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# Estimating the impact of the US foreign aid withdrawal on HIV/AIDS mortality and life expectancy in Sub-Saharan Africa

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**Abstract**

This study estimated the impact of US foreign aid withdrawal on HIV/AIDS mortality and life expectancy in Sub-Saharan Africa (SSA). Life table techniques were used to calculate baseline and counterfactual life expectancies under three funding withdrawal scenarios (100%, 50%, and 20%). Results indicate significant cross-country variation in life expectancy losses. Six countries exhibit moderate to severe declines (≥1-year declines) under the full withdrawal scenario, with the most extreme in Zimbabwe (-6.46 years). Progress in HIV/AIDS outcomes in SSA remains heavily dependent on foreign aid, and major global funding disruptions can have impacts almost comparable to losses observed during COVID-19.

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## 1. Introduction

The first months of 2025 marked an unprecedented shift in the foreign aid landscape with wide-reaching global impact. The United States (US) significantly reduced its foreign aid contributions, declaring a blanket freeze in all forms of development aid and programs in the interest of budget reevaluation and realignment.[1] Given that the US is the biggest contributor to aid flows globally (over $72 billion in 2023),[2] it is expected that a lot of global development programs will be stalled with serious effects especially for recipient countries.

Foreign aid for health programs, sometimes referred to as “development assistance for health” or “DAH”, are also affected by this withdrawal. While many high-income countries and philanthropic/private foundations contribute to DAH globally, the US is the biggest contributor. These are funneled through bilateral relations or its aid agency, the United States Agency for International Development (USAID), or through multilateral international bodies and funding mechanisms such as The Global Fund to Fight AIDS, Tuberculosis and Malaria (The Global Fund) and the World Health Organization (WHO). DAH funds many global health programs in low- and middle-income countries (LMICs), from disease-specific programs for control of malaria and HIV/AIDS, to health systems strengthening and health workers compensation.[3]

Among all health focus areas, HIV/AIDS receives the biggest share of DAH from the US. In 2024, the US contributed $5.87 billion to HIV/AIDS spending, almost 72% of HIV/AIDS DAH from all sources or 12% of DAH flows for all health areas combined.[4] The US implements its HIV/AIDS-related support through the US President's Emergency Plan For AIDS Relief (PEPFAR). First launched in 2003, significant investment on HIV/AIDS came from this program which allocated over $6 billion each year in its first 10 years alone.[5]

PEPFAR programs are responsible for funding prevention and treatment interventions, from health education services, distribution of contraceptives, to provision of antiretroviral therapy (ARTs) for persons living with HIV (PLHIV).[6] As of 2024, PEPFAR supported the treatment of 20.6 million people across 55 countries,

and provided testing services for over 84.1 million.[7] PEPFAR is one of the largest global health programs dedicated for a single health area, and is even credited as a “game changer” in the global HIV/AIDS response.[8]

While PEPFAR has global presence, many of its focus areas are in the Sub-Saharan African region (SSA) which disproportionately experiences the burden of HIV/AIDS and has limited resources to respond to the epidemic.[9] Figure 1 illustrates the stark contrast between the burden of HIV/AIDS in SSA compared to other world regions. At its peak in 2003, the HIV/AIDS death rate in SSA reached over 178 per 100,000, much larger than regions that only peaked at a death rate of 15.[10] Decades of progress is unable to close this regional disparity to this day, as two-thirds of PLHIV are concentrated in this region in 2024 (Figure 2).[11]

Figure 1. HIV/AIDS Death Rates per 100,000 by World Bank Region[12]

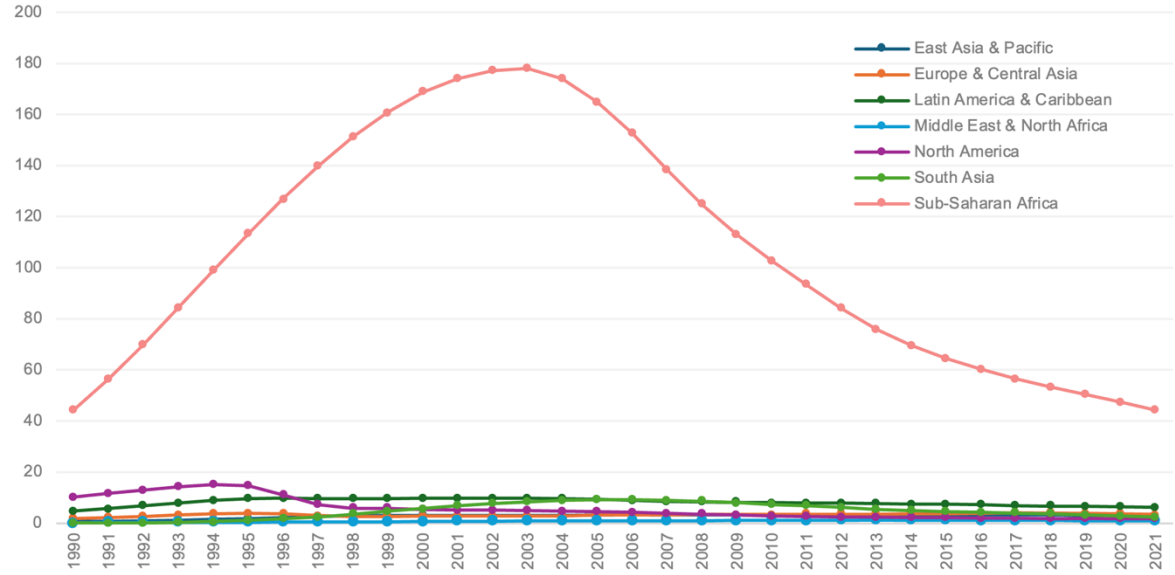
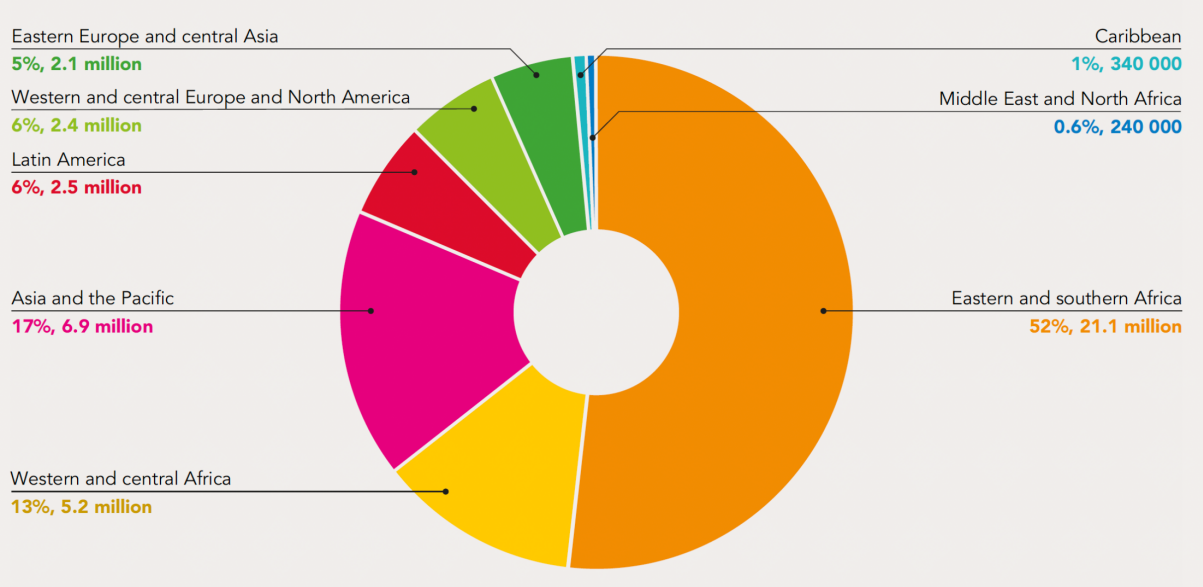


Figure 2. Distribution of people living with HIV, by region, 2024[13]




Historical progress in managing the HIV/AIDS epidemic is reliant on international funding and continues to be dependent to it to this day. In 2022, over 50% of treatment services, 80% of prevention services, and 80% of societal enabler activities in LMICs are reliant on international funding sources.[14] Hence, disruptions on external funding can expose countries to backsliding of progress. DAH cuts can affect HIV/AIDS outcomes through many pathways, from shortages of antiretroviral (ARV) drugs and reduction in health workforce, to disruption of testing and surveillance systems, and halting of community-based education programs. This is why the recent US funding cut has warranted global concern, as it can entail widespread service disruption for SSA countries that are already vulnerable and have limited resources to adapt immediately.

While a waiver was issued in February 2025 indicating the resumption of select HIV/AIDS treatment services in PEPFAR countries, uncertainty on the future of the program continues. As of August, over seven months have passed since the initial 90-day freeze was announced. USAID has officially closed in July, with most of its programs canceled or absorbed by the US State Department.[15] There is some cause for optimism, as a recent US Congress decision has spared PEPFAR from major funding cuts in July. However, the organizational change that placed PEPFAR under the State Department raises concerns on the transparency of service delivery with many of PEPFAR's implementing partners apprehensive on providing

interventions for key populations such as trans patients, sex workers, and gay men.[16] The US funding cut has reemphasized the fragility of the international HIV/AIDS response, and raises fundamental questions on the sustainability of global health progress in an international arena mired with dependencies.

This dissertation aims to estimate and quantify the tangible impacts of the recent US funding cut in SSA countries as expressed in HIV/AIDS mortality and overall life expectancy. It specifically answers the question: *what are the estimated impacts of the withdrawal of US development foreign aid for HIV/AIDS on mortality and life expectancy in Sub-Saharan Africa?*

Life expectancy, defined as the average number of additional years that a person will live after a certain age, is one of the most ubiquitous measures used in demography and public health.[17] It is helpful in comparing the overall health of populations between countries and over time, and is even monitored as part of the Sustainable Development Goals.[18] Comparing the life expectancy of PLHIV against persons without HIV/AIDS is also a common approach to monitoring progress, as the goal of improving access to treatment is to ensure that PLHIV can live just as healthy and long as the general population.[19] Given the HIV/AIDS burden in SSA, it is hypothesized that the life expectancy improvements in the past decades attributable to HIV/AIDS mortality reductions will be reversed, especially in countries highly dependent on US funding. Quantifying these impacts can provide a clear picture of how much of historical health gains are at stake and which countries are most vulnerable.

The succeeding chapters of this dissertation is structured as follows. The literature review traces the history of the HIV/AIDS epidemic, the central role that foreign aid played in the recent decades of response, and the pivotal impact of ART scale up in managing the epidemic in SSA. The chapter concludes with a summary of the existing estimates published in the aftermath of the recent funding cut. The methodology chapter discusses how case countries are identified, how excess deaths are estimated, and how the declines in life expectancy are calculated in different funding scenarios using counterfactual demographic modeling and life table techniques. The results and discussion chapter illustrates the calculated excess

deaths, estimated life expectancy declines, and contextualizes this against the historical gains on life expectancy from decades of HIV/AIDS progress and of the impacts of COVID-19. Finally, the conclusion discusses the limitations of the study and reflections on the future of foreign aid’s role in global health.

## 2. Literature Review

### 2.1. The HIV/AIDS epidemic as a global health problem

The massive global attention given to HIV/AIDS today stands in stark contrast to the initial response to the epidemic. Since it was first detected among homosexual men in the US in 1981, it was perceived as a disease limited only to gay men in high-income countries, therefore not worthy of global attention. Homophobia and stigma felt by gay men has also delayed action.[20] It took years of advocacy and research before Western medical experts accepted the view that HIV/AIDS can be transmitted among heterosexuals, and that it is a major problem affecting many African countries as well.[21] The WHO took initial leadership in the global health response, but its initial actions were also slow and reluctant as leadership saw HIV/AIDS as an overstated problem drawing attention away from its other primary healthcare projects.[22]

The continued rise in cases and clamor from African countries prompted a more urgent global response. By 1986, the WHO has intensified its coordination with donor countries to increase funding in the African region. The WHO Global Programme on AIDS (GPA) was established the year after, and was later succeeded by the Joint United Nations Programme on HIV and AIDS (UNAIDS) that coordinates the international response to this day.[23] These global shifts coincided with the rise of the domestic gay rights movements which reframed the HIV/AIDS crisis as a human rights issue and pressured governments to take political action.[24] The US also increased its foreign investment further in 2000, when the disease was recognized as an issue of national security, acknowledging HIV/AIDS as a threat to political stability in many LMICs.[25] The massive attention to a singular health area by rights movements, governments, and international bodies alike has now been referred to as “AIDS exceptionalism”.[26] With the global coordinated response, transnational rights advocacy, and willing investment from high-income donor governments, the HIV/AIDS response scaled up significantly into the present, with HIV/AIDS foreign aid increasing from $435 million in 1990 to now over $8 billion by 2024 from all sources.[27]

As history suggests, the progress in the HIV/AIDS response is inextricably linked to a favorable global environment. One in which international leadership recognizes the issue's salience and donor countries are willing to invest in the response in resource-limited countries. These roots have arguably shaped how dependent progress is to international dynamics, and how fragile it can be given less favorable conditions.

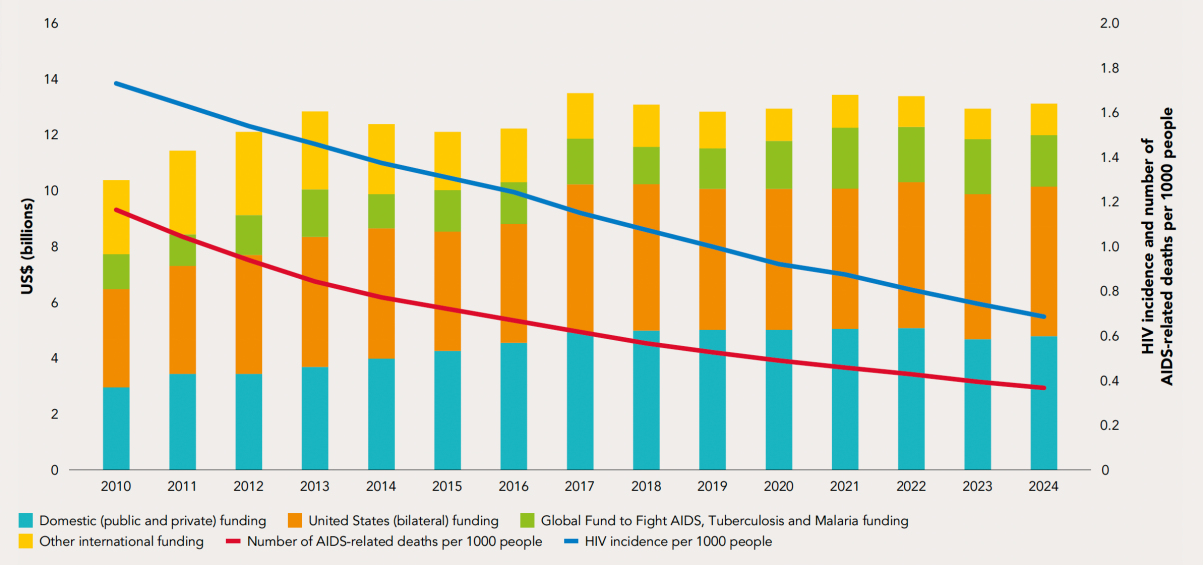
## 2.2. The role of DAH

DAH provided by donor countries was pivotal to cover the scale and cost of the epidemic response in LMICs. Like all DAH, this support came through bilateral donations or through multilateral funding mechanisms such as The Global Fund or projects from the World Bank.[28]

One of the biggest contributors to the global response is PEPFAR. Established during the Bush administration in 2003, it is often described as a cornerstone in the global HIV/AIDS response.[29] According to UNAIDS, PEPFAR has been able to contribute to the reduction of HIV/AIDS deaths by 76% and of new HIV/AIDS infections by 62% from its initiation in 2003 to 2024. Alongside this, many PEPFAR-supported countries also increased their domestic HIV/AIDS expenditure between 2010 and 2024.[30] Figure 3 compares the global trend in HIV/AIDS mortality and incidence as it overlaps with the funding trends, with the US bilateral funding being a major contributor.

DAH, however, is not without criticism. Many reports show that global DAH flows are mired with inefficiencies, as slow disbursements and weak program implementation led to the accumulation of unutilized budgets. This surplus coincides with persistent claims by global institutions that the HIV/AIDS response is under resourced.[31]

Figure 3. Distribution of HIV resources in PEPFAR-supported countries, and trends in HIV incidence and AIDS-related mortality, 2010–2024[32]




Research also illustrates mixed results on DAH's impact. A study on The Global Fund found that it has only been effective in minimizing mortality from two of its three focus diseases (malaria and HIV/AIDS, but not TB) despite its large budget.[33] Evidence on assessing PEPFAR's efficacy reflect similar disagreements. While some have found that PEPFAR's country presence is associated with reductions in mortality from HIV/AIDS, and has potential spillover effects to decreasing all-cause mortality,[34] others showed that it is not associated with the prevention of new infections,[35] reduction in adult prevalence,[36] or even improvements in non-HIV/AIDS health indicators such as adult mortality, deaths from TB, or infant mortality.[37] Interestingly, one study disaggregating per founding source found that, a bilateral mechanism such as PEPFAR is more effective in reducing HIV/AIDS-related deaths compared to multilateral sources such as TGF.[38]

Another stream of research has shown how massive DAH flows can cause adverse outcomes on domestic expenditure. DAH is found to be negatively associated with domestic government expenditure for health programs with every US$1 leading to a $0.43 to $1.14 decrease in local spending.[39] Funding flows from 1992-2005 also suggest that HIV/AIDS may be displacing funding for other issues potentially masked by the aggregate increase in DAH during this period,[40] but more recent evidence is not available. These findings directly contradict UNAIDS claim that higher PEPFAR spending coincides with increases in domestic spending for

HIV/AIDS.[41] The disparate evidence highlights the varied impacts of foreign aid on government expenditure, sometimes to the detriment of domestic leadership.

Further, the disproportionate amount of aid flows creates a hierarchy between development issues leading to decreased resources and attention for other public challenges. As an example, AIDS exceptionalism has shaped the local development sector in Malawi where “doing AIDS” has been equated to “doing development” itself, ascribing a prestige that displaced human resources for other development areas such as food security, agriculture, and education, and drawing people away from working in the government due to lower salaries compared to organizations supported by international funders.[42]

The disparate evidence on DAH’s efficacy and tendency to create inadvertent outcomes in recipient countries is cause for a nuanced outlook on foreign aid, and much changes are needed to ensure its efficient and impactful spending. However, it is worth noting that many intermediate outcomes such as expanding treatment coverage and prevention services are hinged on DAH’s continued presence, so a wide-scale and sudden funding cut can lead to immediate adverse outcomes.

## 2.3. ART and foreign aid: shifting the epidemic’s trajectory

Among the most important interventions funded by foreign aid is the scale up of antiretroviral therapy (ART). Early research started on ART in the late 1980s, but the first announcement of the efficacy of ART in reducing viral load was made in the 1996 International AIDS Conference in Vancouver.[43] ART’s impact in improving prognosis can be noticed in a short period, as viral load suppression can be achieved within 3 months of consistent treatment adherence.[44] HIV/AIDS-related mortality significantly declined in high-income countries as early as 1997 when ART became more accessible.[45]

Given ART’s proven impact, increasing ART coverage and the subsequent viral load suppression has become one of UNAIDS’ primary target. This is referred to as the “95-95-95” treatment cascade, with the goal of 95% of estimated PLHIV

knowing their status, 95% of which initiate and adhere to ART, and 95% of those achieving viral suppression. At least seven countries in SSA have achieved this in 2024, with 8 other SSA countries achieving at least 90% in the three targets.[46] On top of improving the longevity of lives of PLHIV, ART has also given rise to the "treatment as prevention" and "U=U or undetectable = untransmissible" paradigm, as evidence found that PLHIV with undetectable viral load cannot transmit the virus through sex.[47] The success of ART has shifted the outlook on HIV from being an acute disease to now a chronic condition manageable through long-term treatment, with "the end of AIDS" in sight.[48]

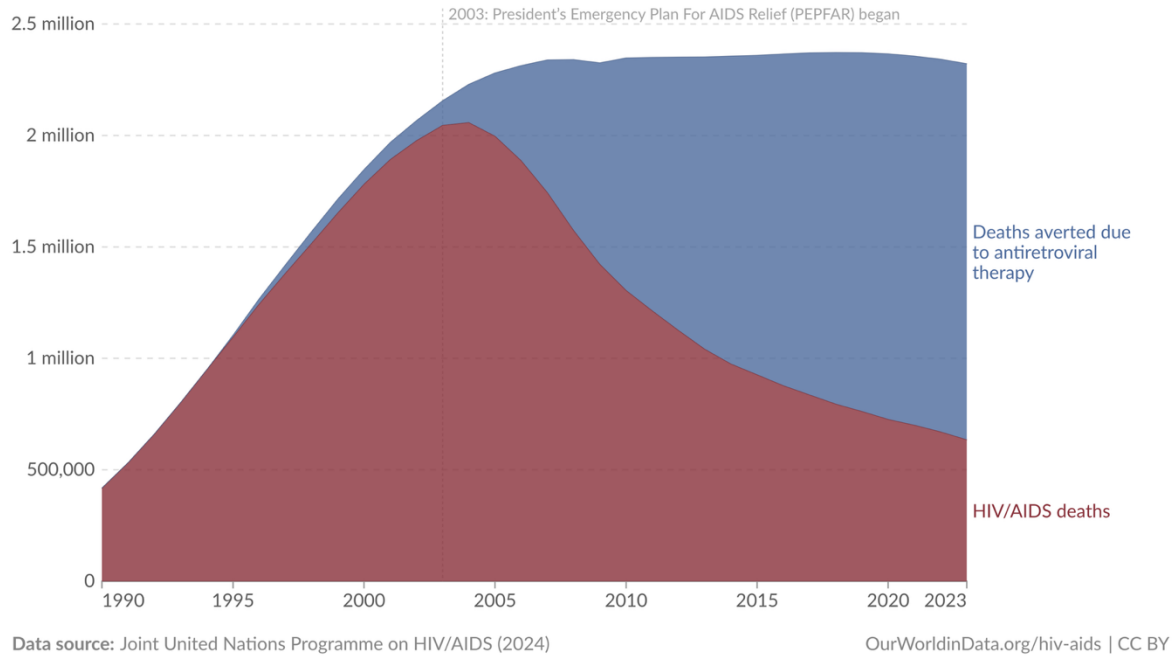
However, the expansion of ART services in LMICs was slow, faced with the same frictions as the initial epidemic response mired with reluctance of global leadership. The massive cost of treatment ($20 thousand per person per year) meant that it is mostly accessible in high-income countries, and UN agencies and donors alike were reluctant to expand access to LMICs claiming that it is not cost-effective compared to prevention programs.[49] While HIV/AIDS-related targets have been placed in global priorities such as the UN Millenium Declaration, these agreements were silent when it comes to setting HIV treatment targets mirroring the lack of full commitment to expanding coverage.[50] The early hope provided by ART took long to materialize in SSA, as the associated costs and lack of international support led to the inequitable and slow adoption.

This pessimistic outlook is changed through successful global advocacy. Activism from PLHIVs, non-government organizations, health providers, scientists, and the media contributed to its placement in global priorities.[51] Furthermore, the leadership of Thailand, Brazil, and India-based manufacturers in developing much more affordable ARV drugs significantly reduced treatment costs.[52] These improvements eventually generated global funding, with now over 31 million people globally.[53] ART's scale-up in SSA was reliant on foreign aid, and for much of SSA, continues to rely on these same funding mechanisms until today.

Research has attempted to quantify its impacts on the burden of HIV/AIDS in the population level since its scale up. A study found an annual decrease in HIV/AIDS-related mortality of around 10-20% per year after the introduction of ART

across multiple SSA countries.[54] These results are consistent with case studies in Malawi where a 10% reduction in adult mortality was observed after eight months since the opening of the first ART clinic,[55] and in a rural area in South Africa which reported a standardized mortality rate ratios (SMRR) of 0.780 among women and 0.706 among men between the pre- and post-ART periods.[56] ART has led to the prevention of many deaths globally as illustrated in Figure 4, with a noticeable increase in averted deaths in 2003 when PEPFAR was established and ART became more widely accessible.

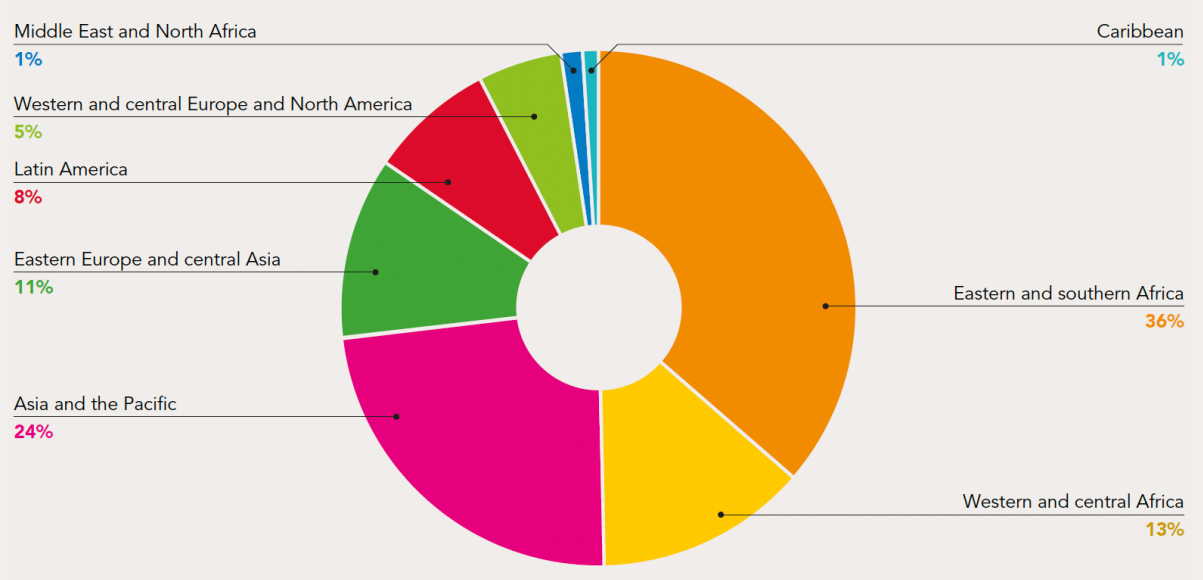
Figure 4. HIV/AIDS deaths averted due to ART, globally[57]




There are persistent issues when it comes to increasing initiation and maintaining adherence to treatment. Almost half of the unmet ART needs globally are concentrated in SSA (Figure 5). Coverage inequities are exacerbated by barriers ranging from individual (e.g. lack of acceptance and non-disclosure of HIV status, concerns of stigma, fear of divorce or separation from partner, depression), socioeconomic (e.g. financial incapacity, distance from clinics, incorrect dosing, and missed appointments), medication-related (e.g. adverse effects, palatability and taste of drugs), and health system factors (e.g. limited supply and accessibility for diagnosis and treatment, shortage of health workers, overcrowding and waiting time

in facilities).[58] DAH plays a crucial role in addressing these barriers, as these require comprehensive interventions that address individual and social factors.

Figure 5. Distribution of unmet antiretroviral therapy need, by region, 2024[59]




The challenge with ART is that it requires early initiation and consistent treatment adherence to be effective, meaning health system disruptions that interrupt ART can lead to substantial reversals observable almost immediately. For PLHIV, viral rebound can occur in as little as days or weeks after treatment interruption.[60] In the population level, a scale back in HIV/AIDS expenditure can lead to 3.24 million new HIV/AIDS infections and 4.25 million deaths over a 10-year period largely attributable to ART disruption.[61] Experiences of widespread interruption such as during COVID-19 also showed that among HIV/AIDS-related interventions, ART interruption can be the biggest contributor to mortality leading to a 1.63 times increase in HIV/AIDS deaths.[62] Progress from ART is significant, but is also fragile. Decades of population health improvements brought by ART is very much reversible if health systems fail to deliver these services consistently.

## 2.4. HIV/AIDS, ART, and life expectancy

The trajectory of the HIV/AIDS epidemic, life expectancy changes, and ART expansion have historically been intertwined. The widespread trend of life

expectancy declines between 1990 and 2000 is strongly associated with the increase in HIV/AIDS prevalence in this period. Countries in SSA with prevalence rates over 10% exhibited life expectancies at birth as low as 40 years, compared to countries with below 1% prevalence where life expectancy reached above 70 years.[63] The breadth of HIV/AIDS impact was sufficient to impact population-level indicators such as life expectancy.

The eventual improvements in life expectancy can be attributed to improvements in containing the epidemic. The scale up of ART services coincides with major improvements in overall life expectancy at birth in SSA, from 56.5 years in 2010 to 62.3 years in 2024, almost 7 years of improvement.[64] In South Africa, 8.9 years of life expectancy gained between 2006 and 2017 has been attributed to declines in HIV/AIDS mortality alone.[65] Another analysis observed 11.3 years of gain in adult life expectancy when comparing the period before and after ART introduction.[66]

Early ART initiation and sustained adherence have also been credited for the improved the life expectancy of PLHIV. Untreated PLHIV have significantly shorter life expectancy compared to individuals undergoing treatment.[67] Further, life expectancy is higher among those who initiated treatment earlier with higher CD4 counts.[68] Unfortunately, these improvements are not evenly experienced by PLHIV. For people in high-income countries, PLHIV who are non-white and have a history of injection experienced little improvements in life expectancy.[69] In low-income countries, men with HIV/AIDS are also shown to experience less gains in life expectancy compared to women.[70]

While these disparities exist, the evidence is clear that early ART initiation and maintenance leads to life expectancy improvements for PLHIV and investing in interventions that secure equity in access can mitigate these disparities. These also reveal that while progress is possible, the required life-long adherence to treatment means ART service disruptions can threaten the progress in managing HIV/AIDS and lead to a poor prognosis for PLHIV who stop treatment. These vulnerabilities became clear during the wide-scale disruption during COVID-19, and the same

possibility may be expected from other health system shocks that affect service interruption such as the US funding cut on PEPFAR.

## 2.5. Early estimates of the impact of the 2025 US funding cut

The US foreign aid withdrawal immediately prompted researchers to assess its impacts. UNAIDS estimates that by 2030, an additional 4 million HIV/AIDS-related deaths and 6 million new HIV infections are to be expected globally resulting from disrupted services funded by PEPFAR – almost to the same levels as the epidemic's peak in the early 2000s.[71] A modeling study in seven SSA countries found that the initial 90-day funding freeze can lead to between 60 to 74 thousand deaths and between 35 to 103 thousand new HIV infections in those seven countries alone.[72] Another estimates over 109 thousand deaths across PEPFAR-supported countries.[73] In South Africa specifically, the funding disruption is estimated to add 286 to 565 thousand infections over ten years, and life expectancy of PLHIV can drop by 3.71 years.[74] The rapid response tool PEPFAR Impact Counter provides live updates on the estimated deaths starting from the funding freeze, with one additional adult death every 3.3 minutes and one child death every 31 minutes.[75] While these studies provide a wide range of estimates, there is consensus that the massive reliance of the global HIV/AIDS response on PEPFAR can lead to devastating impacts and needless deaths, with recipient countries threatened to experience reversal in the significant gains made from the previous decades.

## 2.6. Contribution of this study

This dissertation contributes to these studies by estimating the anticipated excess deaths and declines in life expectancy with the disruption of PEPFAR funding. The US funding cut has exposed how the persistent dependencies that underpin major global health initiatives can be the very reason for its fragility and reversal. Quantifying these losses can illustrate its concrete public health impacts, identify disparities on which countries may be most affected, and inform policy that can support long-term resilience of health systems.

## 3. Methodology

This study used a demographic counterfactual modeling approach using life table methods to estimate the impact of the PEPFAR funding cut and the subsequent ART service disruption on excess deaths and life expectancy. A baseline scenario was constructed to reflect the existing mortality and life expectancy. Subsequently, counterfactual scenarios for the worst-case, moderate case, and limited case was constructed, which assumes varying intensities of funding withdrawal from PEPFAR from 100%, to 50% and 20% respectively. The primary outcome of interest is the difference between each counterfactual and the baseline scenarios, which is the estimated life expectancy decline that can be attributed to the PEPFAR funding cut.

### 3.1. Data Sources

Life table construction methods established by Chiang[76] and Preston et al.[77] allow the construction of multiple decrement life tables using age-specific mortality rates (ASMRs). To calculate these ASMRs, estimates on population and number of deaths by cause disaggregated by age group were taken from the Global Burden of Disease 2021 (GBD) study.[78] The baseline population and mortality were constructed by averaging the estimates from the latest three years of the GBD (2019-2021) to minimize the impact of annual shocks. The life tables follow 5-year intervals up to age 80+ years, excluding the youngest age groups where <1 year is separated from 1-4 years. Values for the 1-4 years age group were calculated by adding the 12-23 months and 2-4 years age groups. A total of 18 age groups were included. Only the central estimates were used for this study.

The estimated excess deaths resulting from the funding cut were derived from the UNAIDS Epidemiological Estimates which provide the number of deaths averted due to ART annually in 2024.[79] Meanwhile, data on HIV/AIDS funding were taken from the UNAIDS Global AIDS Monitoring (GAM) reports.[80] The GAM provides country-reported data on HIV/AIDS funding disaggregated by source (e.g. domestic public, domestic private, international sources, PEPFAR) and by the type of program funded (e.g. treatment, care, ART, prevention campaigns, etc.). The primary data of interest is ART expenditure from PEPFAR and from other sources.

## 3.2. Country Cases

While this study was interested in estimating the impact for all SSA countries, limitations on the funding data reduced the cases included. Most countries do not submit funding data annually, and some do not disaggregate by funding source. Hence, this study included countries with expenditure data in the GAM that meet the following criteria:

1. The expenditure year must be from the last 10 years (2015 onwards). For countries with reported expenditure for multiple years, the latest report with complete data is used.
2. The reported ART funding from PEPFAR and domestic public expenditure must both be non-zero to ensure completeness of reported values by source.
3. The contribution of PEPFAR in the overall ART spending must be greater than 10% to narrow focus on countries with higher reliance.

A total of 18 countries were included based on the first two criteria and is further narrowed to only 10 countries after the third criteria is accounted for. The final list of countries included in this study are as follows:

Table 1. Case Countries and ART Expenditure by Source

| Country | Reporting cycle | Expenditure Year | ART expenditure from PEPFAR | ART expenditure from all sources combined* | PEPFAR share of ART expenditure** |
|---|---|---|---|---|---|
| Angola | GAM 2025 | 2024 | $4,531,363.00 | $16,338,874.71 | 27.73% |
| Botswana | GAM 2022 | 2019 | $4,923,551.06 | $42,743,441.96 | 11.52% |
| Eswatini | GAM 2021 | 2019 | $8,264,971.79 | $25,099,383.82 | 32.93% |
| Kenya | GAM 2025 | 2024 | $168,790,150.63 | $398,658,126.15 | 42.34% |
| Mozambique | GAM 2020 | 2019 | $112,288,232.50 | $186,200,599.96 | 60.30% |
| Namibia | GAM 2019 | 2017 | $23,543,990.00 | $114,725,810.00 | 20.52% |
| Nigeria | GAM 2024 | 2021 | $53,343,054.00 | $129,618,767.00 | 41.15% |
| Togo | GAM 2025 | 2024 | $1,198,921.20 | $7,385,646.13 | 16.23% |
| Uganda | GAM 2024 | 2020 | $104,929,222.24 | $198,216,314.56 | 52.94% |
| Zimbabwe | GAM 2023 | 2020 | $42,568,543.00 | $57,711,015.80 | 73.76% |

* Includes sources such as domestic private spending and funding from other international donors

Ideally, the expenditure data used for the analysis is from 2024 to reflect the current level of funding dependency but given the limitations, it is assumed that the latest funding data reflects the same level of dependency. Funding decline is defined as the share of PEPFAR contribution to ART funding, as this is the expected amount to be withdrawn in the absence of the program. This is scaled for each scenario, assuming worst-case and limited case scenarios on how much of the PEPFAR funding is lot. calculated as follows.

$$FD_s = \left( \frac{ART_{\text{PEPFAR}}}{ART_{\text{All sources}}} \right) \times \text{Scenario}\%$$

**Where:**

- $FD_s$: Funding decline for scenario $s$
- $ART_{\text{PEPFAR}}$: ART Spending from PEPFAR
- $ART_{\text{All sources}}$: ART Spending from all sources
- $Scenario\%$: Scaling factor for funding decline per scenario (100% for worst case, 50% for moderate, 20% for limited)

## 3.3. Life Tables in Counterfactual Modeling

Life tables are widely used in demographic research to summarize the mortality experience of a population and estimate population outcomes such as life expectancies.[81] A life table constructs a hypothetical cohort and assumes that each individual in this cohort experiences the mortality rates of the period from which the life table is constructed. Life tables serve many uses, from capturing a snapshot of mortality within a single population, to comparing the mortality experience between different populations (e.g. by country, sex, race, health status, etc.).

The use of life table methods to attribute the contribution of diseases to life expectancy, and model potential scenarios given certain assumptions about mortality patterns in a given population is an established practice. For instance, a study decomposing the contribution of HIV/AIDS in improving life expectancy in South Africa found that of the 11.1 years of life gained between 2006 and 2017, 8.9 of those years were caused by the reduction of HIV/AIDS mortality within this period.[82] This study accomplished this by constructing baseline life tables following existing HIV/AIDS ASMRs in the country and modeling counterfactual scenarios where the HIV/AIDS ASMR from 2006 did not improve until 2017. The difference between the

life expectancies in those life tables were taken as the life expectancy gains attributable to HIV/AIDS improvements.

Another common application of counterfactual modeling through life tables is the use of *cause-deleted* life tables, which illustrates how disease elimination can improve life expectancy. This is accomplished by subtracting deaths from a specific cause and recalculating the life table values with this adjusted mortality pattern. In these life tables, the mortality from a specific cause of interest is arbitrarily set to zero while mortality from other causes is held constant. The difference between the calculated life expectancies reflects the expected gains in life expectancy once a certain cause of death is eliminated. These insights are valuable for public health planning as it provides quantitative metrics on the impact of a specific disease in public health, identifying which are groups are most affected, helping in the comparison and prioritization among health threats.[83]

A related approach uses *cause-modified* life tables to estimate the impacts of changes in a population's exposure to different risks or health interventions that can affect the existing mortality patterns. This has been adopted for a diverse range of health issues, from the impacts of increased exposure to air pollution,[84] to the effects of behavioral factors such as sedentary lifestyles.[85] These studies use assumptions on the quantitative impacts of changed risks or interventions (usually expressed as relative risks or excess mortality rates) relative to the baseline scenario in the absence of the risk. The life table values are recalculated based on the adjusted mortality pattern after exposure to the increased risk or the intervention.

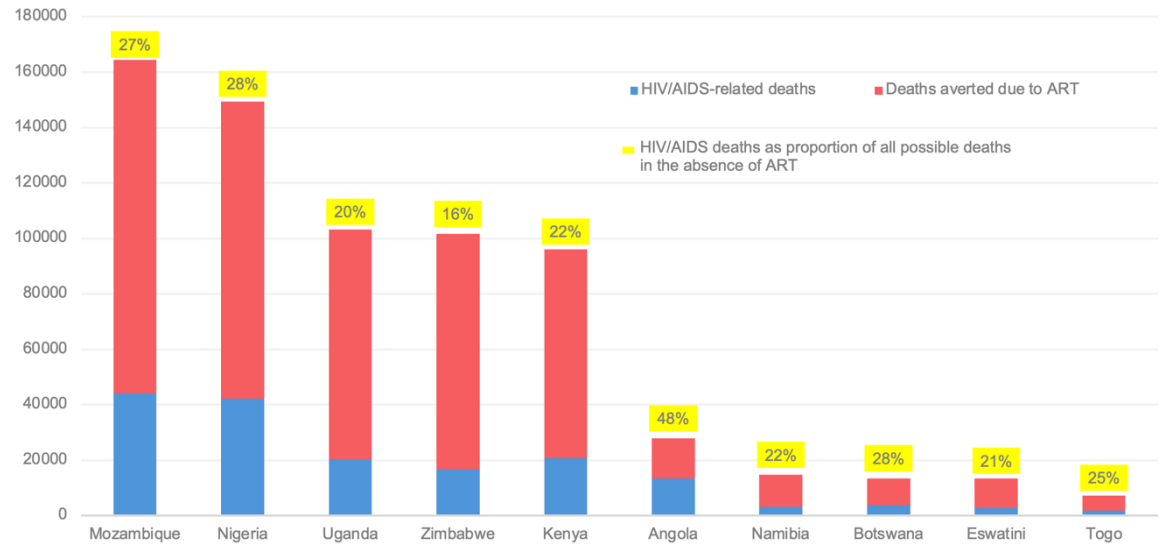
This dissertation used cause-modified life tables by constructing several scenarios resulting from the funding cut: the baseline scenario showing the prevailing mortality patterns in the absence of the funding cut, and counterfactual scenarios following three different funding schemes. These counterfactual scenarios are constructed by adding the estimated excess deaths after the funding cut, as discussed in the next section.

## 3.4. Estimating Excess Deaths

The estimated excess deaths are derived from the existing UNAIDS estimates on total deaths averted due to ART. It is assumed that these total deaths averted is a result of the implementation of ART services with the current available resources and funding, and that a decline in funding leads to a proportionate decrease in ART coverage and subsequent reversal of those averted deaths. Simply put, it is assumed that every 1% of funding reduction corresponds to a 1% decrease in ART coverage that translates to a 1% increase in excess deaths due to ART interruption.

Hence, the deaths averted due to ART effectively set the maximum HIV/AIDS deaths assuming full reversal of progress. Figure 6 shows the steep difference between actual HIV/AIDS deaths and the potential mortality that would have occurred in the absence ART. The maximum potential deaths modeled by UNAIDS shows that most case countries experience only a fifth or quarter of the potential lives lost. These results also imply that a full reversal of ART progress can lead to substantial increases in mortality, from twice at the minimum (Angola) to four or five times for most countries, and up to six times at worst (Zimbabwe).

Figure 6. HIV/AIDS Deaths and Deaths averted due to ART in 2024[86]



How much of these potential deaths translate to actual excess deaths after the funding cut are calculated as follows:

$$D_s^{Excess} = D^{ART} \times FD_s$$

**Where:**

- $D_s^{Excess}$: Total excess deaths for scenario $s$.
- $D^{ART}$: Deaths averted due to ART in 2024 based on UNAIDS estimate.
- $FD_s$: Funding decline for scenario $s$.

These reflect the aggregate number of deaths upon ART interruption. However, it fails to account for age-specific impacts, so these must be distributed accordingly. It is assumed that the excess deaths per age group are proportionate to its share of HIV/AIDS deaths compared to all other age groups. Hence, excess deaths were distributed by age group as follows:

$$D_x^{Excess} = D_s^{Excess} \times \left( \frac{{}_nD_x^{HIV}}{\sum D_x^{HIV}} \right)$$

**Where:**

- $D_x^{Excess}$: Excess deaths for age group $x$.
- $D_s^{Excess}$: Total excess deaths across all age groups in scenario $s$.
- $\left( \frac{{}_nD_x^{HIV}}{\sum D_x^{HIV}} \right)$: Proportion of HIV deaths in age group $x$ vs all ages.

With these computed excess deaths per scenario, the counterfactual life tables can now be generated by adding them to the baseline HIV/AIDS mortality.

## 3.5. Constructing the Baseline and Counterfactual Life Tables

The baseline scenarios for each country were constructed from the population and mortality values from the GBD. The counterfactual scenarios retain the same population and non-HIV/AIDS mortality values, but the HIV/AIDS mortality were adjusted to add the calculated excess death. Hence, HIV/AIDS ASMRs were calculated as follows:

**Baseline**

$$ {}_nm_x^{HIV} = \frac{{}_nD_x^{HIV}}{{}_nP_x} $$

**Counterfactual**

$$ {}^*_nm_x^{HIV} = \frac{{}_nD_x^{HIV} + {}_nD_x^{Excess}}{{}_nP_x} $$

**Where:**

- ${}_nm_x^{HIV}$: HIV/AIDS ASMR for the baseline scenario.
- ${}^*_nm_x^{HIV}$: HIV/AIDS ASMR for the counterfactual scenario.
- ${}_nD_x^{Excess}$: Excess deaths for that age group.

These ${}_nm_x$ values subsequently generated updated probabilities of dying (${}_nq_x$) for each scenario and influences the rest of the values of the life table. A total of four life tables were constructed per country: one baseline life table in which no funding cut is present, and one counterfactual life table for each of the three scenarios (worst-case with 100% PEPFAR withdrawal, moderate with 50%, and limited with 20%).

## 3.6. Calculating the Life Expectancy Decline

The primary outcome of interest are the calculated life expectancies. Since it is assumed that the baseline scenario reflects the life expectancy in the absence of the funding cut while the counterfactual life tables account for the excess deaths, the difference between the life expectancy values between these two tables reflect the impact of the funding cut:

$$ \Delta e_{x,s} = {}^*e_{x,s} - e_{x,baseline} $$

**Where:**

- $\Delta e_{x,s}$: Difference in life expectancy between the counterfactual and baseline scenario at age $x$ in scenario $s$.
- ${}^*e_{x,s}$: Counterfactual life expectancy at age $x$ in scenario $s$.
- $e_{x,baseline}$: Baseline life expectancy in the scenario with no funding cuts.

Countries were grouped in the analysis depending on the size of estimated declines. A country was considered severely affected if any of its age groups showed a life expectancy decline greater than or equal to three years. Moderately affected countries are those whose most affected age group experienced a decline between

one to three years. Countries where no age group reflects a decline greater than one year are considered minimally affected.

### 3.7. Limitations

The chosen methodology, data sources, and assumptions all present several limitations that are worth noting. First, period life tables construct hypothetical cohorts that experiences the same mortality rates throughout their life course. However, different factors over time can affect the mortality patterns: from medical improvements to changes in mortality from different causes.[87] This includes changes in domestic resources for the HIV/AIDS epidemic response. This is one of the criticisms on the use of period life tables for short-term epidemics such as COVID-19, which can mean life expectancy declines are overestimated as improvements may be seen in a relatively short period.[88] Hence, the scenarios must be interpreted as situations in which the same mortality and health system conditions persist throughout the hypothetical cohort's lifetime after the funding cut, with its impact likely to lessen over time.

Further, this study assumed a linear relationship between the funding amount and the deaths averted due to ART, and that a decrease in funding for ART immediately and directly translates to a proportionate increase in excess deaths. However, this linear relationship might not be always true, considering that the funding cut can affect ART services through multiple pathways: reduced ARV medicine, for example, can have much direct impacts on coverage compared to reduction in staffing which can be augmented by increased workload of staff, or similar health system adjustments. Further, the deaths are also not likely to manifest immediately as others may experience viral rebound at different periods.

Finally, the constructed multiple decrement life tables assumes that the causes of death are independent of each other. However, ART disruptions can also have impact on mortality from other causes (e.g. tuberculosis) that cannot be accounted for in this study. Hence, this study only refers to the life expectancy loss

attributable to ART service disruption from the funding cut and not any spillover effects on mortality from other diseases.

Nevertheless, the use of life tables in this study allows for the calculation of relative changes in population outcomes between the modeled scenarios which reflect the intensity of the impacts of the funding cut. Assuming improvements in the reinitiation of ART and general public health improvements over time means the gravity of these estimates may be reduced.

# 4. Results and Discussion

The chapter is divided into four parts. The first looks into the estimated excess deaths in different scenarios, while the second shows how these translate to life expectancy declines in each country. Finally, the third and fourth parts contextualize these observed impacts against the historical progress on life expectancy improvements from all causes and HIV/AIDS, and compares it to the life expectancy losses that resulted from COVID-19.

## 4.1. Excess Deaths

The total estimated excess deaths and adjusted HIV/AIDS mortality for each scenario are found in Table 2, while some summary mortality indicators are found in Table 3. The summarized indicators focus on the moderate scenario (50% decline) to simplify the discussion, but the relative difference per countries are similar across scenarios.

The amount of funding decline shaped how much of the potential HIV/AIDS deaths translated into actual excess deaths upon effect of the funding withdrawal. The highest number of excess deaths in the moderate scenario were noted in Mozambique (36,291) and Zimbabwe (31,333), followed by Nigeria (22,045) and Uganda (21,947). However, the population size effectively scales the broader population-level impact of these excess deaths, with a notable example being Nigeria whose large population masks the excess deaths to a mere 9.80 per 100,000, compared to Zimbabwe at 203. On the other hand, Eswatini’s small population size may have also affected how the excess deaths scale, as a mere total of 1,733 excess deaths were translated to a death rate of 150, surpassing Mozambique at 119.

Table 2. Total Excess Deaths

| Country | Funding Decline | Excess Deaths | | | Adjusted HIV/AIDS Deaths | | |
|---|---|---|---|---|---|---|---|
| | | Worst-Case (100% Decline) | Moderate (50% Decline) | Limited (20% Decline) | Worst-Case (100% Decline) | Moderate (50% Decline) | Limited (20% Decline) |
| Angola | 27.73% | 4019.63 | 2009.82 | 803.93 | 21234.76 | 19224.94 | 18019.05 |
| Botswana | 11.52% | 1123.19 | 561.60 | 224.64 | 6523.44 | 5961.84 | 5624.88 |
| Eswatini | 32.93% | 3467.55 | 1733.78 | 693.51 | 6657.34 | 4923.57 | 3883.30 |
| Kenya | 42.34% | 31878.86 | 15939.43 | 6375.77 | 68228.54 | 52289.11 | 42725.45 |
| Mozambique | 60.30% | 72582.70 | 36291.35 | 14516.54 | 115280.85 | 78989.50 | 57214.69 |
| Namibia | 20.52% | 2361.67 | 1180.84 | 472.33 | 5563.97 | 4383.13 | 3674.63 |
| Nigeria | 41.15% | 44093.14 | 22046.57 | 8818.63 | 119618.53 | 97571.96 | 84344.01 |
| Togo | 16.23% | 891.62 | 445.81 | 178.32 | 3595.09 | 3149.28 | 2881.79 |
| Uganda | 52.94% | 43895.85 | 21947.93 | 8779.17 | 69453.95 | 47506.02 | 34337.27 |
| Zimbabwe | 73.76% | 62667.74 | 31333.87 | 12533.55 | 84193.14 | 52859.27 | 34058.95 |

Table 3. Mortality Indicators (Moderate Scenario)

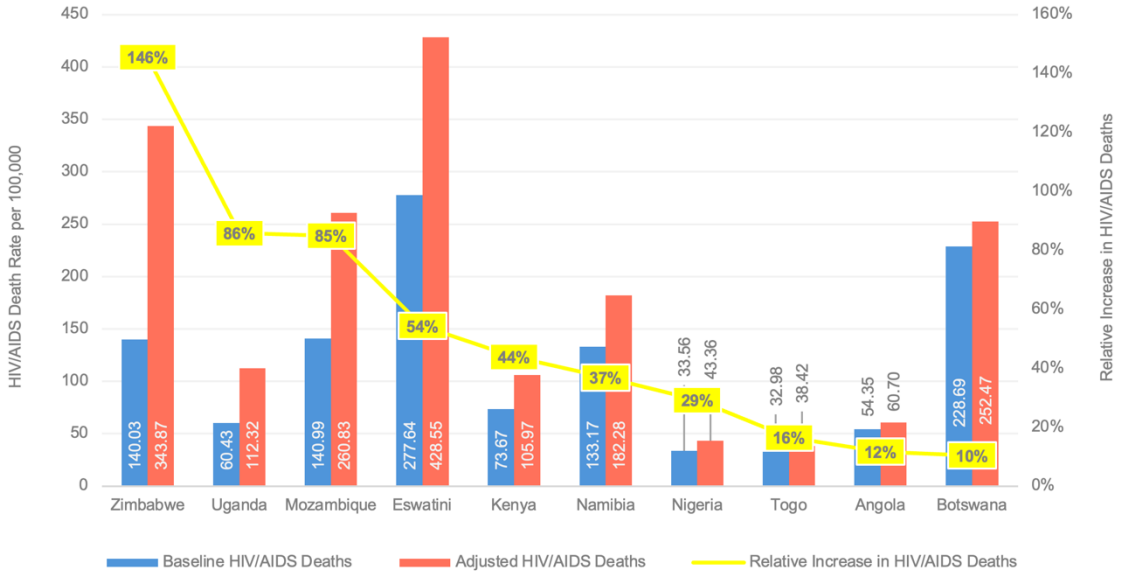
| Country | Death Rates per 100,000 | | | HIV/AIDS Proportionate Mortality | | Relative Increase in HIV/AIDS Mortality (Baseline vs Moderate) |
|---|---|---|---|---|---|---|
| | Baseline HIV/AIDS Death Rate | Excess Death Rate (Moderate Scenario) | Adjusted HIV/AIDS Death Rate (Moderate Scenario) | Baseline | Adjusted (Moderate Scenario) | |
| Angola | 54.35 | 6.35 | 60.70 | 7.73% | 8.55% | 11.67% |
| Botswana | 228.69 | 23.78 | 252.47 | 24.77% | 26.66% | 10.40% |
| Eswatini | 277.64 | 150.91 | 428.55 | 21.61% | 29.85% | 54.35% |
| Kenya | 73.67 | 32.30 | 105.97 | 11.25% | 15.42% | 43.85% |
| Mozambique | 140.99 | 119.84 | 260.83 | 15.41% | 25.20% | 85.00% |
| Namibia | 133.17 | 49.11 | 182.28 | 14.61% | 18.98% | 36.87% |
| Nigeria | 33.56 | 9.80 | 43.36 | 4.30% | 5.49% | 29.19% |
| Togo | 32.98 | 5.44 | 38.42 | 4.56% | 5.27% | 16.49% |
| Uganda | 60.43 | 51.89 | 112.32 | 8.93% | 15.42% | 85.87% |
| Zimbabwe | 140.03 | 203.84 | 343.87 | 13.27% | 27.31% | 145.57% |

Adding these excess deaths to the baseline HIV/AIDS deaths is a viable way to anticipate the relative change in the domestic burden once the funding cut takes effect. As shown in Figure 7, the highest relative increase in HIV/AIDS mortality in the moderate scenario is experienced in Zimbabwe, where HIV/AIDS mortality more than doubles (146% increase), followed by Uganda (86%), Mozambique (85%), and Eswatini (54%). Kenya, Namibia, and Nigeria follow with more moderate increases (44%, 37%, and 29% respectively), while the remaining three countries experience only between 10-16% increases.

These relative increases are larger compared to previous modeling studies involving temporary ART disruptions in SSA, which anticipates an increase of 1.75-3.51 times after a 6-month disruption of 100% people on ART covered during COVID-19.[89] This is likely because the UNAIDS epidemiological estimates on potential deaths in the absence of ART from which the estimated excess deaths

were based anticipated much higher excess deaths upon full breakdown of its progress, and that the COVID-19 modeling study anticipated a temporary breakdown while UNAIDS estimates are focused on complete absence of ART.

Figure 7. HIV/AIDS Mortality (Baseline vs Moderate Scenario) and Relative Increase




The relative increases in HIV/AIDS mortality are particularly interesting as they can anticipate how the other values in the scenario life tables are calculated. With all other values held constant, relative increase gives the average aggregate increase in ${}_nm_x$ values. With that, we may expect the largest impacts to be noticeable in Zimbabwe, Uganda, Mozambique, and Eswatini, but the age distribution to the specific ${}_nm_x$ values in the life table can still shift the impact on life expectancy.

It is worth noting that the estimated relative increase in HIV/AIDS mortality do not directly correspond to the intensity of the experienced funding cut. While the highest relative increases are found in most dependent countries (Zimbabwe, Mozambique, and Uganda), Eswatini reflected higher relative increase compared to Kenya and Nigeria despite experiencing a smaller funding cut (32% cut for Eswatini; 42% and 41% for Kenya and Nigeria, respectively). Additionally, Namibia also reflected higher relative increase compared to Nigeria despite experiencing only half of the funding cut felt by Nigeria (20% for Namibia; 41% cut for Nigeria). These indicate that funding impact is further shaped by baseline country contexts such as

existing HIV/AIDS burden, potential deaths in the absence of ART, or even the population size that can mask increases.

## 4.2. Declines in Life Expectancy

How do these excess deaths translate to life expectancy changes? The calculated declines across all age groups are found in Table 4, and is aided by a categorization of countries depending on the severity of impact in Table 5.

### 4.2.1. Range of Declines

Significant cross-country variation is found in the life expectancy declines. In the worst-case scenario, four of the ten countries (Eswatini, Mozambique, Uganda, and Zimbabwe) are severely affected (≥ 3 years decline in at least one age group), while two (Kenya, Namibia) are moderately affected (between 1-3 years decline in at least one age group). Less countries are affected in the moderate scenario, where only one country is severely affected (Zimbabwe), and three are moderately affected (Eswatini, Mozambique, Uganda). In the limited scenario, only moderate declines are observable in two countries (Mozambique, Zimbabwe), while the other eight are relatively unaffected. Across all funding scenarios, four countries experience minimal impact on life expectancy (Angola, Botswana, Nigeria, Togo). It must be noted that the categorization of severe, moderate, and limited impact are arbitrarily set for ease of discussion on the relative impacts between countries and should not minimize how the funding cut is understood in terms of its public health impact.

The most extreme decline observed in the worst-case scenario are expected in Zimbabwe (6.72 years decline). The highest declines in other severely affected countries are Mozambique (-5.13), Eswatini (-4.37), and Uganda (-3.01). The other two moderately affected countries are Namibia (-1.95) and Kenya (-1.60). In the moderate scenario, only Zimbabwe will be severely affected (-3.62), while the other three moderately affected countries are Mozambique (-2.68), Eswatini (-2.29), and Uganda (-1.54). In the most conservative scenario, only Zimbabwe (-1.52) and Mozambique (-1.10) are affected.

Table 4. Declines in life expectancy

| Age Group | Angola | | | Botswana | | | Eswatini | | |
|---|---|---|---|---|---|---|---|---|---|
| | Worst-Case | Moderate | Limited | Worst-Case | Moderate | Limited | Worst-Case | Moderate | Limited |
| <1 | -0.33 | -0.16 | -0.07 | -0.84 | -0.43 | -0.17 | **-4.24*** ** | **-2.22** ** | -0.91 |
| 1-4 | -0.34 | -0.17 | -0.07 | -0.87 | -0.44 | -0.18 | **-4.37*** ** | **-2.29** ** | -0.94 |
| 5-9 | -0.32 | -0.16 | -0.06 | -0.88 | -0.44 | -0.18 | **-4.31*** ** | **-2.26** ** | -0.93 |
| 10-14 | -0.32 | -0.16 | -0.06 | -0.88 | -0.44 | -0.18 | **-4.26*** ** | **-2.23** ** | -0.92 |
| 15-19 | -0.32 | -0.16 | -0.06 | -0.88 | -0.44 | -0.18 | **-4.19*** ** | **-2.19** ** | -0.90 |
| 20-24 | -0.31 | -0.16 | -0.06 | -0.86 | -0.44 | -0.18 | **-3.98*** ** | **-2.08** ** | -0.86 |
| 25-29 | -0.30 | -0.15 | -0.06 | -0.83 | -0.42 | -0.17 | **-3.71*** ** | **-1.94** ** | -0.80 |
| 30-34 | -0.27 | -0.14 | -0.05 | -0.77 | -0.39 | -0.16 | **-3.34*** ** | **-1.74** ** | -0.71 |
| 35-39 | -0.22 | -0.11 | -0.04 | -0.69 | -0.35 | -0.14 | **-2.75** ** | **-1.43** ** | -0.58 |
| 40-44 | -0.17 | -0.09 | -0.03 | -0.58 | -0.29 | -0.12 | **-2.18** ** | **-1.12** ** | -0.46 |
| 45-49 | -0.12 | -0.06 | -0.02 | -0.45 | -0.23 | -0.09 | **-1.55** ** | -0.80 | -0.32 |
| 50-54 | -0.07 | -0.04 | -0.01 | -0.33 | -0.16 | -0.07 | **-1.07** ** | -0.54 | -0.22 |
| 55-59 | -0.04 | -0.02 | -0.01 | -0.21 | -0.10 | -0.04 | -0.64 | -0.33 | -0.13 |
| 60-64 | -0.02 | -0.01 | 0.00 | -0.12 | -0.06 | -0.02 | -0.36 | -0.18 | -0.07 |
| 65-69 | -0.01 | -0.01 | 0.00 | -0.06 | -0.03 | -0.01 | -0.20 | -0.10 | -0.04 |
| 70-74 | -0.01 | 0.00 | 0.00 | -0.03 | -0.02 | -0.01 | -0.10 | -0.05 | -0.02 |
| 75-79 | 0.00 | 0.00 | 0.00 | -0.02 | -0.01 | 0.00 | -0.05 | -0.03 | -0.01 |
| 80+ | 0.00 | 0.00 | 0.00 | -0.01 | 0.00 | 0.00 | -0.02 | -0.01 | 0.00 |

| Age Group | Kenya | | | Mozambique | | | Namibia | | |
|---|---|---|---|---|---|---|---|---|---|
| | Worst-Case | Moderate | Limited | Worst-Case | Moderate | Limited | Worst-Case | Moderate | Limited |
| <1 | **-1.56** ** | -0.79 | -0.32 | **-4.91*** ** | **-2.56** ** | **-1.05** ** | **-1.90** ** | -0.97 | -0.39 |
| 1-4 | **-1.60** ** | -0.81 | -0.33 | **-5.13*** ** | **-2.68** ** | **-1.10** ** | **-1.95** ** | -0.99 | -0.40 |
| 5-9 | **-1.56** ** | -0.79 | -0.32 | **-5.01*** ** | **-2.61** ** | **-1.07** ** | **-1.94** ** | -0.99 | -0.40 |
| 10-14 | **-1.54** ** | -0.78 | -0.31 | **-4.93*** ** | **-2.57** ** | **-1.06** ** | **-1.92** ** | -0.98 | -0.40 |
| 15-19 | **-1.52** ** | -0.77 | -0.31 | **-4.82*** ** | **-2.51** ** | **-1.03** ** | **-1.90** ** | -0.97 | -0.39 |
| 20-24 | **-1.46** ** | -0.74 | -0.30 | **-4.66*** ** | **-2.43** ** | -1.00 | **-1.81** ** | -0.92 | -0.37 |
| 25-29 | **-1.40** ** | -0.71 | -0.29 | **-4.28*** ** | **-2.23** ** | -0.91 | **-1.72** ** | -0.88 | -0.35 |
| 30-34 | **-1.31** ** | -0.66 | -0.27 | **-3.75*** ** | **-1.95** ** | -0.80 | **-1.61** ** | -0.82 | -0.33 |
| 35-39 | **-1.17** ** | -0.59 | -0.24 | **-2.99** ** | **-1.54** ** | -0.63 | **-1.40** ** | -0.71 | -0.29 |
| 40-44 | -0.99 | -0.50 | -0.20 | **-2.14** ** | **-1.10** ** | -0.45 | **-1.17** ** | -0.59 | -0.24 |
| 45-49 | -0.76 | -0.38 | -0.15 | **-1.28** ** | -0.65 | -0.26 | -0.89 | -0.45 | -0.18 |
| 50-54 | -0.52 | -0.26 | -0.11 | -0.84 | -0.42 | -0.17 | -0.63 | -0.32 | -0.13 |
| 55-59 | -0.32 | -0.16 | -0.06 | -0.50 | -0.25 | -0.10 | -0.38 | -0.19 | -0.08 |
| 60-64 | -0.18 | -0.09 | -0.04 | -0.28 | -0.14 | -0.06 | -0.21 | -0.11 | -0.04 |
| 65-69 | -0.09 | -0.04 | -0.02 | -0.15 | -0.08 | -0.03 | -0.11 | -0.06 | -0.02 |
| 70-74 | -0.04 | -0.02 | -0.01 | -0.08 | -0.04 | -0.02 | -0.06 | -0.03 | -0.01 |
| 75-79 | -0.02 | -0.01 | 0.00 | -0.04 | -0.02 | -0.01 | -0.03 | -0.01 | -0.01 |
| 80+ | -0.01 | 0.00 | 0.00 | -0.01 | -0.01 | 0.00 | -0.01 | -0.01 | 0.00 |

*** Severe decline (≥ 3 years) ** Moderate decline (1-3 years)

Table 4. Declines in life expectancy (continued)

| Age Group | Nigeria | | | Togo | | |
|---|---|---|---|---|---|---|
| | Worst-Case | Moderate | Limited | Worst-Case | Moderate | Limited |
| <1 | -0.56 | -0.28 | -0.11 | -0.26 | -0.13 | -0.05 |
| 1-4 | -0.59 | -0.30 | -0.12 | -0.27 | -0.13 | -0.05 |
| 5-9 | -0.60 | -0.30 | -0.12 | -0.27 | -0.13 | -0.05 |
| 10-14 | -0.59 | -0.30 | -0.12 | -0.27 | -0.13 | -0.05 |
| 15-19 | -0.59 | -0.29 | -0.12 | -0.26 | -0.13 | -0.05 |
| 20-24 | -0.58 | -0.29 | -0.12 | -0.25 | -0.13 | -0.05 |
| 25-29 | -0.56 | -0.28 | -0.11 | -0.24 | -0.12 | -0.05 |
| 30-34 | -0.53 | -0.26 | -0.11 | -0.23 | -0.11 | -0.05 |
| 35-39 | -0.46 | -0.23 | -0.09 | -0.20 | -0.10 | -0.04 |
| 40-44 | -0.37 | -0.19 | -0.07 | -0.16 | -0.08 | -0.03 |
| 45-49 | -0.27 | -0.14 | -0.05 | -0.12 | -0.06 | -0.02 |
| 50-54 | -0.18 | -0.09 | -0.04 | -0.08 | -0.04 | -0.02 |
| 55-59 | -0.11 | -0.05 | -0.02 | -0.05 | -0.02 | -0.01 |
| 60-64 | -0.06 | -0.03 | -0.01 | -0.02 | -0.01 | 0.00 |
| 65-69 | -0.03 | -0.02 | -0.01 | -0.01 | -0.01 | 0.00 |
| 70-74 | -0.02 | -0.01 | 0.00 | -0.01 | 0.00 | 0.00 |
| 75-79 | -0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 80+ | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| Age Group | Uganda | | | Zimbabwe | | |
|---|---|---|---|---|---|---|
| | Worst-Case | Moderate | Limited | Worst-Case | Moderate | Limited |
| <1 | **-2.89**** | **-1.48**** | -0.60 | **-6.46***** | **-3.48***** | **-1.46**** |
| 1-4 | **-3.01***** | **-1.54**** | -0.63 | **-6.72***** | **-3.62***** | **-1.52**** |
| 5-9 | **-3.01***** | **-1.54**** | -0.63 | **-6.69***** | **-3.60***** | **-1.51**** |
| 10-14 | **-3.01***** | **-1.54**** | -0.63 | **-6.62***** | **-3.57***** | **-1.50**** |
| 15-19 | **-2.98**** | **-1.53**** | -0.62 | **-6.51***** | **-3.51***** | **-1.47**** |
| 20-24 | **-2.91**** | **-1.49**** | -0.60 | **-6.33***** | **-3.41***** | **-1.43**** |
| 25-29 | **-2.75**** | **-1.41**** | -0.57 | **-5.98***** | **-3.22***** | **-1.35**** |
| 30-34 | **-2.49**** | **-1.27**** | -0.52 | **-5.57***** | **-2.99**** | **-1.25**** |
| 35-39 | **-2.10**** | **-1.07**** | -0.43 | **-4.92***** | **-2.64**** | **-1.10**** |
| 40-44 | **-1.69**** | -0.86 | -0.35 | **-4.21***** | **-2.24**** | -0.93 |
| 45-49 | **-1.27**** | -0.65 | -0.26 | **-3.32***** | **-1.76**** | -0.73 |
| 50-54 | -0.88 | -0.45 | -0.18 | **-2.40**** | **-1.25**** | -0.52 |
| 55-59 | -0.55 | -0.28 | -0.11 | **-1.46**** | -0.75 | -0.31 |
| 60-64 | -0.32 | -0.16 | -0.06 | -0.80 | -0.41 | -0.17 |
| 65-69 | -0.17 | -0.09 | -0.03 | -0.42 | -0.21 | -0.09 |
| 70-74 | -0.09 | -0.05 | -0.02 | -0.22 | -0.11 | -0.04 |
| 75-79 | -0.05 | -0.02 | -0.01 | -0.10 | -0.05 | -0.02 |
| 80+ | -0.02 | -0.01 | 0.00 | -0.04 | -0.02 | -0.01 |

*** Severe decline (≥ 3 years) ** Moderate decline (1-3 years)

Table 5. Severity of Impact

| Country | Worst-Case (100% PEPFAR Reduction) | Moderate (50% PEPFAR Reduction) | Limited (20% PEPFAR Reduction) |
|---|---|---|---|
| Angola | | | |
| Botswana | | | |
| Eswatini | Severe | Moderate | |
| Kenya | Moderate | | |
| Mozambique | Severe | Moderate | Moderate |
| Namibia | Moderate | | |
| Nigeria | | | |
| Togo | | | |
| Uganda | Severe | Moderate | |
| Zimbabwe | Severe | Severe | Moderate |

*** Severe = at least one age group experiencing ≥ 3 years decline
** Moderate = at least one age group experiencing between 1-3 years decline
* Blank cells indicate Limited impact = no age group exhibiting ≥ 1 year decline

The wide disparity of impact reflects the fragility of progress in HIV/AIDS outcomes in each country. On one hand, even a 20% funding cut is sufficient to translate to moderate declines in life expectancy in Mozambique and Zimbabwe. On the other, some countries can experience full withdrawal of PEPFAR support and still see limited impact. As anticipated, the observed declines directly reflect the patterns observed in the relative increase of HIV/AIDS mortality. Hence, the interaction between baseline country outcomes and HIV/AIDS progress, dependency on aid, and relative changes in mortality affect the extent to which the funding cut can manifest in population-level indicators.

### 4.2.2. Age-Specific Impacts

The greatest declines are concentrated in the younger age groups, with significantly lower changes experienced in the oldest age groups, as shown in Figure 8. While almost all countries have experienced the most extreme declines in the 1-4-year age group, the difference in impact between this age group and the preceding/succeeding age groups are marginal.

This age trend stands in contrast to the distribution of excess deaths across the age groups. Figure 9 shows the age-specific excess death rates. It is worth

noting that these trends are directly proportional to the baseline HIV/AIDS ASMRs as the excess deaths were distributed proportionally. The excess ASMRs are concentrated in the adult age groups (30-34 to 55-59 years) and relatively low at the young age groups, except for a small spike in the 1–4-year age group.

The disparity between the age patterns of excess deaths and life expectancy impact reflects a fundamental nature of life expectancy measures, in which deaths at younger ages have significantly bigger impacts in life expectancy than those in older age groups.[90] Notably, the four countries experiencing the biggest life expectancy declines also exhibit highest age-specific excess death rates in the 1-4-year age group. Eswatini and Mozambique also have their peak deaths concentrated at a comparatively younger age group (40-44) as opposed to other countries with peaks at 50-54, which can slightly impact the intensity of life expectancy decline at the younger age groups.

Figure 8. Decline in Life Expectancy per Age Group (Moderate Scenario)

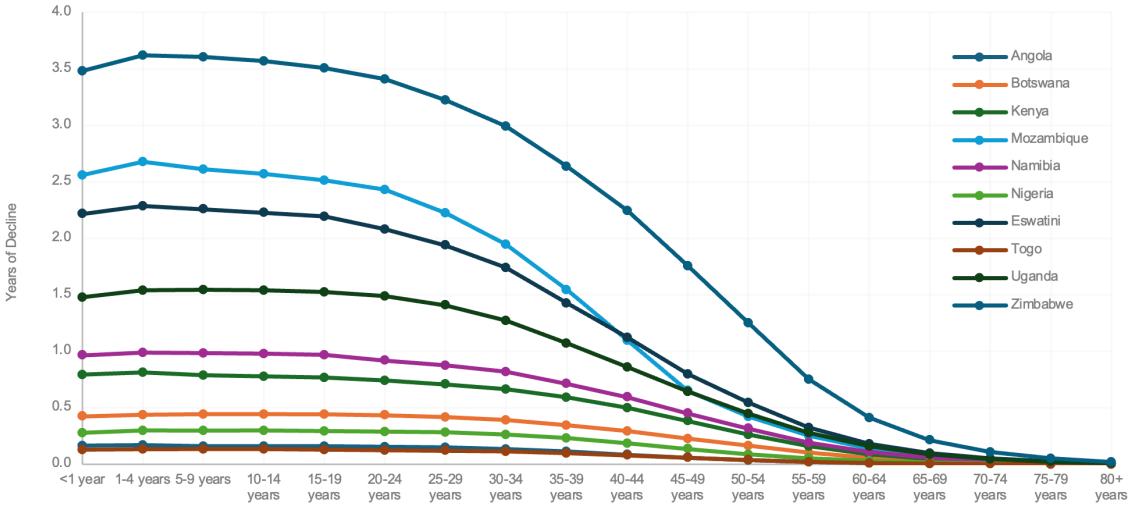
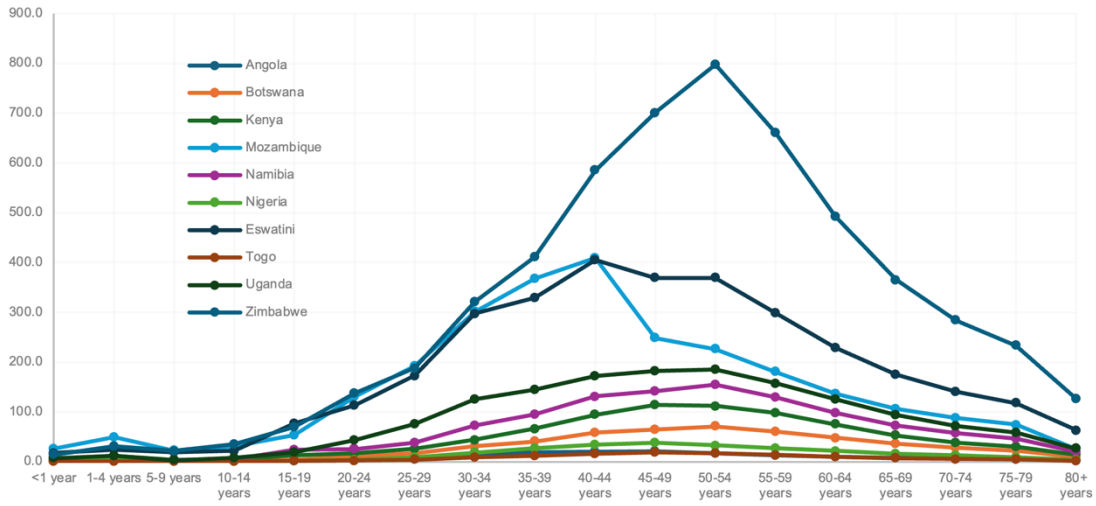


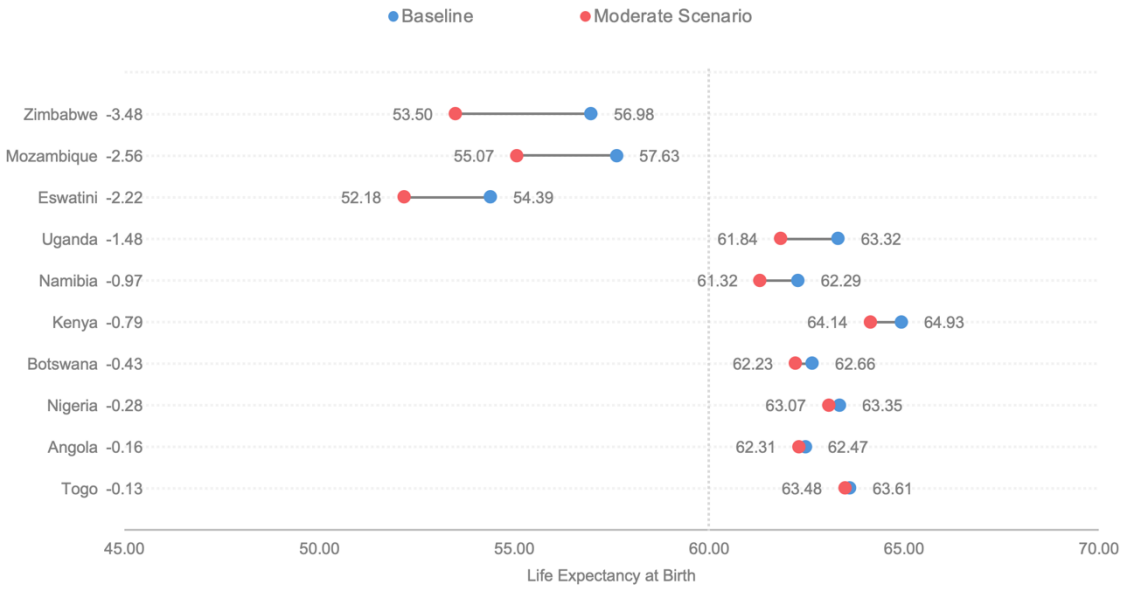
Figure 9. Age-Specific Excess Death Rate per 100,000 (Moderate Scenario)




## 4.2.3. Impact on life expectancy at birth ($e_0$)

Life expectancy at birth ($e_0$) is worth discussing as it is one of the most commonly used indicators for measuring public health progress, providing an intuitive summary of the mortality experience of a population.[91] Figure 10 compares $e_0$ between the baseline and moderate scenario.

Figure 10. Life expectancy at birth



There is already a wide disparity in $e_0$ even before the funding cut. The highest life expectancies range from 54.39 years (Eswatini) to 64.93 years (Kenya), a range of 10.53 years, with a median of 62.56 and mean of 61.16. At baseline, seven of the ten countries exhibit $e_0$ greater than 62 years, while the other three countries fall below 58 (Zimbabwe, Mozambique, and Eswatini), indicating wide inequalities even at the status quo. These existing disparities are expected to deepen once the funding cut takes effect. In the moderate scenario, the range widens from 52.18 (Eswatini) to 61.14 (Kenya), a difference of 11.97 years. The median $e_0$ is at 62.03 while the average falls below 60.

These results show that the funding cut is anticipated to deepen the already existing disparities among countries. Most notably, the three countries that experience the most extreme declines in $e_0$ are the same countries that have baseline life expectancies that are significantly lower than the rest. The initial range between these three countries from 54.39 to 57.63 years fall to 52.18 to 55.07. Meanwhile, the range for the other seven countries starting from 62.29 to 64.39 only fall to 61.32 to 64.14. Even after experiencing the funding cut, the adjusted $e_0$ of the seven countries are significantly higher than the baseline scenario of the other three countries. This reinforces the consistent finding that existing contexts and funding dependencies can compound the impact of the funding cut and lead to differentiated outcomes, with some countries more vulnerable than others.

### 4.3. Backsliding of historical advancements in $e_0$

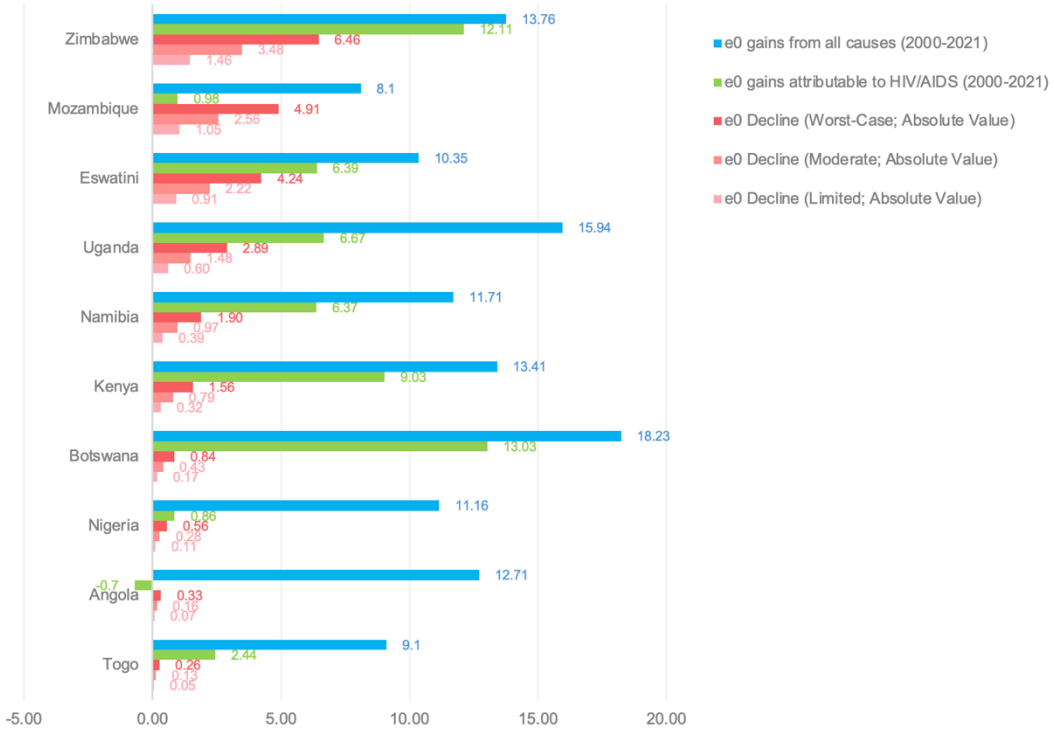
It is interesting to compare by how much the funding cut can contribute to the backsliding of historical progress on life expectancy. Figure 11 compares the estimated declines in $e_0$ with the historical improvements from all causes and HIV/AIDS between 2000 to 2021 as decomposed by the GBD.[92] These total gains are not the net gains between this period, as these are offset by declines from other sources such as COVID-19.

For many of the countries a large part of the total $e_0$ gains were attributable to HIV/AIDS (e.g. 12.11 of 13.76 years gained in Zimbabwe, 13.03 of 18.23 in

Botswana). Interestingly, in some countries this was much less pronounced (e.g. 0.98 of 8.1 years in Mozambique, 0.86 of 11.16 in Nigeria) and HIV/AIDS even contributed negative gains in the case of Angola (-0.7 years). These do not necessarily indicate little HIV/AIDS progress, as it suggest that improvements in other diseases may have had equal or bigger contributions (e.g. malaria, diarrheal diseases, lower respiratory infections).[93]

At the most extreme, a full withdrawal can reverse $e_0$ gains attributable to HIV/AIDS by around half in Zimbabwe, Eswatini, and Uganda. For the case of Mozambique, all funding scenarios are sufficient to affect even the life expectancy gains outside HIV/AIDS, partly because only a small portion of $e_0$ gains are attributable to HIV/AIDS in this country. The gains in other countries were barely affected, as is the case of Botswana and Togo, indicating higher resilience. These figures reinforce the key finding that historical public health gains are reversible especially for a chronic disease such as HIV/AIDS that require life-long treatment to be managed.

Figure 11. Comparison with e0 gains between 2020 to 2021



## 4.4. Comparisons with COVID-19

To put things into perspective, it is worth exploring how these estimated impacts compare with the experience of another global health emergency, the COVID-19 pandemic. COVID-19 has led to over 1.1 million excess deaths in SSA in 2021 and has contributed to the backsliding of life expectancy at birth within the region even within a short period.[94] Figure 12 illustrates the estimated COVID-19 death rate from 2021 and the estimated excess death rates per scenario, while Figure 13 shows the declines in $e_0$ between 2019 to 2021 attributable to COVID-19,[95] and compares it with the estimated $e_0$ declines following the funding cut.

The excess deaths from the US funding withdrawal are generally lower in most countries, save for a few cases where the excess deaths can approach or even exceed levels during COVID-19. These are found in the full withdrawal scenarios in Zimbabwe, Mozambique, and Uganda. This indicates that under worst-case circumstances HIV/AIDS can surpass the burden experienced during COVID-19. The moderate scenario for these countries and Eswatini remain high, but are slightly lower than COVID-19 death rates.

Figure 12. Comparison with COVID-19 death rates from 2021

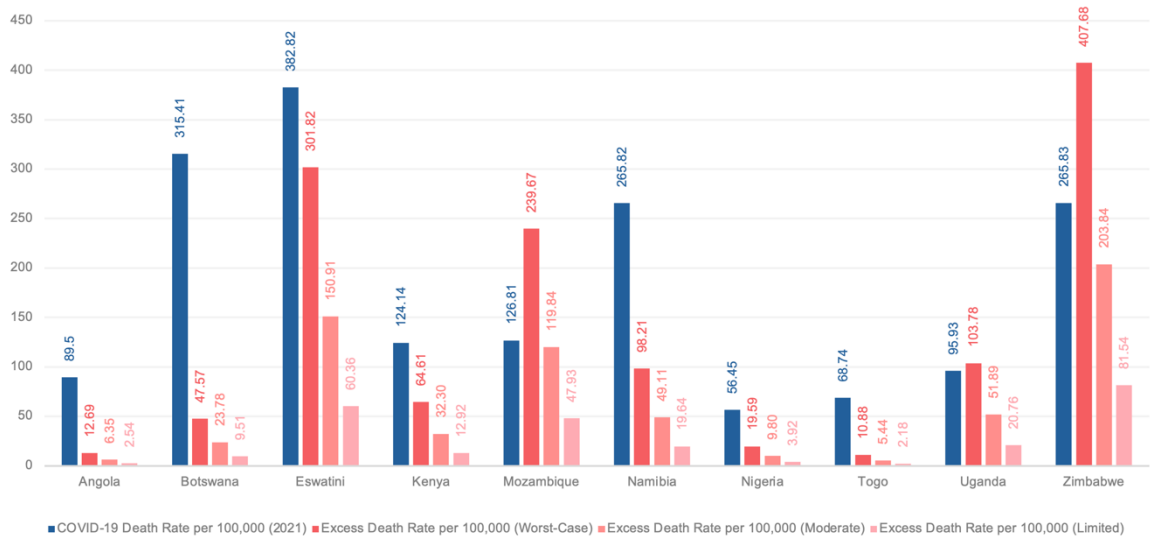
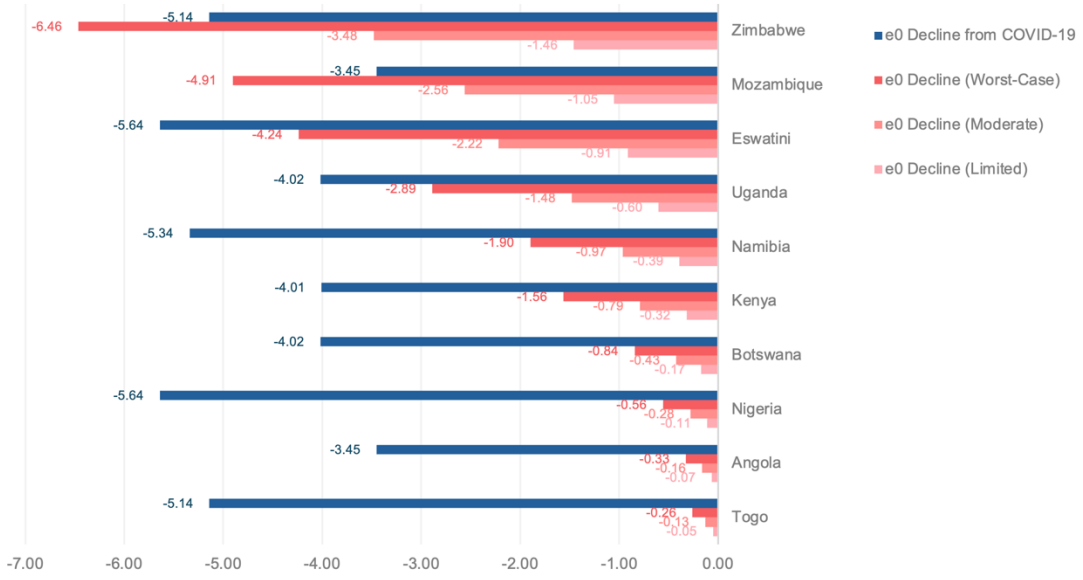


Figure 13. Comparison with declines in life expectancy at birth between 2019 to 2021 attributable to COVID-19




The same patterns are also observable on the life expectancy estimates. In Zimbabwe, a full funding withdrawal can lead to a decline of 6.46 years, much higher than the 5.14 years lost due to COVID-19. The other extreme is found in Mozambique, showing a decline of 4.91 years compared to COVID-19's contribution of 3.45 years. Other countries do not experience declines as drastic, but are still approaching similar declines as COVID-19, such as the case of Eswatini and Uganda in the full withdrawal scenarios, or Zimbabwe and Mozambique in moderate scenarios. These findings put into perspective the progress on HIV/AIDS outcomes, and how fragile these gains are in light of major global health disruptions. As shown, a the US funding withdrawal can have impacts that approach and even exceed the impacts of COVID-19.

This is not to say that these two public health emergencies are directly comparable, as there are fundamental differences. COVID-19 has a skewed age distribution that disproportionately affects the elderly,[96] while the excess deaths from the funding cut are concentrated in the adult age group which is younger in relative terms. This difference can skew how the excess mortality translates to declines in life

expectancy at younger age groups, as the younger concentration of excess deaths from the funding cut may have more drastic impacts in $e_0$ compared to COVID-19.

Another key difference between these two is that the excess deaths from funding cuts are very much avoidable. COVID-19 as a novel disease led to devastating impacts partly because of the absence of sufficient knowledge and medicine to interrupt its transmission and prevent mortality. This stands in stark contrast to HIV/AIDS, where ART and other prevention interventions have been proven effective and decades of progress have already manifested its positive impact. Instead, the excess deaths from the funding cut was a direct result of political and foreign policy choices from the US, and was further shaped by decades of domestic dependency to foreign sources.

## 5. Conclusion

This study estimated the impacts of the recent US foreign aid funding cuts for HIV/AIDS programs on the mortality and life expectancy in select Sub-Saharan African countries. This was accomplished by estimating the excess deaths resulting from ART interruption proportionate to the funding lost from PEPFAR, and using life table techniques to construct counterfactual scenarios under different funding conditions.

The study found significant cross-country difference among the impact felt by case countries. The most severe declines are observed in Zimbabwe, Mozambique, Eswatini, and Uganda, while other countries such as Angola, Botswana, Nigeria, and Togo reflected next to no impact observable in the population level. The younger age groups are most affected by the life expectancy declines, with most countries experiencing the highest decline in the 1-4-year age group. As far as the researcher is aware of, this study is the first to apply life table methodologies to estimate the impact of the recent US funding cut and, more broadly, to prospectively model the impact of anticipated increases in HIV/AIDS resulting from a policy change.

The insights from these results can be summarized as follows. First, there is significant cross-country variation on the impact of the funding cut on excess deaths and life expectancy, shaped by varying contextual factors such as baseline HIV/AIDS mortality, potential HIV/AIDS deaths in the absence of ART, population size, as well as the dependence on PEPFAR and anticipated relative increase in HIV/AIDS mortality after the funding cut. Second, the withdrawal of PEPFAR can widen existing disparities, as evidenced in the observed life expectancies at birth. Countries with lower baseline life expectancy also happen to be more dependent on PEPFAR for funding, so the observed backsliding in these countries exacerbate the difference with others. Third, major funding interruptions can reverse decades of life expectancy gains from public health improvements on HIV/AIDS and beyond. As a chronic disease, HIV/AIDS requires life-long adherence to treatment, so these gains can be reversed with widespread ART interruptions. Finally, the funding withdrawal can lead to devastating public health impacts almost comparable to that of COVID-

19, showing how political and foreign policy choices can become as much of a public health threat as a pandemic.

## 5.1. Limitations

While this study provided quantifiable measures of the impact of the funding cut on population health, it is limited by several factors. First, only 10 countries were included due to limitations on the available funding data for ART disaggregated by source. Some of the funding data used may also no longer reflect the same level of dependency. There is reason to believe, however, that other SSA countries may also experience similar impacts, as a lot of countries that only reported total expenditure (not disaggregated per program) still show that PEPFAR and international funding sources continue to support a large portion of the domestic response.[97] The volatility of the aid landscape also means the results can be interpreted in so far as they align with the modeled funding scenarios.

Second, this study estimated the impact of ART service interruption only. PEPFAR is responsible for funding initiatives beyond treatment such as prevention, testing, counseling, and research, making it likely that the excess deaths are underestimated as it fails to account for the potential increase in transmission and failure to detect and initiate ART early for people yet to undergo treatment. However, this study focused on ART as it is anticipated that treatment interruption will contribute to most to excess deaths compared to other service disruptions.[98]

UNAIDS and other researchers have already released estimates using to assess the impact on other HIV/AIDS indicators such as the 95-95-95 treatment cascade, so future research can focus on using empirical data recorded from the countries within the months since the funding disruption took effect. This can help validate the existing studies and serve as a grounded basis of calibrated estimates and priorities for recovery.

## 5.2. Closing Reflections

The recent US funding cut resurfaces urgent questions surrounding foreign aid and its role in global health. While funding from high-income countries and international donors have been critical in the decades of progress in combating HIV/AIDS, the dependency inherent in foreign aid shows how fragile and reversible these improvements are for LMICs. This emphasizes that the epidemic response cannot be measured on indicators of disease burden and population health alone. Global health progress necessarily includes health system strengthening, to ensure that improvements in health and disease are guarded from external shocks and can be sustained domestically.

A paradigm shift is needed to use foreign aid not for direct service provision, but as a transition tool for domestic capacity building and long-term investment. Whether it be for enabling local ART manufacturing, to health workers training, or improved testing and surveillance, foreign aid can be instrumental to support these health systems strengthening efforts while governments improve domestic planning and financing capabilities in the long-term. The burden of short-term consumable support such as procuring antiretroviral drugs, expanding treatment coverage, and implementing community-based services must slowly be transitioned from foreign-supported to locally-owned during this period.

The historical abundance of HIV/AIDS foreign aid have contributed to a perspective that takes foreign aid for granted, or a resource that will always be available. The recent funding cut exposes the limits of external support and emphasizes the importance of domestic investment to ensure the sustainability of progress and resilience of health systems. The sustainability of public health progress relies not only on improving mortality and life expectancy outcomes, but on creating favorable domestic health system conditions that keep them guarded.

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