

Making HIV Responses More Efficient: Recent Innovations in Approach and Applications

A Report from Pharos Global Health Advisors to UNAIDS

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I. Framework for Efficiency

A companion report from Pharos emphasizes how HIV financing has moved through three phases—from emergency financing from the international community to donor fatigue to the current focus on sustainability within a wider policy of integration and UHC. Alongside this shift there has been a growing realization that improving the efficiency of *existing* investments will be critical to the ongoing HIV response. Efficiency in HIV programming has become even more urgent in light of the economic shocks that COVID-19 has caused in many nations and the resulting impacts on the HIV financing landscape.(64)

Optimizing the use of existing resources also matters because the global burden of HIV exceeds the resources available to address it.(65) As Arin Dutta and colleagues say, future resource needs for ART scale-up “significantly threaten the sustainability of the global HIV response without additional resource mobilization from domestic or innovative financing sources or efficiency gains.”(66)

While the international health community must of course continue to make the case for increasing both external and domestic financing for HIV services, countries must also take steps to get “more health for the money”—that is, to get the most out of available funding. They can do this, say Sergio Bautista-Arredondo and colleagues, “by providing the optimal mix of evidence-based interventions targeted at appropriate populations and geographic areas to minimize new HIV infections and AIDS-related deaths (allocative efficiency) and by delivering the highest possible quality HIV services at the lowest feasible cost (technical efficiency).”

Inefficiencies in HIV programs are well described in the empirical literature. To give one example, HIV service delivery unit costs (e.g., for PMTCT, HIV testing and counselling, and ART) have been shown to vary widely within and between countries.(67) In this chapter, we examine the most recent evidence, from 2015-2020, on ways to address these inefficiencies.

Defining efficiency

There are many different types of efficiency described in the literature, including:

- **Allocative efficiency:** maximizing health outcomes using the least costly mix of health interventions; for HIV, allocative efficiency means optimal allocation of HIV funding to the combination of HIV interventions that will yield the greatest impact.
- **Technical efficiency:** the maximum output has been produced with the least input, i.e. the least unit cost; two ways to improve technical efficiency are economies of scale and of scope.
- **Program efficiency:** optimal use of management, procurement systems, human resources and information to support effective and efficient service delivery.

In this literature review, rather than using these definitions to organize our findings, we have used the results to help address **four key questions** (Table 1) that the review tried to answer:

1. How do we get the most out of a fixed budget?
2. How can we achieve budgetary savings?

3. Is one intervention superior to another in achieving the same goal?
4. Is this intervention cost-effective?

Table 1: Key efficiency questions

Key question	Explanation	Example
How do we get the most out of a fixed budget?	Budget optimization could be achieved, for example, by reallocating funding to a different mix of services (<i>allocative efficiency</i>) or by reducing unit costs (<i>technical efficiency</i>)	<ul style="list-style-type: none"> ■ With a fixed national HIV budget, studies have shown that the most efficient approach is to (i) increase the share of the allocated budget for testing and ART, and (iii) increase allocations to the populations with the highest incidence
How can we achieve budgetary savings?	What amount of savings could we achieve by moving to a different approach?	<ul style="list-style-type: none"> ■ A robust body of evidence shows that cost savings can be achieved through task shifting activities in HIV/AIDS programs
Is one intervention superior to another in achieving the same goal?	Should we do A or B? In other words, is one intervention superior to another to achieve the same goal (as measured by the cost per unit of output)?	<ul style="list-style-type: none"> ■ Universal HIV screening in pregnant women is superior to targeted screening
Is this intervention cost-effective?	Is this intervention cost-effective against an accepted threshold or benchmark for cost-effectiveness (e.g. 1 x GDP/capita)? In other words, does it achieve the threshold test for being efficient?	<ul style="list-style-type: none"> ■ HIV self-testing is cost-effective

Following the literature review, we also investigate how the HIV investment case approach, which started a decade ago and has generated many country analyses, has helped countries address the above four key questions.

II. Methodology

Research questions

1. What evidence is available from the recent research literature (2015-2020) on ways to improve the efficiency in the HIV response?
2. Are there recent innovative approaches that have resulted in improved efficiency?
3. Where are the key evidence gaps and opportunities to make further improvements in efficiency?
4. Is there evidence of uptake of efficient HIV response strategies across countries?

Search strategy

To inform discussions about ways to drive efficiency in HIV prevention and treatment, we conducted a narrative literature review of the formal peer-reviewed and grey literature with a specific focus on recent literature published between 2015-2020. The literature search strategy was developed by the research team in consultation with a Duke University librarian (shown in Table 2 below). We applied the search strategy using Boolean search terms across three databases: PubMed, EMBASE and Web of Science to identify relevant articles from the peer-reviewed literature. A total of 9545 articles were identified from the databases. After removal of duplicated, 3340 abstracts were reviewed for relevance and 3116 studies have been found to be irrelevant at the title and abstract screening stage. 224 articles were fully assessed out of which 49 articles were included in this synthesis. To identify relevant articles from the grey literature, a Google search was conducted using the same search terms applied the websites of major organizations such as UNAIDS, PEPFAR, Global Fund and the World Bank.

The team identified several inclusion criteria to determine eligibility of articles included in the report. First, all articles needed to be HIV-focused to be included in the review. Second, studies should have reported on different forms of financing efficiency to be included. Studies that only focused on clinical effectiveness of interventions without reporting financing efficiency implications were excluded from the review. Thirdly, only studies that focused on low-and middle-income settings were included for review. Study protocols and clinical trials were excluded from the scope of the review. Wherever peer-reviewed studies and grey literature did not report cost data but included discussions on implementation and policy implications for efficiency, these were used to supplement the gaps and opportunities where future work is needed to improve the evidence on HIV efficiency gains.

Table 2: Literature search strategy

Key words	
Terms 1	"Acquired Immunodeficiency Syndrome" OR "HIV Infections" OR HIV OR "human immunodeficiency virus" OR AIDS OR "acquired immune deficiency syndrome"
Terms 2	"Economics" OR "Cost Savings" OR "Cost-Benefit Analysis" OR "economies of scale" OR "economies of scope" OR "integrated delivery" OR "integrated intervention" OR "financial" OR "costs" OR "value for money" OR "optimal resource allocation" OR "optimization" OR "resource analysis" OR "intervention" OR "policies" OR "service delivery" OR "operational capacity" OR "cost utility" OR "value for money" OR "model" OR "modeling" OR "budgets" OR resources
Terms 3	"efficiency" OR "efficient" OR "efficiently" OR "effective" AND "technical" OR "productive" OR "allocative" OR "implementation" OR "financing" OR "program" OR "programme"

Framework

As described earlier, in this literature review, rather than reporting the findings by type of efficiency, we organized the results to help address **four key questions** (Table 1) that would be useful to policymakers and practitioners to make policy and investment decisions.

Identification of case studies

In addition to summarizing the evidence from the literature, we also highlighted examples of efficiency analyses that have influenced and shaped HIV policy and investment decisions. In order to develop the case studies, the peer-reviewed literature was used as a starting point to identify countries that have successfully adopted the efficiency interventions and implemented them at scale. Additional search of the peer-reviewed and grey literature was conducted to find supportive data on uptake, implementation, and efficiency gains. While the literature summaries provide an overview of the evidence, the case studies supplement the research evidence by providing specific examples and a closer look at the uptake of interventions, along with implementation strategies and efficiency gains across countries.

We begin with a summary of our review findings and case studies, organized around the four questions shown in Table 1. We include a brief discussion of the limitations of the literature on each type of efficiency intervention. We then highlight the key gaps and opportunities for future research from the literature, and finally we present general policy recommendations.

III. Summary of the Literature Review

Question 1. How do we get the most out of a fixed budget?

Our review found evidence on budget optimization at the national level and on the value of international actors optimizing allocations across nations.

1.1 Budget optimization at the country level

Potential efficiency gains: Multiple studies have shown that (i) better targeting of existing resources can reduce both new HIV infections and HIV-related deaths, (ii) if no expansion in the HIV budget is expected, the share of the allocated budget for testing and ART should be increased, and (iii) there are efficiency gains from increasing allocations to the populations with the highest incidence. One study of PrEP suggested that in settings with low budgets, it may be more cost-effective to focus resources on expanding access to testing and ART *before* adding PrEP. When there is high budget availability, modeling indicates that PrEP has an increasing role in optimal prevention portfolios but other interventions—including enhanced testing and ART, VMMC and condom promotion—may be more cost-effective for prioritization.

Summary of research: Multiple studies have used the Optima model (hiv.optimamodel.com), a dynamic population-based compartmental model to model optimized investments of available HIV resources. We also found a scoping review of studies on PrEP and budget optimization. These studies are described below.

A study by Minnery et al (2020) (68) used Optima to model the efficiency gains to 2023 from targeting existing resources in Eswatini (they used Eswatini’s most recently reported national annual HIV budget, US\$123 million in 2017, of which \$63 million was invested in programs whose direct impact on the HIV epidemic could be readily modelled). The researchers estimated the number of infections and deaths that could be prevented by optimization across HIV programs, then across service delivery modalities for VMMC, HIV testing, antiretroviral refill, and switching to a lower cost ARV regimen. *The most important efficiency gain would be from scaling up HIV testing to the general population.* More infections could then be averted with further optimization between service delivery modalities across the HIV cascade: (a) Scaling up index and self-testing could lead to 100,000 more people getting tested for HIV (25% more tests) with the same budget; (b) by prioritizing fast-track, community-based, and facility-based antiretroviral refill options, an estimated 30,000 more people could receive treatment (17% more than baseline or US\$5.5 million could be saved, 4% of the total budget); (c) switching nonpregnant HIV-positive adults to a dolutegravir-based ART regimen and concentrating delivery of VMMC to existing fixed facilities over mobile clinics, US\$4.5 million (7% of total budget) and US\$6.6 million (10% of total budget) could be saved, respectively.

Stuart et al (2018) (69) used Optima to model allocative efficiency in 23 countries to 2030.¹ They found that the optimal distribution of HIV resources depends on the available HIV budget and the characteristics of each country's epidemic, response and targets. Universally, modeling found that *scaling up treatment coverage is an efficient use of resources*. There are also efficiency gains by targeting the HIV response towards the geographical regions and populations with the highest HIV incidence. A "more efficient allocation of HIV resources could reduce cumulative new HIV infections by an average of 18% over the years to 2020 and 25% over the years to 2030, along with an approximately 25% reduction in deaths for both timelines." In most countries, however, *efficiency gains alone* would still not be enough to meet the targets of the national strategic plan (budget increases of up to 185% would be needed).

Kedziora et al (2019) (70) used a new *geographical optimization algorithm*, implemented as an extension to the Optima HIV model, to identify optimal funding of HIV programs across three regions in Ukraine from 2016-2030. The authors defined geographical optimization as "reallocation of funds between regions."² They note that the greatest efficiencies are typically due to reallocating resources to the most effective interventions, especially testing and ART, but "further gains can be achieved by optimally reallocating resources between regions." Geographic optimization would shift resources away from low to high prevalence regions. In the Ukraine, ART and needle syringe programs (NSPs) are the most cost-effective programs for reducing HIV-related deaths and new HIV infections, respectively, and these are the two main contributors to DALYs. Shortening the 15-year timeframe of the analysis would shift funding towards ART; conversely, lengthening the timeframe would shift funding towards prevention (specifically, needle-syringe programs).

In a scoping review of studies of the impact, cost and cost-effectiveness of oral PrEP in sub-Saharan Africa,³ Case et al (2019) (71) found that in low-budget settings, it may be more cost-effective to focus limited resources on expanding access to testing and ART before adding PrEP.

Limitations and unanswered questions: Modeling analysis projections need to be confirmed in a practical setting.

¹ Indonesia and Vietnam from the East Asia and Pacific (EAP) region; Argentina, Colombia, Mexico, and Peru from the Latin America and Caribbean (LAC) region; Armenia, Belarus, Bulgaria, Georgia, Kazakhstan, Kyrgyzstan, Macedonia, Moldova, Tajikistan, Ukraine, and Uzbekistan from the Eastern Europe and Central Asia (EECA) region; Zambia from the Sub-Saharan Africa (SSA) region; and Cote d'Ivoire, Niger, Senegal, Sudan, and Togo from the West and Central Africa (WCA) region

² The algorithm has three steps: (1) calibrating the model to each region, (2) determining the optimal allocation for each region across a range of different budget levels, and (3) finding the budget level in each region that minimizes the outcome (such as reducing new HIV infections and/or HIV-related deaths), subject to the constraint of fixed total budget across all regions.

³ Studies were conducted in Nigeria, Uganda, South Africa, Zimbabwe, Ethiopia, the DRC, Kenya, Tanzania, Sudan, Mozambique, Cameroon, Cote d'Ivoire, Angola, Niger, Burkina Faso, Botswana, and Lesotho

Box 1: Belarus: Country Case Study Example for HIV Allocative Efficiency

Background

In 2014-15, multiple allocative efficiency (AE) exercises were conducted by UNAIDS and its co-sponsors in World Bank's Europe and Central Asia region. These AE exercises aimed to promote a shift towards investment thinking to help country governments understand how HIV funding could be optimally allocated across HIV response interventions that could yield the highest impact.

Belarus has the third highest HIV incidence in Europe (72) and has a growing epidemic, with new infections increasing by 34% and HIV-related deaths by 156% between 2010 and 2017.(73) Belarus' epidemic is concentrated among key populations. HIV prevalence was estimated to have increased from 25.1% in 2015 to 30.8% in 2017 among PWID, and 5.7% in 2015 to 9.8% in 2017 among MSM.(74) HIV prevalence has remained stable among FSW, reported at 7% in 2017.(73)

This case study demonstrates how AE analyses conducted across multiple years in Belarus have helped improve HIV efficiency. The exercises also helped to point out areas where more efforts are needed to improve the HIV response through improved allocations. The three studies include:

- 1) A 2014-15 Optima Allocative Efficiency study undertaken jointly by a steering group convened by the World Bank and involving the Global Fund, UNAIDS, and the United Nations Development Programme (UNDP);
- 2) A follow-up analysis done in 2016 to estimate the effect of actual changes in budget (and the 2016-20 National HIV/AIDS Prevention Program which defines the vision of the HIV response in the country) that were brought due to the 2014-15 AE analysis;
- 3) Another optimization study conducted in 2018-19 through partnership with the Belarusian Government, the Global Fund, UNAIDS, and the Burnet Institute.

Results from these three studies have been used to identify areas where Belarus has been successful and not quite successful in its HIV response between 2014 and 2018, including the implementation of the optimization recommendations.

Projected changes in Belarus' HIV burden according to the AE analyses over the years

According to the 2014-15 Optima estimates, MSM were becoming a rapidly growing segment of the epidemic at that time and by 2030, were projected to account for 1 in 7 new infections. In line with the projection, 19% new infections occurred among MSM in 2018, compared to 7% in 2014. Moreover, transmission through drug injecting practices continues to remain a key factor in the spread of HIV in Belarus, while the role of sexual transmission continues to increase. Although transmission is shifting towards sexual transmission, the 2014-15 AE analysis predicted that even in 2030 over 33% of infections are projected to remain among PWID. It is estimated that over 55% of new HIV infections occurred among PWID in 2018, compared with 50% in 2014.(74)(75) Figure 1 summarizes the breakdown of PLHIV, new infections, and deaths among various sub-populations in Belarus in 2014.(74)(75)

Figure 1: Distribution of estimated PLHIV, Estimated new infections, and Estimated AIDS-related deaths, by population group in Belarus (2014-15 Optima Analysis)

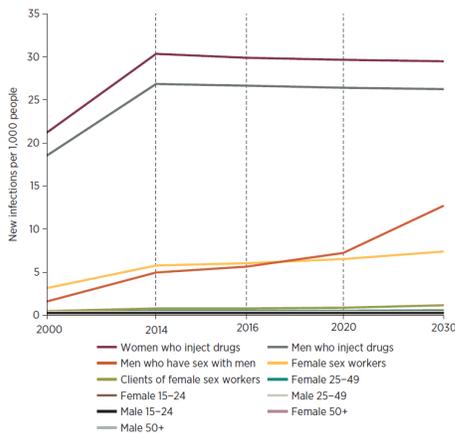
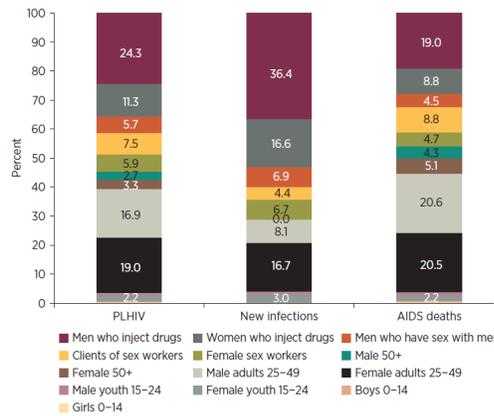


Figure 2: Estimated HIV incidence rates in specific populations 2000-2030 (2014-15 Optima Analysis)



Source: World Bank 2015.

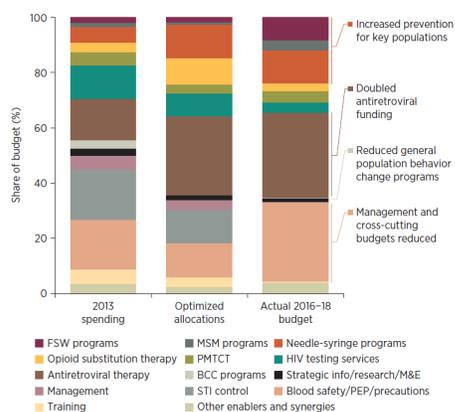
Recommendations from the 2014-15 Allocative Efficiency Study (75)

- The 2014-15 optimization analysis suggested further strengthening and scaling up ART; increasing ART coverage to 60% of PLHIV was predicted to achieve a 50% reduction in deaths and contribute to minimizing new infections. ART could be scaled up through increased initiation of ARV support for people already known to be living with HIV and through increased HIV testing and counselling for key populations.(76)
- A core finding from the analysis was the need to scale up prevention for key populations—particularly harm reduction for PWID including needle and syringe exchange and OST. From an HIV prevention perspective, NSPs would be the most cost-effective investment to reduce the rates of needle-sharing and thereby the risk of HIV infection.
- Programs for the general population were found to be much less cost effective compared to programs for key populations. The analysis suggested that Belarus could increase the impact of its HIV program by reallocating funds from general population, management, and other cross-cutting expenses to high-impact programs.
- The analyses suggested that optimizing allocations of the same amount of funding available in 2013 (US\$20 million) over 2015–20 could reduce new HIV infections by 7% and deaths by 25%. Whereas, the optimized mix and cost of programs to achieve national targets (reducing incidence by 45%, deaths by 65%, and MTCT to below 1%) required approximately US\$58 million (3 times current investment). This funding requirement was driven primarily by the very large necessity for HTC to achieve the specified ART coverage.

2016 Reallocation of Funds Based on 2015 Optimization Study (76)

Findings from the 2014-15 allocative efficiency study were used to plan and budget for the National HIV/AIDS Prevention Program (NAP) 2016–2020 and the development of a three-year Global Fund Concept Note covering the 2016–18 period. NAP is the main guidance document on Belarus' vision of the HIV response.(76) The key recommendations from the 2014-15 analysis that were used to inform 2016-18 NAP included: (1) scaling up ART; (2) focusing on prevention for key populations; (3) moving funds to high-impact programs.

Figure 3: Comparison of 2013 spending with 2016-18 budget allocation⁴



Source: World Bank based on Belarus government AIDS spending assessment data and the Optima model.

⁴ Note: The bar for the 2016–18 budget shows the annual average. Spending on prevention for key populations increased from 12 percent to 27 percent. Antiretroviral funding rose from 15 percent to 31 percent. Spending on general population behavior change programs decreased from 3 percent to less than 1 percent. Spending on management and crosscutting budgets fell from 52 percent to 34 percent. BCC = behavior change communication; FSW = female sex worker; HIV = human immunodeficiency virus; M&E = monitoring and evaluation; MSM = men who have sex with men; PEP = post-exposure prophylaxis; PMTCT = prevention of mother-to-child transmission; STI = sexually transmitted infection.

Areas of success or improved HIV efficiency between 2014 and 2018:

- Belarus has successfully reallocated budget to high-impact areas as suggested by the 2014-15 optimization analysis. Belarus has maintained and scaled up harm reduction programmes (especially NSPs) with government resources.
- Belarus, in line with the Optima recommendations, doubled its spending on ART between 2013 and 2018. It has also successfully reduced the cost of first-line treatment regimens in recent years to increase ART coverage funded by the government.(73)
- To prevent vertical transmission, Belarus' government provides screening during pregnancy, as well as free formula for children of HIV positive mothers. In 2015, 94% of HIV positive pregnant women were reportedly covered with the ART therapy.(77) In 2016, Belarus was validated by the World Health Organization (WHO) as having eliminated mother-to-child transmission of HIV.(78)
- Belarus introduced HIV self-testing and started selling HIV tests through pharmacies in 2017.(79)

Areas that need improvement:

- HIV prevalence rates among people who inject drugs have increased in Belarus. Harm reduction services (such as NSPs and OST) have not been made available at large.
 - Since 2014, Belarus has scaled-up its provision of OST services, but the coverage continues to remain suboptimal.(80) OST has proven to be efficacious and cost-effective, and the AE modeling exercise in 2014-15 recommended the parallel scaling up of NSPs and OST. The actual allocations of 2016-18, reflect a scaling up of NSPs but OST remains stagnant at 3% of total spending.(76)
 - In 2014, only 46 sterile needles and syringes were distributed per PWID, and this figure dropped to 43 in 2018. Belarus is far from meeting the WHO recommended standard for good coverage of 200 needles per PWID.(81)
- The epidemic in Belarus has continued to grow over the years which means that the treatment gap continues to remain large. For this reason, Belarus needs to reduce HIV transmission among its key populations. Although Belarus has increased its budget allocation to increase prevention amongst key populations, it has not matched the allocation recommendations in the 2014-15 model. Belarus needs to better target its key populations. A strengthened HIV treatment cascade can enable Belarus in knowing its key population sizes, reaching key populations with programs including outreach, and retaining key populations in focused prevention services.(76)
- The 2018-19 Optima analysis suggests that even 100% optimized allocations will be insufficient to achieve the 95-95-95 targets by 2030. It is estimated that the annual HIV program budget from 2019 to 2030 should be increased to 150% of the latest reported budget level (an additional \$6M annually) to allow Belarus to have 92% of people living with HIV be aware of their status, 97% of those diagnosed on treatment, and 95% of those on treatment to have achieved viral suppression.(74)
- In Belarus, ART therapy is funded by both government and international grants, which sometimes poses barriers in consistent supply of drugs . Self-sufficiency in ART can facilitate uninterrupted ART supply to PLHIV, hence promoting adherence.(77)

1.2 Budget optimization at the global level through enhanced coordination among donors, and between donors and national coordinating bodies

The Global Fund, Gates Foundation, and PEPFAR working group plans to roll out Activity-Based Costing and Management (ABC/M) in many high-burden countries. ABC/M will enable entities, including the host government, to understand what the actual cost of services should be as opposed to only seeing what the implementing partners pay for the service. This approach can generate a better understanding of cost-saving potential for HIV programs.(82)

Box 2: Efficiency from the perspective of donors: A PEPFAR case study

PEPFAR approached the challenge of cutting costs and improving efficiency through the development of an Impact and Efficiency Acceleration Plan back in 2011.(83) Since then, PEPFAR has adopted strategies to practice cost-saving that fall under three broad categories (84):

1. Improving the collection and use of economic and financial data:
 - PEPFAR introduced a new financial classification system in 2018 to ensure consistent financial data across budget formation, budget execution and expenditure reporting. This new classification structure allows PEPFAR to track budgetary and fiscal reporting in the same way, and map what is actually purchased to how it contributes to program results, thus driving efficiency.(82)
 - PEPFAR plans to roll out Activity-Based Costing and Management (ABC/M) in many high burden countries to enable development partners, as well as the host country, understand what the actual cost of services should be as opposed to what the implementing partners pay for a service.(82)
2. Efficient implementation of PEPFAR programs:
 - PEPFAR has adopted a number of cost-saving interventions including Test and Start, multi-month dispensing (MMD) of ARVs, same-day treatment initiation, and client-centered differentiated service delivery (which includes TB and TB prevention and human resources for health (HRH) interventions like task shifting).(85) Test and Start is now fully implemented in PEPFAR countries and enables same-day initiation of ART which prevents costs of reidentifying an individual who has failed to engage in treatment. Early treatment reduces HIV-related morbidity and mortality, has significant prevention benefits, and lowers hospitalization costs and TB and other opportunistic infections.(82)
 - In the past, approval for generic versions of antiretroviral drugs (86), as well as using a negotiated Pooled Procurement Mechanism (PPM) to procure drugs (84) has helped PEPFAR in expanding treatment to more people. PEPFAR has supported rapid rollout of more effective regimens containing Dolutegravir (DTG), which is inexpensive, well tolerated, and leads to better results including faster viral suppression. PEPFAR has also worked to help reduce prices of other commodities, including viral load tests, costs for which have decreased from \$40 per test to as low as \$15, resulting in cost savings.(82)
3. Coordination and collaboration with governments and multilateral organizations to maximize the impact of PEPFAR's resources
 - In 2020, PEPFAR has continued its collaboration with Global Fund and Bill and Melinda Gates Foundation (BMGF) on Resource Alignment efforts. Each PEPFAR country team conducts analysis of Global Fund, BMGF and host-country disaggregated investments in HIV to avoid duplication and ensure complementarity in efforts.(82)

Question 2. How can we achieve budgetary savings?

We found evidence that budgetary savings could be achieved by reducing service delivery costs for ARVs; reducing service delivery unit costs for HIV counselling and testing (HCT) and PMTCT; through task shifting more broadly; and through the use of digital interventions to support ART adherence.

2.1 Budgetary savings by reducing service delivery unit costs for ARVs

Potential efficiency gains: ARV service delivery unit costs vary widely and understanding the drivers of this variation can help drive efficiency. These costs could be reduced through optimization of ARV regimens (including dose optimization), task-shifting and decentralization of services.

Summary of research: We found a meta-analysis of 4 costing studies and an additional modeling study at the facility level. These studies are described below.

A 2019 meta-analysis of 4 empirical costing studies (conducted in Kenya, Eswatini, Uganda, Zambia, and Nigeria) by Cerecero-García et al (87) found very large variability of ART costs linked to different characteristics of service delivery platform characteristics. The study found an inverse relationship between ART unit cost and the number of patients served in a year.

Dutta et al (2015) (66) modeled facility level resource needs for 97 countries for scaling up ART from 2015-2020 under three scenarios: (1) continuation of countries' current policies of eligibility for ART, (2) universal adoption of WHO 2013 eligibility guidelines (i.e. initiate ART only when CD4 is under 500 cells/mm³ blood), and (3) expanded eligibility as per the WHO 2015 guidelines to meet "90-90-90" targets. The estimated facility-level financial resources needed were US\$45.8 billion (scenario 1), US\$48.7 billion (scenario 2), and US\$52.5 billion (scenario 3). Expanding treatment eligibility drives efficiency in the long term, though the initial resources needed are higher.⁵ *The estimated gap over 6 years between the resources needed and the domestic/external resources available ranged from US\$19.8 billion to US\$25.0 billion* depending on the eligibility scenario. The authors examined ways to drive efficiency by driving down facility-level costs of ART provision and concluded that task-shifting, decentralization and optimization of ARVs (Table 3) would be the most promising interventions.

Table 3: Budget savings from ART regimen optimization: Impact on 2015-2020 ART funding gap under scenario one

ARV Development	Potential Impact on Unit Cost	ARV Cost Savings (in Billions of US Dollars)	Commodity Gap (in Billions of US Dollars)
Improved three-drug regimens	First-line adult regimens could cost as low as US\$60 per patient per year. Second-line adult regimens could cost US\$266–US\$357 per patient per year.	\$1.6 (adult)	\$12.7
Improved two-drug maintenance combinations	Cabotegravir/rilpivirine (long-acting injectable) and dolutegravir/rilpivirine are used in patients who are virally suppressed. These new regimens cost about US\$40 per patient per year.	\$7.0 ¹ (adult), \$0.3 ¹ (children)	\$7.5
EFV dose optimization	Dose optimization could reduce the unit cost of EFV by US\$16 per patient per year.	\$1.0 (adult), \$0.02 (children)	\$14.0

¹Assuming 76% of all those on treatment are virally suppressed [6].

doi:10.1371/journal.pmed.1001907.t006

⁵ A 2012 study in South Africa by Granich et al. estimated that expanding ART to all people living with HIV would decrease new HIV infections by 45% and save about US\$10 billion over 40 years (<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0030216>).

Limitations and unanswered questions:

Cerecero-García et al: The meta-analysis used facility-level primary data and standardized cost categories to ensure comparability, but the researchers could not control for study design and measurement methods. Not all included studies included in their analysis came from representative samples of facilities. They *excluded above site costs* from the analysis. The data in the study were from different years (there may have been variations in ARV costs due to changes in guidelines and prices of these drugs).

Dutta et al (2015): Excludes costs above facility level (e.g., implementation partner overheads and trainings, integrated ART provision, transportation and storage costs, insurance, taxes).

2.2 Budgetary savings by reducing service delivery unit costs for HIV counselling and testing (HCT) and for PMTCT

Potential efficiency gains: In Nigeria, there is large variability in unit costs for HCT and PMTCT across facilities. There is evidence consistent with economies of scale (scale accounted for 44% of the variability of the average cost per client tested and 22% of the variation in the average cost per HIV-positive client identified) and scope (especially integration of HIV services), and of efficiency gains in facilities implementing task-shifting. Similarly, in Malawi there is a wide range across facilities of costs per test episode and per HIV diagnosis, and efficiencies are possible through increasing the number of daily testing episodes among existing health workers or allocating health workers to tasks in addition to testing. In southern Africa, targeting testing among men in low-income settings was found to be cost effective if they cost below \$ 585 per diagnosis.

Summary of research: We found a micro-costing study of HCT and PMTCT in Nigeria; a retrospective facility-based cost and financial analysis in Malawi of HIV testing and treatment services; and a study of the cost-effectiveness of testing programs in southern Africa using data from Malawi. These studies are described below.

Sergio Bautista-Arredondo et al (2018) (88) conducted a cross-sectional, observational, micro-costing study in Nigeria in 141 HCT and 137 PMTCT facilities. They found large variation in unit costs across facilities (*differences of 3-4 orders of magnitude in costs for the same services*). A large proportion of the variation was explained by scale. But even after controlling for scale, there was still variation in unit costs persisted. Efficiency was linked to service delivery characteristics and management practices. At the national level, there were economies of scope: *integration of HIV services* (measured by the number of PMTCT or HCT clients tested and by the presence of ART services) seemed to be efficient and facilities providing integrated HCT and PMTCT services, or ART services, were less costly. The researchers found that *task-shifting consistently predicts lower unit costs* for both HCT and PMTCT. At the facility level, there were statistically significant associations between unit costs and management practices: (i) external supervision, performance-based funding, and government involvement in financial decisions were associated with higher costs (the study did not assess cost-effectiveness, only costs), (ii) community involvement and individual incentives and were associated with lower unit costs. Quality was not significantly associated with unit costs.

Seema Vyas et al (89) conducted a retrospective facility-based cost and financial analysis in Malawi of HIV testing and treatment services. The average cost per testing episode was US\$2.85 (range US\$1.95 to US\$8.55)—the highest costs were in facilities conducting the lowest daily number of tests (i.e. variation due to scale). The average cost per HIV diagnosis was US\$116.35 (range US\$77.42 to US\$234.11)—the highest costs were in facilities with the lowest HIV yield. The authors concluded that there would be efficiencies in HIV service delivery “through increasing daily testing episodes among existing health workers or allocating health workers to tasks in addition to testing.” They note that costs per diagnosis will rise as yields decline—at that point, targeted testing strategies that increase yield will be more efficient.

A 2019 study by Phillips et al (90) examined the how cost-per-diagnosis can help to determine cost-effectiveness of testing programs in southern Africa using data from Malawi. Using cost effectiveness analysis and modeling, the study projected testing scenarios and found that HIV testing programs that focus on increasing testing in men in low-income settings are on average cost-effective if they cost below \$585 per new diagnosis. The study did not find it to be cost-effective to test women more generally if 6-monthly testing is prevalent among all pregnant and female sex workers.

Limitations and unanswered questions: With a cross-sectional design, the Sergio Bautista-Arredondo et al (2018) study noted that causality cannot be inferred. Records at the facility-level were sometimes incomplete and, in all cases, are prone to measurement error. Costs estimate rely on the results of time-motion measurements, which are vulnerable to measurement error (e.g., from the Hawthorne effect). There were missing data and implausible values in unit costs (the researchers lost about 30% of facilities from the original sample).(88) The Phillips et al study noted that the analysis and assumptions would need to be updated with changes that would occur over the succeeding years.

2.3 Budgetary savings from task shifting used more broadly in HIV programs

Potential efficiency gains: Task shifting can lead to cost savings across low- and middle-income countries (LMICs). It can be effective in reducing costs and increasing health care access across a wide range of health professionals including pharmacy technicians, lay counsellors, and medical assistants apart from the traditional community health workers.

Summary of research: We found a systematic review of whether task shifting can drive efficiencies in LMICs, including in HIV programs.

The systematic review was published in 2017 (91) and conducted by Gabriel Seidman and Rifat Atun conducted. The aim was to investigate whether task shifting in low-income and middle-income countries (LMICs) results in efficiency improvements by achieving cost savings. The systematic review included 34 studies that demonstrated cost impact of a testing program in LMIC

settings.⁶ While the study looked across several disease programs, it found a robust body of evidence that supports cost savings achieved through task shifting activities in HIV/AIDS programs. Task shifting was found to result in cost savings through task shifting for high-risk groups like MSM to community-based organizations, ART dispensing from pharmacists to Indirectly Supervised Pharmacist Assistants (ISPA), adherence clubs, or other pharmacy-only refill programs. In low resource settings, task-shifting to clinically stable patients familiar with the routine of taking these drugs was also found to be suitable. The studies covered in the review did not find adverse impact on patient retention, viral load, and mortality, indicating quality maintenance. However, one study did not find statistically significant differences due to task shifting, while another study found task shifting to clinics driving up costs in one state and decrease in another state.

Limitations and unanswered questions: The authors note that the measurement of costs and efficiency vary across the studies included in the review, and is limited by biases in reporting and publication of individual references. The study did not look at the implications of a new task shifting program and also includes only two studies that looked at hospital settings. Nonetheless, task shifting needs to be explored by program planners and cost savings across emerging global health priorities and health system strengthening activities like as supply chain management or monitoring and evaluation need to be further explored by researchers.

2.4 Digital health (text messages, apps, data-informed counseling) to support ART adherence

Potential efficiency gains: Emerging evidence that supporting ART adherence through digital interventions could drive efficiencies.

Summary of research: We found a review of studies on digital interventions to support ART adherence.

The review of the literature, by Amico (2015) (92), identified 13 studies conducted in the US (7), Nigeria (1), China (2), South Africa (1), Canada (1), and India (1). These examined four types of digital interventions to increase ART adherence: (i) computer software e.g., counselors, clients and treatment partners using computer programs together; adapting in-person interventions to computer delivery, (ii) Internet websites for virtual follow-ups, social media and networking websites; (iii) mobile phones for phone calls, mobile messages; and (iv) data informed counseling. The author concluded that these approaches have the potential for cost savings. The costs are low, e.g. in India it would cost the India National AIDS Control Programme just USD 1.27–1.77 per patient per year.

⁶ 22 studies were in Sub-Saharan Africa (covering Cameroon, Burkina Faso, Mozambique, Cote d'Ivoire, Rwanda, Zambia, Uganda, Ghana, South Africa, Nigeria, Ethiopia, Malawi), eight in Asia (covering Pakistan, Bangladesh, Myanmar, India, China) and four in Central or South America (Argentina, Honduras, Guatemala, Brazil)

Limitations and unanswered questions: This was a narrative review, using PubMed only.

Question 3. Is one intervention superior to another?

When it comes to the evidence on whether one intervention is superior to another to achieve the same goal (as measured by the cost per unit of output), our review found evidence on community level versus facility-based treatment support services; crowdsourcing versus social marketing for promoting condom use and HIV testing; universal versus targeted HIV screening in pregnant women; targeting of VVMC by age and risk behaviour versus no targeting; and targeting of PrEP during periods of risk and to high risk people versus no targeting.

3.1 Community level versus facility-based treatment support services

Potential efficiency gains: Community-based treatment support models are less expensive than facility-based models and have clear advantages with regard to the number of patients that can be reached with support services.

Summary of research: We found a cost analysis of community level services in Tanzania; a systematic review of community-based ART delivery; an RCT of community-based vs standard clinic-based ART services in South Africa and Uganda; a narrative review of the evidence on differentiated service delivery (DSD) models; and three studies on the costs and potential cost savings of DSD models. These studies are described below.

Forsythe et al (2019) (93) conducted a cost analysis across 27 sites (hospitals, health centers, dispensaries, communities) across three regions in Tanzania. They found that the provision of support services at the community level (either through direct provision at the community level or through a combination of facility and community programs) resulted in cost savings.⁷

A systematic review by Nachega et al (2016) (94) compared the effect of community-based ART delivery on treatment engagement, ART adherence, virologic suppression, and all-cause mortality among PLWH in LMICs against results obtained from patients treated in traditional health care facilities. The study found that average total cost per patient in the first year was US \$29 among the community-based participants compared to the US \$60 facility-based patients. In terms of health-service costs, the same study reported average cost per patient per year to be US\$793 among the community-based participants compared to US\$838 among facility-based patients in Jinja, Uganda. Also, Bango and colleagues reported from South Africa that ART adherence clubs (AAC) were most cost-effective than standard of care (SOC), with a cost per patient year of \$296

⁷ Community-based sites reached the largest number of people and also offered a wide array of ART support services at the lowest cost per client (\$20 per client per year). The next lowest unit costs were achieved by programs that were jointly managed from facilities and the community (\$45 per client per year), followed by the facility-based sites that perform outreach with staff based in these facilities (\$108 per client per year).

for AAC versus \$374 for SOC. A cost-effectiveness study by Marseille and colleagues concluded that a home-based ART program in rural Africa may be more cost-effective than most previous estimates for facility-based ART programs. Available data suggest that community-based ART services even if they are equivalent to, but not superior to clinic-based programs, may be more cost-effective from a societal perspective because personnel, operational, and utility costs are likely to be lower, and transportation costs for patients will also be lower; these facts, added to the increased effectiveness in terms of retention, are likely to make community-based ART much more cost-effective and sustainable in the long run.

A randomized control study in 2020 by Barnabas et al(95) compared community-based vs standard clinic-based ART services in South Africa and Uganda. PLHIV in rural and peri-urban settings in KwaZulu-Natal, South Africa and the Sheema District, Uganda were randomly assigned one of the following ART services: (i) mobile phone ART initiation with quarterly monitoring and ART refills through mobile vans; (ii) ART initiation at the clinic followed by mobile van monitoring and refills (hybrid approach); (iii) standard clinic ART initiation and refills and their HIV viral suppression was monitored for 12 months. The study also estimated costs which included all activities and supplies supporting ART initiation and follow-up including personnel, laboratory testing, and medications. It was found that annual cost of community-based ART per client was \$217 in Uganda and \$308–312 in South Africa in the first year and \$187 in Uganda and \$244–246 in South Africa in subsequent years. While the annual cost per person virally suppressed was \$402–422 in the clinic group and \$325–390 in the community-based group in South Africa, in Uganda, the annual cost per person virally suppressed was \$214 in the clinic-based group and \$275 in the community-based group. The RCT found that compared to standard clinic-based services, community-based ART delivery increased viral suppression among PLHIV with detectable viral load.

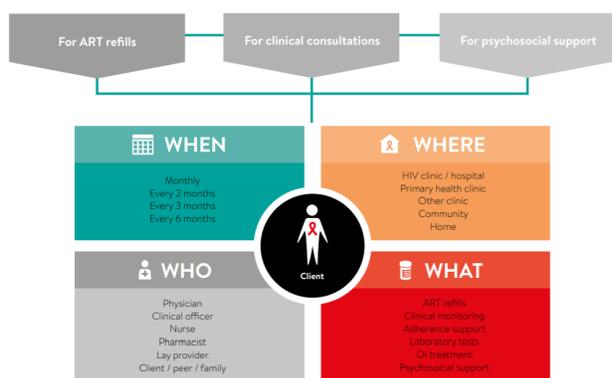
A narrative review of the evidence on differentiated service delivery (DSD) models by Monika Roy et al (96) examined the cost data on a range of care models along the HIV care cascade, from individual to group-based care and facility to community-based health delivery systems. It concluded that DSD could help to “mitigate the crisis in HIV treatment financing by providing care for more clients at the same cost.” For example, fast-track drug refill and adherence club models have been found to be cost-effective when compared with standard of care.

Yigezu et al compared the cost-effectiveness of facility-based, stand-alone and mobile-based HIV voluntary counseling and testing (VCT) methods in Addis Ababa, Ethiopia. Their 2020 study found that the cost of test per client for facility-based, stand-alone and mobile-based VCT was \$5.06, \$6.55 and \$3.35, respectively. The unit costs of test per HIV seropositive client for the corresponding models were \$158.82, \$150.97 and \$135.82, respectively. Mobile-based VCT approach (community-based) costed less than both the facility-based and stand-alone approaches, in terms of unit cost per tested individual as well as unit cost per HIV seropositive case identified. The stand-alone VCT approach was not cost-effective compared to facility-based and mobile-based VCT.

The differentiated service delivery (DSD) model has also been found to be highly cost-effective in several studies. The DSD is “an approach to service delivery centered on people

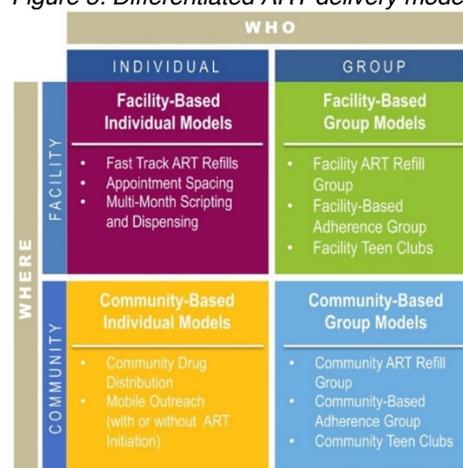
living with HIV that simplifies and adapts HIV services across the cascade of care to reflect the preferences and expectations of various groups of people living with HIV while reducing unnecessary burdens on the health system.”(98) Examples include reduced frequency of clinic visits and medical prescriptions for clinically stable patients, adapting care to focus resources on patients that need intensive care and clinical follow-up. The WHO talks about four key building blocks of differentiated care that center around the patient: *when, where, who and what services are being offered* (Figure 4). The DSD approach aims to effectively allocate resources and deliver quality care by assessing the level of care required by individuals. It uses approaches such as simplification, task shifting and decentralization to improve service delivery.(98,100) Different categories of DSD models can be found in the literature. Grimsrud et al 2017 (101) describe four main types of differentiated ART (DART) models which are shown in Table 4. The DART categories used by the Columbia CQUIN project is shown in Figure 5. While facility-based DART models customize services to different population groups, community-based DART models aim to deliver ART closer to clients.

Figure 4: Building blocks for differentiated ART delivery



Source: World Health Organization. Key considerations for differentiated antiretroviral therapy delivery for specific populations: children, adolescents, pregnant and breastfeeding women and key populations. World Health Organization; 2017.

Figure 5: Differentiated ART delivery models



Source: Columbia CQUIN project for differentiated service delivery

Table 4: DSD delivery models and examples from Sub-Saharan Africa

Model	Definition	Example of DSD interventions adopted by countries
Facility-based individual models	One-to-one HIV care provision at the healthcare facility	<ul style="list-style-type: none"> Fast track refills and multi-month scripting in Malawi. 3-monthly ART refills were included in Malawi's national guidelines
Out-of-facility based individual models	Community care provision to each individual patient	<ul style="list-style-type: none"> Centralized chronic medicines dispensing and distribution and community-based ART pick-up points in South Africa Community drug distributions points in Uganda ARV community delivery in Tanzania
Healthcare worker led groups	Group model typically supported by a clinically trained healthcare worker or a lay health worker	<ul style="list-style-type: none"> Youth care club and adherence clubs in South Africa. Facility-based distribution groups in Kenya Facility-based treatment clubs in Swaziland Club refills in Zimbabwe
Client led groups	Patient-led group model where health care provision is either in the community or at the facility	<ul style="list-style-type: none"> Community ART groups in Malawi Community adherence groups in Mozambique Community client-led ART delivery or CCLAD in Uganda

Source: Grimsrud, A., Barnabas, R.V., Ehrenkranz, P. and Ford, N., 2017. Evidence for scale up: the differentiated care research agenda. *Journal of the International AIDS Society*, 20(Suppl 4); Kuchukhidze, S., Long, L., Pascoe, S., Huber, A., Nichols, B. and Fox, M., 2019. Patient benefits and costs associated with differentiated models of service delivery for HIV treatment in Sub-Saharan Africa. *Boston, MA*.

A 2017 study by Baker et al (102) modeled the impact of using differentiated care models (DCMs) in 38 sub-Saharan African countries from 2016 to 2020 to see how it affected the 90-90-90 targets. The study estimated the costs of three service delivery models: (1) undifferentiated care, (2) differentiated care by patient age and stability, and (3) differentiated care by patient age, stability, key vs. general population status, and urban vs. rural location. The cost estimates included total costs of antiretroviral drugs, laboratory commodities, and facility-level personnel and overhead. The study found that compared to the five-year cost of undifferentiated facility-based ART care provision, provision using age and stability-based DCM model led to 17.5% cost savings and the four-criteria DCM led to 16.8% cost savings. The study also estimated that the full-time equivalent health workforce requirements for ART was 46.4% (95% CI: 46.1%–46.7%) lower in 2020 for the age and stability DCM compared with undifferentiated care. The study concluded that adopting DCMs can result in significant efficiency gains in terms of reduced costs and health workforce needs, even with the costs of scaling up community-based ART support under DCMs.

Another 2019 systematic review by Roberts et al (103) assessed the cost of facility- vs. community-based and individual- vs group-based differentiated ART (DART) models in sub-Saharan Africa by comparing the annual per-patient service delivery cost and incremental cost of DART compared with the standard of care. The study reported costs on 16 DART models in 7 countries and found that the annual cost per patient within DART models (excluding drugs) ranged from \$27 to \$889 (2018 USD). Out of 11 models that reported incremental costs, 7 studies found DART to be cost saving with a median incremental saving per patient per year of \$67 across the models. The most common drivers of cost savings were personnel costs through task-shifting and

reduced frequency of visits. Care needs to be taken to design DART models to avoid overhead costs that could reduce savings.

The AMBIT project at Boston University conducted a review of provider costs associated with DSDs for ART for HIV treatment across Sub Saharan African countries.(104) While all studies included in the review did not include costs, some of the studies pointed towards potential cost savings to providers through use of DSD models. The study notes that providers must respond to changes in resource use resulting from DSD models to experience cost savings—for example, re-deploying health workers for other tasks once frequency or number of patient visits is reduced due to DSD models. AMBIT conducted another study under USAID’s EQUIP Health Project, with support from PEPFAR, to examine whether DSD models contributed to cost savings in sub-Saharan Africa.(105) This included 5 studies⁸ of which three were RCTs of community and facility based multi-month dispensing and two observational studies and observational evaluations of DSD models. The study found that while some DSD models were more expensive than conventional care, others cost less. Models that used 6-month medication dispensing were found to be less costly than conventional models, although cost differences were small. ARV medications were a large share of the total cost per patient and these costs were mostly uniform across models. Costs to patients were substantially lower in DSD models compared to conventional approaches. Out of pocket and opportunity costs, if reported, were 25%-50% less due to the reduced number of full clinic visits required by DSD models.

Limitations and unanswered questions: Lack of data on retention limits conclusions about the long-term efficiency gains of community-based treatment support models.

Box 3: Antiretroviral therapy delivery using community-based interventions

Key messages

- The global 90-90-90 targets as well as the 2015 World Health Organization (WHO) treatment guidelines call for ART to be given to all people living with HIV irrespective of their CD4 cell count.(106,107)
- Although ART is effective in averting deaths, and leads to large economic gains, millions of people are not yet receiving ART worldwide.(108)
- Over time, many studies have looked at the cost-effective and innovative approaches through which ART services can be delivered.
- There is growing evidence that community-based treatment support models are less expensive than facility-based models and have clear advantages with regard to the number of patients that can be reached with support services.(93,94,100,109)

Community-based ART delivery in Zambia: The HPTN 071 - Population Effects of Antiretroviral Therapy to Reduce HIV Transmission (PopART) cluster-randomized trial was conducted by PEPFAR across 21 urban and pre-urban communities in Zambia and South Africa to help inform the scale-up of future HIV programs and identify cost-effective interventions. Under the trial, community care providers provided three combination HIV prevention packages – one group received universal ART, a second group received the PopART package with ART given to only those eligible based on in-country guidelines, and the third group received no household

⁸ Studies included two cluster randomized trials of community-based models of multi-month dispensing, in Lesotho and Zimbabwe; cluster randomized INTERVAL trial in Malawi and Zambia of facility-based multi-month dispensing; observational evaluation of five partner-driven models being piloted in Zambia and observational evaluation of the five Ministry of Health-approved models in widespread use in Uganda.

intervention but could access HIV testing and treatment services according to in-country guidelines. The trial found that delivery of an HIV prevention strategy that used community-based HIV and treatment based on prevailing in-country guidelines can substantially reduce new HIV infections. A cost and cost-effectiveness analysis (110) of the PopART intervention was also undertaken. The cost-effectiveness analysis considered two scenarios of continuing or discontinuing the PopART intervention (see Table 5 below). Further studies showed that greater use of community service delivery led to a 32% decline in per-patient treatment costs compared to facility-based services.(100,110,111)

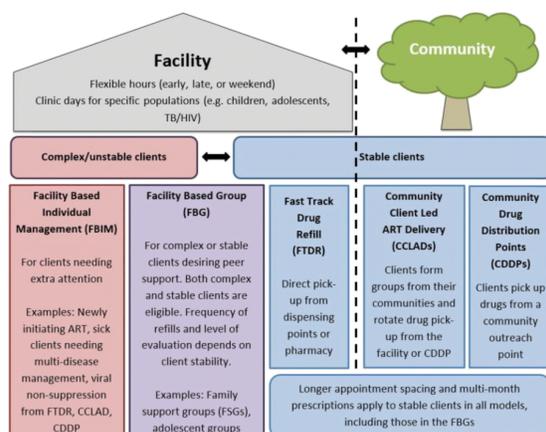
Table 5: Results from the cost-effectiveness analysis of PopART in Zambia

Intervention scenario	Outcome averted	ICER range (US\$)
PopART continued 2014-30	Infections	1,427 – 2,673
	DALYs	465 – 847
PopART discontinued after trial period (2014-2017)	Infections	2,324 – 4,712
	DALYs	196 - 392

The community based ART interventions also helped to achieve the first two of the UNAIDS 90-90-90 targets. Knowledge of HIV status among those aged 20–24 years living with HIV increased sharply from 24% to 73% among men and from 34% to 84% among women. Moreover, ART coverage increased from 22% to 50% among men and from 26% to 56% among women.(100,109)

Differentiated service delivery for ART in Uganda: Uganda has made great progress towards achieving the Fast-Track Targets. As of 2020, only 1.4% of adults aged more than 15 years have unsuppressed viral load.(112) The country was successful in reducing new HIV infections by 48% and AIDS-related deaths by 55% between 2010 - 2016.(113) Uganda introduced WHO treatment guidelines according to which people found to be HIV positive through testing should be enrolled on ART regardless of CD4 count in 2015.(114) The country has a long history of using differentiated service delivery models (DSDs) for both HIV and tuberculosis (TB) care provision. The different DSD models used in Uganda are shown in Figure 6.

Figure 6: Differentiated service delivery models of HIV and TB care in Uganda



Source: Ministry of Health, Implementation Guide for Differentiated Service Delivery Models of HIV and TB Services in Uganda (June 2017).

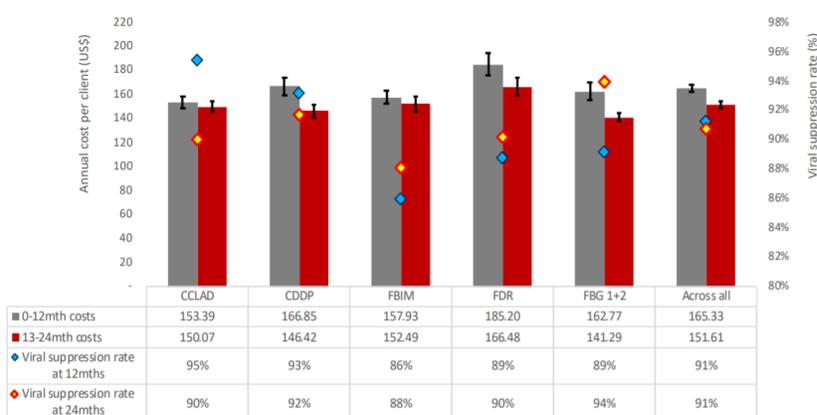
Using a DSD model approach, Uganda used community-based services to provide ART to stable clients through task-shifting to lower-levels of healthcare workers.(115) This was aimed at both improving ART adherence and retention, while also reducing costs. A retrospective cost analysis conducted in 2016 compared costs across three task-sharing models - Kitovu Mobile which delivers ART services through task-shifting using non-facility-based community locations; the AIDS Support Organization (TASO) which provides the CDDP shown above; and Uganda Cares which uses stand-alone clinic and mobile services to provide drugs and supplies to government health clinics. While the study did not compare costs with regular delivery models, it found an equal distribution of costs across different categories including personnel and drugs, and it reported reductions to costs at scale. While modeling DSD's effect, the study estimated that a 15% reduction in the unit cost per person on ART can be achieved through scale-up of DSD in Uganda. The annual costs per client

(\$404 for Kitovu Mobile, \$332 for TASO, and \$257 for Uganda Cares) were found to be lower than in the previous analysis in 2011.(116)

The study also found that using the community-based approaches of CDDP and CCLADs, clients on ART improved CD4 evolution (a 6% increase), a fall in missed appointments by 6%, and a 10% increase in 12-month retention compared to those receiving ART at the facility level. CCLADs and CDDPs also showed similar treatment outcomes – adherence rate was 88% compared to 89% at facilities.(116,117)

A more recent 2020 study by Guthrie et al (118) compared costs across Uganda's DSD delivery models across 47 out of 605 DSD locations in Uganda. The study found that the average cost per client per year was lowest for FBG at \$141, followed by CDDP (\$146), CCLAD (\$150), FBIM (\$152) and FDR (\$166). While this implies minimal cost differences between the community-based DSDs and the standard FBIM, the viral suppression rates of community models were found to be higher than facility-based models.

Figure 7: Comparison of costs across Uganda's DSD delivery models



3.2 Crowdsourcing has lower per unit costs than social marketing for driving HIV testing and condom use

Potential efficiency gains: To promote condom use and HIV testing, the per unit cost of crowdsourcing is lower than social marketing.

Summary of research: We found a scoping review of studies, described below.

Crowdsourcing “involves a group of non-experts and experts working together to solve a problem and then sharing solutions with the public” (Tang et al, 2019).(119) A scoping review of studies conducted in China, Australia, the US, Uganda, and Thailand—mostly targeting men who have sex with men (MSM)—found that crowdsourcing could be effective in “informing the design and implementation of HIV and sexual health interventions.” Of the four randomized controlled trials (RCTs) included in the review, three suggested that crowdsourcing is a low-cost and effective approach for improving HIV testing and condom use among key populations. In one RCT in China, “cost data showed that the crowdsourcing intervention was 45% less expensive than the social marketing intervention.” In another RCT in China, a crowdsourced video was non-inferior to the social marketing video in promoting condom use among Chinese MSM and “the per unit cost of the crowdsourced video was less than the social marketing video (\$58 vs. \$84).”

Limitations and unanswered questions: Most studies were in high- and middle-income countries (more are needed in low-income countries). Studies are needed of the impact of crowdsourcing in promoting other interventions, including HIV self-testing and PrEP, and with other members of key populations or marginalized groups.

3.3 Universal HIV screening in pregnant women is superior to targeted screening

Potential efficiency gains: *Universal* screening is the most cost-effective strategy, not just compared with no screening but also to a voluntary screening approach. The cost-effectiveness of first trimester screening increases with increasing HIV prevalence rate among pregnant women, but it remains *very* cost effective even when the prevalence is low (through averting newborn HIV and through the gain in life expectancy for infected mothers and babies). If universal screening is impossible, targeted screening towards high-risk groups or high prevalence regions would also be cost-effective.

Summary of research: We found a systematic review of screening approaches. The systematic review by Bert et al (2017) (120) of 21 studies⁹ confirmed the cost-effectiveness of HIV universal antenatal screening and also of rescreening in late gestation in high-, middle- and low-income countries.

Limitations and unanswered questions: The type of screening test differed between studies (this matters because rapid tests are more cost-effective than the standard ELISA test); indirect medical costs were not included; not all languages were included in the review; and researchers assumed an equal prevalence rate among women who accepted and those who refused HIV testing.

3.5 Targeting of VMMC by age and by high risk sexual behaviour is more efficient than offering VMMC to all eligible men

Potential efficiency gains: Multiple studies found efficiencies from age targeting. In a modeling study in *Mozambique*, (i) scaling up VMMC in men 20 to 29 will have the most immediate impact on HIV incidence; (ii) the greatest impact over a 15-year period would be from circumcising men 15 to 24 in most of the priority provinces; (iii) in terms of efficiency, fewer circumcisions would be needed to avert an HIV infection when scaling-up VMMC in males ages 20-34 in priority provinces; and (iv) in terms of cost-effectiveness, the cost per HIV infection averted over 15 years would be lowest when reaching the target coverage among males ages 15 to 34. In *Zimbabwe*, program efficiency could also be improved by prioritizing young sexually active males (15-34) and men whose sexual behaviour puts them at higher risk for acquiring HIV.

⁹ Studies conducted in USA, UK, Mexico, New Zealand, Australia, Thailand, India, S Africa, Hong Kong, Netherlands, US Virgin Islands, Colombia, Uganda, China

Summary of research: We found modeling studies conducted in Mozambique and Zimbabwe, described below.

Dent et al (2018) (121) used the Decision Makers' Program Planning Toolkit (DMPPT version 2) to project the cost-effectiveness and impact on HIV incidence through 2030 of VMMC targeted to different age groups in Mozambique.

Awad et al (2015) (122) modelled different VMMC scale-up scenarios to 2025 in Zimbabwe. Based on the results, the authors argue that while Zimbabwe is “already targeting an efficient and impactful age bracket (13–29 year old)” it is not the optimal one—program efficiency would be improved by (a) targeting ages 15–34 years (large efficiency gains), (b) prioritizing geographic areas with higher HIV prevalence than the national HIV prevalence (small efficiency gains); and (c) prioritizing men whose sexual behavior puts them at higher risk for acquiring HIV (huge efficiency gains).

Limitations and unanswered questions: Limitations in the Mozambique study included: limited subnational data (DMPPT 2 requires subnational data); the VMMC program data do not account for the possibility that clients were circumcised outside their districts of residence; and there was uncertainty in the impact estimates and around the VMMC unit costs used in the model.

Box 4: Age targeting for voluntary male medical circumcision (VMMC)

Key messages

- Efficiency in voluntary male medical circumcision (VMMC) programs has been defined as the number of VMMCs per HIV infection averted over a chosen time period (typically 15 years in most modeling studies).
- Multiple modeling studies, including in Malawi, Mozambique, South Africa, Swaziland, Tanzania, Uganda and Zimbabwe, have shown that there are efficiency gains from targeting VMMC by age
- Efficiency gains from age targeting are not achieved from a “one size fits all” approach—the optimal age range varies by setting. For example, the lowest number of VMMCs per HIV infection averted would be produced by circumcising males ages 20–34 in Malawi but ages 15–34 in Swaziland.

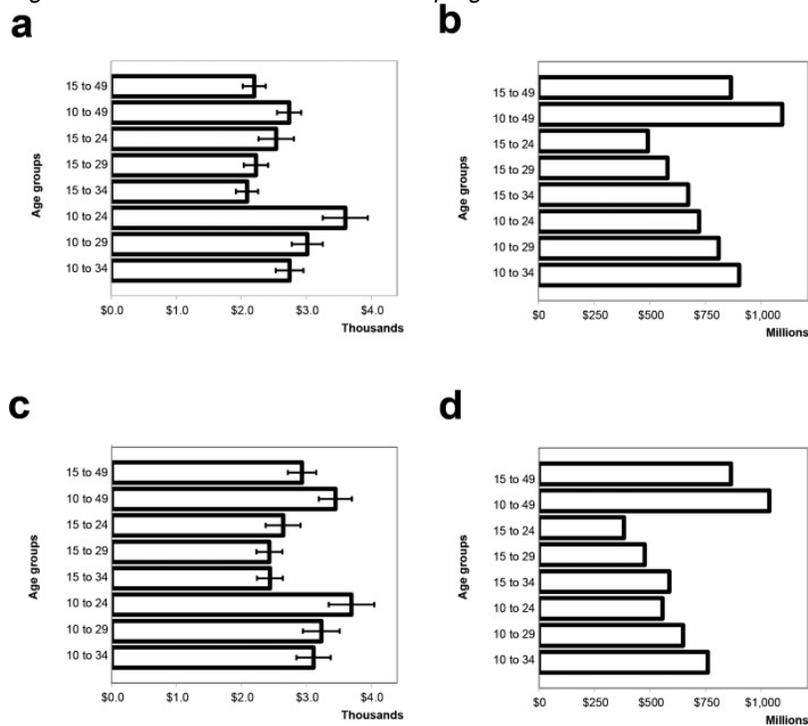
Age targeting of VMMC in South Africa

With 7.5 million people living with HIV and 200,000 new infections in 2019, South Africa has one of the largest HIV epidemics worldwide.(123) In the early 2000s, several randomized controlled trials showed the effectiveness of voluntary medical male circumcision (VMMC) as an HIV prevention method, specifically for female-to-male sexual transmission.(124–126) In 2007, the WHO and UNAIDS followed up with guidance for settings with high HIV prevalence and low male circumcision coverage to integrate VMMC with existing HIV prevention programming.(127) The joint recommendations pinpointed 13 countries—including South Africa—where VMMC scale-up would be prioritized. As part of the 2012-2016 National Strategic Plan (NSP) on HIV, STIs, and TB, South Africa set a goal for 80% of men aged 15-49 (about 4.3 million) to be circumcised by 2015.(128) In the 2017-2022 NSP, VMMC remains a recommended intervention ideally offered as part of the sexual and reproductive health service package.(129) From 2008 to 2020, a total of 4,460,432 VMMCs were performed in the country.(130)

Kripke et al. (2016)(131) used the Decision Makers' Program Planning Toolkit, Version 2.0 (DMPPT 2.0) to analyze the impact and cost-effectiveness of age-targeted VMMC interventions. The model assumed a scale-up target of 80% coverage from 2014 to 2018. It projected that prioritizing men ages 20-34 has the greatest impact on HIV incidence in the short term (5 years) and requires the fewest circumcisions for each infection averted. In the longer run (15 years), targeting men ages 15-24 yields the largest impact. The 15-29 age group (cost of ~US\$ 2,500 per HIV infection averted, Figure 8, panel c) is the most cost-effective given that the unit cost of VMMC rises with age. If the cost is the same for all ages, men ages 15-34 (cost of ~US\$ 2,100 per HIV infection averted, Fig 8, panel a) are the most cost-effective group. Cost-sensitivity analysis showed that even if the unit costs were to increase with age, the order of prioritization based on

cost-effectiveness would not change significantly. Although the Government of South Africa’s national VMMC program covers men ages 15-49, the United States President’s Emergency Plan for AIDS Relief (PEPFAR) prioritizes the 15-34 age group due to the cost-effectiveness of age targeting.(132) The DMPPT 2.0 analysis by Kripke et al. showed that VMMC scale-up among the 15-34 age group would mean 303,000 HIV infections would avert 82% of the HIV infections from scaling up VMMC among ages 15-49 (the current government strategy in South Africa).

Figure 8: VMMC cost-effectiveness and program cost with and without increasing unit cost with client age



Using the ASSA2008 model, Haacker, Fraser-Hurt, and Gorgens (2016) (133) found that the return on investment is highest when men undergo VMMC between the ages 20 and 25. Even though VMMC is an effective one-off intervention, the number of HIV infections averted (and in parallel, cost savings) decreases significantly with age at circumcision. Specifically, after age 20, the effects (direct and indirect) of VMMC decrease by about one-third by age 25 and two-thirds by age 30. A person infected with HIV at an older age has a shorter lifespan left, resulting in lower costs (e.g. treatment) than someone infected at a younger age—VMMC delivery later in a client’s life yields relatively less cost savings. Haacker, Fraser-Hurt, and Gorgens state that circumcisions at age 20 are most effective, giving a financial rate of return of 14.5% or net savings of US\$ 617 (with a discount rate of 5%). While circumcision for infants is less expensive for young adults with similar effectiveness, the impact is delayed and the effects lessened.

Table 6: Summary of results (based on one male circumcision performed in South Africa in 2013)

Age at male circumcision	Impact on HIV Incidence			Male circumcisions per HIV infection averted	Cost per HIV infection averted (US\$)		Net savings from one male circumcision (US\$, at 5% disc.)	Amortization period (y, at 5% disc.)	Financial rate of return (%)
	Total	Direct	Indirect		(at 0% disc.)	(at 5% disc.)			
0	0.236	0.082	0.154	4.2	221	859	301	30.6	7.8
10	0.232	0.084	0.147	4.3	450	1,157	401	22.8	9.9
15	0.218	0.085	0.133	4.6	478	867	475	17.4	11.5
20	0.227	0.088	0.139	4.4	460	659	617	12.2	14.5
25	0.159	0.083	0.076	6.3	657	854	412	11.6	13.6
30	0.079	0.059	0.020	12.6	1,316	1,749	123	16.6	8.8
35	0.040	0.034	0.006	25.1	2,623	3,455	-2	n.a.	4.9
40	0.022	0.020	0.002	46.2	4,826	6,135	-52	n.a.	1.8
45	0.014	0.013	0.000	72.7	7,592	9,268	-74	n.a.	-0.9
50	0.009	0.009	0.000	113.3	11,819	13,709	-86	n.a.	-3.6
55	0.005	0.005	0.000	214.2	22,350	24,157	-95	n.a.	-6.8

Additionally, an analysis performed by Tchuente et al. (2016) (134) showed the potential cost savings should task-shifting be used for VMMC. If professional nurses were to assume the role of physicians in VMMC delivery, the direct labor cost could be reduced from US\$ 56.60 to US\$ 47.18 per circumcision (a saving of US\$ 9.41, or 17% of direct labor costs, or 7% of the unit cost per circumcision). There are possible benefits beyond the direct labor costs as well. For instance, more nurses are available than physicians, which would allow for higher service output. In addition, a VMMC scale-up study found less burnout among nurses, meaning that task shifting may also improve the consistency of staff and quality of services.

3.5 Targeting of PrEP during periods of risk and to high-risk people is superior to offering it to everyone

Potential efficiency gain: For PrEP implementation to be cost effective, it should be targeted to those at substantial risk for HIV infection.

Summary of research: We found a review of studies on PrEP in SSA; a study that modelled the scale up of PrEP in 13 countries under different scale-up scenarios; and a modeling study of PrEP in the form of the dapivirine vaginal ring in KwaZulu Natal. These three studies are described below.

Mugo et al (2016) (135) reviewed the literature on program implementation of PrEP in SSA. Among HIV sero-discordant couples, the number needed to treat (NNT) to avert one HIV infection was under 30 when targeted to couples with an HIV incidence of $\geq 5/100$ person years (this NNT is similar to the NNT in the iPrEx study of men and transgender women who have sex with men).

Carel Pretorius et al (2020) (136) modelled the scale-up of PrEP in 13 nations (Eswatini, Ethiopia, Haiti, Kenya, Lesotho, Mozambique, Namibia, Nigeria, Tanzania, Uganda, Zambia and Zimbabwe) under four different scenarios: (i) national rollout for female sex workers (FSWs) only; (ii) national rollout for FSWS and serodiscordant couples (SDCs); (iii) national rollout for FSWS and SDCs and geographically prioritized medium-risk adolescent girls and young women (AGYW); and (iv) national rollout for FSWS and SDCs and medium-risk AGYW in all provinces/regions (no geographic prioritization). For most countries in the analysis, more than 50% of the HIV infections averted by oral PrEP in the scenarios examined could be obtained by rollout to FSWS and SDCs alone. For many countries (though not all), expanding oral PrEP to include medium-risk AGYW in all regions increased the impact. In terms of geographic prioritization, there were greater efficiency gains from such prioritization in countries with more concentrated or geographically focused epidemics. There were large variations in cost-effectiveness across countries, reflecting differences in HIV incidence and variations in unit costs.

A modeling study of PrEP in the form of the dapivirine vaginal ring, by Robert Glaubius et al (137), assessed the impact of PrEP implementation in KwaZulu Natal given with no prioritization (“unprioritized”) or prioritized based on HIV incidence ($\geq 3\%$ per year), age (22 to 29 years), or female sex worker status. They found that (a) over a lifetime horizon, PrEP among female sex workers would be cost-saving, and (b) prioritizing women at substantial risk or those aged 22-29 could have “substantial impact on HIV prevention at affordable economic value.” Using prioritization based on incidence (i.e. when priority is given to those with an incidence $\geq 3\%$ per year), the incremental cost-effectiveness ratios were as follows: incidence-based PrEP cost

\$1898 per life-year gained relative to PrEP among female sex workers, and \$989 versus a reference scenario of no PrEP. They also found that incidence-based PrEP was more cost-effective than age-based or unprioritized PrEP.

In a 2020 modeling study by Pretorius C et al, the impact and cost-effectiveness of PrEP was projected between 2018 and 2030 across multiple scenarios involving three priority populations – FSWs, serodiscordant couples (SDCs) and adolescent girls and young women (AGYW), both with and without geographic prioritization. This model was applied across 13 countries (Eswatini, Ethiopia, Haiti, Kenya, Lesotho, Mozambique, Namibia, Nigeria, Tanzania, Uganda, Zambia and Zimbabwe), and the base case assumed achievement of the Joint United Nations Programme on HIV/AIDS 90-90-90 antiretroviral therapy targets, 90% male circumcision coverage by 2020 and 90% efficacy and adherence levels for oral PrEP. The results suggested that providing oral PrEP only to FSWs has relatively low impact and that substantial additional benefits could be gained by expanding rollout to include SDCs. For all but Eswatini, Lesotho and Mozambique, the analysis suggested that more than 50% of HIV infections averted were obtained by providing oral PrEP to FSWs and SDCs alone. For those three countries and, to a lesser extent, for Kenya and Uganda, expanding oral PrEP rollout to include medium-risk AGYW in all regions greatly increased the impact. Overall, the benefits of geographic prioritization of AGYW varied across countries in terms of both efficiency and impact and countries with more concentrated epidemics achieved more pronounced efficiency gains by geographic prioritization of oral PrEP for AGYW.

Limitations and unanswered questions: The Mugo et al study was a narrative review, not a systematic review. Pretorius C et al were unable to include other high-risk populations such as MSM and PWID in their analysis due to lack of reliable data across countries.

Box 5: Targeting of high-risk population groups through Africa's largest PrEP program

Kenya adopted the AIDS Strategic Framework which aimed to reduce HIV infections by 75% by 2020 and reduce new infections to zero by 2030. As part of the strategy, oral PrEP was introduced and integrated in to the existing ART system since July 2016.

PrEP was first introduced in Kenya as part of a series of global randomized clinical trials to understand the efficacy of PrEP for HIV serodiscordant couples, MSM, persons who inject drugs (PWID) and heterosexual individuals.⁽¹³⁹⁾ A scenario analysis was led by the Division of National AIDS and STI Control Program (NASCO) to determine impact and cost implications of rolling out the PrEP program through either targeting specific populations or country-wide rollout. Factors considered included varied HIV incidence throughout the country and geographical distribution of the key populations.

One study focused on cost-effectiveness of PrEP across 6 counties in Western Kenya by evaluating scenarios that targeted specific populations (NASCO option 1).⁽¹⁴⁰⁾ Through microsimulation modeling (EMOD-HIV v2.5) of demographic, programmatic, and epidemic data, cost-effectiveness and impact of PrEP of the scenarios were evaluated in all 6 counties in the scale of HIV infections averted per 1,000 person-years of PrEP.⁽¹⁴⁰⁾ The study found PrEP rollout to FSW is most likely the most cost-effective as compared to providing PrEP to high-risk adolescent girls and young adults of the general population.⁽¹⁴⁰⁾ Results also reinforced that cost-effectiveness is maximized in geographic areas where risk of acquiring HIV is high.⁽¹⁴⁰⁾

Scenario analyses were also performed by OPTIONS to evaluate five rollout scenarios (shown in figure below) and the potential impact and cost.⁽¹⁴¹⁾ These scenarios evaluated cost-effectiveness scale-up options that would target three particular population groups: high risk general population groups (SDCs AGYW), key populations (FSW and clients, MSM and prisoners, and PWID) and bridging populations (fisher folk, truck drivers).⁽¹⁴¹⁾ This two-step delivery approach framework evaluated HIV incidence by location and the size/spread of key populations, resulting in 5 possible scenarios. 19 Kenyan counties with high incidence and

high potential of PrEP users were prioritized to yield maximum efficiency. To balance the trade-off between impact and cost, scenarios 1 and 2 were deemed the best option. Both options suggest a national rollout that provides PrEP beyond just key populations, which would require a larger-scale rollout, but this would be effective in reducing the majority of new infections, which is ultimately more cost-effective in the long-run.

Figure 9: Five PrEP Rollout Scenarios.

	Scenario	Counties
County Rollout	1 Highest incidence cluster 4 counties	<ul style="list-style-type: none"> General population rollout (incl. SDC, AGYW and bridging populations) in Homa Bay, Siaya, Migori Key population and high-risk AGYW rollout in Kisumu via DICES and NGO programs All four counties have current demonstration projects and relatively high HTC and ARV uptake (range from 60 - 75%)
	2 High new infections 7 counties	<ul style="list-style-type: none"> General population rollout (incl. SDC, AGYW and bridging populations) in Homa Bay, Siaya, Migori Key population and high-risk AGYW rollout in Kisumu, Kiambu, Mombasa, and Nairobi All seven counties have current demonstration projects and relatively high HTC and ARV uptake, except Kiambu (range from 50 - 75%)
	3 High + medium new infections 19 counties	<ul style="list-style-type: none"> General population rollout (incl. SDC, AGYW, and bridging populations) in Homa Bay, Siaya, Migori, Muranga and Nyeri Key population and high-risk AGYW rollout in Kisumu, Nairobi, Kiambu, Mombasa, Kisii, Kakamega, Machakos, Makueni, Kitul, Nyamira, Kilifi, Meru, Bungoma, and Kwale Some medium-incidence counties included in Bridge to Scale; lower rates of HTC and ARV uptake (range from 30 - 75%)
Population Rollout	4 High PLHIV to reach discordant couples 12 counties	<ul style="list-style-type: none"> Discordant couple rollout via CCCs in Nairobi, Homa Bay, Siaya, Kisumu, Migori, Kiambu, Mombasa, Kakamega, Nakuru, Busia, Kisii and Machakos Partners study focused on sero-discordant couples will inform delivery Note: This scenario uses PLHIV as a proxy for discordant couples
	5 High + medium key populations 16 counties	<ul style="list-style-type: none"> Key population rollout via DICES in Busia, Migori, Kisumu, Kiambu, Kisii, Siaya, Mombasa, Nairobi, Kilifi, Nakuru, Bungoma, Kakamega, Machakos, Meru, Vihiga, and Uasin Gishu Varied rates of HTC and ARV uptake; Bridge to Scale will inform rollout to medium-incidence counties

Note: Population rollout scenarios target only the specific population in each county via the relevant delivery channel.
Note: High-risk AGYW are those determined to be at substantial ongoing risk according to the Kenya PrEP indication guidelines.

Sources: FSG analysis

The PrEP program in Kenya was supported by various policies like the Kenya Prevention Revolution Roadmap that was led by the Ministry of Health, the Kenya Strategic Framework, and the Fast-track Plan to end HIV and AIDS among Adolescents and Young People.(144) Roll out was successful in making PrEP available in an abundance of settings from HIV treatment sites, prevention centers, STI clinics, drop-in centers for key populations, and even safe spaces for adolescents. In 2018, over 3,000 people have been trained in PrEP delivery nationwide through the cascade approach. Training and tools have also been implemented to reduce stigma and improve uptake. Oral PrEP introduction and scale-up has been successful.(142,145) As of December 2019, there are 71,000 clients initiating PrEP, all 47 counties have access to oral PrEP, and 1,994 facilities distribute oral PrEP.(146) Kenya's national rollout of PrEP has made oral PrEP available to all populations at notable risk of HIV, which includes FSW, MSM, SDCs, and AGYW.

In 2018, the Kenyan Ministry of Health published guidelines on the use of antiretroviral drugs for treating and preventing HIV under NASCOP, which recommends oral PrEP to be offered to all HIV negative individuals at "substantial ongoing risk of HIV infection" after eligibility assessment, readiness for proper use, and required HIV testing every 3 months.(147) The guidelines include preferred dosage and alternative does of oral PrEP, comprehensive criteria for PrEP indications, and assessments to ensure PrEP will be distributed and taken correctly.(147)

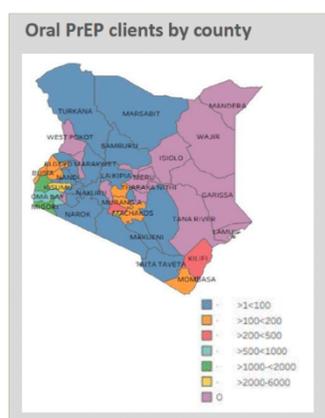


Figure 10: Oral PrEP clients by county in Kenya.

This national PrEP program has been very successful in Kenya; there has been significant progress in ensuring adequate infrastructure, proper engagement of health care workers, standard clinical guidelines for prescription and use, and incremental resources as roll out expands are all in place.(7) PrEP was integrated into existing HIV prevention and treatment interventions, making it widely available. Both community- and facility-based service delivery models were adapted for PrEP. While PrEP is initiated by official health care providers, elements of support come from the community level with support groups, peer educators, community health volunteers, etc. Those groups are also noted for their vital role in "demand creation and linkage with health facilities and other venues where PrEP is provided. In this national roll out, a national case-based training curriculum was also developed for PrEP through utilization of a cascade approach to train people. This allowed proper PrEP education from the national level down to county level where even peer educators were well-informed.(142)

3.6 Highly active antiretroviral therapy (HAART) is more cost-effective than other therapeutic regimens

Potential efficiency gain: HAART has been found to be more cost-effective when initiated early in terms of CD4 counts and more cost-effective compared to other standard of care regimens. In general, HAART was found to be more cost-effective than other therapeutic regimens.

Summary of research: We found a review of 22 economic evaluations, described below.

Tse et al (2015) (148) reviewed 22 economic evaluations which examined different forms of HAART regimens. The studies included in the review compared the cost-effectiveness of HAART regimens from different perspectives such as HAART without any intervention, optimal HAART initiation based on CD4 T-cell count, HAART across different population groups such as injecting versus noninjecting drug users, breast feeding mothers, and HAART based on different methods of administration such as self-administered HAART versus directly observed HAART. For cases where HAART was compared with no interventions, the cost for HIV infection averted was \$998 per person and cost per DALY saved was \$35.36. When comparing HIV infected groups with and without HIV, the cost per life years gained was \$5,189 and \$7,109 per QALY gained in the AIDS group, and \$6,652 per life year gained and \$9,782 per QALY gained in the non-AIDS groups. Studies covered in the review reported that darunavir boosted with low-dose ritonavir (DRV/r)-based HAART was more cost-effective than other standard-of-care protease inhibitor (PI)-based regimens among people living with HIV with ICER less than GDP per-capita. HAART was also found to be more cost-effective when initiated early with CD4 counts greater than 350 cells/mm³.

Limitations and unanswered questions: This is a narrative review focused on comparative analysis rather than quantitative analysis. The review included heterogenous studies and quality of the studies were not evaluated in the review. To identify the most suitable combination of HAART, further investigations are needed, especially analysis of head-to-head analyses based on “ideal” and “typical” trials of different combination of regimens.

3.7 Lifelong antiretroviral therapy (ART) for pregnant and breastfeeding women (Option B+) is more cost-effective compared to ART during pregnancy or breastfeeding only (Option B)

Potential efficiency gains: Option B+ ART under which all HIV-infected pregnant and breastfeeding women are given lifelong ART regardless of their CD4 count or HIV clinical stage was found to prevent more vertical transmissions compared to Option B. It was found to be cost-effective when total future costs and lost lifetime of the infected infants are taken into account.

Summary of research: We found one cost-effectiveness analysis of Option B+ in Malawi, described below.

Tweya et al (2016) (149) looked at the cost-effectiveness of Option B+ for prevention of mother to child transmission of HIV. Using modeling analysis that used individual simulation, the study evaluated Malawi’s Option B+ program that was introduced in 2011. Under Options B+, all HIV-infected pregnant and breastfeeding women are given lifelong ART regardless of their CD4 count

or HIV clinical stage. Compared to this, Option B recommends ART only for the duration of pregnancy or breastfeeding, unless women qualify for ART for their own health. It was seen that usually during the first pregnancy, 15% of the infants born to HIV-infected mothers acquired the infection. While 39% of the women were put on Option B+ from the beginning of the second pregnancy, 18% were given Option B. It was seen that the rates MTCT during the second pregnancy were 11.3% with Option B+ and 12.3% with Option B. Considering 20 years and 60 years life expectancy for treated infants, the ICER comparing the two options ranged between US\$ 500 - US\$ 1300 per DALY averted respectively. Option B+ was found to not only prevent more vertical transmissions when mothers were put on ART at the beginning of the next pregnancy, but also found to be a cost-effective strategy for PMTCT if the total future costs and lost lifetime of the infected infants are accounted for.

Limitations and unanswered questions: The study focused only on prevention of new infections and did not model subsequent pregnancies beyond two. The study did not model the viral load trajectories explicitly and also excluded women already on ART or last stages of HIV infection during first pregnancy.

Question 4. Is this intervention cost-effective?

Cost-effectiveness analysis has been used to show that a number of innovations in HIV service delivery represent good value for money, including demand creation incentives (e.g. cash) for VMMC and HIV self-testing.

4.1 Demand creation for voluntary male medical circumcision (VMMC)

Potential efficiency gains: Economic compensation is a cost-effective way to increase uptake of VMMC, and a range of approaches (e.g., cash, vouchers) have been shown to work in RCTs. It may be most cost-effective to introduce financial incentives in settings with an already high prevalence of VMMC to focus on men who would not have accessed the services otherwise.

Summary of research: We found three reviews and one additional study of demand creation interventions for VMMC, including economic compensation, described below.

In a mixed methods systematic review of demand creation interventions for VMMC, which included studies done in South Africa, Zambia, Tanzania, Uganda, Malawi, and Zimbabwe, Ensor et al (2019)(150) found that the greatest *absolute* impact on VMMC prevalence was from a VMMC promotion training for religious leaders. However, the largest *relative* effects were from financial incentives.

In a systematic review of studies conducted in Kenya, Tanzania, and South Africa, Carrasco et al (2018)(151) found that “economic compensation and incentives may prove to be most cost-effective in contexts where a certain VMMC threshold has been reached to ensure that the economic compensation and incentives are targeted to those who would not have accessed the service otherwise.” The authors suggest that such incentives may help to address financial

barriers and lost wages, or provide additional encouragement to access VMMC among late adopters.

In a systematic review and meta-analysis of economic compensation to increase VMMC uptake, Kaitlin Kennedy et al (152) identified five RCTs and three non-randomized trials that met their inclusion criteria, conducted in Kenya, Malawi, South Africa, Tanzania, Uganda, Zambia, and Zimbabwe. A meta-analysis of four of the RCTs found a significant impact of *any* economic compensation on VMMC uptake. The largest effects were from food/transport vouchers and conditional cash transfers. This systematic review informed the WHO guidelines on VMMC—these describe the tailoring of VMMC to local settings and to adequate community engagement.

A cost effectiveness analysis on demand creation for VMMC in two regions of Tanzania (153) examined costs of surgery, demand creation activities and implementation, including monitoring and supervision using the Decision Makers' Program Planning Tool. The study by Torres-Rueda et al found that despite additional costs for demand creation activities, VMMCs are cost-effective and cost-saving in the long run. More infections were averted in the intervention groups compared to the control group. The average costs per VMMC per person was \$81.63 in the intervention clusters which is lower than the control clusters at \$101.31. Economies of scale along with savings from ART costs averted due to VMMCs also provided scope for additional cost savings.

In a 2020 systematic review of service delivery interventions to increase VMMC uptake amongst adolescent and adult men, Atkins et al identified four RCTs and five observational studies taking place in South Africa, Tanzania, Uganda, Zambia and Zimbabwe. "Service delivery interventions" were defined as changes or improvements to the ways VMMC services are provided. Community-, facility-, and school-based service delivery interventions were all associated with improved VMMC uptake. Interventions that increased adult men's uptake included mobile services (compared to static facilities), home-based testing with active referral follow-up, and facility-based HIV testing with enhanced comprehensive sexual education. Eleven cost studies suggested that service delivery interventions create economies-of-scale and efficiencies when implemented widely.

Limitations and unanswered questions: There was marked heterogeneity in study designs—studies used various settings (urban and rural) and a wide range of study designs, and inconsistent intervention definition and delivery. There were differences in baseline circumcision rates, studies measured different VMMC outcomes and in some studies the absolute impact of interventions could not be calculated. The findings may not be generalizable to low prevalence VMMC settings. Studies have mostly been done in countries where scale-up of VMMC has been relatively successful, and the findings may not apply to countries that have not yet scaled up VMMC.

4.2 Self-testing for HIV

Potential efficiency gains: There is strong evidence of the effectiveness of community-based HIVST on increased testing coverage. HIVST has potential to be cost-effective, contingent on (a) delivery to high burden settings with low coverage of HIV testing; (b) reductions in delivery costs

through less resource intensive implementation and cuts in HIVST unit costs; (c) improvements in linkage to prevention among HIV-negative individuals.

Summary of research: We found a review of cost studies in SSA; a prospective longitudinal micro-costing analysis to estimate the costs of community-based HIV testing services, including HIVST, in Lesotho; and a narrative review of the evidence on HIVST gathered from the Self-Testing AfRica (STAR) Initiative.⁽¹⁵⁵⁾ These are described below.

A review of cost studies in SSA by Indravudh et al (2018) (156) found that HIVST has the potential to be cost-effective, contingent on factors described above. Cost data from urban Malawi suggests HIVST could be cost-effective in high-burden settings: the mean cost per person tested was similar to facility-based testing, self-testers incurred almost no costs (compared to US\$2.93 for facility testers),¹⁰ and self-testers were diagnosed at earlier stages. One year after ARV initiation, a follow-on analysis reported no differences in economic and quality of life outcomes between self-testers and facility testers.

Marc d'Elbée et al (157) conducted a prospective longitudinal micro-costing analysis to estimate the costs of community-based HIV testing services (HTS) in Lesotho and assess the potential efficiency gains achieved by adding HIVST and then self-testing booths. They estimated costs per positive case identified over three phases: phase 1 was HTS alone, phase 2 added HIVST, and phase 3 was HST and HIVST and individual HIVST booths in which clients were encouraged to self-test on-site followed by “on-site confirmative testing for those with reactive self-test.” They found that costs per HIV-positive case identified increased between phase 1 (US\$956) and phase 2 (US\$1249) then dropped in phase 3 (US\$813). The authors conclude that adding HIVST increases the overall program's affordability for case finding. The improved case finding and yield, they say, was driven by an increase in index testing activities, “thanks to the efficient introduction of self-testing and booths in period 3, allowing more staff to conduct index testing instead of being mobilized at the mobile outreach.”

A narrative review of the evidence on HIVST gathered from the Self-Testing AfRica (STAR) Initiative, by Heather Ingold et al (155), concludes that HIVST could improve health system efficiency by “triaging those without HIV straight to prevention services and freeing up health workers' time” and it could thus reduce costs of HIV testing services. HIVST may also improve efficiency by “refocusing testing services and resources on those with a reactive self-test result in need of confirmatory testing, thereby increasing the efficiency of conventional testing systems.”

Limitations and unanswered questions: Real world cost and implementation data remain limited.

¹⁰ Mean cost per individual tested through community-based HIVST (US\$8.78) was comparable to facility-based HIV testing (US\$7.54), but higher per HIV-positive individual identified (US\$97.50 versus US\$25.30-US\$76.14).

4.3 Integration of HIV and infectious and non-communicable disease (NCD) screening

Potential efficiency gains: While HIV-NCD integration could be moderately cost-effective in Kenya, cost-effectiveness could be substantially improved by lowering the cost of hypertension management. At the commonly used WHO threshold of cost-effectiveness (less than GDP per capita per DALY averted), HIV-NCD integration would be 90% most likely to be cost-effective. A targeted approach to HIV-NCD integration that prioritizes regions with higher HIV prevalence would be more effective given regional variations in prevalence.

Summary of research: We found a modeling study in Kenya; a micro-costing study in KwaZulu-Natal; a systematic review of studies conducted across Africa; a costing study to estimate the costs of a population-wide hybrid community approach for HIV testing combined with multiple disease screening in Uganda and Kenya; ; and an economic evaluation of an integrated approach for triple elimination of MTCT of HIV, hepatitis B and syphilis in Cambodia. These studies are described below.

A 2020 modeling study by Kasaie et al (158) in Kenya looked at the cost-effectiveness as well as epidemiological impact of a community-wide integrated screening and treatment program for HIV, hypertension and diabetes. The study used microsimulation of cardiovascular diseases (CVDs) risk with a population-based Spectrum model of HIV dynamics to study the impact of the integrated program between 2019-2033 on individuals with 10-year risk of CVDs. Integrated population-based screening and treatment for HIV and NCDs in Kenya is not only 90% more likely to be cost-effective at the common less than GDP per capita per DALY averted threshold, but found to have substantial impact over 15 years averting 64% of new HIV infections, 284,000 HIV-related deaths, 43,600 CVD-related deaths, and 7.8 million HIV- and CVD-related DALYs. Where hypertension prevalence is higher than HIV incidence (Central region), cost of integration was found to be higher. Integration would also require significant investments equivalent to 12% of the Kenya health budget over a 15-year period.

A 2018 study by Golovaty et al studied the cost of integrating non-communicable disease screening into home-based HIV testing and counseling in South Africa. A micro-costing study was conducted to estimate the incremental costs of NCD screening as part of home-based HIV testing and counseling (HTC) and referral to care in KwaZulu-Natal, South Africa. The study found that integrating all-inclusive NCD screening as part of home-based HTC in a high HIV prevalence setting increased program costs by \$3.95 (42%) per person screened (from \$9.36 to \$13.31 per person). Integrated NCD screening, excluding point-of-care cholesterol testing, increased program costs by \$2.24 (24%). Further, NCD screening integrated into HTC services reduced the number of persons tested by 15–20% per day. The incremental costs per person screened was found to be modest through a liquid assay or targeted screening approach compared to all-inclusive NCD screening which increase the incremental cost per person by over 40%.

Nugent et al (2018) (159) conducted a systematic review of costs and cost-effectiveness of HIV/NCD integration in Africa to assess the efficiency of integration in limited capacity settings. 9 studies that examined the efficiency of integrating screening services only were included in the review. The review found limited evidence of the cost or cost-effectiveness of integration among

non-cancer NCDs, including hypertension, diabetes, and associated risk factors. A study in rural Zambia included in the review found that integrated HIV - cervical cancer screening with enhanced counseling was more cost-effective compared with a non-integrated standard of care. Another study by Vodicka et al found that cost of using an integrated cervical cancer screening strategy in Kenya was less costly than stand-alone services due to reduced overhead costs, patient transport costs and time saved. The additional cost of integrating NCD screening with HIV care ranged between 6%–30% increase in the total costs in studies that reported costs.

Chang et al (2016) conducted a costing study to estimate the costs of a population-wide hybrid community approach for HIV testing combined with multiple disease screening. This study was conducted across 12 SEARCH Trial communities in Uganda and Kenya. The hybrid HIV testing model included door-to-door census enumeration, a multi-disease testing at community health campaigns (CHCs), and home-based tests for individuals who did not visit CHCs. The mobile CHC provided rapid antibody HIV testing for all, point of care (POC) CD4 tests for HIV positive persons, along with hypertension and diabetes screening, and malaria testing and treatment. It was found that CHC testing costed \$13.8 and home-based tests costed \$31.7. Moreover, in the case of the multi-disease testing at CHCs, the marginal costs for hypertension and diabetes screening was \$1.16 per person and \$0.90 per person for malaria. Even when POC CD4 tests costed \$16 per HIV positive person identified, it was found to be highly competitive given the added advantages of multi-disease screening at low marginal costs. The study provides evidence in support of a hybrid innovative approach to integrate screening for multiple diseases, while achieving near universal HIV testing through community mobilization.

In October 2017, the WHO Regional Office for the Western Pacific adopted a regional framework for the EMTCT of communicable diseases, focusing on HIV, Hepatitis B (HBV) and syphilis in the Western Pacific Region. The framework emphasized the principle of mother–newborn–child-centered care and proposed an integrated and coordinated approach to achieve triple elimination efficiently. A 2019 economic evaluation by Zhang et al assessed the impact and cost-effectiveness of the integrated approach in the Cambodian context and found that integrating HIV and syphilis prevention reduced the total time required to provide integrated care by 19% for health workers and by 32% for pregnant women, resulting in a net saving of \$380,000 per year for the EMTCT programme. The integrated approach was also found to reduce MTCT of: HIV from 6.6% to 6.1%; HBV from 14.1% to 13.0%; syphilis from 9.4% to 4.6%. Including HBV screening and treatment to the integrated approach significantly increased costs, but the EMTCT programme still remained highly cost effective.

Limitations and unanswered questions: The authors noted that both Spectrum and the NCD models use simplified assumptions that don't capture the full extent of interactions between HIV and NCDs. Limitations also apply to the simplified estimation of CVD risks based on a largely white male population which does not accurately reflect CVD risk in African populations. The model also ignores other positive benefits of treating hypertension and diabetes. The Nugent study reported a limited scope of the review and a lack of studies estimating the cost of facility-based integration for non-cancer NCDs, given that NCD management is usually facility-based. The Chang study noted that it did not consider cost estimates related to linkage to care or viral

suppression. It also did not conduct any scenario comparisons. Zhang et al used national-level data that did not reflect variations across the country. They also modeled improvements in programme coverage brought about by the integrated approach rather than using actual empirical findings.

4.4 Integrated HIV and family planning and sexual reproductive health (SRH) interventions targeting sex workers

Potential efficiency gains: Most of the HIV and SRH interventions targeting sex workers are highly cost-effective, with the most cost-effective models combining biomedical, structural and behavioural components within existing health programs. The main drivers of cost-effectiveness were HIV incidence and prevalence amongst sex workers, number of sexual partners of sex workers, and commodity costs.

Summary of research: We identified a systematic review of the cost-effectiveness of SRH interventions targeting sex workers; a modeling study of HIV and syphilis testing in Malawi; an evaluation of integrated HIV testing and family planning program for couples in Zambia; and an evaluation of whether integrated delivery of HIV and sexual and reproductive health services increased cost-effectiveness and uptake in Zambia. The studies are described below.

Rinaldi et al (2018) (162) conducted a systematic review of the literature between 1995 - May 2018 on cost-effectiveness of SRH interventions targeting sex workers. The review included 19 studies¹¹ and evaluated the integrated interventions that consisted a combination of biomedical, structural or behavioural components using the WHO recommended threshold and Woods et al cost-effectiveness thresholds.¹² All studies except one included in the review were found to be highly cost-effective and fulfilled both the WHO and Woods et al thresholds with an ICER of less than 20% of GDP per capita. The ICERs of biomedical interventions (STI test and treatment, HIV vaccination, female condoms) were all less than 2% of GDP per capita and mixed interventions (biomedical and behavioural such as voucher incentives) had average ICER of 3% of GDP per capita (ranging from 0.2 to 20%). It was also found that integrated interventions on average, had a much lower ICER of \$79 (ranging from \$18 to \$264), compared to stand-alone interventions with ICER of \$469 (ranging from \$4 to \$3017).

A 2016 modeling study by Bristow et al compared four algorithms to check the cost-effectiveness of HIV and syphilis testing in Malawi - (i) HIV rapid test (ii) dual HIV and syphilis rapid tests (iii) single rapid tests for HIV and syphilis, and (iv) HIV rapid and syphilis laboratory tests. The study

¹¹ Studies covered 3 low income countries and 16 middle income countries in mostly in Asia and few in Sub-Saharan Africa and Latin America.

¹² As per the WHO recommended cost-effectiveness threshold, if the cost-effectiveness ratio i.e. cost per DALY averted is less than the GDP per capita, it is considered highly cost-effective; a ratio between one and three times the GDP per capita is considered cost-effective, and if it is more than three times the GDP per capita, it is not cost effective. The Woods et al cost-effectiveness threshold considers a cost-effectiveness threshold of less than 50% of GDP per capita.

found that dual RDTs for HIV and syphilis was the least costly option at US\$ 214.79 per pregnancy compared to the other three options with costs above \$218.64. It was also found that the dual test prevented the largest number of adverse pregnancy outcomes.(163,164)

Another study in Zambia(165) that evaluated an integrated HIV testing and family planning program for couples in Zambia found it to be cost-effective. The implementation study was carried out across 55 government facilities across seven cities in Zambia. The integrated program which focused on couples and long-acting reversible contraception was found to result in cost savings of \$280 - \$445 per HIV infection averted, along with \$3- \$51 per QALYs saved, \$5-\$21 per unintended pregnancy averted and \$618- 5,453 per perinatal infection averted. Additionally, the integrated program averted around 7,165 HIV infections and 62,275 unintended pregnancies. This integrated model was found to be highly adaptable to the Sub-Saharan African setting more generally as a cost-effective delivery model.

Hewett et al (2016) (166) conducted an evaluation to see whether integrated delivery of HIV and sexual and reproductive health services increased cost-effectiveness and uptake in Zambia. The randomized evaluation focused on 3,963 adult clients over the age of 18 years availing family planning, HIV testing and counseling (HTC), and male circumcision were randomly allocated to one of three service delivery channels: (i) standard service delivery at entry point (ii) add-on services including enhanced counseling and referral with follow-up and (iii) services under (ii) plus additional escort offer. Using the WHO standard of cost-effectiveness of less than three times the country's GDP per capita, intervention (iii) was found to be cost-effective with a cost of \$3180 per DALY averted. The integrated intervention was not only highly cost-effective, but also increased uptake of VMMC and cervical cancer screening services among clients. Integrated delivery sites were also able to provide HTC and VMMC services at a lower cost per client than the segmented, vertical delivery sites lead to technical efficiencies.

Limitations and unanswered questions: The underlying studies did not take in to account interactions between different types of interventions. Cost-effectiveness of interventions were not directly comparable to determine the optimal intervention. The authors noted that the quality of cost-effectiveness evidence reporting can be greatly improved to be a useful source of information for decision makers, including use of comprehensive measures such as DALY or QALY to allow comparability and to also look at broader perspectives that can facilitate optimal resource allocation decisions and enhance the comparability across different sectors.

4.5 Providing HIV services to key populations through non-government organizations

Potential efficiency gains: Compared to a business-as-usual scenario, provision of HIV services through NGOs was found to be highly cost-effective as per WHO standards with cost-effectiveness measured in terms of cost per DALYs averted being half of the GDP per capita.

Summary of research: We found a retrospective observational evaluation of service provision via NGOs in Nigeria, described below.

Under the USAID ASSIST Project in Nicaragua, the PrevenSida program aimed to provide services to key populations, including MSMs, FSWs and female transgender through NGOs. A retrospective observational evaluation was carried out by Broughton et al in 2016 (167) to evaluate the cost-effectiveness of the program. NGOs that received PEPFAR grants and funds under the Key Population Challenge Fund to provide HIV prevention services to key populations were included in the evaluation. The study compared costs of grants and administrative costs for technical assistance and also compared costs across regions. Compared to a scenario of no program, the program aimed at key populations was found to be cost-effective with an ICER of \$50,700/HIV case averted or \$2,600/DALYs averted and highly cost-effective as per the WHO criteria. Further cost-sharing by NGOs improved cost-effectiveness. Given the challenges of accessing services among key populations, investing in capacity building among NGOs is a cost-effective strategy to tackle HIV infections.

Limitations and unanswered questions: The study limitations include economic and epidemiological modeling limitations, along with data deficiencies. The study did not use age-weighting to account for the fact that the highest incidence of HIV occurs in those who are generally the most productive and therefore have the highest DALY age weighting.

4.6 Treatment eligibility for ART at any CD4+ cell count is cost-effective

Potential efficiency gains: Treatment eligibility at any CD4+ cell count would be cost-effective, even under health system constraints. Excessive loss-to-follow-up and mortality in patients not eligible for treatment can be avoided by changing guidelines in demand-side constrained systems.

Summary of research: A 2016 modeling study by Hontelez et al looked at the cost-effectiveness of ART in Sub-Saharan Africa.(168) The study conducted in Sub-Sharan Africa¹³ aimed to investment needs, health gains and cost-effectiveness of scaling up ART under different supply and demand side constraints. The modeling study considered different demand and supply side scenarios to check the impact of changing ART guidelines at different CD4+ cell counts. The scenarios considered were: (i) Pessimistic scenario with current financing levels (ii) Pessimistic scenario with health system supply-side and demand-side constraints (iii) a realistic scenario with continued scale up, but with demand-side constraints (iv) an optimistic scenario with rapid scale up with demand-side constraints (v) an optimistic no constraints scenario with the 90-90-90 targets (vi) a highly optimistic scenario with expanded 90-90-90 (90-90-90+) scenario. The study found that changing guidelines to provide ART at any CD4+ cell count is highly cost-effective in all scenarios, especially in scenarios with demand-side constraints. However, if this is done with supply-side constraints, there was an impact on population health with healthier patients crowding out people with more acute needs. The cost for ART at any CD4+ cell count ranged between US\$54 per life-year saved under the pessimistic health systems constraints to US\$1358 per life-

¹³ Countries included in the modeling analysis were Ethiopia, Kenya, Malawi, Mozambique, Nigeria, South Africa, Tanzania, Uganda, Zambia, and Zimbabwe).

year saved for the 90-90-90+ optimistic scenario. It was also found that changing eligibility guidelines to ART at any CD4+ cell count with demand-side constraints resulted in more benefits with around 20 million life-years saved compared to a universal test and treat scenarios that saved 5 to 10 million life years.

Limitations and unanswered questions: Due to lack of data, economies of scale were not considered and unit costs were assumed to be linear to program scale-up which may not be realistic. The study also did not account for efficiency benefits of removing triaging and pre-ART care from ART delivery, or negative impacts such as poorer adherence of healthier patients or transmission of drug resistant strains due to lack of available data.

IV. Gaps and Opportunities for Improvement Highlighted by the Review

Gaps

Several academic studies included in this review note the absence or poor quality of costing data as a serious limitation of the research. A 2019 systematic review by Cameron et al reviewed the quantity and characteristics of published cost data from HIV interventions in sub-Saharan Africa and concluded that although HIV costing data reporting has improved, cost reporting is lacking across several dimensions. The study found few cost estimates from HIV interventions in west Africa, and inconsistencies in reporting of key dimensions of cost including platform type, ownership and urbanicity.(181)

If gaps at the beginning of the cascade such as identification and treatment initiation are not addressed, it will be more expensive to achieve targets over the long term. Using cascade analysis can help to identify these gaps. For example, the PEPFAR- and USAID-funded Health Policy Plus (HP+) project performed cascade analysis in three African countries (Ghana, Kenya, and Tanzania) and three Asian countries (Indonesia, Kyrgyz Republic, and Tajikistan) between the years 2015 and 2019. They identified potential efficiency gains in each country using a four-step process: (1) identifying failure points along the cascade, (2) identifying solutions to prevent losses along the cascade, (3) projecting cascade outcomes and health impacts, and (4) costing the cascade and solutions to prevent losses.(182)

More studies on cost-effectiveness of community-based ART programs, particularly in under-represented patient groups such as HIV-infected children, adolescents, and pregnant women are needed.

While there is increasing evidence regarding the use and uptake of digital interventions for HIV prevention and treatment adherence, studies on cost-effectiveness of these interventions are limited. Two reviews, one by Bell and Haberer (2018) and another by Gibson et al (2018) looked at the status of digital and technological interventions in resource limited settings in low- and middle-income countries.(183,184) While the studies identified several innovative interventions such as use of cell-phones for HIV education, SMS for care linkage and retention, use of technological adherence monitors to improve HIV services, they found limited evidence on cost-effectiveness of these interventions.

In terms of the investment case approach, while it is a useful tool for making investment decisions and priority setting, the availability of reliable national data is an important factor for making reasonable estimates and projections. Moreover, the process is very political, involving diverse stakeholders and difficult investment choices and requires buy-in from important stakeholders like finance ministries and planning departments to secure funding and budget allocations. It was also found that structural constraints like required legal and regulatory frameworks, for eg procurement and supply system issues, punitive laws against key populations, legal barriers that prevent domestic government funding for community organizations remain a major barrier in many countries, hampering the implementation of recommendations emerging from the investment cases. For the investment case approach, there is scope to link the impact to more broader linkages to national development issues like poverty reduction, human rights and social justice,

and gender equality to make a stronger investment case and improve buy-in and policy uptake across a wide range of stakeholders and key decision-makers.

Opportunities

The peer-reviewed literature has pointed towards a large body of evidence that support the use of various cost-effective interventions.

There is a large body of evidence in support of community-only or a combination of community and facility support services producing the most affordable and efficient delivery of support services. There is evidence of greater uptake and application of differentiated ART service delivery models. Community-based and differentiated service delivery models hold great promise for ART among stable patients with suppressed viral loads.

Targeting of services at specific population groups has been found to be highly cost-efficient. For example, age-targeting of VMMC has been found in multiple studies to drive efficiency.

There is increasing evidence on the use of technology for HIV care, to reduce costs and increase reach. This includes the use of mobile phones and social networks for ART adherence to create responsive, patient-centered approaches to HIV care.

Decentralization and task shifting is another effective way to lower facility level costs without affecting health outcomes. While services are often transferred to community health workers through task sifting, studies have found that other groups such as clinically stable patients, pharmacists, and adherence clubs, can also be effective for task-shifting.

Geographical optimization is likely to play an increasingly important role in health economic decision making. Although the largest gains are typically due to reallocating resources to the most effective interventions, especially treatment, further gains can be achieved by optimally reallocating resources between regions.

Increased returns to scale with larger patient volumes can reduce costs. One study reported that volume of services is a critical factor in determining the efficiency of HCT and PMTCT services, with scale accounting for 44% of the variability of the average cost per client tested and 22% of the variation in the average cost per HIV-positive client identified.

While integration of HIV and NCD services may be initially expensive, new differentiated delivery models that integrate community and other primary health care programs can be cost-effective.

It may be cost-effective to use financial incentives in settings of high prevalence of VMMC. Cash may be more cost-effective than vouchers, though this has not been seen in all studies.

Universal HIV screening in pregnancy has been found to be highly cost-effective. Staff time is a key contributor to testing costs, and home-based testing as well as task shifting can help reduce HIV testing costs.

V. The Investment Case: A Major Contributor to Improved HIV Efficiency

Over the past decade, the HIV investment case framework has emerged as a useful approach to help countries to guide countries in allocating limited resources to priorities that are cost-effective, efficient, and produce maximum impact.(169)(170) The UNAIDS launched the HIV Investment Framework in 2012 which has since been used by multiple countries to inform strategic decision-making for their HIV investments. The key component of this framework is the investment case – a country-led exercise of linking investments with impact based on a “robust analysis of the epidemiology, the current response and recent scientific evidence modeling”.(170)

The framework for investment was first highlighted in a policy paper published in *The Lancet* (Schwartzländer et al) in June 2011.(171) Resource allocation approaches at that time encouraged scaling up numerous strategies in parallel, irrespective of how they may overlap or leave gaps in coverage.(171) The investment approach departs from this “commodity approach” by simplifying and streamlining the different elements of HIV efforts, along with emphasizing the synergies between HIV program elements and quantifying these interactions.(171)(172) The investment framework uses empirical evidence to identify gaps and allocate resources towards combinations of interventions that achieve the greatest impact, while also enhancing equity and inclusiveness for key populations.(172)

Figure 11: What is an investment approach? What is an investment case?

What is an investment approach? What is an investment case?

An investment approach:

- Maximizes the returns of investment in the HIV response
- Allocates resources towards combinations of interventions that will achieve the greatest impact
- Enhances equity and impact by focusing efforts on key locations and populations with the greatest needs
- Improves the efficiency of HIV prevention, treatment, care and support programmes
- Uses empirical evidence and modelling to identify priorities and gaps
- Enables countries to secure sustainable funding for HIV programmes
- Provides the framework to align government domestic funding strategies for the medium and long term with donor-supported efforts

An investment case:

- Is an instrument for strategic decision-making around resource allocation, resource mobilization, service delivery and funding
- Can be articulated in a variety of forms, based on countries' specific contexts and needs
- Is a means of demonstrating national leadership in the response
- Unites diverse stakeholders including Ministries of Finance, Health, Development and Planning; Civil Society; people living with HIV; and international partners
- Articulates a common effort to identify programmatic gaps and bottlenecks and to create a roadmap for action
- Is sometimes different from a national strategic plan, which often includes an extensive and aspirational articulation of needs and is constrained by set time-frames

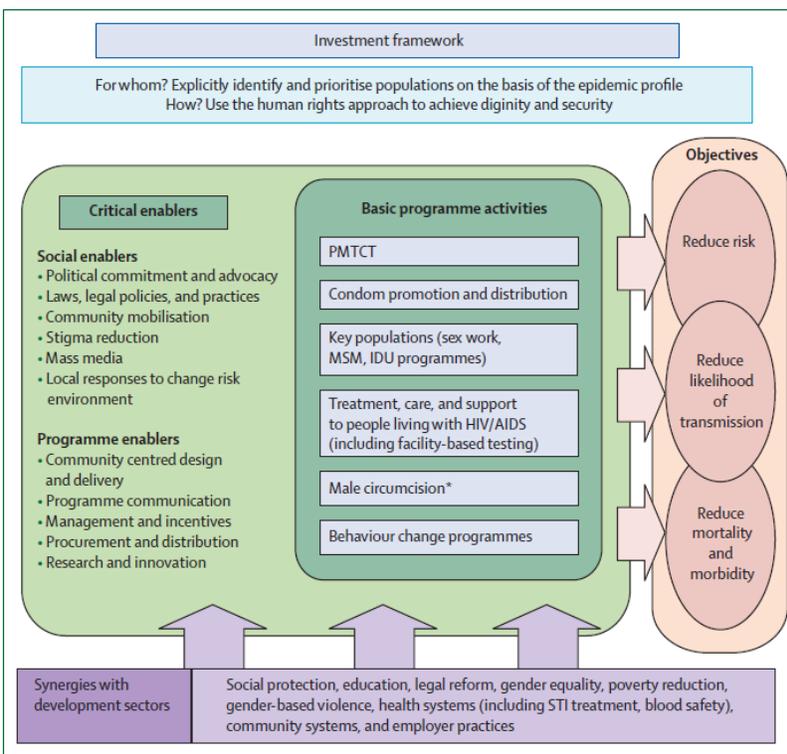
Source: UNAIDS, *Smart Investments*, 2013 (173)

Modeling the implementation of the investment framework in 2011 showed that it would avert 12.2 million new infections and 7.4 million AIDS-related deaths globally between 2011 and 2020. The *Lancet* study indicated that the framework was cost-effective, with investment largely offset by savings in treatment costs alone.(171)(172)

The investment framework uses a human rights approach as a starting point to ensure that the HIV response for a country is universal, equitable, and inclusive. The framework divides key elements of the HIV response into the following three categories:

1. **Basic programme activities:** Core building blocks of national AIDS responses; comprised of 6 basic activities that “aim to directly reduce HIV transmission, morbidity and mortality” and are essential for an adequate HIV response.
2. **Critical enablers:** “Activities that are necessary to support the effectiveness and efficiency of basic programme activities”. The Investment Framework divides critical enablers into two subcomponents: social enablers and programme enablers.
3. **Synergies with development sectors:** “Investments in other sectors that can have a positive effect on HIV outcomes”. The Framework identifies a few key development sectors that present opportunities for synergies in multiple contexts, including social protection, education, and others (see Figure 12 below).(171)(174)

Figure 12: Framework for the Investment Approach



Source: Schwartländer et al, *The Lancet*, 2011 (171)

* Applicable in generalized epidemics with a low prevalence of male circumcision.

Critical enablers under the framework are inclined to be HIV-specific. A key purpose of the enablers is to improve HIV-related outcomes and can be assessed in terms of their effectiveness in increasing uptake, equitable coverage, rights-based delivery and quality of programme activities. Development synergies, on the other hand, are less HIV-specific and can have a broader range of impacts across health as well as other development areas including social

protection and gender equality. The investment framework recognizes the need for the HIV response to be aligned with the broader country development objectives.(174)

The investment framework has been utilized by a number of countries to develop investment cases. The 2012 UNAIDS guide highlights four key steps in developing an investment case: (see Figure 13)

Figure 13: Key steps in developing an investment case

➤ Understand

National responses need to be grounded in thorough understanding of the past and current epidemic and response. Countries comprehensively analyze epidemiological data, assess inclusiveness, equity and structural obstacles to the uptake of services, use evidence-informed methods to project how the epidemic is likely to change and assess current programmatic efforts, content, coverage and resource allocation. This review identifies key locations and populations with the greatest HIV burden and the greatest unmet needs for HIV services.

➤ Design

Building on a robust analysis to “know your epidemic, know your response”, countries select the combination of interventions that are likely to have the greatest effects on their epidemic. Modelling and other tools are used to estimate the effect of this combination on the number of people acquiring HIV infection and the number of people dying from AIDS-related causes, and agreement is reached on approaches that will be given higher and lower priority.

➤ Deliver

Investment cases use evidence-informed strategies to estimate both the future costs of the HIV response and the net efficiency to be generated. They identify and address bottlenecks to effectively implementing and scaling up programmes intended to achieve equity among those most affected by HIV, including stigma and discrimination. Comparing current commodity prices to international prices, countries develop strategies to minimize commodity procurement costs, maximize programme efficiency and revise delivery methods.

➤ Sustain

Based on estimates of the total optimized investment needed to accelerate the response towards the end of AIDS, the investment case provides a vehicle for identifying new sources of domestic funding and proposes plans to mobilize new resources.

Source: Investing for results. Results for people: a people-centred investment tool towards ending AIDS. UNAIDS; 2012 (175)(173)

Since 2011, UNAIDS and other international organizations have prompted countries to counter the downward trend in international funding for HIV programs by developing an investment case for their national HIV responses. These cases aim to maximize the impact of programs on HIV incidence and deaths by correcting any mismatch between the epidemic and the response, identifying how to go to the required scale and maintain it, cutting unnecessary costs and diversions of capacity while generating efficiencies, and ensuring the sustainability of program funding. Here we highlight the application of the HIV investment case approach across five different countries.

1. Tanzania

HIV background

Over 1.7 million people live with HIV/AIDS in Tanzania. Tanzania has achieved great progress towards epidemic control over the past two decades. From 2009 to 2017, ART coverage among people living with HIV (PLHIV) nearly tripled from 22% to 57%. Annual new infections also declined from 120,000 in 2000 to 65,000 in 2017. These improvements were largely facilitated by ART scale-up, voluntary medical male circumcision (VMMC), and prevention of mother-to-child transmission.

Looking forward, Tanzania has committed to achieving the 2030 Fast Track targets. However, while 94% of PLHIV who are aware of their status are on ART and 87% are virally suppressed, only 61% of all PLHIV are aware of their status, illustrating a steep shortfall on the first target. Among all PLHIV, only 57% are on ART and 50% are virally suppressed. To achieve the first target, testing coverage must be improved.

This challenge is compounded by the fact that external funding is expected to decline when Tanzania currently depends heavily on them. 93% of Tanzania's HIV funding came from external sources in 2018. However, the principal sources of funding, PEPFAR and the Global Fund, have been leveling off and may even decline rapidly even while the proportion of domestic contributions has remained relatively stagnant over the past several years.

Besides financing, efficiency in Tanzania's HIV programs can also be improved. Areas including HIV testing, AIDS treatment, and allocative efficiency towards priority prevention activities and high burden geographic regions have all been reported to be lacking.

Key objectives

In order to address these challenges and guide stakeholders in making decisions that will maximize impact with limited resources, Tanzania updated its HIV Investment Case in 2019. The first investment case framework (Investment Case 1.0 or IC 1.0) in Tanzania was adopted in 2015 and informed the country's national strategic plans. The second framework (Investment Case 2.0 or IC 2.0) was developed in 2019 to build upon IC 1.0 by taking account realized efforts towards allocative efficiency in the previous few years and the most recent epidemiological, programmatic, and financing information.

The objective of IC 2.0 was to establish a framework for Tanzania's HIV response that focused particularly on financial sustainability in the face of funding uncertainty and implementation efficiency. IC 2.0 did this by capturing five future possibilities for the national program based on different potential programmatic and funding scenarios and evaluating each of their impacts on the HIV epidemic.

The development of IC 2.0, like the first version, was a country-led process. The IC 2.0 Steering Committee was chaired by the Tanzania Commission for AIDS (TACAIDS) and National AIDS Control Program (NACP). Development was divided into three phases: the Project Kick-Off phase, Modeling phase, and Finalization phase. During the first phase, all stakeholders were consulted to identify key questions to be addressed, ideate different programmatic and financing scenarios, and collect more recent data on policy and program changes and epidemiological and financial parameters. In the modeling phase, the scenarios were further designed and workshopped with stakeholders and the Goals model used to analyze each of their epidemiological and financing implications. Lastly, the finalization phase consisted of drafting of a final written brief and presentation of the IC.

Methodology

IC 2.0 used well-known software developed by Avenir Health to model and analyze five defined scenarios, each of which compared a different future for Tanzania's HIV response. The

software included the Spectrum epidemiological estimates and projections, Goals and AIM, as well as new Goals updates related to HIV testing and services for adolescent girls and young women (AGYW). The investment case compared and evaluated the costs and impact of the following five scenarios. Two of the scenarios are coverage-driven, meaning the foremost priority is to reach certain coverage targets and the costs of doing so are calculated, and three are funding-driven, meaning the model must work within a fixed resource envelope and the health outcomes are calculated.

Target-driven scenarios:

- **Constant Coverage (CC):** A status quo scenario where ART coverage is maintained at current levels. This is a pessimistic scenario that shows the consequences of failing to take the national response to a higher level.
- **National Strategy (NS):** A scenario that uses the ambitious targets of the Tanzania's National Multisectoral Strategic Framework IV and Health Sector HIV Strategic Plan IV and assumed no reallocation across services or other efficiency gains. This scenario measures the impact of this approach and the associated large funding gap due to its very high price tag.

Resource-constrained scenarios:

- **Optimization with Constant Coverage Funding (O-CCF):** A best-case scenario assuming external and domestic funding are maintained at levels required to keep constant ART coverage for 2019-2030.
- **Optimization with Declining Donor Funds (O-DDF):** A worst-case scenario with declining donor funds and no increase in government funding, leading to the largest funding gap.
- **Optimization with Domestic Resource Mobilization (O-DRM):** A hybrid scenario with government funds offsetting declining donor funds partially.

Table 7: Description of the five financing scenarios investigated in Tanzania's investment case

Scenario	Abbreviation	Driving question of scenario	Scenario constraint			Optimization		Increasing domestic resource mobilization
			Coverage or funding constraint driven?	Coverage constraint	Funding constraint	Prioritization	Technical efficiencies	
Constant coverage	CC	What impact will be achieved if current program coverage levels remain static?	Coverage	2018 coverage levels	--			
National strategy	NS	What will it cost to achieve the national strategy?	Coverage	National strategic targets	--			
Optimization-Constant coverage funding	O-CCF	If technical efficiencies and prioritization of funds are pursued to optimize Constant Coverage resources, how far can base funding be maximized?	Funding constraint	--	Resource envelope of Constant Coverage scenario (USD 6.0 B)	✓	✓	
Optimization-Declining Donor Funding	O-DDF	If donor funding declines dramatically, what is the maximum impact that can be achieved even when considering Prioritization + Innovations?	Funding constraint	--	Declining donor resources, constant government resources (USD 4.6 B)	✓	✓	
Optimization -- Domestic Resource Mobilization	O-DRM	If donor funding declines but the government increases its contributions, what impact would be possible after considering prioritization and innovations?	Funding constraint	--	Declining donor resources, increasing government resources (USD 5.3)	✓	✓	✓

The Goals-Spectrum modeling software was already well-known in Tanzania and used in the modeling exercises for IC 1.0. It was used again for IC 2.0 to estimate the future costs of achieving specified levels of coverage in each scenario from 2019-2030. Two additional models were used for sub-analyses on AGYW and testing.

In determining allocative efficiency strategies, especially in prioritization of prevention and treatment interventions, cost-effectiveness ratios in the form of cost per infection averted were used to guide decision-making. Geographic prioritization was conducted by disease burden in regions and sub-regions. Technical efficiencies in ART delivery were also investigated to reduce the unit cost of delivering HIV services so that more coverage can be achieved with the same amount of money, or the same coverage with less money.

Key data sources for IC 2.0 include epidemiological and programmatic data from national household surveys, AIDS Indicator Survey 2003/4, HIV/AIDS and Malaria Survey 2007/8 and 2011/12, Demographic and Health Surveys 2010 and 2015/16, Tanzania HIV Impact Survey 2016/17, Tanzania Fourth National Multisectoral Strategic Framework for HIV/AIDS 2018/19-2022/23, and the IC 1.0. Financing data were sourced from the National AIDS spending Assessment, Global Fund Funding Request 2016, Global Fund expenditure data 2011-2016, PEPFAR COPs, a PEPFAR planning letter, and PEPFAR expenditure data 2014-2018.

Results and policy implications

The analysis concluded that optimization through prioritization of funds towards the most cost-effective interventions and the implementation of treatment-related efficiencies could enable Tanzania to come close to the goals of the National HIV Strategy, even with 2018 funding levels. Condoms, VMMC, FSW, MSM, BCC interventions were found to be the most cost-effective prevention interventions, and thus more resources should be shifted towards them. With regards to ART delivery, technical efficiency can be achieved through three policy shifts that would increase cost savings: 1) scaling up dolutegravir-based ARV regimens, 2) full implementation of a simplified lab testing algorithm for stable patients, and 3) introducing community-based support services for ART. If fully adopted, these efficiencies would reduce ART costs 25% and generate as much as USD 50 million in annual savings.

IC 2.0 also determined that it is possible for Tanzania to reach the 90% target for PLHIV who are aware of their status by 2025 while spending even less than today on testing and counselling. This would require scaling up provider-initiated testing and counselling (PITC), voluntary counselling and testing (VCT), and self-testing through 2022, then keeping PITC and self-testing volumes high when VCT scales back in 2022. This would cost less than USD 40 million annually, compared to the USD 50 million spent annually in the current strategy.

Under the CC scenario, IC 2.0 found that Tanzania would see only a 55% reduction in new infections and 53% reduction in AIDS-related deaths from 2010-2030. This is a major shortfall towards the Fast Track target. The NS scenario, on the other hand, would nearly achieve the Fast Track goals with 85% reduction in new infections and 83% reduction in AIDS deaths by 2030. However, the cost would be 40% higher than the cost of CC. The resource needs for NS are thus very high and may not be feasible.

The O-CCF scenario demonstrated that optimizing allocative and technical efficiency approaches while maintaining constant funding would achieve the same impact as the NS scenario, but for USD 2.5 billion less. This demonstrates the tremendous power of optimization at scale in reducing the price tag of important epidemiological impacts.

The pessimistic O-DDF scenario showed that new infections would increase by 7% and AIDS-related deaths by 24% during 2019-2030 if donor funding declined gradually with no additional domestic resource mobilization. However, the O-DRM scenario with would partially offset declining donor funds by an addition USD 10-15 million each year until 2030 would maintain annual HIV funding at close to CC scenario levels. With this funding, this scenario would bring Tanzania close to achieving its 2030 goals even though results would be slightly less than under the O-CCF scenario. Domestic resources would be mobilized from a combination of MOH budget increases, national health insurance resources, and special HIV Fund levies.

Lastly, analysis of prevention interventions for AGYW determined that a comprehensive prevention package for AGYW would cost USD 150 million annually in 2020 and rise to USD 275 million by 2030. As this is more than half of Tanzania's current HIV/AIDS expenditures, it is difficult to imagine where these funds may be sourced from. However, the long-run payoffs from protecting AGYW as well as the many-fold benefits of female empowerment beyond HIV and health (such as in education and livelihoods) may justify such additional investments and the sharing of costs with other sectors and ministries.

Overall, IC 2.0 established a clear policy message that Tanzania must mobilize additional domestic funding in order to continue advancing towards the Fast Track targets for 2030. An average increase of USD 10 to 15 million per year, which appear to be affordable given Tanzania's economic outlook, would greatly improve long-run sustainability and, along with optimization of spending through allocative and technical efficiencies, advance epidemic control.

2. Vietnam

HIV background

At the time of developing the investment case in 2013, Viet Nam's HIV epidemic was concentrated among PWID, MSMs and FSWs with prevalence rates of 10.3%, 3.7% and 2.6%, respectively. The HIV response in Viet Nam was guided by the National Strategy on HIV/AIDS Prevention and Control till 2020 with a vision to 2030, the 2012-2015 National Target Programme on HIV/AIDS Prevention and Control and other comprehensive guidelines. Viet Nam had made significant progress in terms of stabilizing new infections at around 14,000 per year since 2010, with declining prevalence among PWID, FSWs and MSMs through harm reduction strategies, promotion of condom uses and treatment of STIs, and behavioural change communication. There were also significant improvements in PMTCT service coverage and ART coverage, resulting in marked declines in HIV-related morbidity and mortality. However, the country continued to face challenges in tackling HIV which accounted for a large part of the national disease burden and premature deaths. The HIV incidence was also found to be growing and higher in certain urban

areas, cities and the mountainous northern region, and new infections were growing within intimate partner relationships.

While many preventive measures were adopted for key populations, coverage remained inadequate and there was poor targeting of HIV investments, leading to wide variations in geographic and population coverage, and disproportionately lower levels of spending on key populations who accounted for 54% of new infections in 2013. These challenges were further aggravated by stigma and discrimination which posed barriers to uptake of HIV services.

In terms of HIV spending, as much as 75% of Viet Nam's HIV expenditure came from external sources. In 2010, 91% of spending on HIV treatment and 82% of spending on prevention were donor-funded, and, less than 30% of prevention expenditure was spent on key populations. Vietnam was at the cusp of transitioning from receiving concessional development assistance from the World Bank and the UK development agency, DFID. In a bid to ensure smooth transition, the development partners recommended that Viet Nam should refocus the government funding of HIV prevention programs on provinces in the country based on epidemiological impact, infrastructure, and ability of communities to mobilize resources for its HIV programs. This led to a coordinated effort to develop an HIV investment case in Viet Nam which was published in 2014.(176)

Key objectives

The main objective of the Viet Nam HIV investment case was to identify priorities and the most effective approaches to strengthen the national HIV response to "End AIDS by 2030". With upcoming donor transitions, which would lead to declining donor funds, the investment case Viet Nam was developed as a coordinated effort to ensure that the country had sustainable domestic finances for HIV which are used optimally to eliminate HIV AIDS in the next 15 years.

The HIV investment case was led by the Federal Ministry of Health. Several development partners and civil society stakeholders were part of the consultative process for developing the investment case. A technical working group comprising of national and international experts supported the development of the investment case that involved modeling analysis, consultations with civil society, and reporting to and providing recommendations to a steering committee comprising of representatives from the Ministry of Health, the Viet Nam Union of Science and Technology Associations (VUSTA) and international stakeholders.

Methodology

The process to develop the investment case began with a review of both qualitative and quantitative evidence. The investment case used the AIDS Epidemic Model (AEM) which enables policymakers to estimate future impact of proposed policies and estimate costs and coverage levels was used to analyze the impact and cost of the following five investment scenarios during the period 2014-2030:

- Scenario 1: Baseline + adding 80% coverage of immediate treatment (at CD4/1000) for key populations and treatment at CD4<350 for other PLHIV.

- Scenario 2: Halfway to National Targets + 80% coverage of ART (at CD4/1000) for key, and treatment at CD4
- Scenario 3: National Targets + 80% coverage of ART (CD4/1000) for key populations.
- Scenario 4: National Targets + 80% coverage of ART (CD4/1000) for key populations and 80% of ART coverage at CD4/500 for other PLHIV.
- Scenario 5: “Ending AIDS”: “National Targets” + 80% treatment coverage for all at CD4 1000, 65% NSP coverage, 35% MMT coverage, and positive prevention for serodiscordant couples.

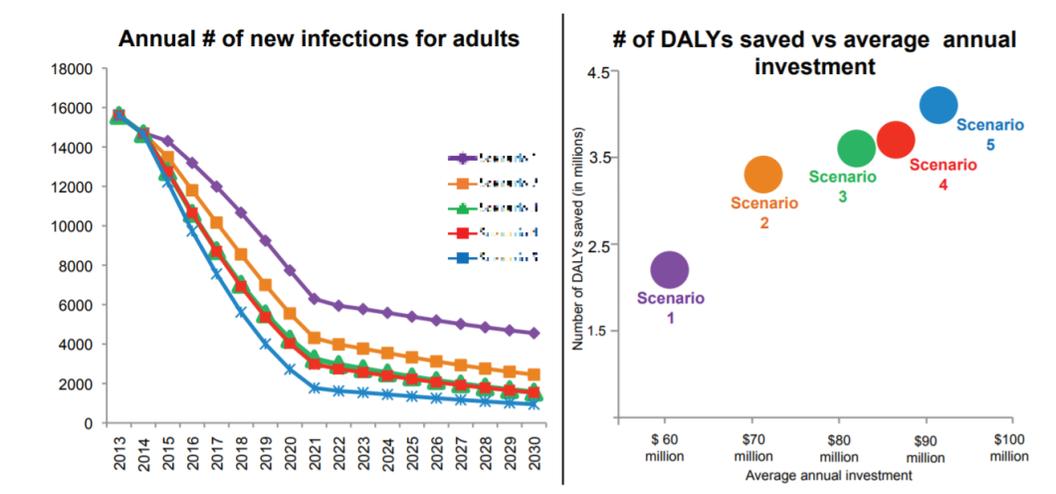
The epidemiological and response data for the analysis came from Viet Nam’s National AIDS Spending Assessments (NASA), integrated biological and behavioural surveys, surveillance data, and national HIV estimations and projections.

Three workshops were held to design, validate and analyze a baseline model and the five scenarios described above. The results of the analysis were shared by the technical group during consultations held with the civil society and the steering committee. Inputs were obtained from PLHIV, PWID, FSW, MSM and community workers to identify priorities and address access issues.

Results and policy implications

Based on the modeling analysis, scenario 5: “Ending AIDS” was identified as the most effective approach, both in terms of saving lives and cost-effectiveness measured by DALYs saved.

Figure 14: Modeling analysis for the Vietnam HIV investment case



Based on this, the following 6 key priorities were identified that would contribute to accelerating progress towards the vision of “Ending AIDS”:

- Scale up evidence-based and comprehensive harm reduction for key populations, including needle and syringe programs, condom programs, and Methadone maintenance therapy.

- ii. Scale up HIV testing and treatment, including immediate treatment for key populations
- iii. Focus on key populations in high-burden areas
- iv. Improved sustainable financing, through increased domestic budget and through more comprehensive coverage of HIV services through national health insurance
- v. Integration and decentralization of HIV service delivery systems, including health systems strengthening, along with greater coordination with TB and MCH programs.
- vi. Sufficient supply of ARV drugs, methadone, reagents and other commodities for the HIV response

The policy implications of the Viet Nam investment case are seen in the adoption of the “Ending AIDS” scenario to develop the country’s national strategic plan, especially for estimation of HIV resource needs and priority setting. As a result, greater emphasis has been put on increasing HIV funding, especially due to impending donor transitions during the period.

3. Namibia

HIV background

The prevalence of HIV in Namibia is approximately 12% among the population aged 15 to 64 years. This corresponds to 201,000 people aged 15 to 64 years living with HIV in Namibia, one of the highest prevalence estimates globally.

However, Namibia has made significant progress towards the 90-90-90 and Fast Track goals over the past decade and is one of the few countries on course to meet them. It is globally recognized for its particularly strong HIV treatment program. As of 2018, 86% of all people living with HIV (PLHIV) aged 15 to 64 years were aware of their status, 96% were on ART, and 91% of those on ART were virally suppressed. In fact, the Namibia Population HIV Impact Assessment even estimated that for females, the 90-90-90 targets have already been met with 90% of all females aged 15 to 64 years aware of their status, 97% of aware females on ART, and 92% of females on ART being virally suppressed. On the other hand, the largest programmatic gap persists in testing, with only 80% of males living with HIV being aware of their status.

Prevention efforts have also led to new HIV infections declining from over 10,000 annually in 2010 to less than 6,000 in 2018. Prevention of mother-to-child transmission is nearly universal with over 95% of pregnant women living with HIV on ART.

Despite these remarkable accomplishments, Namibia faces significant challenges ahead. PEPFAR and the Global Fund, the two primary funders of Namibia’s HIV response that together account for more than 95% of Namibia’s external funding for HIV, have indicated plans to decrease their support in coming years to support other countries. From 2015 to 2018, the Global Fund reduced its funding by almost 50% from USD 72 million to USD 39.4 million. Meanwhile, PEPFAR reduced its investments similarly drastically from USD 98.3 million to USD 45.9 million between 2010 and 2016.

Namibia is facing slow economic growth and severe fiscal constraints that pose challenges in mobilizing additional domestic resources to address the anticipated funding gap. After a period of

exceptional GDP growth between 2010 to 2015, Namibia's economy faced a sharp downturn in 2016 which has continued into 2020. The Namibian government has demonstrated a strong commitment in the past to self-financing its health and HIV programs, with domestic expenditure increasing from 39% to 54% of total HIV expenditure between 2012-2016. However, recent pressures on government revenues have led to successive contractions of the public health budgets and led to no real growth in the health budget from 2017 to 2020.

To continue advancing towards the 95-95-95 targets and achieve sustained epidemic control, Namibia must optimize intervention packages and efficiency gains while strengthening domestic resource mobilization for the Ministry of Health and Social Services (MoHSS).

Key objectives

Because of the large burden HIV continues to place on Namibia and the growing urgency to address declining donor contributions, the sustainability has come to forefront of HIV response planning and discourse. One of the key inputs for a sustainability plan is an update to Namibia's first HIV Investment Case (IC 1.0), which was undertaken in 2015-2016. Recommendations from IC 1.0 included improvements in program efficiency such as strengthening adherence clubs, introducing alternative service delivery models, scaling up community-based services, and reducing drug prices.

The updated Investment Case (IC 2.0) aimed to investigate the required resource levels and funding gaps under different assumptions of program targets, efficiency, and financing situations. In doing so, it built upon IC 1.0 while accounting for new epidemiological information, differentiated models of care, cost information, baseline expenditure, and updated projections for external and domestic financing levels. Its overall objective is to offer the latest recommendations for optimization and increasing efficiencies for Namibia to achieve its HIV/AIDS targets under uncertain and likely declining donor financing, as well as inform the national HIV sustainability plan, next national strategy framework annual budgets, and PEPFAR and Global Fund operational budgets.

Methodology

IC 2.0 used well-known software developed by Avenir Health to model and analyze five defined scenarios, each of which compared a different future for Namibia's HIV response. The software included the Spectrum epidemiological estimates and projections, Goals and AIM, as well as new Goals updates related to HIV testing and services for adolescent girls and young women (AGYW). The investment case compared and evaluated the costs and impact of the following six scenarios. Two of the scenarios are coverage-driven, meaning the foremost priority is to reach certain coverage targets and the costs of doing so are calculated, and four are funding-driven, meaning the model must work within a fixed resource envelope and the health outcomes are calculated.

Target-driven scenarios:

- Constant Coverage (CC): A scenario serving as a baseline reference point and representing the costs of inaction. It is defined by constant coverage of ART and all other primary-prevention interventions with no new efficiencies.
- National Strategic Framework (NSF): A scenario that estimates the cost of achieving the goals of the 2017-2021/22 NSF using the current program design informed by recommendations from IC 1.0. This scenario represents Namibia's current national targets and priorities.

Resource-constrained transition scenarios:

- Transition to Domestic Responsibility with Minimum Response (Transition Minimum): A worst-case scenario that considers the impact that a sharp cut in donor funding would have on the national HIV program, without technical efficiencies or optimization of remaining domestic funding and only a slight mobilization of domestic funds.
- Transition with Technical Efficiencies (Transition + Efficiencies): A scenario that shows how adopting measures to reduce the unit cost of delivery for interventions could free up funding for other interventions. These technical efficiencies can channel savings to other cost-effective services with unmet needs.
- Transition with Optimization (Transition + Optimization): A scenario that shows how optimization of interventions based on cost-effectiveness can also re-align investment priorities. Unlike technical efficiencies, optimization does not free up money but rather re-allocates funds to other services.
- Transition + High Domestic Resource Mobilization (Transition + High DRM): A scenario that illustrates the additional benefits that additional domestic funds can have on keeping Namibia on track to reaching its National Strategy goals and targets.

Table 8: Description of the financing scenarios investigated in Namibia's investment case

Scenario	Description	Technical efficiencies	Optimization	Domestic resource mobilization
Constant coverage (CC)	Coverage levels, service unit costs and program support stay as at 2019	No	No	No
National Strategic Framework (NSF)	Annual program cost rises as a function of progress in reaching NSF coverage targets of 2021/22 and maintaining these thereafter	No	No	No
Transition to Domestic Responsibility with Minimum Response <i>(Transition Minimum)</i>	PEPFAR and Global Fund financing significantly fall over 2025-2030 with minimal counteraction from the government except a small increase in domestic funding. As a result, coverage of all interventions will have to be cut across the board.	No	No	Minimum domestic resource mobilization: 10% increase in public sector funding over the 2023-2025 MTEF
Transition to Domestic Responsibility with Technical Efficiencies <i>(Transition + TE)</i>	Technical efficiencies are explored as an approach to restoring intervention coverage, for ART as a priority. Efficiencies modelled are price reduction for ARVs and condoms (thanks to pooled procurement), and improved VLS thanks to teen adherence support clubs and transition to DTG. Improved VLS in turn will reduce HIV incidence and future ART need.	✓		
Transition to Domestic Responsibility with Technical efficiencies + Optimization <i>(Transition + Optimize)</i>	To further stretch the value of limited funds, this scenario reallocates the available funding, including and savings from TEs, across interventions by order of cost-effectiveness (cost per new infections averted).	✓	✓	
Transition to Domestic Responsibility with Technical Efficiencies + Optimization + High domestic resource mobilization <i>(Transition + High DRM)</i>	This scenario assumes implementation of technical efficiencies and optimization, and adds substantial domestic resource mobilization, to further restore intervention coverages toward NSF targets.	✓	✓	High domestic resource mobilization: Increasing domestic financing for HIV by 26% 2020-2030, reaching USD 129 M in 2030

The Goals model in Spectrum was used to estimate the historic and current epidemic and program status and impact, and the future health impact and cost of alternative program scenarios. The Goals model was calibrated to the latest national estimates for adult incidence, prevalence, and mortality generated using Spectrum AIM in May 2019. Broad consistency was ensured by calibrating the Goals estimates to the same survey and surveillance data as the 2019 AIM estimates. The 2013 Demographic and Health Surveys, 2017 Namibia Population-based HIV Impact Assessment, and the 2013 Integrated Bio-Behavioural Surveys in FSW and MSM were used to calibrate the distribution of the adult population and HIV burden by risk group. Biomedical parameters such as infection stage durations were fitted according to global consensus best estimates. As a result, the calibrated Goals model fit well to Namibia's historical survey and surveillance data. Namibia's HIV baseline care cascade was also estimated using the Goals.

The main sources for unit cost data were the Government of Namibia resource tracking reports for health and HIV 2015/16-2016/17, Namibia national ART costing study 2019, Global Health Costing Consortium Unit Cost Repository, MoHSS internal budgets and expenditure reports, Global Fund budgets, and the South Africa National Strategic Plan 2017-2022.

Lastly, future funding scenarios were calculated in two variants, minimum domestic resource mobilization and high domestic resource mobilization. Under the first, domestic funding for HIV

remains stable from 2020 until 2022, then has a single 7% increase from 2023-2025 before remaining stable until 2030. Under the second, domestic funding is assumed to be tied to nominal GDP. Thus, annual domestic resources increase from USD 96 million in 2020 to USD 129 million in 2030.

Results and policy implications

IC 2.0 determined that under CC scenario, Namibia will not be able to reach its 95-95-95 goals or NSF goals. New infections and mortality would increase slightly. Under the NSF scenario, IC 2.0 determined that Namibia would require additional resources beyond what it is currently spending. Achieving the NSF targets would avert about 25% more new infections than in the CC scenario and reduce AIDS deaths by 4% between 2020-2030 but require funding to rise to USD 183 million. It is unclear whether it is feasible for Namibia to mobilize such resources given its slow overall economic growth.

The worst-case Transition Minimum scenario shows a gradual decline in funding from USD 171 million in 2020 to USD 115 million in 2025 as PEPFAR and Global Fund contributions decline significantly while domestic resources increase only by a modest 7%. Under this scenario, the number of PLHIV on treatment would fall from 192,000 to 115,000, or only about 56% of PLWHIV aged 15 years and above. There would be 15,000 more new infections than in the CC scenario and 20,000 more deaths between 2020-2030.

However, by implementing technical efficiencies through the Transition + TE scenario, Namibia would be able to restore adult ART coverage by 10% as compared to the Transition Minimum scenario. This would avert 33% of the deaths that would occur under the Transition Minimum scenario from 2020-2030.

The Transition + Optimize scenario would allow Namibia to allocate scarce HIV funds to the most cost-effective interventions. Priority interventions identified as extremely cost-effective, or cost-saving, include condom promotion, BCC/IEC for youth delivered through non-school channels, and outreach to FSW. Very cost-effective interventions include youth in-school interventions, VMMC, and adult ART. With this allocative efficiency realized, Namibia could boost ART coverage to 75% and 81% of adult men and women, respectively. This would prevent 12,000 more new infections compared to Transition + TE alone.

Lastly, the Transition + High DRM scenario would still result in a decline in available funding, but this would be less severe than the reduction to USD 115 million as described in the Transition Minimum scenario. While total funding would decline from USD 172 million in 2019 to USD 136 million in 2025 due to a fall in donor contributions, government financing of the HIV response would increase to 89% in 2025 and 93% by 2030, indicating near self-sufficiency by the end of the decade. When used along with technical efficiencies and optimized allocations, these additional domestic funds would allow Namibia to achieve ART coverage of nearly 95% of adult PLHIV by 2030, the same reduction in new infections as in the NSF scenario, and nearly the same reduction in AIDS-related mortality as in the NSF scenario.

IC 2.0 also investigated program coverage for AGYW, which lags behind the country's overall progress towards the 90-90-90 targets. It found that scaling an AGYW package by geographic

targeting would cost USD 198 million per year, well above the estimated available funds. However, cost-sharing with other sectors and ministries due to the multi-sectoral benefits of AGYW interventions may mitigate the direct burden on the HIV budget.

Overall, IC 2.0 suggests that Namibia should pursue a strategy that transitions gradually and efficiently away from donor aid while increasing domestic resources modestly. Specifically, the challenge will be to 1) maximize technical efficiencies, especially in AIDS treatment, 2) optimize the HIV prevention budget, and 3) mobilize an additional USD 120 million over the next 10 years from MoHSS budgets and national health insurance funds. This would help Namibia achieve its HIV/AIDS goals affordably while moving towards self-sufficiency.

4. Ukraine

HIV background

During the 2000s, Ukraine had one of the fastest growing HIV epidemics in the world, with cases being concentrated among the key population. In 2013, there were approximately 237,000 HIV-positive individuals in Ukraine. While the epidemic was concentrated in urban areas and among injecting drug users (IDUs) in the 1990s, the epidemic evolved with cases accelerating in key population groups including female sex workers, most-at-risk adolescents, and men who have sex with men (MSM). It was noted that although there were harm reduction and preventive efforts such as outreach, ART, HIV counseling and testing, needle and syringe exchanges and related counseling, and medication-assisted treatment, these efforts were unevenly distributed. There was more focus on IDUs, uneven geographic distribution of services, and large variations in quality of provision.

In terms of HIV service provision, it was seen that there was stagnation or decline in services for key groups. For example, outreach for HIV prevention among MSMs with regards to HIV testing and condom provision had only slightly improved from 50% in 2007 to 53.1% in 2011. For FSWs, this proportion fell from 69% in 2007 to 61.2%. In 2013, the ART needs of only 40% of the adult population was met (only 11% of adults on ART were IDUs), which created great mortality and morbidity risks for individuals due to the lack of access to life-savings drugs. Moreover, only a third of HIV positive individuals in medication-assisted treatment were receiving ART. These have serious implications on the impact and effectiveness of preventive efforts.

A 2012 assessment of the National AIDS Programme called for more sustainable, efficient and effective HIV response, and urged for more focus on key populations and the youth, and called for adapting the prevention strategy in line with the evolving nature of the epidemic. The inadequate HIV response was further threatened by the potential closeout of Global Fund's grant support to Ukraine in 2016 which would lead to critical service gaps for key populations serviced by Global Fund support.

Key objectives

In order to improve its HIV response, the State Service of Ukraine on HIV/AIDS and Other Socially Dangerous Diseases partnered with the USAID and PEPFAR funded Health Policy

Project to conduct a cost and effectiveness study to inform its National AIDS Programme (NAP) 2014-2018.(177) The draft NAP 2014-18 identified several key coverage targets that included access to prevention programs for all most-at-risk groups, 100% coverage of HIV prevention programs at educational institutions, 100% social, medical and support services for PLHIV, uninterrupted ART for all PLHIV, 50% reduction in mortality among TB/HIV co-infection. The HPP group was tasked with examining the cost components of the NAP and the development of an investment case for the evolving and concentrated HIV epidemic in Ukraine.

Methodology

To undertake the study, a financial analysis of costs of the HIV response for the NAP 2014-18, with a focus on prevention was done, along with mathematical modeling to study the effects of the proposed key interventions. The Goals mathematical model was used to project the effects of scaling up interventions, including treatment, harm reduction and behavioural interventions.

Four alternative scenarios were considered to scale-up key interventions:

1. Baseline scenario with constant 2012 coverage for treatment care and prevention
2. Increased coverage in line with targets proposed in the NAP 2014-18
3. Providing universal access for all prevention interventions under the NAP
4. Assuming Global Fund grants are not renewed, leading to discontinuation of NAP prevention services for key populations that were supported by Global Fund.

For each scenario, the Goals model projected the HIV epidemic and rate of infections in the adult population aged 15-49 years based on frequency of service provision and treatment. For each scenario, the model projected the rate of new HIV infections among adults between the ages of 15 and 49. The coverage for the select HIV interventions under the 4 scenarios is shown below:

Table 9: Coverage of selected HIV interventions in 2014 and 2018 under four scenarios

Intervention	Coverage in year 2014				Coverage in year 2018			
	1.Constant	2. NAP	3. NAP with UA	4. GF Risk	1.Constant	2. NAP	3. NAP with UA	4. GF Risk
HCT*	12%	7.5%	7.5%	7.5%	12.6%	7.9%	7.9%	7.9%
ART	39%	56%	56%	56%	32%	83%	83%	83%
Youth at risk	23%	34%	34%	34%	25%	42%	80%	5%
School-based	0%	100%	0%	100%	0%	100%	100%	100%
FSW package	36%	39%	40%	39%	38%	47%	60%	0%
MSM package	11%	14%	20%	14%	12%	28%	60%	0%
IDU MAT	3%	5%	14%	5%	3%	9%	60%	5%
IDU package	57%	58%	57%	58%	60%	53%	60%	0%

* Coverage for the general population only. Due to specific assumptions, coverage for HCT is higher in scenario 1's "constant" than other scenarios, which have higher coverage for other interventions.

Results and policy implications

The model analysis found significant results based on the assumptions for the four scenarios. It was found that the worst-case baseline scenario of constant 2012 coverage would

lead to a decline in ART coverage and significant increases in HIV incidence by 2018. Similarly, the scenario of non-renewal of the Global Fund grant would lead to sharp increase in infections between 2016-2018 with termination of services for key population groups. While both these scenarios showed increased HIV incidence in 2018 compared to 2013, the most ambitious scenario 3: Providing universal access was found to be most effective and efficient in averting new infections. The cost-effectiveness analysis comparing incremental costs and HIV infections averted showed increasing effectiveness and allocative efficiency moving from the Global Fund risk scenario to the NAP with universal access scenario. It was estimated that providing universal access to preventive services for key population groups with an incremental cost of UAH 101,252 (US\$12,318) per HIV infection averted would lead to the lowest number of new infections by 2018. Thus, it was recommended to adopt this ambitious scale-up plan if resources were available.

Figure 15: New HIV infections among adults 15–49 years, 2014–2018, by scenario

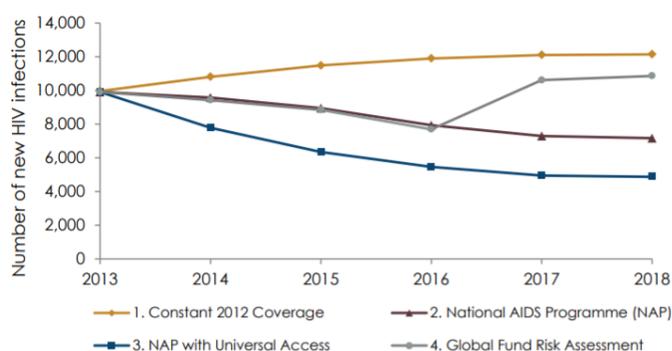
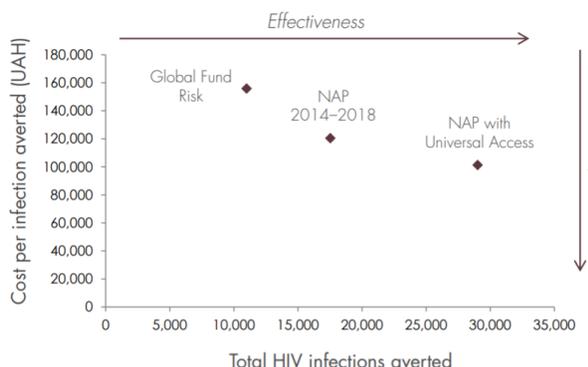


Table 10: Incremental cost-effectiveness ratios (ICER) UAH/US\$ adult HIV infection averted, all scenarios compared to the Constant 2012 Coverage scenario

Scenario	2014–2018		
	Total HIV infections averted	ICER, UAH per HIV infection averted	ICER, US\$ per HIV infection averted
1. Constant 2012 Coverage	N/A	N/A	N/A
2. NAP 2014–2018	17,541	120,475	\$14,656
3. NAP with UA	29,032	101,252	\$12,318
4. GF Risk	10,999	155,843	\$18,959

Figure 16: Comparison of cost-effectiveness and impact for the scenarios



While implementing the NAP 2014-18 would cost UAH 6,380 million (US\$ 776 million), the NAP with universal access scenario would cost an additional UAH 928 million (US\$ 113 million) over the period 2013-18. The financial analysis showed that greater investments in HIV prevention was affordable, and more investments in preventive services, treatment, care and support was possible.

This investment case helped Ukraine to identify key interventions, especially the need to secure funding for prevention services that would be impacted by the loss of global Fund support for key population groups. This investment case helped the State Service to advocate government stakeholders to improve HIV investments.

5. South Africa

HIV background

At the time of developing the South Africa investment case, HIV and TB posed a great threat to the health of South Africans, with HIV accounting for 18% of the global burden of PLHIV in 2013. PLHIV comprised more than 12% of the population of South Africa, and 31% deaths in South Africa in 2014 were HIV/AIDS related. Women in South Africa were found to be twice as likely to be infected by HIV than men, with women in the 15-24-year-old age group being four times more likely to be infected than young men. While new HIV infections among children below 15 years age was declining due to rapid expansion of PMTCT services, incidence among pregnant women had remained stable. The most significant prevalence of HIV was found among key populations – the 2012 national survey found that Black African women in age groups 20-34 years and men aged 25-49 years had HIV incidence of 31.6% and 25.7% respectively. Other groups included disabled persons, high-risk drinkers and unmarried people living together. National data on other key population groups like PWID, FSWs and MSMs was lacking in South Africa. Moreover, the epidemic more concentrated in some provinces like KwaZulu-Natal and Mpumalanga. A host of behavioural and biological factors, including decrease in reported condom use, multiple sex partners were found to be the key factors fueling the HIV epidemic.

While South Africa did not have a TB-prevalence survey, it was a leading cause of deaths in years 2011-2013. South Africa had estimated 340,000 new HIV cases and 450,000 new TB cases in 2013. It was noted that country's TB epidemic was compounded by the HIV epidemic causing increased vulnerability and TB case load. The National Strategic Plan which guides the country's HIV and TB response. HIV and TB treatment accounted for 39% of all HIV and TB spending in 2011-13, and emphasized scale-up HIV treatment, including HIV counseling and testing, scale-up of ART, condom distribution, voluntary medical male circumcision, management of STIs and TB. South Africa had the largest ART program in the world which was mostly funded domestically. Under the South African National TB program 1997-2013, several achievements were made, including ART for all HIV-infected TB persons, management of MDR TB. It was noted that integration of HIV and TB services could help the country to accelerate progress towards reaching the 90-90-90 targets by 2020.

Key objectives

In order to streamline HIV and TB spending, it was proposed to develop the South Africa HIV and TB investment case that would inform the development of a National Strategic Plan for HIV, TB and STIs (NSP) by quantifying the returns on health investment.(178) To lead this effort, the South African National AIDS Council (SANAC) brought together key stakeholders from different sectors, including government representatives, development partners and civil society. An investment case Steering Committee including members from SANAC, Treasury, UNAIDS, World Bank, Gates Foundation, and civil society was set up to coordinate and align efforts across the HIV Think Tank, TB Think Tank, and the TB Targets project of the TB Modelling and Analysis Consortium who were involved in the development of the investment case. A national dialogue on investment choices and priority setting was also undertaken.

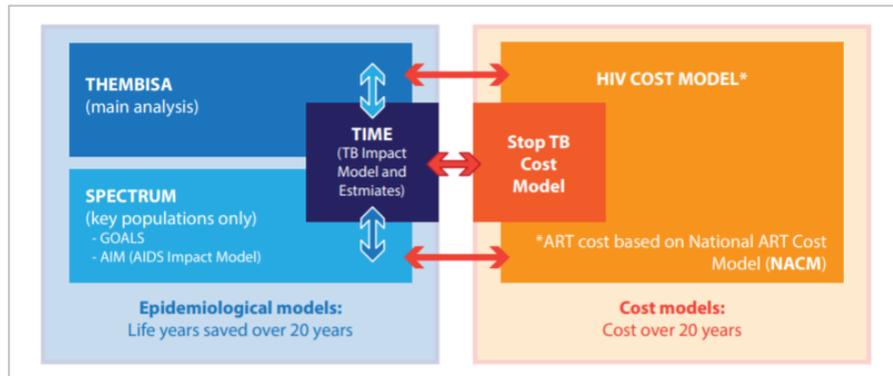
The goal of the investment case was to inform long-term planning to end the HIV and TB epidemics through identification of the most cost-effective mix of interventions to address HIV and TB over the next 20 years. The investment case focused on optimizing allocative efficiency, by correcting mismatches between the epidemic and the response, optimizing returns on investment. It also aimed to identify biomedical and behavioural interventions, technical efficiency factors and strategic enablers that can combat the twin epidemics of HIV and TB. The investment case was used to inform the domestic budgets for HIV and TB, develop the concept note for a Global Fund proposal, as well as develop donor budgets, including the PEPFAR budget for South Africa, and support the implementation of the 90-90-90 strategy.

Methodology

The South Africa investment case was developed in 3 phases:

1. Phase 1 focused on national level results, including evidence review, analysis and review of results by stakeholders. This involved stakeholder consultations, grading of evidence by consultants and modelers, cost and cost-effectiveness analysis and expenditure analysis.
2. Phase 2 focused on provincial level results, including development of provincial HIV business plans incorporating a full TB cost model and TB efficiency factors
3. Phase 3 focused on sub-provincial level results, including geospatial modeling and development of district level HIV-TB implementation plans.

An integrated demographic and epidemiological model called Thembisa was the primary model used for the analysis. Along with this, secondary analysis for key populations was done using the Spectrum AIM and Goals modules, and the TIME model was used for the TB investment case. Cost effectiveness was measured as cost per HIV or TB infection averted, as well as number of life years saved, by the entire program of interventions. Results informed national HIV and TB policy as well as domestic government budgets and funding proposals to international donors.

Figure 17: Models used in the South Africa HIV-TB investment case

The South Africa HIV-TB investment case different from the original framework in terms of its focus on both HIV and TB epidemics, inclusion of several programmes beyond those suggested in the original framework, including biomedical prevention. It also focused on quality of evidence and technical efficiency, while aiming to maximize allocative efficiency across interventions.

Six scenarios were considered for the investment case:

1. Baseline scenario maintaining coverage and technical efficiency at 2014 levels.
2. Achievement of government targets for current mix of HIV and TB interventions;
3. Unconstrained optimization of the most efficient mix of interventions against HIV and TB, with efficiency measured in cost per live year saved, over the next 20 years;
4. Constrained optimization of scenario 3 using budget constraints of national and external resources
5. “90-90-90” optimization scenario; and
6. Budget scenario to inform relevant domestic and donor budgets in line with the 90-90-90 targets.

Results and policy implications

Based on the investment case, the following interventions and coverage levels were identified that would optimize the HIV response in South Africa:

Condom availability (90%)	MMC (90%)	SBCC campaign 1 (90%)	MMC age group targeting
Testing at 6 weeks (90%)	ART at current guidelines (90%)	PMTCT B+ (60%)	HCT (90%)
SBCC campaign 3 (90%)	Universal test and treat (90%)	Testing of adolescents (90%)	Birth testing (90%)
PrEP for sex workers (90%)	Microbicides (90%)	PrEP for adolescents (90%)	PrEP for discordant couples (90%)

In general, it was found that South Africa’s response to HIV is relatively efficient from an allocative perspective, and the investment case was not found to have significant impact on HIV incidence and deaths as the HIV mortality and incidence curves have already been bent. Introduction of

ART had significantly helped to reduce incidence, and potential gains from changing the relative prioritization of interventions in South Africa's response are limited.

The investment case determined that the government's already relatively efficient policies. The analysis showed that the government target scenario was affordable under the current budget and the response can be maximized by increasing condom availability, increasing access to male medical circumcision, implementing social and behavioural change communication programs focused on increasing HIV testing uptake in adolescents and discouraging multiple sexual partners, and maximum scale up of ART. However, regardless of the estimated spending, HIV would not be eliminated by 2030. It was recommended to focus on improving efficiency of services before expanding eligibility and coverage to be cost-effective.

The results if the investment case were useful in developing the 90/90/90 HIV and TB district-level implementation and business plans. It also helped to inform the Global Fund proposal by highlighting key population service and funding gaps.

Takeaways from select HIV investment cases

The summaries of select national HIV investment cases in this section provide an overview of how the investment case framework has been applied in different countries to inform key investment decision making and priority setting to improve national responses. The investment case has also become a key aspect of Global Fund applications where evidence to support funding request for the national strategic plans are weak.(179) The investment case approaches can vary from using a geographic approach to focus resources and services in to areas of greatest need, or improving allocations for populations with the greatest need, identifying cost reduction strategies, identifying alternate service delivery models, or optimizing investments by eliminating duplication and wastage. As such, the investment case framework can be used to answer all the key questions outlined in Table 1.

While there are differences in country context and broader planning and health sector issues, in most cases, the approach was used to make a case for increased domestic HIV investments and greater efficiency in the use of existing resources, particularly allocative efficiency. To link the investments with impact, the investment case approach uses modeling to project short and long-term impacts on health and resource needs. While the models used can vary depending on key features and needs, all investment cases follow a similar process of analyzing epidemiological data, efficacy and cost-effectiveness of programs, critical enablers, and fiscal analysis. Cost-effectiveness in terms of impact is usually measured in terms of deaths averted or DALYs saved, while providing a resource needs estimate.

Key national stakeholders have been central in leading the coordination and process for development of the investment cases, through a national dialogue and consultations with external stakeholders and civil society. The uptake and policy implementation of the investment cases is strengthened by the endorsement of ministry officials who can advocate for greater budget allocation and policy changes based on the findings of the investment cases to accelerate progress and close resource gaps.(173,178)

VI. Recommendations to Improve Efficiency

Use of incentives

Incentives can be useful for both demand creation as well as behavioural change. These include interventions that reduce time and transport costs for care seeking such as community-based ART delivery and income transfers.

The least-costly cost-effective interventions that can be prioritized include voluntary medical male circumcision and behavior change communication for the high-risk groups, and early ART for the general population.

Optimizing service delivery

Low-cost community-based service delivery has been found to be effective for HIV services like ART. Exploring longer intervals of check-in, remote monitoring and delivery of drugs, and use of mobile health clinics can reduce cost of care at point of delivery. Task-shifting models using low cost health workers, lay providers and stable patients can also be effective mechanisms to reduce costs while delivery effective care—for example, the WHO recommends the use of trained lay providers for HIV-testing.(185) Differentiated service delivery models are a novel approach that can be explored for cost-saving and cost-effective approaches to delivery care.(99,186)

Table 11: WHO recommendations on ART service delivery

Recommendations for decentralizing ART initiation and maintenance:

- initiating ART in hospitals and maintaining ART in peripheral health facilities;
- initiating ART and maintaining ART in peripheral health facilities; and
- initiating ART at peripheral health facilities, with maintenance at the community level between regular clinic visits in settings such as outreach sites, health posts, home-based services or community-based organizations.

Recommendations on use of lay providers for ART distribution:

- Trained non-physician clinicians, midwives and nurses can initiate first-line ART.
- Trained non-physician clinicians, midwives and nurses can maintain ART.
- Trained and supervised community health workers can distribute ART between regular clinic visits.

Differentiated ART delivery (DART) can be considered for the following clinically stable clients:

- received ART for at least one year;
- no adverse drug reactions that require regular monitoring;
- no current illnesses, including such conditions as malnutrition in children, mental health conditions or postpartum depression;
- a good understanding of lifelong adherence; and
- evidence of treatment success: two consecutive viral load measurements of 200 cells/mm³

Optimizing PrEP

When resources are very limited, other interventions are more cost-effective than PrEP. However, PrEP has an important role to play in the optimal allocation of resources when budgets expand. Based on their modeling analysis, McGillen et al conclude that: “As a function of expenditure, the interventions prioritized earliest are voluntary medical male circumcision and behaviour change communication for the high-risk groups, and early ART for the general population. These are followed at higher expenditures by early ART for the high-risk groups, PrEP for the high-risk groups, PrEP for the general population, and finally behaviour change communication for the general population.” PrEP among female sex workers will be cost-effective to limit onward transmission. Integration of PrEP in to existing services, demand generation, and use among high risk groups are important factors that determine cost-effectiveness of PrEP. It should be noted that ART alone will not reduce the over HIV burden. In limited resource settings, other interventions should be evaluated to check if they are more cost-effective than PrEP.(188)

Improving allocative efficiency

To inform allocative efficiency decisions, countries can choose from a range of allocative efficiency tools. Allocative efficiency tools are useful to inform HIV program planning and developing national strategic plans; develop investment cases to close funding gaps and inform resource mobilization and allocation to scale up effective interventions; and improve program implementation design and operationalize national strategic plans. Allocative efficiency studies are most useful when conducted prior to the budget- or target-setting process, so that they can help inform health-related targets and determine the funding envelopes and allocations commensurate with these targets. To make the analysis most useful, policy recommendations should be accompanied by an operational plan and supplemented with technical support to ensure effective implementation. The three main allocative efficiency models that can be used for conducting analyses are described in the table below.

Table 12: Summary of allocative efficiency models

Tool	Purpose	Use
Spectrum Goals model	<ul style="list-style-type: none"> Estimate the impact of available funding on HIV prevalence Helps to determine (i) funding requirement to achieve strategic plan goals (ii) what goals that can be achieved with available resources (iii) assess impacts of alternate allocation patterns on program goals 	<ul style="list-style-type: none"> Used by UN agencies and country stakeholders for national strategic planning Can be linked to One Health Tool for sectoral planning Allows automatic optimization of resources across interventions.
Optima	<ul style="list-style-type: none"> Estimate optimal funding needs across different service delivery models Can be used for targeting population groups and geographies 	<ul style="list-style-type: none"> Supported by World Bank and PEPFAR and used in consultation with country stakeholders. Used for operations and technical support to governments Allows optimization of resources across interventions and geography toward achieving strategic objective
Asian Epidemic model (AEM)	<ul style="list-style-type: none"> Assess effects of scale-up with varying costs and effectiveness scenarios Assess effect of alternate allocation patterns 	<ul style="list-style-type: none"> More popular in Asia and used in the case of concentrated epidemics. Policy and planning tool

Cascade cost analysis

Countries should consider undertaking cascade cost analysis to determine how effective an intervention is at identifying new PLHIV, linking them to care, and retaining them in care and how scaling these interventions will result in downstream effects in the cascade. Such analyses are useful to prioritize interventions that address the key underlying issues that hampers achievement of HIV targets through a combination of cost and impact modeling evidence and stakeholder engagement.

Integration of HIV and NCD services

For integration of HIV and NCD services, it is important for assessments of optimal services and policy packages should incorporate the most cost-effective interventions while taking into consideration the population needs, projected resources available, and regions. For countries

aiming to evaluate HIV-NCD integration, the following minimum economic dataset can be used to guide investment decisions.

Table 13: Integration of HIV and NCD services

Major components	Economies of scale	Economies of scope	Efficiency
Personnel	Size of program (clients)	Total cost of HIV care alone	Number of cases screened/yr
Equipment	Number of staff	Total cost of NCD care alone	Proportion aware of NCDs
Drugs and other consumables	Quantities of resources	Total cost of HIV + NCD care	Proportion on NCD treatment
Indirect (overhead) costs		Breakdown fixed/variable costs	Proportion with controlled NCD
Patient out-of-pocket costs		Size of HIV program (clients)	Comparison of NCD and HIV outcomes
Payer information		Size of HIV + NCD program (clients)	

Research has found the following five key areas to be important to facilitate integration of HIV and NCD services(189):

1. *Communication, relationships and collaboration*: This involves creating formal and informal linkages both vertical and horizontal across different departments and teams to ensure coordination and clear referrals;
2. *Trained and incentivized health workers, with role clarity*: Adequate and well-trained staff facilitates integration. Training staff on the integrated model and task shifting have been found to be effective for integration.
3. *Institutional structures and resources*: Physical access to facilities offering integrated care, while reducing patient travel time are important considerations for integration.
4. *Leadership and management*: Leadership and organizational structure influence other facilitators. Creating consistent guidelines, referral systems, checklists and modes for communication exchange and lessons learnt facilitate smooth and effective implementation.
5. *A patient-centred health system*: Finally, patient preferences, family support, social norms and culture are also important for integration of services. Creating a patient centred health system includes improved communication, services adapted to patients, addressing stigma, improving dignity of care and equity.

Best practices and key interventions to improve efficiency through the investment case approach

The investment case approach has demonstrated in many countries how to optimally allocate resources, while maximizing the gains in terms of lives saved and deaths and infections averted. While every country has unique needs and requires tailored set of interventions based

on the country's socio-economic, demographic and epidemiological context, UNAIDS has identified six high priority activities that drive an effective national HIV response.

1. Focus outreach on people at higher risk through targeting
2. Provide ART for PLHIV to close the treatment gap, while improving access and continuity of care
3. Treatment for prevention
4. Provision of HIV preventive services for women and girls who are pregnant to tackle intimate partner transmission and vertical transmission from mother to child.
5. Behavior change including condom promotion
6. Male circumcision in countries with high HIV prevalence and low rates of circumcision.(180)

Based on the different national investment cases, the following best practices have been identified in the literature:

- For improved HIV response based on the investment case analysis, identification of potential sources of sustainable financing is useful.
- Inclusion of an advocacy plan in the investment case can be a useful resource to guide investment advocacy
- Highlight the need to avoid wasteful investments, and focus resources in priorities that have the greatest needs.
- Provide clarity regarding the audience at which the report is targeted.
- Emphasize the human and financial costs of inaction.
- Strengthen links to or alignment with broader national development plans or goals.
- Articulate economic benefits alongside human rights perspectives to improve service provision to key population groups for which there may be resistance.
- Use the investment case to develop a transition plan from external donor financing to domestic resources.
- Update investment cases periodically to reflect the changes in funding, epidemiological and demographic patterns.(175,180)

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