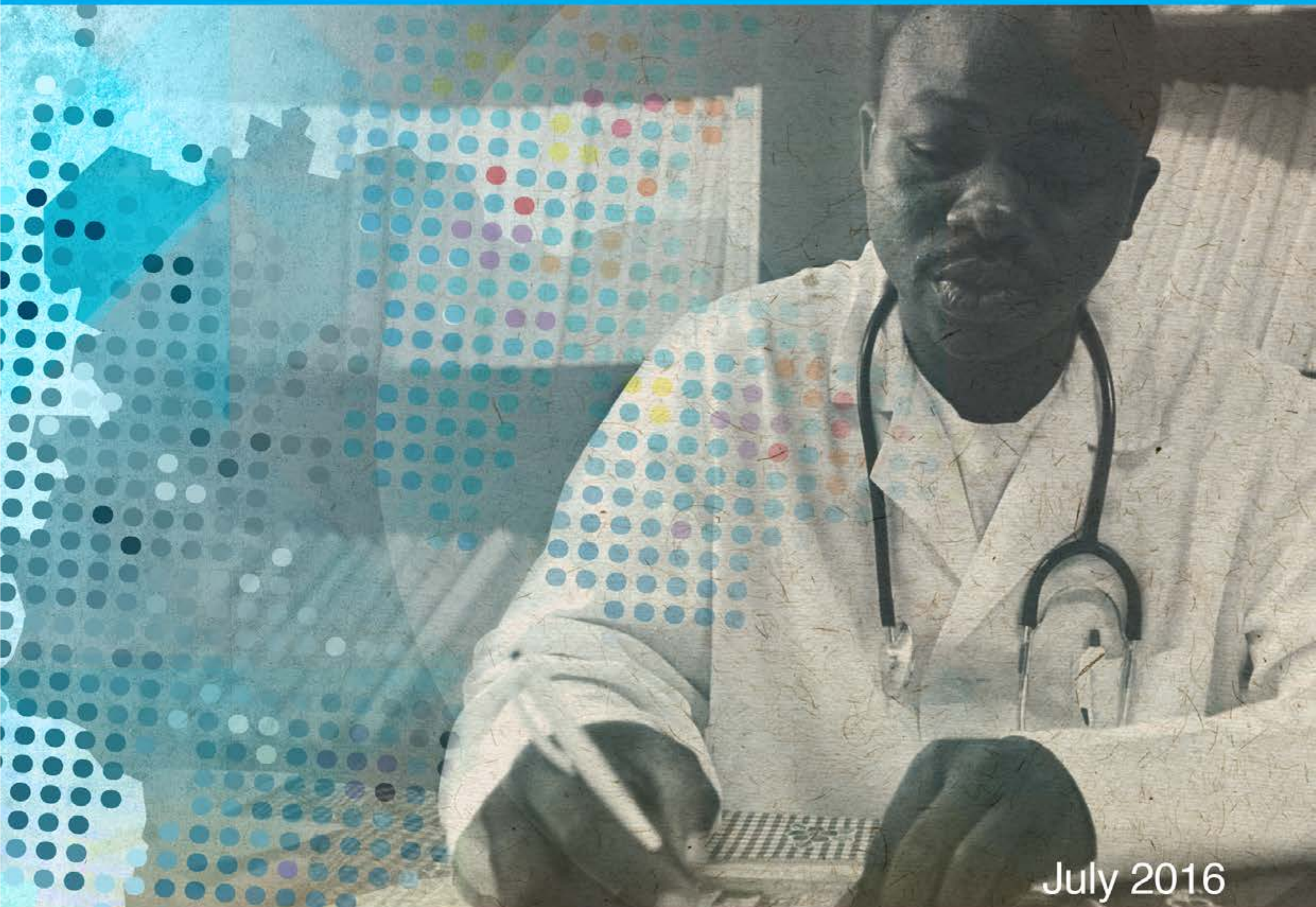
HIV Investment in Côte d'Ivoire

# Optimized Allocation of HIV Resources for a Sustainable and Efficient HIV Response



July 2016

## Findings from an HIV Allocative Efficiency Study

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# HIV investment in Côte d'Ivoire. Optimized allocation of HIV resources for a sustainable and efficient HIV response.

Findings from an HIV Allocative Efficiency Study

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# Contents

# Abbreviations

| | |
|---|---|
| AIDS | Acquired immunodeficiency syndrome |
| ART | Antiretroviral therapy |
| DALY | Disability-adjusted life year |
| DSA | Disease specific accounts |
| DU | Drug user |
| FSW | Female sex worker |
| GARPR | Global AIDS Response Progress Report |
| GDP | Gross domestic product |
| GNI | Gross national income |
| HDI | Human development index |
| HIV | Human immunodeficiency virus |
| HTC | HIV testing and counseling |
| IBBS | Integrated Bio-Behavioral Survey |
| KP | Key population |
| MSM | Men having sex with men |
| NASA | National AIDS Spending Assessment |
| NGO | Non-governmental organization |
| NHA | National health accounts |
| NSP | National strategic plan |
| PLHIV | People living with HIV |
| PMTCT | Prevention of mother-to-child transmission |
| PPP | Purchasing Power Parity |
| SBCC | Social and Behavior Change Communication |
| SRH | Sexual and Reproductive Health |
| STI | Sexually Transmitted Infection |
| UNAIDS | Joint United Nations Program on HIV/AIDS |
| UNGASS | United Nations General Assembly Special Session |
| UNICEF | United Nations Children's Emergency Fund |
| UNSW | University of New South Wales |
| WHO | World Health Organization |
| YLL | Years of life lost |

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# Executive summary

**BACKGROUND**

This report summarizes the findings of an allocative efficiency analysis of Côte d'Ivoire's national HIV epidemic and response, conducted in 2015-2016. This study was conducted during the development of Côte d'Ivoire's new National HIV Strategic Plan (2016-2020), and was intended to contribute to the national strategic planning process, and more broadly to the implementation of the national HIV response. Currently, around 86% of the HIV funding comes from international sources (mainly from the US Government), and the Government of Côte d'Ivoire would like to mobilize additional domestic and private resources for the national HIV response. To assure that the resources that are being or will be mobilized are used in the most efficient way, and to determine the allocation of resources that brings the greatest health benefit, the Government requested the World Bank to conduct this allocative efficiency analysis (Chapter 1), using the Optima HIV mathematical model (Chapter 4 and Appendix).

Côte d'Ivoire is a lower-middle income country, located in West Africa (Chapter 2). The country has faced some political instability during the past decades, including two civil wars (2002-2007 and 2010-2011). Nevertheless, the country now has a stable and growing economy and a relatively developed infrastructure. The human development index (HDI) of Côte d'Ivoire ranks the country 172nd out of 188 countries in the world. Côte d'Ivoire's HDI has increased by only 19% since 1990.

Both infectious and non-communicable diseases contribute substantially to Côte d'Ivoire's burden of disease (Chapter 2). About one-third of disability-adjusted life years were caused by infectious and parasitic diseases. Among infectious diseases, HIV was the most common cause, followed by malaria and diarrheal diseases. HIV represents more than 10% of all DALYs, and the number of DALYs caused by HIV has increased by more than 200% since 1990.

Côte d'Ivoire's health system suffered greatly as a result of political and social crises between 2002 and 2010 (Chapter 2). An electoral crisis soon followed in 2011-2012 resulting in the closure of all health centers in the western part of the country as well as some communes in Abidjan. In 2013, only 3-4% of the population had health insurance. In March 2014, the country adopted the Universal Health Care Law, which they plan to progressively implement between 2015 and 2019. It is expected that 40% of the population will be covered by the scheme by 2020. The Government will also partially subsidize the poorest households.

The HIV epidemic in Côte d'Ivoire is mixed and mainly driven by sex-work related HIV transmission and multiple partnerships (Chapter 3). In 2014, an estimated 460,000 people were living with HIV in Côte d'Ivoire. The adult prevalence in 2015 was 3.2% (UNAIDS 2015 estimates[1]), the highest in West Africa. Among certain high-risk populations, the prevalence is very high: female sex workers (FSW, 11.7%-28.7%); men who have sex with men (MSM, 18%); and drug users (DU, 9%).

After the first case of AIDS was reported in 1987, the government established a National Committee for the Fight against AIDS presided by the head of state (Chapter 3). Successive five-year plans were developed and implemented to guide the national response to HIV/AIDS. In 2001, the Ministry of HIV/AIDS was created for multisectoral coordination of HIV/AIDS activities, supported by the HIV Care and Treatment Unit in the Ministry of Health. Application of the World Health Organization's

[1] http://www.unaids.org/en/regionscountries/countries/ctedivoire

(WHO) 2010 guidelines to initiate patients onto ART at a CD4 count below 350 began in January 2013 and has increased the number of ART clients. The national HIV response remains precariously layered across a weak public health system that is under-resourced.

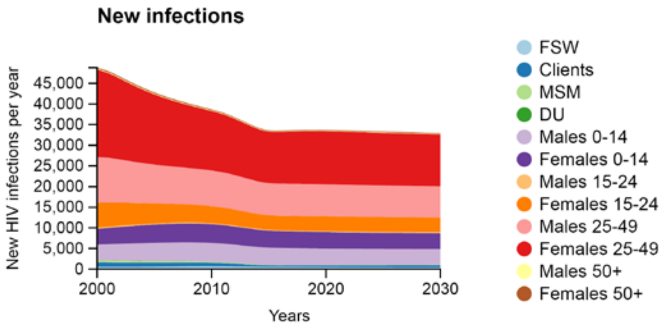
**METHODS**

The analysis was conducted using the Optima HIV model, which is a mathematical model of HIV transmission and disease progression (Chapter 4 and Appendix; also see www.optimamodel.com and Kerr et al, 2015[2]). The model is population-based and flexible in structure and fitting for specific country contexts; here, it was applied to represent the demographic and risk profiles in Cote d'Ivoire and reflect its HIV epidemic. The Optima HIV model also includes intervention cost functions and a formal method of optimization to quantitatively and objectively determine optimal allocations of HIV resources across the set of comprehensive HIV programs. For the analysis, the inputs into the Optima HIV model were gathered through a comprehensive literature review, and key parameters were defined using a participatory consultation of key stakeholders with knowledge of the HIV epidemic and response in Cote d'Ivoire. Local demographic, epidemiological and programmatic data were used to populate the model. Cost and expenditure estimates were derived from the NASA.

**KEY FINDINGS**

- **Under current conditions the number of new HIV infections and AIDS deaths is projected to be relatively stable between 2014 and 2030:** The Optima HIV model estimated a total of 33,700 new infections and 25,300 HIV-related deaths occurred in 2014 (Figure 1). Of the new infections, most were estimated to occur among males and females aged between 25 and 49 years with 7,790 (23.1%) and 12,500 (37.1%) infections respectively. It is estimated that 33,000 new infections and 26,300 HIV related deaths will occur in 2030, representing a slight decrease in the number of new infections (2.1% reduction) and an increase in the number of HIV-related deaths (4.0% increase).

FIGURE 1. NEW HIV INFECTIONS ACQUIRED OVER TIME BY POPULATION GROUP

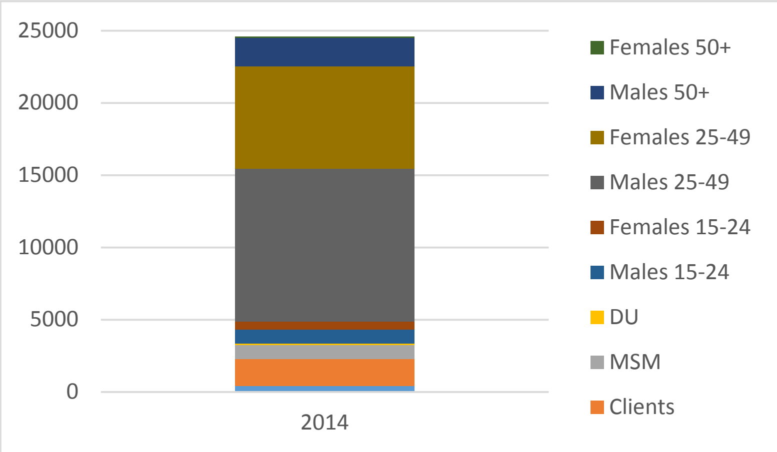



Of the new infections, 1.7% are predicted to have been transmitted by FSW, 7.5% by FSW clients, 4.0% by MSM, 43.1% and 28.7% by males and females aged between 25 and 49 years, respectively (Figure 2). HIV incidence in 2014 was highest among the key populations, at

[2] Kerr CC, Stuart RM, Shattock AJ et al. Optima: A Model for HIV Epidemic Analysis, Program Prioritization, and Resource Optimization, Kerr C.C. et all, JAIDS, 2015 Jul 1;69(3):365-76.

0.010 and 0.012 per person-year for FSW and MSM, respectively. For comparison, HIV incidence among the general population was 0.002 per person-year in 2014.

FIGURE 2. NEW HIV INFECTIONS TRANSMITTED BY POPULATION GROUP, 2014




- **NSP targets are unattainable, assuming current funding levels and allocation patterns across populations and programs for 2016-2020.** Specifically, if the 2013 allocation of funding to programs of US$ 106 million per year[3] were available over the lifespan of the next NSP period (2016 to 2020), it is predicted that 202,200 new infections and 158,500 HIV-related deaths would occur in 2016-2020 and 469,800 new infections and 372,400 HIV-related deaths in 2016-2030. This is on par with current annual numbers of new HIV infections and AIDS deaths. This means it is impossible to reach the NSP targets – reducing the annual number of new HIV infections by 50% and HIV-related deaths by 75% by 2020 – with the 2013 funding volume.

- **At current funding levels, small allocative efficiency improvements are possible:** If the 2013 HIV program budget ($106m per year, over 5 years of the strategy period) was allocated optimally, the annual number of new infections would decrease by 4% and the annual number of HIV-related deaths by 5% by 2020 compared with the current scenario. This indicates that there is not much room for allocative efficiency improvements at current funding volumes – the reason being the large proportion of funds already allocated to essential lifelong HIV treatment.

- **Technical and production efficiency changes are essential to bring about room/space for allocative efficiency improvements.** Currently, a fifth of total HIV spending is on management and administration. If, for example, these costs were reduced from 20% to 17% (by reducing program and coordination costs, which are part of management and administration, by 25%) and the money saved allocated to finance HIV program implementation. This would decrease the annual number of new infections and AIDS deaths by approximately 11%, which is an additional 85,400 new infections and 69,500 deaths

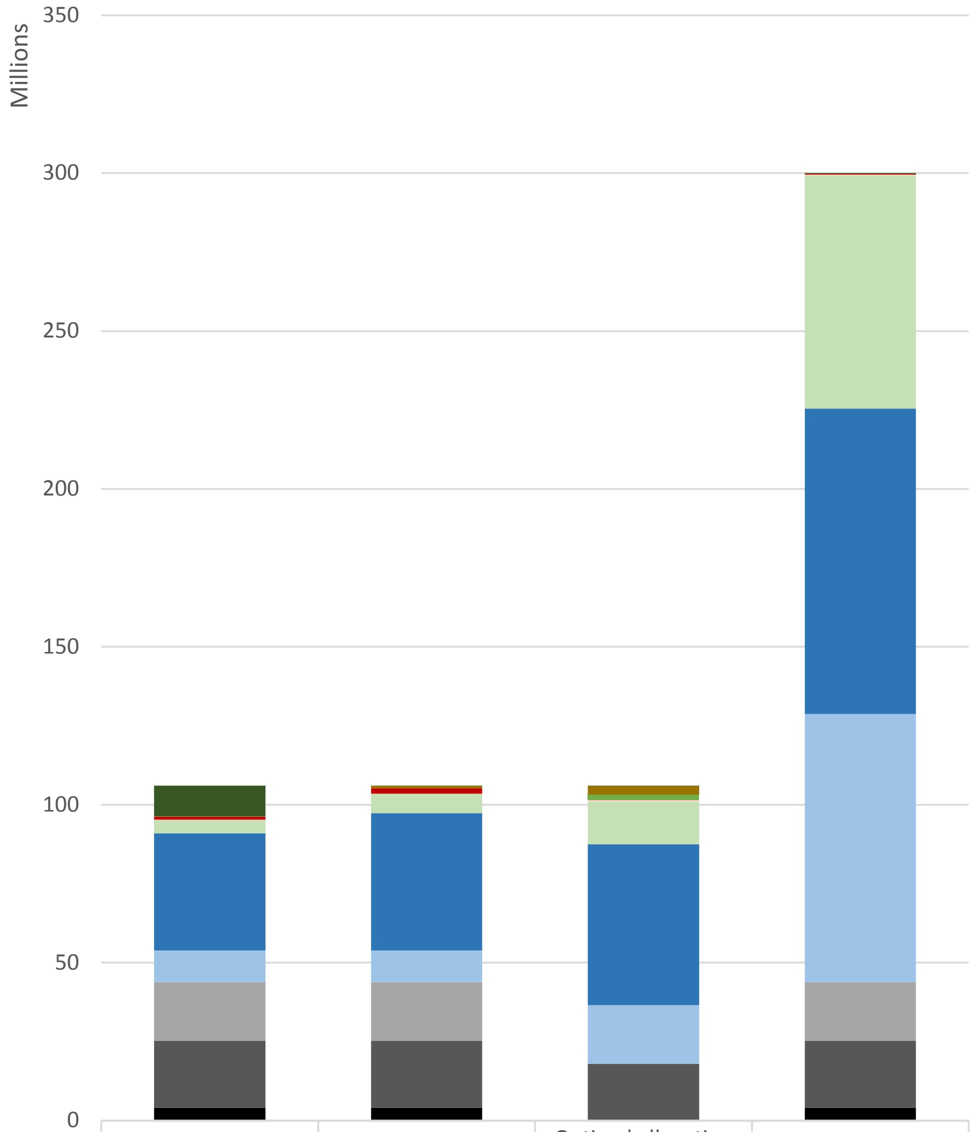
[3] This amount is the annual HIV funding available in 2013, based on NASA 2013 results

averted as compared with the optimal allocation without the additional savings from program coordination and administration funding.

- **To achieve the NSP targets, more funding, allocated more efficiently is needed.** It is impossible to reach the NSP targets – reducing the number of new HIV infections by 50% and HIV-related deaths by 75% by 2020 - with the current budget. In order to achieve the above NSP targets, an additional US$ 194 million per year is required (US$ 300 million per year total or US$ 1.5 billion over the NSP period) or US$ 168.2 million per year, if the current indirect cost could be reduced by US$ 25.6 million[4]). This funding, as Figure 3 illustrates, should be shifted from HIV prevention programs targeting the low-risk general population to (a) the scale-up of HCT and treatment (for the general and key populations) and (b) increasing resources for HIV prevention programs targeting FSW. Such a shift in allocation would avert an estimated 31,500 additional HIV infections and 31,300 additional deaths during the period 2016-2030 compared with the current allocation.

[4]In this scenario, we assumed that management and administration costs could be reduced by 14% (by reducing program coordination and administration costs by 25%), and that indirect HIV programs that have wider health sector benefits such as blood safety, OVC program etc. would be financed from other sources. This would free an additional US$ 25.8 million to allocate for direct HIV programs.

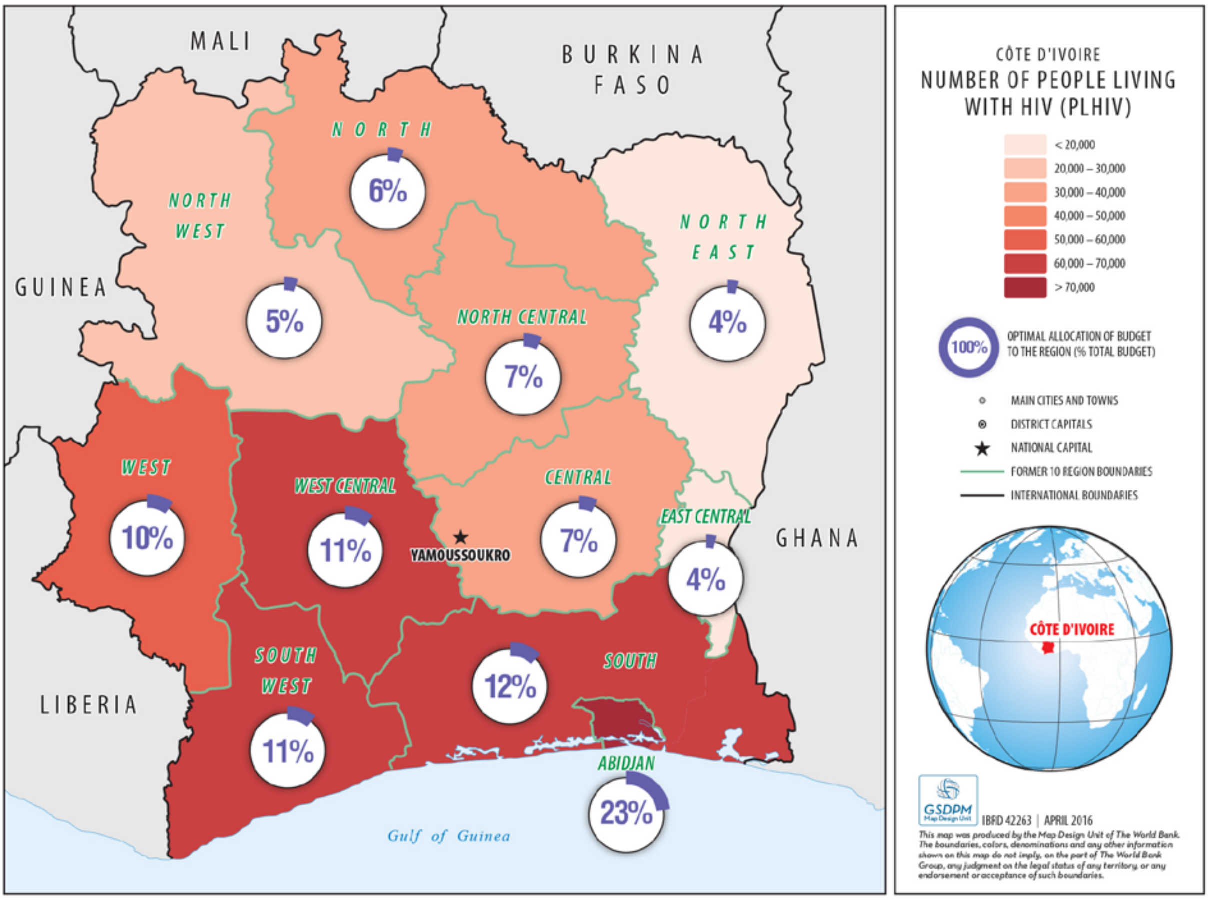
**Figure 3 Current and optimal allocation of funding between programs with current budget, and with a budget needed to achieve NSP targets**




| | Current allocation | Optimal allocation | Optimal allocation with reduced MGMT cost, indirect programs ' budget included in optimization | Reached NSP target |
|---|---|---|---|---|
| Condoms and SBCC | 9,743,235 | 42,066 | 79,457 | 153,736 |
| SBCC (15-24) | 26,634 | 755,646 | 2,713,755 | 13,778 |
| FSW programs | 991,028 | 1,742,626 | 1,729,419 | 345,904 |
| MSM programs | 190,652 | 88,202 | 258,489 | 131,959 |
| DU programs | 19,151 | 18,633 | 127,086 | 161,461 |
| HTC | 4,119,532 | 6,051,451 | 13,635,597 | 73,724,844 |
| ART | 37,040,353 | 43,433,961 | 50,958,180 | 96,663,995 |
| PMTCT | 10,078,639 | 10,078,639 | 18,522,497 | 84,972,653 |
| OVC | 18,520,146 | 18,520,146 | 0 | 18,520,146 |
| MGMT | 21,345,909 | 21,345,909 | 18,018,413 | 21,345,909 |
| Blood safety | 3,965,614 | 3,965,614 | 0 | 3,965,614 |

- **It is important to target the right programs in the right locations.** There is geographical variation in the HIV prevalence across Cote d'Ivoire. Therefore, the optimal allocation of resources by region would further avert infections and deaths. The Optima HIV model used geospatial epidemiological data with costing data to identify the optimal allocation of resources by geographical area (Figure 4). The optimal allocation is roughly commensurate with the overall HIV burden. If financial resources are optimally allocated, Abidjan should ideally receive the greatest prioritization (optimally receiving 23% of the budget, 26.4% of people living with HIV), followed by South (12% of the budget, 12.3% PLHIV), South West (11% of the budget, 11.2% of PLHIV), West Central (11% of the budget, 11.3% of PLHIV), and West (10% of the budget, 10.1% of PLHIV).

FIGURE 4. NUMBER OF PEOPLE LIVING WITH HIV PER DISTRICT AND THE OPTIMAL ALLOCATION OF THE NATIONAL BUDGET PER DISTRICT




The Optima HIV model was also used to analyze the influence of different HIV program and target scenarios on the projected future trajectory of the country's HIV epidemic. The following key results were obtained:

- Defunding non-ART HIV prevention programs targeting key populations would have a significant negative impact on the HIV epidemic as well as on long-term HIV-related costs. It is estimated that defunding prevention programs for key populations would result in an increase of new HIV infections among key populations by 52%.

- Reaching the UNAIDS 90/90/90[5] targets in Côte d'Ivoire would avert 263,300 new HIV infections (63% of the predicted new infections assuming no change in funding) and 265,600 HIV-related deaths (78% of the predicted deaths) between 2016 and 2030. If the 90/90/90 targets were reached by 2020, HIV-related costs would initially increase due to scale-up of ART and testing (requiring an additional $284 million) and then decrease due to reduced new infections (total HIV-related costs would reduce by $121 million between 2015 and 2030). An additional $284 million would be required to achieve these goals by 2020.

## Conclusions

**1. Cote d'Ivoire has a significant HIV disease burden:** HIV prevalence in Côte d'Ivoire is one of the highest in West Africa (3.2% of the general population is HIV-positive). HIV prevalence is higher among key populations including female sex workers (11.7% – 28.7%), men who have sex with men (18%) and people who inject drugs (9%).

**2. Cote d'Ivoire has ambitious targets to reduce new HIV infections, and better optimization of existing resources can help improve HIV outcomes and closer achievement of targets**

Optimization analysis suggest that by allocating current resources from non-ART HIV prevention programs for the low-risk general population to the scaling up of HTC and ART for the general and key populations as well as non-ART prevention programs for female sex workers and youth, Côte d'Ivoire could avert a total of 8,100 (4%) new HIV infections and 7,900 (5%) HIV-related deaths during its current National Strategic Plan (NSP) period (2016-2020).

**3. Even with optimization, the NSP targets cannot be achieved without additional funding.**

An additional US$ 194 million per year (or US$ 300 million per year total) would be needed to achieve the NSP targets – reducing the number of new infections and HIV-related deaths by 50% and 75% by 2020 respectively – representing a 183% increase in the overall budget.

**4. Setting even more ambitious targets (reaching the '90/90/90' goals) would impact the HIV epidemic but will initially require significant increases in resources.**

Achievement of the 90/90/90 goals by 2020 would have a significant impact on the HIV epidemic in Cote d'Ivoire including averting 63% (263,300) new infections and 78% (265,600) HIV-related deaths between 2016 and 2030. Achieving these goals by 2020 would cost an additional US$ 284 million. However, the reduced number of new infections as a result of

[5] By 2020, 90% of all people living with HIV will know their HIV status, 90% of all people with diagnosed HIV infection will receive sustained antiretroviral therapy, and 90% of all people receiving antiretroviral therapy will have viral suppression.

achieving these targets would decrease the total HIV-related cost in 2015-2030 by US$ 121 million.

**5. Reductions in HIV funding would result in dramatic increases in disease burden**

Currently, the national HIV response is primarily financed from international sources (86%). Any major shifts in the level of financing – both international and domestic – will have an impact on the delivery of HIV services and the future sustainability of the national HIV response. If HIV financing is not secured (i.e. there are no investments in HIV, either international or domestic financing), an estimated 266,200 additional new HIV infections and 154,200 additional HIV-related deaths would occur between 2016 and 2030, compared to a situation whereby the country maintains the current spending pattern. However, even with current spending patterns, it is important to ensure the optimal allocation of resources and explore options for improving technical and production efficiencies.

# 1. Introduction

In an increasingly resource-constrained environment, today's HIV responses are faced with the double challenge of scaling-up targeted but comprehensive HIV services that reduce the transmission of HIV and treat a larger number of people living with HIV than ever before, as well as improving allocative efficiency. Focused and efficient HIV program design and delivery is essential to ensure that programs can do more with the available resources.

## 1.1 Allocative efficiency in HIV and health

The concept of allocative efficiency takes health interventions (including services, drugs, and other activities that have the primary intention of improving health) as inputs and the health of the population as an output[6]. The term allocative efficiency refers to the **maximization of health outcomes with the least costly mix of health interventions**. Practically, allocative efficiency of health interventions is about the right interventions being provided to the right people at the right place in such a way that health outcomes are maximized.

HIV allocative efficiency studies are generally trying to answer the question *"How can HIV funding be optimally allocated to the combination of HIV response interventions that will yield the highest impact (achieve HIV response goals in the areas of HIV prevention, treatment, care and support) in the shortest period of time?"*

The dialogue around HIV financing has been changing in recent years, from a focus on universal access and estimation of the total resource needs to comprehensively finance universal access, to **prioritized high-impact HIV response scenarios within the realistic constraints of an amount of funding a country is likely to raise**. In this context, some of the following developments should be noted:

- The shared interest to move towards more predictable levels of HIV funding support for countries;
- The promotion of better alignment between HIV investment decisions and "need", informed by disease burden and ability to pay;
- The concept of shared responsibility or "fair share" promoted by UNAIDS, calling on governments to contribute public sector funds to the HIV response;
- The stabilization of most HIV epidemics globally, resulting in a change from HIV's special disease status to a condition with long-term treatment needs similar to some non-communicable diseases in many settings;
- The move from vertical HIV interventions to more integrated HIV and health service provision with strong linkages to TB and Sexual and Reproductive Health (SRH) services and the management of chronic conditions; and
- The change from an HIV/AIDS spending approach towards an investment approach, using longer time horizons, and analytical approaches to determine where investments should be prioritized given a resource-constrained environment.

[6] WHO (2003). Policy tools for allocative efficiency of health services. By Xingzhu Liu

There is wide consensus that **better outcomes could be achieved in many settings with a given amount of HIV money, or given outcomes could be achieved with less HIV money, if the resources are distributed optimally, or if resources are technically used in the most efficient way**. One way in which to do this is to use mathematical modeling to determine optimal HIV resource allocation. As an HIV allocative efficiency model, Optima HIV is designed to provide investment guidance on allocatively efficient HIV responses. The optimal allocation of resources predicted by the model differs markedly depending on the policy objective(s), and the optimal distribution of resources across programs changes substantially based on the amount of funding available to be allocated.

**The Optima HIV model:**

- is a mathematical model of HIV transmission and disease progression that is population-based and flexible;
- provides a formal method of optimization that quantitatively and objectively determines optimal allocations of HIV resources across numerous prevention and treatment programs to address multiple policy objectives;
- estimates intervention impact, cost-effectiveness and return-on-investment; and
- provides analysis on the longer-term financial consequences of HIV infections and HIV investments.
- Has been successfully used in multiple countries in Africa and beyond including Niger, Sudan, Swaziland, South Africa, Zambia, and Belarus.

## 1.2 Rationale for an HIV allocative efficiency analysis in Côte d'Ivoire

Côte d'Ivoire's HIV epidemic is one of the largest in West and Central Africa. While HIV spending has increased over the last decade, the country still relies heavily on external financing (87% of HIV financing is provided by external donors). The country has recently developed a new National Strategic Plan (2016-2020) that has an ambitious target of reducing the number of new infections by 50% and the number of AIDS-related deaths by 75%. An allocative efficiency analysis can help the country ensure that all the funding that it has already mobilized, or will mobilize in the future, has and will be allocated in an optimal way to bring about the best possible health and HIV outcomes – thus maximizing the effectiveness of the existing resources, as well as any new resources that are mobilized. Such an analysis is also able to inform the country's Global Fund concept note for future financing (next submission scheduled for 2016). In this regard, the Government requested technical support from UNAIDS and the World Bank to undertake an Optima HIV analysis (the key results of which are presented in this report). The recommendations from this allocative efficiency study will help provide answers to these questions:

a) How existing funding could be allocated more efficiently
b) Where additional funding needed to achieve HIV program goals should be prioritized

Answers to these questions will help influence program resource allocations to more efficient program spending.

## 1.3 Objectives of the analysis

The first part of the analysis focuses on the country's future HIV response, as articulated in its new NSP (2016-2020). In this new NSP Côte d'Ivoire has set its priorities for its HIV response including the following key impact targets:

- Reduce the number of new HIV infections by 50%
- Reduce the number of AIDS-related deaths by 75%

In collaboration with stakeholders from Côte d'Ivoire, the following questions for an optimization analysis were set:

- **How close will we get to National Strategic Plan targets under current funding?**

Over the new National Strategic Plan period, how close will Côte d'Ivoire get to their National Strategic Plan's disease-related targets:

a) With the current volume of funding, allocated according to current expenditure?
b) With the current volume of funding, allocated optimally?

- **How much funding is required to achieve Côte d'Ivoire's National Strategic Plan Impact targets?**

Over the new National Strategic Plan period, according to current program implementation practices and costs:

a) How much total funding is required to meet the National Strategic Plan targets?
b) How can this funding be optimally allocated between programs and across regions?

- **What is the expected future impact of policy or program implementation scenarios?**

For this question, we analyzed a number of scenarios to assess the projected future trajectory of the country's HIV epidemic. The scenarios analyzed included:

a) What is the projected future trajectory of Côte d'Ivoire's HIV epidemic if non-ART HIV prevention programs for key populations are defunded?
b) What is the impact of reaching UNAIDS' 90/90/90 goals[7] on the HIV epidemic and on long-term HIV-related costs?

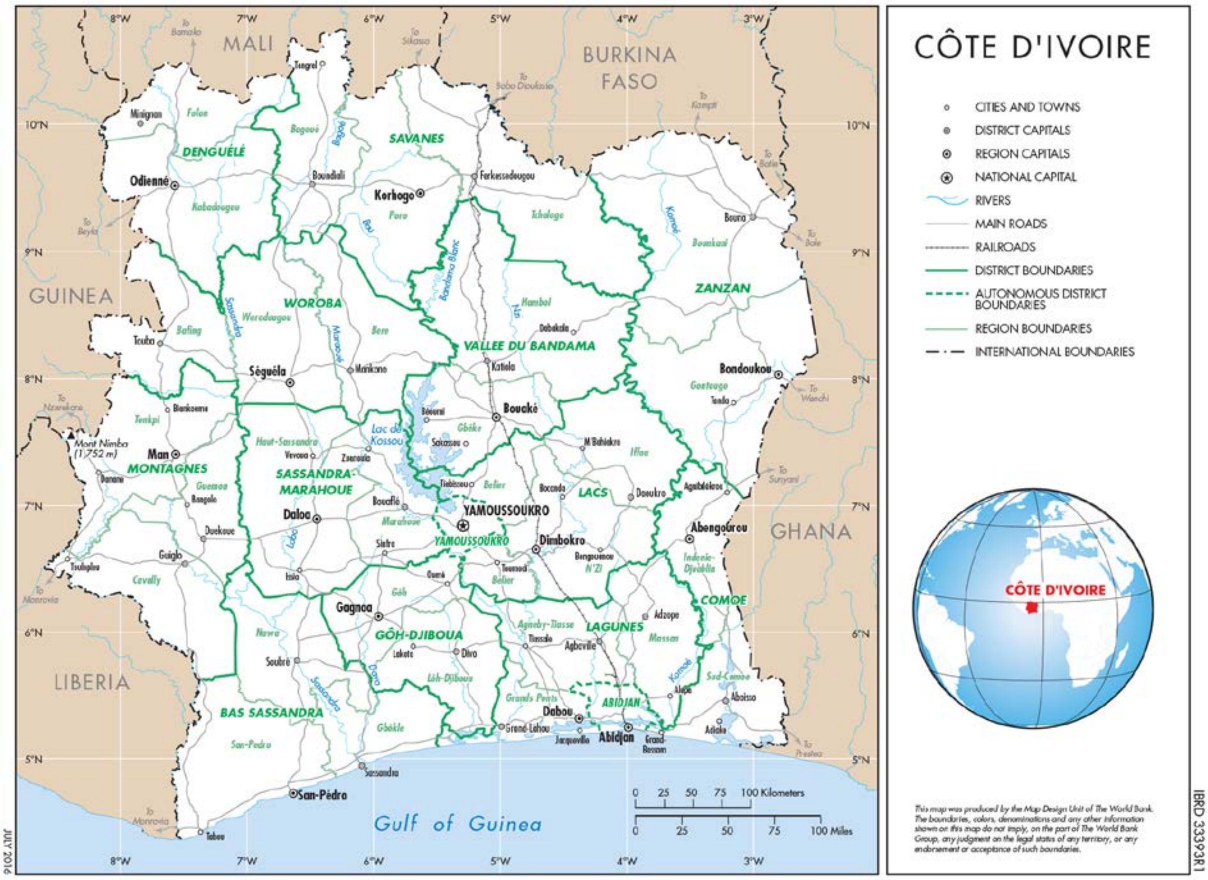
[7] By 2020, 90% of all people living with HIV will know their HIV status, 90% of all people with diagnosed HIV infection will receive sustained antiretroviral therapy, and 90% of all people receiving antiretroviral therapy will have viral suppression.

# 2. Country context

## 2.1 Economy

Côte d'Ivoire is located in West Africa and has an area of 322,000 km$^2$ (Figure 5). In 2014, the population was estimated at about 24 million people with over half living in urban areas.

**FIGURE 5 MAP OF CÔTE D'IVOIRE**




The country is classified as a lower middle-income country. The largest city, Abidjan, heavily dominates the Ivorian economy: the metropolitan area has an estimated population of 4.7 million (20% of the total population of the country), making it the second largest city of West Africa. The Greater Abidjan area also includes 80% of the country's formal employment sector and 90% of all formal enterprises. The country has faced some political instability during the past decades, including two civil wars (2002-2007 and 2010-2011). Nevertheless, the country now has a stable and growing economy and a relatively developed infrastructure, including a wide-spread network of paved roads and modern telecommunication facilities. The economy is dominated by the export of natural resources. Côte d'Ivoire is the world's largest producer and exporter of cocoa, contributing to a 30% share of the global production. Other important agricultural resources include cashew, cotton, and other food-crop production (rice, plantain, cassava and corn). The oil industry of Côte d'Ivoire is also one of the key elements in its economy. The downstream industry is well developed with an oil refinery in Abidjan and eight oil companies engaged in the distribution and marketing of petroleum products. With two large ports, Côte d'Ivoire also acts as an important transit location for export of products to neighboring countries.

## 2.2 Human development

In 2014, Côte d'Ivoire had a HDI of 0.462, classifying it as a 'Low Human Development' country and ranking it 172nd out of 188 in the world. This is below the sub-Saharan Africa average of 0.518, and the HDI of Côte d'Ivoire has increased by only 19% since 1990 (the equivalent of a 0.72% average annual increase). The average annual increase in the same period for all countries classified as having 'Low Human Development' and for sub-Saharan Africa were 1.32% and 1.08%, respectively.

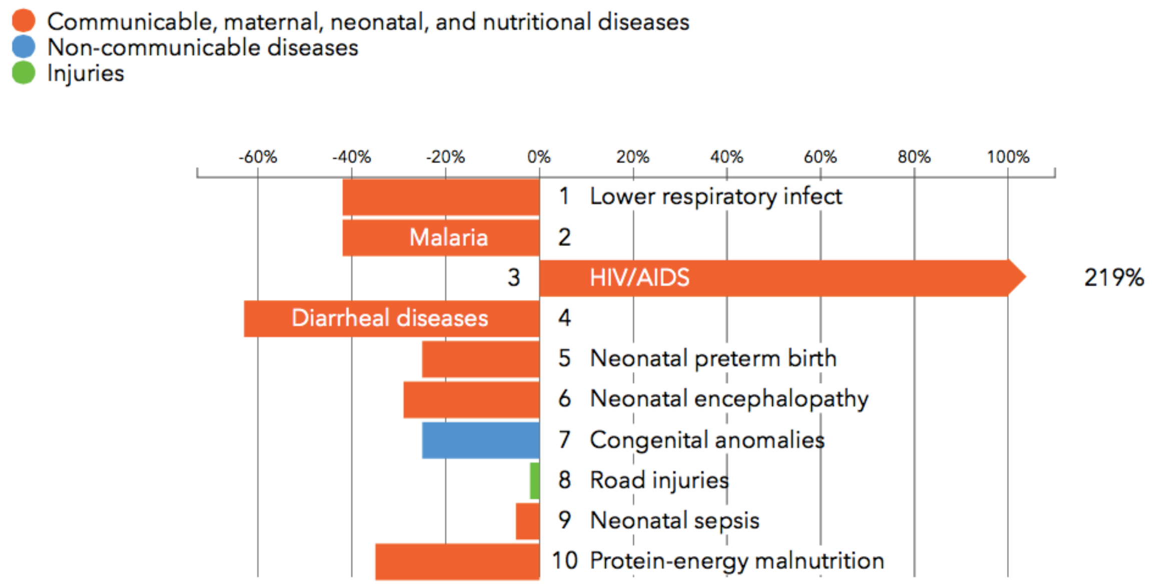
Life expectancy at birth in Côte d'Ivoire is 51.5 years (2014) and, like in most other countries, higher for women (52.4 years) than men (50.7 years).[8] The expected number of years of schooling for children who enter school today is 8.9 years while mean years of schooling is 4.3 years. The proportion of boys and girls attending primary school (secondary school) is 66% (54%) and 57% (36%) respectively. Almost 60% (59%) of the adult population (aged 15 years and above) are illiterate, though a higher proportion of women are illiterate (70%) compared to men (48%).

## 2.3 Burden of disease

In 2013, the total number of disability-adjusted life years (DALYs) in Côte d'Ivoire was 12.8 million[9]. A DALY is a measure that takes into account the life-years lost, as well as the life-years lived with disability. About one third of DALYs (6.1 million, 34%) were caused by infectious and parasitic diseases. Among infectious diseases, HIV was the most common cause with 1.8 million DALYs, followed by malaria (1.5 million) and diarrheal diseases (1.4 million)[10]. Overall, HIV represents more than 10% of all DALYs and has increased by more than 200% since 1990 (Figure 6).

[8] http://hdr.undp.org/en/data, 2015
[9] Institute of Health Metrics and Evaluation. Global Burden of Disease, Cote d'Ivoire, 2013. http://vizhub.healthdata.org/gbd-compare/
[10] WHO, Global Burden of Disease, 2012

FIGURE 6. PERCENT CHANGES IN DALYS IN COTE D'IVOIRE (1990-2013)




Source: Institute of Health Metrics and Evaluation. Global Burden of Disease, Cote d'Ivoire, 2013. http://www.healthdata.org/cote-divoire

## 2.4 The Health System and Health Financing

### 2.4.1 The Health System

Côte d'Ivoire's health system suffered greatly as a result of political and social crises between 2002 and 2010[11]. During this period, over half of all health centers in the country (52%) were closed, particularly in the central and northern parts of the country[11]. An electoral crisis soon followed in 2011-2012 resulting in the closure of all health centers in the western part of the country as well as some communities in Abidjan[11]. In addition, it has been reported that many hospitals and health clinics were looted across the country and still remain in poor condition today. However, in 2011 after the political and social instability had subsided, the country introduced a policy of free healthcare for all. As a result of escalating costs, the policy was changed in early 2012 to providing free services for selected populations or situations, such as pregnant women, children, and medical emergencies. In 2013, only 3-4% of the population (primarily those formally employed by the private sector, civil servants, and military personnel) had health insurance. In March 2014, the country adopted the Universal Health Care Law, which they plan to progressively implement between 2015 and 2019[12]. To be insured under the scheme, a monthly contribution of FCFA 1,000 per person is required. It is expected that 40% of the population will be covered by 2020. The Government will also partially subsidize the poorest households who are unable to afford the monthly contribution, at an estimated annual cost of 0.2% of GDP, depending on the coverage.

[11] http://www.worldbank.org/en/news/press-release/2014/11/25/world-bank-group-to-support-cote-divoires-health-systems-strengthening-and-ebola-preparedness
[12] International Monetary Fund. IMF Country Report No. 14/163. Cote d'Ivoire. June 2014.

Côte d'Ivoire's health sector follows the classical three-tiered pyramid that includes an administrative and a care provision side. At the peripheral level (the base of the pyramid), there are 72 health districts that play an operational role implementing the vast majority of health programs, including HIV care programs. Care facilities at this level include district hospitals and health centers. The intermediate level includes 19 regional delegates of public health who provide technical support to the peripheral level for the implementation of national health policies. Regional hospitals are found at this level. The central level (at the top of the pyramid) consists of the central structures of the Ministry of Health and the Fight against AIDS (MOH), who develop health policy and health development strategies, monitor their implementation and regulate the health system. Care facilities at this level include general hospitals, referral centers, and university and central hospitals.

Both the public and private sectors provide health services in Côte d'Ivoire, with more than half (51.6%) of all health facilities being private[13]. These include authorized and unauthorized commercial health facilities as well as private faith- and community-based health facilities, which are mainly found in urban settings.

There is a shortage of human resources for health in Côte d'Ivoire. The number of physicians per 10,000 inhabitants is 1.4 while the number of nursing and midwifery personnel is 4.8 per 10,000 inhabitants (2007-2013)[14]. The current ratios are below the Africa regional average (2.7 physicians and 12.4 nursing and midwifery personnel per 10,000 inhabitants), as well as below the World Health Organization's (WHO) minimum recommended numbers of doctors and nurses, which states that a minimum of two doctors and twenty-one nurses per 10,000 inhabitants are required to provide basic services.[15]

### 2.4.2 Healthcare Financing

Total health spending per capita in Côte d'Ivoire was 181 international dollars using the purchasing power parity (PPP) method. While this represents an increase of 25% since 2000, the total expenditure on health as a percentage of the Gross Domestic Product (GDP) has changed very little in Côte d'Ivoire over the same time period. In 2012, 6.1% of the country's GDP was spent on health compared to 6.0% in 2000[16] (Table 1). Around 30% of all health expenditure comes from Government sources with 7% of all Government health expenditure earmarked for social security (2014)[16]. The rest of the expenditure on health predominantly comes from private sources with a small contribution coming from external resources[16]. Of all private expenditure on health, 72% is in the form of out-of-pocket payments while 4.5% comes from private prepaid plans[16]. As previously mentioned, however, the country is currently implementing a Universal Health Care insurance scheme and it is expected that 40% of the population would be covered by 2020[12]. The set up costs for the scheme are estimated to be FCFA 15 billion[12].

[13] SHOPS Project, 2014. Côte d'Ivoire Private Health Sector Assessment. Brief. Bethesda, MD: Strengthening Health Outcomes through the Private Sector Project, Abt Associates Inc.
[14] WHO. Health Statistics Report, 2015. http://apps.who.int/iris/bitstream/10665/170250/1/9789240694439_eng.pdf?ua=1
[15] WHO. World Health Report, 2006.
[16] WHO National Health Accounts Database, http://apps.who.int/nha/database/Key_Indicators/Index/en, accessed 20 April 2016

**TABLE 1. TRENDS IN HEALTH EXPENDITURE IN COTE D'IVOIRE, 2000-2013**

| Indicator | 2000 | 2005 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|
| GDP (current prices, US$, millions) | 10,717 | 17,085 | 24,885 | 25,382 | 27,041 | 31,293 | 34,254 |
| Total health expenditure (US$, millions) | 643 | 923 | 1,568 | 1,624 | 1,650 | 1,815 | 1,952 |
| Total health expenditure (US$ per capita) | 39 | 51 | 78 | 79 | 79 | 84 | 88 |
| Total health expenditure as a percentage of GDP | 6.0 | 5.4 | 6.3 | 6.4 | 6.1 | 5.8 | 5.7 |
| Government health expenditure as a percentage of total health expenditure | 29.8 | 23.6 | 26.5 | 25.5 | 30.7 | 30.9 | 29.4 |
| Private health expenditure as a percentage of total health expenditure | 70.2 | 76.4 | 73.5 | 74.5 | 69.3 | 69.1 | 70.61 |
| Government health expenditure as a percentage of total government expenditure | 10.0 | 7.0 | 8.2 | 8.9 | 8.5 | 8.2 | 7.3 |
| External resources for health as a percentage of total health expenditure | 4.4 | 4.1 | 10.2 | 11.1 | 10.0 | 8.8 | 9.4 |
| Social security expenditure on health as a percentage of total government expenditure | 2.0 | 6.5 | 6.5 | 6.0 | 6.2 | 6.5 | 7.2 |
| Out-of-pocket health expenditure as a percentage of private health expenditure | 78.8 | 78.5 | 76.8 | 77.1 | 75.5 | 71.9 | 71.9 |

Source: WHO National Health Accounts Database, http://apps.who.int/nha/database/Key_Indicators/Index/en, accessed 20 April 2016, and World Bank Data, http://data.worldbank.org/country/cote-divoire, accessed 22 July 2016

# 3. HIV in Côte d'Ivoire

## 3.1 HIV Epidemic in Côte d'Ivoire

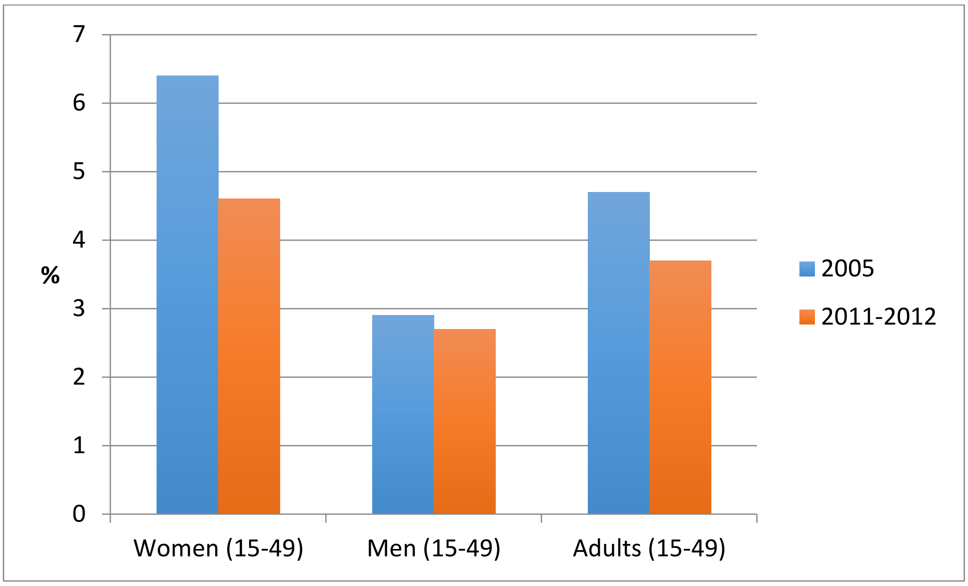
In Côte d'Ivoire the HIV epidemic is mixed, with one of the highest HIV prevalence in West Africa. This epidemic profile is likely due to rapid spread among key populations in the second half of the 1980s and the early 1990s, with a large FSW population and extremely high prevalence among them, well-documented in Abidjan, combined with high levels of risky sexual behavior among men. These factors led to a mixed epidemic, with sustained transmission occurring among key populations, among the general population, and between them.

According to the EPP/Spectrum model[17], HIV prevalence grew rapidly during the 1990's reaching a peak value of 5.5% in 1999, and has since then been gradually decreasing. The adult prevalence in 2011/2012 was 3.7%[18] from 4.7% in 2005[19]. HIV prevalence is expected to continue to decrease

[17] Spectrum, 2015. http://www.avenirhealth.org/software-spectrum.php
[18] DHS, 2011-2012
[19] DHS, 2005

during the coming years[20]. The largest decrease in HIV prevalence has been among women, with a 28% reduction from 6.4% to 4.6%, between 2005 and 2011/2012 while for men over the same period HIV prevalence decreased by less than 7%, from 2.9% to 2.7% (Figure 7).

**FIGURE 7. COMPARISON OF DHS-BASED HIV PREVALENCE AMONG ADULTS (15 AND OLDER) IN COTE D'IVOIRE, 2005 AND 2011-2012**




Source: DHS 2005 and DHS 2011-2012, Cote d'Ivoire

HIV prevalence is also higher in urban settings (4.3%) compared to rural settings (3.1%) and there is considerable heterogeneity in HIV prevalence across Cote d'Ivoire's different regions[18]. HIV prevalence being highest in the Abidjan (5.1%), North Central (4.4%), South West (4,3%) and East Central (4.0%) regions followed by West (3.6%) and Central (3.0%) regions[18]. HIV prevalence is less than 3% in the North (2.5%) North East (2.3%), North West (2.3%) and West Central (2.2%) regions[18].

HIV prevalence is very high among certain high-risk populations, including female sex workers (FSW) (11.7%-28.7%)[21][22], men who have sex with men (MSM) (18%)[23], and drug users (DU) (9.5%)[24].

## 3.2 The National HIV response

After the first case of AIDS was reported in 1987, the government established a National Committee for the Fight against AIDS, presided by the Head of State[25]. Successive five-year plans were developed and implemented to guide the national response to HIV/AIDS, primarily focusing on prevention programs for the general population and targeted interventions. In 1998, the government launched the HIV/AIDS Treatment Access Initiative to provide antiretroviral therapy to people living

[20] http://aidsinfo.unaids.org/
[21] Vuylsteke, B. S. (2012). HIV and STI Prevalence among Female Sex Workers in Côte d'Ivoire: Why Targeted Prevention Programs Should Be Continued and Strengthened. *PLoS ONE*
[22] FSW IBBS, Cote d'Ivoire, 2012
[23] Survey of HIV and Associated Risk Factors Among MSM in Côte d'Ivoire (SHARMCI), 2012
[24] Study « Y'a pas drap » / Santé des usagers de drogues à Abidjan, 2014
[25] http://www.who.int/hiv/HIVCP_CIV.pdf

with HIV/AIDS, in collaboration with UNAIDS, the project RETRO-CI/CDC, the ANRS (Agence Nationale de Recherche sur le SIDA) and the Infectious Disease Clinic. In 2001, the Ministry of HIV/AIDS was created for multisectoral coordination of HIV/AIDS activities, supported by the HIV Care and Treatment Unit in the Ministry of Health. A law adopted in 2001 provided a tax exemption for treatment as well as for salaries and expenses paid by an employer for health care provided to employees with HIV/AIDS. Currently, the ministry responsible for HIV/AIDS is the Ministry of Health and the Fight against AIDS.

The political and military crises in Côte d'Ivoire have limited the national capacity to respond to the HIV/AIDS epidemic, particularly between 2002 and 2011. However, as indicated in a review of the National Strategic Plan for HIV/AIDS (NSP-HIV/AIDS) 2011-2015, access to HIV/AIDS prevention, care, and treatment services has been greatly expanded. As of September 2012, 93,065 patients were on ART with around 1,800 new ART initiations per month, and 129,601 HIV-positive people had received some form of care and support during the previous year.

Despite these advances, the national response remains precariously layered across a weak public health system that is under-resourced[26]. Access to and uptake of prevention of mother-to-child HIV transmission (PMTCT) and other gateway services remain insufficient, particularly in rural areas. As of September 2012, only 9% of HIV-positive children and 17% of children in need of ART had been identified and were receiving lifesaving care. National guidelines and tools to ensure a continuum of response (CoR) are in place, but implementing even the former (2010) World Health Organization (WHO) guidelines that recommend initiating ART at CD4 counts below 350 remains challenging, and the lost-to-follow-up rate among ART patients after one year is about 40% (routine PEPFAR data, January 2013)[27].

HIV programs aimed at the general population include HIV testing and counseling, communication for social and behavior change, and condom promotion that is also implemented using a social marketing strategy. The network of condom distribution has grown from 1,614 selling points registered in 2010 to 15,077 in 2012 and 45,793 in 2014. Condoms were also distributed among the general population through community counselors and peer educators. However, this covers only a fraction of the number of condoms that were supposed to be distributed. Promotion of female condoms remains difficult mostly because of ignorance or prejudices about their use. Campaigns to raise awareness about correct and systematic condom use have been largely successful. In 2013, it was estimated that these campaigns reached 47% of the general population.

Mass campaigns for the promotion of voluntary counseling and testing have been organized. Flyers, T-shirts, CDs and different gadgets have been used to publicize the message of prevention. As a result, the number of people who were counseled for HIV has almost doubled in the past 3 years (from 1,001,076 in 2012 to 1,826,269 in 2014). In 2014, 83% of the health facilities had a testing center. HIV testing has been free of charge since 2004. However, the number of people counseled and tested is still low compared to the number of people reached by the awareness raising campaigns. The main reason for this is the lack of human resources for the implementation of the programs.

Specific HIV programs focusing on youth also exist in Côte d'Ivoire. It is estimated that over 3.6 million young people aged 15-24 years have been reached by behavior change HIV prevention programs between 2012 and 2014. Interventions have been organized in schools but also through

[26] www.pepfar.gov/documents/organization/222161.pdf
[27] www.pepfar.gov/documents/organization/222161.pdf

other organizations to target young people not attending schools. The structures that provide care for youth have also been strengthened. National coordination of the youth prevention programs is still lacking, however.

A national program focusing on key populations was created late in 2008 by the Ministry of Health. This program coordinates the interventions related to HIV prevention and management in these populations. As a result of this national program, about 90% of the highly vulnerable populations now benefit from HIV prevention services. The services offered to vulnerable and key populations include HCT for FSW and MSM by peer educators, income generating activities for peer educators in order to retain them, night clinics at sites of sex work, awareness raising via internet, and follow-up of incarcerated and recently released PLHIV. A total of 18,265 sex workers have been exposed to condom promotion programs. In general, coverage of programs for key populations remains insufficient and in particular, commodities are a major challenge.

Programs have also been developed to increase the number of pregnant women who are aware of their HIV status. The proportion of pregnant women aware of their HIV status increased from 64% in 2012 to 72% in 2013. The target for 2015, which has not been attained, is that 95% of all pregnant women should know their HIV status. This requires the significant expansion of HCT and the availability of related commodities. In 2011, only about half of pregnant women had access to HIV testing, and only about 16% of pregnant women attended antenatal care regularly. As a part of the same program, 35% of the partners of pregnant women are expected to have been tested, but information about the HIV status amongst partners is difficult to obtain. Forty-three percent of HIV infected women and their infants received antiretrovirals for PMTCT. Laboratory data indicate that in 2011, 844 children (4%) born to HIV-positive mothers had a virological test during their first two months of life.

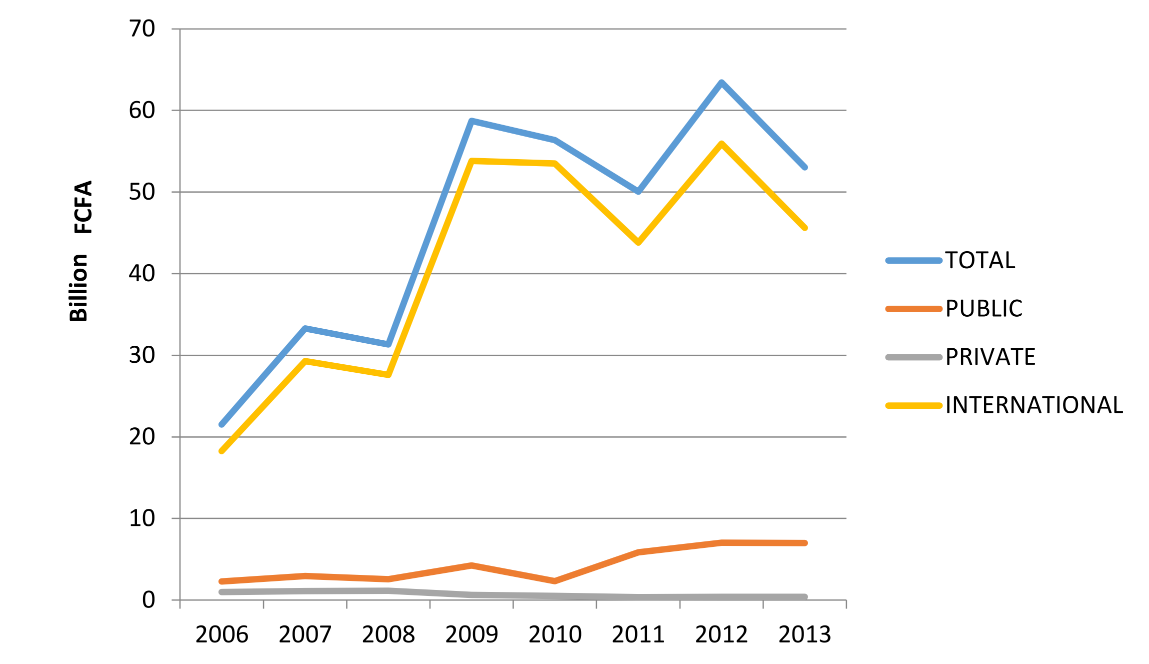
## 3.3 HIV Financing

### 3.3.1 HIV financing by source

In Cote d'Ivoire, HIV financing is 0.8 % of total health expenditure (2.4% of Government health expenditure), which is 0.04% of GDP of Cote d'Ivoire.

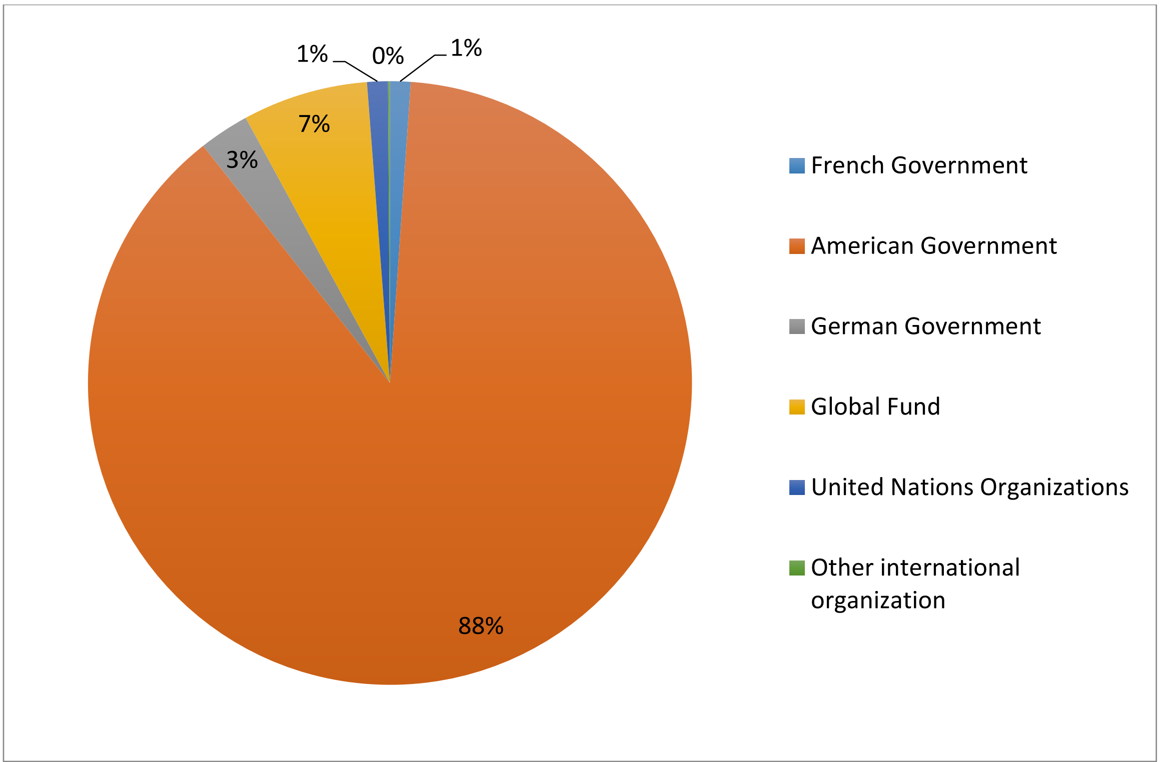
Since 2006, HIV spending has more than doubled. In 2013, the total HIV spending in Côte d'Ivoire was 53 billion FCFA (around 90 million USD), compared to 21.5 billion FCFA in 2006 (around 36.5 million USD). The financing of the HIV response is heavily reliant on international financing. Eighty-seven per cent of HIV spending was from international donors, with the US government being the largest donor (76% of all HIV spending and 88% of all international HIV spending). Public and private funds (mainly direct household funding) accounted for 13% and <1% of the total HIV spending, respectively. Figure 8 and Figure 9 highlight HIV spending trends over time and by source of financing.

**FIGURE 8. HIV FINANCING OVER TIME AND BY SOURCE, 2006-2013**




Source: NASA, 2012-2013. Exchange rate used – 1 US$ = 590 FCFA

**FIGURE 9. INTERNATIONAL SPENDING BY SOURCE, 2013 (TOTAL INTERNATIONAL SPENDING= 45.6 BILLION FCFA)**

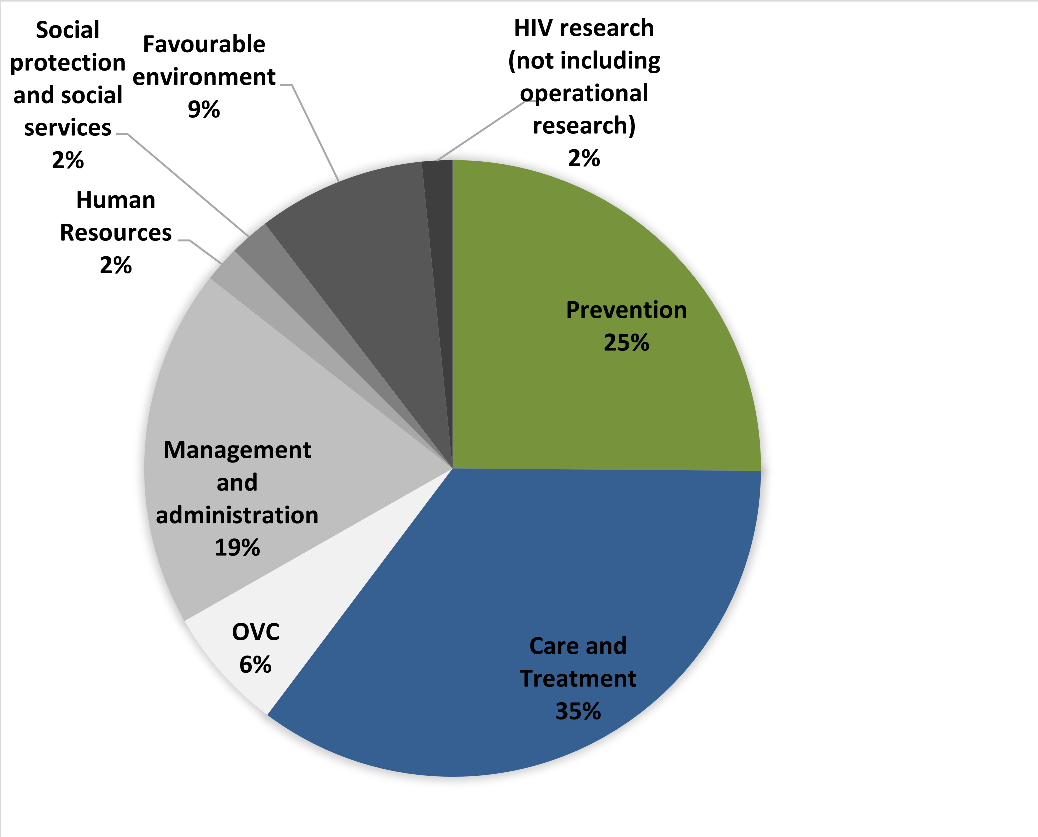



Source: NASA, 2012-2013

### 3.3.2 HIV spending by program

In 2013, 35% of all HIV financing was spent on care and treatment, and a quarter of all HIV spending was on non-ART HIV prevention. Almost a fifth of the total HIV spending (19%) was spent on management and administration, and programs promoting a favorable environment represented 9% of all HIV spending. Programs supporting orphans and vulnerable children (OVC) received 6% of the HIV budget while HIV research (excluding operational research), human resources, social protection and social services each received 2% of the HIV budget (Figure 10). For additional details on HV allocation by programs please refer to Annex 3. HV allocation of financial resources by programs.

FIGURE 10. HIV SPENDING BY PROGRAM, 2013 (TOTAL SPENDING = 53.2 BILLION FCFA)




Source: NASA, 2012-2013

# 4. Methodology

To assess HIV epidemic trends, we used the epidemic model of Optima HIV, which consists of a mathematical model of HIV transmission and disease progression. Optima HIV uses best-practice HIV epidemic modelling techniques and incorporates evidence on biological transmission probabilities, detailed infection progression, sexual mixing patterns and drug injection behavior. Optima HIV is calibrated to HIV prevalence data points available from the different sub-populations (e.g. female sex workers, men who have sex with men, drug users), as well as to data points on the number of people on ART, and in consultation with local experts in Côte d'Ivoire.

To assess how incremental changes in spending affect the HIV epidemic and determine the optimal funding allocation, the model parameterizes relationships between the cost of HIV intervention programs, the coverage level attained by these programs, and the resulting outcomes. These relationships are specific to the country, population and program being considered.

Using the relationships between cost, coverage and outcome in combination with Optima HIV's epidemic model, it is possible to calculate how incremental changes in the level of funding allocated to each program will impact on overall epidemic outcomes. Furthermore, by using a mathematical optimization algorithm, Optima HIV is able to determine the "optimal" allocation of funding across different HIV programs, i.e. an allocation that brings the greatest benefit in terms of health outcomes. Further details about Optima HIV can be found on the website http://www.optimamodel.com.

## 4.1 Analytical framework

The first step of the modeling procedure was to select the input parameters for the Optima HIV model. These include the population groups, expenditure areas, baseline scenario and funding. Expenditure areas can either be included in the optimization, or have fixed costs. The parameterization was defined in discussions between representatives of the World Bank, University of Bern, Optima team and the Côte d'Ivoire stakeholders, and are summarized in the following table:

TABLE 2 INPUT PARAMETERS FOR THE OPTIMA HIV MODEL

| Category | Parametrization in Optima HIV Model |
|---|---|
| Populations defined in model | • Boys (0–14)<br>• Girls (0-14)<br>• Young women (15–24)<br>• Young men (15–24)<br>• Adult women (25–49)<br>• Adult men (25–49)<br>• Older women (50+)<br>• Older men (50+)<br>• Female sex workers<br>• Clients of sex workers<br>• Men having sex with men (MSM)<br>• Drug users (DU) (injecting and non-injecting) |
| Expenditure areas defined in model and included in optimization analysis | • Targeted non-ART prevention services for FSW (incl. condoms, HTC but excluding |

| | |
|---|---|
| | ART)<br>• Targeted non-ART prevention services for MSM (incl. condoms, HTC, but excluding ART)<br>• Targeted non-ART prevention services for DU (incl. needles, condoms, HTC, but excluding ART)<br>• Condoms and SBCC programs for the general population (aged 25+)<br>• Condoms and SBCC programs for young adults<br>• HTC for the general population<br>• PMTCT (constrained – funding for PMTCT cannot be decreased in the optimization for NSP period)<br>• ART (including first and second line treatment and other HIV-related patient care, nutritional support associated with antiretroviral therapy, psychological support, laboratory monitoring) |
| Expenditure areas not included in optimization | • Programs for orphans and vulnerable children, favorable environment and social protection (program referred to collectively as OVC in result figures)<br>• Blood safety<br>• Management and administration (including HR, infrastructure and operational research) |
| Time frames | • 2015-2020<br>• 2015-2030<br>• We assume throughout that the spending in 2015 is the same as in 2013, as NASA 2013 is the most recent data on HIV spending. |
| Baseline scenario/counterfactual HIV epidemic projection | • The baseline scenario is an epidemic projection assuming constant spending from 2015 onwards (and assuming the same allocation as in 2013).<br>• The epidemic and financial impact of this scenario is used as a counterfactual against which the extent of reductions in new infections and deaths as well as savings with optimal allocations are measured. |
| Baseline scenario funding (2013 NASA year) | • CFA 53.21 billion (programmatic spending) |

## 4.2 Model calibration

As part of the model validation process, calibration was done to align Optima projected trends in HIV prevalence with historically observed trends in HIV prevalence in different population groups. Please refer to Annex 4. Model calibration results for additional details on the model calibration.

## 4.3 Program data: Cost-coverage-outcome relationships

The relationship between program spending and coverage describes the level of output achieved (proportion of target population who are reached with the program) with a specific level of financial input (cost). For example, this relationship would describe how many female sex workers can be provided with a standard package of services for different amounts of investment up to 1,000,000 USD. The relationship between coverage and outcome describes the proportion of people who are expected to adopt a specific behavior (such as condom use or consistent use of ARVs leading to viral suppression) in relation to the program coverage. Programs for which it is possible to describe the relationship between spending and impact on HIV epidemics in this way are herein referred to as 'direct programs'.

### 4.3.1 Program coverage

Table 2 provides the definitions used to define coverage and the assumed coverage used for each program included in the modelling analysis.

TABLE 3 ASSUMED PROGRAM COVERAGE IN 2013

| Program | Definition of coverage | Assumed Coverage in 2015 |
|---|---|---|
| FSW non-ART HIV prevention | % FSW who received condoms and know a place to get an HIV test | 58% |
| MSM non-ART HIV prevention | % MSM who received condoms and know a place to get an HIV test | 31% |
| DU non-ART HIV prevention | % DU who received condoms, received clean needles, and know a place to get an HIV test | 0% |
| HTC | % adults in general population (excluding key populations such as FSW, MSM and DU) who got tested for HIV in the last 12 months. (estimated using 8 USD as a unit cost) | 4% |
| ART | % PLHIV eligible for treatment receiving treatment | 32% |
| PMTCT | % pregnant HIV-positive mothers receiving ART for preventing mother-to-child transmission ("Option B+") | 64% |
| Condoms and SBCC | % adults in the general population (excluding key populations such as FSW, MSM and DU) who received condoms in the last 12 months | 25% |
| Condoms and SBCC for youths | % youth population who were reached by any campaign for youth increasing HIV awareness. | 18% |

### 4.3.2 Program cost

Program expenditure was derived from Côte d'Ivoire's National AIDS Spending Assessments (NASA), which has been carried out for the years 2006-2013. Using these data as well as outcome data (such as HIV testing rates for HTC programs, condom use per population for condom promotion programs, number of people on ART for ART programs etc.) we developed cost-outcome curves that define the relationship between program expenditure and respective outcomes. It is important to note that the relationship between spending and outcome does not need to be linear. We can include a saturation effect when the spending increases. The cost-outcome curves are shown in Annex 2. These cost-outcome curves allowed us to derive unit costs for each program; this top-down costing approach derives unit costs from expenditure data and the reported number of people served or reported program coverage data (See Table 4 Unit costs for different programs).

**TABLE 4 UNIT COSTS FOR DIFFERENT PROGRAMS**

| Program | Unit costs (USD per patient reached per year) |
|---|---|
| Targeted non-ART prevention services for FSW (incl. condoms, HTC outreach) | 43$ |
| Targeted non-ART services for MSM (incl. condoms, HTC outreach) | 28$ |
| Targeted non-ART prevention services for DU (incl. condoms, HTC outreach) – not available, assumed the same cost as for MSM | 28$ |
| HIV testing and counseling services for the general population – HTC | 8$ |
| Condoms and SBCC for the general population (aged 25+) | 0.14$ |
| Condoms and SBCC for young adults | 0.3$ |
| Prevention of mother-to-child transmission (per woman living with HIV identified and provided with PMTCT) | 630$ |
| ART incl. other HIV care | 300$ |

## 4.5 Scenario analysis

We used the Optima HIV model to analyze the influence of different scenarios on the projected future trajectory of the country's HIV epidemic. In the baseline scenario, all aspects of HIV-related behavior (e.g. coverage of condom use, PMTCT, ART, use of new syringes etc.) were kept constant at the 2013 level. We assumed that program coverage scale-up or scale-down is achieved by 2020. The following scenarios were analyzed:

*a) Investments in specific programs*

- What is the projected future trajectory of Côte d'Ivoire's HIV epidemic if non-ART HIV prevention programs for key populations (female sex workers, men who have sex with men and drug users) are defunded? Defunding is assumed to increase risk behavior by 50% (e.g. condom use decreases by 50% and HIV testing rates decrease by 50%).

*b) Attaining the global 90/90/90 targets*

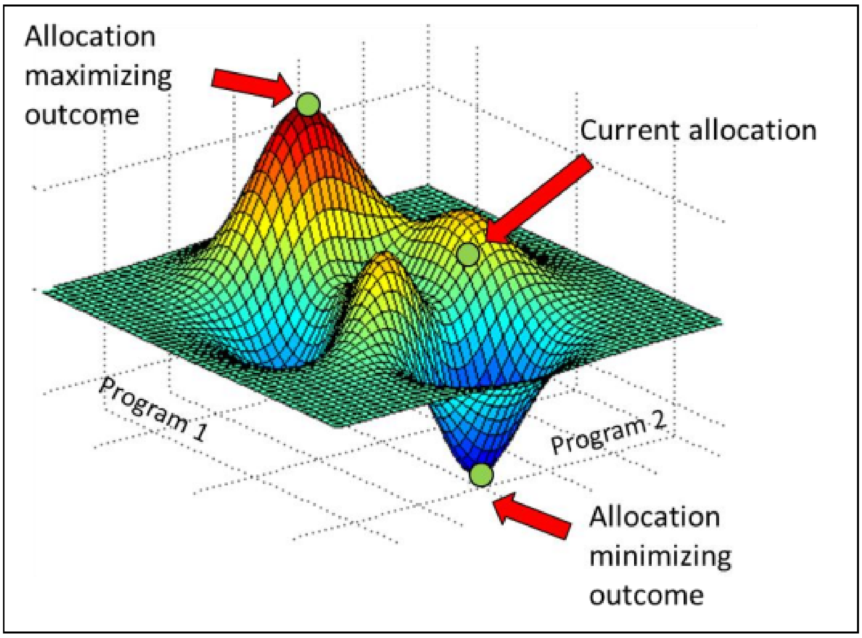
- What is the projected future trajectory of Côte d'Ivoire's HIV epidemic if, by 2020, 90% of all people living with HIV know their HIV status, 90% of all people with diagnosed

HIV infection receive sustained antiretroviral therapy, and 90% of all people receiving antiretroviral therapy have viral suppression?

## 4.6 Optimization

The mathematical optimization provided by the Optima HIV model is a formal and precise way to determine the "best" allocation of resources and spending to achieve different defined objectives (e.g. minimizing HIV incidence, minimizing HIV related deaths, or minimizing a weighted sum of these two). The model determines the allocation of resources that best meets the objective. This process can be graphically depicted as follows (Figure 11):

FIGURE 11 GRAPHICAL ILLUSTRATION OF OPTIMAL ALLOCATION OF RESOURCES INTO TWO PROGRAMS.




Source: UNSW unpublished documentation on Optima

## 4.7 Limitations of the analysis

### 4.7.1 Limitations specific to Côte d'Ivoire

- **Limited/scarce data:** Some data are not yet available for Côte d'Ivoire after 2011. The prevalence data for FSWs differ strongly between different sources. One likely reason for this is that the different surveys were conducted among different groups of FSW - for example, it is likely that the HIV prevalence differs between FSW coming to the clinics and FSW reached by IBBS. In addition, the calibration of the model had overall very few data points available on the HIV prevalence level in each of the chosen populations. There was also a lack of data on historical program spending, and little information to associate program spending to impact or performance. Some populations of interest could not be included as separate groups into the analysis due to lack of data. This includes populations of humanitarian concern, such as migrants.
- **Migration effects:** There is limited data available on the effects of migration (both within Côte d'Ivoire, and between Côte d'Ivoire and neighboring countries). Migration can influence

the HIV epidemic due to differences in HIV prevalence across the regions among other factors.

### 4.7.2 Limitations of the modeling methodology

The modeling methodology itself also had several limitations:

- In our approach, all changes in behavior are assumed to be due to changes in program funding. This assumption is common in epidemic models.
- The analysis uses past ratios of expenditure to coverage as a basis for determining program cost rather than unit costs. This approach of using past cost and results has a number of advantages over using projected costs from plans and budgets, which are ultimately predictions of future cost, but also has the disadvantage that there may be future increases or decreases in cost in relation to new approaches, implementation arrangements or technologies.
- The modelling approach we used to calculate relative cost-effectiveness between programs is not based on direct causal relationships, but instead on unit costs, observed ecological relationships between outcomes of program coverage or risk behavior and the amount of money spent on programs in the past, as well as the modelled impact of these programs on the epidemic.
- We did not determine the technical efficiency of programs as this was beyond the scope of this analysis. However, gains in technical efficiency would decrease unit costs and therefore affect optimal resource allocation.
- Effects outside the HIV endpoints are not considered (e.g. wider effects of PMTCT within maternal and child health, of condom use as a contraceptive, or effects of sex work interventions on other STIs).
- Our approach does not consider equity or quantification of human rights, stigma and discrimination, ethical, legal or psychosocial implications.
- The results of this analysis are influenced by our assumptions and the limitations of Optima HIV, and may differ from results produced by other models. We therefore encourage to compare the results of different modelling analyzes and understand the reasons causing these differences.

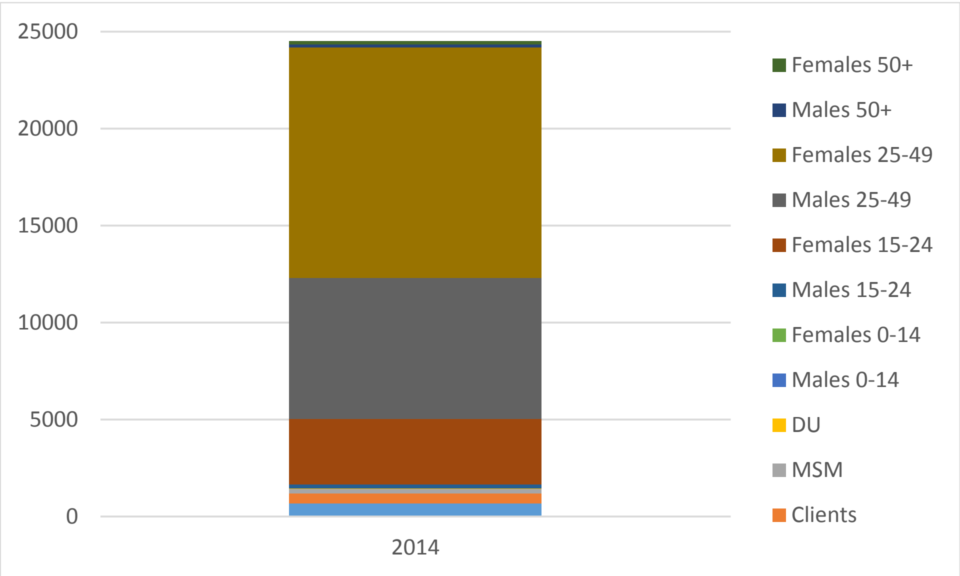
# 5. Results

This Section presents the results of the modeling including the projected trajectory of the HIV epidemic, the resource requirements for achieving the national strategic plan targets, the optimal resource allocation across populations, programs and geographical areas to maximize health benefits, and the HIV investment cascade given varying levels of available resources.

## 5.1 HIV transmission dynamics

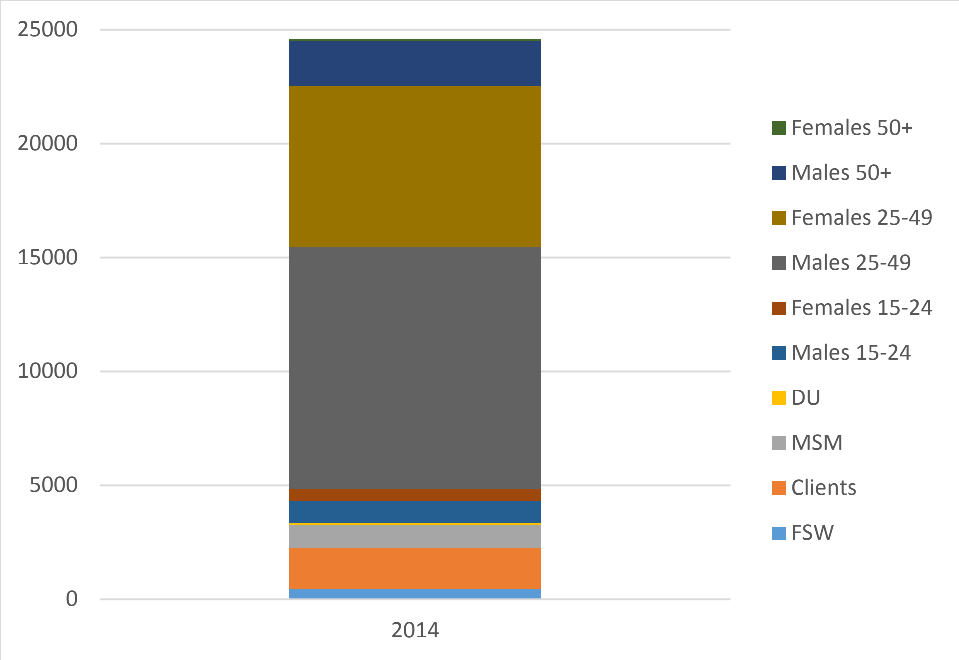
According to the Optima model, an estimated 33,700 new infections and 25,300 HIV-related deaths occurred in 2014. Of the new infections, most were estimated to occur among males (7,790; 23.1%) and females (12,500, 37.1%) aged between 25 and 49 years. An estimated 513 (1.5%) were predicted to occur among FSW, 430 (1.3%) among FSW clients, 90 (0.8%) among MSM, 20 (0.1%) among drug users, 8,300 (18.6%) among children, 220 (0.6%) and 3510 (10.4%) among young males and females aged 15-24 years respectively, and 150 (0.4%) and 170 (0.5%) among males and females aged 50 years and older respectively (Figure 12). In terms of transmission of new infections, 1.7% are predicted to have been transmitted by FSW, 7.5% by FSW clients, 4.0% by MSM, 0.5% by drug users, 3.9% and 2.1% by male and female youth, respectively, 43.1% and 28.7% by males and females aged between 25 and 49 years, respectively, and 8.1% and 0.3% by males and females aged 50 years and older, respectively (Figure 13). HIV incidence in 2014 was 1.0 per 100 person-years among FSW and 1.2 per 100 person years among MSM. For comparison, HIV incidence among the overall population was 0.2 per 100 person-years in 2014.

**FIGURE 12 NEW HIV INFECTIONS ACQUIRED BY POPULATION GROUP, CÔTE D'IVOIRE, 2014**




Source: Optima HIV application, February 2016. The number of new infections acquired by children is not included in the figure to help with comparisons with HIV transmission, but can be found in Figure 14.

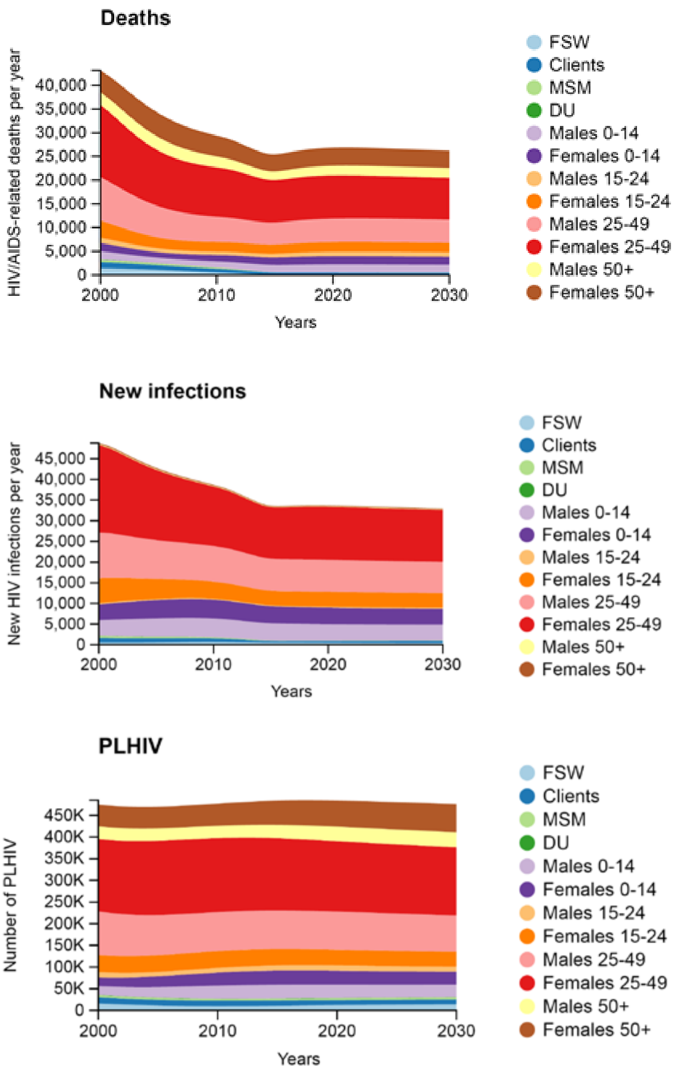
FIGURE 13 NEW HIV INFECTIONS TRANSMITTED BY POPULATION GROUP IN CÔTE D'IVOIRE, 2014



Assuming that all programs receive the same funding as in 2013 (total US$ 106 million, see Figure 10 for the distribution between different programs) each year until 2030:

- An estimated 33,700 (21,000-29,000 according to Spectrum) new infections and 25,300 (18,000-32,000 according to Spectrum) HIV-related deaths occurred in 2014
- An estimated 33,000 new infections and 26,300 HIV-related deaths would occur in the year 2029, representing reduction of 2.1% and increase by 4.0% in the annual numbers of new HIV infections and deaths, respectively (Figure 14).
- In 2029, there will be an estimated 476,200 persons living with HIV, compared to 483,500 (420,000-510,000 according to Spectrum) in 2014.

**FIGURE 14 PROJECTED NUMBERS OF HIV-RELATED DEATHS (PANEL A) NEW INFECTIONS (PANEL B), AND PLHIV IN DIFFERENT POPULATION GROUPS (PANEL C) BETWEEN 2000 AND 2030.**




Source: Optima HIV application, February 2016.

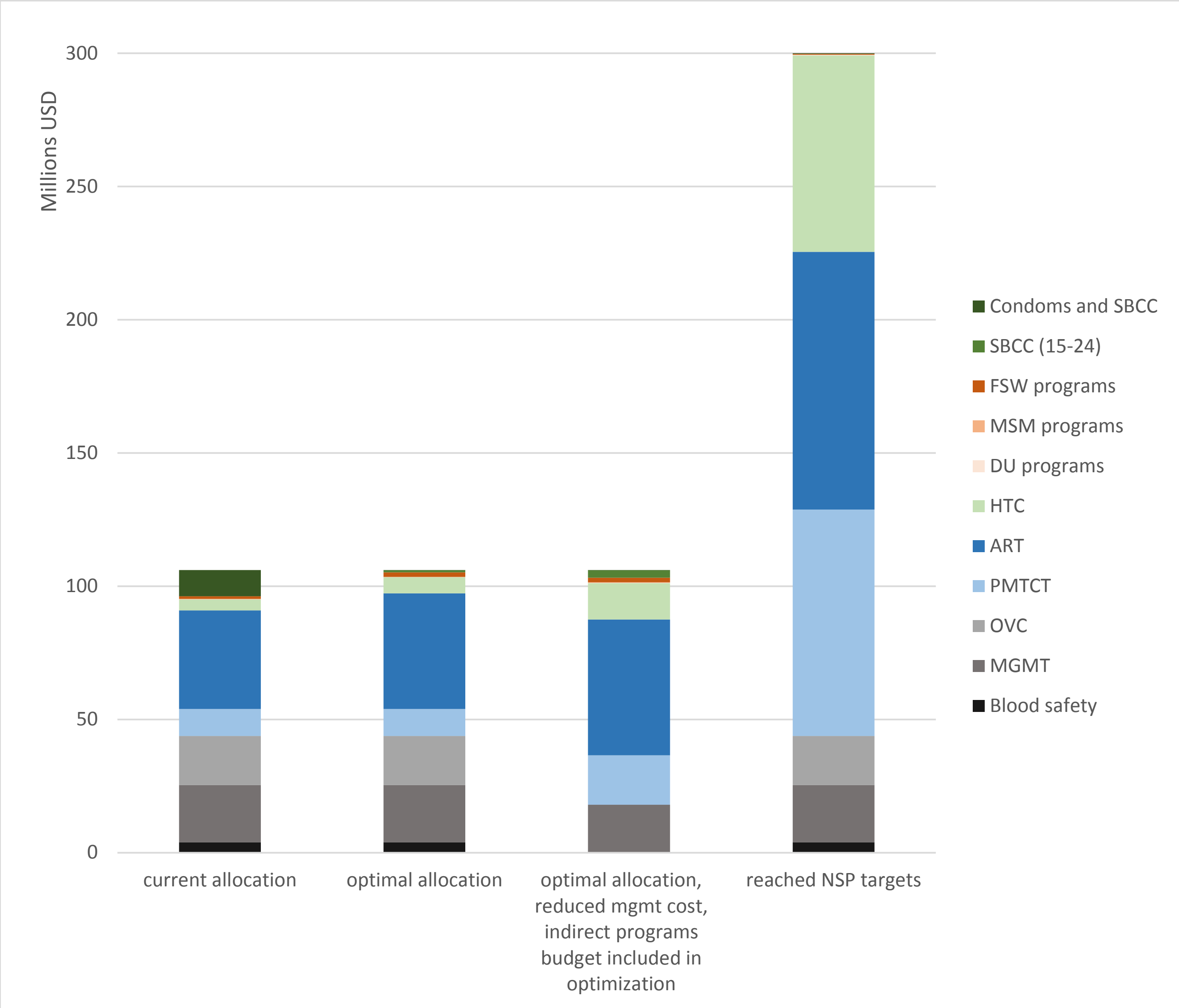
## 5.2 Achieving the National Strategic Plan targets

Côte d'Ivoire's current National Strategic Plan covers the period 2016-2020 and has an impact goal of reducing the number of new infections by 50% and the number of HIV-related deaths by 75% by 2020 compared with 2015. There were approximately 33,500 new infections and 25,500 HIV-related deaths in 2015. With the current budget (US$ 106 million) allocated between the programs in the same way as in 2015, the number of new annual infections and deaths are expected to remain relatively stable over the period 2015-2020. If spending on direct programs (programs with a measurable direct impact on HIV transmission and/or mortality that are included in the optimization) remained at the 2013 level (US$ 62.2 million) but was allocated optimally between programs to minimize new infections (50% weight) and HIV related deaths (50% weight), the number of new annual infections would decrease by 6% to 31,600 and the number of annual HIV-related deaths would decrease by 2% to 25,000 compared with 2015 over the NSP time period (optimal allocation, Figure 15 and Table 5). We assumed that the remaining spending (US$ 43.8 million), which was allocated to spending categories with no direct impact on the HIV response (such as program management) and/or with wider health benefits beyond HIV (such as blood safety), remained at the 2013 level. We also assumed that funding for PMTCT would not be reduced below the 2013 level.

However, if spending for management and administration was reduced by 14% (by reducing the allocation for coordination and administration of programs, which is part of management and administration, by 25%) to US$ 18 million, and if "indirect programs" such as OVC (including a favorable environment and social protection) and blood safety were financed from sources other than the HIV budget this would save US$ 25.8 million for the HIV budget. If this money was optimally allocated to the programs with a direct impact, the number of new annual infections would be expected to decrease by 17% to 27,800, and the number of annual HIV-deaths by 12% to 22,500 by 2020 (optimal allocation, Figure 16 and Table 5).

Reaching the NSP targets of reducing AIDS deaths by 75% and new HIV infections by 50% would require an additional US$ 194 million per year or US$ 300 million per year total (US$ 1.5 billion over the NSP period) which represents a 183% increase in the total budget. If money is saved from improved management efficiencies and indirect costs such as OVC (including a favorable environment and social protection) and blood safety are financed from other budgetary sources, an addition US$ 168.2 million per year would be required to reach the NSP targets (159%) increase in the total budget. The NSP time period is only five years and reducing deaths by 75% in this short period would be particularly expensive. The optimal allocation of the budget between programs is presented in Figure 15 and Table 5. The NSP targets prioritize the reduction of HIV-related deaths over the reduction of new infections. Because of this, programs focusing on diagnosing and treating people living with HIV (ART, PMTCT and HTC) are prioritized over purely preventative programs. In order to achieve the NSP target, funding for HTC should be dramatically increased (18 times), ART should get 2.6 times more funding, and PMTCT 8 times more funding compared to 2013. Optimal allocations of a lower budget that gives more weight to reducing HIV incidence than mortality would recommend for a higher allocation for non-ART prevention programs. Aiming to minimize only HIV-related deaths and ignoring new infections is not recommended since this would influence the future need for investments in treatment and care.

**FIGURE 15 CURRENT AND OPTIMAL ALLOCATION OF FUNDING BETWEEN PROGRAMS WITH CURRENT BUDGET, AND WITH A BUDGET NEEDED TO ACHIEVE NSP TARGETS. SEE TABLE 5 FOR DETAILED SPENDING.**




Source: Optima HIV 2016

TABLE 5 CURRENT AND OPTIMAL ALLOCATION OF THE CURRENT BUDGET AND THE BUDGET NEEDED TO ACHIEVE NSP TARGETS

| | Current allocation | | Optimal allocation | | Optimal allocation (reduced management costs)** | | Budget increased and allocated optimally to achieve NSP targets | |
|---|---|---|---|---|---|---|---|---|
| | USD | %** | USD | %** | USD | %** | USD | %** |
| **Blood safety** | **3'965'614** | **3.74%** | **3'965'614** | **3.74%** | - | **0.0%** | **3'965'614** | **1.3%** |
| **MGMT** | **21'345'909** | **20.13%** | **21'345'909** | **20.13%** | **18'018'413** | **16.99%** | **21'345'909** | **7.1%** |
| **OVC*** ** | **18'520'146** | **17.47%** | **18'520'146** | **17.47%** | - | **0.0%** | **18'520'146** | **6.2%** |
| PMTCT | 10'078'639 | 9.50% | 10'078'639 | 9.5% | 18'522'497 | 17.5% | 84'972'653 | 28.3% |
| ART | 37'040'353 | 34.93% | 43'433'961 | 41.0% | 50'958'180 | 48.1% | 96'663'995 | 32.2% |
| HTC | 4'119'532 | 3.88% | 6'051'451 | 5.7% | 13'635'597 | 12.9% | 73'724'844 | 24.6% |
| Non-ART DU programs | 19'151 | 0.02% | 18'633 | 0.0% | 127'086 | 0.1% | 161'461 | 0.1% |
| Non-ART MSM programs | 190'652 | 0.18% | 88'202 | 0.1% | 258'489 | 0.2% | 131'959 | 0.0% |
| Non-ART FSW programs | 991'028 | 0.93% | 1'742'626 | 1.6% | 1'729'419 | 1.6% | 345'904 | 0.1% |
| Condoms and SBCC (15-24) | 26'634 | 0.03% | 755'646 | 0.7% | 2'713'755 | 2.6% | 13'778 | 0.0% |
| Condoms and SBCC | 9'743'235 | 9.19% | 42'066 | 0.0% | 79'457 | 0.1% | 153'736 | 0.1% |
| **Total** | **106'040'892** | **100.0%** | **106'042'892** | **100.0%** | **106'042'892** | **100.0%** | **299'999'999** | **100.0%** |

* Management costs are reduced by 14% (representing a 25% reduction in the budget for planning and coordination). Blood safety and OVC including favorable environment and social protection are assumed to be funded from other sources, as these are not HIV specific programs, and they are needed in the country regardless of the HIV epidemic. The money saved is freed-up for optimization and is reallocated to the direct programs.

**Proportion of total budget

***Also includes favorable environment and social protection

## 5.3 Optimal resource allocation for maximum long-term impact

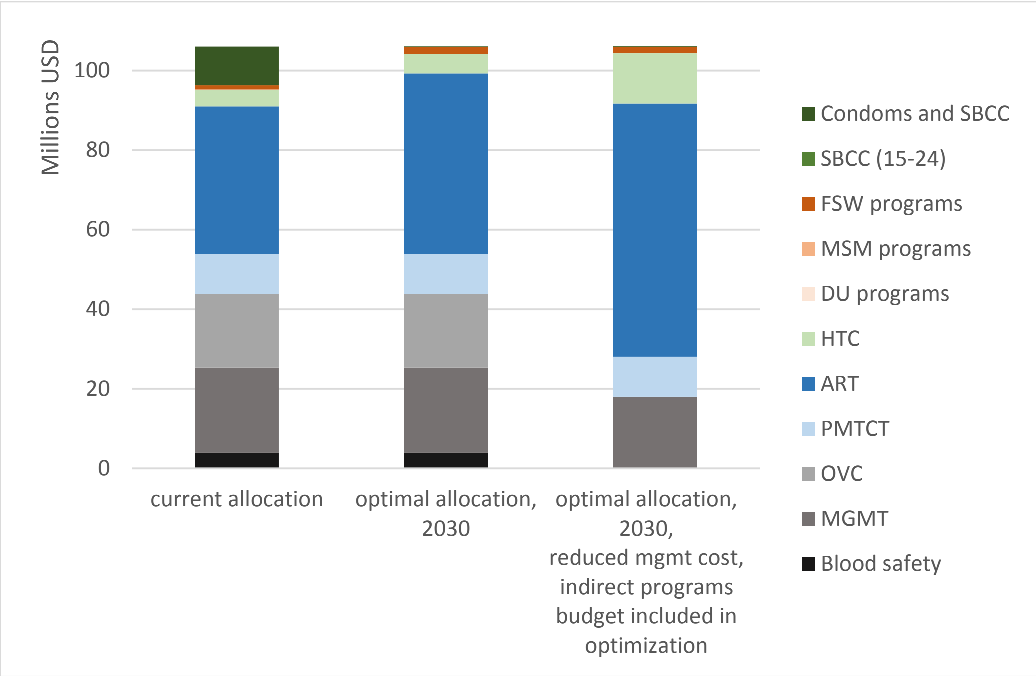
**For maximum long-term impact, HIV financial resources should be shifted from prevention programs targeting the low-risk general population to the scale-up of HTC and treatment (for the general and key populations), while increasing resources for non-ART prevention programs targeting FSW.**

One of the key aims of this analysis was to determine the optimal allocation of current HIV financial resources (106 million US dollars annually) for the period 2016-2030 to minimize the number of new HIV infections and AIDS-related deaths over this time period. We assumed that preventing one new infection and one death would be weighted equally. To answer this question, we used Optima HIV's optimization algorithm, which combines information on the relationship between costs and outcomes of each program (Annex 3, Cost-coverage curves).

Compared to the 2013 spending pattern, minimizing HIV incidence and HIV-related mortality until 2030 would prioritize the scale-up of HTC and ART for all populations, and increase resources for non-ART HIV prevention programs targeting FSW (Figure 15 and Table 6). Since the total budget remains unchanged, this means that financing for prevention programs targeting the low-risk general population would be reduced. In addition, while the model recommends that financing for non-ART prevention programs for MSM and DU be decreased, the total funding for MSM and DU would increase due to increased ART coverage (Figure 17). Total funding for FSW would increase by 33%. Specifically (Figure 17 and Table 6):

- Spending on ART (general population and key populations) should be increased from 35% to 41% of the total budget.
- Spending on HTC should be increased from ~4% to ~6% of the total budget
- Spending on non-ART prevention programs targeting FSW should increase from ~1% to ~2% of the total budget
- Financing for condom promotion and SBCC targeting the low-risk general population (excluding youth) should be reduced from ~9% to less than 0.1% of the total budget.
- Financing for condom promotion and SBCC targeting youth and young adults (aged 15-24 years) should more than double, however, from ~0.03% of the budget to ~0.07% of the budget
- Optimization of the current budget (annual average of USD 106 million) to minimize HIV incidence and mortality would avert 31,500 new infections and 31,300 HIV related deaths during the period 2016-2030 compared to maintaining the current allocation
- Based on the current funding envelope, the modelling results reinforce the need for more targeted HIV prevention programs for certain population groups including prioritizing condom promotion and SBCC for youth and young adults over the low-risk general population.

**FIGURE 16. CURRENT AND OPTIMAL ALLOCATION OF THE HIV BUDGET (2015 LEVEL).**




Source: Optima HIV application, May 2016.

TABLE 6 CURRENT ALLOCATION AND THE OPTIMAL ALLOCATION WITH THE CURRENT BUDGET; OPTIMAL ALLOCATION WITH REDUCED MANAGEMENT COST AND INDIRECT PROGRAMS INCLUDED IN OPTIMIZATION

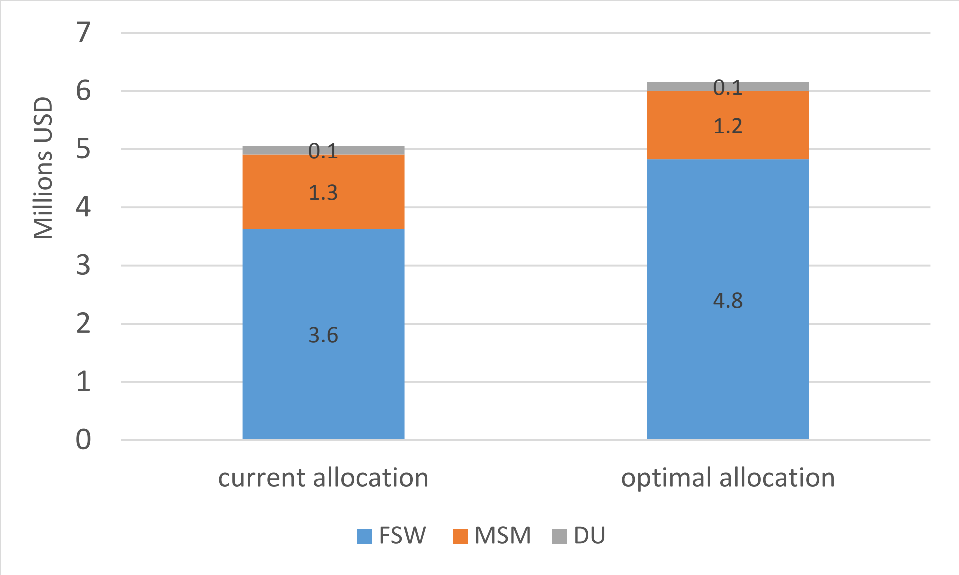
| | Current allocation | | Optimal allocation | | Optimal allocation, (reduced management costs)* | |
|---|---|---|---|---|---|---|
| | USD | %** | USD | %** | USD | %** |
| **Blood safety** | **3,965,614** | **3.74%** | **3,965,614** | **3.74%** | **-** | **0.00%** |
| **Management** | **21,345,909** | **20.13%** | **21,345,909** | **20.13%** | **18,018,413** | **16.99%** |
| **OVC*** ** | **18,520,146** | **17.47%** | **18,520,146** | **17.47%** | **-** | **0.00%** |
| PMTCT | 10,078,639 | 9.50% | 10,078,639 | 9.50% | 18'522'497 | 17.5% |
| ART | 37,040,353 | 34.93% | 43'433'961 | 41.0% | 50'958'180 | 48.1% |
| HTC | 4,119,532 | 3.88% | 6'051'451 | 5.7% | 13'635'597 | 12.9% |
| Non-ART DU programs | 19,151 | 0.02% | 18'633 | 0.0% | 127'086 | 0.1% |
| Non-ART MSM programs | 190,652 | 0.18% | 88'202 | 0.1% | 258'489 | 0.2% |
| Non-ART FSW programs | 991,028 | 0.93% | 1'742'626 | 1.6% | 1'729'419 | 1.6% |
| Condoms and SBCC (15-24) | 26,634 | 0.03% | 755'646 | 0.7% | 2'713'755 | 2.6% |
| Condoms and SBCC | 9,743,235 | 9.19% | 42'066 | 0.0% | 79'457 | 0.1% |
| **Total** | **106,040,892** | **100.00%** | **106,042,892** | **100.00%** | **106,042,892** | **100.00%** |

* Management costs are reduced by 14% (representing a 25% reduction in the budget for planning and coordination). Blood safety and OVC including favorable environment and social protection are assumed to be funded from other sources, as these are not HIV specific programs, and they are needed in the country regardless of the HIV epidemic. The money saved is freed-up for optimization and is reallocated to the direct programs.

**Proportion of total budget

***Also includes favorable environment and social protection

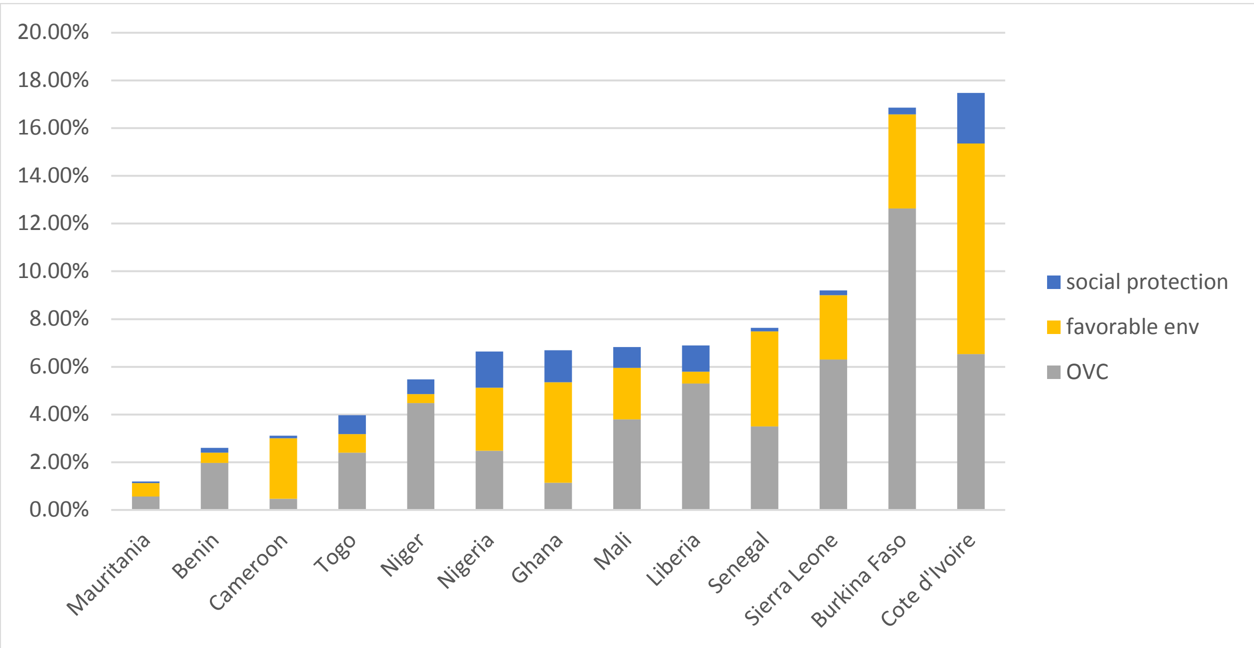
FIGURE 17 TOTAL SPENDING FOR KEY POPULATIONS (INCLUDING NON-ART PREVENTION PROGRAMS AND ART)




Source: Optima HIV application, February 2016.

A considerable part of the HIV budget in Côte d'Ivoire (37%) is spent on management and administration and other indirect programs (their direct influence on HIV epidemics is not known and/or they have wider societal benefits beyond HIV/AIDS). The proportion of the HIV budget spent on OVC in Cote d'Ivoire is the second highest in the region while the proportion spent on social protection and a favorable environment is higher than any other country in the region (Figure 18)[28].

FIGURE 18 PROPORTION OF THE HIV BUDGET SPENT ON OVC, SOCIAL PROTECTION AND FAVORABLE ENVIRONMENT IN WEST AFRICAN COUNTRIES.




Source: NASA reports, http://www.unaids.org/en/dataanalysis/knowyourresponse/nasacountryreports

[28] This does not take into account overall budget and total number of PLHIV.

Within the current budget envelope (current level of resources) an additional USD 25.8 million could be allocated to direct HIV prevention and care programs if the budget for planning and coordination of programs was decreased by 25% (the total funding for management and administration would be decreased by 14%) and indirect programs that have benefits beyond HIV (such as OVC including social protection and a favorable environment; and blood safety) were funded from other sources. The optimal allocation of the budget with the additional funding would increase the budget for ART up to USD 51 million and HTC up to USD 13.6 million compared to USD 43.4 million and USD 6.1 million with the reduced budget allocated optimally (allocated as per current expenditure) respectively. This increased budget would also allow for additional financing for non-ART MSM and DU programs (see Figure 17 and Table 6). The optimal allocation must take into account the factors influencing both new infections and deaths. In order to minimize new infections only, we would see a different picture where other non-ART prevention programs targeting the non-drivers of the epidemic become more important (PMTCT, condoms and SBCC as well as key populations programs would have much higher priority than in a scenario with minimizing HIV-related deaths only), as shown in Supplement Figure 7 and Supplement Table 2 in Annex 5. Minimizing new infections only and deaths only.

**These shifts in allocation emphasize the relatively high effectiveness of ART in population level reductions in transmission and for individual clinical benefit, the need of broader scale testing and focusing non-ART prevention programs for youth and FSW.**

## 5.4 HIV investment cascade

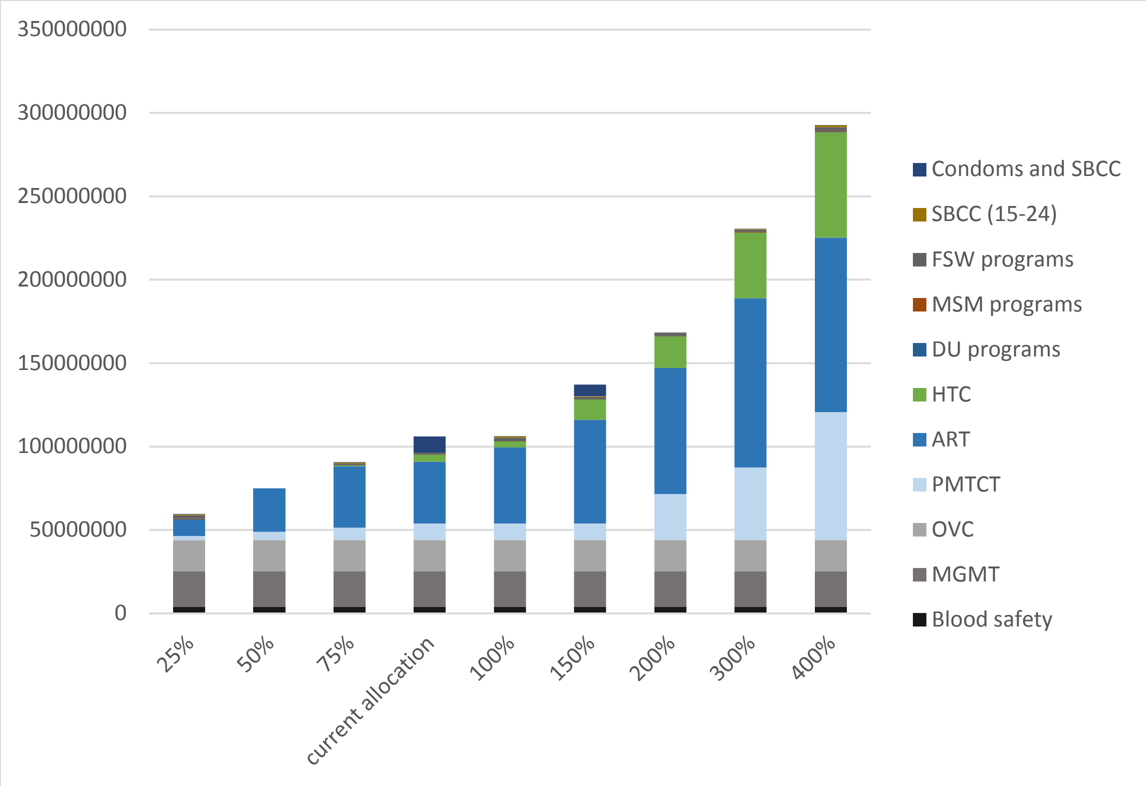
If HIV funds are either very limited or more abundant, allocations can be guided by an investment cascade. This helps to prioritize expenditures with different levels of funding available to minimize new HIV infections and HIV-related deaths (Figure 19).

- If the total budget is reduced from the 2013 level, HTC and ART for the general and key populations should be given first priority, followed by spending on prevention programs targeting FSW.
- With larger budgets, ART and HTC should be further scaled up.
- If the total optimizable budget is increased at least 2-fold, HTC and PMTCT should be massively scaled up, and prevention programs for key populations (especially FSW) and youth should also receive more funding.

In the investment cascade shown in Figure 19, there was a constraint that the budget for PMTCT cannot be reduced for the current or a higher budget. For budgets 25%, 50% and 75%, PMTCT was constrained to receive at least 25%, 50%, 75% of the current PMTCT funding respectively.

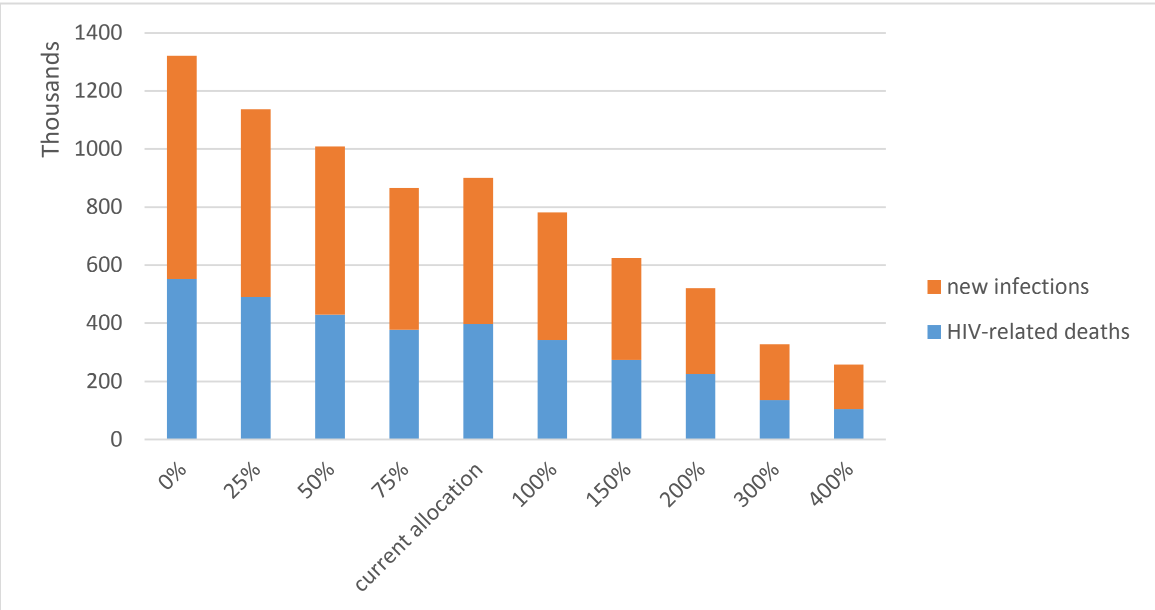
Without any funding, 552,100 HIV-related deaths and 769,500 new HIV infections are expected to occur in Côte d'Ivoire between 2016 and 2030 (Figure 20). The number of deaths and new infections decrease gradually with increasing budget, if the available funding is allocated optimally. With 75% of the currently available direct-program funding, similar or better results than now could be achieved if the funding is allocated optimally. If four times more funding was available to the direct programs than now, only 104,700 HIV related deaths and 153,000 new infections would be expected during the period 2016-2030.

FIGURE 19 INVESTMENT CASCADE FOR VARIABLE BUDGET: OPTIMAL ALLOCATION OF BUDGETS RANGING BETWEEN 25% AND 400% OF THE CURRENT OPTIMIZABLE BUDGET




Source: Optima HIV application, February 2016. The percentages refer to the optimizable budget (i.e. excluding funding allocated to management, blood safety and OVC).

FIGURE 20 PROJECTED HIV RELATED DEATHS AND NEW INFECTIONS WITH DIFFERENT LEVELS OF SPENDING ALLOCATED OPTIMALLY BETWEEN 2016 AND 2030.

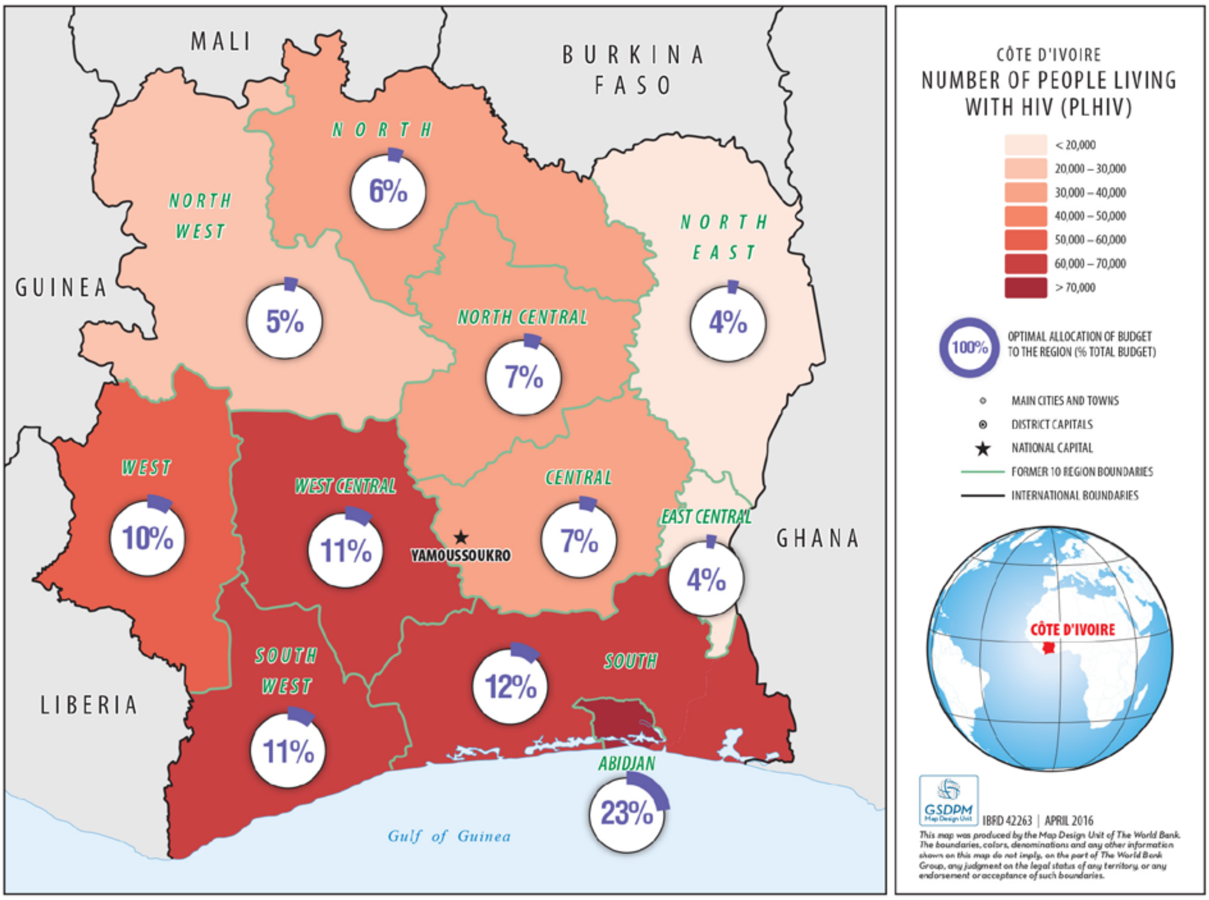


Source: Optima HIV application, February 2016

## 5.5 Geographical prioritization analysis

We extended the analysis to enable geospatial targeting of resources. We gathered HIV prevalence and population size data across each of the 11 regions of Côte d'Ivoire. There is variance in HIV prevalence across Cote d'Ivoire. The Optima HIV model used geospatial epidemiological data with costing data and the optimization algorithm to determine the optimal funding level for each region when considering the national budget, heterogeneous epidemiology and relationship between funding and cost-effectiveness ratios in each region. It was calculated that further infections and deaths could be averted by shifting resources optimally between regions, roughly commensurate with overall burden. Specifically, it was calculated that Abidjan is the region that should ideally receive greatest prioritization (optimally receiving 23% of the budget compared with 26.4% of people living with HIV), followed by South (12% of the budget, 12.3% PLHIV), South West (11% of the budget, 11.2% of PLHIV), West Central (11% of the budget, 11.3% of PLHIV), and West (10% of the budget, 10.1% of PLHIV), see Figure 28. Despite the need for more geographical prioritization, it was found that all regions need attention (resourcing of combinations of programs) in order to reach national targets.

**FIGURE 21 NUMBER OF PEOPLE LIVING WITH HIV PER DISTRICT AND THE OPTIMAL ALLOCATION OF THE NATIONAL BUDGET PER DISTRICT.**




Source: Optima HIV application, February 2016

## 5.6 Expected future impact of policy and program implementation scenarios

The Optima HIV model was used to analyze the influence of different scenarios on the projected future trajectory of the country's HIV epidemic. 2015 was used as the year of baseline expenditure, assuming that the allocation in 2015 was the same as in 2013.

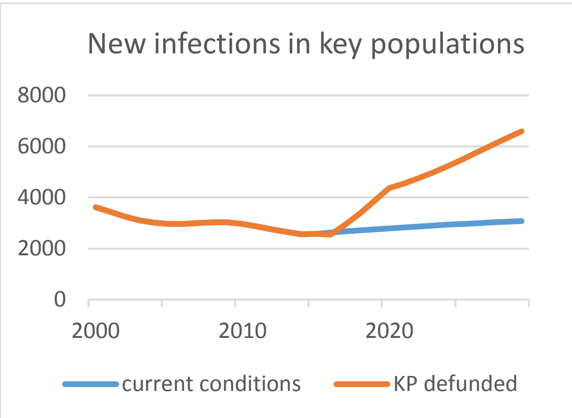
### 5.5.1 Investments in specific programs

*Scenario 1:* What is the projected future trajectory of Côte d'Ivoire's HIV epidemic if programs for key populations are defunded?

**Defunding HIV prevention programs targeting key populations would have a negative impact on the HIV epidemic as well as on long-term HIV-related costs**

In this analysis, we examined the influence of defunding programs for the key populations: FSW, clients of FSW, MSM and drug users (focusing on injectors). We used 2015 as the year of baseline expenditure, assuming that the allocation in 2015 was the same as in 2013. We assumed that high-risk behavior among key populations would increase gradually and by 2020 there would be a 50% decrease in: condom use between sex workers and clients, condom use among MSM in casual partnerships, and the use of clean syringes and needles by injecting DU. We further assumed that during the same period treatment-seeking behavior (uptake of HIV testing) among key populations would decrease by 50% till 2020 (and remain on the 2020 level till 2030) compared with the level of the baseline year (2015). We found that defunding prevention programs for key populations would result in an increase in the number of new HIV infections among key populations by 52% between 2016 and 2030 (Figure 22). The number of new infections overall is estimated to increase by 4.4%. Cumulative HIV related costs between 2014 and 2030 would increase by 1.1%.

**FIGURE 22 NEW INFECTIONS AMONG KEY POPULATIONS (FSW, MSM, DRUG USERS) UNDER CURRENT CONDITIONS AND WITH THE DEFUNDING OF KEY POPULATION PROGRAMS**



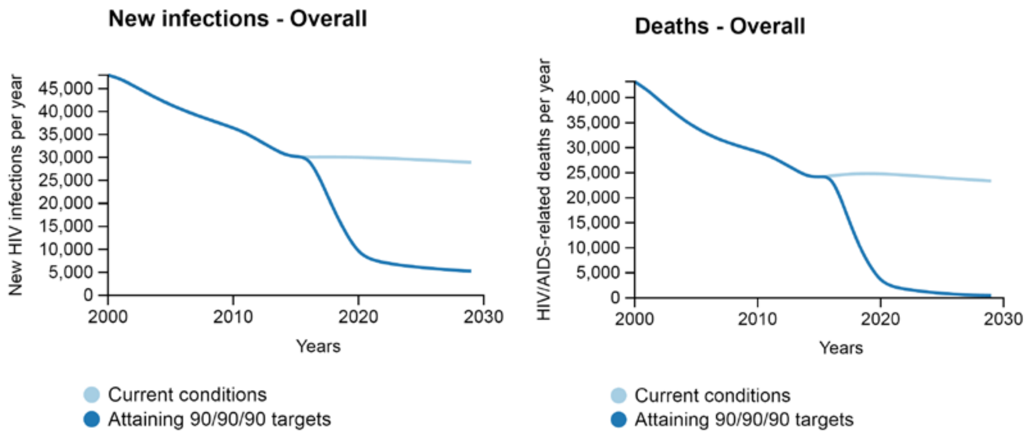

Source: Optima HIV application, April 2016.

*Scenario 2:* What is the projected future trajectory of Cote d'Ivoire's HIV epidemic if, by 2020, 90% of all people living with HIV know their HIV status, 90% of all people with diagnosed HIV infection receive sustained ART, and 90% of all people receiving ART have viral suppression?

**Reaching 90/90/90 goals would have a significant positive impact on the HIV epidemic as well as on long-term HIV-related costs.**

In this analysis, we examined the impact of reaching the 90/90/90 goals on the HIV epidemic. We used 2015 as the year of baseline expenditure, assuming that the allocation in 2015 was the same as in 2013. It is estimated that reaching the 90/90/90 goals in Cote d'Ivoire would avert 263,300 new infections (63% of predicted new infections with the baseline expenditure) and 265,600 HIV-related deaths (78% of predicted new infections with the baseline expenditure) by 2030 (Figure 23).

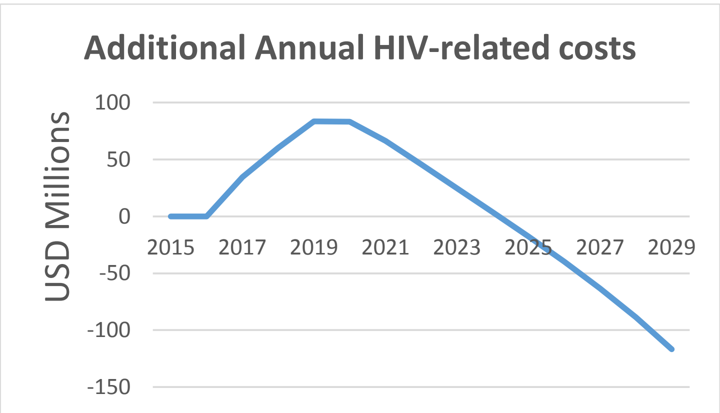
FIGURE 23. PROJECTION OF HIV-RELATED DEATHS AND NEW INFECTIONS WITH CURRENT CONDITIONS AND WITH REACHING THE 90/90/90 GOALS




Source: Optima HIV application, February 2016.

If the 90/90/90 targets were reached by 2020, HIV-related costs would initially increase due to scale-up of ART and testing (requiring an additional $284 million) and then decrease due to reduced new infections (total HIV-related costs would reduce by $121 million between 2015 and 2030) (Figure 24). An additional $284 million would be required to achieve these goals by 2020.

FIGURE 24 THE ADDITIONAL HIV-RELATED COST IN CASE OF REACHING 90/90/90 TARGETS BY 2020



# 6. Discussion

## 6.1 Epidemic spread and potential

Côte d'Ivoire has a mixed epidemic, with an overall HIV prevalence of 3.5% among adults aged between 15 and 49 years. HIV prevalence among certain key populations, such as FSW (11.7%-28.7%), MSM (18%), and drug users (9%), is substantially higher. The large number of FSWs, combined with the very high prevalence among this group, may have been a major driving force of the HIV epidemic in Cote d'Ivoire. The crises in Côte d'Ivoire between 2002 and 2011 increased poverty, forcing more women into sex work, and weakened the health system. Nevertheless, the overall HIV prevalence in the country has been decreasing, albeit slowly, after it reached its peak value of 5.5% in 1999. Our predictions show that this decreasing trend will continue in the next 15 years, if the financial investment in the national HIV response stays at current levels. However, a significant increase in the level of financing will be needed to have dramatic reductions in the number of new infection and AIDS deaths, and to achieve the ambitious targets set out in the National Strategic Plan (2016-2020) of reducing the number of new infections by 50% and HIV-related deaths by 75% by 2020. It is estimated that an additional USD 194 million per year, optimally allocated, is required over the period 2016-2020 to achieve the NSP targets. The optimal allocation of financial resources for reaching the NSP targets by 2020 favors the scale-up of ART for all population groups, HTC, and PMTCT, while reducing financial resources focused on non-ART prevention interventions among the low-risk general population, such as the promotion of condom use and behavioral change (except for youth). While the NSP gives higher priority for preventing deaths, prevention of new infections should not be neglected. Optimizing the budget for minimizing deaths only without considering ongoing transmission would influence future investments in treatment and testing. If the same weight is put on reducing incidence and mortality, non-ART prevention programs for FSW should be scaled up. Both ART and HTC should be scaled up regardless of whether the relative priority in the targets of the national HIV response is on reducing mortality or HIV incidence that is the weighting of averting deaths and new infections. Rapidly scaling up HTC and improving the effectiveness of testing services in Cote d'Ivoire are prerequisites to achieving the NSP targets and should be part of the strategy to reduce HIV incidence and minimize deaths. In addition, ART scale-up is important in and of itself but also as a prevention strategy.

## 6.2 Funding for the national HIV response

Like most resource-constrained countries, Côte d'Ivoire relies heavily on international support for financing its national HIV response. In 2013, 86% of the total HIV funding came from international sources, with 76% of the total HIV funding coming from the US Government. About one seventh of the HIV response was financed from domestic sources, primarily with public funds, but also partly by direct household spending. Globally, international financing for HIV has decreased and this trend is expected to continue. A situation where international financing for the HIV response continues to decrease leads to several considerations. First, the uncertainty in long-term international funding means that the country should attempt to mobilize additional domestic resources for the national response. In addition to increased public funding, the involvement of private companies and enterprises in the national HIV response should be promoted and supported. Second, the country must be prepared for a reduction in international funding and understand the possible implications of such reductions in funding. We demonstrated, for example, that defunding of the non-ART prevention programs for FSW, MSM and drug users—that may happen if there is a substantial decrease in international donor funding—would increase the number of new infections among key populations by 52% and by 4.4% in the overall population by 2030. While incidence is higher among key populations, the majority of new infections still occur among the general population because of the relatively large size of the general population compared to key populations. Programs for key populations are not only important in reducing HIV incidence for key populations, they also are important in protecting the general low-risk population, and they have likely played a role in preventing a more generalized epidemic in Côte d'Ivoire. The high-risk key populations such as FSWs are closely linked with the low-risk general population through bridge populations such as clients of sex workers who may spread the infection from FSW to their regular partners (young women). Finally, the likely decrease in total funding calls for more efficient use of the available resources. It is essential that Côte d'Ivoire maximizes the health benefits from the resources it has, both international and domestic. This can be done through a more efficient allocation of resources across programs, populations and regions. All regions of Côte d'Ivoire require attention, and our findings suggest that the funding allocated between regions should be roughly proportional to the number of PLHIV living in the area. The geographical prioritization results are preliminary and do not take into account travel patterns of the population.

## 6.3 Optimal HIV resource allocation

In our optimization analysis for long-term impact (up to 2030), we found that resources should be shifted from non-ART prevention programs focusing on the lower-risk general population to testing and treatment for all. Non-ART prevention programs should primarily target the key populations who are at higher risk of having or acquiring HIV. The reasons behind the shift towards treatment, in particular antiretroviral therapy, are easy to understand. As demonstrated by Cohen et al[29], antiretroviral therapy not only helps the treated patients, but also effectively prevents onward transmission. Globally, the role of testing and ART in the response to HIV is underscored in strategies such as the global "90-90-90" targets, which focus on diagnosing people living with HIV, initiating them onto therapy, and maintaining viral suppression among those on treatment. This demonstrates that testing and treatment are now also seen as a major method of prevention. Our results – showing that resources should be shifted from purely preventive interventions among the general population (such as condom distribution and behavioral change) to HTC and ART - supports this global trend.

In our model, ART was not divided according to population groups, since we expect that all patients diagnosed with HIV should have equal access to therapy according to the guidelines in place, regardless of their individual characteristics or risk behavior. Based on our results, funding for all non-ART prevention programs (apart from programs targeting FSW, drug users and youth) should be decreased, since more resources are needed for HTC and antiretroviral therapy, but the magnitude of decrease differed greatly between the programs. Condom and SBCC programs for the general population aged 25 years and older were clearly defunded even if the total available budget was higher than it is currently. Programs promoting condoms and less risky behavior among the general population only prevent HIV acquisition or transmission if these programs have a high impact; being targeted by a promotion campaign does not directly imply any behavioral changes and the impact of such programs for the general population are questionable. HTC on the other hand is also needed to promote ART, by identifying HIV infected people as early as possible. Of the key population programs, FSW programs should get more funding, while MSM and DU non-ART prevention programs should be maintained at the current levels.

[29] Cohen et al. 2011. Prevention of HIV-1 Infection with Early Antiretroviral Therapy. N Engl J Med 2011; 365:493-505

Targeting FSWs can prevent new infections among the bridge populations (FSW clients) and consequently slow down onward transmission. Funding for programs targeting young people should also be maintained.

Côte d'Ivoire spends a one fifth (20.1%) of the total HIV budget on management and administration (including HR, research and infrastructure) of the HIV response. It is close to the West African average. Since management does not have a direct effect on reducing infections and deaths, we were not able to optimize this program. However, we recommended exploring the reduction of the budget for management by 14% (program coordination and administration by 25%) to gain more funding for the programs directly influencing HIV epidemics. Furthermore, the HIV budget is currently used to fund programs that are needed in the country regardless of the HIV epidemic, such as support for orphans and vulnerable children, and blood safety. These programs are also essential for the HIV response and should not be defunded, but it should be considered if they could be funded from the general healthcare budget instead, as their main benefits are not in HIV prevention and care. If the management of the HIV program could be made more efficient and OVC and blood safety funded from other sources, the budget available for direct HIV prevention and treatment programs would increase by over US$ 25 million each year. This would more than double the number of infections and deaths that can be averted with optimizing financial resources.

## 6.4 Strengths and limitations of this analysis

Mathematical modeling is a powerful tool to predict the development of epidemics. Models can be based on the existing evidence, parameterized with routinely collected and observed data. Mathematical models can be used to produce long-term predictions on the development of the epidemic under numerous different scenarios, to compare the effect of different interventions, and to inform decision-making.

This analysis was performed using Optima HIV, a widely recognized model of HIV disease progression and transmission. Optima HIV uses mathematical optimization to find the mix of spending between programs that gives the greatest benefit in terms of averted new infections, averted deaths, or both. Optima HIV has been used for similar allocative efficiency studies for a number of countries worldwide.

However, we must acknowledge some limitations. There is substantial uncertainty around some of the input parameters, which also leads to uncertainty in the outcomes. However, as with all modeling, this exercise used the best data available to produce guidance for decision making as the logical implication of available evidence. Key parameters influencing the results include the population size estimates, HIV prevalence and risk behavior in different population groups: the availability of such data for Côte d'Ivoire were limited, and often based on small-size surveys among accessible sub-populations. It may be questionable to extrapolate such results into the whole population group: for example, prevalence and behavior may differ substantially between sex workers who work in brothels or on the street and are thus easier to access and overrepresented in the surveys, and "hidden" sex workers contacting customers primarily through the internet.

The results of mathematical modeling studies should always be interpreted with caution. Decisions that may influence the lives and health of the people should never be made based solely on the findings of one particular modeling approach, without thoroughly considering the assumptions, input parameters, limitations and uncertainty of results. Ideally, the stakeholders should rigorously search and review the available body of evidence including also other published clinical studies and mathematical models.

# 7. Conclusions

Côte d'Ivoire has one of the largest HIV epidemics in West Africa, in terms of both prevalence and the number of people living with HIV. The national HIV response relies primarily on international donor funding, which is currently decreasing and its availability in the long-term is uncertain. Therefore, there is an urgent need to mobilize additional domestic resources, and reallocate the currently available funding (as well as any future financial resources mobilized) in a manner that maximizes health benefits. Côte d'Ivoire's HIV epidemic is mixed: the prevalence among the general population is relatively high, but the epidemic is also highly driven by high-risk key populations. Our findings have shown that interventions targeting especially FSW are essential for controlling the epidemic, and preventing new infections and deaths also among the general population. Resources should be shifted from purely prevention interventions, targeting mainly the general low-risk population, towards HTC and treatment for everyone who is HIV positive (both general population and key populations). Achieving the ambitious targets of the National Strategic Plan is impossible with the level of financial resources currently available. This will require an increase in overall financial resources available for the national HIV response and exploring opportunities for achieving efficiency gains. For example, additional resources may be available for programs if management and administration can be made more efficient, and if the costs of indirect programs with wider health sector benefits such as blood safety, and OVC programs could be borne by other non-HIV financing. However, this alone is not enough. Achieving the NSP goals requires more funding and will require the ramping up of resource mobilization efforts—both domestic and international—, allocating these resources most efficiently, improving the efficiency within each program and spending category, and a fair financing of programs with multiple benefits between HIV and other health sector budgets.

# ANNEX 1. Technical data in Optima HIV model

## 1.1. Data Collation and Synthesis

Performing our evaluations of HIV prevention and treatment programs required a large amount of data describing the HIV epidemiology, population demographics, acquisition related behavior, clinical characteristics, and HIV program and health costs.

### 1.1.1. Data Collation.
In order to evaluate programs, their funding, coverage and outcomes we collated data from all available publications, documents, reports, and data files. The data included:

1. Estimated population sizes for different age groups of the general population and the key populations or most at-risk populations (MARPs).
2. The epidemiological characteristics of the HIV epidemic. Specifically, we obtained data on HIV prevalence, annual HIV diagnoses, number of people currently on first- and second-line antiretroviral therapy (ART), and number of reported or estimated mother-to-child transmissions.
3. Descriptions of risk behavior, HIV transmission patterns, and health-care seeking behavior. We used this data to understand modes of HIV transmission between populations and the risk of HIV acquisition. Specific data collected includes characteristics of sexual behavior (number of sexual acts with regular, casual and commercial partners and level of condom usage in sexual acts), and rates at which people in specific populations test for HIV.
4. HIV program funding, spending data from National AIDS Spending Assessments and health utilities for PLHIV at all stages of disease progression.

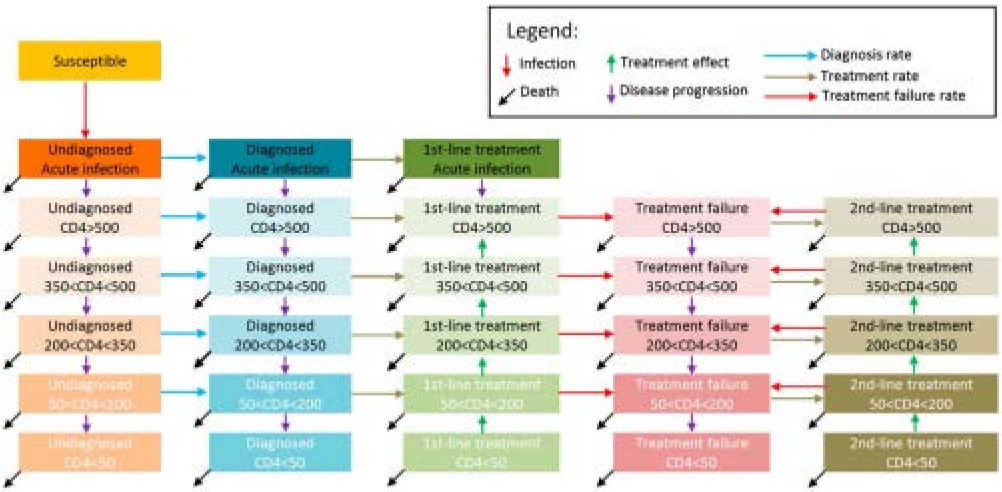
### 1.1.2. The Optima HIV Model

We use the Optima HIV model to calculate the change in HIV incidence and in the number of HIV/AIDS deaths due to changes in funding. Optima HIV is sufficiently flexible to track epidemiological and behavioral parameters over time to produce long-term forecasts, and to allow us to conduct allocative efficiency analyzes. Optima HIV uses best-practice HIV epidemic modeling techniques and incorporates realistic biological transmission processes, detailed infection progression, sexual mixing patterns and drug injection behaviors. Optima HIV describes the impact of HIV programs indirectly through their influence on behavioral and clinical parameters.

### 1.1.3. Model of HIV Transmission and Progression

Optima HIV incorporates a model of HIV transmission and progression. The model uses a coupled system of ordinary differential equations to track the transmission of HIV and the movement of infected people between 21 health states (Supplement Figure 1). The model distinguishes people who are undiagnosed, diagnosed, and on effective antiretroviral therapy (ART). Diagnosis of HIV-infected individuals occurs based on a HIV testing rate dependent on CD4 count and population type. Similarly, diagnosed individuals begin treatment at a rate dependent on CD4 count. The model tracks those on successful first- or second-line treatment (who have an increasing CD4 count) and those with treatment failure.

**SUPPLEMENT FIGURE 1. SCHEMATIC DIAGRAM OF HIV INFECTION PROGRESSION. EACH COMPARTMENT REPRESENTS A SINGLE POPULATION GROUP WITH THE SPECIFIED HEALTH STATE WHILE EACH ARROW REPRESENTS THE MOVEMENT OF INDIVIDUALS BETWEEN HEALTH STATES. ALL COMPARTMENTS EXCEPT FOR "SUSCEPTIBLE" REPRESENT INDIVIDUALS LIVING WITH HIV.**




HIV infections occur through the interaction between different populations via regular, casual, or commercial sexual partnerships. The force-of-infection for a population determines the rate at which uninfected individuals within the population become infected. This depends on the number of risk events individuals are exposed to in a given period and the infection probability of each event. Sexual transmission risk depends on:

- The number of people in each HIV-infected stage (that is, the prevalence of HIV infection in partner populations)
- The average number of casual, regular and commercial homosexual and heterosexual partnerships per person
- The average frequency of sexual acts per partnership
- The proportion of these acts in which condoms are used
- The efficacy of condoms
- The extent of male circumcision
- The prevalence of ulcerative STIs (which increase transmission probability)
- The stage of infection (chronic, AIDS-related illness/late stage, or on treatment) for the HIV-positive partner in a sero-discordant couple also influences transmission risk— due to different levels of infectiousness in each infection stage.
  Mathematically, we calculate the force-of-infection using:

$$\lambda = 1 - (1 - \beta)^n$$

where $\lambda$ is the force-of-infection, $\beta$ is the transmission probability of each event, and *n* is the effective number of at-risk events per year (thus *n* gives the average number of interaction events with infected people where HIV transmission may occur). The value of the transmission probability is inversely related to the CD4 count (http://www.optimamodel.com/docs/optima-parameter-priors.pdf). It differs for different modes of transmission (heterosexual or homosexual intercourse, intravenous drug injection) and may be modified by behavioral interventions (for example, condom use or circumcision). The number of events *n* not only incorporates the total number of events, but also other factors that may limit the possibility of transmission, such as condom use or circumcision. There is one force-of-infection term for each type of interaction and the force-of-infection for a given population will be the sum of overall interaction types. Optima HIV calculates the number of children infected through mother-to-child transmission using the birthrate and prevalence of HIV in female population groups. Children who are breastfed have a higher risk of acquiring HIV than those who are not breastfed in the model. Prevention of mother-to-children programs reduce the overall probability of children acquiring HIV through a multiplicative factor equal to one minus the product of the efficacy of PMTCT and coverage of PMTCT. In addition to the force-of-infection rate, which determines how individuals move from uninfected to infected states, individuals may move between health states via seven other pathways:

- Individuals may die, either due to the background death rate (which affects all populations), due to injecting behavior, or due to HIV/AIDS (which depends on the CD4 cell count)
- In the absence of intervention, individuals progress from higher to lower CD4 cell counts Individuals can move from undiagnosed to diagnosed states based on their HIV testing rate, which is a function of the CD4 count (for example, people with AIDS symptoms have a higher testing rate) and population type (for example, IDUs usually get tested more frequently than low-risk males).
- Diagnosed individuals may move on to treatment, at a rate dependent on CD4 count
- Individuals on treatment (first- or second-line) may experience treatment failure
- Individuals on failing treatment may switch to second-line treatment
- While on successful first- or second-line treatment, individuals may progress from lower to higher CD4 count.

In total, the model for Côte d'Ivoire accommodates 247 compartments (13 populations each with 19 health states), and the change in the number of people in each compartment is determined by the sum over the relevant rates described above multiplied by the compartments on which they act. For example, the number of individuals in the compartment corresponding to undiagnosed female sex workers with a CD4 count between 200 and 350 cells/µL changes according to the following equation:

$$\frac{\mathrm{dU_{FSW200-350}}}{\mathrm{dt}} = \mathrm{U_{FSW350-500}}\tau_{350-500} - \mathrm{U_{FSW200-350}}(\mu_{200-350} + \tau_{200-350} + \eta_{FSW_{350-500}})$$

Where $\mathrm{U_{FSW200-350}}$ is the current population size of people with undiagnosed HIV and with a CD4 count between 350 and 500 cells/µL, $\mathrm{U_{FSW200-350}}$ is the population size of the compartment with lower CD4 count (200–350 cells/µL), $\tau$ is the disease progression rate for the given CD4 count, $\mu$ is the death rate, and $\eta$ is the HIV testing rate. (Note: this example does not consider movement between populations, such as female sex workers returning to the low-risk female population and vice versa.) Each compartment (boxes in Supplement Figure 1) corresponds to a single differential equation in the model, and each rate (arrows in Supplement Figure 1) corresponds to a single term in that equation. Most of the parameters in the model are related to calculating the force-of-infection; a list of model parameters is provided in Supplement Table 1. We interpret empirical estimates for model parameter values in Bayesian terms as prior distributions.

**SUPPLEMENT TABLE 1. MODEL PARAMETERS**

| | Biological parameters | Behavioral parameters | Epidemiological parameters |
|---|---|---|---|
| Population parameters | Background death rate | | Population sizes (TP) |
| HIV-related parameters | Sexual HIV transmissibility* (H) STI-related transmissibility increase* Condom efficacy* Circumcision efficacy* HIV health state progression rates (H) HIV-related death rates (H) | Number of sexual partners* (TPS) Number of acts per partner* (S) Condom usage probability* (TP) Circumcision probability* (T) | HIV prevalence (TP) STI prevalence (TP) |
| MTCT parameters | Mother-to-child transmission probability | Birth rate PMTCT access rate (T) | |
| Treatment parameters | ART efficacy* ART failure rates | HIV testing rates (TPH) | Number of people on ART (T) |

Note: T = parameter value changes over time; P = parameter value depends on population group; H = parameter depends on health state; S = parameter depends on sexual partnership type; * = parameter is used to calculate the force-of-infection.

### 1.1.4. Calibration to the HIV epidemic data

We calibrated Optima HIV to Côte d'Ivoire's HIV epidemic to match available population group HIV prevalence data, overall annual diagnoses, and the uptake of ART. While primarily calibrated to match epidemiological data, Optima HIV also optimizes input parameters to match available demographic, behavioral, biological and clinical data. Given the challenges inherent in quantifying all known constraints on an epidemic, we calibrated the model manually, with oversight by and collaboration with in-country stakeholders where possible.

### 1.1.5. Reconciliation with cost-outcome relationships

The parameter values for the best-fit simulation in 2014 need to match the outcome values corresponding to the estimated 2014 spending levels in the cost-outcome relationships (described in detail in Annex 2). Otherwise, there will be a mismatch in parameter values for future projections and a sharp change in epidemiological trends even if there is no change in spending. Depending on the parameters affected or the available country data, we either adjust the calibration to match the data used in the logistic cost-outcome curves or adjust the cost-outcome curves to match the calibration.

## 1.2. Optimal allocation

To investigate the potential impact of future HIV prevention programs we ran model projections into the future from 2014 under different investment or programmatic scenarios.

### 1.2.1. Optimization of Program Allocation

The primary aim for our analysis is to determine the allocation of resources or spending required that best meet the specific objectives described in Section 1.2 of the report. For each of these objectives we used Optima HIV with the best-fitting simulation and an adaptive stochastic linear gradient-descent optimization method to determine the allocation of funding best achieving these objectives for a specific budget. In this method, Optima HIV starts with a fixed budget with program funding allocated randomly. At each step of the optimization process Optima HIV determines the expected behavioral and clinical parameters associated with each program's funding level using the logistic cost-outcome relationships.

# Annex 2. Cost-outcome curves

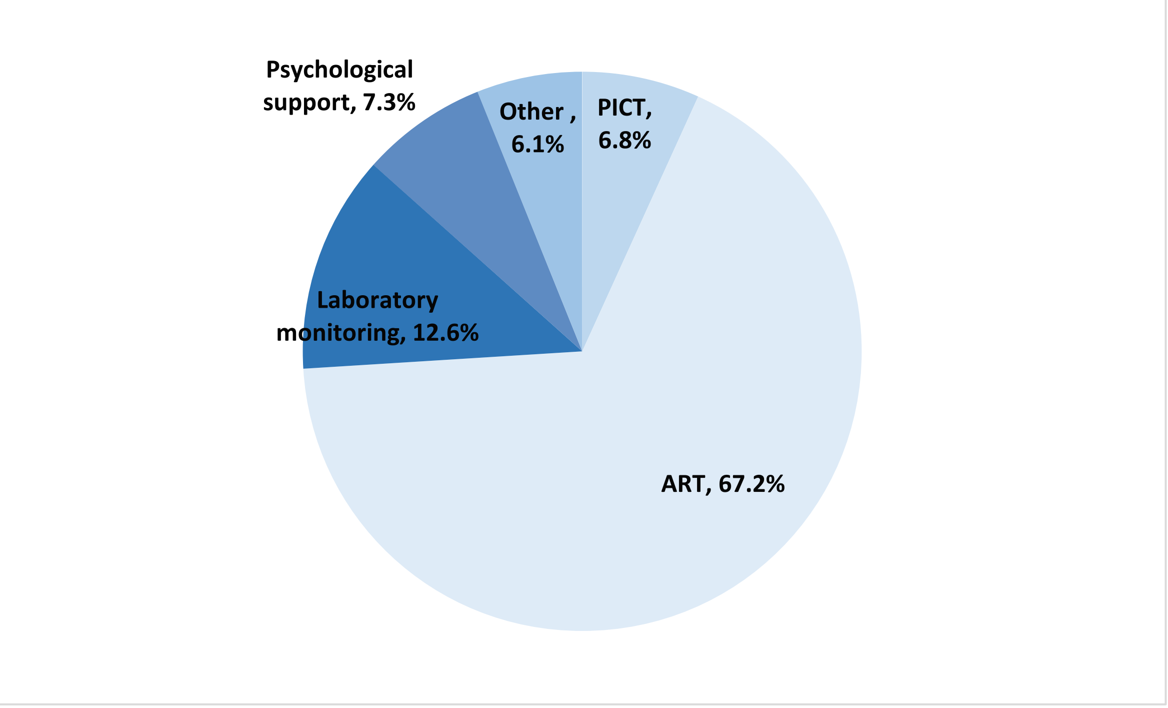
A central component of our analyzes is the relationships between the cost of HIV prevention programs and the resulting outcomes. Such relationships are required in our analyses, to understand how incremental changes in spending ultimately affect HIV epidemics and determine the optimal funding allocation. Our analysis requires country specific relationships for each risk-population and prevention program. A large amount of behavioral and spending data is required, to inform such relationships. We used an ecological "top-down" approach to relate program cost and outcomes. For each population at risk, we derived a set of relationships directly linking estimated funding to behavioral data for the population's primary risk-behavior. We describe our approach in detail below. To produce these relationships, we assume indirect costs have no direct impact on HIV transmission parameters; but changes to HIV programs may affect these costs to supply additional condoms, clean syringes, and methadone, for example. A limitation of our approach is the assumption that all changes in behavior are assumed to be due to changes in program funding.

## 2.1. Methodological details

We use a logistic or sigmoid function to model cost-outcome relationships. This type of function can incorporate initial startup costs, which may have no direct effect on a behavioral outcome, and allow changes in behavior to saturate at high spending levels. Using our data synthesis, we identified years where both spending data and outcome data were available for each model population. We then used this data to fit a four parameter logistic function of the form, where $x$ is the estimated amount of funding for the population, $A$ is the lower asymptote value, $B$ is the upper asymptote value, $C$ is the point of maximum change, and $D$ is the growth rate. Our fits were further constrained using an assumed range for the maximum/saturation value of the outcome. We estimated this saturation range subjectively, based on data from high income countries where funding is effectively unlimited. We fitted the logistic function to the available data and saturation range using Matlab© 2013a with a trust region reflective algorithm.

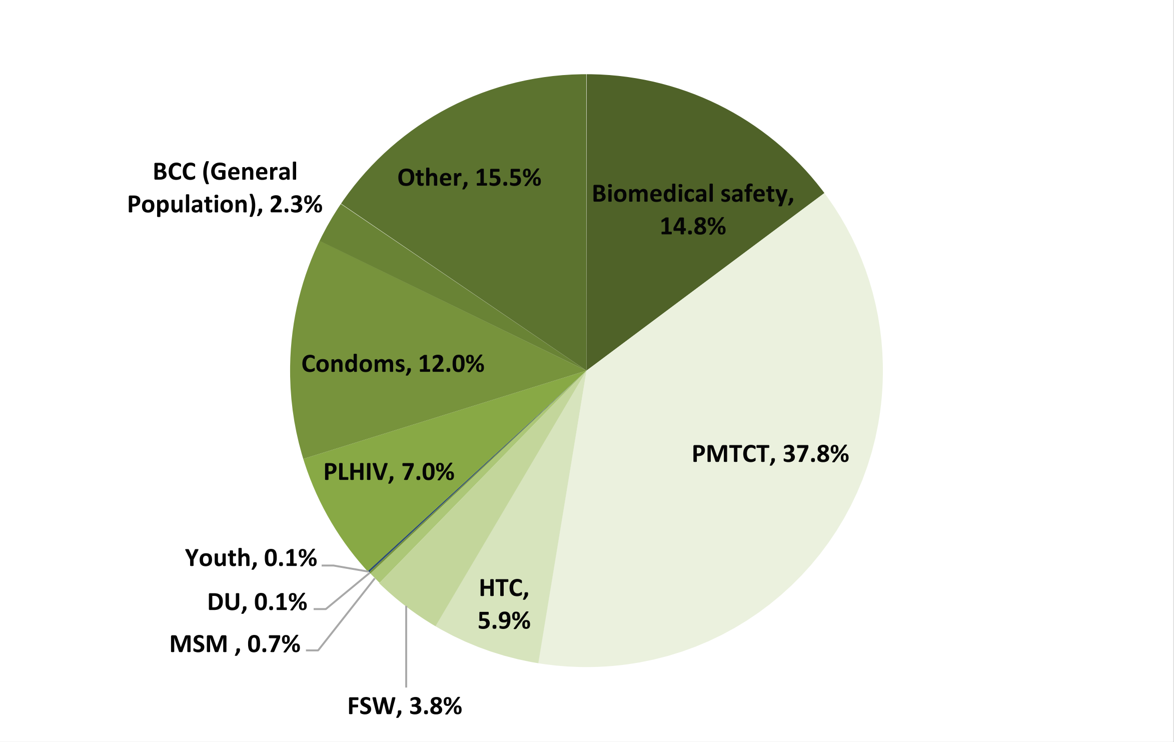
# Annex 3. HV allocation of financial resources by programs

**Supplement Figure 2. Allocation of spending across care and treatment programs, 2013 (total spending = 18.6 billion FCFA). PICT – provider initiated counselling and testing.**



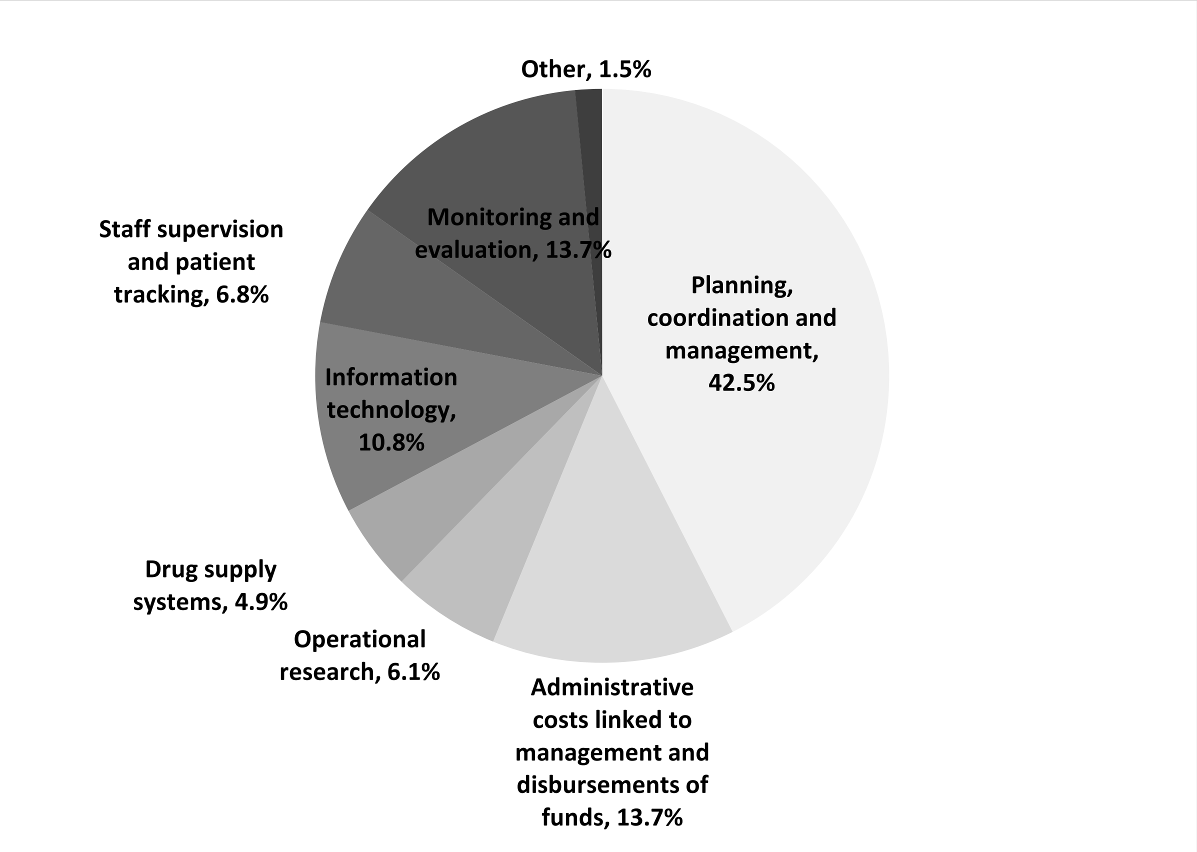

Source: NASA, 2012-2013

SUPPLEMENT FIGURE 3. ALLOCATION OF SPENDING ACROSS PREVENTION PROGRAMS, 2013 (TOTAL SPENDING = 13.3 BILLION FCFA)



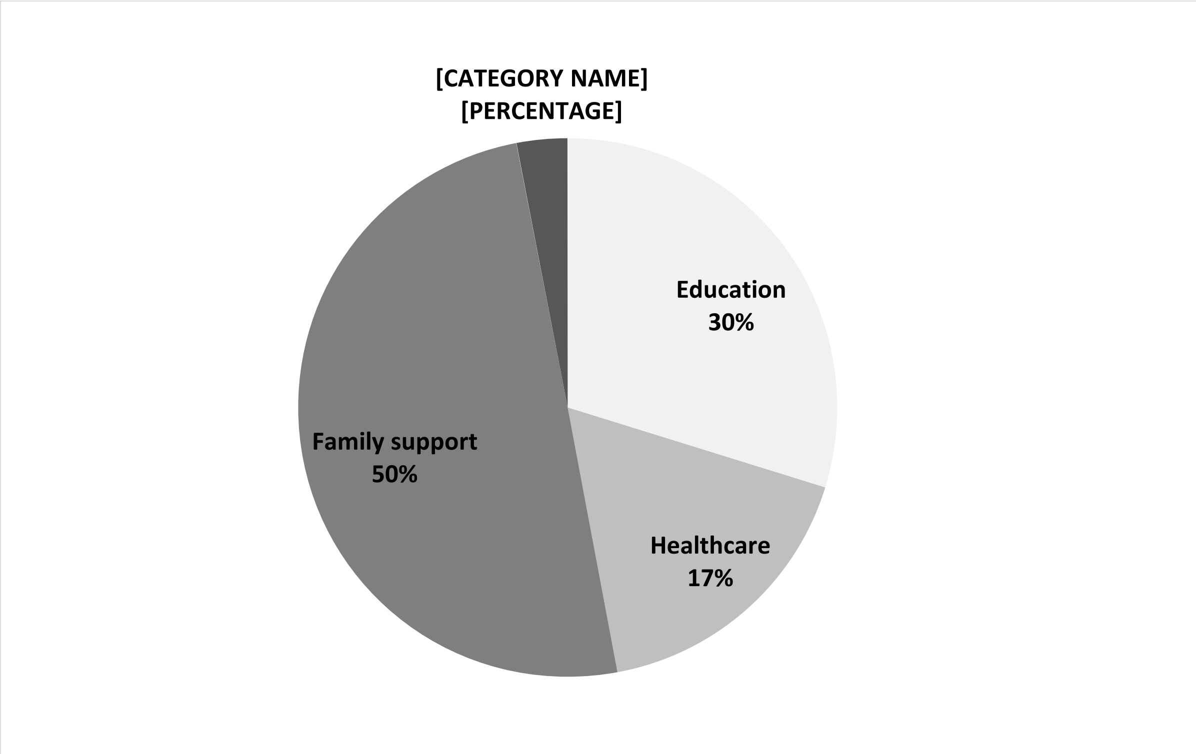

Source: NASA, 2012-2013.

SUPPLEMENT FIGURE 4. ALLOCATION OF SPENDING FOR ADMINISTRATION AND MANAGEMENT, 2013 (TOTAL SPENDING = 10.0 BILLION FCFA)



Source: NASA, 2012-2013

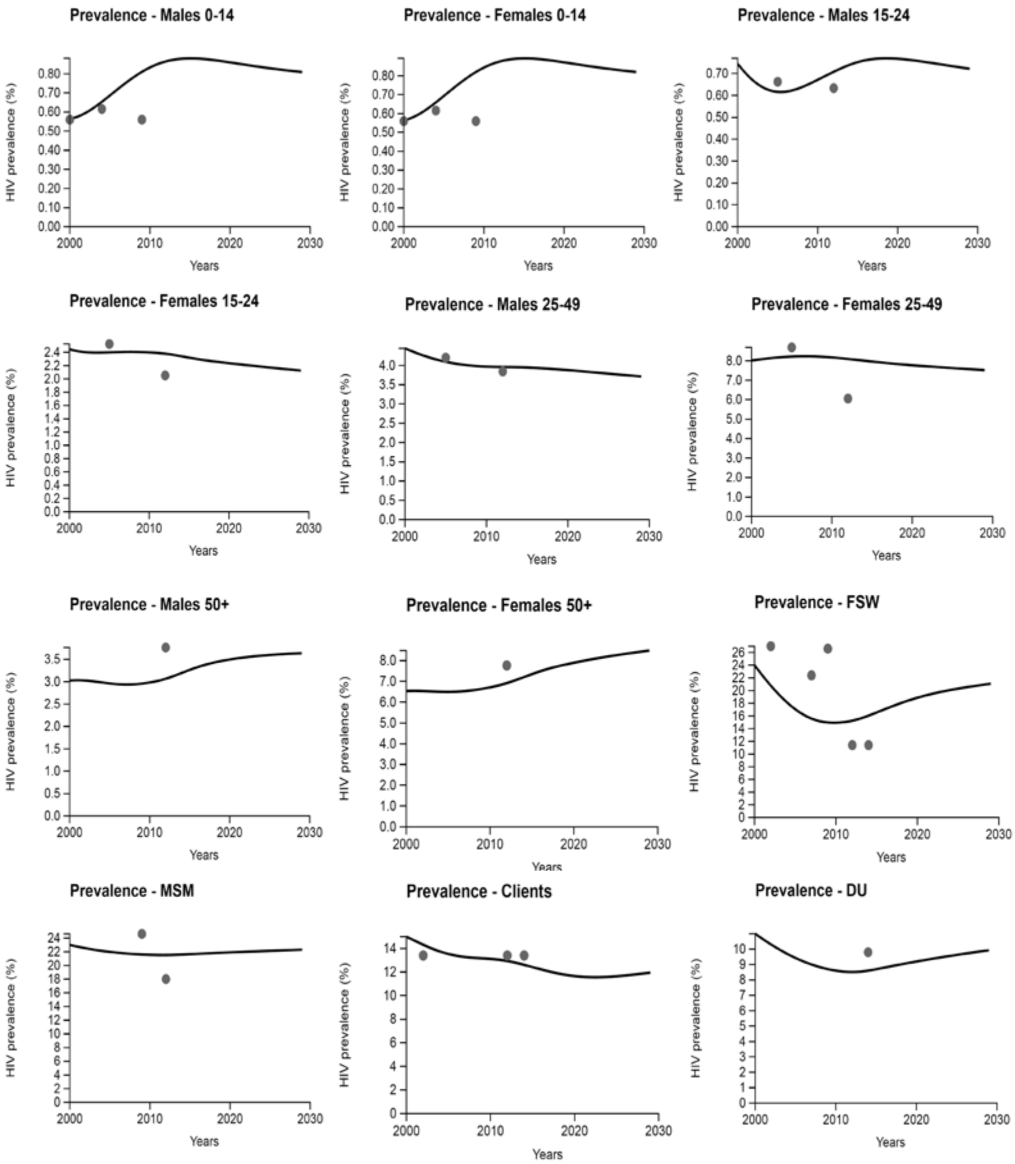
**SUPPLEMENT FIGURE 5. ALLOCATION OF SPENDING ACROSS OVC PROGRAMS, 2013 (TOTAL SPENDING = 3.5 BILLION FCFA)**




Source: NASA 2012-2013

# Annex 4. Model calibration results

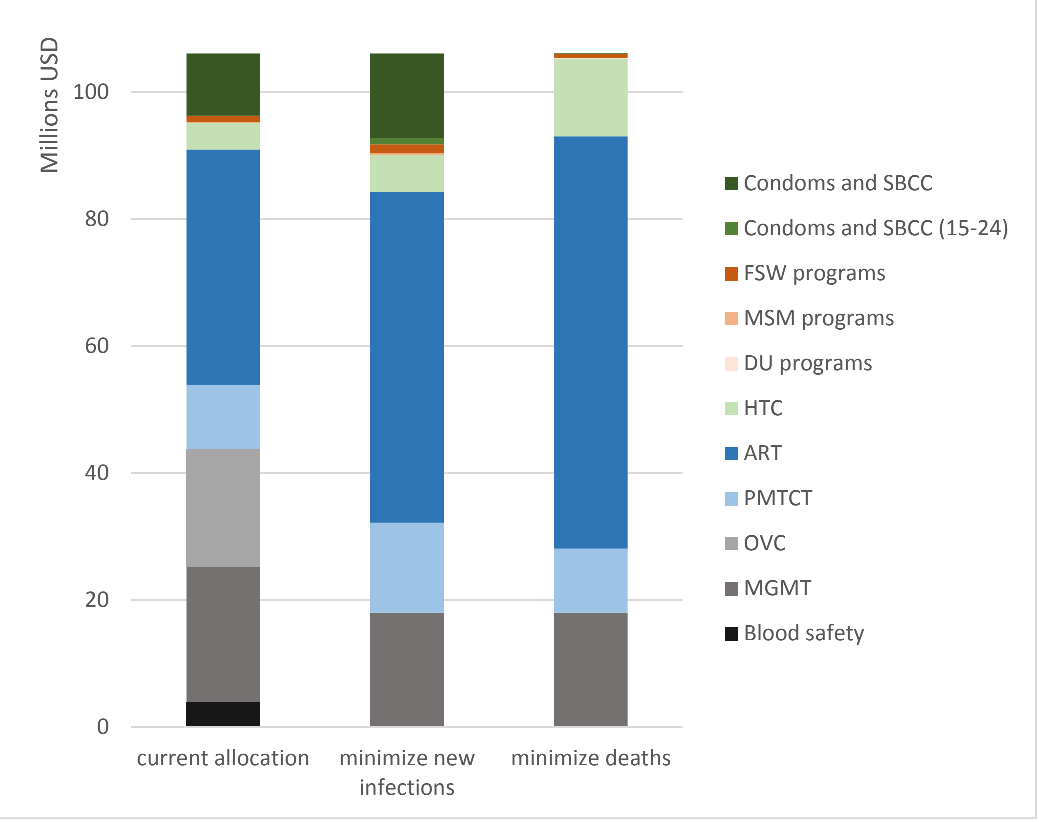
**SUPPLEMENT FIGURE 6. CALIBRATION OF OPTIMA HIV MODEL TO THE EPIDEMIC OF CÔTE D'IVOIRE**




Source: Optima HIV 2016

# Annex 5. Minimizing new infections only and deaths only.

**SUPPLEMENT FIGURE 7. CURRENT AND OPTIMAL ALLOCATION TO MINIMIZE NEW INFECTIONS ONLY AND CURRENT AND OPTIMAL ALLOCATION TO MINIMIZE HIV-RELATED DEATHS ONLY.**



**Supplement Table 2. Current and optimal allocation to minimize new infections only and current and optimal allocation to minimize HIV-related deaths only.**

| | Current allocation | | Minimize new infections | | Minimize deaths | |
|---|---|---|---|---|---|---|
| | USD | %** | USD | %** | USD | %** |
| Blood safety | 3,965,614 | 3.74% | 0 | 0.00% | 0 | 0.00% |
| Management | 21,345,909 | 20.13% | 18,018,413 | 16.99% | 18,018,413 | 16.99% |
| OVC | 18,520,146 | 17.47% | 0 | 0.00% | 0 | 0.00% |
| PMTCT | 10,078,639 | 9.50% | 14,169,908 | 13.36% | 10,114,865 | 9.54% |
| ART | 37,040,353 | 34.93% | 52,076,318 | 49.11% | 64,872,692 | 61.18% |
| HTC | 4,119,532 | 3.88% | 5,791,793 | 5.46% | 12,263,453 | 11.56% |
| Non-ART DU programs | 19,151 | 0.02% | 26,925 | 0.03% | 19,220 | 0.02% |
| Non-ART MSM programs | 190,652 | 0.18% | 268,044 | 0.25% | 40,798 | 0.04% |
| Non-ART FSW programs | 991,028 | 0.93% | 1,393,320 | 1.31% | 668,422 | 0.63% |
| Condoms and SBCC (15-24) | 26,634 | 0.03% | 1,021,600 | 0.96% | 1,640 | 0.00% |
| Condoms and SBCC | 9,743,235 | 9.19% | 13,276,571 | 12.52% | 43,390 | 0.04% |
| Total | 106,040,892 | 100.00% | 106,042,892 | 100.00% | 106,042,892 | 100.00% |

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