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**POLICY BRIEF 22** | OCTOBER 2009

# **Uganda:** Estimating the Potential Impact of an AIDS Vaccine

**Even a partially effective vaccine could significantly alter the course of the AIDS crisis in Uganda**

In Uganda, an estimated 940,000 people are living with HIV and there are an estimated 77,000 AIDS deaths each year (UNAIDS, WHO and UNICEF, 2008). Even as national programs to prevent and treat HIV and AIDS are expanded, the approximately 132,500 new infections occurring each year speak to the ever-growing humanitarian, social and economic burden the country faces (Uganda AIDS Commission, 2008). Uganda, like many other countries, urgently needs new prevention strategies to curb the HIV epidemic.

Vaccines are among the best tools for fighting infectious diseases. A vaccine, used in an integrated prevention and treatment strategy, should be considered one of the best hopes to end the spread of HIV. However, some key questions remain:

- 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 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 countries such as Uganda, Kenya and Brazil. In Uganda, IAVI developed this research in consultation with the Uganda AIDS Commission (UAC). A team at the School of Public Health at Makerere University led the technical work, with assistance from the Futures Institute.

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## Estimating global impact

IAVI and the Futures Institute developed an HIV Vaccine Model in Spectrum software to explore potential AIDS vaccine impacts. The model enables policy makers 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 policy makers to analyze different vaccine delivery scenarios, from broad coverage of the adult population to more targeted vaccination of groups at higher risk of contracting HIV.

A global analysis using this modeling tool shows 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

Uganda has a generalized epidemic; HIV is firmly established in the general population and the epidemic is largely driven by heterosexual transmission (UNAIDS, 2008). Uganda can serve as a useful example to demonstrate the potential impact of a vaccine in other countries with similar epidemic patterns. Uganda's response to HIV and AIDS has grown and improved considerably over the past decade, but evidence from longitudinal cohort studies suggests that HIV incidence and prevalence may be on the rise. Therefore, while existing prevention services are important, they do not completely stop transmission.

The research team produced an initial model of the national epidemic using the most current data from the Ministry of Health and the Ministry of Finance and Economic Planning. Various published sources provided additional demographic, health and behavioral data.


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The indicators chosen to verify the model's baseline projection of the epidemic in Uganda were adult HIV prevalence and AIDS-related mortality. The research team led the effort to ensure the model fit the Ugandan epidemic and to explore various vaccine scenarios. The UAC was 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 after infection).

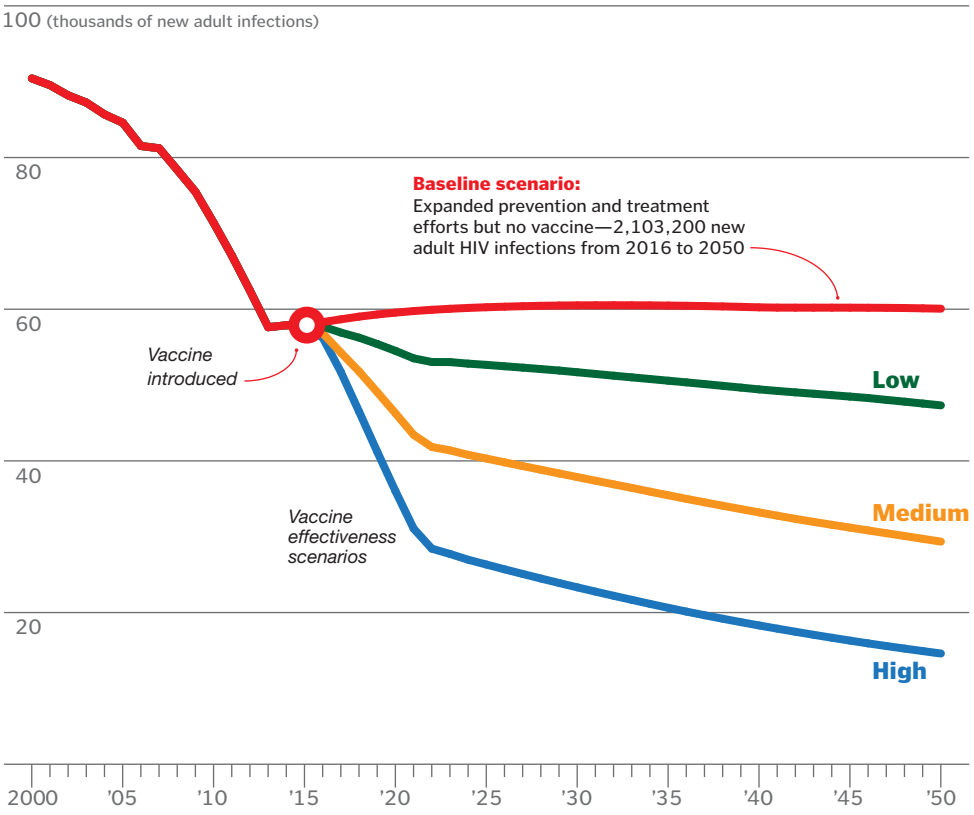
A wide range of scenarios was discussed with Ugandan policy makers; three selected scenarios were deemed to be the most appropriate for the analysis, as they reflected the current understanding of AIDS vaccine science.

It is assumed that the vaccine is introduced in 2015, but maximum coverage is reached in 2020 because of the time needed to successfully scale up coverage. The level of coverage is assumed to increase as vaccine efficacy increases, as a higher efficacy vaccine is likely to be implemented more broadly by governments and face greater uptake among individuals.

A baseline scenario projects the future trajectory of the epidemic if no vaccine is introduced. In this scenario, it is assumed that the targets of Uganda's National Strategic Plan (NSP) are realized. The 2007-2012 NSP aims to reduce HIV incidence by 40% and to expand treatment and care to 80% of those in need. These goals are ambitious and may not be achieved in the given time frame, but Ugandan officials remain confident that significant progress toward them is under way. Therefore, the vaccine scenarios in this study assume that male circumcision increases to 35%, condom use in higher risk groups increases to 80%, and ART coverage increases to 90% by 2012 and is held constant until 2050.

## The impact in Uganda

Results generated by this analysis show that an HIV vaccine could substantially alter the course of the epidemic in Uganda 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 adult population given vaccine | New infections averted, 2016-50 | Percentage reduction in new infections |
|---|---|---|---|---|
| **LOW** | 30% | 20% | 309,100 | 15% |
| **MEDIUM** | 50% | 30% | 780,200 | 37% |
| **HIGH** | 70% | 40% | 1,242,500 | 59% |

The results described above are for both sexes combined. Because HIV prevalence in Uganda among women (8%) is higher than prevalence among men (5%), the absolute number of new infections averted amongst females will be greater than the number of new infections averted amongst males. However, because most new infections in Uganda result from heterosexual transmission, vaccine impact between both sexes is proportional to the prevalence amongst women and men.

While the vaccine is provided only to adults in these scenarios, any reduction in adult HIV incidence would result in fewer new child infections as lower prevalence among pregnant women translates into fewer infections transmitted from mother to child. However, as ART and prevention of mother-to-child-transmission programs are expanded, the potential impact of vaccines on new child infections could be diminished.

## Would a vaccine be cost-effective?

Preliminary findings suggest that AIDS vaccines would be cost-effective. Although the actual cost of future vaccines is unknown, the maximum price at which a vaccine would be considered cost-effective can be calculated using several different approaches; we provide one example below.

*Vaccines v. ART:* An infection averted by a vaccine will mean that a person will not need ART in the future. Thus the cost of a vaccine can be compared with the present value of future treatment costs to determine cost-effectiveness. In Uganda, patients will likely spend on average about 11 years on first-line ART and 11 years on second-line treatment at an estimated total discounted cost of US$ 11,500 (Chandler and Musau, 2005 and TASO, 2006). If each new infection implies a discounted cost of US$ 11,500, then any intervention that prevents that infection for less than US$ 11,500 would not only be cost-effective but cost-saving.

In the medium-efficacy vaccine scenario, impact modeling estimates that approximately 41,511,716 vaccinations would be required to avert 780,236 infections between 2016 and 2050. This means that approximately 53 vaccinations are needed to avert one infection; in comparison to ART, this means that a medium-efficacy vaccine could cost US$ 217 per vaccination (US$ 11,500 divided by 53) and still result in cost savings.

## Key conclusions and next steps

Despite progress fighting the epidemic, AIDS continues to challenge Uganda. This modeling shows that introducing even a medium-efficacy vaccine with limited coverage as part of a comprehensive package of treatment and prevention could significantly affect the number of new HIV infections in Uganda.

HIV prevention can increase productivity and family earnings, reducing the financial cost of AIDS and positively affecting health systems on a larger scale. These potential benefits underscore the importance of sustaining investments and policy efforts both in Uganda and internationally to accelerate AIDS vaccine development. This research demonstrates that vaccines could be cost-effective compared to other interventions in Uganda, which is especially important if resources are limited. Findings from this research highlight the relevance of AIDS vaccines in Uganda and can help to continue building support for vaccine development and make a case for investment in AIDS vaccine R&D.

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



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

Alfred P. Sloan Foundation* ■ Basque Autonomous Government ■ 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. ■ The Haas Trusts ■ Henry Schein, Inc. ■ 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 Foreign Affairs of Sweden ■ Ministry of Science & Technology, Government of India ■ The New York Community Trust ■ Norwegian Royal Ministry of Foreign Affairs ■ 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

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*As of June 2009*