexts, programmatic focus should broaden to shifting wider behavioural norms (e.g., reducing multiple and concurrent sexual partnerships, addressing gender-based violence, and reducing stigma and discrimination related to HIV that hinder uptake of testing and treatment services) while also scaling up interventions for key and other populations experiencing the greatest transmission risk. Although not the main contributors to transmission dynamics within this epidemic typology, these populations may often remain underserved due to persistent structural barriers to prevention, care, and treatment.

Adapted from HIV Epidemic Appraisal in Kenya: A toolkit (2024)

When should this tool be used?

HIV epidemic appraisals can be used to guide (sub)national strategies for prevention programming when characterizing heterogeneity and inequities, and developing programmatic responses within an epidemic are needed. Within epidemic appraisal, prioritization of geographies and populations is based not only on disease burden and epidemic typology, but also on the prevailing gaps in program coverage. For both national and subnational appraisals, this approach requires access to several pre-existing data sources and in-depth information about the geographic context. In case certain data elements are not available at the subnational level, adjustments can be made to the methodology (as detailed in HIV Epidemic Appraisal in Kenya: A toolkit [2024]).

This tool can guide the systematic prioritization of subnational geographies, populations, and programs to reach specific targets. In the context of a Program Science approach, epidemic appraisals are used as tools to support program intelligence, informing decisions related to strategic planning and resource allocation.

Example of the tool in relation to this sphere

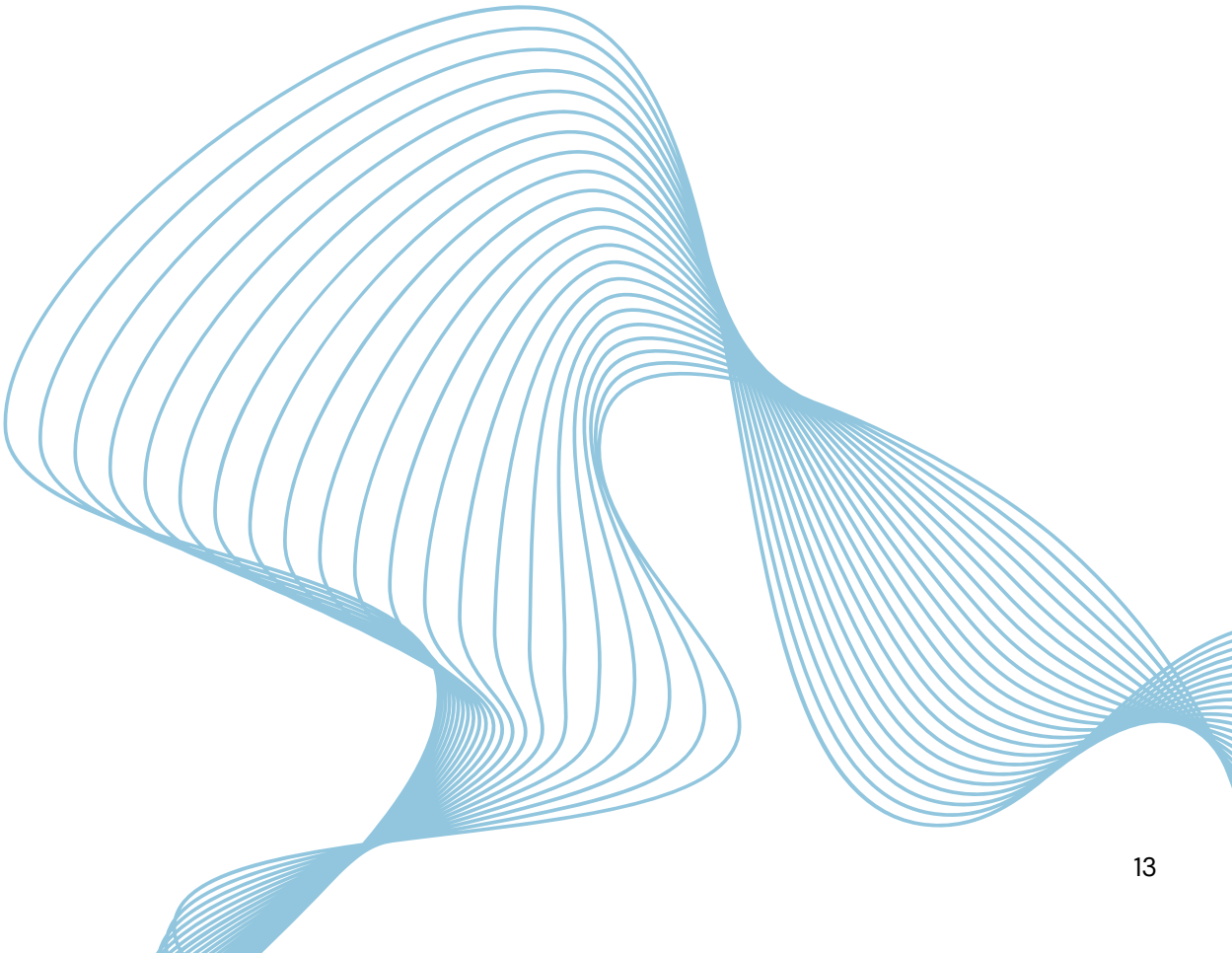
To support strategic planning for the national HIV prevention program in Kenya, in 2021-22, an epidemic appraisal was conducted at the subnational level across 47 counties, with population sizes ranging from 140,000 in Lamu to 4.4 million in Nairobi. Using several sources of existing data, the appraisal systematically prioritized the counties, populations, and programs to support the Government of Kenya's 2030 target of a 75% reduction in new HIV acquisitions. Using the 2021 national and subnational HIV incidence and prevalence estimates from Spectrum/EPP/Naomi models, counties with high HIV incidence and prevalence were identified for geographic prioritization. Local epidemic typologies were defined at the county level to prioritize populations for HIV prevention programs. Within each county, routine program monitoring data were analyzed to assess coverage gaps in HIV prevention programs. The appraisal concluded that the HIV epidemic in Kenya varied by county in terms of intensity and distribution; therefore, it would be necessary for the mix of prevention strategies to also vary accordingly. For more details, see Ramesh et al., 2024.

The main advantage of this approach was the level of granularity it afforded to better understand heterogeneity within Kenya's HIV epidemic. It highlighted that the HIV burden is unevenly distributed in Kenya, and prioritizing HIV prevention programs in counties with greater potential for new acquisitions could potentially achieve greater impact at the national level. It also illustrated how the population focus for prevention strategies can vary according to the epidemic typology (generalizing, mixed, or concentrated), and how program coverage gap analyses can help identify counties where specific programs and services need to be scaled up or reconfigured to maximize utilization.

This epidemic appraisal informed the development of the National Multisectoral HIV Prevention Acceleration Plan 2023–2030[23] for the Government of Kenya. Based on findings from the epidemic appraisal, nine counties with relatively high disease burden have since been prioritized for intensified prevention efforts. Based on the epidemic typologies of (sub)counties, the combination intervention packages offered through the HIV prevention programs were adjusted, and capacity was strengthened within counties to conduct epidemic appraisals at the subcounty level. The Government of Kenya's Acceleration Plan also committed to strengthening routine program outcome measurement and monitoring.

Critical considerations for the use of the tool

A notable advantage of the HIV epidemic appraisal tool is that it leverages existing data sources, requiring limited additional primary data collection. However, this also has implications for data quality. Inconsistencies in data collection methods, changes in reporting standards, and variations in data quality across time and sources might have affected the accuracy and comparability of the findings across counties. Furthermore, as with any modeling approach, the model outputs are affected by data quality and model assumptions. To mitigate these limitations, it is useful to first map the availability, sources, and level (e.g., national, county, subcounty) of each data element required to guide the decision on the level and components (disease burden, typology, and program gaps) of the appraisal.



Tool: Ethnographic Assessment of Epidemic Context

Why is this tool helpful for this sphere?

Program Science is, by definition, a multidisciplinary scientific approach that encompasses 'layers' of empirical evidence from the molecular to the environmental.[4] It applies conceptual frameworks grounded in mathematical, sociobehavioural, and social science theories, while also being equity-focused and aimed at addressing the concerns of the community served by the programs.[3,24]

One key 'layer' is the on-the-ground epidemiological contextual realities that can be effectively examined through a rapid ethnographic assessment. This approach employs ethnographic fieldnotes, participant observations, and qualitative interviews in an iterative data collection and analysis process to describe patterns of social interactions, attitudes, and perceptions that are crucial to the planning and delivery of HIV/STI services.

A rapid ethnographic assessment is participatory and flexible, often involving local stakeholders throughout the research process to enhance the relevance, validity, and ethical grounding of the findings. Rather than striving for comprehensive ethnographic detail, it prioritizes 'good enough' data that are reliable, actionable, and deeply informed by the perspectives of those most affected.[24–28]

These assessments are typically led by an experienced critical social scientist alongside local, community researchers or 'peer ethnographers.' Peer ethnographers are trained in basic qualitative methods, including ethnographic techniques, field immersion, participant observation, informal conversations, fieldnote writing and open-ended qualitative interviewing,[25] and qualitative data analysis. Their involvement meaningfully engages 'peers' (i.e., people already recognized as members of the community) in all stages of the assessment.[29]

Unlike conventional anthropological ethnographers, who may spend years building rapport, peer ethnographers provide access to expertise that would otherwise be difficult to attain.[24,28] They are already trusted and have connections with potential participants, and can often offer a richer representation of participants' experiences.[26]

Approaches that feature community-based participatory research build on the ideals of equitable participation, meaningful community involvement, and the importance of shared decision-making and data ownership.[30–32] Such approaches increase the strength of research collaboration with communities and the intellectual rigour of research processes.[24,33–35]

Ethnographic analyses offer rich, layered insights into the sociocultural context and the experiences of participants, highlighting the social factors that can influence risk, transmission patterns, and drivers. They uncover essential context for other layers of empirical evidence that can support the development and refinement of programmatic services and research

hypotheses. An ethnographic assessment of epidemic context provides contextually rich information that moves away from individual risk to focus on social spaces, social and sexual networks, and structural and political environments.[28]

How does this tool generate knowledge for this sphere?

This comprehensive tool offers a wealth of information about the broader social context of a program and an epidemic, as well as the individual and collective experiences of the population served by a program. This type of ethnographic assessment is conducted over a period of at least six weeks and is organized into three phases. It builds on information and data collected in other assessments, such as programmatic mapping or epidemic appraisals, to identify the locations in which the research should be conducted and initiated.

Phase 1: Participant observation, hearsay ethnography, and ethnographic field notes (Weeks 1-5)

Phase 2: Rapport-building with key participants and interlocutors, enrollment, and interview booking (Weeks 1-5)

Phase 3: In-depth interviews, all other interviews, sexual network mapping (Weeks 1-6)

Ahead of **Phase 1**, peer ethnographers receive specific training to produce information through direct participant observation (e.g., socio-spatial descriptions of venues, performances of gender and sexual networking, descriptions of interactions between social actors and power relationships, and their relation to sexual network formations).

Throughout **Phase 2**, the peer ethnographers identify and build rapport with individuals who may offer more detailed information on sexual networking as key research participants, based on specific criteria established in advance. The final list of participants is carefully reviewed to ensure representativeness of diverse backgrounds and experiences.

During **Phase 3**, interviews are conducted to learn more about the nature of social sexual networks and connections,[36] as well as the power dynamics that mediate these connections.

Different strategies can be employed for group data analysis throughout the data collection process[27] and after the collection is complete, starting with the specific[27] training of peer ethnographers.[24]

When should this tool be used?

Ethnographic assessment of an epidemic context provides rich insights into the environmental and structural factors that shape contexts where epidemics thrive, offering a perspective that is otherwise difficult to capture. It builds on the experience and expertise of local researchers to access and document knowledge as it circulates and re-creates meaning in everyday life. It typically builds upon previous programmatic mapping studies that have identified locations where members of key populations gather to meet sexual partners to collect more information about how these networks develop.[28]

More generally, the use of an ethnographic assessment of epidemic context can foster stronger research collaborations with communities in the production and utilization of evidence, and can facilitate the integration of the study results into community-led program delivery. By directly involving communities in processes of knowledge production, it can ensure that interventions are responsive to context-specific challenges of achieving coverage and equitable outcomes. Furthermore, it has the potential to enhance the applicability of research findings for community-led programming and to position community interests in local, national, and international policy arenas.[24]

Example of the tool in relation to this sphere

The World Bank, in partnership with the Institute for Global Public Health at the University of Manitoba, provided technical support to Nigeria's National Agency for the Control of AIDS (NACA) to conduct a study in 2015 on the sexual ethnography of high-risk venues and locales in urban areas. The study aimed to improve understanding of patterns of sexual behaviours and influences among women and men in locations where sexual networking occurs, generating contextually rich data on the social, cultural and environmental dynamics that shape sexual relationships, practices and networks, and patterns of vulnerability to HIV infection. Building upon earlier programmatic mapping that identified locations where people met new sexual partners, the study employed both qualitative and quantitative data collection methods to inform the design of effective and efficient HIV prevention strategies.

The qualitative component of the study comprised an ethnographic assessment that took place over six weeks in three concurrent phases. The results of the assessment detailed the control that sex workers exerted over their own work lives as reflected in:

1. the choices they make trying to attract particular clients,
2. the effort and pride they put into 'packaging' their appearance, and
3. their ability to negotiate prices with potential clients.

The findings further highlighted the active roles respondents play in the entertainment industry at bars, clubs, and hotels where they work, as well as their relationships with other

social actors, such as police officers, bar or nightclub staff, and other respondents. Lastly, the assessment characterized the sexual networks in specific locations, including their development and overlap. These contextual findings underscore the importance of environmental factors that shape how communities receive (or refuse) interventions and services.

Critical considerations for the use of the tool

Ethnographic assessments of epidemic contexts require the guidance of critical social scientists in their design and implementation to ensure the quality of the results and their adherence to ethical guidelines. Specific attention must be paid to positionality and power dynamics between researchers and all peer ethnographers involved, as well as to proper compensation and work conditions.[24] Ethnographic work of any kind requires specialized training to appropriately consider power relationships and ethical issues, including the management of ongoing consent.[37]

While ethnographic methodologies are not designed to make broader generalizations about venues, they provide critical insight into the complexities and sociocultural processes that are crucial to the effective delivery of culturally tailored programs and interventions.

Box III. Important methodological distinctions

The definitions outlined below originate from distinct theoretical frameworks, each with its own intellectual history and conceptual development, although there are often points of overlap and interaction among them. While these frameworks can be employed in various combinations depending on the context or analytical purpose, they are not interchangeable. Each carries particular assumptions, emphases, and implications that must be acknowledged to avoid conflation. For example, a community-based research project does not have to use qualitative methods, and an ethnography is not a type of qualitative method but instead a holistic research method utilizing the full spectrum of evidence available.

Qualitative methodology: Qualitative inquiry is concerned with the in-depth exploration of the social world and the lived experiences of individuals within it. It uses methods such as interviews, focus group discussions (FGD), literature reviews, and

observation to emphasize language, narrative, and contextual understanding. These approaches share a commitment to capturing the richness and complexity of social life, often prioritizing words and stories over numerical data.[38]

Community-based or participatory research: This approach emphasizes the equitable involvement of community members, researchers, and other stakeholders throughout all stages of the research process. It recognizes and values the knowledge and expertise, perspectives, and skills that each partner contributes and aims to co-produce contextually relevant, action-oriented knowledge that supports meaningful and lasting social change.[39]

Ethnography: Ethnography is a foundational methodological approach rooted in social and cultural anthropology, defined by sustained, immersive engagement with a community through long-term participant observation gathering of various forms of evidence. Its primary aim is to understand social life and cultural practices from the perspective of those being studied, often referred to as an 'insider's point of view'. Ethnographic research is typically inductive, and open-ended, relying on direct, day-to-day interactions to generate rich, detailed accounts of people's lived experiences, beliefs, and social worlds.[40] Often mischaracterized as a purely qualitative method, ethnographers use data that is both qualitative and quantitative, ranging from ethnographic fieldnotes, to questionnaires and health surveys.

Rapid ethnographic assessment: Rapid ethnographic assessment is a time-sensitive, research method that draws on core ethnographic principles to generate in-depth, contextual knowledge about a community or issue in a relatively short timeframe. It is both a methodological approach and a practical toolkit designed to support collaborative, community-engaged research. It is particularly useful in dynamic or resource-limited settings, such as during public health emergencies, humanitarian crises, or when quick, culturally grounded insights are needed to inform policy or programming. It is not simply ethnography done quickly, but a distinct approach that balances rigor and responsiveness. It facilitates collaborative knowledge production, allowing researchers and communities to co-create understandings that are immediately useful for decision-making, intervention design, or advocacy.[41]

Project ethnography: Project ethnography explores how context, practice, agency, and power interact to shape intervention design and implementation, revealing dynamics often obscured in conventional project reporting.[42]

Tool: Programmatic Mapping

Why is this tool helpful for this sphere?

While traditional population size estimation techniques, such as census and multiplier methods, provide reliable estimates, they often fall short of adequately identifying the distribution and specific locations where key populations congregate within and across contexts. Without accurate population size and distribution estimates, planning and delivering effective HIV/STI programming becomes challenging.

As an alternative, programmatic mapping offers a systematic, evidence-based approach to identifying physical (geographic) and virtual locations where key and prioritized populations congregate, whether to meet sexual and/or injecting partners or for other purposes. It generates details on the locations, including the availability of existing services, and can estimate the size of populations congregating in these locations.

When conducted as a community-driven process, programmatic mapping fosters collaboration and strengthens relationships between key populations, program implementers, and service providers. This approach not only enhances data validity by ensuring a deeper understanding of context- and population-specific risk environments but also enables local governments, community-based organizations, and program implementers to design high-impact, data-driven responses to HIV/STI epidemics, ensuring services are directed where they are needed most.

While the primary goal of programmatic mapping is to initiate or improve service delivery,[43] this tool also contributes to understanding local HIV/STI epidemiology, characterizing dynamics of 'risk' over time and space, assessing program coverage, and supporting programmatic decisions around geographic and population prioritization. These estimates can support advocacy efforts, helping to secure adequate funding for effective program implementation by providing data on the proportion of key populations that need to be reached by services.[44]

How does this tool generate knowledge for this sphere?

Programmatic mapping informs a program's goals and strategy by systematically collecting and analyzing data on the size, distribution, and typologies of key population groups. It supports target-setting and helps prioritize populations and geographies/locations based on HIV/STI risk identified through other assessments, such as epidemic appraisals, surveys, and program monitoring.

The methodology consists of multiple phases, including preparatory research to determine the geographic scope of mapping, two levels of data collection, and triangulation of information to ensure accuracy and reliability. Detailed guidelines exist on how programmatic mapping can be leveraged to shape a program's goals and strategy.

In Level One data collection, key informants are engaged to identify geographic locations where key populations congregate, determine when these locations are most active, and describe typologies of key population groups within identified locations. Level One key informants are not necessarily members of key populations but know about key populations' activities due to their professional or social connections. Examples include taxi drivers or transport workers, who may have insight into key population movement patterns, and bar or venue owners/staff, who may work in locations where key populations frequently gather. Prioritizing the safety of key population members is crucial when selecting key informants for mapping exercises.[43] To ensure comprehensive coverage, key informants should be identified and interviewed across different geographic areas and location typologies. The process should continue until no new locations are reported by newly interviewed key informants, ensuring saturation of the mapping data is reached. Interviews with Level One key informants generate the preliminary outputs for mapping estimates.

Central to programmatic mapping is the understanding that community members are experts in their own lives and are best positioned to identify key locations that should be prioritized for service delivery.[44] Level Two data collection involves validating and 'profiling' these preliminary locations through direct engagement with key population members at the locations identified in the first stage. To assist this process, *social mobilizers*, who are members of key populations, work alongside interviewers to connect them to the locations, introduce them to other key population members, and facilitate discussions to profile and characterize identified locations.

In some contexts, social mobilizers may facilitate the discussions with peers themselves. These discussions confirm the typologies and estimated number of key populations at each location, identify behaviours and potential HIV/STI-related risks occurring in these spaces, and verify operational dynamics such as peak activity times, movement patterns, and overlaps between different sites. In addition, information on whether services are provided within the locations can be gathered.

Engaging more than one key population member at each location strengthens the comprehensiveness of the mapping data. Understanding 'what' and 'where' activities take place helps a program strategize the types of services that would be most relevant and accessible for key populations in the identified locations.

This two-step approach ensures that the mapping data are robust, granular, and directly applicable to service delivery. By generating a geospatial understanding of key population size estimates and typologies, programmatic mapping establishes the initial stages of a program's strategy for optimizing program coverage. Mapping data can be leveraged to define a population's denominator for setting required coverage targets. These data can also inform program implementation tools (such as microplanning), helping guide resource allocation, identify when specific spots are busiest, and determine when the greatest numbers of key population members are present, enabling more targeted and effective outreach efforts.

Additionally, programmatic mapping data can generate robust sampling frames for behavioural assessments and studies, supporting research on key population dynamics and risk factors to better inform programming.

Key Resources

- Using Programmatic Mapping to Improve Program Access and Coverage for Key Populations

Box IV. Programmatic mapping for virtual locations

Advances in information technology and mobile networks have made virtual platforms (e.g., dating, social media, and messaging applications) increasingly common modes of connecting with sexual partners.[45] This is especially relevant for those engaged in criminalized behaviours, as these platforms may offer more discreet and safer spaces to meet partners.[46] Programmatic mapping of virtual locations follows a similar approach to physical locations but is conducted in three stages. Using virtual mapping of men who have sex with men as an example, these stages include:

- **Level One:** Through consultations with men who have sex with men community members, compile a list of virtual platforms men use to meet sexual partners and conduct a feasibility assessment to determine which platforms are most suitable for mapping. Relevant factors include whether the platform is specific for men seeking sex with other men, the availability of users' information, the ability to identify users' geographic locations during app use, and overall platform popularity.
- **Level Two:** Characterize platforms by recording key features such as site name, visit timing, user volume, and location to estimate the number of people using them at different times and geographic locations.
- **Level Three:** Conduct interviews with active users sampled from the identified virtual platforms and geographic locations to understand platform usage, engagement across multiple virtual platforms (and physical locations, if applicable), peak activity times, and exposure to existing program services. Collect data to account for duplicate profiles and cross-platform activity, ensuring accurate population size estimates are produced.

Virtual mapping for men who have sex with men has been conducted in Kenya (Kiambu, Kisumu, and Mombasa) and India (Delhi), offering examples of how programmatic mapping efforts can be adapted beyond physical locations.[46,47]

When should this tool be used?

Programmatic mapping can inform national and subnational HIV/STI program strategies, particularly in contexts where prevention efforts require targeted service delivery, as identified during epidemic appraisals. Conducting mapping exercises at the outset of program development ensures that the most effective interventions are implemented in the most appropriate locations and prioritize populations with whom they will have the most impact (vis à vis reducing acquisition and transmission), improving health outcomes, and increasing service accessibility for those most affected by HIV/STI. Mapping exercises may be repeated periodically to capture geographic shifts in sex work locations, evolving location typologies, and changes in key population demographics over time to ensure a program's strategy maintains relevance.[22]

Programmatic mapping is a valuable tool in both stable and dynamic settings, particularly where key populations may exhibit high mobility, face structural barriers to accessing healthcare, and where traditional size estimation methods may not fully capture the extent of key population presence and service needs. In environments where heightened experiences of stigma, discrimination, and violence may discourage key population members from seeking healthcare through conventional means, programmatic mapping helps identify safe and trusted locations where outreach-based services may be delivered. Mapping exercises also provide programs with critical insights to plan efficient and effective outreach strategies to connect key populations with the services these programs aim to deliver. When applied in dynamic contexts, mapping should incorporate methods to account for population movement and ensure accurate estimations.

Example of the tool in relation to this sphere

Research has shown that key populations, specifically female sex workers, men who have sex with men, people who inject drugs, and transgender individuals, are disproportionately affected by the HIV epidemic in Nigeria.[48] Recognizing the need for targeted interventions, NACA, in collaboration with supporting partners, conducted a Key Population Size Estimation (KPSE) study across 20 Nigerian states between 2022 and 2023.[48] This initiative built on two previous phases of programmatic mapping, with the first conducted across eight states in 2012 and expanding to 10 additional states in 2018. By iterating and progressively expanding coverage through multiple phases, programmatic mapping was used to identify locations where key populations congregate and to generate reliable population size estimates within these

locations, complementing other estimation approaches to achieve comprehensive size estimation coverage across all Nigerian states. In some areas, service gaps were also assessed, further strengthening the mapping efforts and equipping NACA and its partners to comprehensively design and implement HIV prevention and treatment strategies across Nigeria.

Pre-mapping activities were conducted to establish a strong foundation for data collection. Level One mapping activities engaged key informants familiar with key population activities across the 20 states (e.g., bar workers, taxi drivers, pharmacists, and service providers), to identify key locations and provide preliminary population estimates for those locations. Field teams then visited these locations during Level Two activities to validate key population presence, confirm estimated population sizes, determine the days of the week and times of day at which peak activity occurred, and assess HIV service access over the past six months. Additionally, a virtual mapping exercise, focusing on men who have sex with men, was conducted to identify online platforms where men sought partners and HIV services to determine platform usage patterns, peak activity times, and gaps in virtual service delivery.

The data generated provided insights into the variation and density of key populations and their typologies, as well as the peak days and times of operation of these typologies at each site. Mapping estimates evaluated the accessibility of HIV-related services, including condoms, lubricants, HIV/STI testing and treatment, and peer education for all four key population groups, as well as needle and syringe program services, and opioid substitution therapy for people who inject drugs. Virtual mapping of men who have sex with men further revealed the proportion exclusively using online platforms, their engagement with HIV peer educators, and their awareness of available HIV programming.

Overall, the KPSE study positioned NACA and its partners to better strategize, plan, and fund programs that address the specific needs of key populations in Nigeria—including those tailored to their nuanced sub-typologies—to ensure that services are implemented where they are most needed. The full report for NACA's KPSE study describes how programmatic mapping was leveraged to ultimately strengthen Nigeria's response to the HIV epidemic in more detail.

Critical considerations for the use of the tool

Programmatic mapping must be driven by the goal of initiating or improving local service delivery, and should not be leveraged exclusively for producing population size estimates at broader levels.[43]

Programmatic mapping can be time-consuming, resource-intensive, and unsuitable in specific contexts due to stigma or risk of criminalization and harm.[44] Before implementation, assessing whether the approach is appropriate, feasible, and safe for the given context is critical. This includes weighing potential risks and benefits, as well as examining contextual factors that may

impact the ethical execution of mapping activities, particularly in relation to criminalized populations, service providers, and the mapping implementation team. The meaningful involvement of members of key population communities in programmatic mapping exercises can substantially mitigate the potential risks.

Mapping efforts must consider local social and legal contexts, acknowledging that vulnerabilities and risks differ across settings and sub-groups. Incorporating qualitative data can strengthen the accuracy and depth of mapping efforts while also helping to evaluate potential risks associated with data collection.[43] If significant risks are identified, an alternative approach may involve mapping broader catchment areas where key and priority populations congregate.[44]

Confidentiality is paramount when collecting and handling mapping data. Given the elevated risks associated with stigma and criminalization faced by members of key populations, information gathered must be protected from law enforcement and other punitive bodies that could misuse it. Unnecessary disclosure of criminalized or stigmatized activities risks compromising the trust of key population networks.

Strict data governance measures, such as deidentification and secure storage, are essential to safeguarding key populations and ensuring mapping data remain relevant to inform a program's eventual implementation and monitoring. While unique identifier codes (UIC) can offer insights for service delivery, their confidentiality is not guaranteed, and their use in mapping efforts must be carefully weighed against potential risks. If used, data should remain unlinked, be managed by implementing organizations accountable to key populations, and exclude any biometric information.[43]

Community-engaged Research & Learning Process

Community-led organizations should be actively involved in programmatic mapping exercises, including data collection, analysis, interpretation, dissemination, and use.[43] While additional technical expertise may be required for certain aspects, sustained engagement with key population communities and networks is critical throughout programmatic mapping to maintain the reliability of the data generated. Involving community members in mapping exercises fosters trust and strengthens connections to key population networks. Hiring key population members as community researchers throughout the mapping process can improve access to populations who are marginalized due to heightened experiences of stigma, discrimination, and violence. Meaningful community involvement in programmatic mapping ensures that more accurate, contextually relevant data are produced, ultimately strengthening findings to better inform program goals and strategies, while also facilitating rapid program enrollment and service uptake.[22]

Program Implementation Sphere

Tools in the Program Implementation sphere guide decisions on service delivery locations, engagement strategies with prioritized populations, and the selection of the most appropriate interventions. These tools enable an effective translation of strategic goals into program components, ensuring that interventions are relevant and accessible to the populations they aim to serve.

Tool: Expanded Polling Booth Surveys

Why is this tool helpful for this sphere?

Expanded Polling Booth Surveys (ePBS) offer a practical and adaptable methodology for implementing and monitoring HIV/STI prevention programs. Initially developed as a tool to enhance acceptability and data quality when engaging in research on sensitive topics related to HIV/STI among female sex workers in rural India,[49] polling booth surveys (PBS) use a group-based inquiry approach in which participants privately record their responses to a set of simple yes/no questions presented simultaneously to the group. This method efficiently generates group-level data on behaviours that can augment risk and vulnerability for HIV/STI acquisition and transmission, as well as access to and use of testing, prevention, and treatment program services.[50] PBS has elicited higher rates of accurate reporting on sensitive behaviours that traditional methodologies (e.g., face-to-face interviews) may suppress due to social desirability bias.[49]

ePBS builds on this technique through two possible expansion modules: (i) mini biobehavioural surveys (BBS) and/or (ii) FGD. BBS collect individual-level biological and behavioural data from PBS participants. FGD data help contextualize PBS findings by exploring barriers and facilitators to service access, needs and preferences of the respondents, as well as highlighting modifications in service delivery that populations engaging with programming may wish to see. By combining these three components, ePBS serve as a valuable tool for program implementation and monitoring through providing a nuanced understanding of social and structural factors that perpetuate inequities in health outcomes and service coverage.[50]

The simplicity, efficiency, and cost-effectiveness of ePBS make it an ideal tool for collecting frequent, real-time data. ePBS data can be leveraged to support rapid adaptations, adjustments, and improvements to a program's strategy, implementation approaches, and monitoring as the context evolves throughout a program's existence. Requiring minimal technical expertise for its implementation and delivery,[50] ePBS remain an accessible option for government agencies, community-based organizations, research teams, program officials, and all others who play a key role in ensuring the impact and sustainability of public health programming.[5]

Meaningful community engagement is integral to the implementation of ePBS; as such, the approach enhances local ownership and accountability over a program's implementation and monitoring, helping to ensure the program remains responsive to the local context and improving its long-term sustainability.[50]

How does this tool generate knowledge for this sphere?

A detailed implementation guide exists for using ePBS to assess HIV outcomes among key and priority populations.[50] Importantly, ePBS balances efficiency with scientific rigour, maintaining methodological standards comparable to traditional research methodologies while rapidly generating actionable data to directly inform HIV/STI prevention efforts.

ePBS encourages an enhanced, population-based sampling methodology, which ensures the inclusion of individuals already accessing program services as well as those not yet engaged. While conventional PBS sampling is typically program-based, the population-based sampling approach used in the ePBS method enables a more comprehensive understanding of the needs and service gaps within priority populations. Although (e)PBS was initially designed for use among key and priority populations, it may be applied more broadly to efficiently collect potentially sensitive behavioural and program coverage data from any population with relatively few resources.

The components of ePBS (i.e., PBS and selected expansion modules) work together to generate comprehensive data that inform program implementation and monitoring. The PBS produces aggregate behavioural data, while the BBS component allows for individual-level behavioural and biological data, such as metrics on HIV/STI prevalence and incidence. This facilitates the measurement of key behavioural and program coverage indicators among participants. FGD data enhance the findings generated by PBS and BBS by exploring the structural and social factors that influence health behaviours, service use, and relevant biological outcomes among populations that the program aims to reach. FGD also provide a platform for participant input on solutions to enhance service delivery.

ePBS allows for analyses stratified by select participant characteristics, including subpopulation, location typology (i.e., different locations where populations congregate and may be engaged for sampling), and geography, which can help identify shifts in epidemiological contexts and highlight the need for program adaptation to maintain responsiveness.

Because data remain in the hands of program implementers, and their collection and analysis are rapid, findings can be applied immediately to strengthen service delivery and program strategy as needed. Dissemination of findings through community forums ensures priority groups can meaningfully engage with and contribute to program refinements. Formal reporting to national and local governments, funders, and global health bodies can facilitate knowledge-sharing and reinforce the importance of a program's interventions for its intended beneficiaries.

Key Resources

- Expanded Polling Booth Surveys (ePBS) for Assessing HIV Outcomes among Key and Prioritised Populations: Implementation guide and manual

When should this tool be used?

ePBS is particularly effective in contexts in which traditional survey methods are constrained by time and financial limitations, participant literacy is limited, or topics of interest—such as HIV, STI, and associated risk behaviours—are highly stigmatized.

Conventional survey responses are often influenced by social desirability bias, compromising accuracy due to societal stigma and discrimination. ePBS mitigates this challenge by ensuring complete anonymity and unlinked responses during PBS implementation, affording confidentiality to participants to encourage accurate responses. This, in turn, results in more reliable data collection on behaviours, perceptions, and outcomes that programs can leverage to improve their coverage and impact.

ePBS generates data quickly and efficiently, making it highly applicable for informing iterative program improvements during implementation and monitoring. The ability to immediately share results with participants facilitates follow-up discussions to explore the underlying factors behind the findings. This real-time feedback loop produces valuable insights that may not be feasible with more time-consuming processes in traditional research methodologies.

Large-scale data collection is often costly and less feasible to conduct on a routine basis, particularly in resource-constrained settings. ePBS offers a cost-effective alternative to conventional survey methods, requiring fewer and reusable resources and significantly less time to administer. By leveraging ePBS as a sustainable option for ongoing monitoring, HIV/STI prevention programs can efficiently gather high-quality data to guide program adjustments, enhance service delivery, and ultimately improve HIV/STI outcomes through improved program coverage. While PBS may be conducted annually as a routine monitoring mechanism, ePBS offers flexibility to accommodate time, resources, and program monitoring needs. Expanding to include mini-BBS and FGD every few years can ensure a tailored approach to data generation that aligns with evolving program priorities.[50]

Example of the tool in relation to this sphere

PBS has been successfully leveraged in multiple countries, including Botswana, Cameroon, India, Kenya, Lesotho, Malawi, Namibia, and Nigeria, to measure HIV/STI-related behaviours and assess program outcomes among key and priority populations.[49,51–54] A recent example in Nairobi, Kenya, demonstrated how the additional inclusion of BBS and FGD was central to generating data that informed the monitoring of Kenya's National Key Population Programme.[52] Launched in 2009,[55] Kenya's National Key Population Programme was developed in response to evidence showing that female sex workers, men who have sex with men, prison populations, and people who inject drugs account for a significant proportion of national HIV incidence.[56] Led by Kenya's Ministry of Health and supported by over 100 implementing partners, the program delivers a standardized HIV combination prevention package in alignment with

national guidelines.[52,55]

Since 2009, the program has expanded significantly, reaching nearly three-quarters of Kenya's counties.[52] The National Key Population Programme continues to operate in a challenging policy environment, with the national criminalization of same-sex relationships and local policy changes (e.g., the 2017 ban on sex work in Nairobi County), exacerbating stigma, discrimination, and violence against key populations. In 2023, ePBS was introduced in Nairobi County to enhance program monitoring and identify gaps in service delivery among female sex workers and men who have sex with men—the communities most affected by these structural barriers.

Female sex workers and men who have sex with men participants were administered PBS questionnaires, with the option to partake in the BBS component. For those who provided informed consent, pre-test counselling and rapid HIV testing were conducted alongside the collection of blood and urine samples. Additionally, a brief behavioural survey tailored to each key population was administered. FGD provided further insights by exploring the challenges these populations faced in accessing and utilizing the program's implemented HIV services in Nairobi.

By embedding ePBS within the National Key Population Programme's monitoring framework, both quantitative and qualitative data were rapidly generated, offering a comprehensive overview of the program's coverage. PBS and BBS findings provided basic monitoring data on the availability, coverage, and utilization of key HIV prevention and treatment services, including condoms, PrEP, and ART. While PBS data are not collected at the individual level, they can be readily disaggregated by county and sub-population type (e.g., female sex workers, men who have sex with men), allowing for additional equity analyses to identify disparities in service access and uptake. FGD further contextualized these findings by identifying the root causes of service gaps among each key population (e.g., travel distance, shortages in condoms and lubricants, experiences of discrimination at service points), and strategies to improve program coverage and utilization (e.g., improving peer educator-to-peer ratios to strengthen community outreach and service linkage).[52]

Kenya's National Key Population Programme was well-positioned to leverage ePBS findings to guide iterative programmatic adjustments for two prioritized populations, ensuring that the program's component interventions and service delivery platforms remain appropriate and responsive to Nairobi's evolving HIV epidemiological trends and local contexts. Specifically, based on disaggregated analyses, the program was able to intensify prevention efforts in certain sub-counties that were found to have suboptimal coverage of condom availability and utilization. In response to overall low levels of PrEP coverage in Nairobi County, the program led additional training with peer educators and service providers around the fundamentals of PrEP, increased availability of PrEP through mobile outreach clinics, and focused on 'inreach' strategies to enhance uptake among PrEP-eligible individuals who were already using other program services. Implementation strategies were also adjusted to address signals of

suboptimal contact coverage identified through ePBS findings by clustering outreach locations to streamline peer educators' efforts. Following the success of the ePBS research study in Nairobi County, the Kenyan government, with support from The Global Fund, committed to implementing ePBS across additional counties to assess prevention program outcomes.

Critical considerations for the use of the tool

Aggregate-level PBS findings, individual-level BBS data, and qualitative insights from FGD collectively provide a more comprehensive understanding of program outcomes (e.g., service availability, utilization, and HIV prevalence), structural outcomes (e.g., experiences of violence and stigma), and key barriers and facilitators to program engagement across different populations. To ensure efficiency, all components of the ePBS should be concise. Ideally, the PBS should be limited to 30-40 questions, while the BBS should comprise no more than 20 questions.

Data collectors administering the three ePBS components should be thoroughly trained, including hands-on practice sessions that guide them through the implementation processes from beginning to end, to ensure data quality and proficiency in participant engagement.

Maintaining confidentiality is essential when integrating the ePBS's multiple data sources. PBS responses must remain entirely anonymous, and BBS and FGD data are only linkable to PBS data at the group level.[50] This separation safeguards participant privacy, preserving data integrity by reducing social desirability bias, yet still allows for equity analyses to identify disparities and support targeted programmatic adjustments.

To maximize the impact of ePBS, findings should be promptly shared with relevant partners involved in the program's implementation. Dissemination must prioritize community members and primary beneficiaries.[50]

Meaningful community engagement is critical for the successful application of ePBS. Involving participant populations in the design and implementation processes fosters trust, creates a safer environment for participation, and encourages active community engagement.[50] When communities view the process as a tool for empowerment and advocacy, there is more incentive to take ownership of the findings and incorporate them into practice to enhance programmatic impact.

Tool: Microplanning

Why is this tool helpful for this sphere?

Microplanning is an approach to improving HIV/STI service delivery by training and empowering key population members, referred to as peer microplanners, to conduct outreach and manage services within their own networks.[57–60] By identifying and prioritizing key locations and individuals, it aims to achieve complete intervention coverage for key populations across the geographies where programming is implemented.[61]

Guided by outreach supervisors and supported through peer collaboration, microplanning equips peer microplanners with the tools to maintain a registry of key population members, documenting individual profiles, service needs, and accessibility for outreach purposes. Peer microplanners use this information to deliver tailored services and strengthen engagement in HIV/STI interventions.[59] The data generated also enable outreach teams to track service progress, identify service gaps, and adapt strategies to improve delivery and optimize scale.[57]

Microplanning creates structured opportunities for peer learning, where microplanners share strategies, troubleshoot challenges, and co-create solutions to strengthen outreach.[59] Its community-led, participatory design fosters greater ownership of interventions among key populations,[62] positioning peer microplanners as proactive program partners who assess needs and refine approaches in real time.[58,59,61]

Microplanning can also be used by implementing partner organizations to identify broader program gaps, assess barriers to service uptake, and adapt strategies and resource allocation based on community feedback.[57] It provides rapid, localized insights that connect service delivery with health outcomes. For instance, in settings where funding disruptions may affect community-based programs, microplanning has helped organizations quantify the impact of service interruptions, such as declines in outreach contacts and condom distribution on STI transmission rates.[62] This allows for quick adaptations in service delivery, helping to mitigate potential long-term effects of funding uncertainties.[62]

How does this tool generate knowledge for this sphere?

Microplanning enhances service delivery by ensuring prioritization and targeted outreach, optimizing resource allocation, promoting community leadership, and facilitating real-time tracking for timely intervention and program adjustments.[57] Comprehensive implementation manuals outline how microplanning serves as a data-driven, community-centred approach to strengthening HIV/STI interventions, expanding service coverage, and improving health outcomes for key populations. These resources include templates and examples of several options for microplanning tools that peer microplanners can use for planning, outreach, and monitoring at the local level.[57,59–61,63,64]

Key Resources

- LINKAGES Standard Operating Procedure: Programmatic Mapping and Microplanning
- Designing Outreach and Microplanning for Key Population Programmes
- Micro-Planning in Peer Led Outreach Programs: a handbook based on the experiences of the Avahan India AIDS Initiative
- Standard Operating Procedure to Implement Effective Community-Led Outreach and Microplanning Strategies in Key and Vulnerable Population Programmes in Tanzania

Peer microplanners, trained by program outreach workers, play a crucial role in identifying and addressing the needs of key populations through regular contact with a set number of key population members. Peer microplanner ratios ideally range from 35 to 85 individuals per peer microplanner.[58] Working primarily within their own social and geographic networks, peer microplanners provide information and counselling to individuals on their registry, distribute prevention and harm reduction supplies tailored to individual needs, and encourage engagement with and build trust in program services.[57,58,61] Peer microplanners have a deep understanding of the risks and needs of those they support, enabling them to gauge the level of assistance needed and contribute to effective resource allocation within the broader program.[61]

Using simple, adaptable tools, microplanning empowers peer microplanners to develop targeted, population and geography-specific plans that ensure effective individual-level service delivery. Examples of these tools include site load and social network maps to visualize outreach coverage and key population connections; daily diaries and tracking forms to document outreach activities; risk assessment tools to prioritize higher-risk individuals; gap analysis tools to monitor service coverage; and preference ranking tools to identify barriers to clinical service attendance and develop targeted solutions.[57,60,63]

When should this tool be used?

Microplanning is effective when a key population size estimate and an understanding of where key populations congregate have been established through programmatic mapping.[57,59] Leveraging microplanning helps validate mapping data, contextualize the data within the local context, and understand the needs of key populations to prioritize outreach efforts, service delivery, and resource allocation within areas and population groups of greatest need. Additionally, the data generated through microplanning helps refine existing program strategies by identifying gaps and improving outreach tactics for more effective service delivery.[57]

Microplanning is particularly valuable in contexts where engagement with key populations is inconsistent due to legal and structural barriers, stigma, and social exclusion.[61] It helps identify obstacles to service uptake and assess their impact on program coverage. As a community-led approach, the tool generates contextually relevant learnings that can be used to adjust

program strategy and implementation to optimize coverage of safe and effective services for key populations.[65]

Example of the tool in relation to this sphere

In 2009, Zimbabwe's Key Population Programme (formerly *Sisters with a Voice*) was established in collaboration with female sex workers to function as both a comprehensive service platform and a source of evidence to inform national HIV program design, implementation, and expansion.[66,67] Now operating across 120 primary care clinics nationwide,[66] the program aims to prevent HIV among female sex workers and enhance care for those living with HIV to reduce transmission and improve associated health outcomes.[67] It provides a range of services, including HIV prevention commodities (e.g., condom distribution, on-site PrEP), HIV/STI testing and treatment, cervical cancer screening, as well as health education and legal support through peer microplanners, who mobilize female sex workers to engage in government ART services.[66]

Between 2019 and 2021, the Adapted Microplanning to Eliminate Transmission of HIV in Sex Transactions (AMETHIST) intervention was introduced to enhance engagement with Zimbabwe's Key Population Programme.[67] Using peer-led microplanning and self-help groups, the intervention aimed to improve HIV prevention and care for female sex workers by optimizing peer microplanners' ability to assess and respond to female sex workers' varying levels of risks and need. By fostering community cohesion and providing intensified support to those at highest risk,[66–68] AMETHIST applied an HIV status-neutral approach to minimize mistrust and focus on shared community priorities, empowering female sex workers to overcome barriers to safer practices.[66]

Peer microplanners iteratively mapped locations within a designated geography every six months to estimate the female sex worker population size and monitor program coverage.[66,67] Each peer microplanner recruited and oversaw 50–80 female sex workers, assessing individual-level risk quarterly using a risk score based on self-reported factors such as age, duration in sex work, substance use, condom use, experiences of violence, and client volume. Outreach intensity was adjusted accordingly. For example, female sex workers deemed *high-risk* were contacted weekly, *moderate-risk* biweekly, and *low-risk* monthly. During meetings, peer microplanners provided condoms, PrEP/ART adherence support, and referrals to clinic services based on individual need. Peer microplanners tracked outreach efforts and met weekly with program outreach supervisors to address challenges and plan the subsequent week's outreach activities.[67,68] Additionally, with supervisor support, they invited female sex workers under their care to join peer-led self-help groups to strengthen community cohesion and empowerment.[68] Microplanning data identified key performance gaps, which were then addressed through targeted optimizations, leading to increased outreach contacts, clinic registrations, and monthly clinic visits.[67]

The AMETHIST intervention resulted in nearly 7,200 female sex workers registering with Zimbabwe's Key Population Programme, with over 216,000 recorded interactions over the intervention period. These initiatives significantly increased engagement with HIV services at clinics, leading to higher rates of clinic registration, HIV testing, diagnoses, ART linkages, and PrEP initiation. Among female sex workers living with HIV, 94% in the intervention group reached virologic suppression, significantly outperforming the control group. Adherence to PrEP remained low despite increased initiation, with biomarker data revealing that very few female sex workers had protective drug levels. Additionally, there was no significant reduction in HIV acquisition risk among HIV-negative women, and condomless sex remained prevalent. While structural barriers, including violence, mental health challenges, and substance use, likely contributed to these gaps,[68] implementation research for AMETHIST also highlighted more individual- and social-level barriers to HIV prevention. Many female sex workers had expressed doubts about the value of taking PrEP while still HIV-negative. Some held fatalistic beliefs that HIV infection was inevitable. These attitudes were reinforced by stigma, anticipated side effects, and the perception that PrEP and ART did not differ, leading some female sex workers to avoid PrEP for fear of being seen as already HIV-positive.[69]

As a result of the AMETHIST trial, microplanning has been scaled up nationwide,[68] now informing strategic program indicators for Zimbabwe's Key Population Programme. The trial's findings, including gaps in PrEP adherence and persistent structural and social barriers, provide critical insights for refining program strategies, such as those to strengthen adherence support, integrate broader harm reduction and mental health services, and tailor prevention interventions to better address the complex realities and concerns of female sex workers in Zimbabwe. By equipping the program with real-time data, microplanning enables continuous adjustments to implementation challenges, thereby improving strategic decision-making and enhancing long-term program sustainability.[67]

Critical considerations for the use of the tool

Effective microplanning depends on a well-structured supervisory system. Many programs follow a two-tiered approach, with outreach supervisors managing and supporting small teams of four to six peer microplanners, and each peer engaging a defined number of key population members within their own networks.[57] Both peer microplanners and outreach supervisors should be fully trained before they begin their roles,[61] and peer microplanners should receive ongoing, hands-on support and mentoring after microplanning begins.[57] Group training at program initiation, along with periodic refresher sessions, helps to strengthen implementation and peer microplanner retention.[57,61] Providing fair and adequate compensation, aligned with government or other program standards, is also essential to retaining peer microplanners.[57]

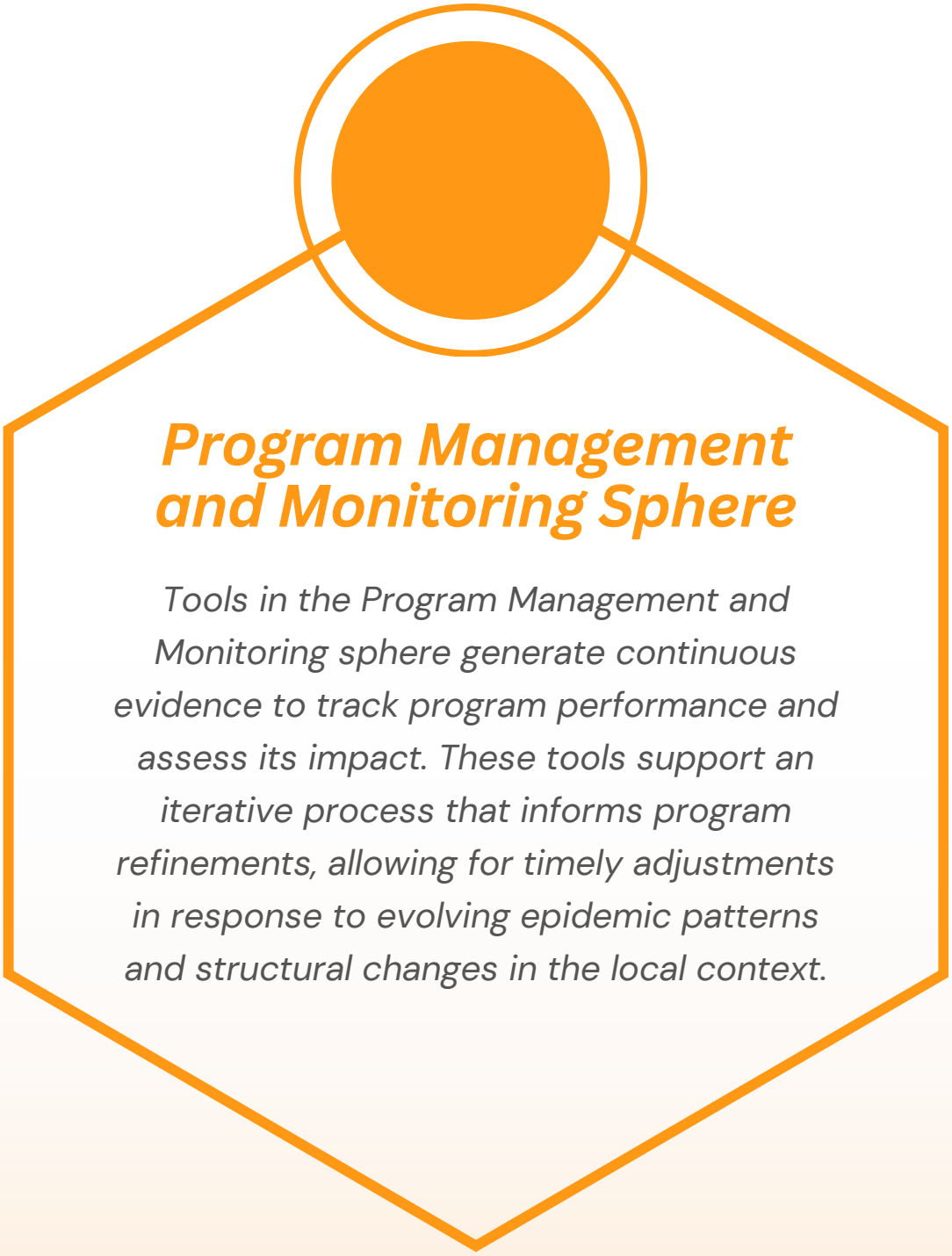
Peer microplanners must be trusted individuals within the local key population community, demonstrating strong interpersonal skills and a commitment to confidentiality. An optimal peer

microplanner-to-key population ratio is crucial for maintaining outreach quality and consistency, as well as for enhancing engagement among key population members with clinical services.[58]

Protecting the privacy of key population members is essential to the success of microplanning. Most programs assign UIC to both outreach locations and key population members engaged through outreach activities as a mechanism to safeguard privacy and confidentiality.[57,61] Sensitive documents, including maps and contact lists, should be securely stored.[57] Data protection and confidentiality measures should be reinforced during training with peer microplanners and outreach supervisors.[61]

Peer microplanners should be actively involved in developing and adapting microplanning tools to ensure they are relevant and easy to understand. Tools should use clear language and visuals to account for varying literacy levels, be field-tested for accessibility, and be adjusted to the needs of peer microplanners.[57,61] The use and timing of microplanning tools should be adapted to the characteristics of the key population members in the service area. For example, while site load and social network mapping are generally updated every six months, areas with highly mobile key populations may require more frequent revisions.[57]

Community-led approaches, such as microplanning, have traditionally depended on external funding. However, the emerging discourse on reallocating donor funds for key population services from non-governmental and community-based organizations to the public sector raises essential considerations. While integrating these services into national systems may enhance affordability and government buy-in, it also risks exacerbating privacy concerns and stigma, potentially deterring engagement. Furthermore, mainstreaming community-led initiatives could standardize programs in ways that diminish the unique advantages of approaches like microplanning, such as their flexibility, responsiveness, and community trust. Ensuring that scale-up efforts preserve these strengths is critical to maintaining both the effectiveness and sustainability of interventions.[65]



Program Management and Monitoring Sphere

Tools in the Program Management and Monitoring sphere generate continuous evidence to track program performance and assess its impact. These tools support an iterative process that informs program refinements, allowing for timely adjustments in response to evolving epidemic patterns and structural changes in the local context.

Tool: Community-led Monitoring

Why is this tool helpful for this sphere?

Community-led monitoring (CLM) is a structured, ongoing process in which community members engaged by programs take the lead in monitoring the services, policies, and outcomes that directly affect them. Through routine collection and application of data, communities identify issues, offer actionable recommendations, and engage directly with providers and decision-makers to improve service delivery and accountability.

CLM is distinct from other forms of community or government-led monitoring, such as periodic population surveys, routine data collection by community health workers, or the use of community data collectors in non-community-led efforts.[70] The tool serves both as an accountability mechanism and as a means of establishing community agency and influence over programs. Although partners, such as government officials, health providers, and civil society organizations, play key roles in acting on CLM findings, the process remains fundamentally community-owned and community-led.[70,71]

Communities define CLM priorities, develop indicators, and lead data collection and analyses, ensuring that findings reflect lived experiences rather than external agendas.[71,72] These data are used in real time to inform program improvements, adjust implementation strategies, and guide continuous learning and refinement of CLM as a program monitoring tool.[73] This collaborative approach promotes shared responsibility between community and program implementers for identifying challenges and co-creating solutions.[72]

As a tool for implementation and monitoring, CLM helps address the limitations of traditional monitoring systems, which often fail to adequately capture lived realities and respond to the needs and priorities of key and other prioritized populations, particularly due to stigma, discrimination, or other systemic barriers.[73] CLM is monitoring by communities, for communities, ensuring that the perspectives of those most affected are not just included but centred in the monitoring process. In this way, communities are not simply data collectors, but equal partners in shaping how findings are applied to strengthen program implementation and policy. By offering an independent, community-driven perspective, CLM helps challenge structural gaps and fosters more equitable, responsive health services.[72]

How does this tool generate knowledge for this sphere?

CLM can be implemented in various ways, though its design should always be tailored to the local context and shaped by the communities it aims to serve.[74] Regardless of the approach, the ultimate goal of CLM remains to equip communities with the tools to assess and improve the quality of HIV (and other STI) services through systematic data collection and strategic engagement.[75] The International Treatment Preparedness Coalition (ITPC) outlines a four-

phase model[74] for CLM implementation:

- **Education:** Communities begin by bridging their understanding of HIV and standards for prevention, treatment, and care, followed by discussions to explore current gaps between service expectations and the reality of experiences.
- **Evidence:** Trained community members gather both qualitative and quantitative data on service delivery, which they then analyze to identify key issues and recurring patterns that require attention.
- **Engagement:** Community members share findings with health providers, government officials, and other relevant actors to collaboratively develop solutions and drive program improvements.
- **Advocacy:** When initial responses are insufficient, communities use CLM evidence to increase advocacy, mobilizing public support and applying pressure to ensure meaningful action from those responsible for service delivery.

Data collection in CLM is continuous and occurs both within health service delivery points and outside of service settings.[70,73] This process highlights key challenges communities face in accessing quality care (e.g., long wait times, unexpected costs, and stigmatizing interactions with providers), shedding light on gaps that may hinder progress toward program goals, such as screening, testing, and treatment adherence. CLM can also be leveraged to identify effective practices that should be replicated or scaled up to improve service delivery.[70,71,73] By integrating both qualitative and quantitative data, CLM ensures robust triangulation, enhancing the depth, reliability, and relevance of findings. These insights can be used in conjunction with national program indicators to identify and address the systemic barriers that impact program effectiveness.[73] Communities can also assess whether promised improvements are being delivered through ongoing tracking and feedback, ensuring accountability and driving sustained improvements in service quality.[71]

Key Resources

- How to Implement Community-led Monitoring: A Community Toolkit

When should this tool be used?

CLM is particularly valuable in settings where traditional monitoring systems fail to detect or adequately address structural challenges such as human rights violations, gender-related barriers, or systemic weaknesses in service delivery.[70] These issues can be overlooked or misunderstood due to prevailing societal attitudes that confound the understanding of what may constitute a problem or an effective solution. In such contexts, CLM enables communities to define their own priorities and indicators, ensuring that data collection, interpretation, and communication of results reflect their lived experiences rather than external assumptions or biases.[72,73]

CLM is well-suited for situations where timely evidence is needed to inform program implementation or adapt ongoing monitoring. Because trusted community members who share lived experiences with those being engaged lead the process, data can be collected more quickly and authentically than conventional monitoring methods, which often require lengthy periods of rapport building. This enables the real-time identification of issues and the provision of rapid feedback to improve service delivery and health outcomes,[74] particularly among populations often underserved by existing systems.

In contexts where power imbalances between communities and service providers or policymakers may limit dialogue, CLM strengthens advocacy and accountability by centring community voices in evidence generation and problem-solving. This collaborative process bridges the gap between community members, who have firsthand knowledge of the necessary changes, and partners in positions of power who can take concrete action to address those needs. Together, they facilitate meaningful change and ensure that services are responsive and equitable for the populations they aim to serve.[73]

Example of the tool in relation to this sphere

In late 2020, ITPC, in partnership with local organizations and with support from The Gates Foundation, launched the Citizen Science Project as a CLM initiative to assess the impact of COVID-19 on HIV and tuberculosis services in South Africa and Malawi. It served as a platform for routine, structured monitoring of HIV and tuberculosis services at 33 health facilities across both countries. Grounded in collaboration and community leadership, the Citizen Science Project was a model mechanism to strengthen accountability and responsiveness in service delivery.[74,76]

In South Africa, CLM activities began with education through joint briefings for community implementers and government partners, aimed at building trust, aligning priorities, formalizing roles, and enabling community access to the government's health information system. Community members participated in additional education sessions on global HIV prevention, treatment, and care standards, as well as FGD to highlight gaps between expected service delivery and their lived experiences. These discussions informed the selection of monitoring priorities and the development of tailored indicators, which were shared with partners to promote transparency and ensure continued access to data.[74] With the Citizen Science Project's implementation, CLM efforts took place across 19 sites (15 government and four community facilities) in South Africa's West Rand District, serving a catchment population of nearly 355,000 people. Thirty-eight trained community data collectors routinely tracked 36 indicators (23 quantitative and 13 qualitative).[76]

CLM allows for the proactive identification of emerging program issues.[74] For example, despite national goals to significantly expand oral PrEP uptake, CLM data from 2022 revealed that

young women had the lowest PrEP initiation rates across monitored sites, even as they remain among the most affected by HIV. A sub-analysis of qualitative data suggested that many young women had limited awareness of PrEP, with most reporting they were never offered it during visits to any of the monitored facilities.

In response, community implementers organized feedback sessions with facility managers, hosted targeted community PrEP information sessions to build awareness and interest, and distributed government-approved educational materials. Advocacy efforts targeted district health authorities, resulting in renewed government engagement, including a commitment to enhancing PrEP awareness and uptake. This involved the government issuing revised PrEP targets to facilities, and supporting multiple community-led PrEP refresher trainings that reached over 100 healthcare workers, facility managers, and district officials across monitored sites.[76]

CLM data collected in 2023 indicated steady improvements in PrEP uptake and continuation across monitored sites. Over the year, more people remained on PrEP, with over 2,500 new initiations—368 of them among young women, marking an increase from the previous year. Individuals accessing services at CLM-supported facilities were also significantly more likely to initiate PrEP following an HIV test compared to those at other sites in the West Rand District.[76] These outcomes highlight how the institutional embeddedness of CLM processes within networks of duty-bearers across government and facility-level service providers enabled the timely uptake of community-generated recommendations to strengthen PrEP service delivery.

Critical considerations for the use of the tool

CLM must be rooted in community ownership and leadership. The process should reflect the lived experiences, priorities, and preferences of affected populations, whose involvement spans the entire CLM cycle, from selecting indicators to interpreting data, driving advocacy, and shaping decisions.[72] Accordingly, data generated through CLM is owned and typically stored by community-led networks and organizations, with decisions about sharing directed by the community.[71]

Early engagement of knowledge users and key partners is essential for establishing transparent data-sharing processes and building the relationships necessary to ensure that CLM findings are translated into timely action and integrated into existing systems.[70,73] National and subnational platforms provide critical spaces for collaborative analysis, co-creation of solutions, and shared accountability for follow-up.[72]

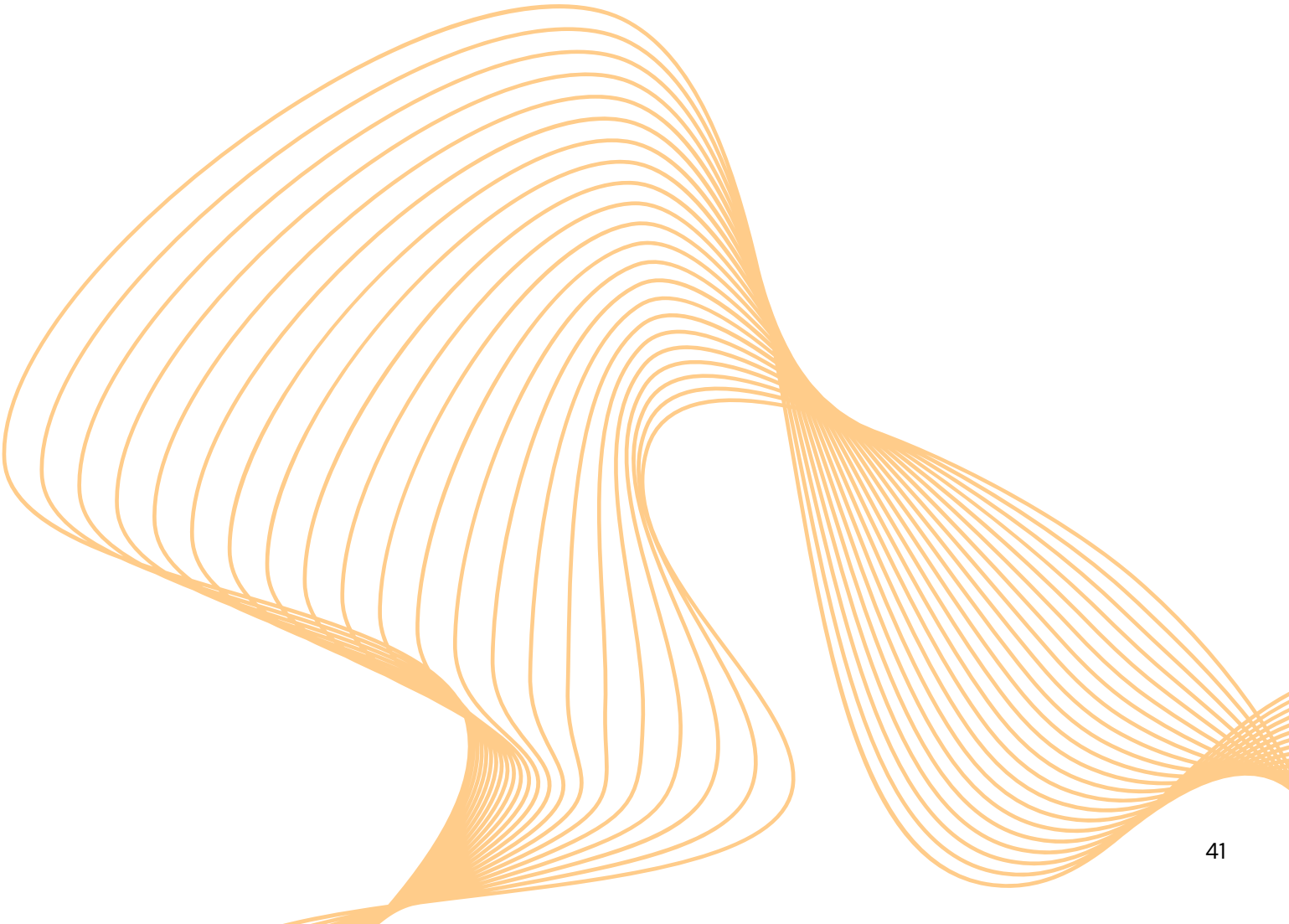
Returning findings to the communities that contributed to the process should be prioritized. This feedback reinforces the value of their participation, strengthens trust, and empowers community members to engage as advocates in ongoing dialogue with service providers. It also validates the learnings by grounding them in participants' lived realities, ensuring that resulting

actions are contextually relevant and responsive to their needs and priorities.[73] In doing so, the community intelligence generated through CLM positions it as an effective tool to sustain responsive programming and decision-making amid structural disruptions (e.g., funding cuts and shifting priorities, conflict and war). These efforts must uphold the leadership, voices, and priorities of community advocates.

Consent, confidentiality, and privacy are foundational to the ethical implementation of CLM, particularly when collecting sensitive information about health and service experiences.[72] CLM data should always be anonymized to protect individuals and minimize risk, especially in settings where participants may face increased stigma, criminalization, or other harms.

Overall findings, such as identified service gaps and proposed solutions, should be accessible to all relevant partners to inform program improvements.[71] Ensuring the accuracy and integrity of CLM data requires robust quality assurance mechanisms and ongoing investment in the training and mentorship of community implementers.[72]

CLM requires stable financial support to ensure its sustainability as a tool. While external funding and technical assistance can play supportive roles,[73] long-term success hinges on embedding CLM within established community-led organizations that have the capacity to manage, adapt, and sustain the tool over time.[72]



Tool: Integrated Biobehavioural Surveys

Why is this tool helpful for this sphere?

Integrated Biobehavioural Surveys (IBBS) are cross-sectional surveys that collect both behavioural and biological data from the same individuals during a single survey period.[77] Typically implemented among key and other priority populations within defined geographic areas, IBBS generate essential surveillance data on HIV/STI prevalence, related behaviours and experiences, broader contextual factors, and service access.[78,79] These insights help identify epidemiological and transmission patterns, monitor service uptake, and uncover gaps in service access and acceptability, enabling programs to adjust as needed to ensure broad and equitable coverage and quality of services.[77]

While data are collected at the individual level from a representative sample, the survey design enables the generation of population-level estimates of demographic profiles, disease burden, and behavioural trends.[77] Their findings may also highlight structural or contextual factors that shape these health behaviours and outcomes, which are critical for informing policy and refining program responses at the national level.[80]

When implemented with enough frequency, IBBS allow for tracking national and subnational trends over time and across subpopulations. This helps support evidence-based prioritization of prevention, care, and treatment efforts by governments and implementing partners,[77] while also meeting routine monitoring requirements often mandated by major program funders and donors.[80] As such, their findings can be leveraged to secure additional funding, scale up programs, and advocate for expanded resources.[77]

Box V. Integrated biobehavioural survey terminology

The term Integrated Biobehavioural Surveys (IBBS) is often used interchangeably with Integrated Biobehavioural Assessments (IBBA) and Integrated Biobehavioural Surveillance Surveys (IBBSS). While slight variations in terminology may exist across programs or regions, all refer to cross-sectional surveys that collect both behavioural and biological data to inform HIV/STI surveillance and programming.

How does this tool generate knowledge for this sphere?

Several comprehensive guides have been produced to support the implementation of an IBBS. IBBS are ideally conducted at fixed intervals (e.g., every few years), with the specific timing informed by the program's goals and intensity. More frequent rounds may be warranted for targeted or time-sensitive initiatives, while longer intervals may be appropriate for routine monitoring.

Data may be collected using either paper-based or electronic systems, depending on the context and available infrastructure. Standard questionnaire domains typically include demographics, sexual and reproductive health, service access and uptake, mental health, substance use, and experiences of stigma, discrimination, and violence. Additional modules may be tailored to reflect the needs of specific populations and settings (e.g., exploring injection practices among people who inject drugs, or the nature and context of client interactions among individuals engaged in sex work).

Biological data complement the behavioural component and may include qualitative results (e.g., positive/negative status), quantitative measures (e.g., HIV viral load), or both. The choice of biomarkers included in an IBBS can reflect local epidemiological and national priorities, while also considering practical factors such as cost, laboratory capacity, and legal feasibility for sample transport.[77]

Once collected, IBBS data are analyzed and interpreted to generate insights that inform the implementation and monitoring of HIV programs.[79] Ideally, data analyses and interpretation should be conducted in collaboration with communities most affected by HIV/STI to ensure findings are reflective of context-specific, lived realities. Triangulating IBBS data with other surveillance sources can help validate findings, strengthen the accuracy of interpretations, and contribute to more effective national strategies by ensuring resources are directed where they are most needed.[78]

Early, transparent dissemination, including the prioritization of sharing findings with the surveyed communities, helps build trust, validates participation, and empowers local actors to apply findings in advocacy and service planning.[77,79] Along with workshops for disseminating local knowledge, IBBS outputs typically include a comprehensive survey report, along with targeted materials such as policy briefs or summary fact sheets for decision-makers. These products help translate findings into practical recommendations for improving service delivery, reducing access gaps, addressing structural determinants of risk,[79] and demonstrating program progress to donors and funders.[80]

Key Resources

- Biobehavioural Survey Guidelines For Populations At Risk For HIV
- Integrated HIV Bio-behavioral Surveillance Toolbox
- Integrated Behavioral and Biological Assessment: Guidelines for Surveys of Populations at Risk of HIV Infection
- The bio-behavioural survey "lite": a methodology for monitoring programmes providing HIV, viral hepatitis and sexual health services to people from key populations. Implementation tool

When should this tool be used?

Within the context of HIV/STI programming, IBBS are most valuable when population-specific, individualized data are needed to inform strategic decisions regarding new or existing program implementation and monitoring. Before initiating an IBBS, existing data sources, such as those generated through epidemic appraisals or programmatic mapping, should be reviewed to assess what is already known about the local epidemic, including population sizes, risk and vulnerability profiles, and service engagement of the potential participant populations.[77] A formative (or pre-survey) assessment may also support this process by gathering contextual insights on population size, characteristics, and social dynamics. These formative assessments guide key survey design decisions, such as the sampling approach, survey implementation logistics, and community engagement strategies, helping ensure that the IBBS is feasible, appropriate, and reflective of local realities.[77,78]

IBBS are particularly useful when general population surveys do not adequately capture priority populations, whose behaviours, service needs, and risk environments often differ significantly from the general population and may be obscured in aggregate data. In contexts experiencing 'mixed epidemics' (i.e., HIV transmission occurs both among the general population and within priority groups), IBBS complement broader surveys to ensure that programming is inclusive, and priority populations are not overlooked in national strategic response plans.[77]

IBBS may be conducted at national or subnational levels, depending on resource availability, knowledge gaps, and/or the intended use of the data. National-level IBBS can help track broader trends over time, while more localized assessments offer granular, actionable insights into specific programmatic gaps or emerging risks. The geographic scope and primary sampling unit should align closely with the data needs of policymakers, implementers, or donors to ensure findings are actionable and relevant.[77]

Given their resource-intensive nature, IBBS should be strategically timed and targeted.[80] In some cases, IBBS may be most effective alongside complementary monitoring tools, such as those endorsed by The Global Fund's Prevention Outcome Monitoring Toolkit (e.g., PBS, BBS Lite, or rapid coverage surveys), which offer less resource-intensive alternatives. For example, a

BBS-Lite is a streamlined version of a full IBBS, focusing on a core set of indicators that generate rapid, actionable insights from sampled segments of priority populations.[80]

Example of the tool in relation to this sphere

Nigeria has one of the largest HIV epidemics globally, characterized by a mixed transmission typology in which both the general population and specific priority populations are significantly affected.[81] Evidence increasingly points to female sex workers, men who have sex with men, people who inject drugs, and transgender individuals as disproportionately impacted.[48] While national population-based surveys have provided insights into the broader epidemic, gaps in understanding HIV dynamics among these priority groups persist. To address this, Nigeria has routinely employed IBBS since 2007 as a tool for HIV program monitoring and refinement, implemented by the Federal Ministry of Health in collaboration with NACA, and with support from The Global Fund, the University of Manitoba, the West African Centre for Public Health and Development, and state-level implementation partners.[81]

Between August and December 2020, Nigeria conducted its fourth IBBS round,[81] gathering behavioural and biological data from nearly 18,000 priority population members (4,974 female sex workers, 4,397 men who have sex with men, 4,414 people who inject drugs, and 4,190 transgender individuals). Sampling was conducted across 12 states, selected based on HIV prevalence trends and recent population estimates from a 2018 programmatic mapping exercise. The 2020 IBBS aimed to assess HIV-related knowledge, attitudes, and behaviours, along with biological indicators such as HIV/STI prevalence, viral load, and progress toward the 90-90-90 targets, generating evidence to inform prevention and care strategies for these priority populations at both national and subnational levels.

A detailed report from the 2020 IBBS was produced, outlining the rationale, methodology, data collection processes, quality assurance measures, and key findings. These findings identified critical gaps and led to several programmatic and policy recommendations, including the expansion of HIV testing, differentiated service delivery for priority populations, improved condom use messaging, and intensified prevention and treatment programming, particularly for people who inject drugs and transgender individuals. The report also advocated for increased resource mobilization and provided guidance on strategic adjustments at both national and subnational levels. Additionally, it recommended a nationwide ethnographic study to strengthen understanding of transgender populations and inform the development of inclusive, evidence-based programming.

Critical considerations for the use of the tool

Engagement with local community members, service providers, non-government organizations, researchers, and national program partners is essential throughout the IBBS process, from early planning to dissemination. Their contributions help ensure that a survey reflects local realities, fosters meaningful participation, and increases the likelihood that findings will be used to strengthen programs and policies.[77]

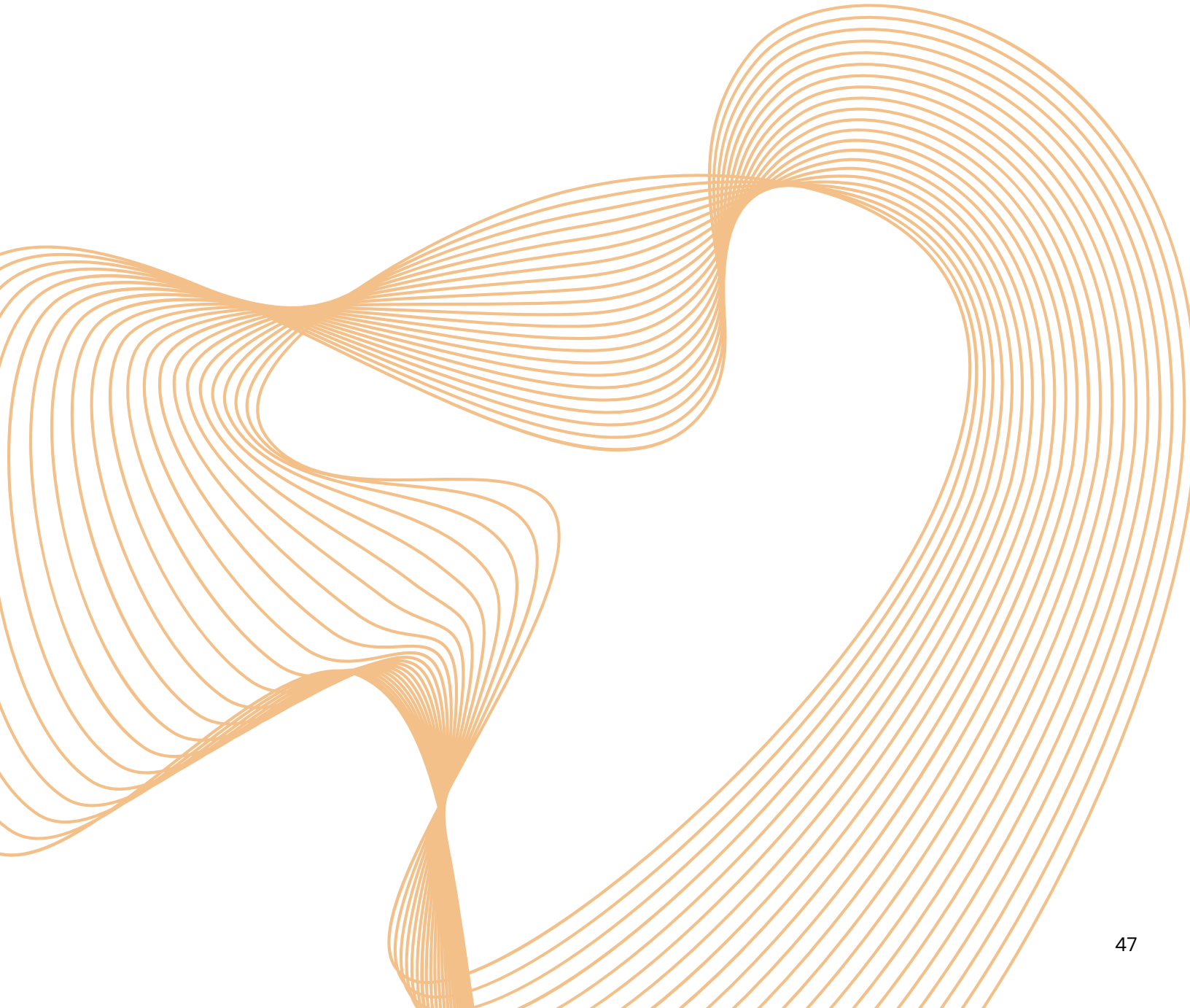
While national IBBS are valuable for providing a broad overview of an epidemiological context, including estimates of HIV/STI prevalence and key behavioural indicators among key and priority populations, they are resource-intensive and may offer limited utility for informing subnational priorities and local program implementation, particularly within large, diverse geographies.[82] National IBBS are typically conducted every few years, making it challenging to capture evolving behaviours and epidemic trends. To ensure a more comprehensive and timely understanding of emerging needs, IBBS data may be supplemented with other sources, such as routine programmatic data, embedded research, or additional surveillance tools,[79] including ePBS. Additionally, more localized or disaggregated IBBS approaches, particularly those grounded in community participation, can yield faster, context-specific insights that better support local ownership, program implementation and adaptation, and timely decision-making. When aggregated, subnational data can complement national surveillance and provide a more nuanced picture of an epidemic.[82]

IBBS are cross-sectional in design, meaning they capture data at a single point in time (or at multiple points if repeated) but cannot establish causal relationships. Observed changes in behaviours or HIV/STI prevalence generated through an IBBS should not be interpreted as direct outcomes of program implementation but rather treated as ecological observations.[77]

The effectiveness of an IBBS is dependent upon thoughtful questionnaire design. Within a priority population, there may be subpopulations with distinct behavioural patterns or differing levels of HIV/STI risk. To ensure data adequately reflect their experiences, certain subgroups may warrant data collection using separate, tailored IBBS where their size permits.[78] While standardized questions are often prioritized across IBBS rounds to support comparability and monitor trends over time, co-developing survey tools with affected populations can enhance the contextual relevance and utility of the IBBS data.

Biological sample collection is a standard component of IBBS, enabling the generation of HIV/STI prevalence estimates among participant groups. In doing this, IBBS investigators assume an ethical responsibility for returning results to participants and supporting linkage to appropriate care. This is especially important in settings where access to health services may be limited or affected by stigma. The selection of biomarkers should consider not only local epidemiological priorities but also logistical and resource capacity, and ethical obligations to participants around testing and follow-up.[77]

Participants must provide informed consent for each component of an IBBS, including the interview, biological sample collection, and any future use or storage of biological specimens, if applicable. They must retain the option to decline participation in any part of the assessment. Given the sensitivity of data collected, particularly among key and priority populations who are often criminalized, marginalized, or face stigma in health and research settings, research ethics committees must review and approve IBBS protocols to ensure participant safety, equitable processes, and strong data protections. While UIC are an integral part of surveys to support data linkage, the use of biometrics is not required when implementing an IBBS. If biometric identifiers are included, extensive community consultation should be conducted, and the outcomes of these consultations must guide decisions. Safeguarding confidentiality, preventing misuse, and ensuring alignment with community expectations are essential to protecting individuals and sustaining trust between communities and programs.[77]



Tool: HIV Prevention Self-Assessment Tool

Why is this tool helpful for this sphere?

The UNAIDS HIV Prevention Self-Assessment Tool (PSAT) is a valuable resource for assessing the quality and effectiveness of HIV prevention programs.[83] It provides a structured, participatory, and context-sensitive framework for implementing organizations and national programs to critically assess their efforts[83,84] in each of the five HIV prevention program pillars from the UNAIDS HIV Prevention 2020 Road Map.[85]

The PSAT is designed as a comprehensive, user-friendly tool aimed at fostering self-reflection, local ownership, and shared learning by bringing together diverse stakeholders (e.g., government agencies, civil society organizations, and affected community members) to collectively assess their program performance and develop plans to address identified gaps.[86] Originally designed for use at the national level, the PSAT has since been successfully leveraged at subnational levels for program management and monitoring.

Through facilitated discussions and consensus-building, the tool enables participants to identify context-specific challenges and strengths, prioritize areas for improvement, and develop concrete action plans. This participatory process aims to increase the likelihood that the resulting insights are grounded in lived experiences and immediately relevant to decision-making and program planning. The common use of visual dashboards to display a program's PSAT score further enhances its utility by making complex information accessible and actionable, helping facilitate strategic discussions.

Regular use enables teams to track progress over time and evaluate the impact of interventions. Its application in multiple countries has demonstrated its flexibility and scalability, especially in resource-constrained settings.[84]

How does this tool generate knowledge for this sphere?

The PSAT facilitates the identification of programmatic gaps, supports the assessment of organizational capacity, and guides planning for future improvements through a process that is both self-reflective and collaborative. One of the primary ways the PSAT generates knowledge is through reflective practice. By encouraging internal dialogue among program staff and key partners, the tool helps bring to light tacit knowledge (i.e., information and insights that individuals hold but may not routinely express) about program performance, challenges, and strengths.[84] This process allows organizations and national programs to better understand how their HIV prevention activities are functioning and where they may need to focus attention and efforts, or (re)allocate resources. The participatory design of the PSAT also promotes collaborative learning by engaging a wide range of voices and experiences. This inclusivity enables diverse groups of people who use, provide, and contribute to program services to

share their perspectives, clarify assumptions, and build a more comprehensive and context-sensitive understanding of the program environment. Additionally, the PSAT generates data-driven insights by collecting and analyzing responses to a series of defined questions on program management, implementation, and outcomes. It offers both quantitative scores and qualitative feedback, which together provide a nuanced picture that can inform evidence-based decision-making.

The tool contributes to building organizational capacity. As teams work through the assessment, they can evaluate their program's current status while simultaneously developing a clearer vision for future improvements. This process enhances overall knowledge of effective HIV prevention strategies and strengthens the capacity to adapt and respond to emerging needs and challenges.

Pillar	Functions	Element Examples
Program Management	Leadership & Coordination	National key population strategy; accountability; technical working group; partner coordination
	Policy & Regulation	Policies and guidelines
	Program Analytics	Data for decision-making
	Financing	Budget planning; costing
Program Implementation	Targeting & Planning	Demographic assessment; epidemiological assessment; needs assessment; target setting
	Clinical Service Package	Prevention screening and treatment for HIV/STI, drug and alcohol use; provision of PEP, VMMC, NSP, MAT*, condoms, etc.
	Structural Intervention Package	Mitigating and managing violence; stigma reduction interventions; legal literacy training; strategies for law enforcement engagement
	Community Engagement & Empowerment	Peer outreach educators; safe spaces/drop-in centres; community committees
	Differentiated Service Delivery	Health worker training; accessible services; acceptable services
	Program Monitoring & Evaluation	Routine monitoring; rereferral system tracking; quality assessment; surveillance
Program Outcomes	Outcomes among Key Populations	E.g., Condom use by key populations among partner typologies; safe injection practices
	Sustainability	Domestic resourcing; social contracting; capacity building

*PEP: post-exposure prophylaxis; VMMC: voluntary medical male circumcision; NSP: needle and syringe programs; MAT: medication-assisted treatments.

Figure 3. Components of the HIV Prevention Self-Assessment Tool (adapted from: Using the HIV Prevention Self-Assessment Tools (PSAT) to assess and monitor sex workers HIV programmes in selected countries in Africa)

Key Resources

- Five HIV prevention self-assessment tools (PSATs)
- Prevention Self-Assessment Tools (PSATs): an easy-to-use method for country-led review of national programmes
- PSAT-Lite is an abridged version of PSAT that can be used to monitor program performance over time. One example of a PSAT-Lite: Kenya Female Sex Worker Programme (2022).

When should this tool be used?

The PSAT is best used at key moments in the planning and review cycles of HIV prevention programs. By supporting structured reflection and collaboration, organizations can assess and refine their efforts based on emerging evidence, contributing to iterative program improvements in response to evolving needs and contexts.[84] The tool is recommended for regular use, ideally once a year, or at critical strategic phases, including during the development of national strategic plans, preparation of funding proposals, or mid-term evaluations.[86]

The PSAT is typically used in facilitated workshops that bring together a technical and implementation team, along with broader technical working groups, to ensure a diversity of perspectives and a consensus-driven assessment. During these sessions, participants first complete the tool in small groups before coming together in larger discussions to validate scores and findings. Plans are developed to address the areas with low scores. Areas with high scores are identified as strengths that can be shared with other countries in the future. Final results are then validated by a local technical working group and used to inform programmatic refinement.[86]

Example of the tool in relation to this sphere

Emmanuel and colleagues report on the implementation of a sex worker–focused PSAT (SW-PSAT) across ten Global HIV Prevention Coalition countries in Africa between August 2020 and July 2021.[84] In each country, a technical team of eight to 10 national stakeholders (including government, civil society, and key population representatives) collaboratively completed the PSAT, facilitated by the South-to-South HIV Prevention Learning Network. They rated three core program domains: Program Management, Program Implementation, and Program Outcomes & Sustainability, using an intuitive rubric scored from 1 to 5.[84]

The tool automatically generated domain-specific and aggregate scores, which were then visualized in dashboards to identify sector-specific strengths and weaknesses. Scores for Program Management and Program Implementation generally ranged between 3 and 4. In contrast, Outcomes & Sustainability scored lower, reflecting limited large-scale implementation of otherwise strong strategies alongside widespread challenges in collecting

and using outcome data to monitor coverage and assess quality. Countries with higher PSAT scores also reported higher condom use and reduced HIV incidence, suggesting alignment between self-assessments and behavioural outcomes.

Fifteen key informant interviews were conducted to assess the usefulness and practicality of the PSAT process. Respondents emphasized that facilitated self-assessment encouraged honest reflection, consensus, and local ownership of results. They also appreciated that the exercise was entirely country-led, requiring no primary data collection or ethical review.

The use of PSAT fostered critical self-reflection, enhanced stakeholder buy-in, and provided clear, actionable insights to guide planning and resource allocation. By linking programmatic performance to epidemiological metrics, the process strengthened evidence-based decision-making and reinforced a culture of continuous, peer-supported learning.[84]

Critical considerations for the use of the tool

Representation is essential with the PSAT's application. The tool relies on group consensus, so all relevant voices must be included, particularly those from key populations.[86] Without meaningful participation from these groups, the assessment may fail to reflect the lived realities of those most affected by HIV.[84] On the other hand, when used in its intended purpose, the PSAT can serve to build trust and cohesion within the program or country assessed.[86]

Unlike traditional monitoring tools, the PSAT emphasizes qualitative reflection alongside quantitative scoring, which inherently introduces a degree of subjectivity. While this approach helps capture nuanced, context-specific insights that numeric metrics alone may overlook, the results may be influenced by the composition of the group and the dynamics of the discussion. Facilitators should therefore cultivate safe, open environments where participants feel empowered to speak candidly, and be attentive to power imbalances to ensure the insights generated are authentic and actionable.[86]

The timing of the PSAT should align with existing program planning, budgeting, or reporting cycles so that its findings contribute directly to real-time decision-making. As Emmanuel et al. note, "since this is an extremely comprehensive tool, its completion is a lengthy and time-consuming process and countries might find it challenging to repeat the process to track programs' progress regularly."[84] Even so, the PSAT is open-source and subnational adaptations are increasingly common, offering flexible formats including simplified or 'lite' versions that can be tailored to different contexts.

Institutional commitment is equally important, as the tool's impact relies on organizations' willingness to acknowledge challenges and follow through on recommended adjustments.[86] Open-access training resources are available to support effective use. When these elements come together, the PSAT can serve not only as a diagnostic tool but also as a catalyst for inclusive, evidence-informed HIV prevention planning.

Tool: Mathematical Modelling

Why is this tool helpful for this sphere?

Mathematical models can be used to describe the spread and control of infectious diseases. They provide a theoretical framework for specifying assumptions and integrating relevant data,[87] which can help predict the expected course of epidemics and the potential impact of interventions, whether implemented individually or in combination with other methods. These predictions can inform program planning, facilitate communication, and contribute to advocacy efforts. Models can also provide counterfactual scenarios of alternative outcomes in the absence of an intervention, helping to assess whether observed outcomes align with expectations.

A primary focus of modeling is to assess the risk of acquiring an infection or disease, and to identify the key factors that influence this risk. Non-communicable diseases involve linear processes that can be modeled to demonstrate how genetic and environmental exposures affect disease incidence within populations, as well as to assess the impact of interventions on disease progression and resolution. In contrast, communicable or infectious diseases spread through interactions between infected and susceptible individuals, resulting in nonlinear pathways that generate more pronounced and dynamic transmission patterns.[88]

Using observed distributions of infections and diseases as inputs, models can infer processes or estimate parameter values that influence transmission and progression. Alternatively, the best estimates of parameter values can be used to predict patterns of infection and disease. By combining these two approaches, Bayesian analyses of models facilitate the comparison of model outputs with observations, enabling the iterative refinement of understanding and the improvement of model validity.[89]

In the context of a Program Science approach, mathematical models can help decision-makers track epidemics, determine optimal epidemic control strategies, and assess progress toward achieving epidemic control. Models of infection and disease also underpin health economic analyses, in which costs can be attributed to model inputs and outcomes to evaluate the cost-effectiveness of alternative interventions.

How does this tool generate knowledge for this sphere?

Epidemiology, the quantitative science of public health, has a long history of utilizing models to inform public health programs. Models are commonly used to understand how the world works, though they often rely on assumptions that are not always clear or well-validated. By translating processes leading to disease in mathematical terms, models make underlying assumptions explicit, allow outcomes to be tested against observations, and facilitate exploratory, 'what if' questions to understand how implemented interventions might have

changed outcomes in relation to counterfactual scenarios.

Models should include explicit equations of algorithms to ensure precise communication of underlying assumptions. These equations can be solved analytically, deriving results directly from the equations, or numerically, using a stepwise computational approach.

Solving models requires estimating parameter values, which can be derived from clinical and epidemiological studies or by fitting predictions to observed trends. Model predictions are made both with and without parameters describing interventions, allowing for calculation of the interventions' impact. The required coverage of interventions to achieve specific results can be used to calculate program targets. Practical constraints, such as budget limitations, healthcare workforce capacity, and product availability, can be imposed on parameter values to assess their influence on outcomes and help planners optimize results within their given context.

Sensitivity analyses explore how changing assumptions and parameter values affect model outcomes, while uncertainty analyses quantify the degree of uncertainty around assumptions and parameter values. Critically, biases in model structures and parameter values can propagate through model calculations, potentially leading to a false level of confidence in the model's results.

Models are increasingly available with user interfaces that allow users to set parameter values and visualize results. However, expert guidance remains essential to understand the model's strengths and weaknesses, to contextualize assumptions, and to help interpret results.

Box VI. Types of mathematical models

There are varying levels of detail used in modeling populations, infections, and diseases.

Deterministic vs. Stochastic Models: In deterministic models, a given set of parameter values consistently produces the same outcome. These models are considered easier to solve and are useful for approximating outcomes in large populations. Stochastic models, by contrast, incorporate randomness, meaning that even with the same parameters, a range of plausible outcomes is possible. Stochastic models are particularly useful for capturing local events and exploring variations in expected outcomes, even when parameters remain constant.

Compartmental vs. Individual-based Models: Populations can be modeled as groups, typically called compartmental models, or as individuals, using individual-based

simulations (or agent-based models). Compartmental models are generally easier to solve and can incorporate increasing levels of detail by adding strata. Individual-based models can offer greater granularity, however, their distinction from compartmental models is often less pronounced in practice. Individual-based simulations frequently group individuals and apply similar parameter values that effectively create compartments within the model.

When should this tool be used?

Mathematical models are best utilized in planning and evaluating programs, including assessing the impact and cost-effectiveness of novel interventions, determining the optimal mix of interventions, defining who can benefit most from programs, evaluating coverage targets, and determining whether the component interventions have had an impact on outcomes of interest. Models can help determine the allocation of resources, leading to 'allocative efficiency' when the right interventions are used in the right places for the right people.

Models have been used by national planners, but could also be used to explore local epidemiology in more detail and the potential impact of local programs. With more granular planning, individual-based and stochastic simulations become more relevant.

Models provide a framework for estimating the incidence and burden of infections and diseases. For example, UNAIDS supports the HIV estimation process using the Spectrum suite of models.[90] These models fit data from past surveys and sentinel surveillance, along with intervention coverage, demographics, and HIV epidemiology, to project the current HIV incidence and prevalence, and associated mortality.

Example of the tool in relation to this sphere

Models have long been used to study how infections progress and how behaviours contribute to their spread.[91] Early models of gonorrhea, for example, explored the impact of contact tracing interventions.[92] During the early years of the HIV pandemic, mathematical models were applied to predict epidemic scale, demographic impact, and key drivers of transmission.[93] As innovations in prevention and treatment strategies emerged, models of HIV evolved to assess their effectiveness, including the impact of ART coverage,[94] condom use,[95] VMMC,[96] and PrEP targeted to different prioritized groups.[97] While these models are often integrated as part of international research, their application at a local level remains limited.

Two models have dominated work at the country-level: Avenir's GOALS model[98] and the Optima model.[99] These models were designed to support national planning and were accompanied by technical assistance to facilitate their use. Their results have informed national strategic plans, PEPFAR operational plans, and The Global Fund's applications for the prevention and treatment of AIDS, tuberculosis, and malaria.

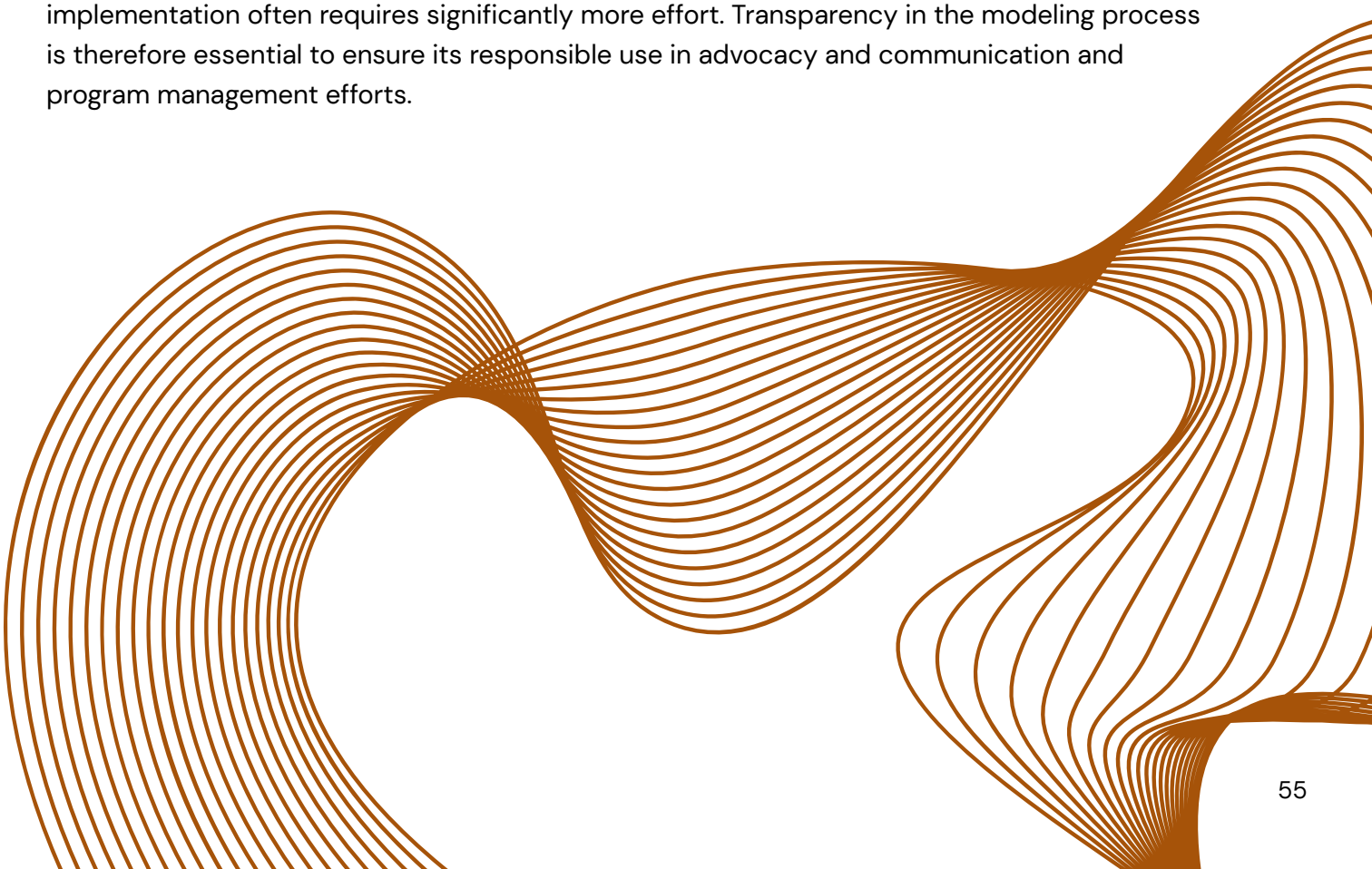
Critical considerations for the use of the tool

The results of mathematical models are predictions based on assumptions and parameter values. The accuracy of these assumptions and values directly influences the accuracy of a model's results.

Models often contain more parameters than can be reliably estimated through calibration with observed data. As a result, different combinations of parameter values can generate epidemics with similar characteristics. For example, adjusting various parameters within a mathematical model (e.g., increasing transmission probabilities or contact rates) may both yield accelerated epidemics; however, understanding which factors drive epidemic growth in particular contexts is critical for understanding the potential success of different interventions in that context. There is a trade-off between model complexity and tractability. While more detailed models may better capture the context of epidemics, they can become more challenging to interpret and leverage for informing local program planning.

The results of models can influence the outcomes they aim to predict. For example, if warnings about a projected epidemic lead to behaviour changes, the trajectory of the epidemic may shift. Models must therefore be revisited and updated as contexts evolve.

Models can serve as tools for communication and advocacy. One key concern is the potential for model assumptions or inputs to be manipulated to produce desired results for advocacy, rather than grounding them in objective data. While it may be easy to adjust a parameter to simulate the potential effect of an intervention, achieving the same effect through real-world implementation often requires significantly more effort. Transparency in the modeling process is therefore essential to ensure its responsible use in advocacy and communication and program management efforts.



The Future of Program Science

Program Science was introduced to strengthen HIV/STI prevention by bridging the gap between science and programs. Over time, this approach has demonstrated that program design, delivery and impact are strengthened when guided by rigorous, iterative evidence. Lessons from HIV prevention in resource-constrained contexts underscore the value of Program Science in enhancing the adaptability and effectiveness of public health programs. Tools and strategies such as programmatic mapping, population and geographic prioritization, and dynamic monitoring cycles—initially developed to address HIV epidemics—are now recognized as critically relevant and transferable to other infectious disease programs,[4] including tuberculosis and malaria control, as well as programming for chronic and noncommunicable diseases.

Opportunities to Support Adapting and Evolving Health Systems

Program Science strengthens investments by ensuring that evidence-based interventions are implemented, continually utilized, and adapted as contexts evolve, maximizing their effectiveness and long-term impact. Yet, decades of investments in the HIV response have built programmatic, human resource, and governance infrastructures that remain underutilized. Program Science offers a strategic approach to repurpose these assets toward broader health priorities, while maintaining a focus on population-level impact and addressing structural determinants, such as poverty, stigma, and inequity.[3]

As global health shifts from vertical, disease-specific programming to integrated delivery platforms, Program Science provides practical guidance for integration. This can be applied across points of service delivery, within technical systems such as supply chains and health information systems, and through governance structures via partnerships and knowledge networks. By leveraging these mechanisms, Program Science provides an opportunity to support the development of horizontal health systems that are evidence-based, responsive, and accountable to the populations they serve.

As the scope of Program Science expands, so does the opportunity to strengthen its core principles. This evolution involves deepening its focus on understanding who is affected, where, and why; enhancing iterative program refinement to address the growing complexity and interdependence of health outcomes; and ensuring that structural and contextual determinants remain central to program design. By maintaining responsiveness and contextual specificity, Program Science can broaden its impact while preserving the qualities that have made it a transformative approach to public health.[3] Advancing Program Science will require transdisciplinary innovation to develop and refine the methods and methodologies used to operationalize the strategy.

Technology and Innovation in Program Science

A core principle of Program Science is that programmatic adaptations should respond to evolving population needs, rather than prioritize the adoption of new technologies for their own sake.[1,2] While innovative tools and products can be powerful, their impact is limited if misaligned with local needs and contexts. This misalignment often leads to 'implementation backlogs' where programs appear ineffective, not due to the innovation itself, but because of a disconnect between the intervention and the realities on the ground.

Technologies—such as diagnostic platforms, digital surveillance systems, and biomedical prevention tools—that are developed in well-resourced settings often require careful adaptation to be effective and sustainable in resource-constrained settings. A Program Science approach offers a framework to navigate this process, balancing the integration of new innovations with the continued use of proven interventions. Decisions around adopting new technologies and innovations must consider cost-effectiveness, feasibility, and long-term sustainability to ensure meaningful and lasting population-level impact.[4]

Program Science reframes innovation as part of an iterative cycle of accountable implementation. Through continuous monitoring, joint goal setting, and the use of locally relevant evidence, it ensures that new approaches strengthen rather than destabilize health systems. Rapidly evolving technologies related to artificial intelligence (AI) and machine learning could offer new opportunities to enhance the responsiveness and precision of public health programming. When developed and designed appropriately to meet public health needs and tailored to local contexts, these tools may help to identify changing trends in program coverage, monitor evolving service needs, and inform efficient (re)allocation of resources by analyzing large volumes of real-time program data. Embedded within Program Science's iterative monitoring cycles, AI-driven insights could help strengthen decision-making and support evidence-based decisions about when to adopt, adapt, or defer new technologies, aligning their delivery with evolving population needs.[3]

The Role of Academia and Research Institutes in Program Science

From its inception, Program Science has aimed to bridge the gap between research and practice by reducing the disconnect between scientific knowledge and program implementation.[2] Academic institutions and research organizations play a central role in sustaining this bridge. In an era where scientific evidence is increasingly contested, Program Science emphasizes grounding decisions in local data and community experience. Its tools foster mutual accountability among researchers, implementers, policymakers, and the communities,[4] aligning research agendas with programmatic goals. In doing so, Program Science builds public trust and ensures that science remains responsive to needs, rather than prescriptive.

Academic institutions can further support this alignment by developing research agendas and methods that respond directly to programmatic needs and aim for population-level impact. Program Science is particularly valuable for identifying limitations in existing tools and stimulating the development of new, context-specific methodologies.[1,3] By partnering with implementers to co-develop, test, and refine approaches, academic institutions can ensure that methodological innovations remain grounded in the lived realities of those requiring health services and the broader systems that support them.

Program Science also provides a platform for academic engagement in global health diplomacy and advocacy. By demonstrating accountability to populations and governments through measurable impact, academics and research institutions can position themselves as relevant and credible actors within the evolving global health landscape.

Advocacy, Funding, and Accountability

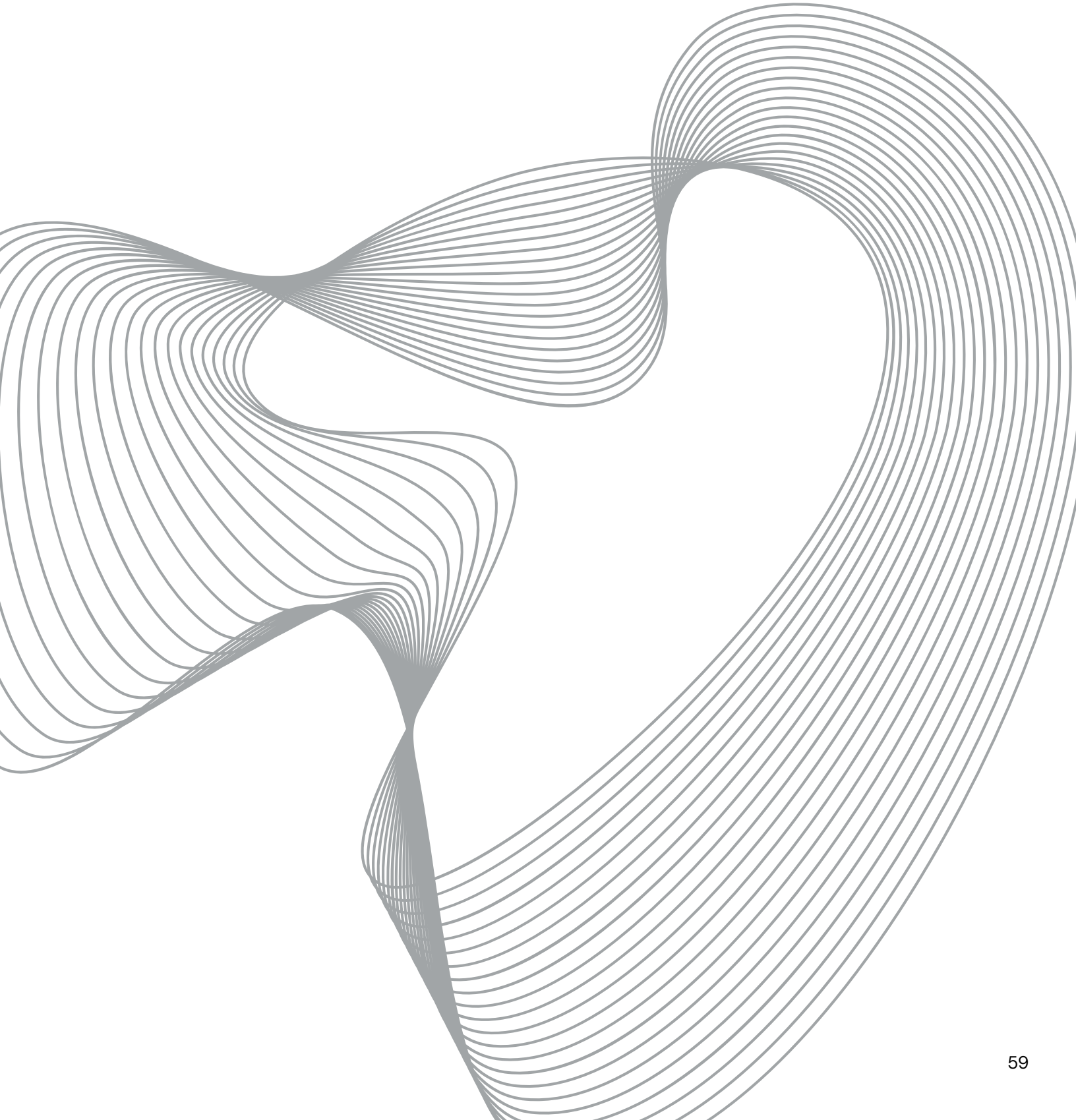
As international HIV funding declines and the global health landscape becomes increasingly politicized, Program Science supports strategic advocacy for sustained investment. It helps build the case for maintaining international commitments while reinforcing domestic ownership and accountability. Through its emphasis on data-driven planning, transparent impact measurement, and responsiveness to evolving needs of prioritized populations, a Program Science approach demonstrates where programming is effective, where resources remain critical, and how programs must adapt. It also highlights the risks of short-term or misaligned funding decisions that can destabilize health services. In this way, Program Science serves as both a scientific approach and a mechanism for advocacy.

Advocacy informed by Program Science can take many forms, depending on the context. In some settings, it may focus on generating evidence to support policy shifts or funding reallocations; in others, it may highlight the value of community-generated data in strengthening national systems to improve accountability. Effective strategies often combine rigorous epidemiological and programmatic data with narratives that reflect the lived experiences of affected populations, ensuring both scientific credibility and resonance with decision-makers.[4]

Call to Action for Advancing Program Science

The evolution of Program Science has demonstrated the transformative potential of embedding iterative learning, structural analysis, and population accountability into program planning and evaluation. As priorities vary across geographies, the core commitments of Program Science remain constant: addressing structural determinants, adapting to resource constraints, ensuring accountability, and advancing equity in population-level outcomes.[3] Program Science is uniquely positioned to drive the development of accountable, evidence-driven, and context-sensitive programs capable of responding to both persistent and emerging health challenges.

To advance this approach, sustained investment is essential. Building capacity, innovating new methodologies and tools, and safeguarding Program Science's foundational principles must be prioritized. By committing to this vision, communities, governments, funders, and academic institutions can work collaboratively to shape effective, integrated, and resilient health systems that are anchored in accountability and driven by impact.



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