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ORIGINAL ARTICLE

PEPFAR Funding and Reduction in HIV Infection Rates in 12 Focus Sub-Saharan African Countries: A Quantitative Analysis

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ABSTRACT

Background: HIV and AIDS continue to have a calamitous effect on individuals living on the continent of Africa. U.S. President George W. Bush implemented the President's Emergency Plan for AIDS Relief (PEPFAR) with the objective of committing approximately $15 billion from 2004 through 2008 to assist with the reduction of the HIV pandemic worldwide. The majority of the PEPFAR policy and funding focused on 12 countries in sub-Saharan Africa: Botswana, Cote d'Ivoire, Ethiopia, Kenya, Mozambique, Namibia, Nigeria, Rwanda, South Africa, Tanzania, Uganda, and Zambia. The policy question this research paper seeks to analyze is whether the PEPFAR funding (as a % of Gross Domestic Product (GDP)) allocated to the 12 countries in Africa had any effect on the decrease of HIV infection rates of males and females between the ages of 15 and 49.

Methods: A fixed-effects panel regression analysis was conducted to determine if this association exists. This study examined the 12 African countries that received PEPFAR funding over the years 2002 to 2010; even though PEPFAR was only active from 2004 through 2008, this research included two years prior and two years after this timeframe in order to better estimate the effect of PEPFAR funding on HIV reduction.

Results: The results illustrate that on average, *ceteris paribus*, for every 1 percentage point increase in PEPFAR funding per GDP a country received, the country's HIV infection rate decreased by 0.355 percentage points.

Conclusions and Global Health Implications: While the empirical findings in this study suggested that the correlation between PEPFAR funding and HIV reduction is statistically significant, the practical significance is perhaps less obvious. Arguably, the reduction rate should be higher given the extent of funding targeted to this project. The conclusion of this research provides suggestions on future research and the policy implications of PEPFAR.

Keywords: AIDS Africa • Disease Prevention • Global Health HIV • PEPFAR • President's Emergency Plan for AIDS Relief • PEPFAR

Background

For many years, the global community has observed the calamitous effects of the human immunodeficiency virus (HIV) on the human population. HIV was historically viewed as an incurable disease that gradually progressed into acquired immune deficiency syndrome (AIDS) and led to one's untimely death.[1] During his tenure (2001–2008), United States President George W. Bush recognized the devastating impact of HIV as a global health crisis that required immediate action. Through bipartisan efforts between President Bush and the 108th US Congress, the passage of HR 1298 (Public Law 108–25) led to the creation of the President's Emergency Plan for AIDS Relief, commonly referred to as PEPFAR.[1] The objective of PEPFAR was to provide $15 billion in aid, targeting 12 focus countries in sub-Saharan Africa: Botswana, Cote d'Ivoire, Ethiopia, Kenya, Mozambique, Namibia, Nigeria, Rwanda, South Africa, Tanzania, Uganda, and Zambia.[1]

In an empirical research that was conducted on the impact of international humanitarian assistance on combating HIV/AIDS, Azuine et al. discovered that the increase of donor assistance in developing countries led to an overall reduction of HIV infection rates.[2] PEPFAR has illustrated the pertinence of an interconnected world and the urgency to embrace those connections during stages of global stress. According to the United Nations, the United States has contributed more funding to the fight against HIV/AIDS than any other country.[3] The research presented here provides a better understanding of how well PEPFAR advanced that fight and whether the allocation of a large amount of dollars for PEPFAR was crucial in saving lives and decreasing HIV infection rates in sub-Saharan Africa.

The general policy research question for this research was to determine whether the PEPFAR funding allocated to the 12 resource-scarce countries in sub-Saharan Africa had any relevant effect in reducing the HIV infection rates of males and females between the ages of 15 and 49. An analysis to determine whether the PEPFAR policy was effective and efficient may influence future global humanitarian assistance provided to other countries by the United States.

Researchers agree that the continent of Africa is the focal point of the HIV pandemic and that HIV/AIDS is a detrimental problem for the global community.[4,5] Even though other countries such as Guyana, Haiti, and Vietnam were also recipients of PEPFAR funding, the majority of the crisis, population affected, and funding allocated for PEPFAR was concentrated in the above-mentioned 12 African countries. The specific focus addressed herein is whether the PEPFAR funding allocation was effective in meeting its intended purpose of reducing HIV infection rates in the 12 African countries that received funding.

Embracing Connections During Global Stress: Fighting the Pandemic

To this day, Africa prevails as the most HIV/AIDS affected continent in the world, in particular the sub-Saharan areas. Africans account for approximately two thirds of HIV infections and three quarters of deaths associated with HIV from around the world.[4,6] The Joint United Nations Programme on HIV/AIDS (UNAIDS), United Nations Children's Fund (UNICEF), and World Health Organization (WHO) determined that approximately 75% of people in sub-Saharan Africa between the ages of 15 and 49 are unaware of their HIV status.[7,8]

Together, HIV and AIDS have devastating effects on society and the economy. Together, HIV and AIDS create reproductive concerns, reduced revenues, increased healthcare expenses, decreased school enrollment, increased rates of absence at work, disruptions in the family environment, decreased human capital, increases in poverty rates, a lower Gross Domestic Product (GDP), and more orphaned children.[9-14] Due to high levels of poverty, many developing countries in sub-Saharan Africa do not have the necessary resources or funding to combat the HIV/AIDS pandemic occurring in their nations.

PEPFAR was the largest international health commitment and global health initiative by any nation.[15,16] The methods that were used to treat and prevent further growth in cases of

HIV/AIDS were education, counseling, HIV testing, antiretroviral medication, and building health care infrastructure.[17,18,4] The treatment category of funding from PEPFAR focused on the amount of monetary support given to an African country for HIV treatment, the purchase of antiretroviral (ARV) drugs, and the building of health infrastructure. One of the most essential components of the PEPFAR program was the increased access to generic ARV medication and therapy. The purpose of the ARV medication is to reduce the plasma level of HIV viral load.[19,20] The reduced viral load resulting from ARV therapy not only improves the health of the infected individual, but also lowers the risk of passing the disease on to someone else. The availability of ARV was critical in prolonging the lives of HIV infected individuals and reducing transmission rates.

The prevention category of PEPFAR focused on the foundational strategy of preventing the proliferation of HIV. This foundation was known as the ABC approach: (A) abstain, (B) be faithful, and (C) use condoms.[18] There was strong emphasis on the "abstinence from sex before marriage" and "be faithful" aspects, which sometimes generated controversy because of the religious component in the program. Safe-sex education was also a pertinent program in the fight against HIV/AIDS.[21,22] The care category of PEPFAR focused on counseling, testing people for HIV/AIDS, taking care of orphan children, and palliative care for individuals with HIV/AIDS. Since the majority of people in sub-Saharan Africa are unaware of their HIV status, this negligence could well lead to the rapid spread of the disease through sexual intercourse.[7]

The final category of PEPFAR efforts focused on training in health management, increasing health care staffing levels, and strengthening the healthcare management system. Health management and effective management systems are important because one of the common theories is that the spread of HIV/AIDS in Africa is worsened by high corruption rates and lack of accountability among government officials.[23] The rampant level of government corruption may prevent government officials from being effective leaders in addressing the HIV/AIDS pandemic.

Methodology

Based on theoretical evidence, this study expected that the 12 focus countries in Africa that received PEPFAR funding would see a decrease in the HIV infection rates. Even though ARV medications are able to prolong the lives of HIV infected individuals, the HIV infection rates that are calculated by the World Bank take into consideration individuals who are taking the ARV medication. The software used for the collection of HIV infection rates reduced the infectivity rates among people receiving ARV treatments.[24]

Table 1 lists the 12 countries in Africa that received PEPFAR funding and Table 2 provides the amount of PEPFAR funding that was received from 2004 through 2008 in millions of US dollars. Table 3 shows the HIV infection rates of males and females between the ages of 15 and 49 in the 12 countries in Africa that received PEPFAR funding from 2004 through 2008.

The following theoretical models were applied to this research:

Model 1

$$HIVrate_{it} = \beta_1 + \beta_2 \%PEPFAR\ per\ GDP_{it} + \varepsilon_{it}$$

Model 2

$$HIVrate_{it} = \beta_1 + \beta_2 \%PEPFAR\ per\ GDP_{it} + \beta_3 \%Health\ per\ GDP_{it} + \beta_4 corruption_{it} + \beta_5 gdppc_{it} + \varepsilon_{it}$$

Table 1. PEPFAR Focus Countries in Sub-Saharan Africa

PEPFAR Focus Countries in Africa
Botswana
Cote d'Ivoire
Ethiopia
Kenya
Mozambique
Namibia
Nigeria
Rwanda
South Africa
Tanzania
Uganda
Zambia

Source: United States President's Emergency Plan for AIDS Relief

Table 2. Countries that Received PEPFAR Funding (millions of US dollars), 2004-2008

Country	2004	2005	2006	2007	2008
Botswana	$24.3	$51.6	$54.9	$76.2	$93.2
Cote d'Ivoire	$24.4	$40.9	$46.6	$84.4	$120.5
Ethiopia	$48.1	$83.7	$122.9	$241.8	$354.4
Kenya	$92.5	$141.3	$208.3	$368.1	$534.8
Mozambique	$37	$58.9	$94.4	$162	$228.6
Namibia	$24.6	$42.5	$57.3	$91.2	$108.9
Nigeria	$70.9	$111.4	$163.3	$304.9	$447.6
Rwanda	$39.2	$53.9	$72.1	$103	$123.5
South Africa	$89.3	$143.3	$221.6	$397.8	$590.9
Tanzania	$70.7	$105.5	$129	$205.5	$313.4
Uganda	$90.8	$147	$170	$236.6	$283.6
Zambia	$16.8	$20.6	$22	$23.5	$26.4

Source: United States President's Emergency Plan for AIDS Relief

Table 3. HIV Infection Rates (%) of Males and Females Ages 15-49, 2004-2008

Country	HIV infection rates of males and females (ages 15-49) (%)				
	2004	2005	2006	2007	2008
Botswana	26.2	25.8	25.4	25	24.6
Cote d'Ivoire	5	4.6	4.3	3.9	3.6
Ethiopia	2.9	2.6	2.4	2.1	1.9
Kenya	7.2	6.8	6.6	6.4	6.3
Mozambique	11	11.1	11.2	11.3	11.3
Namibia	15.6	15.1	14.6	14.2	13.9
Nigeria	3.7	3.6	3.6	3.6	3.6
Rwanda	3.4	3.3	3.1	3.1	3
South Africa	17.2	17.3	17.3	17.2	17.2
Tanzania	6.4	6.1	6	5.8	5.8
Uganda	6.4	6.4	6.4	6.6	6.7
Zambia	14.2	13.9	13.6	13.3	13.1

Source: United States President's Emergency Plan for AIDS Relief

The dependent variable was HIV infection rates in Africa. The main independent variable was PEPFAR funding per GDP. The control independent variables were healthcare expenditure per GDP, corruption rate of a country, and GDP per capita. Where:

- β_1 is the intercept of the models and ε_{it} is the stochastic error term of the models.
- $HIVrate_{it}$ was the HIV infection rates of males and females between the ages of 15 and 49 measured in percentage (World Bank).[25]
- $\%Health\ per\ GDP_{it}$ was the percent of total public and private healthcare expenditures per GDP in US dollars (World Bank).[25]
- $Gdppc_{it}$ was the GDP per capita of each country in US dollars (World Bank).[25]
- $\%PEPFAR\ per\ GDP_{it}$ was the percent of PEPFAR funding received per GDP in US dollars (PEPFAR).[26]
- $Corruption_{it}$ was the score of perceptions on the level of corruption in the public sector, based on the Corruption Perceptions Index, where 0=very corrupt and 10=not corrupt (Transparency International).[27]

This study used panel data from 2002 through 2010 covering the 12 countries that received PEPFAR funding in the continent of Africa. Even though PEPFAR was active from 2004 through 2008, this research includes two years before (2002 and 2003) and two years after (2009 and 2010) in order to increase the ability to estimate the actual effect of receiving PEPFAR funding.

In order to analyze the correlation between PEPFAR funding and HIV infection rates in Africa, this research used Stata software version 13 and conducted a fixed-effects panel regression analysis. The fixed-effects technique was chosen based on results from the Hausman and Sargan-Hansen tests, which were performed through Stata. There was the possibilities of both heteroskedasticity and autocorrelation in this study because this analysis included a combination of cross-sectional and time-series data. The use of panel data for this research required statistical tests to determine if the regression model did indeed encounter a problem with heteroskedasticity and autocorrelation. As expected, the results of the tests indicated the presence of these problems in the regression model. In order to correct for the heteroskedasticity and autocorrelation problems, this research used the robust standard errors for panel regression with cross-sectional dependence model.[28]

Results

Although several components have likely contributed to the declining HIV rates in the

PEPFAR focus countries, the main objective of this research was to determine whether PEPFAR was an effective factor in lowering the HIV/AIDS infection rates, and, if so, by how much. Table 4 provides the results from the fixed-effects panel regression analysis for models 1 and 2. In model 1, PEPFAR funding per GDP was statistically significant at the 0.01 level. In model 2, PEPFAR funding per GDP and GDP per capita were statistically significant at the 0.01 level. Healthcare expenditure per GDP was significant at the 0.05 level. Corruption was not statistically significant.

Even though this research found correlation between HIV infection rates and PEPFAR funding, as the adage goes, correlation does not imply causation. Thus, the results must be considered in light of this caveat, as is the case with all empirical analyses. In model 1, the results illustrate that on average, *ceteris paribus*, for every 1 percentage point increase in PEPFAR funding per GDP a country received, the country's HIV infection rate decreased by 0.41 percentage points. The within R^2 value for this model was 0.1684, indicating that 16.84% of the variability in the dependent variable was explained by the independent variables.

In model 2, several pertinent control variables were included. The results illustrated that on average, *ceteris paribus*, for every 1 percentage point increase in PEPFAR funding per GDP a country received, the country's HIV infection rate decreased by 0.355 percentage points. For every $1,000 increase in GDP per capita a country received, the HIV infection rate decreased by 0.37 percentage points. For every 1 percentage point increase in healthcare expenditure per GDP, the HIV infection rate decreased by 0.10 percentage points. The within R^2 value for this model was 0.3733, indicating that 37.33% of the variability in the dependent variable was explained by the independent variables.

Table 4. Fixed-effects Panel Study Regression Results

Variables	(1)	(2)
	Model 1	Model 2
PEPFAR per GDP	−0.410*** (0.0180)	−0.355*** (0.0776)
GDP per capita		−0.37*** (9.40e-05)
Health per GDP		−0.103** (0.0373)
Corruption		0.162 (0.189)
Constant	9.907*** (0.0933)	10.85*** (0.773)
Observations	108	103
Number of groups	12	12
Within R^2	0.1684	0.3733

Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

Figure 1 provides graphs depicting a comparison between the amounts of PEPFAR funding received by the 12 countries in sub-Saharan Africa and the HIV rates from 2002 through 2010. Even though PEPFAR funding had steadily increased for each of the countries, most of the HIV infection rates decreased slightly, but remained relatively steady overall.

The United States provided large monetary support toward the PEPFAR program. Even though the results indicated that PEPFAR was statistically significant, the evaluation of whether PEPFAR was politically and economically significant remains subjective. Some may argue that any decrease in HIV infection rates highlights the relevance of the continued efforts of PEPFAR, while others could argue that the large amount of money invested in PEPFAR should have generated larger decreases in the HIV infection rates in Africa than the rates found in this study. Based on this research, the overall HIV rate decreased, but the large amount of money invested to combat HIV infections did not drastically lower the HIV infection rates.

The success of combating HIV/AIDS involves the collaboration of many public and humanitarian organizations.[2] Future research should include analysis on the impact of public sector agencies, universities, faith-based organizations, private contractors, and non-governmental organizations in this philanthropic mission. The Center for Global Development released data that provided specific dollar amounts on how much PEPFAR funding was allocated to the different organizations from 2004 through 2006 in the categories of treatment, prevention, care, and other. Although the data is sparse, analyzing the data supplied by the Center for Global Development would provide a better indication of the role and impact each sector had in the PEPFAR program.

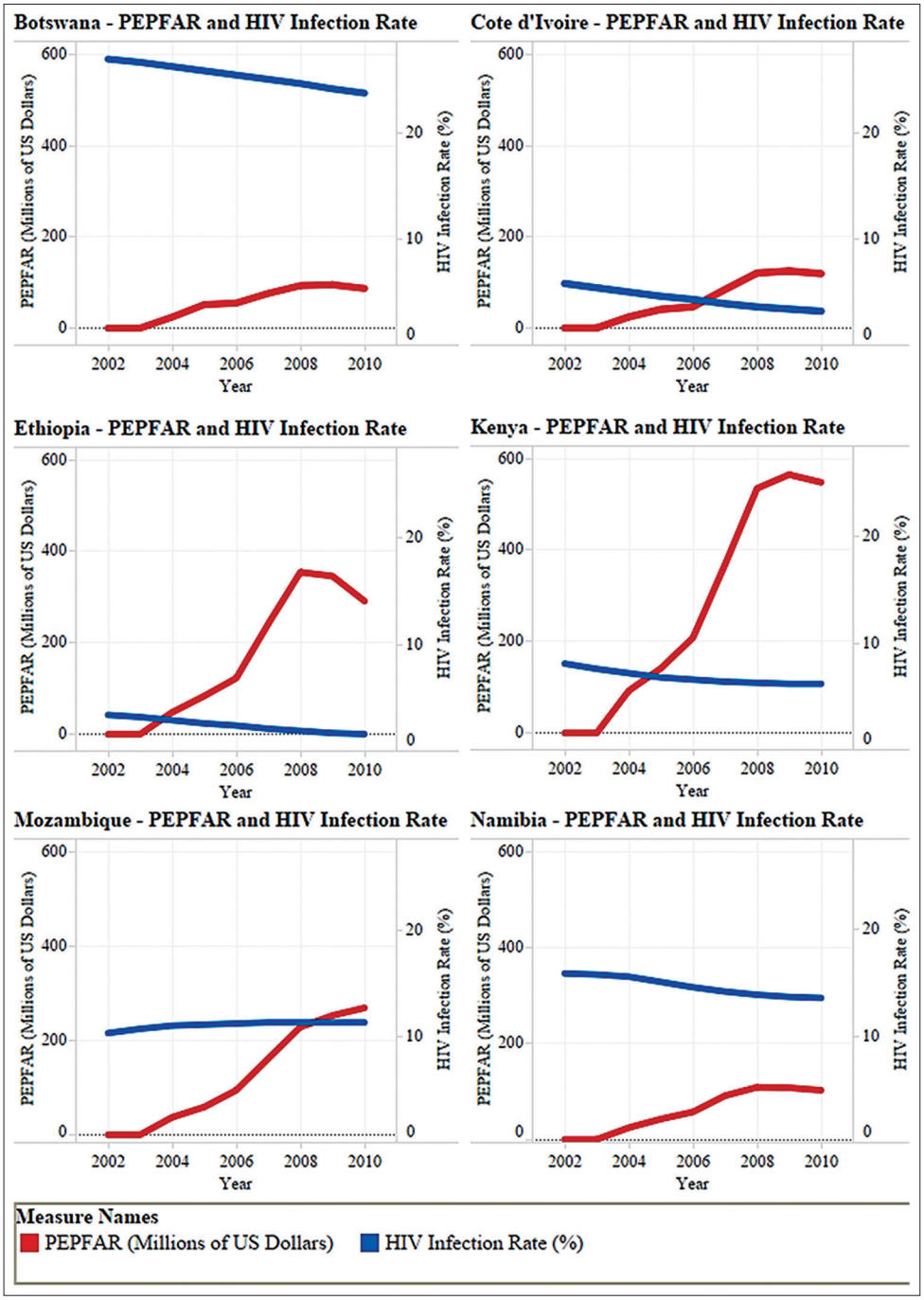

Figure 1. Comparison of HIV Infection Rates and PEPFAR Funding

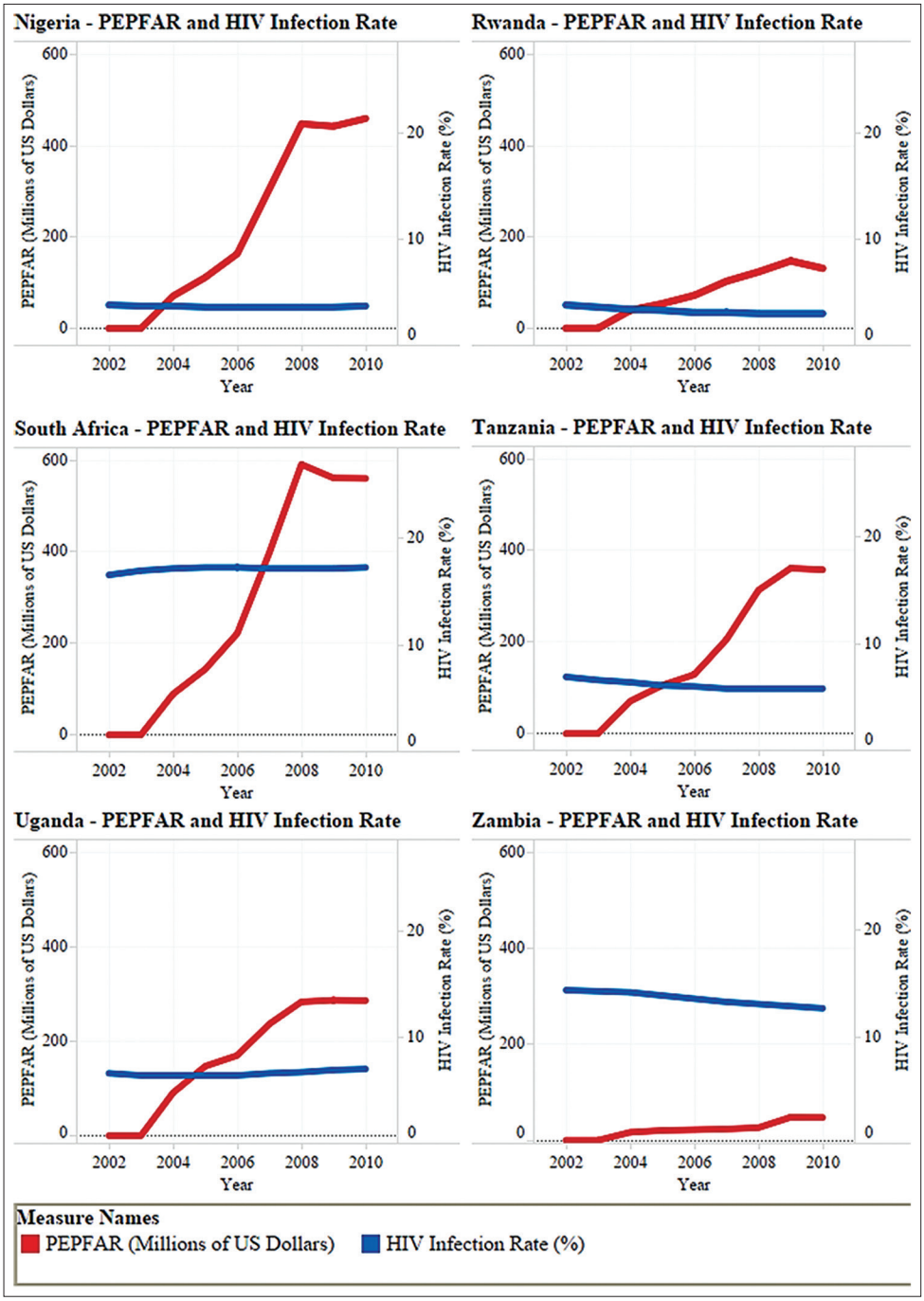

Figure 1. Continued.

Conclusion and Global Health Implications

A clear understanding of the global impact with the struggle against HIV/AIDS and the role that PEPFAR has played in that struggle is appropriate for future public policies, legislation, and programs. To the degree that it succeeded, the objectives and intentions of PEPFAR were met through an embrace of global connections and cooperation in order to reduce the increasing spread of HIV/AIDS in sub-Saharan Africa. The global community is becoming more interconnected and societies are becoming mutually dependent on one another to combat health crises. The increase of social, economic, and political globalization broadens the realization that HIV/AIDS does not recognize race, gender, ethnicity, sexual orientation, or geographic borders.

PEPFAR had some impact on the HIV pandemic in the 12 focus countries in sub-Saharan Africa through increasing humanitarian funding, providing access to cost-effective ARV medication, developing improved healthcare infrastructures, and implementing a number of prevention programs. Even though HIV/AIDS cannot be cured as of yet, there is intrinsic value in preventing the rapid spread of this malady. Although the programs and allocated funding of PEPFAR accomplished most of the stated objectives, there remains even more that needs to be accomplished, for HIV/AIDS continues to persist as a global pandemic presenting significant challenges. Despite a few limitations, this study was able to analyze and illustrate the relative effectiveness of PEPFAR funding in lowering the HIV infection rates on the continent of Africa, and has hopefully provided valuable insight for future policy considerations.

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Key Messages

- The objectives and intentions of PEPFAR were met through an embrace of global connections and cooperation in order to reduce the increasing spread of HIV/AIDS in sub-Saharan Africa.
- On average, ceteris paribus, for every 1 percentage point increase in PEPFAR funding per GDP a country received, the country's HIV infection rate decreased by 0.36 percentage points.
- For every $1,000 increase in GDP per capita a country received, the HIV infection rate decreased by 0.37 percentage points.
- For every 1 percentage point increase in healthcare expenditure per GDP, the HIV infection rate decreased by 0.10 percentage points.

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