The Potential Cost and Impact of Expanding Male Circumcision in Rwanda

In support of efforts to scale up male circumcision (MC) in PEPFAR programs, readily available data have been applied to estimate the potential cost and impact of scaling up medical MC services in Rwanda to reach 80 percent of adult and newborn males by 2015. The results presented here are illustrative and for only one possible scenario; they can be modified to reflect a variety of possible policies at the country level. Key conclusions from this initial scenario are that scaling up the program would result in averting more than 64,000 adult HIV infections over the time period 2009 to 2025, would result in cumulative net savings of more than US$200 million over the same time period, and would require almost 900,000 MCs to be performed in the peak year (2012).

Key Messages

Scaling up male circumcision to reach 80 percent of adult and newborn males in Rwanda by 2015 would

- avert more than 64,000 adult HIV infections cumulatively between 2009 and 2025;
- yield total net savings of US$200 million between 2009 and 2025; and
- require 900,000 MCs in the peak year (2012).

Background

According to the Joint United Nations Program on HIV/AIDS (UNAIDS), at the end of 2007 overall adult HIV prevalence in Rwanda was 2.8 percent. The primary mode of transmission is unprotected heterosexual sex. There are no data available from the 2005 Rwanda Demographic and Health Survey on male circumcision. According to Williams and others (2006), the male circumcision rate in Rwanda is 10 percent.

Male Circumcision: Decision Makers' Program Planning Tool

In March 2007, participants at a high-level consultative meeting held by UNAIDS and the World Health Organization (WHO) concluded that male circumcision should be a priority prevention service in countries with high HIV prevalence rates and low prevalence of MC, due to its effectiveness in reducing men's risk of acquiring HIV. To

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further support MC program planning, the USAID | Health Policy Initiative collaborated with UNAIDS to develop the Male Circumcision: Decision Makers' Program Planning Tool to assist countries in developing policies for scaling up services to provide medical male circumcision. This tool allows analysts and decisionmakers to understand the costs and impacts of different policy options regarding the introduction or expansion of medical male circumcision services. It is part of a larger toolkit developed by UNAIDS/WHO that provides guidelines on comprehensive approaches to male circumcision, including types of surgical procedures and key policy and cultural issues. The key policy options addressed by the model are the following:

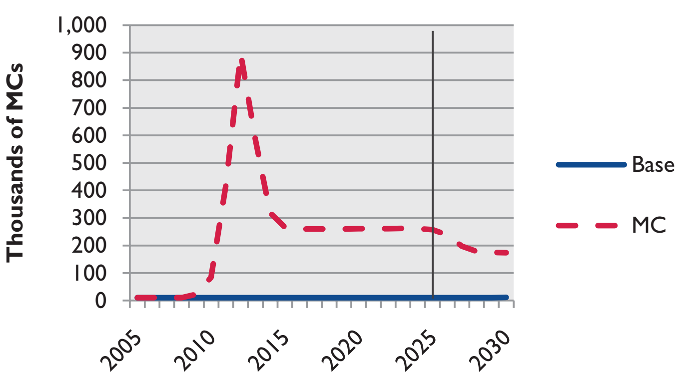
- Priority populations: all male adults, young male adults, adolescent males, male newborns, and men at higher risk of HIV exposure
- Target coverage levels and rates of scale-up
- Service delivery modes: hospital, clinic, outreach, mobile van; public, private, nongovernmental organization, and "other"
- Task shifting and task sharing: surgeon, family physician, and clinical officer[1]

In the results displayed in the following charts, "Base" refers to the Base case scenario (maintaining current levels of male circumcision throughout the time period), while "MC" refers to the male circumcision scale-up scenario. Results are shown through 2025, except for the number of new male circumcisions required annually, which is extended to 2030 to illustrate the number required over the long term. **Table 1** in the Annex summarizes results and describes the model methodology; **Table 2** lists key data assumptions; sources are listed on page 6.

Results

If no MC scaling up occurs in Rwanda, the number of MCs that would maintain the "Base" level (10% of adult males) is about 11,000 per year (see **Figure 1**). A rapid scale-up to meet a target of 80 percent by 2015 would result in a large increase in the number of new MCs required per year in the short term, peaking at almost 900,000 in 2012 before reaching a new equilibrium of about 175,000 annually. The level would represent approximately 80 percent of newborn males in 2030, as all adult and adolescent males requiring circumcision have received it by that time.

Figure 1. Number of New MCs Required for Adults (15–49) and Newborns (thousands)



Scaling up medical MC services to reach 80 percent of all adult and newborn males by 2015

[1]Task shifting refers to moving the complete male circumcision surgery to less specialized workers, such as from a surgeon to a clinical officer, while task sharing moves specific steps of the surgery to less specialized workers.

would reduce the number of new adult HIV infections by more than half by the end of 2025 (see **Figure 2**). Over the time period 2009–2025, the total number of annual new infections would decline from about 12,000 to about 6,000, and the cumulative number of adult HIV infections averted would be about 64,000 or 26 percent of all new adult infections that would have occurred otherwise in the "Base" scenario. Note that scaling up only newborn MCs would not result in adult infections being averted until after the newborns have grown up and become sexually active. As a result, most infections would not begin to be averted until after 2025

The number of adult HIV infections averted is displayed in **Figure 3**. The solid line is the number of infections averted per year, while the dotted line is the cumulative number of infections averted between 2009 and 2025. The numerical results are also displayed in **Table 1** in the Annex. **Figure 3** shows the dramatic impact of MC; by 2025, cumulatively about 64,000 adult HIV infections are averted due to scaling up medical MC services.

Figure 4 shows the number of MCs performed per adult HIV infection averted. This is calculated as the cumulative number of additional MCs performed, divided by the cumulative number of adult HIV infections averted over the respective time periods. The number of MCs per infection averted is high initially but declines over time as the impact of MC grows. The number of MCs required to avert one infection drops substantially, reaching 47 during the time period 2016–2025.

Figure 2. New Adult HIV Infections by Scenario

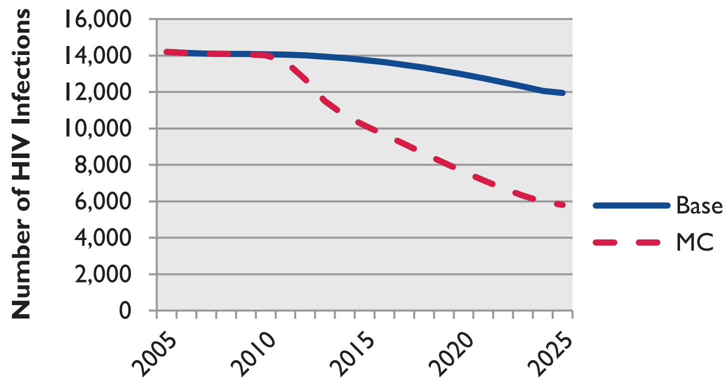


Figure 3. Infections Averted and Cumulative Infections Averted (thousands)

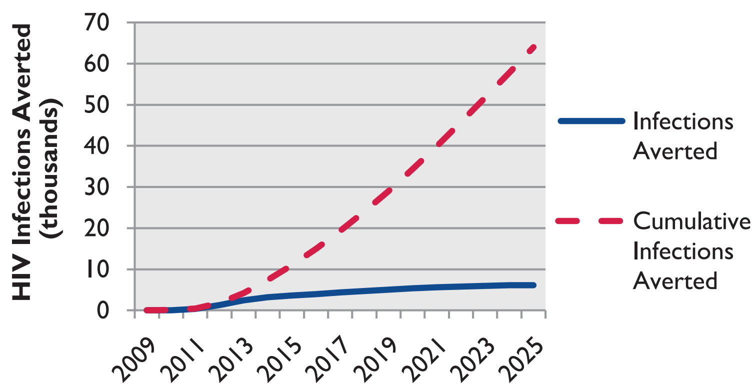
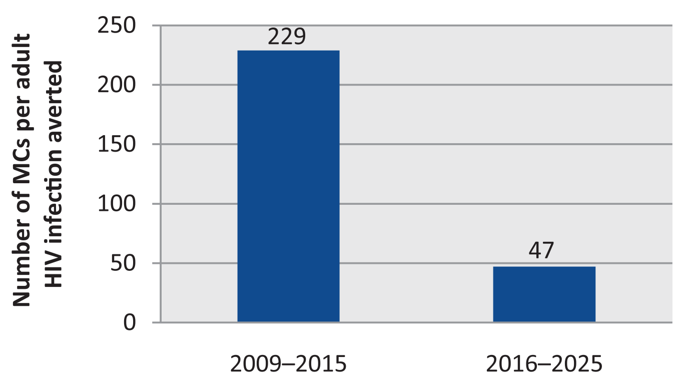


Figure 4. Number of MCs per Adult HIV Infection Averted



Assuming that 80 percent of new MCs are provided through the public sector and 20 percent are provided through the private sector, the resources required to scale up medical MC services are shown in **Figure 5**. The underlying unit cost assumptions for both adult and newborn MCs are listed in **Table 2** in the Annex. In addition, we assume that US$500,000 is spent annually on public education activities (all costs are in US$ in order to compare results across countries). Total annual costs peak at US$32.7 million in 2012—a net increase of approximately US$32 million over current MC expenditure levels, assuming similar unit costs. Costs are lower after the initial intensive scaling-up occurs, reaching about US$8.9 million between 2015 and 2025—a net increase of about US$8 million over current levels. If the unit cost in Rwanda is 25 percent higher than the UNAIDS default values, total costs peak at about US$40 million in 2012 before reaching around US$11 million in the later time period. If the unit cost is 25 percent lower, total costs peak at almost US$25 million before reaching about US$6.7 million between 2015 and 2025.

Figure 5. Costs for Scaled-up MC Program with Different Unit Costs (millions US$)

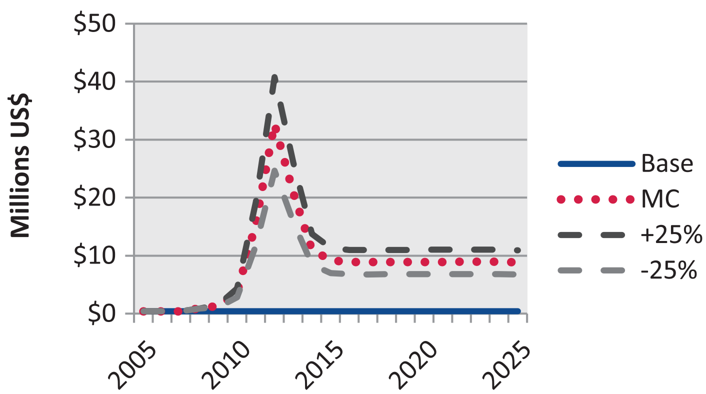
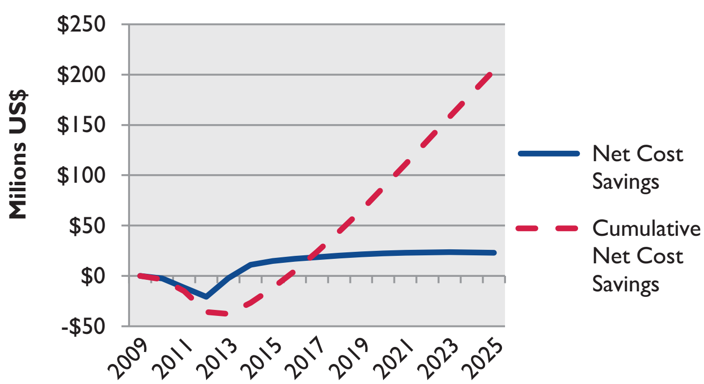


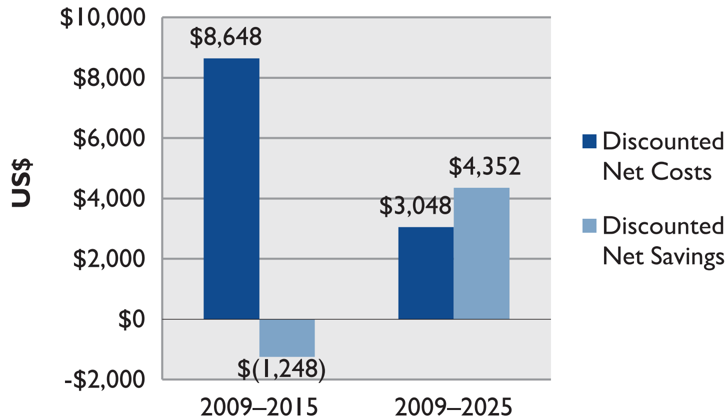
Figure 6. Discounted Net Cost Savings and Cumulative Net Cost Savings (millions US$)



The discounted net cost savings in millions of dollars are displayed in **Figure 6**—defined as the lifetime antiretroviral therapy costs (multiplied by the annual number of infections averted) less the cumulative net costs of implementing the scaled-up MC program. Over the time period 2009–2025, the cumulative net cost savings increase rapidly, reaching over US$200 million by 2025.

The discounted net cost and discounted net savings per adult HIV infection averted are also calculated using the results above. The discounted net cost per adult HIV infection averted is the cumulative incremental net costs incurred through implementing the scaled-up MC program, divided by the cumulative number of adult HIV infections averted over the relevant timeframe and discounted appropriately. Net cost savings is defined as above and then is divided by the cumulative number of adult HIV infections averted over the relevant timeframe and discounted appropriately. The results are displayed in **Figure 7**; details of the underlying data are shown in **Table 1** in the Annex. The net cost per adult HIV infection averted drops substantially in the longer term from US$8,648 to US$3,048 once the number of adult HIV infections averted increases. The net savings per infection averted of $4,352 outweigh the net costs when evaluated over the entire time period 2009–2025.

Figure 7. Discounted Net Costs/Savings per Adult HIV Infection Averted (US$)



A final question is what kind of impact scaling up MC would have on the HIV epidemic if other prevention programs are scaled up as well. Results (not shown here) indicate that if all other prevention interventions are scaled up to 80 percent coverage, adding a scaled-up program of medical MC to the scaled-up prevention interventions results in a further decline in the number of new adult HIV infections from about 7,500 in 2025 to a level of about 3,700. Thus, a scaled-up MC program in the presence of scaled-up other prevention activities (assuming maximum impact) would have synergistic effects, hastening the decline in the number of new HIV infections in Rwanda.

Further Methodological Details on Model

The Male Circumcision: Decision Makers' Program Planning Tool (DMPPT) was developed by the USAID | Health Policy Initiative in collaboration with UNAIDS. The tool calculates the cost of male circumcision services by delivery mode based on clinical guidelines and locally derived inputs on staff time and salaries, supplies, equipment, and shared facility and staff costs. It estimates the impact on the epidemic using a transmission model that calculates new infections by sex and two age groups that can vary as a function of the current force of infection, coverage levels, and speed of scale-up. The tool incorporates sensitivity analysis for key inputs, including a direct impact of male circumcision on HIV risk in women, and was refined through consultations with key MC modeling groups (see UNAIDS/WHO/SACEMA Expert Group, 2009).

The DMPPT also allows for choice of the intended target population by age (newborn, adolescent, adult) and risk (e.g., sexually transmitted disease clinic attendees, sero-negative men in discordant partnerships); service delivery mode (hospital, clinic, campaign); provider (surgeon, family physician, clinical officer); adverse events; ancillary services (HIV testing and counselling, programs promoting gender sensitivity); potential risk compensation (increased number of sexual partners, decreased condom use); scale-up rate; and coverage goals. The tool estimates HIV incidence, HIV prevalence, AIDS deaths, overall costs, and net cost per HIV infection averted as a function of the number of male circumcisions performed for each service delivery and coverage timeframe option.

Limitations of the model include issues regarding data (e.g., male circumcision rates are self-reported in the Demographic and Health Surveys and so may be biased). In addition, the model is also limited by several simplifying assumptions that are made, including the lack of a sexual mixing matrix and the use of HIV prevalence used to fit the epidemic model rather than HIV incidence.

A complete description of the variables and equations used in the model can be found in the "Methods" worksheet in the DMPPT, available at: http://www.malecircumcision.org.

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Sources:

1. Demographic and epidemiologic data from Spectrum files using country-specific data from UNAIDS and UN Population Division.
2. Rwanda Demographic and Health Survey 2005.
3. UNAIDS Epidemiological Fact Sheet on Rwanda, 2008 Update, available at: http://www.who.int/globalatlas/predefinedReports/EFS2008/full/EFS2008_RW.pdf.
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7. Williams BG, Lloyd-Smith JO, Gouws E, Hankins C, Getz WM, Hargrove J, de Zoysa I, Dye C, Auvert B. The potential impact of male circumcision on HIV in Sub-Saharan Africa. *PLoS Med*. 2006 Jul;3(7):e262.
8. World Development Indicators database, various years.

Annex. Results Summary and Methodology

Table 1. Results Summary and Methodology

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Total number of MCs (thousands)	23	85	415	897	585	319	267	260	260	260	260	261	261	261	262	261	258
Infections averted (thousands)	0.0	0.1	0.0	1	2	3	4	4	4	5	5	5	6	6	6	6	6
Cumulative number of infections averted since 2009 (thousands)	0.0	0.1	0.0	2	4	7	11	15	19	24	29	34	40	46	52	58	64
Cost savings (millions US$)	-0.9	-3	-12	-21	-2	11	15	17	19	20	21	22	23	23	24	23	23
Cumulative cost savings since 2009 (millions US$)	-0.9	-3	-15	-36	-38	-27	-12	5	24	44	65	88	111	134	158	181	204

Table 2. Key Data Assumptions

Indicator	Value	Source
Male circumcision prevalence	10%	Williams et al. (2006)
HIV prevalence – 2007	2.8%	UNAIDS Epidemiological Fact Sheet, 2008 Update
Average unit cost for adult MC	US$37 ($28-$46)	UNAIDS (-/+ 25%)
Average unit cost for newborn MC	US$30 ($23-$38)	UNAIDS (-/+ 25%)
Annual public information cost	US$500,000	UNAIDS
Discounted lifetime antiretroviral therapy cost	US$7,400	UNAIDS; Assumes (a) 1st year continuation rate of 86%, 90% thereafter for both 1st and 2nd line therapy, (b) ARV drug prices trend to reach $210 for 1st line, $590 for 2nd line by 2015

For more information

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