



# Measuring Revenue Streams and Profitability for HIV Drugs

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### **About the Brookings Private Sector Global Health R&D Project**

Global health remains one of the world's most pressing challenges. Particularly in developing economies, a complex set of factors impede development, deployment, and affordability of medications, vaccines, and diagnostic tests. While there is no single solution to this challenge, an important part of the overall solution lies in incentivizing investors and pharmaceutical companies to raise their investment in global health R&D.

The Brookings Private Sector Global Health R&D Project seeks to find ways to address this investment shortfall. The project recognizes the need to complement the research on the social returns to global health R&D by examining the potential financial returns to private sector global health R&D investors, and offers policy solutions that can boost those returns. This publication is the fifth in a series of reports published by the Private Sector Global Health R&D Project. To contact the report authors, please email [HealthRD@brookings.edu](mailto:HealthRD@brookings.edu).



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## Introduction

For-profit corporations invest considerable money in global health R&D in support of vaccine and drug development. According to a 2017 analysis, pharmaceutical firms devote nearly \$157 billion annually on global health R&D. However, only \$5.6 billion is focused on the developing world and \$471 million emphasizes neglected tropical diseases.<sup>1</sup> That money is far below what is needed to improve public health and take care of patients in low and middle income nations.

In talking to private investors, a number of them argue there are limited returns on R&D investments and this is a key reason why companies don't spend more on neglected diseases. If the rates of returns are not sufficiently positive, it is hard to justify the large expenditures needed for drug and vaccine development.

In this report, we estimate revenue streams and profitability for HIV drug treatments. In particular, we compile information regarding HIV disease prevalence and incidence rates, antiretroviral therapy (ART) coverage, future population growth, and drug prices. This material allows us to estimate the revenue streams available to drug-makers.

Our research focuses on the six most populous sub-Saharan and North African nations (Democratic Republic of Congo, Egypt, Ethiopia, Nigeria, South Africa, and Tanzania) as well as potential returns for investment in Africa, the Middle East, and the world as a whole. This paper is the latest in a series of publications under the Brookings Private Sector Global Health R&D Project. Past reports examined health governance capacity, private funding levels, rate of return on investment, and barriers to private investment.

## The HIV Pandemic

The human immunodeficiency virus (HIV) attacks cells of the immune system, rendering them vulnerable to infections and diseases.<sup>2</sup> According to the World Health Organization, "immunodeficiency results in increased susceptibility to a wide range of infections, cancers and other diseases that people with healthy immune systems can fight off."<sup>3</sup> As the disease progresses, those infected become increasingly ill, ultimately culminating in the acquired immunodeficiency syndrome (AIDS).

**TABLE 1 | Global HIV Data, 2000-2016**

	2000	2005	2010	2015	2016
People Living with HIV	27.7 million	31.0 million	33.2 million	36.1 million	36.7 million
New HIV Infections (total)	3.0 million	2.5 million	2.2 million	1.9 million	1.8 million
AIDS-related deaths	1.5 million	1.9 million	1.5 million	1.1 million	1.0 million
People accessing antiretroviral therapy	685,000	2.1 million	7.7 million	17.1 million	19.5 million

Source: "Fact Sheet—World AIDS Day 2017." UNAIDS.

According to the World Bank, since AIDS first was diagnosed in high income settings in 1981, 65 million people have been infected with the disease and 35 million have died.<sup>4</sup> The spread of HIV is even more ubiquitous. According to UNAIDS, 36.7 million people globally were living with HIV in 2016 (see Table 1).<sup>5</sup> As Table 1 below demonstrates, it is clear that even though the rate of new infections is slowing, the number of people diagnosed with the disease continues to rise.

Although there is no cure for HIV/AIDS, with early diagnosis, disease education and proper treatment, the disease can be controlled. The frontline treatment for suppressing HIV/AIDS is known as anti-retroviral therapy (ART) and consists of the administration of antiretroviral (ARV) drugs. As the table above shows, the number of people accessing antiretroviral therapy is increasing substantially, but still remains insufficient. For example, according to the UNAIDS data, in 2016, 19.5 million people infected with HIV globally had access to ART treatments but the population diagnosed with the disease numbered 36.7 million. This meant that ART coverage globally was just over 53 percent. U.S. Center for Disease Control data show HIV/AIDS was the 8th leading cause of death for 25 to 34 year olds and the 9th for those aged 35 to 44. Without ART, the disease is much more likely to progress to AIDS and become lethal.<sup>6</sup>

## Barriers to Private Investment

The large number of individuals living with HIV shows the importance of developing new treatments and making sure patients have access to them. It is vital to understand how to make progress in this area and what are the best ways to move forward.

However, there are numerous barriers that have made it difficult to increase investment in global health R&D. In our research team's previous reports, we have highlighted challenges such as high drug development costs, a lack of systematic data regarding prevalence, risks, and costs, and limited markets for many disease drugs. Those factors constrain drug development and keep people from getting the treatments they need.

One of the largest impediments is the high costs of producing new drugs and vaccines. As we noted in an earlier report, drug development is costly, takes a long time to complete, and has a number of failures along the route.<sup>7</sup> Tufts researcher Joseph DiMasi concluded that pharmaceutical R&D can cost as much as \$2.6 billion and that Phase I-III clinical trials on average take over 6 years.<sup>8</sup> Based on proprietary data from pharmaceutical companies, he argued one of the factors driving up development costs was the high failure rate (around 90 percent) on developing new products.

Some experts such as Jerry Avorn, though, have disputed his figures on grounds he included capital as well as research expenses and the former constitute almost half of the overall cost.<sup>9</sup> Nevertheless, there is a recognition that drug development is time-consuming and expensive even if the exact numbers are in dispute.

Another key barrier preventing developed world capital from investing in global health R&D is the lack of systematic data on pharmaceutical and emerging world risks and returns. Investors aim to maximize return for each given level of risk, but without accurate data on potential returns, investors are less likely to put money into drug development.

There furthermore is a limited market for neglected disease drugs. Although the burden of disease for neglected diseases is quite high, they often affect populations without the resources to afford the medications. The result is that pharmaceutical companies do not invest the necessary money into R&D and medical treatments suffer. Without confidence that markets will be able to purchase the drugs, companies will not invest. With that particular barrier in mind, we undertake research to analyze the size of revenue streams available for HIV drugs in the emerging world.

## Forecasting HIV Drug Revenues

To examine possible revenue streams from publicly available sources, we compiled data from several different sources for the countries and regions where HIV is prevalent. We started by gathering current data on the number of people living with HIV using World Bank prevalence and incidence rates and population statistics for those between 15 to 49 years of age.<sup>10</sup> Using linear regression analysis, we projected the number of people living with HIV for 2017 to 2021 based on earlier periods. As a check on this analysis, we also forecasted the future number of people with HIV based upon the number of people who became infected and the number of people who passed away. The difference of

these two rates is the change in the number of people from year to year and hence another method for forecasting. Since each of these approaches represents a reasonable though slightly different approach, we averaged the two methods to arrive at our figure for the future number of people with HIV.

In order to measure revenues, we not only need to estimate the future number of people living with HIV, but also the coverage rate of people receiving antiretroviral therapy (ART) and the price for the treatments in each country. To analyze coverage, we used the World Bank World Development Indicator's antiretroviral therapy coverage and forecast this trend from current data using regression analysis for each country and region. To measure future drug prices, we used the World Health Organization's Global Price Reporting Mechanism (GPRM) data for median drug price by country and region, and forecast it using regression.<sup>11</sup> Finally, as shown in the equation below, we multiplied the forecasted number of people living with HIV by the forecasted ART coverage ratio and the forecasted drug price to derive the projected revenues for each year.

$$\text{HIV Drug Revenues} = (\text{Number of People Living with HIV}) \times (\text{ART Coverage Rate}) \times (\text{Future Drug Price})$$

In our analysis, we corrected for the time value of money by discounting revenues by a rate of 10.5 percent, which is consistent with estimates from pharmaceutical research. The time value of money suggests that we value money now more than we do in the future because of the real interest rate and opportunity costs. Therefore, in order to correct for future compound growth, we divide future forecasted revenues by the "discount rate" to calculate its present value.

Our methodology is consistent with the literature on forecasting future rates of HIV prevalence from investing in treatments for this disease. In his web series "Our World in Data," British Economist Max Roser



provides an analysis on HIV/AIDS. His study shows the interrelated nature of incidence and HIV death rate and how they interact to influence the prevalence rate.<sup>12</sup> Another excellent resource is the World Health Organization’s technical report *Combined Global Demand Forecasts for Antiretroviral Medicines and HIV Diagnostics in Low- and Middle-Income Countries from 2015 to 2020*, where the authors use different methods to forecast potential revenues, including linear regression, linear extrapolation, and forecasts from companies.<sup>13</sup> Finally, the Clinton Health Access Initiative (CHAI) has helpful forecasts for future diseases prevalence, and we compared our estimates to these sources and found similar numbers.<sup>14</sup>

## HIV Drug Treatment Revenues in Six African Nations for 2017 to 2021

Table 2 shows that there are \$2.2 billion in possible HIV drug treatment revenues from 2017 to 2021 in these six African nations (based on ART treatments). This includes \$1.5 billion in South Africa, \$343.8 million in

Nigeria, \$281.5 million in Tanzania, \$60.7 million in Ethiopia, \$45.3 million in the Democratic Republic of Congo, and \$17.1 million in Egypt.

## HIV Drug Treatment Revenues for Africa and the Middle East for 2017 to 2021

ART treatments are not limited to these particular countries, but are being utilized in several regions. As such, we employed the methodology described above to analyze the potential revenues for the Sub-Saharan Africa and Middle East/North Africa regions as a whole. We used regression analysis to analyze the previous trends by region, and then forecast them for the years 2017 to 2021. In addition, we used a mortality accounting methodology to estimate the future number of people living with HIV/AIDS. Averaging these two results, we arrived at our estimate for number of people living HIV/AIDS for the next five years. We then multiplied this by the ART coverage rate and our forecast of future drug prices to estimate revenues.

**TABLE 2 | Projected Revenue Streams for HIV Drugs in Six African Nations, 2017-2021 (in millions)**

Country	2017	2018	2019	2020	2021	Total
South Africa	\$267.6	\$282.5	\$295.8	\$307.7	\$318.2	\$1,471.9
Nigeria	71.3	70.7	69.2	67.3	65.3	343.8
Tanzania	55.6	56.2	56.5	56.6	56.6	281.5
Ethiopia	11.6	14.5	12.9	11.5	10.2	60.7
Dem Rep Congo	10.8	8.9	8.7	8.5	8.3	45.3
Egypt	2.6	3.0	3.4	3.8	4.2	17.1
<b>Total</b>	<b>\$419.4</b>	<b>\$435.7</b>	<b>\$446.6</b>	<b>\$455.6</b>	<b>\$462.9</b>	<b>\$2,220.2</b>

Data Sources: World Bank World Development Indicators, UNAIDS, WHO Global Price Reporting Mechanism, Authors’ computations.

**TABLE 3** | Projected Revenue Streams for HIV Drugs in Africa and the Middle East, 2017-2021 (in millions)

Country	2017	2018	2019	2020	2021	Total
Sub-Saharan Africa	\$949.1	\$902.8	\$854.9	\$806.1	\$757.1	\$4,270.1
Middle East and North Africa	6.7	6.5	6.1	5.7	5.2	30.3
<b>Total</b>	<b>\$955.8</b>	<b>\$909.3</b>	<b>\$861.0</b>	<b>\$811.8</b>	<b>\$762.3</b>	<b>\$4,300.4</b>

Source: World Bank World Development Indicators, UNAIDS, WHO Global Price Reporting Mechanism, Authors' computations.

Table 3 shows that for sub-Saharan Africa and Middle East/North Africa, revenues for HIV/AIDS drugs could total as much as \$4.3 billion over the next 5 years. This includes about \$4.2 billion in sub-Saharan Africa and \$30.3 million in the Middle East and North Africa. The disease is far more prevalent in the former than the latter, hence the larger market possibilities.

It is possible that projected revenues between 2017 and 2021 may remain flat as opposed to declining due to the increase in the number of patients receiving treatment and drug prices that could remain stable. If those conditions hold, the revenue streams should remain solid for the foreseeable future.

## The Impact of Taxes on Profits

It is important to consider the impact of taxes on projected drug revenues. In Table 4, we compile data on corporate taxes in the several countries with a high incidence of HIV/AIDS. The data show the corporate tax rates range from 22.5 percent in Egypt to 35 percent in the Democratic Republic of Congo. Several countries have 30 percent tax rates. On top of this, the new Trump tax plan approved in December 2017 put about a 12 percent cost on taxes repatriated from abroad back to the United States.<sup>15</sup>

## Possible HIV Drug Treatment Profitability

Table 5 summarizes the profit possibilities for HIV drug treatments. This includes \$4.3 billion for sub-Saharan Africa (SSA) and Middle East/North Africa (MENA) and \$1.84 billion in revenue from developed nations. The latter estimate is derived from the 30 percent of the global HIV/AIDS market that is outside of Africa and the Middle East. According to the UNAIDS, about 70 percent of the world's 36.7 million individuals with HIV/AIDS live in sub-Saharan Africa (25.5 million people) and North Africa/Middle East (230,000).<sup>16</sup>

**TABLE 4** | Corporate Tax Rates by Country, 2017

Democratic Republic of the Congo	35%
Egypt	22.5%
Ethiopia	30%
Nigeria	30%
South Africa	28%
Tanzania	30%

Source: Deloitte. "Corporate Tax Rates." March 2017.



**TABLE 5** | HIV Drug Treatment Profitability, 2017-2021

HIV Drug Revenues for SSA and MENA	\$4.3 billion
HIV Drug Revenues for Developed Countries	\$1.8 billion
HIV Drug Revenues Total	\$6.1 billion
Drug Development Costs	\$2.6 billion
Difference	\$3.5 billion
Minus 30% Corporate Tax	\$2.5 billion
Minus 12% Tax Repatriation	\$2.2 billion
Production, Transportation, Marketing, and Breakage Costs	Unknown

Source: Authors' calculations.

Those numbers create a drug revenue total of \$6.1 billion in global HIV drug treatment receipts. Using DiMasi's \$2.6 billion development cost figure, there is a possible drug profit of \$3.5 billion before taxes. Assuming a 30 percent corporate tax (with limited deductions) and a 12 percent tax repatriation rate, that produces a possible profit of \$2.2 billion for SSA, MENA, and the developed world.

It is important to point out there is imprecision in these numbers because data are not available for production, transportation, marketing, and breakage costs.<sup>17</sup> In addition, the developed country revenues could be greater if ART prices are above what is found in the developing world. Furthermore, the profits could be larger if DiMasi's drug development costs are too high, as argued by some of his critics.<sup>18</sup> Finally, effective corporate tax rates vary country-by-country based on deductions and exclusions so the tax numbers are approximate in nature.

## Conclusions

To summarize, there are some profits available to Western pharmaceutical firms willing to invest in antiretroviral therapy (ART) for emerging world countries with endemic HIV/AIDS rates. Through our analysis we analyzed the potential financial returns available to firms by investing in ART treatments for six countries as well as the Middle East/North Africa and Sub-Saharan Africa regions. We found that \$4.3 billion could be earned in those regions (plus another \$1.8 billion in the developed world), but after drug/vaccine development, corporate taxes, and tax repatriation costs are factored in, the possible profits are around \$2 billion and would be well below that level once production, transportation, and marketing expenses are incorporated.

With diseases of the developing world, there are political and economic uncertainties associated with doing business in emerging markets. In addition, there are major governance challenges that complicate business planning. This includes corruption, theft, weak medical delivery systems, poor transportation, marketing costs, and limited health infrastructure.<sup>19</sup>

To overcome these limitations as well as market imperfections, it remains important to employ priority review vouchers (PRV) and advanced market commitments (AMC). Private companies argue that their return on investment is too low given the geo-political risks and alternative investment possibilities. If that is the case, PRVs and AMCs represent important ways to build higher incentives for private investment.

This is especially the case with neglected tropical diseases where drug manufacturers do not have the capacity to cross-market in developed nations and thereby create viable markets. In those cases, the revenue models are not sufficient for drug

development and companies need greater incentives to build a drug pipeline.

Researchers have demonstrated that the generic antiretroviral industry has played a constructive role in HIV therapies. Drug firms generally license their drugs royalty-free to generics manufacturers that market to low and middle income countries.<sup>20</sup> It is more advantageous for pharmaceutical companies to do that rather than sell directly to those markets. Many of the HIV/AIDS medications available in low and middle income countries are produced by Indian companies that sell generic drugs. These firms have licensing agreements for large, pharmaceutical companies and sell their products at lower prices. According to Cole, Edwards, Lakhani, Prabhu, and Staple, what is needed to improve licensing are early licensing, broad geographic coverage, use of novel drug combinations, and limiting terms for generic licenses.<sup>21</sup>

To improve private investment, we recommend several steps. First, to remedy the high costs dissuading pharmaceutical investment in emerging markets,

we recommend the expansion of both domestic and international tax credits to reduce the high costs from taxes, tariffs and repatriation fees. Second, to reduce the risk associated with foreign investment in emerging markets, we advocate for increased data regarding the potential rewards and governance risk. With the rise of Big Data and the Internet of Things (IoT), it may soon be possible to increase our knowledge of previously opaque emerging markets, which could be leveraged to improve risk management in these investments. Third, we argue for increased regulation surrounding the PRV program to only award the vouchers to firms that produce original research and development. Fourth, we recommend increased participation by governments in the advanced market commitment program to grant greater subsidies and thus incentivize greater investment in global health R&D. Finally, we encourage the adoption of artificial intelligence and data analytic techniques that could lower drug and vaccine development costs. By deploying new technologies, it may be less time-consuming and costly to search for available options and find effective pathways.

## Endnotes

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- 10 UNAIDS also publishes statistics of the number of people living with HIV on their website. We compared our values against their statistics and found them within the range of equivalence, although our numbers are slightly lower because they only consider the population from 15 to 49 years of age.
- 11 Our analysis focused on first-line drugs because they provide the majority of treatments. Their levels currently are around \$85 in most low and middle income countries. In the future, there could be lower prices at around \$75 based on the introduction of new drugs such as Dolutegravir (DTG).
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- 15 The repatriation charge varies from 8 to 15 percent, depending on the particular asset. We used an average of 12 percent to cover the various categories.
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- 17 HIV drugs generally don't require a large sales force for pharmaceutical firms. In high income countries, companies merely have to work with benefit providers for individual companies to make sure there is adequate coverage. And in low and middle income locales, firms typically work through the procurement processes of the Global Fund or the U.S. President's Emergency Plan for AIDS Relief (PEPFAR). That helps to keep marketing costs down in the HIV area, but production, transportation, and breakage costs could be substantial.
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