POLICY BRIEFS ON

ECONOMIC IMPACT OF HIV

2.

INCREASED HEALTH & LIFE PROSPECTS & THEIR ECONOMIC VALUATION

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KEY POINTS

- **Antiretroviral therapy has dramatically improved the life prospects of people living with HIV.**
- **Reduced AIDS-related mortality has been a dominant driver of improvements in life expectancy across sub-Saharan Africa and has made important contributions even in countries facing relatively low HIV prevalence.**
- **The principal economic gains arise from improved longevity through higher lifetime earnings, which can offset the costs of health investments. The longevity gains also have intrinsic value in excess of these financial impacts.**

Implications of treatment for life and health prospects of people living with HIV

Antiretroviral therapy has dramatically improved the health and life prospects of people living with HIV, and is transforming their health needs.

The scaling-up of treatment has resulted in steep declines in mortality among people living with HIV (Brief #1), to the point that – provided that treatment is initiated sufficiently early – life expectancy of people living with HIV (PLHIV) is approaching the corresponding levels for HIV-negative adults (Johnson et al., 2013). These changing consequences of HIV, and the impact of treatment, are illustrated in Figures 2.1 and 2.2 from the perspective of an individual adult who contracts HIV.

Morbidity and mortality outcomes for PLHIV are greatly improved if an individual starts treatment before the disease has progressed substantially. In the absence of treatment, this adult would on average survive only 12 years from the time of infection, and would have virtually no chance of reaching old age (e.g., the probability of surviving 30 years from the time of infection is only 1 percent). If the individual initiates treatment before the disease has progressed significantly and their CD4 count drops below 200 cells/microlitre, their remaining life expectancy reaches 25 years (including an expected 15 years on treatment), and the 30-year survival probability dramatically improves to 36 percent. With even earlier treatment initiation, at a CD4 cell count of 350 or above, remaining life expectancy from the time of infection surpasses 30 years, and the individual would be more likely to eventually die from other causes rather than AIDS-related conditions.

1 In what follows, we follow convention and modelling practice by using the CD4 cell count as measure of disease progression. The CD4 cell count measures the number of a type of white blood cell critical for the functioning of the immune system; these cells are gradually destroyed by HIV. A low CD4 count means that progression to AIDS-related illnesses and, ultimately, death is likely.

Figure 2.1: Survival under different treatment eligibility criteria (percent)

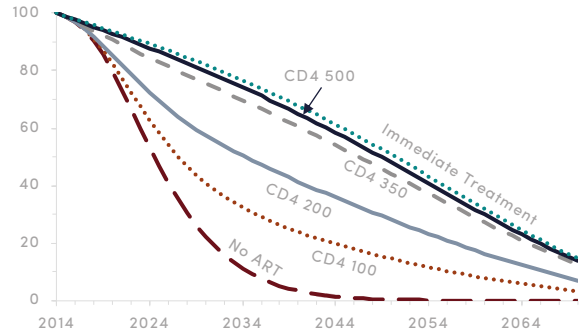
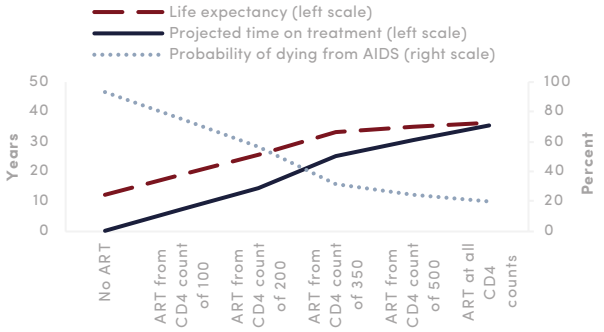


Figure 2.2: Life expectancy, projected time on treatment, and probability of dying from AIDS



Source: Haacker, 2016.
Note: The example is based on demographic and HIV-specific projections for South Africa, using Spectrum software, and shows life prospects for a person who contracts HIV as an adult (population-weighted average by sex and age at infection; average age at infection is about 30 years). ART = antiretroviral therapy.

As a consequence of earlier treatment initiation, the health needs of PLHIV are changing. AIDS-defining diseases like certain cancers have become much less common (Dryden-Peterson et al., 2015), and the incidence of diseases like tuberculosis for which HIV is a major risk factor has been declining (WHO, 2020; see also Brief #12). Meanwhile, the population living with HIV is ageing – the share of people at ages 50 or older among PLHIV nearly doubled over the 10 years from 2008 to 2018 (increasing from 11 percent to 20 percent globally, and from 9 percent to 16 percent over the same period in sub-Saharan Africa). Instead, PLHIV are increasingly developing diseases which become more common in old age, like cardiovascular diseases, kidney disorders or diabetes (Smit et al., 2018 and 2020; Haacker et al., 2019; see also Brief #12).

These changes have implications for assessing the effectiveness and cost-effectiveness of HIV policies or interventions. As PLHIV initiate treatment increasingly early, the immediate health returns to investments in the HIV response, in terms of deaths averted and life years gained, are shrinking, both for efforts to increase treatment access further and for HIV prevention interventions. At the same time, two factors become more important: first, the future costs of treatment (and by extension cost savings from reduced HIV incidence), which can be substantial when most PLHIV receive treatment for several decades, even though average costs per patient have come down (see Figure 2.2). Second, co-existing diseases such as cardiovascular diseases, diabetes or chronic kidney disease, which become more common as PLHIV grow older, need to be incorporated into any full assessment of the cost of HIV interventions. This includes synergies in service delivery (Brief #12A) and possible impacts of HIV or long-term treatment on the incidence of non-communicable diseases (Atun et al., 2009; Bendavid et al., 2012; Hyle et al., 2019).

Population-level effects

The response to HIV, most directly the scaling-up of treatment, has made important contributions to overall health outcomes.

Across sub-Saharan Africa, treatment coverage has improved to 69 percent of PLHIV as of 2019 (up from 24 percent in 2010; UNAIDS, 2020), and CD4 counts at treatment initiation have increased steeply (Anderegg et al., 2018; see also Brief #1). The resulting improvements in the life prospects of PLHIV are visible in overall health outcomes, and have made a large contribution to increases in life expectancy.

In sub-Saharan Africa, the scaling-up of treatment contributed about 3.6 years to population-wide life expectancy between 2003 (roughly when scale-up began) and 2019 (Figure 2.3) – about one-third of the overall gain in life expectancy during that period. In high-prevalence countries, it has been a dominant contributor (6.8 years, out of a total of 12.4 years), and even in countries with HIV prevalence below 3 percent, the HIV response has contributed more than 2 years to gains in life expectancy (UNAIDS, 2018).

The underlying developments are shown in more detail in Figure 2.4, based on demographic and epidemiological estimates for Malawi. HIV resulted in a steep loss in life expectancy from the early 1980s, reaching a maximal loss of 13 years in 1999. From 2001 the impact of the HIV response becomes apparent, reflecting both reduced mother-to-child transmission (which declined by one-half between 2000 and 2012) and the scaling-up of treatment. As treatment coverage increased to 79 percent by 2010, AIDS-related mortality among PLHIV dropped from about 7 percent annually around 2003 to 2.6 percent by 2010, and 1.1 percent as of 2019. However, even in 2019, HIV still accounted for a loss in life expectancy of 2 years.

Figure 2.3: Contributors to increased life expectancy across Sub-Saharan Africa, 2003-2019

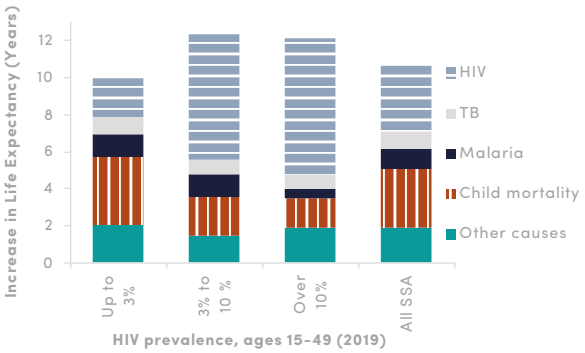
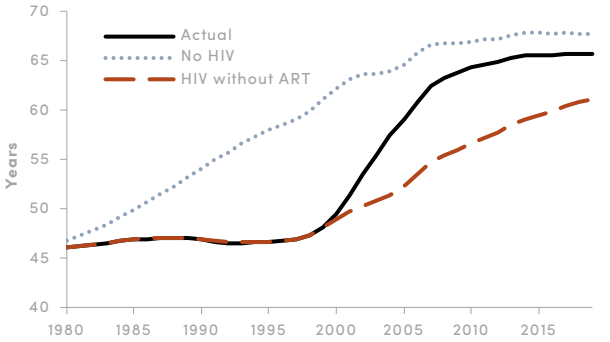


Figure 2.4: Life expectancy, Malawi, 1980-2019



Source: Authors' calculations, using data from IHME (2019) and updating an earlier analysis for UNAIDS, for Figure 2.3, which shows the contribution of reduced disease-specific mortality to the increase in life expectancy between 2003 and 2019. Figure 2.4 was created using the UNAIDS estimates file for Malawi (UNAIDS, 2020b), obtaining the "No HIV" and "HIV without ART" scenarios by switching off HIV altogether or setting treatment coverage equal to zero.

In contrast, the impacts of HIV and of the scaling-up of treatment on morbidity have been comparatively modest, because HIV infection does not cause symptoms until a long time after infection, and the symptomatic phase is relatively short. Global Burden of Disease estimates (IHME, 2019) break down the health burden into years of life lost (YLLs) and years lived with disability (YLDs), which applies disability weights to states of disease. The morbidity effects of HIV are relatively small, accounting for less than 5 percent of the years lost due to early AIDS-related mortality across low- and middle-income countries (IHME, 2019). Relatedly, HIV-related health gains following the scaling-up of treatment have predominantly been achieved as a consequence of reduced mortality (Danforth et al., 2017). As the number of AIDS-related deaths across low- and middle-income countries has declined by 50% between 2003 and 2017, years lived with disability as estimated by IHME (2019) have barely declined, accounting for less than 0.5 percent of the overall health gains.

Valuing health and life gains

Improved health and longer lives lead to higher lifetime earnings, which may offset the costs of health investments. The longevity gains also have intrinsic value in excess of these financial impacts.

Economic analyses of health policies most commonly focus on the health outcomes and the means required to attain these outcomes. For example, the policy can be assessed and ranked in terms of the health gains that can be achieved by one unit of money – e.g., disability-adjusted life years per US dollar, as used by the Disease Control Priorities project (World Bank, 2015-2018), see brief #13. For other purposes – assessing the contributions of investments in health to improving living standards, exploring the extent to which the costs of investments in health are offset by economic gains that can refinance at least some of the costs, or comparing investments in policies implemented within the health care system and in other sectors – it is necessary to establish an economic valuation (i.e., assign a monetary value) to the health gains achieved by the policy.

There are three main approaches to valuing improvements in health and longevity in monetary terms: changes in gross domestic product (GDP); changes in lifetime production (human capital); and changes in individual welfare (willingness to pay). Each serves different purposes and provides different perspectives.

The **impacts on growth of GDP and GDP per capita** (discussed in more detail in briefs #3 to #7) are key development indicators and show whether domestic economic gains could offset some of the costs of the health policy. Assessments of the economic impacts of HIV typically show that HIV slows down GDP growth, mainly because the working-age population grows more slowly due to AIDS-related mortality. The impact of HIV on GDP per capita, though, is more ambiguous. On one hand, AIDS-related morbidity and mortality is thought to reduce labour productivity, which also may be affected by adverse conditions in childhood and expected increased mortality risk due to HIV. On the other hand, increased mortality means that the economy's assets (accumulated capital, natural resources) are shared among fewer people, which increases GDP per capita.

The **human-capital approach** involves measuring the economic value of the health gains in terms of the effects on individuals' estimated lifetime production, providing another perspective on the extent to which economic gains may offset the costs of the policy. The theory of human capital was developed by Becker (1964) and originally applied to the increased earnings associated with investments in education. It refers to a person's contribution to overall production, which depends on their skills, knowledge, and experience. This human capital may be diminished by illness and is eliminated by death. Reduced morbidity increases individuals' ability to participate in the labour force and to be more productive when at work. A person whose death is averted may continue to contribute to the economy for the remainder of his or her productive life. Estimates based on the human capital approach tend to be larger than estimates on contemporary output gains, because they capture projected gains over a longer period – the lifetime of a cohort affected by a policy. Such total lifetime production gains can be large. For example, Lamontagne et al. (2019) estimate that the lifetime production gains among beneficiaries of working age across low- and middle-income countries from a global drive towards "ending AIDS" are on average 2.6 times higher than its costs (Figure 2.5).

The **impacts on welfare** are greater than the impacts on either GDP per capita or human capital. People value reductions in their risk of dying for reasons well beyond its net effects on income or production, including continuing to experience the joys of life itself and delaying the pain and suffering associated with dying. In **benefit-cost analysis** (Robinson et al., 2019), the monetary value of changes in both morbidity and mortality are estimated based on the affected individuals' willingness to exchange their own income for a small change in their own risks of becoming ill or dying within a defined time period, such as one year. Because this individual willingness to pay includes nonpecuniary effects as well as the effects on out-of-pocket medical and other expenditures and earnings (Robinson & Hammitt 2018, Robinson, Hammitt, & O'Keeffe 2019), it does not translate directly into money that can be taxed or otherwise used to fund a policy. It is, however, an important measure of wellbeing that is widely used when assessing the benefits and costs of government and other policies, particularly when comparing across interventions implemented within and outside of the health care system.

Economists typically convert estimates of individual willingness to pay for small changes in mortality risk into estimates of the value per statistical life (VSL). VSL is not the value that the government, or anyone else, places on saving someone's life. Rather, it reflects a person's willingness to exchange his or her own money for a small change in his or her own risk. For instance, if the average individual within a population is willing to pay $100 to reduce his or her risk of dying in the current year by 1 in 10,000, dividing this willingness to pay by the risk change leads to a population-average VSL of US$1 million. This value can then be multiplied by the number of deaths a policy is expected to avert to estimate related benefits. Individual willingness to pay is the fundamental measure – the $100 in this case. The conversion to a $1 million VSL is simply for convenience.

One challenge in applying this approach globally is lack of evidence from low- and middle-income countries where few VSL studies have been conducted so far. Economists instead often extrapolate from the values found in higher income countries. Because a person's willingness to pay is bounded by income, it is expected to decrease as income decreases. For example, in the United States, a $9 million VSL would imply that the average U.S. resident is willing to pay $900 for a 1 in 10,000 mortality risk change, or slightly less than 1.6 percent of U.S. gross national income (GNI) per capita in 2015, which was $57,900. In a lower-income country, where GNI per capita is substantially smaller, it seems implausible or impossible that the average person would be willing to spend US$900 on the same small risk reduction, given other more important needs.

Recent guidance (Robinson et al., 2019) suggests that, while VSL estimates in high income countries may be between 100 to 160 times GNI per capita, values for low- and middle-income countries are likely lower. For example, that guidance suggests that in a country with GNI per capita of $15,000, VSL may be about $1.2 million, or roughly 80 times GNI per capita (international dollars, based on purchasing

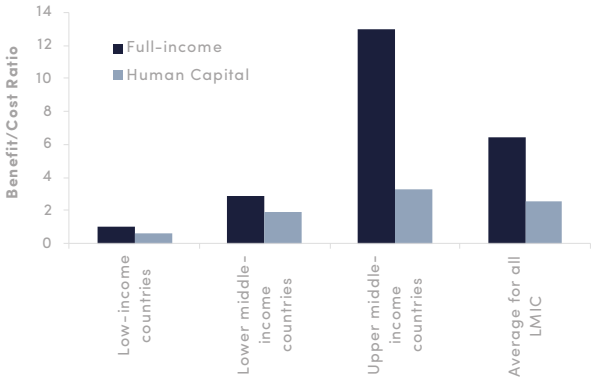
power parity) (Robinson et al. 2019, table 4.2). This implies that the average member of the population would spend about 0.8 percent of his or her income on a mortality risk reduction of 1 in 10,000. For a country with GNI per capita of $1,000, it seems unreasonable to assume that the average member of the population would devote that much of his or her resources to such a small change in risk. If GNI per capita is $1,000, that guidance recommends a VSL of about $0.02 million, roughly 20 times GNI per capita, representing willingness to pay of 0.2 percent of income for a risk reduction of 1 in 10,000 on average. More generally, the guidance suggests that analysts check the sensitivity of their results to variation in the VSL estimates, given related uncertainties.

Some analyses, such as the Lancet Commission on Investing in Health (Jamison et al., 2013) use a **full-income approach** that sums the change in GDP and the value of mortality risks reductions using VSL estimates. Following this approach, UNAIDS (2014) estimated that "fast-tracking the AIDS response between 2015 and 2030 would yield economic returns of US$15 per dollar invested". However, this approach may include some double-counting, since the contribution of labour to wellbeing is included in both the GDP and the VSL estimates. The more recent and differentiated analysis of this strategy by Lamontagne et al. (2019) estimates that "full-income" gains exceed costs by a factor of 6.4, much higher than the life-time output gains (2.6 times costs).

Regardless of the approach used to estimate the value of improved health and longevity, any such analysis must fully account for offsetting costs, which go beyond the cost of the program itself. In the context of HIV, longer survival incurs recurrent cost of treatment. More generally, added life years incur "unrelated costs" of health services (i.e., health costs over time unrelated to HIV, notably through the course of ageing; see Meltzer, 1997), fiscal costs which arise over the life cycle (Auerbach et al., 1994), and cost of living as individuals who survive longer eat and consume in other ways (Nyman, 2004). These costs must be considered in interpreting effects on GDP or GDP per capita and included in comparing human capital gains to the costs of the policy. And VSL estimates presumably include lifetime changes in costs incurred by the individual, but not the costs incurred by the government, private insurers, and donors, which are however relevant from a policy perspective.

Applying any of these approaches in global health, though, involves a tension. Changes in GDP, earnings, or willingness to pay all vary depending on the wealth of the country, as well as the wealth of those within the country whose health and longevity is improved. For example, the returns to investment for "ending AIDS" are estimated by Lamontagne et al. (2019, Figure 2.5) at 13 times cost for upper-middle-income countries, but only one times cost for low-income countries, because costs vary across countries much less than the valuations of increased longevity. Such results run against the logic of global health funding and development assistance, which prioritises disadvantaged populations. This tension is recognized by most practitioners, who recommend consideration of the distribution of both costs and benefits across advantaged and disadvantaged groups rather than solely focusing on the summary results, regardless of whether benefit-cost analysis (Robinson et al. 2019), or cost-effectiveness analysis (NICE International 2014, Wilkinson et al. 2016) is used.

Figure 2.5: Returns to investment under "full-income" and "human capital" approaches



Source: Lamontagne et al., 2019.

The preceding discussion focuses on estimating the values of gains in health and longevity in monetary terms for direct comparison to costs. In health and medicine, cost-effectiveness analysis is often instead used to compare across interventions implemented within the health care system, such as alternative drug therapies. In this case, health outcomes are evaluated based on nonmonetary measures, typically quality-adjusted life years (QALYs) or disability-adjusted life years (DALYs). At times, monetary values are used as thresholds for determining whether an intervention is cost-effective. These monetary values may be derived from VSL estimates (Robinson et al. 2017) or from estimates of health opportunity costs (Woods et al. 2016). The thresholds implied by actual decisions on health expenditures tend to be much lower than these estimates, e.g., one-half times GDP per capita for the United Kingdom (Claxton et al., 2015) or about 10 percent of GDP per capita for the South African HIV Investment Case (Meyer-Rath et al., 2017). In either case, the appropriate value per QALY or DALY is highly uncertain (also see brief #13).

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