



The Potential Cost and Impact of Expanding Male Circumcision in Mozambique

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 Mozambique to reach 80 percent of adult (ages 15–49) and newborn males by 2015. The results presented here illustrate only one possible scenario; the scenarios 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 300,000 adult HIV infections from 2009–2025, would result in cumulative net savings of more than US\$1.5 billion over the same time period, and would require more than 800,000 MCs to be performed in the peak year (2010).

Key Messages

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

- avert more than 300,000 adult HIV infections between 2009 and 2025;
- yield total net savings of more than US\$1.5 billion between 2009 and 2025; and
- require 800,000 MCs in the peak year (2012).

Background

According to the 2008 Demographic Impact Study for Mozambique, at the end of 2007, overall adult HIV prevalence in Mozambique was 14 percent—one of the highest rates in the world. The primary mode of transmission is unprotected heterosexual sex. The 2003 Mozambique Demographic and Health Survey found that 59.5 percent of males ages 15–49 were circumcised across the country. There is significant variation across provinces; however, four provinces have very high circumcision rates of between 88 percent and 95 percent (Niassa, Cabo Delgado, Nampula, and Inhambane), while four provinces have relatively low circumcision rates that range between 8 percent and 21 percent (Tete, Manica, Sofala, and Gaza).

Male Circumcision: Decision Makers' Program Planning Tool

In March 2007, participants at a high-level consultative meeting held by the Joint United Nations Program on HIV/AIDS (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 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 and governments in developing policies for scaling up services to provide medical MC. This tool allows analysts and decisionmakers to understand the costs and impacts of different policy options regarding the introduction or expansion of medical MC services. It is a 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:

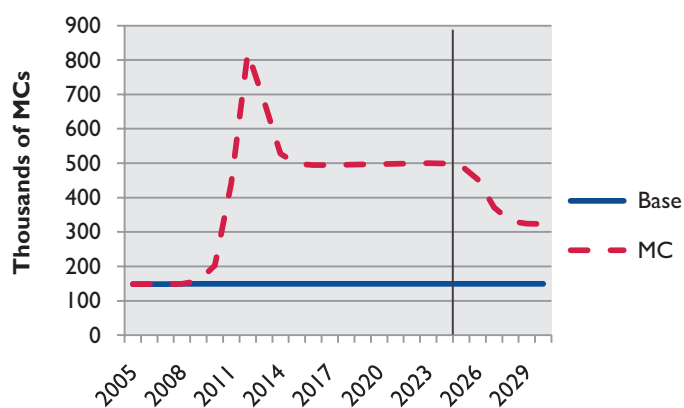
- Priority populations: all male adults, young male adults, adolescent males, male newborns, and men at higher risk of HIV exposure
- Target coverage levels and rates of scale-up
- Service delivery modes: hospital, clinic, mobile van; public, private, nongovernmental organization, and “other”
- Task shifting and task sharing: surgeon, family physician, and clinical officer¹

In the results displayed in the following charts, “Base” refers to the Base case scenario (maintaining current levels of MC 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 MCs required annually, which is extended to 2030 to illustrate the number required over the long term. **Table 1** in the Annex summarizes the results and describes the model methodology; **Table 2** lists key data assumptions; sources appear on page 6.

Results

If no MC scaling-up occurs in Mozambique, the number of MCs that would maintain the current level of MC (59.5% of adult males) is about 150,000 per year (see **Figure 1**). A rapid

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



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 more than 800,000 in 2012 before reaching a new equilibrium of about 325,000 annually. This level would represent approximately 80 percent of newborn males in 2030, as all adult and adolescent males requiring circumcision would have received it by that time.

Scaling up medical MC services to reach 80 percent of all adult and newborn males by 2015 would reduce the number of new adult HIV infections by more than half by the end

¹Task 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.

of 2025 (see **Figure 2**). Over the time period 2009–2025, the total number of annual new infections would decline from about 140,000 to about 106,000, and the cumulative number of adult HIV infections averted would be more than 319,000 or 12 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 annual number of infections averted, while the dotted line is the cumulative number of infections averted between 2009 and 2025. The numerical results are also displayed in **Table I** in the Annex. **Figure 3** shows the dramatic impact of MC; by 2025, cumulatively more than 319,000 adult HIV infections would have been averted due to scaling up medical MC services.

Figure 4 depicts 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 13.0 during the time period 2016–2025.

Figure 2. New Adult HIV Infections by Scenario

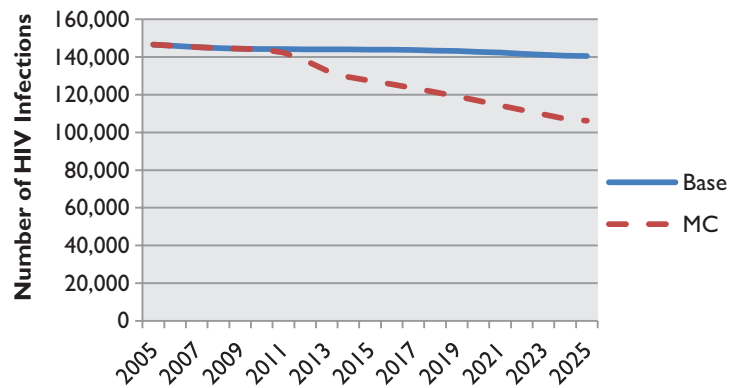


Figure 3. Infections Averted and Cumulative Infections Averted (thousands)

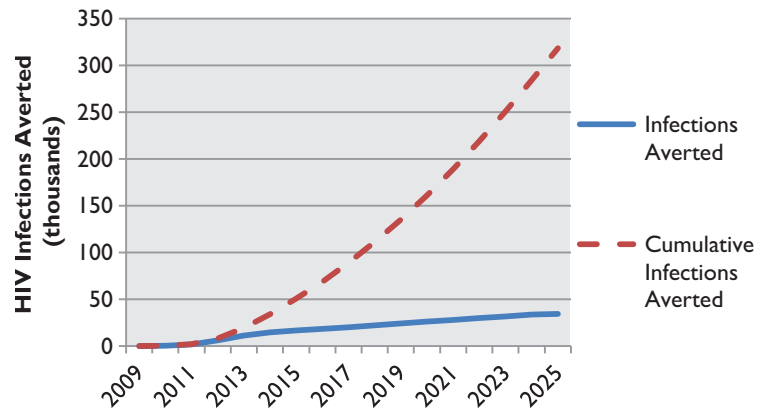
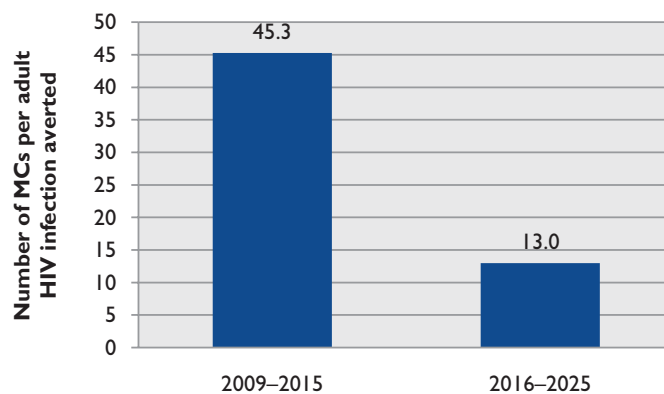


Figure 4. Number of MCs per Adult HIV Infection Averted



Assuming that all new MCs are provided through the public 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

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

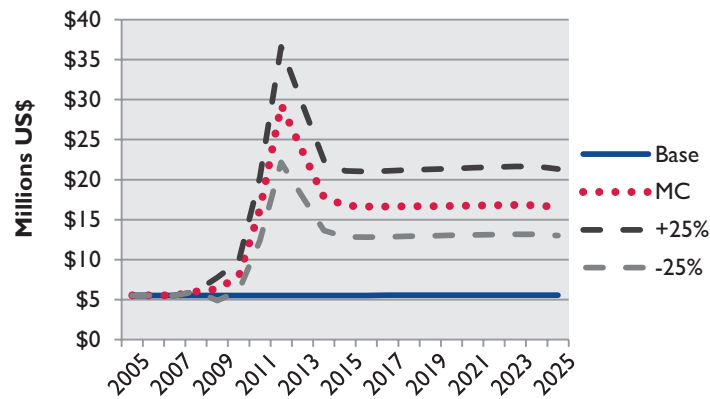
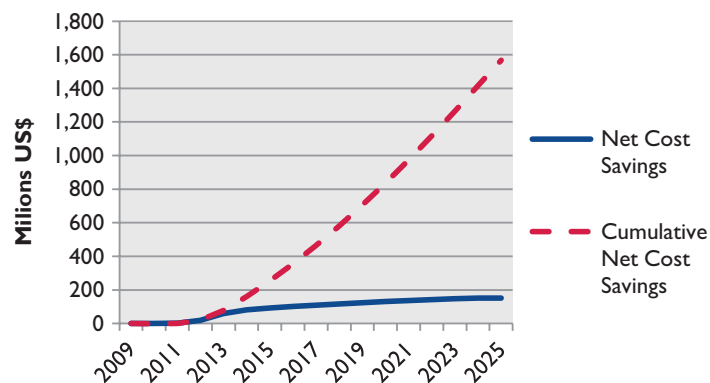


Figure 6. Discounted Net Cost Savings and Cumulative Net Cost Savings (millions US\$)



peak at about US\$29 million in 2012—a net increase of approximately US\$24 million more than current MC expenditure levels, assuming similar unit costs. Costs are lower after the initial intensive scaling up occurs, declining to about US\$16.5 million between 2015 and 2025—a net increase of about US\$11 million over current levels. If the unit cost in Mozambique is 25 percent higher than the UNAIDS default values, total costs peak at about US\$36.5 million in 2012 before reaching around US\$21 million in the later time period. If the unit cost is 25 percent lower, total costs peak at US\$22 million before reaching about US\$13 million between 2015 and 2025.

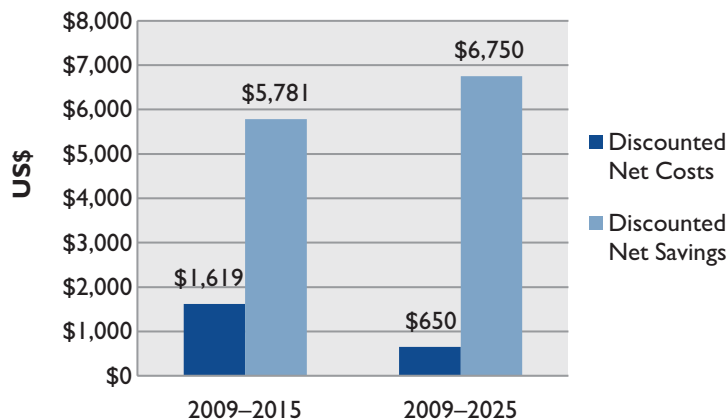
The discounted net cost savings in millions of dollars are displayed in **Figure 6**—defined as the lifetime antiretroviral therapy costs (multiplied by the annual number of infections averted), less the cumulative net costs of implementing the scaled-up MC program. Over the time period 2009–2025, the cumulative net cost savings increase rapidly, reaching more than US\$1.5 billion 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 I** in the Annex. The net cost per adult HIV infection averted drops substantially in the longer term from US\$1,619 to US\$650 once the number of adult HIV infections averted increases. The net savings per infection averted far outweigh the net costs, varying from about US\$5,800 in the short term to US\$6,750 over the entire time period 2009–2025.

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, even if all other prevention interventions are scaled up to reach 80 percent coverage by 2015 with maximum impact, 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 85,000 in 2025 to a level of about 63,000 in 2025. 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 Mozambique.

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



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. Demographic and Health Survey for Mozambique, 2003.
3. Demographic Impact of HIV/AIDS in Mozambique, 2008.
4. UNAIDS Epidemiological Fact Sheet on Mozambique, 2008 Update, available at: http://www.who.int/globalatlas/predefinedReports/EFS2008/full/EFS2008_MZ.pdf.
5. Male Circumcision: Decision Makers' Program Planning Tool. Model and manual are available at: <http://www.malecircumcision.org>.
6. UNAIDS informational website on medical MC, available at: <http://www.malecircumcision.org>.
7. UNAIDS/WHO/SACEMA Expert Group on Modelling the Impact and Cost of Male Circumcision for HIV Prevention. 2009. Male circumcision for HIV prevention in high HIV prevalence settings: What can mathematical modelling contribute to informed decision making? *PLoS Medicine*. 6(9):e1000109, September 2009.
8. World Development Indicators database, various years.

Annex. Results Summary and Methodology

Table I. 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) | 157 | 202 | 443 | 821 | 678 | 528 | 498 | 495 | 495 | 496 | 497 | 497 | 498 | 499 | 500 | 500 | 493 |
| Infections averted (thousands) | 0.0 | 0.3 | 2 | 6 | 11 | 15 | 17 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 33 | 34 |
| Cumulative number of infections averted since 2009 (thousands) | 0.0 | 0.3 | 2 | 8 | 19 | 34 | 50 | 69 | 89 | 111 | 135 | 161 | 189 | 219 | 251 | 284 | 319 |
| Cost savings (millions US\$) | -0.6 | 0 | 2 | 19 | 59 | 82 | 93 | 101 | 109 | 117 | 124 | 131 | 137 | 143 | 148 | 152 | 151 |
| Cumulative cost savings since 2009 (millions US\$) | -0.6 | -1 | 1 | 20 | 78 | 161 | 254 | 355 | 464 | 581 | 705 | 836 | 974 | 1,117 | 1,264 | 1,416 | 1,568 |

Table 2. Key Data Assumptions

| Indicator | Value | Source |
|--|--------------------|--|
| Male circumcision prevalence | 59.5% | 2003 Mozambique DHS |
| HIV prevalence – 2007 | 18.1% | 2008 Mozambique Demographic Impact Study |
| 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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