

Brazil: Estimating the Potential Impact of an AIDS Vaccine

Targeted vaccination strategies may be highly effective and cost-beneficial in a country like Brazil, where the HIV epidemic is concentrated in population groups with higher-risk behaviors.

Nearly 30 years into the pandemic, 33 million people are living with HIV worldwide. Each year, almost 3 million become infected, and another 2 million die of AIDS (UNAIDS, 2009).

In Brazil, an estimated 730,000 people were living with HIV in 2007 (UNAIDS, 2008). Brazil has been a leader in the campaign against AIDS since the early 1990s, particularly because of its pioneering and remarkably successful public sector antiretroviral treatment program for all in need. Yet the more than 500,000 reported AIDS cases and 200,000 AIDS deaths to date (Ministry of Health, 2008) reflect the ever-growing humanitarian, social, and economic burden the country faces. Brazil, like many other countries, urgently needs new prevention strategies to stem the tide of new infections.

Vaccines are among the best tools for fighting infectious diseases. As part of an integrated prevention and treatment strategy, future vaccines could potentially end the spread of HIV. However, questions persist:

- Would a vaccine be useful if its efficacy is less than 100%?
- Would a vaccine still be needed if existing prevention programs and antiretroviral therapy (ART) are significantly expanded while a vaccine is still being developed?
- Would a vaccine be cost-effective?

To address these questions, the International AIDS Vaccine Initiative (IAVI) has drawn upon robust data and mathematical models to examine the future epidemiology of the AIDS pandemic and the impact that a vaccine could have both globally and in key countries such as Brazil, Kenya, and Uganda. In Brazil, IAVI developed this research in consultation with the Brazilian STD-AIDS and Hepatitis Department; National Secretary for Health Surveillance (SVS); and the Ministry of Health. A team at the Evandro Chagas Clinical Research Institute (IPEC), a unit of the Oswaldo Cruz Foundation (FIOCRUZ), led the technical work, with assistance from the Futures Institute.

Estimating global impact

IAVI and the Futures Institute developed an HIV Vaccine Model in Spectrum software to explore potential vaccine impacts. The model enables policymakers to consider HIV vaccines with a range of characteristics that match the current vaccine candidates in the research and development (R&D) pipeline, including first-generation vaccines that may provide only partial protection against HIV. The model also allows policymakers to analyze different vaccine delivery scenarios, from broad coverage of the adult population to more targeted vaccination of groups with greater vulnerability.

A global analysis using this modeling tool showed that a vaccine that is 50% effective, given to just 30% of the population, could reduce the number of new HIV infections in the developing world by 24% over 15 years (IAVI, 2009). These results indicate that including even partially effective vaccines as part of a comprehensive response can make a significant impact on the AIDS pandemic in the coming decades.

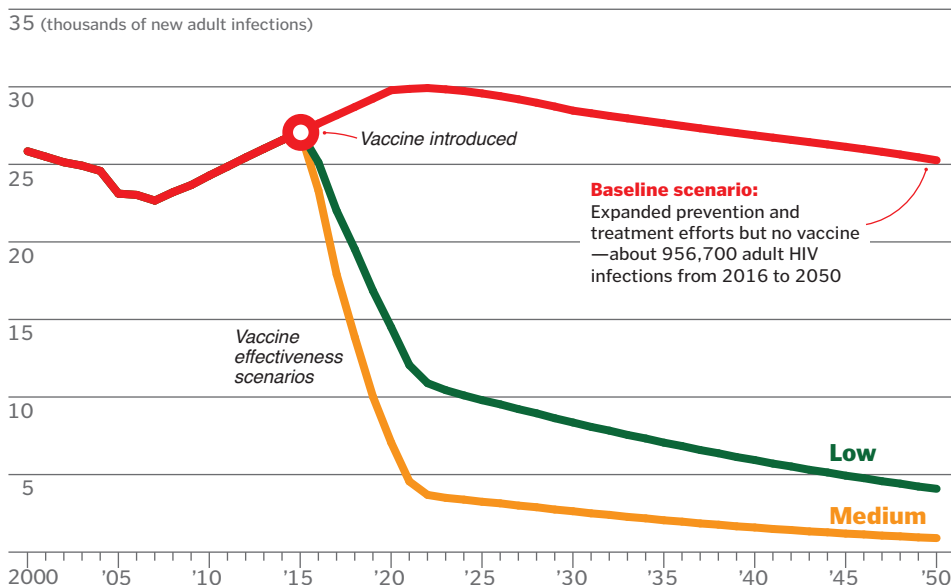
Potential vaccine scenarios

Brazil's epidemic is not generalized, so it serves as a useful example to demonstrate the potential impact of a vaccine in countries with concentrated epidemics. Because of years of strong HIV-prevention programs Brazil's epidemic has been stable over the past decade, indicating that while prevention services are adequate, they do not completely stop transmission, especially within populations at higher risk.

The research team produced an initial model of the national epidemic using the most current data from the epidemiological surveillance systems at the STD-AIDS and Hepatitis Department. Various published sources provided additional demographic, health, and behavioral data. The three indicators chosen to verify the model's baseline projection of the epidemic in

Estimated number of new infections in Brazil

Results generated by this analysis show that an HIV vaccine could substantially alter the course of the epidemic in Brazil and reduce the number of new infections, even if vaccine efficacy levels are relatively low and other programs for treatment and prevention are scaled up.



Vaccine scenarios	Efficacy	Percentage of population given vaccine	New infections averted, 2016-50	Percentage reduction in new infections
LOW	40%	80%	617,647	73%
MEDIUM	70%	80%	775,481	92%

Brazil were AIDS-related mortality, the number of adults on ART, and adult HIV prevalence. The IPEC/FIOCRUZ team led the effort to ensure the model reflected the history and trends of the Brazilian epidemic and to explore various vaccine scenarios. The STD-AIDS and Hepatitis Department and other stakeholders working in the field in Brazil were also consulted for this analysis.

Although the level of protection that first-generation vaccines will provide is still unknown, scientists believe they may be only partially effective in protecting against HIV. Based on the vaccine candidates currently being tested, a vaccine could use a

combination of the following three mechanisms:

- Protect the vaccinated individual against HIV infection (i.e., reduced susceptibility).
- Reduce the probability that a vaccinated individual who later becomes infected will transmit the infection to others (i.e., reduced infectiousness).
- Slow the rate of progression from HIV infection to death in vaccinated individuals (i.e., an increase in average survival time following infection).

Estimating the Potential Impact of an AIDS Vaccine in Brazil

The researchers constructed scenarios using plausible ranges to reflect current understanding of AIDS vaccine science.

Because Brazil has a strong history of extensive coverage of HIV prevention and treatment interventions, a relatively high coverage level of 80% was used for the national analysis. Although the efficacy of a future first-generation vaccine is unknown, it is likely to be much less than 100%. Therefore, a wide range of scenarios were discussed with Brazilian policymakers; the selected scenarios were deemed to be the most appropriate for analysis.

Both the low- and medium-efficacy vaccine scenarios presented in this study assume the continuation of other prevention and treatment efforts. These scenarios introduce the vaccine in 2015, with maximum coverage reached in 2020. Other issues explored but not presented here include the analysis of disease-modifying vaccines, the potential effect of behavioral disinhibition—when vaccinated individuals believe they are protected from infection and therefore increase the behaviors that put them at greater risk of exposure to HIV—and the cost-effectiveness of vaccines compared to other technologies. More information on these analyses can be found in the forthcoming article from the IPEC/FIOCRUZ research team and IAVI, “Modeling an HIV Vaccine in Brazil: Assessing the impact of a future HIV

vaccine on reducing new infections, mortality, and number of people receiving ART”.

Vaccination strategies

When a vaccine becomes available, a key policy question will be whether to employ a vaccination strategy that covers the general population or instead targets specific population groups with increased vulnerability to HIV, such as men who have sex with men (MSM), injecting drug users (IDUs), and sex workers. The research team used the low-efficacy vaccine scenario to project differences across the following strategies:

- Vaccinating 80% of all adult population groups (15 to 49 years old).
- Vaccinating 80% of all adolescents at the age of sexual initiation (15 years old).
- Vaccinating 80% of individuals with behaviors placing them at higher risk of infection (MSM, IDUs, heterosexuals with multiple partners, sex workers and their customers).

Although vaccinating the general adult population results in the largest reduction of new infections, this strategy requires a very high number of vaccinations compared to targeted strategies. Such high coverage can be difficult to achieve if resources

are limited. Additionally, this result may only be possible if the general vaccination program is able to capture higher-risk groups such as MSM and sex workers. Failing to reach marginalized groups would result in lower impact.

Targeting groups at higher risk of infection requires approximately the same number of vaccinations as targeting 15-year-olds, yet results in more than three times as many infections averted. The data show that the lowest impact on curbing the epidemic resulted when vaccinating only adolescents at age of sexual initiation, which would avert about 14% of new HIV infections.

A person who does become infected will eventually require ART. While treatment is widely available in Brazil, it incurs a significant cost to the government. Averting new infections would decrease the burden of treatment costs for the country and loss of productivity. Thus, the projections presented in the table below indicate that in the Brazilian context, targeting higher-risk groups may be more cost-effective than focusing on the general population.

These results also suggest that using appropriate targeted vaccination strategies can be highly effective, even with low-efficacy vaccines, particularly in countries with concentrated epidemics.

Potential impact of vaccination strategies in Brazil

Vaccine strategy	Coverage of target population	Percentage reduction in new infections, 2016-50	New infections averted, 2016-50	Vaccinations required	Vaccinations per infection averted
General adult population	80%	73%	617,647	241,025,871	390
Higher-risk groups	80%	52%	442,211	43,206,542	98
15-year-olds	80%	14%	122,467	43,318,438	354

Key conclusions and next steps

This modeling shows that introducing even a low-efficacy vaccine as part of a comprehensive package of treatment and prevention a decade from now could significantly affect the number of new infections in Brazil. HIV prevention can lead to increased productivity and family earnings, reducing the financial cost of AIDS and positively affecting health systems on a larger scale. This underscores the importance of sustaining investments and strong policy efforts to accelerate AIDS vaccine development, such as Brazil's 2008-2012 HIV Vaccine Plan, both in Brazil and internationally.

Vaccination strategies for the general adult population in Brazil should also include populations at greater risk to HIV infection, since vaccinating only lower-risk individuals would diminish potential impact.

This research demonstrates that targeted vaccination strategies may be highly effective and cost-beneficial in a country like Brazil, where the epidemic is concentrated in population groups with higher-risk behaviors. Such a strategy could be optimal if there is insufficient supply initially or

if resources are limited, whether for purchasing vaccines or for education programs to counter the potential effects of behavioral disinhibition.

Findings from this research highlight the relevance of AIDS vaccines in Brazil and can help to continue building support for vaccine development, while helping decision makers consider the potential cost-benefits of different vaccine targets and the future access issues they are likely to face in the coming decades.

References

- UNAIDS. 2009. *Report on the global epidemic*. UNAIDS: Geneva.
- UNAIDS. 2008. *Epidemiological Fact Sheet on HIV and AIDS: Brazil*. UNAIDS: Geneva.
- Ministry of Health of Brazil. 2008. *AIDS Epidemiology Bulletin* 5(1).
- IAVI. 2009. *Estimating the Impact of an AIDS Vaccine in Developing Countries*. Policy Brief #20. New York: IAVI.

Acknowledgments

This work was done in close collaboration with IAVI's partners at the Brazilian STD, AIDS and Hepatitis Department, National Secretary for Health Surveillance (SVS), Ministry of Health, as well as the research team led by Maria Goretti P. Fonseca at the Evandro Chagas Clinical Research Institute (IPEC), a unit of the Oswaldo Cruz Foundation (FIOCRUZ). Special thanks to Valdiléa Veloso of IPEC and Cristina Possas, Gerson Pereira and Francisca Lucena of the STD-AIDS and Hepatitis Department for guidance on and support of this project.



**STD-AIDS AND
HEPATITIS DEPARTMENT**
Brazilian Ministry of Health

Insights

IAVI's policy brief series outlines key public policy issues in the research, development, and eventual distribution of AIDS vaccines.

www.iavi.org
info@iavi.org



IAVI gratefully acknowledges the generous support provided by the following major donors



Alfred P. Sloan Foundation* ■ Basque Autonomous Government (Spain) ■ Becton, Dickinson and Company (BD) ■ Bill & Melinda Gates Foundation ■ Bristol-Myers Squibb (BMS) ■ Broadway Cares/Equity Fights AIDS ■ Canadian International Development Agency ■ The City of New York, Economic Development Corporation ■ Continental Airlines ■ European Union ■ Foundation for the National Institutes of Health ■ Google Inc. ■ Government of Japan ■ Irish Aid ■ James B. Pendleton Charitable Trust ■ The John D. Evans Foundation ■ Ministry of Foreign Affairs and Cooperation, Spain ■ Ministry of Foreign Affairs of Denmark ■ Ministry of Foreign Affairs of The Netherlands ■ Ministry of Science & Technology, Government of India ■ National Institute of Allergy and Infectious Diseases ■ The New York Community Trust ■ Norwegian Royal Ministry of Foreign Affairs ■ The OPEC Fund for International Development ■ Pfizer Inc ■ The Rockefeller Foundation* ■ The Starr Foundation* ■ Swedish International Development Cooperation Agency ■ Thermo Fisher Scientific Inc. ■ U.K. Department for International Development ■ Until There's a Cure Foundation* ■ The U.S. President's Emergency Plan for AIDS Relief through the U.S. Agency for International Development ■ The World Bank through its Development Grant Facility

And many other generous individuals from around the world

*Founding donors of IAVI