

# Voluntary Medical Male Circumcision Modeling Meeting Report

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# Executive Summary

On March 18, 2014 the Bill & Melinda Gates Foundation (BMGF) and the U.S. President's Emergency Plan for AIDS Relief (PEPFAR) convened a one-day meeting in Johannesburg, South Africa, to introduce the new Voluntary Medical Male Circumcision (VMMC) modeling that could allow geographic and age prioritization of sub-populations. The event provided an opportunity to share preliminary results from applying these new modeling approaches in six countries. The meeting objectives were to:

1. Share and discuss the methodologies, applications and limitations from new modeling approaches on the epidemiological and economic impact of prioritizing sub-populations
2. Share and discuss the results and experiences on how the new modeling results are being used by policy and decision makers from select countries
3. Discuss implications of the new modeling results on demand creation and service delivery
4. Share new modeling tools (ASM and

DMPPT 2.0) that are available for countries to help prioritize and cost their scale up efforts

5. Provide an opportunity for countries to request technical assistance to utilize the new modeling tools in country, and
6. Inform policy and decisions related to prioritizing and costing VMMC scale up efforts.

## BACKGROUND

The Decision Makers' Program Planning Tool (DMPPT) was developed in 2007 to model the impact of VMMC on HIV incidence and the cost of expanding male circumcision for HIV prevention in Southern and Eastern Africa. Results from this model suggest that scaling up VMMC to reach 80% of men ages 15-49 years in 14 priority countries by 2015 and maintaining 80% coverage through 2025 would avert 3.36 million new HIV infections and result in a net reduction in care and treatment costs of US \$16.51 billion.<sup>1,2</sup>

Since 2009, VMMC programs have been

launched and are moving to scale in the 14 priority countries in Eastern and Southern Africa. The annual number of males circumcised has continually increased from 20,000 in 2008 to 2.8 million in 2012/2013.<sup>3</sup> An estimated six million circumcisions were performed among men of all ages by end of 2013<sup>3</sup>; 4.7 million of these were supported by PEPFAR.

As programs continue, more data and practical experience is generated, allowing exploration and consideration of the most efficient and effective approaches. Given the highly ambitious target of circumcising 80% of males between the ages 15-49, an important question in most countries is whether or not prioritizing scale up efforts (such as demand generation activities and supply models) among sub-population(s) of the current target (80% of men 15-49 years old) would maximize infections averted while focusing efforts and using resources more efficiently. The relatively small number of circumcisions among men 25 years and older also begs the question of what level of effort should be made

to increase uptake among them, particularly if fewer HIV infections are averted by circumcising men in this age category. Finally, as the VMMC community progresses toward the sustainability phase of VMMC, it is important to further ascertain the benefits and cost of circumcising younger adolescents along with the entire adolescent age group and infants during their first two months of life.

### NEW MODELING TOOLS

In 2013, PEPFAR through the USAID Health Policy Project, BMGF, and the World Bank supported the creation of new modeling tools to answer questions that cannot be answered by the DMPPT. These models are available to help individual country VMMC programs project public health and economic benefits of VMMC scale-up across a variety of ages and geographic locations.

The three new models and modeling approaches are the Male Circumcision Decision Maker's Program Planning Tool version 2.0 (DMPPT 2.0) developed by PEPFAR through the USAID Health Policy Project, the Age-Structured Model (ASM) funded and developed by BMGF and its partner Weill Medical College of Cornell University, and a modeling tool that the World Bank developed and applied to VMMC programs in South Africa to examine cost-effectiveness of VMMC and long-term fiscal space savings<sup>4</sup> as a result of investing in VMMC in the short-term. This model introduced the analysis of VMMC effects by age at circumcision.

Both DMPPT 2.0 and ASM models project public health and economic benefits of VMMC scale up focused on specific age groups and geographic locations. The ASM model can also examine the impact of focusing VMMC on specific behavioral risk

groups. Specific outcome estimates include: the number of circumcisions needed to prevent one HIV infection; the magnitude of HIV incidence reductions in men and women; the rate at which HIV incidence is reduced in men and women; cost effectiveness; and total costs. DMPPT 2.0 also projects net savings (e.g., in treatment costs due to improved HIV prevention outcomes) of the VMMC program.

Because the ASM model is more complex, it can also answer additional questions such as the impact of changing age of sexual debut or numbers of partners, or circumcising proportionally fewer HIV-positive clients.

It is important to note that modeling tools do not take into account programmatic feasibility considerations and therefore should be interpreted with programmatic elements in mind when used to consider shifts in strategy.

### COUNTRY LEVEL MODELING

DMPPT 2.0 and ASM models were applied and validated using data from Zambia and Zimbabwe and they produced similar results with respect to age targeting. They were also reviewed and validated by key stakeholders, external experts and modelers. DMPPT 2.0 is a simple spreadsheet model that can be taken to the country level as a tool to assist with target setting and resource planning. ASM is a more complex and comprehensive model that can assist in target setting and resource planning, and can also address additional questions, but takes longer to apply and requires more data to set up. Both models were applied in Zambia, Zimbabwe and Malawi; DMPPT 2.0 was also applied in Tanzania, South Africa and Swaziland and will be applied in Uganda and Lesotho. The World

Bank modeling approach is based on a fiscal consequences and savings economic tool that the World Bank developed for HIV programs in general. The tool was adjusted and linked to the adapted and expanded Actuarial Society of South Africa (ASSA) tool used in South Africa, and can be customized for other contexts. It is a general tool that can be applied more broadly in any context and can be applied to overall HIV programs, or to calculating the short and long term cost savings from specific HIV programs.

Countries that have used these modeling tools are in the process of reviewing and discussing their age-specific VMMC national targets and in some cases taking into consideration specific regions of the country. Different stakeholders might have different priorities (e.g., magnitude of impact vs. immediacy of impact or cost-effectiveness), so the analysis is not prescriptive in terms of the best sub-populations to target. Each country is considering the model findings in conjunction with considerations of programmatic feasibility and policy issues when choosing specific targets and focus for its national VMMC program.

### PROGRAMMATIC IMPLICATIONS

ASM and DMPPT 2.0 are available for countries that have not yet used them to improve the effectiveness and efficiency of their VMMC programs. Modeling exercises may contribute to formal revisions of national strategies and annual targets. Country programs may also decide to maintain current targets but intensify demand creation for particular sub-populations to maximize epidemiological and economic impacts. Scale-up strategies should be tailored to each country's context, realities, and goals, and should ensure that no eligible adolescent or adult man is denied access to VMMC.





*Emmanuel Njeuhmeli (USAID) presenting at the VMMC Modeling Meeting in Johannesburg, South Africa.*

Focusing on sub-groups will require more segmented demand creation strategies and service delivery models. This means understanding what drives demand among various population segments and developing tailored interventions that speak to each segment’s values, beliefs, lifestyle, and realities. On the supply side, programs will need to offer a broader mix of service delivery models that are convenient for sub-populations.

Programs targeting younger adolescents 10-14 years of age where most of whom are not yet sexually active will need to develop new approaches to VMMC counseling and interpersonal communication. Parents and guardians of young adolescent males will need information and counseling about VMMC; and service providers will need training to provide services and counseling for adolescent VMMC clients as well as older men.

## RECOMMENDATIONS

Participants of the modeling meeting

in Johannesburg recommended the following next steps:

1. Modeling results should be published and disseminated to priority country partners. BMGF, PEPFAR and World Bank are planning to come together to publish the final results in peer-reviewed journals in collaborative way to help countries use targets for decision making.
2. Development partners should communicate at policy and program levels about new results that focus on sub-population targeting.
3. Country programs that have not already applied the new modeling tools may use ASM and/or DMPPT 2.0 to determine possible scenarios for sub-population targeting. Countries can request technical assistance from BMGF or PEPFAR through USAID.
4. Policymakers for country programs will be considering the modeling results and exploring

options in sub-population targeting. Countries also need to consider programmatic feasibility when deciding whether or not to prioritize sub-populations.

5. Demand creation and implementation strategies will need to be adapted for sub-population targeting.
6. Document and improve VMMC data collection and monitoring systems.
7. Further dialogue will be needed at both international and national levels regarding EIMC and the sustainability phase of VMMC programs. (A meeting was organized by UNICEF to discuss EIMC immediately following the VMMC Modeling Meeting in Johannesburg.)<sup>5</sup>
8. When the available incidence data does not allow for sub-regional prioritization, use estimated rural/urban differences in impact and costs of VMMC for prioritization.

9. Improve in-service VMMC communication and counseling for adolescents and make the service more adolescent friendly.
10. Calculate the fiscal space savings incurred as a result of VMMC investments to justify program expenditure for governments.
11. Participants also identified the following questions in need of further evidence:
  - What is known about women's influence on their sexual partners' decisions to circumcise?
  - What is the effect of VMMC on sexual behavior in high risk populations? There are still some concerns about behavioral disinhibition, although several studies have shown no evidence of increased high risk practices following VMMC.
  - Demand creation strategies will need to be assessed after early adopters are saturated. What are the differences between early adopters and non-adopters? How do we use these differences to increase uptake?
  - What are the unit costs for adolescent VMMC and EIMC?
  - What are the health impacts of VMMC other than HIV infections averted (cervical cancer, herpes, sexually transmitted infections, maternal health/mortality, neonatal and infant health) as well as non-medical benefits such as couple communication?
  - What is the impact of the VMMC program on HIV testing and counseling?
  - What are the benefits of couples presenting for VMMC?
  - What motivates men of different age groups to come forward for VMMC?

## List of Abbreviations

<b>AIDS</b>	Acquired Immune Deficiency Syndrome
<b>AIM</b>	AIDS Impact Model
<b>ART</b>	Antiretroviral Therapy
<b>ASSA</b>	Actuarial Society of South Africa
<b>ASM</b>	Age Structured Model
<b>BMGF</b>	Bill & Melinda Gates Foundation
<b>COP</b>	Country Operational Plan
<b>CDC</b>	Centers for Disease Control and Prevention
<b>CSG</b>	Communication Sub-Group (of the VMMC Technical Working Group)
<b>DFID</b>	Department for International Development
<b>DHS</b>	Demographic and Health Surveys
<b>DMPPT</b>	Decision Makers' Program Planning Tool
<b>DOD</b>	Department of Defense
<b>EIMC</b>	Early Infant Male Circumcision
<b>GFATM</b>	Global Fund for AIDS, TB and Malaria
<b>HIV</b>	Human Immunodeficiency Virus
<b>HPP</b>	Health Policy Project
<b>MC</b>	Male Circumcision
<b>MOHSW</b>	Ministry of Health and Social Welfare
<b>OGAC</b>	Office of the Global AIDS Coordinator
<b>PEPFAR</b>	The US President's Fund for AIDS Relief
<b>TB</b>	Tuberculosis
<b>UK</b>	United Kingdom
<b>UN</b>	United Nations
<b>UNAIDS</b>	Joint United Nations Program on HIV/AIDS
<b>UNICEF</b>	United Nations Children's Fund
<b>USAID</b>	United States Agency for International Development
<b>VMMC</b>	Voluntary Medical Male Circumcision
<b>WHO</b>	World Health Organization

# Background

In 2007, the Joint United Nations Program on HIV/AIDS (UNAIDS) and the World Health Organization (WHO) recommended the scale-up of voluntary medical male circumcision (VMMC) as one of the strategies for addressing the HIV epidemic in countries with high prevalence of HIV and low prevalence of male circumcision.<sup>6</sup> Following this recommendation, 14 priority countries in Eastern and Southern Africa are currently scaling up VMMC. These scale-up efforts are supported by the national governments, the U. S. President's Emergency Plan for AIDS Relief (PEPFAR), the Bill & Melinda Gates Foundation (BMGF), the Global Fund for AIDS TB and Malaria (GFATM), the United Kingdom Department for International Development (DFID), World Bank, United Nations (UN) agencies and several implementing partners.

The Decision Makers' Program Planning Tool (DMPPT) was developed in 2007 to model the impact of VMMC on HIV incidence and the cost of expanding male circumcision for HIV prevention in Southern and Eastern Africa.<sup>4,5</sup> Results from this model suggested that scaling up VMMC to reach 80% of men ages 15-49 years in the 14 countries by 2015 and maintaining 80% coverage through 2025 would avert 3.36 million new HIV infections.<sup>7,8</sup>

Such a scale-up would require performing 20.34 million circumcisions between 2011 and 2015. Maintaining 80% coverage thereafter would require

VMMC among an additional 8.42 million men aged 15-49 years between 2016 and 2025.<sup>6</sup>

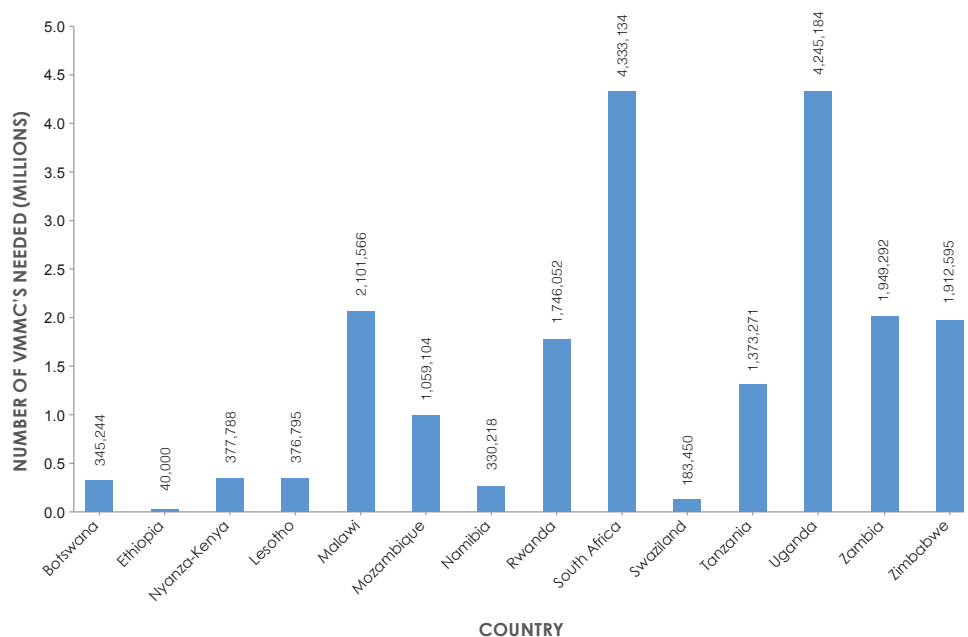
Reaching such numbers would cost a total of US\$2 billion, and would result in net savings of US\$16.51 billion due to averted treatment and care costs between 2011 and 2025.<sup>9</sup>

Between 2009 and 2011, countries used DMPPT to generate data that informed country VMMC strategies and costed implementation plans, many of which aim to achieve 80% coverage among men 15-49 years by 2015.

Since then, VMMC programs have been launched and are in the process of scaling up in the 14 priority countries, and the annual number of men circumcised has continually increased from 20,000 in 2008 to 2.8 million in 2012/2013.<sup>10</sup>

Service statistics from many of the countries show that VMMC program circumcisions are more concentrated among the younger age groups (10-19 year olds) and less so among males older than 25 years. In Zimbabwe and Zambia, the distribution reflects the distribution of this age group in the overall population. However, this is not

DMPPT Estimate of Number of VMMC's Needed per Country to Reach 80% Coverage Among Adults 15-49 Years

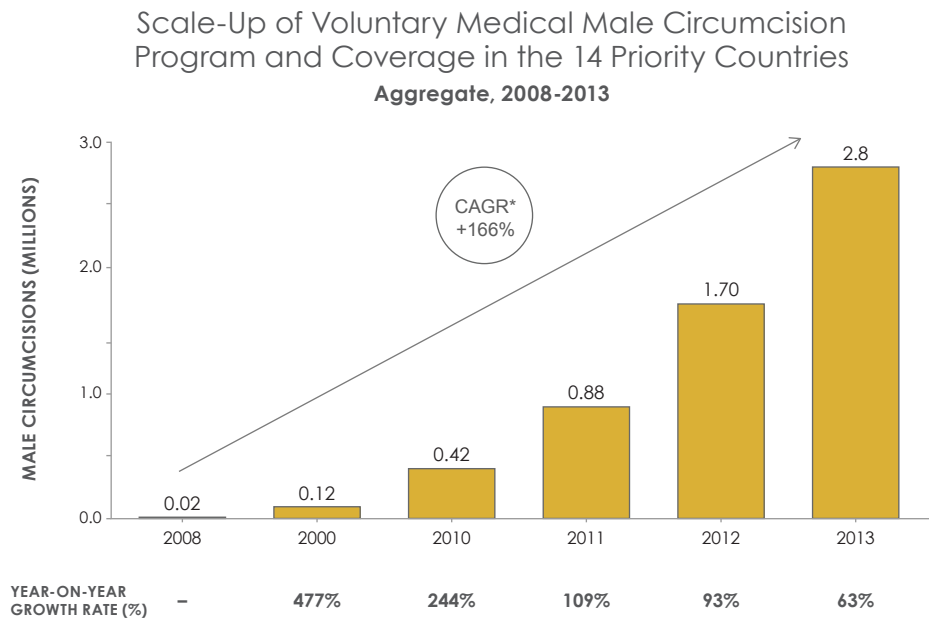




the case in all other countries including South Africa, Malawi and Tanzania where there is disproportionate uptake of VMMC among younger males.

By the end of 2013, approximately 30% of the highly ambitious 20.3 million target had been achieved. As programs mature, more data and practical experience become available. This provides information to explore key questions and consider the most efficient and effective approaches to scale up. One consideration is a better analysis of the effects on HIV incidence and program costs of prioritizing VMMC for sub-groups among the overall 15-49 year olds, as well as the benefits and costs of introducing early infant male circumcision and VMMC for early adolescents 10-14 years of age.

In 2013, PEPFAR through the USAID Health Policy Project, World Bank and BMGF supported the design of three new modeling tools to answer questions that cannot be answered by the DMPPT. Two of these models are available to help

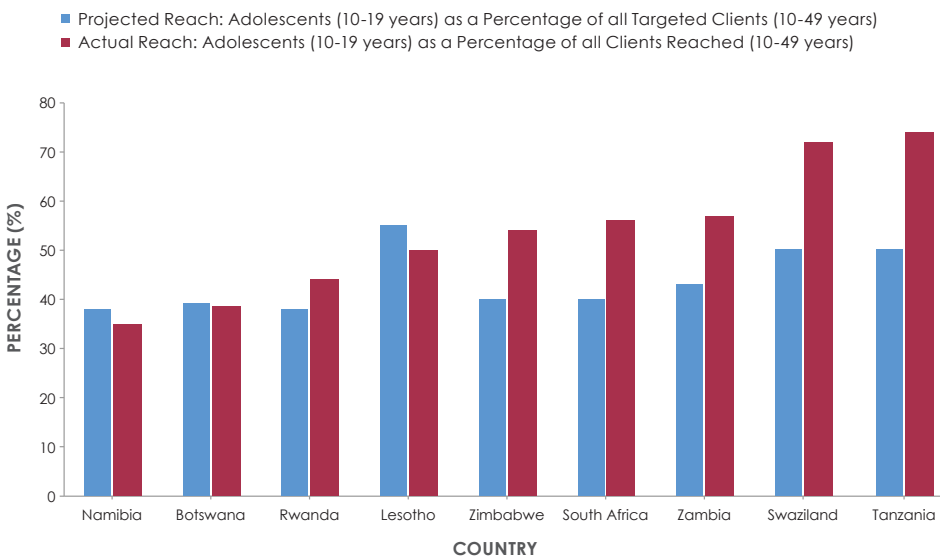


Source of 2008-2012 data is the WHO 2012 VMMC report [38]. 2013 numbers have been estimated using data from PEPFAR and the Bill & Melinda Gates Foundation. \*CAGR, compound annual growth rate, calculated based on the average proportional growth each year.  $CAGR(t_0, t_n) = (V(t_n)/V(t_0))^{1/(t_n - t_0)}$ , where  $V(t_0)$  is the start value and  $V(t_n)$  is the finish value and  $t_n - t_0$  is the number of years. doi:10.1371/journal.pmed.1001641.g002.

individual country VMMC programs become more effective and efficient by projecting public health and economic benefits of VMMC scale-up across a variety of ages and geographic locations.

Several countries including Tanzania, Malawi, Zambia, Zimbabwe, South Africa and Swaziland have used the new modeling tools to examine whether they wish to prioritize certain sub-populations for more focused scale-up efforts, and to calculate the long term fiscal space savings that the country incurs as a result of short term aggressive investments in VMMC.

Adolescents (10-19) represent a large percentage of the population reached (35-72%) and of the existing population (40-62%) of uncircumcised men (10-49).



Graph reference: Njeuhmeli E, Hatzold K, Gold E, et al, Lessons learned from scale up of Voluntary Medical Male Circumcision Focusing on Adolescents: Benefits, Challenges, and Potential Opportunities for Linkages with Adolescent HIV, Sexual and Reproductive Health Services, JAIDS 66: Supplement 2, July 1 2014.

On 18 March 2014, BMGF and PEPFAR convened a one day Southern and Eastern Africa regional meeting in Johannesburg, South Africa, of key VMMC program decision makers within the 14 national governments, BMGF, OGAC, CDC, USAID, DoD, UNAIDS, WHO, UNICEF, the World Bank, the Global Fund for AIDS TB and Malaria (GFATM), and technical, communication and advocacy experts to share the new modeling tools that are available for countries to help prioritize and cost their scale up efforts; and to discuss the epidemiological and economic impact of prioritization of sub-populations for VMMC services. This report summarizes the deliberations and recommendations that arose during the meeting.

# New VMMC Modeling Approaches

Modeling can inform programs about the efficiency, cost, magnitude and immediacy of impact associated with prioritization of various age groups and sub-populations. PEPFAR through the USAID Health Policy Project, BMGF, and the World Bank, have supported the development of three new models to estimate the cost, impact and cost-effectiveness of scaling up VMMC and early infant male circumcision (EIMC) at national and sub-national levels. The models also explore alternative strategies: focusing VMMC on different age groups; focusing VMMC on different regions; and rates of scale-up. The three models are:

## AGE STRUCTURED MODEL [ASM]

Age and risk structured mechanistic model of HIV transmission informed by sexual behavior. Prepared by Weill Cornell Medical College in Qatar under funding from the Bill & Melinda Gates Foundation.

## DECISION MAKERS POLICY PLANNING TOOL 2.0 [DMPPT 2.0]

Simple spreadsheet model that uses HIV incidence, population, and mortality projections from the national Spectrum model to estimate HIV incidence by age among circumcised and uncircumcised populations. Prepared by Futures Institute under PEPFAR, through the USAID-funded Health Policy Project.

## THE WORLD BANK MODEL

The model is based on a generic fiscal costs and savings tool that the World Bank has developed. It provides cost-effectiveness data by looking at the long-term effects of VMMC on HIV incidence. It looks at age of circumcision,

the number of infections averted directly and indirectly and the costs of HIV care and treatment over time in South Africa, as well as the cost-savings arising over time thanks to VMMC. Furthermore, it determines how long it takes to recover the costs of VMMC provision (the amortization period). Given that most model outputs are highly sensitive to the age at circumcision, all analyses are conducted by age group.

ASM and DMPPT 2.0 were compared in Zambia and Zimbabwe where they produced similar results with respect to age targeting. They were also reviewed and validated by key stakeholders, external experts and modelers. The World Bank model was applied in South Africa.

## ASM MODEL

This model estimates the impact of male circumcision as an HIV prevention intervention. It stratifies the population according to sex, circumcision status, age groups, sexual risk groups, HIV status and stage of HIV infection. It generates complex simulations that require different types of country data which may include: HIV prevalence time series data (UNAIDS estimates), HIV prevalence by age (from Demographic and Health Surveys (DHS) or sero-behavioral surveys), population size and projections, and behavioral, epidemiological and natural history data. The model accounts for direct benefits of VMMC for males and also the indirect benefits of VMMC such as reducing onward transmission to females. The model can address how countries can develop more strategic programs by prioritizing circumcisions for sub-

populations. Prioritization may include: age, risk profile, and geography. One example of a research question would be the comparison of VMMC impact on urban versus rural areas.

## DECISION MAKERS POLICY PLANNING TOOL 2.0

This model also estimates the impact of VMMC as an HIV prevention intervention. It projects the impact and cost of focusing male circumcision for HIV prevention on specific five-year age bands and sub-national regions. The model requires the following information at country or sub-national level: population by age and sex for each year of the projection, non-AIDS mortality by age and sex for each year, and HIV incidence by age and sex for each year (Spectrum AIM or Goals). It also requires information about baseline prevalence of male circumcision by age, unit costs of VMMC and ART, and historical VMMC program data. DMPPT 2.0 is a simple spreadsheet model that can be taken to the country level as a tool to assist with target setting and resource planning.

ASM and DMPPT 2.0 models have so far been applied in six countries<sup>11</sup> to generate data for decision-making. Countries are reviewing and discussing the results within the context of their current national targets and financial resources to develop revised or new Costed Operational Plans for VMMC. Countries are considering prioritization of certain age groups and geographic areas to maximize impact and efficiencies. Each country is considering the model findings in

conjunction with considerations of programmatic feasibility and policy issues when choosing the specific targets and focus of its national VMMC program. The models reinforce the importance of prioritizing populations for HIV prevention programs according to HIV incidence rather than HIV prevalence.

The age groups that could be prioritized to maximize impact and efficiency vary across countries based on the epidemiology and population dynamics of the country, the baseline rates of male circumcision by age, as well as programmatic and policy considerations. Prioritization implies ensuring that demand creation activities and service delivery models are designed to reach these groups, while adolescent and adult males outside of the priority age ranges who request circumcision will not be refused service.

#### THE WORLD BANK MODEL

The World Bank modeling approach is based on a fiscal consequences and savings economic tool that the World Bank developed for HIV programs in general. It provides cost-effectiveness data by looking at the long term effects of VMMC on HIV incidence. It looks at age of circumcision, the number of infections directly and indirectly averted, and the costs of HIV care and treatment over time. The tool was adjusted and linked to the ASSA tool used in South Africa, and can be customized for other contexts. It is a general tool that can be applied more broadly in any context, and can be applied to overall HIV programs, or to calculating the short and long term cost savings from specific HIV programs.

In this analytic approach, HIV is viewed as a chronic disease that

can take five to eight decades to see the full impact. So, the model provides an incremental analysis of the expected effects and fiscal space savings of one VMMC done in 2013 over the years.

#### LIMITATIONS OF MODELS

All models are estimates and rely very much on the accuracy of data inputted. The key consideration influencing model outputs is the level of certainty around future HIV incidence projections, which can significantly influence modeling results. Sub-national incidence estimates (for specific geographic regions or behavioral risk groups) may have greater levels of uncertainty

**Modeling can inform programs about the efficiency, cost, magnitude and immediacy of impact associated with prioritization of various age groups and sub-populations.**

than national estimates. The smaller the sub-population, the greater the degree of uncertainty that results. Likewise, future HIV incidence projections may change with different scale-up patterns for antiretroviral treatment and other HIV interventions. The farther into the future HIV incidence is projected, the greater the degree of uncertainty that results. It is not possible to precisely quantify the degree of uncertainty of future HIV incidence estimates used in the models, as they inherently depend upon assumptions and unknowns about future events. In addition to incidence, models are populated by other inputs that are subject to uncertainty and assumptions, such as baseline male circumcision prevalence, unit costs, and discount rates.

The model results do not reflect important programmatic considerations and experiences, such as the feasibility of rapid scale-up assumptions (scale-up is, in part, constrained by the demand for the service). Programs should also base decisions on:

- Resources available: human, financial, material.
- Demand creation challenges and service delivery models associated with specific groups.
- Benefits of VMMC services and activities for all ages such as access to testing and counseling and linkages to care and treatment.
- Policy realities such as parental consent or political commitments such as access parity.

The impact of VMMC estimated by two of the models focuses mainly on the direct benefits of VMMC in reducing HIV acquisition. In the World Bank model, the indirect costs of averting new infections amongst females, as well as the male partners of these females, and the indirect effects on vertical transmission, is taken into account in the cost effectiveness calculations. ASM can also estimate the effects of VMMC on cervical cancer incidence and STIs, provided countries have such data. However, DMPPT 2.0 cannot. Participants of the consultative meeting in Johannesburg pointed out that VMMC is associated with more than reduced incidence of HIV. It also may decrease mother-to-child HIV transmission. VMMC can also result in more men testing for HIV and getting linked to care and treatment, thus reducing HIV associated mortality. As currently designed, the models most likely under-estimate the overall impact of VMMC.

# Key Modeling Results and Program Implications from South Africa, Tanzania, Zambia, Zimbabwe, Malawi and Swaziland

The section summarizes key findings and program implications from modeling exercises in six countries where ASM and/or DMPPT 2.0 have been applied: South Africa, Malawi, Swaziland, Tanzania, Zambia, and Zimbabwe. It also reviews program implications of the new models for Uganda, where they have not been applied yet.

## SOUTH AFRICA

South Africa has set the target of circumcising 4.3 million men by 2015. Between 2010 and 2013, 1.3 million male circumcisions were performed,

which is approximately 30% of its target. Adolescents 10-19 years of age represent 59% of VMMC clients.

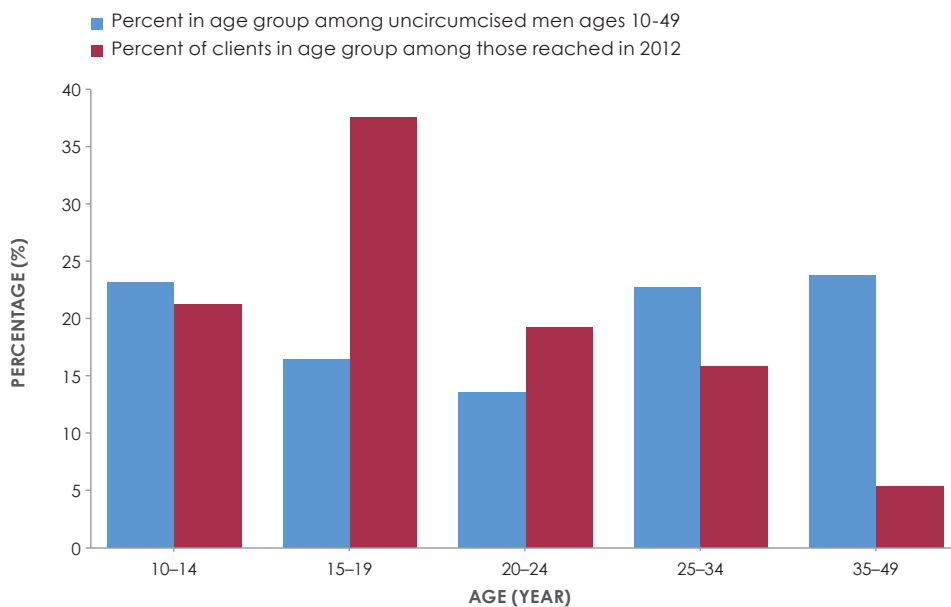
DMPPT 2.0 was applied in South Africa with the following key results:

- The highest magnitude in incidence reductions in HIV incidence over the long term are achieved by circumcising the 10-19 year age group.
- The most immediate impact on HIV incidence can be achieved by targeting men ages 20-34 years.
- The cost per HIV infection averted is

the lowest when targeting the 25-29 year age group; it is 67% of the cost per infection averted when targeting the 10-49 year age group. This corresponds with the age group where HIV incidence is highest in South Africa.

- Targeting the 15-34 year age group in South Africa would achieve 80% of the potential maximum impact, with 56% of the male circumcisions and 61% of the total cost.
- If the cost of VMMC increases substantially with the age of the client, the most cost-effective age range changes to 15-29, but the 15-34 age group is still more cost-effective than focusing on the entire 10-49 year age group. In this scenario there are also increased cost efficiencies by focusing on the 10-29 and 10-34 year age groups. Since the cost of VMMC by the age of the client is currently unknown, it would be helpful to gather information about this.
- The VMMC program is cost saving compared with HIV treatment costs averted in all provinces in South Africa.

Age Group Distribution Among Uncircumcised Men and VMMC Clients in South Africa



VMMC client data are from PEPFAR reporting data 2010-2014. Age distribution of uncircumcised men is from the DMPPT 2.0 model.

When the World Bank modeling approach was applied in South Africa, the model estimated that VMMC done between birth and 20 years has the greatest impact on HIV incidence, and produces the largest cost savings. The cost-effectiveness of VMMC drops off sharply after the age of 30 using this model. Fiscal space savings combine

Summary of Results  
(Based on One Male Circumcision performed in South Africa in 2013)

Age at MC	Impact on HIV Incidence		MCs per HIV infection averted	Cost of MC per HIV infection averted (US \$)	Net savings from one MC (US \$, at 3% discount)	A mortization period (years at 3 % discount)
	Total	Direct				
0	0.24	0.08	4.2	127	1,328	27.4
10	0.23	0.08	4.3	410	1,518	23.1
15	0.22	0.09	4.6	435	1,576	15.2
20	0.23	0.09	4.4	418	1,808	10.1
25	0.16	0.08	6.3	598	1,193	9.3
30	0.08	0.06	12.6	1,198	461	12.9
35	0.04	0.03	25.1	2,388	149	18.7
40	0.02	0.02	46.2	4,393	24	28.4
45	0.01	0.01	72.7	6,911	-28	N/A
50	0.01	0.01	113.3	10,759	-56	N/A
55	0.00	0.00	214.2	20,345	-77	N/A

Source: Haacker, Gorgens, Fraser-Hurt, and Obst, Effectiveness and Cost-Effectiveness of Male Circumcision as an HIV Prevention Intervention in South Africa, 2014.

savings from averting and delaying infections.

As can be seen from Table 2, each circumcision of a male 0-40 years of age eventually results in financial savings. As these savings are spread over many decades, it is possible to estimate the amortization period of investments in male circumcision at various ages. The amortization period is the time it takes to recover the costs of a male circumcision through savings from the reduced demand for HIV/AIDS services. As can be seen from Table 2, the amortization period is lowest, at 9 years, for male circumcisions occurring at age 25. Although the impact on HIV incidence is higher for circumcisions among younger men, the amortization period is longer. This is because the effects of circumcision in terms of infections averted are realized more quickly for

a 25 year old compared to a younger male. The amortization period is longer for an older man because the impact on HIV incidence is much less compared to a 25-year-old man. While these estimates are for South Africa, it is likely results would be similar for other countries in sub-Saharan Africa.

South Africa plans to adopt a range of different age targets across provinces, based on HIV incidence. It plans to follow a three-step process: 1) better understand the HIV epidemic across its nine provinces, 2) recommend age targeting strategies to focus demand creation efforts in each province, and 3) seek input from provinces and modify recommended age targeting strategies accordingly.

#### MALAWI

In 2011, Malawi initiated a VMMC

program targeting 2.1 million circumcisions among men 15-49 years old to prevent 265,000 new infections between 2011 and 2015. Malawi is far from meeting its targets of 439,878 VMMCs per year.

In 2013, with support from PEPFAR, the DMPPT 2.0 was applied in Malawi, with the following results:

- Priority age groups for male circumcision in Malawi are 10-19 year olds for long-term magnitude of impact; and 20-29 year olds for immediacy of impact on reducing HIV incidence, and 15-34 year olds for the lowest cost per HIV infection averted.
- The infections averted in Malawi when targeting the 10-34 year age group are 87% of the infections averted when targeting the 15-49 year age group. Likewise the 10-29 year age group averts 75% of the



infections averted when targeting the 15-49 year age group. This is important to note as older men are harder to recruit into VMMC services.

- There is broad variation in the cost per infection averted across the five zones of Malawi, with the lowest cost per infection averted in the South Western and South Eastern zones. This is a result of variation in the incidence projections across zones.
- The cost per infection averted is three-fold lower in urban areas compared with rural areas, suggesting that key cities such as Lilongwe should continue to be prioritized even though they are located in zones with higher overall cost per infection averted.
- In Malawi, the VMMC program is still cost saving when ART is scaled up to 80% among all adults with CD4 counts below 500.
- The VMMC Technical Working Group discussed these findings in February 2014 and decided to incorporate the following revised targets into its VMMC Strategy and Operational Plan:
  - Priority target age will be 10-34 years.
  - The Southern Zones and urban areas will be a priority for VMMC scale up.

### SWAZILAND

Swaziland began its male circumcision program in 2008, and currently plans to circumcise 70% of men and 50% of infants by 2018. To date, Swaziland has circumcised 58,000 men. Approximately 44% have been 10-18 year olds.

In 2013, the DMPPT 2.0 was applied in Swaziland with these results:

- The greatest long-term magnitude of impact will be obtained by targeting 10-24 year olds for VMMC.
- The highest magnitude of impact on reducing HIV incidence will result from targeting 20-29 year olds.

- The cost per HIV infection averted will be lowest if 15-29 year olds are targeted.
- Targeting the 10-34 age group in Swaziland would result in 96% of the potential maximum impact, with 87% of the male circumcisions and 90% of the total cost.

The modeling results were presented to the VMMC Technical Working Group in February, 2014 and subsequently revised after incorporating data from the Swaziland HIV Incidence Measurement Survey. Swaziland would like to use modeling results at the decentralized level to increase understanding of VMMC impact and generate local ownership for targeting and programming.

### TANZANIA

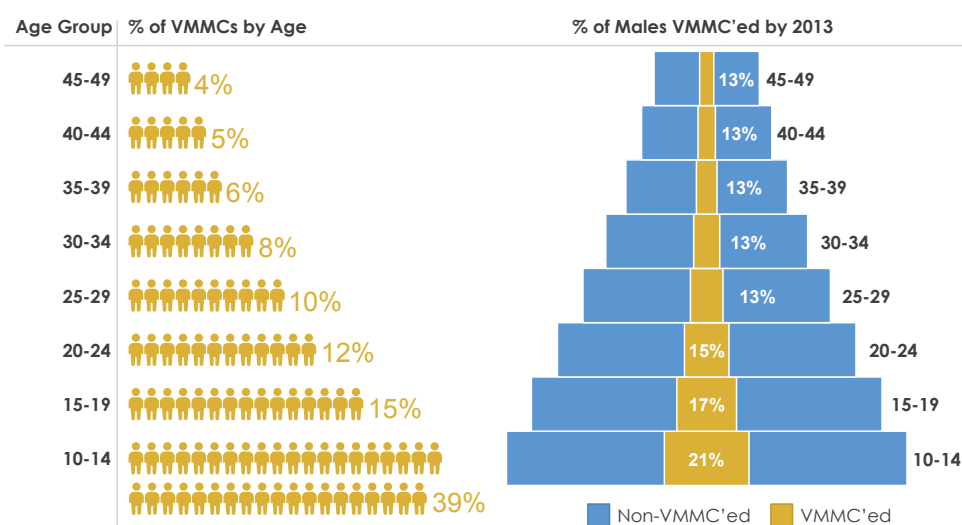
In 2010, Tanzania launched its National Strategy for Male Circumcision for HIV Prevention, with a target of circumcising 2.8 million men 10-34 years of age in five years in 11 priority regions and one district. As of March, 2014, the Tanzania program had circumcised 900,439 men, 81% of whom are between 10 and 19 years of age.

In mid-2013, Tanzania designed a new five-year country operational plan (COP). The COP exercise coincided with DMPPT 2.0 modeling technical assistance. The DMPPT 2.0 modeling was very important to Tanzania because it showed a wide variation in the cost-effectiveness of VMMC across priority regions in Tanzania. This is largely a function of HIV incidence differences across the regions, indicating that some review of prioritization of resources may be needed. The DMPPT 2.0 modeling exercise concluded that Tanzania has been scaling up at a pace in the 11 priority regions such that, if sustained, it will reach the 80% target over the next five years. MOHSW believes that focus on the 11 priority regions and one district should remain unchanged for now.

The modeling exercise also provided the following information regarding age targeting:

- Long-term magnitude of impact on HIV infections averted will be highest by targeting the 10-19 year olds.
- Immediacy of impact on reducing HIV incidence will be highest by targeting 15-29 year olds.

The Current Age Distribution of VMMCs in Zambia  
2010-2013 Program Effort



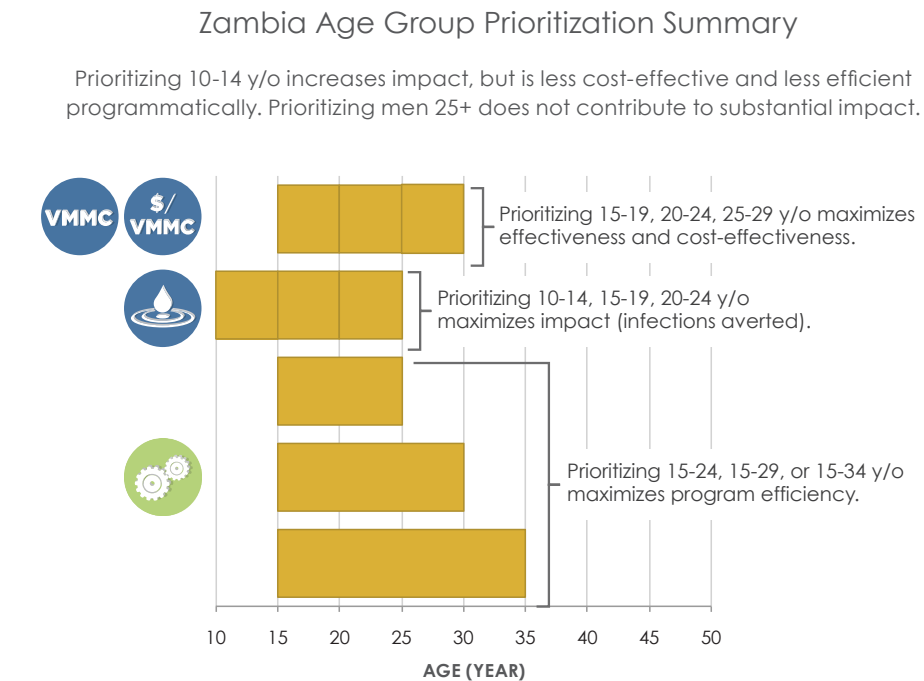
- The cost per HIV infection averted will be lowest by targeting 15-29 year olds.
- Reductions in HIV incidence achieved from VMMC scale-up among males older than 29 years are modest compared to younger males; dedicating large amounts of additional resources/efforts on recruiting men older than 29 years to the VMMC program in Tanzania may not be warranted.

These findings alleviated pressure to focus on “resistant” older men, and allowed implementation to emphasize increasing coverage of younger men, where there is demand for VMMC. This has led to a re-examination of issues related to serving young adolescents such as age of consent, who can consent, and the appropriateness of VMMC counseling materials for young adolescents. It also highlighted the need to develop a long-term sustainability plan after “scale-up” phase targets are met, as hundreds of thousands of Tanzanians will be turning ten each year. This is being more vigorously incorporated into the new COP.

The use of incidence data rather than prevalence data during the modeling process made participants question some long-held beliefs about the Tanzanian epidemic. PEPFAR/Tanzania is now considering ways to use incidence data for decision-making for other HIV programming beyond VMMC. The modeling exercise also raised questions about the financial and programmatic value of introducing early infant male circumcision (EIMC).

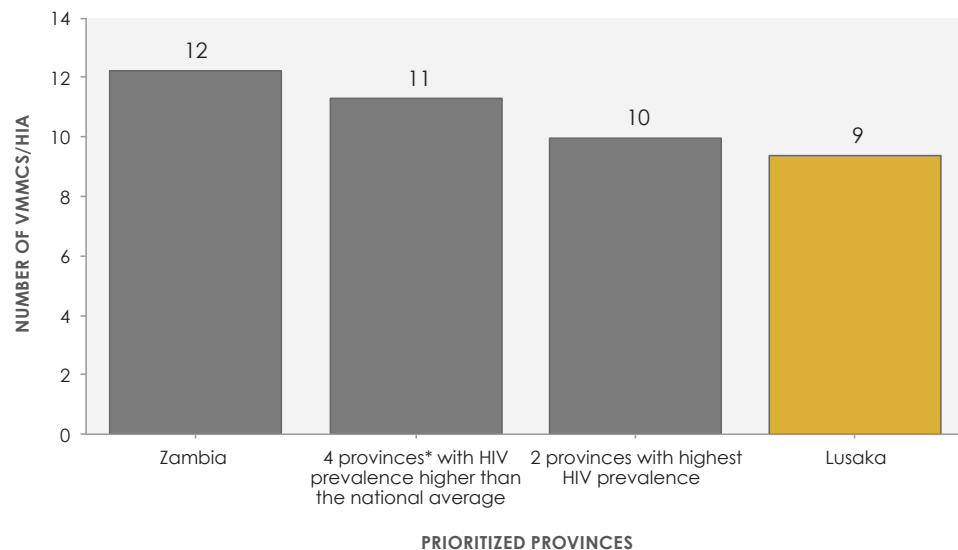
### ZAMBIA

In 2007, Zambia set the ambitious target of reaching 80% adult coverage by 2015, aiming to provide 1.949 million circumcisions among men 15-49 years of age by 2015. As of the end of 2013, 636,347 men had been circumcised, of which 383,456 (60%) were 15-49 years old. The remaining 40% were 10-14 years



### Geographical Prioritization Highest Effectiveness in Prioritizing Lusaka

Achieving 80% coverage by 2017



\*Central, Copperbelt, Lusaka, and Western

old. As shown in the figure below, the age distribution of VMMC uptake is largely influenced by the country’s population pyramid (i.e., there are more 10-19 year olds in the population than 40+ year olds). Although 39% of circumcised men are young adolescents of 10-14 years of age, they represent 21% of the population

of 10-14 year olds in Zambia. Similarly, 15% of circumcised men are 15-19 year olds; representing 17% of all 15-19 year olds. In fact, older men, 40-44 and 45-49 year olds, make up only 5% and 4% respectively of circumcised men; yet they represent 13% of the population in their respective age groups. Hence, the age

distribution of VMMC uptake reflects the age distribution of the population pyramid. These results have important implications on demand generation, service delivery and communication.

The ASM model was applied to Zambia with the following key findings:

- For maximizing effectiveness and cost-effectiveness, 15-19, 20-24, and

25-29 year olds should be prioritized.

- In terms of HIV infections averted, prioritizing 10-14, 15-19, and 20-24 year olds would have the greatest impact.
- Taking into account both of the above, prioritizing 10-14 year olds increases impact but is less cost-effective; while prioritizing those older than 25 may be more effective and cost-effective.

- To maximize program efficiency (where we maximize gain in terms of infections averted but minimize input in terms of total circumcisions and resources) or total policy impact (where it is both total cost-favorable and cost-effectiveness favorable), 15-24, 15-29 or 15-34 year olds may be most advantageous for prioritization.

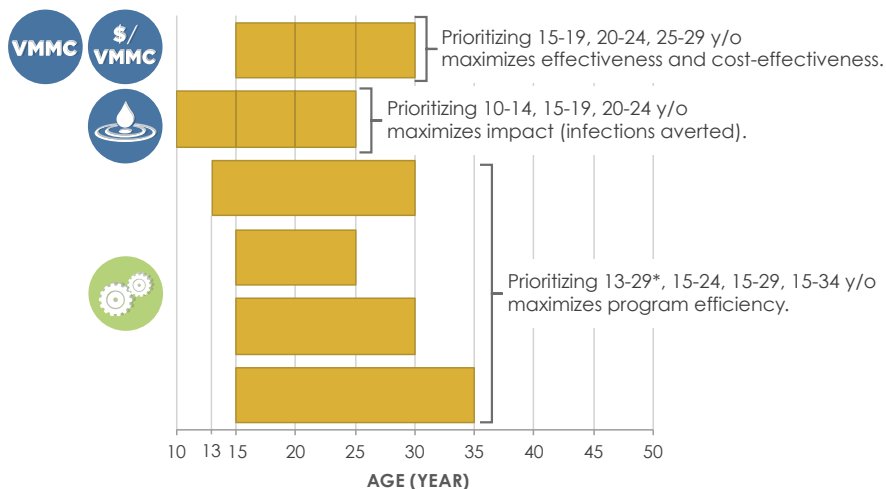
Again, program experience and feasibility are also important considerations.

Focusing VMMC for men in Lusaka and the two provinces with the highest HIV prevalence will result in the highest number of infections averted per circumcision.

The Zambian government shared the modeling results with stakeholders and is now reviewing its national program focus to ensure goals are more attainable, efficient and impactful. Zambia is considering increasing uptake among young men (15-29 years) during its “scale up” phase by focusing on demand creation strategies that appeal to that age group, while continuing to provide VMMC services for men of all ages. Realizing that young adolescents (10-14 years) currently constitute 39% of VMMC clients, and will become part of the adult population as the years pass, they would like to track the impact on HIV incidence of VMMC uptake among this age group.

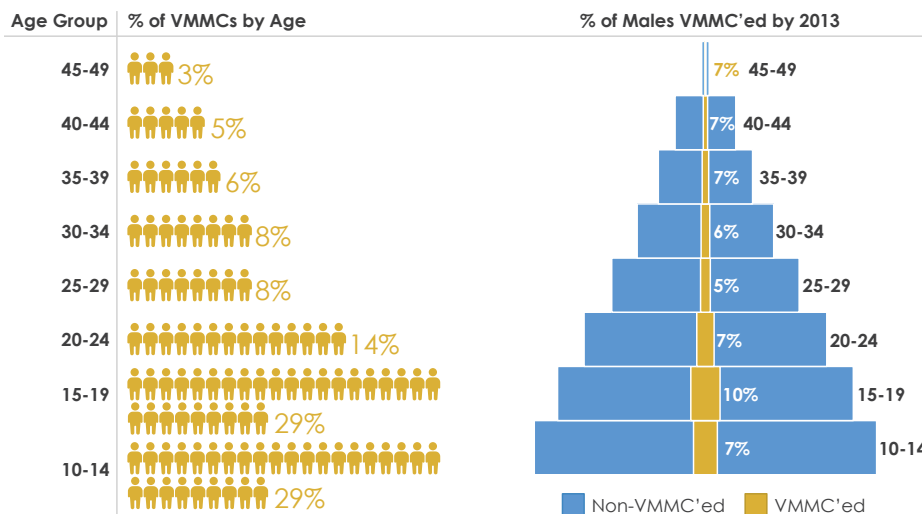
### Zimbabwe Age Group Prioritization Summary

Prioritizing 10-14 y/o increases impact, but is less cost-effective and less efficient programmatically. Prioritizing men 25+ does not contribute to substantial impact.



\*Used programmatic data for age distribution of MCs performed up to 2013 – i.e., 13-14 y/o at 28%, 15-29 y/o at 72%.

### The Current Age Distribution of VMMCs in Zimbabwe 2010-2013 Program Effort



### ZIMBABWE

As of the end of 2013, a total of 204,310 adolescent and adult men 13-29 years old had been circumcised against a target of 1.3 million men in that age group by the year 2017. Similar to Zambia, the proportion of 10-14 year olds who have been circumcised between 2010 and 2013 represents a large portion (29%) of VMMC uptake. However, putting this age group in the perspective of the population pyramid, 10-14 year olds who have circumcised make up only 7% of all boys in the age group. For 15-19 year olds, the proportion of VMMC uptake is

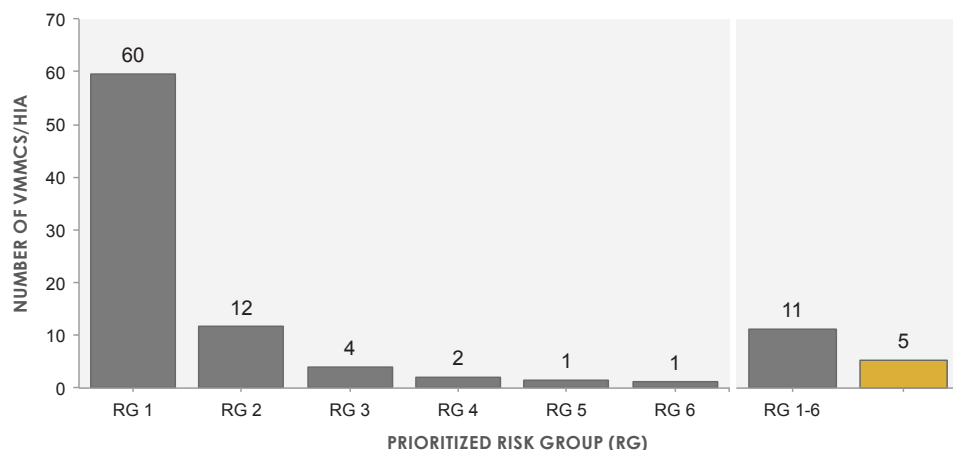
29% but this represents 10% of males in that age group. Similar results are also shown for older men.

ASM findings are summarized here:

- Prioritizing VMMC among 10-14, 15-19, 20-24 year olds would have the greatest impact on HIV infections averted.
- Prioritizing VMMC among 15-19, 20-24, and 25-29 year olds would maximize effectiveness and cost effectiveness.
- Taking into the account both of the above, prioritizing VMMC for 10-14 year olds increases impact but is less cost-effective; while prioritizing VMMC for those older than 25 may be more effective and cost-effective, impact on incidence reduction is not substantial.
- In order to maximize program efficiency (where we maximize gain in terms of infections averted but minimize input in terms of total circumcisions and resources) or total policy impact (where it is both total cost-favorable and cost-effectiveness favorable), prioritizing VMMC for 15-24, 15-29, or 15-34 year olds would be most efficient.
- Focusing VMMC for men at higher risk of HIV (e.g., those with more than one sexual partner) will decrease the number of circumcisions needed to avert one new infection. However, the programmatic feasibility of this type of prioritization is questionable.

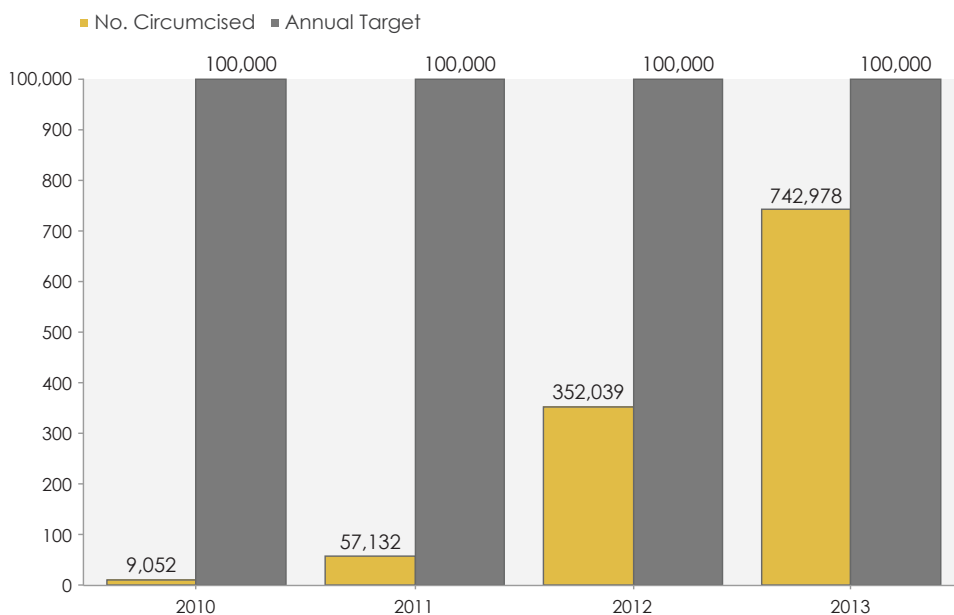
Modeling results above show that targeting 15-24, 15-29 or 15-34 year olds for VMMC in Zimbabwe will be most cost efficient and most impactful. Zimbabwe currently targets 13-29 year olds for VMMC, and has revised its target to reach 1.3 million men by 2017 instead of 2015. The country does not intend to revise its age prioritization targets, but will use the modeling results to validate impact and enhance program understanding.

### Risk Group Prioritization (Zimbabwe) Shows Prioritizing High Risk Groups More Effective Zimbabwe achieving 80% coverage by 2017 with projection to 2025



### Uganda's VMMC Program from 2010-2013

A five year target of circumcising 4.2 million men 15-49 years old by 2016. To date, 1.4 million VMMCs have been performed.



#### UGANDA

Uganda's VMMC program began in 2010 with a five year target of circumcising 4.2 million men 15-49 years old by 2016. To date, 1.4 million VMMCs have been performed. Program data shows that 80% of VMMC clients are 15-24 years old.

Uganda has not benefited from the new modeling tools, but would like to use both ASM and DMPPT 2.0 to learn the projected impact of its current program as well as the cost implications and impact of circumcising 10-14 year old boys as compared to other age groups.

# Early Infant Male Circumcision (EIMC) Modeling Analysis

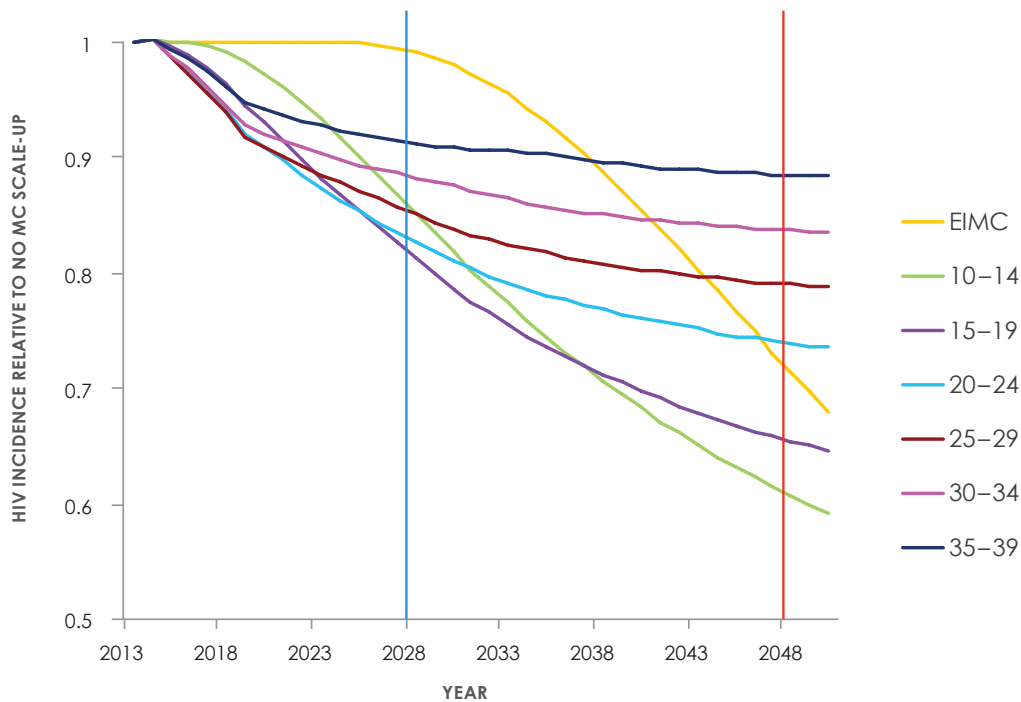
Separate modeling is underway to examine the long-term benefits of EIMC—circumcising male infants during the first 60 days of life. The HIV risk reduction benefits of EIMC are not realized until a male’s sexual debut, generally 15-20 years after EIMC. Though EIMC HIV risk reduction benefits are slow to accumulate compared to those of VMMC for adolescents and adult men, the addition of EIMC modeling data illustrates a set of implementation scenarios to help inform decision-making.

In the graph below obtained using the DMPPT 2.0 by USAID Health Policy Project; each line represents a circumcision strategy targeting only that age group. The age group listed in the legend represents only those who are getting circumcised. The reductions in incidence are for the entire population, not just for that age group. The model is tracking the males who are circumcised as they age over time. Each line represents a comparison of incidence reduction of the scale-up strategy depicted versus no scale-up.

As shown, the impact of circumcising infants (yellow EIMC line) is delayed compared with circumcising adults and adolescents. It takes a long time for the impact of circumcising infants to catch up with the impact of circumcising older age groups. Eventually, if projected out long enough, the yellow line will cross the green line at the bottom and end up with about the same overall impact as circumcising 10-14 year olds, or a slightly greater impact.

The USAID Health Policy Project (HPP)

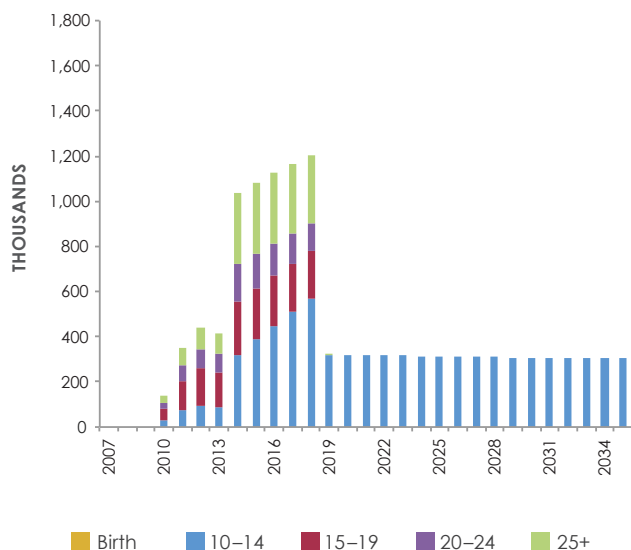
Age Group Distribution Among Uncircumcised Men and VMMC Clients in South Africa





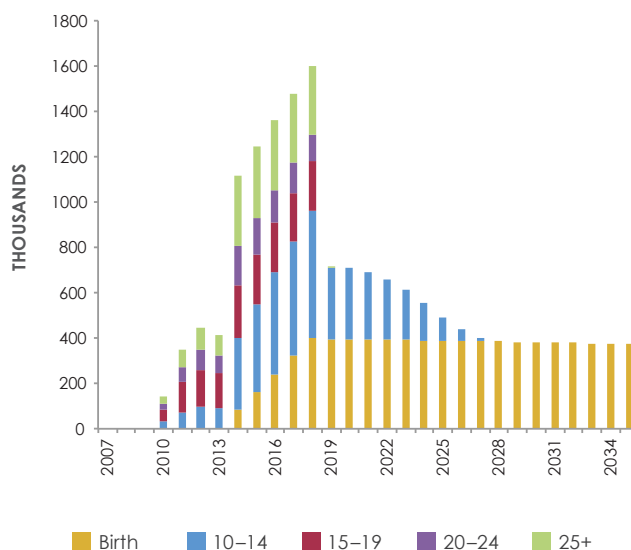
## Two Scenarios: South Africa

### Number of VMMC by Age



Scale up to 80% coverage  
among 10–34 year-olds

### Number of VMMC by Age



Scale up to 80% coverage  
among 10–34 year-olds + 80% EIMC

used DMPPT 2.0 to model two scenarios in South Africa, Malawi and Swaziland: 1) scaling up VMMC among 10-34 year olds to 80% coverage between 2013 and 2018 and maintaining that coverage until 2050; and 2) scaling up VMMC among 10-34 year olds and neonates to 80% coverage between 2013 and 2018 and maintaining that coverage until 2050. The inclusion of EIMC during the scale-up phase would result in the need to circumcise fewer 10-14 year olds during the maintenance phase, and would mean that by 2027, South Africa would only need to provide EIMC to maintain 80% coverage. This scenario would result in a 3% increase in the number of infections averted between 2013 and 2050, 29% increase in the number of MCs required and generate a cost savings estimated at 9%. HPP also found no substantial reduction in impact

on infections averted from delaying introduction of EIMC until 80% of men 10-34 years were circumcised. Similar trends were observed for Malawi and Swaziland.

The cost-effectiveness of EIMC is difficult to estimate, as there is very little information on the cost of EIMC. Assuming that EIMC costs about 50% of the cost of adult VMMC and a discount rate of 3%, the lifetime cost-effectiveness is equal to adult VMMC for countries with very low baseline prevalence of MC. If it is possible to reach higher coverage with EIMC compared with adolescent VMMC, EIMC would be more cost-effective than adolescent VMMC. The cost effectiveness of EIMC introduction will be highly sensitive to demand, which relies on changes in social norms. As more adolescents and adult men are circumcised, parents may be more

likely to adopt infant circumcision for their sons in the future.

In conclusion, the introduction of EIMC during scale-up now or in the future will determine the age of MC clients necessary for sustaining the program in the long term. If EIMC is not introduced, then the long term program will focus on VMMC for 10-14 year olds. If EIMC is introduced, the long term program will focus on EIMC or a combination of EIMC and VMMC. Delaying or slowing the introduction of EIMC only expands the duration of the adolescent VMMC program, but does not substantially change the impact of the overall program. The cost-effectiveness of EIMC is improved if the cost of EIMC is substantially lower than the cost of adult/adolescent VMMC, and if it is possible to reach higher coverage with EIMC compared to VMMC.

# Programmatic Implications of the New VMMC Modeling Tools

The ASM and DMPPT 2.0 modeling tools provide an opportunity for more strategic programming, focusing on efficient use of limited resources. They enable country programs to focus VMMC demand creation strategies and service availability to reach populations that stand to generate the greatest public health benefits. Modeling exercises may result in formal revisions of national strategies and annual targets. Country programs may also decide to maintain current targets but intensify demand creation for particular sub-populations to maximize epidemiological and economic impacts. Scale-up strategies should be tailored to each country's context, realities, and goals. Country programs that have not yet applied the modeling tools (Uganda, Botswana, Lesotho, Mozambique, Namibia, Rwanda) can request technical assistance from PEPFAR through USAID and BMGF to do so.

For all sexually active males, VMMC provides biological protection against HIV acquisition and reduces infection risk by 60%. All sexually active males and parents or guardians of boys should be aware of the HIV prevention benefits of VMMC, even those at a relatively lower risk of HIV infection. It is likely that as more men become circumcised, social norms will gradually shift to a stronger preference for circumcision including infant circumcision. Communication should continue to emphasize that VMMC is a healthy option for all men, not just some, and no eligible adolescent or adult male should be denied access to VMMC.

## DEMAND CREATION AND SERVICE DELIVERY

Most country VMMC demand creation strategies have not been designed to attract males of particular ages or risk groups. However, if programs want to attract particular sub-populations to VMMC services, they will need to create segmented demand creation strategies. This means understanding what drives demand among various population segments and developing tailored interventions that speak to each segment's values, beliefs, lifestyle, and realities.

Programs can use this opportunity to continue improving and focusing VMMC demand creation efforts. This can be done by leveraging disciplines other than health, such as behavioral economics, ethnography, psychology, and consumer marketing; by better evaluating demand creation to understand what works and what does not; by using data within programs to better monitor whether communication interventions are generating demand; and by improving coordination among partners and stakeholders to ensure a unified approach.

On the supply side, programs need to explore various service delivery models that are tailored to the needs of sub-populations. Programs may need to offer a broader mix of service types to make them convenient for their clients. Services may be offered on weekends or nights for young adolescents who are going to school, or older men who

are working. Services may need to be provided through mobile clinics that bring services closer to men, through workplace clinics, or at schools.

## SERVICE COMMUNICATION (COUNSELING AND INTERPERSONAL COMMUNICATION)

Most VMMC programs have targeted sexually active males 15-49 years. However, service uptake data shows that in multiple countries (Tanzania, Malawi, Swaziland, etc.), 10-19 year olds comprise the largest percentage of uncircumcised men between 10 and 49 years of age and the largest proportion of VMMC clients in 2012.

There is a need to closely assess the quality and age-appropriateness of counseling and interpersonal communication. For maximum effectiveness, information should be tailored to the needs and realities of specific audience segments. Important considerations when segmenting VMMC clients are their age, marital status and sexual experience or readiness. A key question for VMMC programs to ask is: how well do we meet the needs of boys 10-19 years old who may not yet be sexually active, as well as older married men, and the males who fall in between these extremes?

Programs need to ensure age-appropriate education, counseling and materials during pre-operative education, individual HIV prevention counseling, post-operative counseling, and follow up visit counseling.



*A member of Zambia's Voluntary Medical Male Circumcision (VMMC) program distributes flyers in Kanyama on the outskirts of Lusaka, Zambia on March 30, 2012.*

In addition to content, approaches and materials should be tailored to appeal to particular audience segments, including younger adolescents. The quality of the VMMC experience is critical for client satisfaction and for future demand creation. Programs need to make better use of idle waiting time at facilities to communicate about VMMC through the use of videos, comic strips, or other client-friendly channels. Programs should consider introducing peer-to-peer approaches to counseling, as has been done with adolescent reproductive health services.

Parents and guardians of young adolescents (10-19 years) are another important audience to reach with VMMC information. They need to be educated about VMMC and involved in pre-operative counseling. In South Africa, for example, parents and guardians are involved in school events that include information about

VMMC. Standard procedures for parental consent for VMMC and HIV counseling and testing among minors are also required in many countries. It is also important to ensure parents and guardians receive information about post-operative care.

To support VMMC services, programs will need to improve service provider's knowledge, attitudes and skills to educate and counsel adolescents 10-19 years of age as well as older men. This may require the development of age-specific training materials and job aids.

To learn first-hand about the needs, aspirations, and concerns of adolescents, their parents and guardians, and the service providers who provide VMMC services, PEPFAR through USAID HC3 project has commissioned a multi-country Adolescent VMMC Assessment. The assessment will

inform guidance on VMMC programming for adolescents 10-19 years old. Findings will be shared across priority countries, and will be used to shape the design of adolescent VMMC programs as well as providing tools for ongoing country specific assessment and monitoring. The PEPFAR MC Technical Working Group (TWG) Communication Sub-Group is drafting a VMMC Counseling Guide that will be reviewed by all key VMMC stakeholders, and available for adaptation by country programs.

#### **LONG-TERM FISCAL SPACE SAVINGS BECAUSE OF VMMC PROGRAMS**

Because of the stark protective effect of circumcision and the low cost (once-off procedure with no recurrent cost), male circumcision is an excellent HIV investment in those countries where there is high HIV prevalence and low levels of male circumcision.

# Recommendations and Next Steps



*A circumcision kit at Bophelo Pele Male Circumcision Clinic in Orange Farm.*

Participants of the modeling meeting in Johannesburg recommended the following next steps:

1. Modeling results should be published and disseminated to priority country partners. BMGF, PEPFAR and World Bank are planning to come together to publish the final results in peer-reviewed journals in a collaborative way to help countries use targets for decision making.
2. Development partners should communicate at policy and program levels about new results that focus on sub-population targeting.
3. Country programs that have not already applied the new modeling tools may use ASM and/or DMPPT 2.0 to determine possible scenarios for sub-population targeting. Countries

can request technical assistance from BMGF or PEPFAR through USAID.

4. Policymakers for country programs will be considering the modeling results and exploring options in sub-population targeting, taking into consideration programmatic feasibility.
5. Demand creation and implementation strategies will need to be adapted for sub-population targeting.
6. Document and improve VMMC data collection and monitoring systems.
7. Further dialogue will be needed at both international and national levels regarding EIMC and the sustainability phase of VMMC programs. (A meeting was organized by UNICEF to discuss EIMC immediately following the VMMC Modeling Meeting in Johannesburg.)<sup>12</sup>
8. When the available incidence data does not allow for sub-regional prioritization, use estimated rural/urban differences in impact and costs of VMMC for prioritization.
9. Improve in-service VMMC communication and counseling for adolescents and make the service more adolescent friendly.
10. Calculate the fiscal space savings incurred as a result of VMMC investments to justify program expenditure for governments.

11. Participants also identified the following questions in need of further evidence:

- What is known about women's influence on their sexual partners' decisions to circumcise?
- What is the effect of VMMC on sexual behavior in high risk populations? There are still some concerns about behavioral disinhibition, although several studies have shown no evidence of increased high risk practices following VMMC.
- Demand creation strategies will need to be assessed after early adopters are saturated. What are the differences between early adopters and non-adopters? How do we use these differences to increase uptake?
- What are the unit costs for adolescent VMMC and EIMC?
- What are the health impacts of VMMC other than HIV infections averted (cervical cancer, herpes, sexually transmitted infections, maternal health/mortality, neonatal and infant health) as well as non-medical benefits such as couple communication?
- What is the impact of the VMMC program on HIV testing and counseling?
- What are the benefits of couples presenting for VMMC?
- What motivates men of different age groups to come forward for VMMC?



# Appendix 1: List of Participants

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# Footnotes

- <sup>1</sup> Hankins C, Forsythe S, Njeuhmeli E (2011) Voluntary Medical Male Circumcision: An Introduction to the Cost, Impact, and Challenges of Accelerated Scaling Up. *PLoS Med* 8(11): e1001127. doi:10.1371/journal.pmed.1001127.
- <sup>2</sup> Njeuhmeli E, Forsythe S, Reed J, Opuni M, Bollinger L, et al. (2011) Voluntary Medical Male Circumcision: Modeling the Impact and Cost of Expanding Male Circumcision for HIV Prevention in Eastern and Southern Africa. *PLoS Med* 8(11): e1001132. doi:10.1371/journal.pmed.1001132.
- <sup>3</sup> Sgaier SK, Reed JB, Thomas A, Njeuhmeli E (2014) Achieving the HIV Prevention Impact of Voluntary Medical Male Circumcision: Lessons and Challenges for Managing Programs. *PLoS Med* 11(5): e1001641. doi:10.1371/journal.pmed.1001641.
- <sup>4</sup> Fiscal space is a relatively new term that refers to the flexibility of a government in its spending choices, and, more generally, to the financial well-being of a government. Reference: [http://en.wikipedia.org/wiki/Fiscal\\_space](http://en.wikipedia.org/wiki/Fiscal_space)  
Fiscal space savings, in this case, are equal to the total amount of fiscal resources released in future years as a consequence of reduced need for HIV/AIDS-related services.
- <sup>5</sup> UNICEF, Early Infant Male Circumcision; Report of a Global Partners Meeting, Johannesburg, South Africa, 19-20 March 2014.
- <sup>6</sup> World Health Organisation. WHO/UNAIDS Technical Consultation on Male Circumcision and HIV Prevention: Research Implications for Policy and Programming. 2007, Montreux, Switzerland.
- <sup>7</sup> Hankins C, Forsythe S, Njeuhmeli E (2011) Voluntary Medical Male Circumcision: An Introduction to the Cost, Impact, and Challenges of Accelerated Scaling Up. *PLoS Med* 8(11): e1001127. doi:10.1371/journal.pmed.1001127.
- <sup>8</sup> Njeuhmeli E, Forsythe S, Reed J, Opuni M, Bollinger L, et al. (2011) Voluntary Medical Male Circumcision: Modeling the Impact and Cost of Expanding Male Circumcision for HIV Prevention in Eastern and Southern Africa. *PLoS Med* 8(11): e1001132. doi:10.1371/journal.pmed.1001132.
- <sup>9</sup> Njeuhmeli E, Forsythe S, Reed J, Opuni M, Bollinger L, et al. (2011) Voluntary Medical Male Circumcision: Modeling the Impact and Cost of Expanding Male Circumcision for HIV Prevention in Eastern and Southern Africa. *PLoS Med* 8(11): e1001132. doi:10.1371/journal.pmed.1001132.
- <sup>10</sup> Sgaier SK, Reed JB, Thomas A, Njeuhmeli E (2014) Achieving the HIV Prevention Impact of Voluntary Medical Male Circumcision: Lessons and Challenges for Managing Programs. *PLoS Med* 11(5): e1001641. doi:10.1371/journal.pmed.1001641.
- <sup>11</sup> DMPPT 2.0 has been applied to Zambia, Zimbabwe, Malawi, Tanzania, South Africa, Swaziland and ASM to Zambia, Zimbabwe and Malawi.
- <sup>12</sup> UNICEF, Early Infant Male Circumcision; Report of a Global Partners Meeting, Johannesburg, South Africa, 19-20 March 2014.

