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Costing Male Circumcision in Zambia and Implications for the Cost-effectiveness of Circumcision as an HIV Intervention

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EXECUTIVE SUMMARY

Background

Clinical trials have now confirmed the efficacy of male circumcision (MC) in reducing female-to-male HIV transmission. Some cost data have been reported (ranging between US$25 and US$69), and these cost data also formed the basis of a cost-effectiveness analysis. It is unclear, however, what exactly is included in the costing studies and hence whether these costs are directly comparable. For example, often, indirect costs are not fully reflected; donations (especially clinicians' time) are not costed; and variation by provider type and level of health facility is not considered. It is anticipated that this cost analysis will provide a more detailed examination of the costs of male circumcision and inform a sounder basis for an assessment of the cost-effectiveness of MC and planning for implementation of MC in Zambia. This analysis is part of a larger study titled the "Costing Male Circumcision in Lesotho, Swaziland, and Zambia: Implications for Cost-Effectiveness of Circumcision as an HIV Intervention." The larger study has two major components: (1) costing MC and (2) modeling the impact of MC on the HIV epidemic.

The purpose of this analysis in Zambia was to assess the cost of providing adult MC in resource-constrained settings and to evaluate the implications of scaling up MC for the cost-effectiveness of MC and for the health system (e.g., resource mobilization and health system capacity).

Design/Methodology

Cost Analysis

The cost analysis is further divided into two components: (1) defining the intervention (reviewing existing literature and protocols and conducting key informant interviews with current and potential providers of circumcision); and (2) costing adult male circumcision (collecting direct and indirect cost data—financial, human resources, drugs, supplies, and equipment costs—from providers). An ingredients approach to costing was followed, whereby all the inputs were listed and their contribution to the overall cost was then quantified. Multiple countries and providers (private, government, nongovernmental, missionary) were considered, allowing for standardization, comparison, and validation. The unit costs were adjusted for the probability of and cost associated with complications. Although generally viewed as part of a comprehensive MC package of services,[3] some MC services were not routinely implemented (e.g., pre- and post-circumcision behavioral counseling and HIV testing and training). The costs of these activities were taken from existing service programs that might be unrelated to MC, such as counseling and testing.

Epidemiologic Modeling

The impact of male circumcision on the number of new HIV infections was estimated using a computer simulation model, Spectrum. The model replicated the dynamics of the HIV epidemic in Zambia by dividing the population into various risk groups: those not sexually active, those with a single sexual partner, those with more than one sexual partner, and sex workers and their clients. The model is initialized with demographic data from the latest population census, epidemiological data from antenatal care (ANC) surveillance, and behavioral data from the Demographic Health Survey (DHS). The model is first fit to the historical epidemic in Zambia and then used to project the expected number of new HIV infections in the future, with no change in MC levels. The impact of an expanded program of male circumcision was then examined by assuming that the percent of men circumcised would increase to just above 50 percent by 2015 and then remain at this level beyond 2015. Based on recent MC studies, this study assumes male circumcision reduces the probability of male infections by 60 percent. The study

[3] There is no formal agreement on what constitutes a *comprehensive package of MC services*, but for the purposes of this study, it was assumed to contain the following elements: communications, pre-and post behavioral counseling, surgical procedure with post-surgical follow-up, counseling with or without testing, and training.

assumes no impact on male-to-female transmission. The difference in the number of new infections between the base projection and the MC program projection represents the reduction in the number of new infections due to scaling up male circumcision.

Results

Uncomplicated circumcisions usually require four visits: an initial visit for the pre-surgical examination and information and education; a second visit for the surgical procedure; and two follow-up visits at 2 and 7 days post-surgery. A fifth visit at one month post-surgery is recommended but seldom occurs in uncomplicated cases. Adult MC is done under local anesthesia. Antibiotics are not routinely prescribed by providers. Dressings are generally not reapplied at the first post-operative visit (although this was not the case in Lesotho and some providers in Swaziland).

The unit cost of a comprehensive package of MC services was estimated at US$46.82 (K200,863) (weighted for the cost of complications). The largest share of this amount was surgical costs (76.5%), followed by communications (15.9%), testing (3.9%), and pre-and post-operative counseling (3.6%). Note that this excludes training, community mobilization, and policy analysis and formulation costs. Based on the cost analysis, the epidemiological impact and cost effectiveness of scaling up MC among males (ages 15–49) to 58.5 percent coverage (i.e., to reduce the number of uncircumcised men by half) between 2008 and 2020 were projected for Zambia. It was estimated that one HIV infection will be averted for every 8.0 circumcisions performed and that the cost per infection averted is US$313 (K1,342,801). Relative to other prevention interventions, MC is potentially a cost-effective intervention. The cost-effectiveness analysis depends on several factors: (1) the period over which the cost-effectiveness analysis is estimated and (2) the pace of scaling up. These findings are largely because MC is a one-time intervention and because there are direct and indirect effects associated with MC. The benefits of male circumcision are therefore multiplicative over time.

How sensitive are the cost-effectiveness results to assumptions about behavioral responses to MC? The impact of changes in condom use on cost per infection averted showed that the results are relatively insensitive to small or moderate reductions. For example, the impact of male circumcision would be less than shown here if those who are circumcised adopt riskier behaviors because they think they are protected by the circumcision. A 25 percent reduction in condom use among those who are circumcised would reduce the impact by about 20 percent. These results underscore the critical importance of (1) locating the surgical provision of MC within a comprehensive set of services that includes behavior change communications and pre- and post-operative counseling; and (2) locating MC services within a broader set of effective prevention interventions.

The scaling up requires approximately 168,293 male circumcisions in 2008, increasing to a high of 264,388 in 2015. As previously mentioned, it is assumed that the percent of men circumcised would remain at the same level beyond 2015. Hence, by 2020, an average annual number of 167,377 circumcisions or a daily average of 697 circumcisions will be required over the next decade to achieve and maintain 58.5 percent coverage. The cumulative total resources needed for scaling up MC between 2008 and 2020 is US$84.9 million (K364.0 billion). The average annual cost is US$6.5 million (K28.0 billion). As expected, the surgical procedure accounts for the overwhelming share of the total costs (76.5%), followed by communications (15.9%) (see Figure 6). As mentioned before, training, community mobilization, and policy analysis and formulation costs are not included in this estimate.

Conclusion

The analysis has shown that MC can be a cost-effective intervention when compared to the relative cost effectiveness of other prevention interventions. There are several factors that influence the potential benefits. The pace of scaling up matters and the benefits from scaling up are not only multiplicative but

also long lasting. In addition, it is important to provide the surgical procedure within a comprehensive set of services that includes behavior change communications and pre- and post-operative counseling and, equally important, to provide MC services within a broader set of effective prevention interventions.

The analysis also showed that the implications to the health system are not trivial. The intention is not to suggest that vast increases in service delivery capacity (in terms of surgical facilities or surgical staff) are necessarily needed in Zambia. Rather, it is recommended that some innovative ways be identified to involve all providers of clinical services. One issue to consider is that public and private provision of MC can be complementary and should not be viewed as mutually exclusive. However, mechanisms should be devised to align practices among private providers with the recommended approaches (routine use of general anesthesia; routine prescription of antibiotics), allowing for standardization of the procedure across all health institutions in the country. The positive externalities associated with MC have been established and lay the basis for justifying public subsidization. However, the specific provider payment methods need to be decided on (e.g., fee-for-service; capitation approaches), as well as the mechanisms of reimbursement (voucher mechanisms, contracting, etc.). The health service, financial, and human resource implications are significant but not insurmountable; taking them into account will be important in ensuring that the benefits of this important public health intervention are realized as soon as possible by the people of Zambia.

Based on consultations with various stakeholders, alternate scenarios can be modeled to assess the affordability and feasibility (in terms of human resource requirements) of various policy targets set for MC in Zambia. The scenarios will likely inform resource mobilization and allocation for MC as an HIV intervention.

INTRODUCTION

Clinical trials have now confirmed the efficacy of male circumcision (MC) in reducing female-to-male HIV transmission. Some cost data have been reported (ranging between US$25 and US$69), and these cost data also formed the basis of a cost-effectiveness analysis.[4] It is unclear, however, what exactly is included in the costing studies and hence whether these costs are directly comparable. For example, often, indirect costs are not fully reflected; donations (especially clinicians' time) are not costed; variation by provider type and level of health facility is not considered; the particular surgical procedure used and the scale of service delivery is unclear. It is anticipated that this cost analysis will provide a more detailed examination of the costs of MC and might inform a sounder basis for an assessment of the cost-effectiveness of MC. This analysis is part of a larger study titled the "Costing Male Circumcision in Lesotho, Swaziland, and Zambia: Implications for Cost-Effectiveness of Circumcision as an HIV Intervention." The larger study has two major components: (1) costing MC and (2) modeling the impact of MC on the HIV epidemic.

The purpose of this analysis in Zambia was to assess the cost of providing adult MC in resource-constrained settings and to evaluate the implications of scaling up MC for the cost-effectiveness of MC and for the health system (e.g., resource mobilization and health system capacity).

METHODOLOGY

Cost Analysis

A detailed cost analysis of a subset of hospitals where circumcision is performed in Zambia was undertaken. The details of the costing model and data collection tool are provided in Appendix A and B. The data collection instrument was designed specifically for this study, and the Ministry of Health (MOH) can replicate the tool at a later stage to better understand the functioning and key determinants of costs as circumcision is implemented or scaled up.

Costing Approach

Standard costing methods were applied. The cost data were collected retrospectively through interviews with clinical and administrative staff at health facilities and various officers in the Ministry of Health. An ingredients approach was used, whereby all the inputs were listed and their contribution to the overall cost was then quantified. The approach allows us to assess whether the costs of the chosen data collection sites can indeed be generalized by making explicit the specific elements of the service that are included in the cost analysis. For example, if a certain cost category is specific to the sites studied, then that item's contribution to the overall unit cost can be removed. This cannot be done if the total program expenditure is merely divided by outputs. This approach is also useful for planning purposes, as it allows planners to add or remove certain elements of the intervention based on the MC guidelines that may be adopted in Zambia.

Method of estimation. The theory behind this estimation is from standard economics theory where total cost (C_t) in year, t, equals price (P) multiplied by the quantity (Q_t) of circumcisions in any given year, t. The aim of this part of the analysis was to estimate the unit cost, P_j. Unit cost of MC, P_j, was estimated as:

[4] Kahn, J.G., E. Marseille, and B. Auvert. 2006. "Cost-Effectiveness of Male Circumcision for HIV Prevention in a South African Setting." *PLoS Medicine* 3(12).

$$C_j = c_j^{direct} + \sigma * c_j^{indirect}$$
$$c_j^{direct} = \sum_{h,j} c_{h,j}$$
$$c_j^{indirect} = \sum_{l,j} c_{l,j}$$

Where: $c_{k,j}$ = direct cost per person served at provider, *j*, for *h*=1 (staff), 2 (drugs), 3 (supplies), etc.
$c_{l,j}$ = indirect cost per person served at provider, *j*, for *l*=1 (facility equipment), 2 (facility utilities), 3 (facility supervision), etc.
σ = share of facility services devoted to MC
Providers (*j*) considered are j=1 (government), 2 (NGO), 3 (missionary)

Direct and indirect costs of MC with complications were also estimated. Unit cost of uncomplicated MCs were weighted by the cost of MC complications and the probability of each complication occurring.

$$C_j^* = pr(uncomplicated\ MC) * C_j^{uncomplicated} + pr(complication_k) * C_j^{complication_k}$$

$$TC_{j,y} = C_j * Q_{j,y}$$
$$TC = \sum_{j,y} \left[TC_{j,y} \big/ (1+r)^a \right]$$

Where: r = real discount rate[5]
a = number of years into the future

In the larger study, multiple countries were considered, allowing for standardization, comparison, and validation. The choice of the countries was guided by the two factors that according to Williams and others (2006)[6] were predictors of a large potential benefit from scaling up MC, namely, high HIV prevalence and low to moderate MC prevalence.

Currency. The cost data is presented in local currency as well in U.S. dollars, using an exchange rate at the time of data collection (April 2007) (US$1 = 4,290.10 Kwacha).

Scale. Scale differences may also influence the estimated unit cost. The scale at which MC is implemented at the various sites is of a similar order or magnitude, allowing for comparison of the cost data.

Indirect costs. The table in Appendix C shows some of the broad categories of costs that were considered. In the costing methodology, goods that have a life of more than one year are treated as capital costs. Financial cost analysis involves estimating the average annual cost of each capital item in terms of simple "straight line" depreciation—the most common form of depreciation.[7] As the table shows, indirect costs also included recurrent costs, such as personnel and non-personnel costs.

[5] A discount rate of 3 percent was used. This is within the range of 3–5 percent recommended in the World Health Organization Guide to Cost-Effectiveness Analysis.
[6] Williams, B.G., J.O. Lloyd-Smith, E. Gouws, Hankins, C., Getz W.M., J. Hargrove, I. De Zoysa, C. Dye, and B. Auvert. 2006. "The Potential Impact of Male Circumcision on HIV in Sub-Saharan Africa." *PLoS Medicine* 3(7).
[7] Depreciation reflects the loss of value of a capital good over time and involves dividing the cost of the item by its useful life or, stated alternatively, by multiplying the cost by the depreciation factor.

Steps in the unit cost estimation. Steps in the analysis included (1) describe the intervention, (2) identify inputs, (3) quantify inputs, (4) collect cost information, (5) assign monetary values, (6) calculate total cost, (7) quantify outputs, and (8) calculate unit cost.

Defining the intervention. Currently, circumcision is not implemented primarily as an HIV prevention intervention; and, therefore, in most instances, not all of the elements of a comprehensive MC package of services were routinely provided. The costing study, however, not only considered the surgical intervention but also the services not currently part of circumcision (information and education, counseling with or without testing, training, etc.); this was done to ensure that the information could be used to inform planning for the implementation of a comprehensive package of MC services. Indirect methods were used to get cost data on the non-surgical elements of comprehensive circumcision services. For example, the cost of counseling with or without testing was obtained from voluntary counseling and testing (VCT) programs. In summary, the costing study takes into account the following components shown in Table 1:

Table 1. Surgical Direct and Indirect Costs and Non-surgical Components

Surgical Procedure	
Direct Costs	**Indirect Costs**
Staff	Management and supervision staff
Drugs	Support staff
Consumable supplies	Infrastructure
Non-consumable supplies	Equipment
	Vehicles
	Maintenance
	Utilities
Non-surgical components	
Counseling	
Testing	
Communications	
Training (not included in all the analyses)	

This study focused on the cost of circumcision in adolescent and adult males. Circumcision at birth or in young boys has very different cost implications. For example, circumcision in young boys has to be performed under general anesthesia, and the costs are much higher. On the other hand, neonatal circumcision is a lower cost procedure, as the surgical procedure is much simpler and less time consuming, no suturing is required, and minimal post-operative follow-up is needed. Implementation of neonatal circumcision will, however, require additional training.

The analysis allows for variation in circumcision practices and patient management. The purpose of this study was not to estimate the costs of various surgical techniques. Instead, the various clinical practices are made explicit and costed accordingly (e.g., whether there is routine use of antibiotic prescriptions; whether there is routine use of general anesthesia, etc.)—all of which have important cost implications.

The analysis was undertaken from the perspective of service providers (i.e., not from households or consumers). The implication is that expenses incurred by patients are not included in the analysis (e.g., travel costs, opportunity cost of travel time, opportunity cost of post-operative healing time, etc.). However, this does not mean that the costs facing patients are not taken into account. Data were collected on the out-of-pocket expenses that patients incur for the services from various provider types.

For the surgical intervention, the inputs were quantified from booking to discharge of the patient and all follow-up visits. The inputs included all staff that are involved (clinical, non-clinical staff); time spent by each staff member; salary and non-salary benefits for staff members; and drugs and supplies by type, quantity, and associated costs. In addition to these direct costs, indirect costs were also included, such as facility operating costs (e.g., electricity, maintenance); facility administrative costs (e.g., superintendent, accountant); and facility equipment costs (e.g., autoclaves, refrigerators, vehicles).

*Selection of facilities***.** Cost data was collected from public facilities operated by the MOH and nongovernmental facilities. Data were collected from three facilities identified in consultation with the MOH: University Teaching Hospital and Livingstone General Hospital (two public hospitals operated by the MOH) and Mums Care Clinic (a private facility).

Epidemiologic Modeling

Male circumcision has been shown by three randomized control trials to be effective in protecting men from HIV infection. The rate of infection among men circumcised in the trials was about 60 percent lower than the rate among men who were not circumcised. The actual impact in Zambia will depend on many factors, including the rate of scale up of circumcision services, the prioritization of target groups in the early stages of the intervention, and the dynamics of the epidemic. To estimate the impact that might be expected in Swaziland, a computer simulation model, Spectrum, was applied to replicate the historical epidemic pattern and demonstrate the effects of increasing the level of male circumcision.

The model simulates the adult population between the ages of 15 and 49 (which accounts for about 85–90% of all adult HIV infections). It is implemented as a module within the Spectrum suite of policy models developed and maintained by the POLICY Project and now the USAID | Health Policy Initiative. Full details, including the model equations, are provided in the Spectrum user's manual.

The population is divided into male and female populations but is not further stratified by age within the 15–49 age group. New entrants to the model are those people reaching 15 years of age. When they initiate sexual activity, they are placed into one of five risk groups: low-risk heterosexuals (those faithful to a single partner), medium-risk heterosexuals (those with multiple partners), high-risk heterosexuals (sex workers and their clients), men who have sex with men (MSM), and injecting drug users (IDUs). People may leave any of the higher risk groups by adopting low-risk behavior.

Every person entering the model population is assumed to be HIV negative and to remain uninfected while not sexually active. The sexually active and IDU populations are at risk of infection each year. The probability of becoming infected depends on characteristics associated with that individual as well as his or her sexual partners. For sexual transmission, these factors include number of partners, number of acts per partner, condom use, presence of other sexually transmitted infections (STIs), use of antiretroviral therapy (ART), stage of infection, and male circumcision.

Most contact is assumed to be with partners in the same risk group. However, for low-risk groups, contact with other risk groups is a major source of new infection. Therefore, calculations for the low-risk population take into account that some individuals who are faithful to their partners will still be at risk because they have partners who engage in riskier behavior.

A person newly infected with HIV is in the Primary Infection Stage and remains in this category for six months. People in this stage are more infectious than those in other stages. An infected person passes out of the Primary Infection Stage to enter the Asymptomatic Stage, where he/she remains for approximately six years and has a low level of infectiousness. An infected person then moves to the Symptomatic Infection Stage, where he/she remains for about two more years, before dying from an AIDS-related illness. Infectiousness is elevated for people in the Symptomatic Infection Stage. People are considered to be eligible for ART during this stage. If they receive ART, then their rate of progression to death is reduced.

The probability of becoming infected is modified by male circumcision and other factors. For the analysis described here, it was assumed that MC reduces the probability of female-to-male transmission of HIV per sexual contact by 60 percent and that there is no effect on the probability of male-to-female transmission. A study is underway in Uganda to test whether male circumcision also reduces male-to-female transmission.

Data for the model are taken from a number of sources. Demographic data are primarily from the United Nations Population Division, HIV prevalence information is from HIV surveillance, and behavioral data come from the Zambia DHS of 2005.

UNIT COST ESTIMATION

Table 2 summarizes the key results of the inputs into the surgical procedure across three facilities. Generally, four visits are required. The first visit is for initial examination and booking of the surgical procedure. The patient is usually seen by a nurse for 30–37 minutes. The nurse and doctor mainly provide information regarding the surgical procedure, healing, potential complications, or adverse events. While behavioral counseling is not routinely provided in the two other countries in this study, in Zambia, some behavioral counseling is provided to patients during this visit. The second visit generally involves a nurse (approximately 30 minutes) and the health professional performing the surgical procedure (approximately 30 minutes). This may be a doctor or a clinical officer. The time inputs in minutes for each staffing category are shown in Table 2. The third visit usually happens 2 days after the surgical procedure. The patient is usually seen by a nurse or clinical officer. The fourth visit is usually 7 days post-surgery and takes about five minutes of a nurse or clinical officer's time. Although a fifth visit at 1 month post-surgery is recommended to the patient, patients with uncomplicated circumcision rarely return for this visit.

Table 2. Summary of Key Results

Facility	**1**	**2**	**3**
Facility type	Hospital	Hospital	Clinic
Ownership	Public	Public	NGO/Private
Visit #1 (initial visit, examination, booking)			
Staff inputs (minutes)			
Nurse	30	37	37
Visit #2 (surgical procedure)			
Staff inputs (minutes)			
Nurse	30	28	28
Clinical Officer	14	5	5
Post graduate doctor	14	0	23
Urologist	3	0	0
Anesthetist	0	0	5
Type of Anesthesia	Local anesthesia	Local anesthesia	Local anesthesia
Antibiotics	None	None	None
Analgesics	Paracetamol	Paracetamol	Paracetamol
Visit #3 (post-surgery follow-up; +2 days)			
Staff inputs (minutes)			
Nurse	15	37	37
Clinical Officer	10	5	0

Consultant Urologist	11	0	0
Anesthetist	0	0	5
Dressing	Not reapplied	Not reapplied	Not reapplied
Visit #4 (follow-up; +7 days)			
Staff inputs (minutes)			
Nurse	5	5	5
Clinical Officer	5	5	0

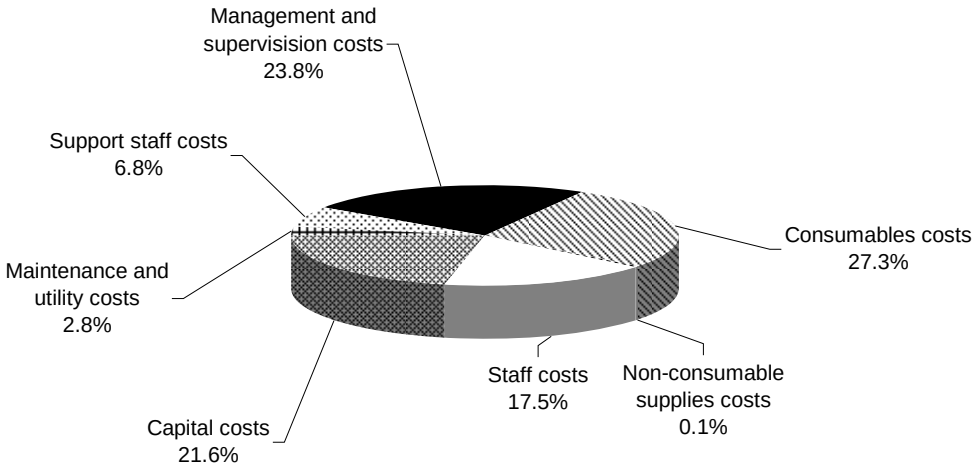
Variation in Services

In the two other countries studied, Lesotho and Swaziland, there was some variance in practices (e.g., in the type of anesthesia used, whether antibiotics were routinely prescribed, and whether a surgical dressing was applied after the third visit (at 2–3 days post-surgery). However, in Zambia, there was considerable standardization in the surgical approach in the facilities visited. There were, though, some differences in the staffing patterns. Essentially two models could be identified. In the first model, the surgical procedure is preformed by a clinical officer or a doctor and overseen by a post-graduate doctor or a specialist urologist. In the second model, the procedure is performed by a nurse and overseen by a clinical officer or a doctor. The results reported in the rest of the analysis reflect an equal weight of the two models.

Direct and Indirect Costs

The breakdown of the direct and indirect costs associated with an uncomplicated MC is shown in Figure 1. The direct costs include the cost of consumable supplies (27.3%), non-consumable supplies (0.1%), and staff costs (17.5%). The indirect costs include capital costs (21.6%), maintenance and utility costs (2.8%), management and supervision costs and support staff costs (30.6%). The largest contributors to the overall cost were staff and consumable supplies.

Figure 1. Breakdown of Cost of Circumcision

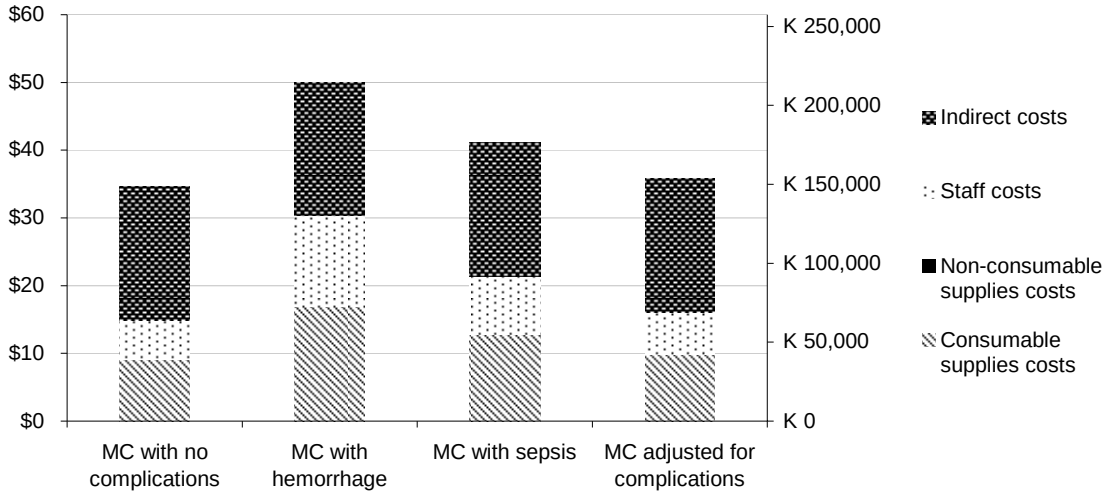


Complications and Related Costs

Post-operative complications are relatively infrequent occurrences, occurring in approximately 15.1 percent of circumcisions in the facilities studied. Mild to moderate pain is generally not viewed as a complication, and analgesics are routinely prescribed as part of the procedure. The most common post-operative complications[8] are hemorrhage and/or hematoma (2.1% of circumcisions) and sepsis (13.0% of circumcisions). These are complications of moderate severity, and no cases of the other adverse events with long-term consequences described in the literature[9]—such as excessive skin removal, problems with urination, or problems with appearance—were reported. Hemorrhage and/or hematoma are the most resource intensive complications, as they require anesthesia, re-opening of the surgical wound, and ligation of each bleeding vessel individually. Hemorrhage is usually detected shortly after surgery and sometimes even before the patient is discharged. Hematoma results from internal bleeding and commonly involves swelling; the patient usually returns within the first day after the surgery. The other complication, sepsis, is usually detected at the first post-operative visit (2 days after surgery).

The two most common complications were costed (hemorrhage and sepsis). These are reflected in an adjusted unit cost weighted for the additional cost of complications and the probability of each complication occurring. Figure 2 shows a breakdown of unit costs of MC without complication, unit costs if a complication arises, and the adjusted (weighted) unit cost. The unit cost of MC complicated by hemorrhage is 44.4 percent higher than an uncomplicated MC. For MC complicated by sepsis, the cost is 18.5 percent higher. Because of the relative infrequent occurrence of these complications, the unit cost weighted by the frequency of complications is only 3.3 percent or US$1.16 (K4,969) higher than a circumcision without any complication. The most important sources of the difference are the cost of consumable supplies and staff costs.

Figure 2. Comparison of the Breakdown of Adjusted and Unadjusted Unit Costs of Surgical Procedure



[8] Note this is not a comprehensive survey of the complications associated with MC in Zambia. These figures are merely used to apply probability weights to the cost data collected. A more detailed assessment of MC complications has been conducted for Zambia, and the rate of MC complications was lower. The differences may be due to differences in definitions and the period over which the complications were studied.

[9] UNAIDS, WHO, London School of Hygiene and Tropical Medicine. Draft 2007. Male Circumcision: Global Trends and Determinants of Prevalence, Safety, and Acceptability.

The results presented here show the inputs and associated costs of circumcision as it is currently implemented in Zambia. There are important omissions that are routinely included as part of a complete MC package of services (e.g., communications, testing, pre- and post-circumcision information and education, and behavioral counseling and training). As mentioned in the description of the methodology, the costs for the additional interventions (pre- and post-circumcision behavioral counseling and HIV testing) were taken from existing programs that offer these services but might be unrelated to MC. The assumptions that underpin the estimation of these costs are shown in Appendix D.

In the comprehensive package of MC services, pre- and post-circumcision behavioral counseling, HIV testing, and communications collectively add 30.7 percent to the cost of the surgical procedure. The unit cost of a comprehensive package of MC services was estimated at U$46.82 (K200,863). Communications account for the largest share of this additional cost. Training costs were also estimated according to the assumptions listed in Appendix D, but these costs have not been included in Figure 1 and Figure 2. This is largely because training needs are dependent on the human resource requirements and do not necessarily have to be repeated annually, and additional consultation is needed to agree on training needs.[10] Other excluded costs are policy formulation and community mobilization costs.

SCALING UP CIRCUMCISION

The future uptake and rate of scale-up of MC is not known. However, to inform planning processes, the results of scenario modeling are presented. The validity of the model was tested by matching the projected prevalence with observed HIV prevalence (from sentinel surveillance surveys). Appendix A includes a more detailed explanation of the model. The epidemiology model was linked to the AIDS Impact Module of Spectrum in order to make the HIV and AIDS projections for Zambia.

Impact and Cost-Effectiveness of Scaling up MC

According to the baseline epidemiologic model, the cumulative number of new infections over the period 2008–2020, given the current level of behavior, will be 1.95 million, or on average, 150,028 annually. Table 3 presents the results of the analysis if MC were scaled up to reach 58.5 percent of all males between the ages of 15 and 49.[11] It is projected that, cumulatively, over the period 2008–2020, 270,928 new infections will be averted. This translates into an average number of 20,841 infections averted annually or 13.3 percent of new infections relative to the baseline projection. The implication is that, on average, over the year period 2008–2020, for every 8 circumcisions 1 new HIV infection will be averted. Using the cost per MC (US$46.82; K200,863) from the cost analysis, the discounted cost per infection averted is estimated at US$313 (K1,342,801)

Table 3. Impact and Cost-effectiveness of Scaling up MC (2008–2020)

	Projection Period: 2008–2020	
	Cumulative	Average Annual
Number of infections averted	270,928	20,841

[10] With the intensification of pre-service MC training in most schools, the need for in-service training will reduce over time. This is particularly true for clinical officer training at the Chainama College of Health Sciences.
[11] This is a preliminary scenario and will be finalized in consultation with the MoH to arrive at the most useful scenarios for planning the implementation of MC in Zambia.

Percentage of infections averted relative to baseline	13.3%	
MCs per infection averted		8.0
Cost per infection averted*		US$313 (K1,342,801)

**discounted*

These estimates are based on a national average analysis for Zambia (i.e., not a regionally disaggregated analysis). In one of the regions in Zambia, the level of circumcision is very high, whereas in the rest of the country, MC prevalence is generally low. The result is that these estimates of impact (in terms of infections averted) or cost-effectiveness are conservative, and a regionally targeted approach will likely yield larger results than estimated in Table 3.

How does this compare with the cost effectiveness of other prevention interventions? Table 4 shows the results from literature on the cost effectiveness of prevention interventions and suggests that at a cost per infection averted of US$313 (K1,342,801), MC is a highly cost-effective intervention.

Table 4. Cost per HIV Infection Averted for Selected HIV Interventions from the Literature[12]

Intervention	Cost per Infection Averted	
Condom distribution	US$10–2,188	K42,901–9,386,739
VCT	US$393–482	K1,686,009–2,067,828
Prevention of mother-to-child transmission (PMTCT)	US$20–2,198	K85,802–9,429,640
STI treatment	US$271–514	K1,162,617–2,205,111
School-based education	US$7,288–13,326	K31,266,249–57,169,873
Male circumcision	US$181[13]	K776,508

Pace of Scale-Up

The preceding analysis assumed a linear scale-up to reach the target coverage of 58.5 percent in 2015. What if the pace of scaling up moves slower or faster than a linear scale-up, as illustrated in Figure 3? Table 5 shows the impact of various patterns of scale-up relative to the linear scale-up. If MC scale-up occurred at a slower pace, the average annual number of MCs over the period 2008–2020 would be similar, but the number of infections averted would be much less (-19.9%) relative to the linear scale-up. If, however, scale-up occurred at a faster pace, as illustrated in Figure 3, the average annual number of MCs needed would again be similar, but the number of infections averted would be higher (16.1%) relative to the linear scale-up. As expected, the number of MCs needed to avert one HIV infection is lower for the faster scale-up, and the cost per infection averted is lower by 11.0 percent relative to the

[12] Creese A, K. Floyd, A. Alban, and L. Guinness. 2002. "Cost-effectiveness of HIV/AIDS interventions in Africa: A Systematic Review of the Evidence." Lancet 2002(359): 1635–43.
[13] Kahn, J.G., E. Marseille, and B. Auvert. 2006. "Cost-Effectiveness of Male Circumcision for HIV Prevention in a South African Setting." *PLoS Medicine* 3(12).

linear scale-up and by approximately 30 percentage points relative to the slow scale-up (see Table 5). The reason for these findings relates to the indirect effects associated with MC and the resultant multiplicative impact of MC illustrated in Figure 4.

Figure 3. Alternate Patterns of Scaling Up MC

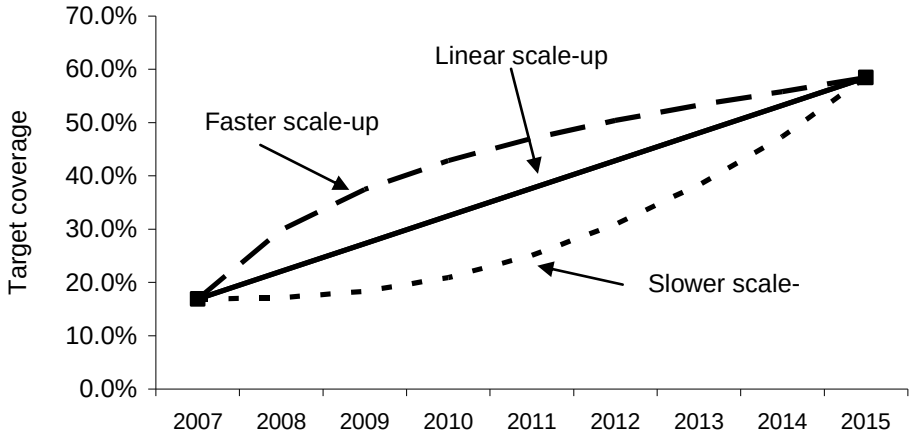


Table 5. Impact of Various Pace of Scaling Up MC (2008–2020)

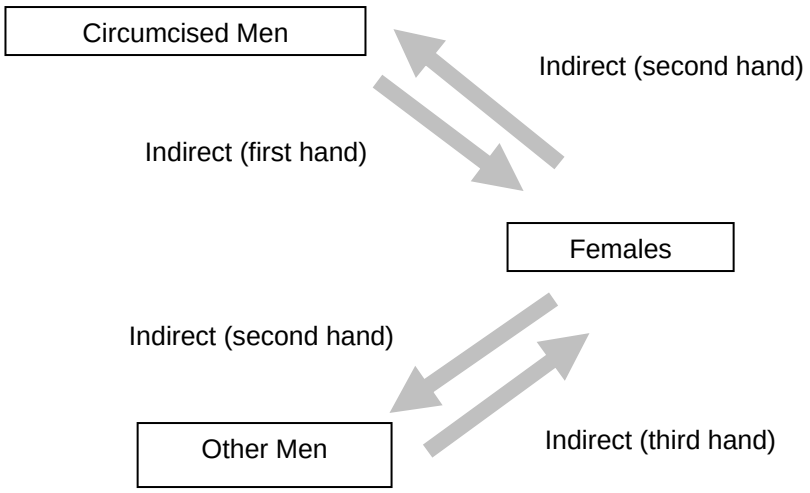
	Linear scale-up	Slower scale-up	Faster scale-up
	2008–2020	**% difference with linear scale-up**	
Average annual number of MCs	167,377	-1.1%	+0.9%
Average annual number of infections averted	20,841	-19.7%	+16.1%
MC per infection averted	8.0	+19.3%	-11.0%
Cost per infection averted*	US$313 (K1,342,801)		

**discounted*

Multiplicative Impact of MC

Figure 4 presented by Smith and others (2007)[14] shows the direct and indirect effects associated with MC. The direct effect is the benefit that accrues to a circumcised male and has been the subject of MC clinical trials. The various indirect effects are determined by epidemiological dynamics. First-, second-, and third-hand indirect effects are illustrated in Figure 4. Because of the protective effect of circumcision, fewer circumcised men will become infected over time. The secondary result is that female sexual partners of these circumcised men are less likely to become infected. This is the first-hand indirect effect. The second-hand indirect effect comes about because these women are less likely to infect other males, whether the men are circumcised or not. Following on the second-hand indirect effect, uninfected women are also less likely to be infected, resulting in the third-hand indirect effect.[15]

Figure 4. Indirect Effects Associated with MC

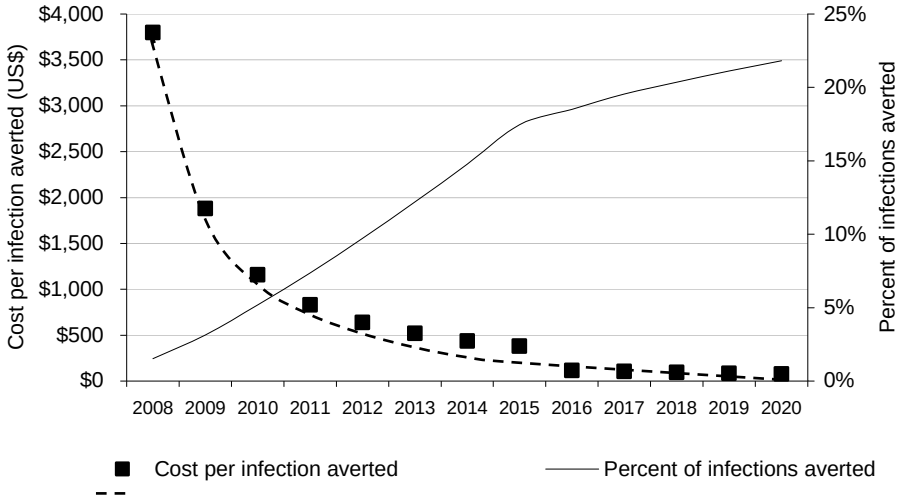


Note that not all the benefits implied in the cost-effectiveness results will be realized within the first few years of implementation. Figure 5 shows the annual estimates of the cost per infection averted of MC, starting at a high of US$3,793 (K16.3 million) per infection averted in 2008 and decreasing to US$77 (K233,014) per infection averted in 2020. This result is derived from the fact that the percent of new infections averted due to scaling up MC is initially only 1.5 percent in 2008 but increases to 21.8 percent in 2020.

[14] Smith J., T. Hallett, S. Gregson, B. Lopman, K. Desai, M. Boily, and G. Garnett. "Understanding the Impact of Male Circumcision as an Intervention." Presentation at HIV Implementers' Conference, Kigali, June 2007. London: Department of Infectious Disease Epidemiology, Imperial College.

[15] This discussion focuses exclusively on the effects on HIV transmission. There are, however, other indirect effects, such as reduced incidence of human papillomavirus (HPV) and cervical cancer in female partners of circumcised males, that have not been considered here.

Figure 5. Estimates of Cost per Infection Averted by Year



Implications to the Health System

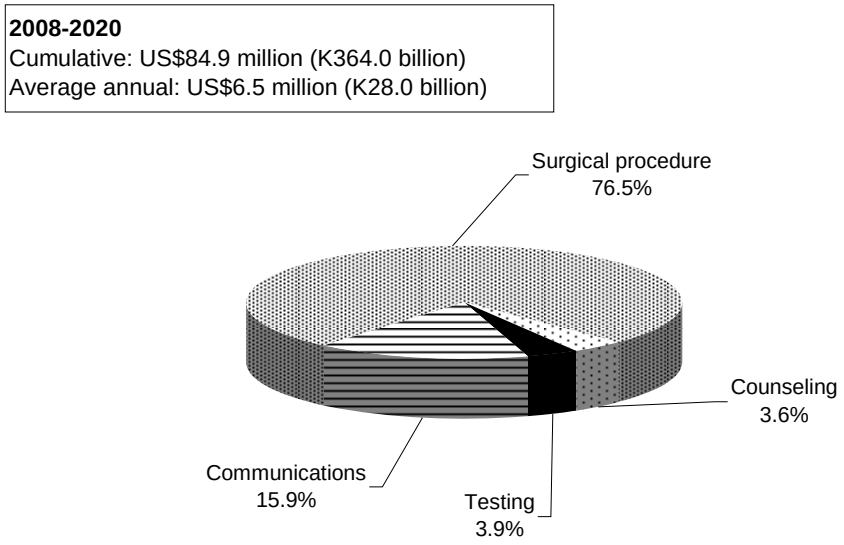
Table 6 shows some of the health service implications of scaling up MC among adult males (15–49 years old). This scenario assumes that 16.9 percent of males are effectively circumcised (i.e., circumcised with sufficient removal of foreskin to afford the protective effect found in the clinical trials). The projection furthermore aims to achieve coverage of 58.5 percent of adult males by 2015. A linear scale-up is assumed. The proportion of HIV-positive men is not factored into this scenario because the MC protocols drafted to date (for example, the protocol proposed by the World Health Organization) do not specify the requirement of an HIV-negative status for MC eligibility. Because male circumcision is a one-time procedure, the number of MCs that need to be performed in a particular year is the difference between coverage estimates for that year and the previous. The number of circumcised males that exit the age group and number of uncircumcised males that enter the age group are also taken into account. Using this approach, it is estimated that scaling up requires approximately 168,293 MCs in 2008, increasing to a high of 264,388 in 2015. As previously mentioned, it is assumed that the percent of men circumcised would remain at the same level beyond 2015. Hence, by 2020, an average annual number of 167,377 circumcisions or a daily average of 697 circumcisions will be required over the next decade to achieve and maintain 58.5 percent coverage.

Table 6. Health Service Implications

	2008–2020 Cumulative	2008–2020 Average Annual
# of new circumcisions needed	2,175,896	167,377
# of circumcisions per month		13,948
# of circumcisions per week		3,487
# of circumcisions per day		697

Figure 6 shows the resource implications of MC scale-up by functional cost breakdown (surgery, counseling, and testing). The cumulative total resources needed for scaling up MC between 2008 and 2020 is US$84.9 million (K364.0 billion). The average annual cost is US$6.5 million (K28.0 billion). As expected, the surgical procedure accounts for the largest share of the total costs (76.5%), followed by communications (15.9%). As mentioned before, training, community mobilization, and policy analysis and formulation costs are not included in this estimate.

Figure 6. Cost Implications of Scaling up MC to 52.5 Percent Coverage (functional breakdown)



Behavioral Responses to MC

How sensitive are the cost-effectiveness results to assumptions about behavioral responses to MC? Risk compensation (also known as disinhibition by epidemiologists or moral hazard in economics) refers to an increase in risky behavior in circumcised males due to a decrease in perceived risk. The impact of changes in condom use on cost per infection averted showed that the results are relatively insensitive to small to moderate reductions. For example, the impact of male circumcision would be less than shown here if circumcised men adopt riskier behaviors because they think they are protected by the circumcision. A 25 percent reduction in condom use among circumcised men would reduce the impact by about 20 percent. These results underscore the critical importance of (1) locating the surgical provision of MC within a comprehensive set of services that includes behavior change communications and pre- and post-operative counseling and (2) locating MC services within a broader set of effective prevention interventions.

Sustainability

MC is a one-time intervention, and as discussed, the benefits are not only multiplicative but also long lasting. One key driver of the annual costs estimated is the circumcision of 15 year olds as they enter the 15–49-year-old age group. While neonatal MC was not the focus of this analysis, it is widely acknowledged that neonatal MC is a lower cost procedure for various reasons—the surgical procedure is much simpler and less time consuming; no suturing is required; and minimal post-operative follow-up is needed. Simultaneous scaling up of adult and neonatal MC offers an opportunity for long-term cost savings and sustainability of the gains in preventing HIV; reduced numbers of adult MCs would be

needed 15 years from now (i.e., beyond 2023). However, the scaling up of MC has two important challenges: (1) the cultural context of MC, particularly where MC is part of the right of passage to adulthood; and (2) the small number of births delivered in health service settings where neonatal MC can be performed.

Limitations

Some limitations of this study are worth noting.

- The cost analysis of the non-surgical elements of comprehensive MC services (e.g., counseling, communications, testing, etc.) was not as extensive as the analysis of the surgical procedure. However, the analysis of the non-surgical elements may be refined as a more detailed approach to implementation becomes clear.

- The analysis only considered the impact of MC on reducing HIV transmission and the number of HIV infections averted. It is, however, increasingly being realized that the scaling up of MC offers an opportunity to improve the delivery of male reproductive health services. A similar analysis of the costs and benefits of MC within the context of a comprehensive package of male reproductive health services might be useful.

Conclusion

Male circumcision can be a cost-effective intervention when compared with the relative cost-effectiveness of other prevention interventions. Several factors influence the potential benefits. The analysis showed that the pace of scaling up matters and that the benefits from scaling up are not only multiplicative but also long lasting. The analysis also illustrated the importance of locating the surgical provision of MC within a comprehensive set of services that includes behavior change communications and pre- and post-operative counseling and, equally important, locating MC services within a broader set of effective prevention interventions.

The human and financial resource implications of scaling up MC are significant. The intention is not to suggest that vast increases in service delivery capacity (in terms of surgical facilities or surgical staff) are necessarily needed in Zambia. Rather, it is recommended that some innovative ways be identified to involve all providers of clinical services. One issue to consider is that public and private provision of MC can be complementary and should not be viewed as mutually exclusive. However, mechanisms should be devised to align practices among private providers with the recommended approaches (routine use of general anesthesia, routine prescription of antibiotics). The positive externalities associated with MC have been established and lay the basis for justifying public subsidization. However, the specific provider payment methods need to be decided on (e.g., fee-for-service, capitation approaches), as well as the mechanisms of reimbursement (voucher mechanisms, contracting, etc.). The health service, financial, and human resource implications are significant but not insurmountable; taking them into account will be important in ensuring that the benefits of this public health intervention are realized as soon as possible by the people of Zambia.

Based on consultations with various stakeholders, alternate scenarios can be modeled to assess the affordability and feasibility (in terms of human resource requirements) of various policy targets set for MC in Zambia. The scenarios will likely inform resource mobilization and allocation for MC as an HIV intervention.

APPENDIX A. EPIDEMIOLOGY MODELING

The analysis used the Spectrum suite of policy models. The various components of Spectrum make it uniquely suited to address the policy questions raised in this study. The *HIV transmission model* is a deterministic model that reveals the key processes or risk factors that give rise to the sexual and intravenous transmission of HIV.[16] The model divides the population into multiple risk groups or compartments, reflecting the heterogeneity in sexual activity (frequency of sex, number of sexual partners, anal sex between males, etc.) and allows for movement (mixing) between the risk compartments. The model is fundamentally based on the Weinstein equation,[17] takes into account heterosexual and homosexual transmission, and is applied to the various risk groups. Example factors that the model takes into account are

- Changes in risk behaviors over time to reflect the impact of prevention interventions;
- Various levels of probability of infection based on the presence of ulcerative and non-ulcerative STIs; and
- Various probabilities of HIV transmission based on the stage of infection (primary infection, asymptomatic, symptomatic) of the HIV-positive individual.

The key variables used for the transmission model are

$$P(Infection)_{r,s,c} = 1 - \left\{ p_r \sum_{s,c} w_{s,c} \left[1 - q_{g,s,c} (1 - f_r e) g \right]^{n_r} + (1 - p_{rp}) \right\}^{m_r}$$

r = risk group
s = STI status
c = circumcision status
p = HIV prevalence in partner
q = probability of HIV transmission by partner combination, STI status, and male circumcision status
f = condom use
e = condom efficiency
g = multiplier based on the distribution of infected population by stage of infection
n = number of contacts per sexual partner
m = number of sexual partners

The transmission probabilities used in the model represent the best estimate based on the literature. These values are periodically reviewed and updated to ensure that they reflect the most recent literature. These values are stated explicitly and are also used in sensitivity analyses.

Although not all the factors considered by the model are directly affected by male circumcision (e.g., transmission between male sexual partners), it is essential to comprehensively and accurately model the HIV epidemic in each country before looking at the impact of circumcision.

International agencies involved with setting guidelines and norms (WHO, UNAIDS, etc.) have stressed the need to view male circumcision as part of a comprehensive prevention strategy (i.e., that the biologically based interventions should be complementary to the behaviorally based interventions). The methodology proposed here is uniquely suited to analyze the impact of male circumcision alongside other HIV interventions.

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[16] While not discussed here, other forms of transmission are reflected in the model. The model treats intravenous transmission similar to the way sexual transmission model is treated here. The model also takes into account other forms of HIV transmission (mother-to-child transmission and infected blood products).

[17] Weinstein, M.C., J.D. Graham, J.E. Siegel, and H.V. Fineberg. 1989. "Cost-Effectiveness Analysis of AIDS Prevention Programs: Concepts, Complications, and Illustrations." In Turner, C.F., H.G. Miller, L.E. Moses (eds.).*Confronting AIDS: Sexual Behavior and Intravenous Drug Use* 1989: 471–499. Washington, DC: National Academy Press.

APPENDIX B. DATA COLLECTION INSTRUMENT

FACILITIES DATA COLLECTION FORM

Name of Facility: _____

District: _____

Local currency

Exchange rate

Type of Facility: ☐ Health Post ☐ Health Centre ☐ Hospital

Facility Ownership: ☐ Private NGO ☐ Private Commercial ☐ Public

Average Number of Clients at this Facility per Months: ☐

Average Number of Male Circumcision Contacts at this Facility per Month: ☐

Name and Location of Nearest Health Centre (for Health Posts only): _____

Distance from Facility: ☐

Name and Location of Nearest Hospital: _____

Distance from Facility: ☐

I. STAFFING, EQUIPMENT, AND MAINTENANCE

A. CLINICAL STAFF

Number of Full-Time Employees

	Number of full-time employees	Annual salary (including benefits)	% of time spent on male circumcision	Notes
Auxiliary/Attendant				
Nurse/Midwife				
General Physician				
Surgeon				
Paediatrician				
Anaesthetist				
Lab Technician				
Counselor				

B. SUPPORT STAFF

Number of Full-Time Employees (*entire facility*, not only for male circumcision)

	Number of full-time employees	Annual salary (including benefits)	Notes
Guard			
Housekeeping			
Reception			
Records			
Supply Clerk			
Maintenance			
Mgmt Officer			
Driver			
Food Preparer			

C. EQUIPMENT

Equipment for *Entire Facility*

	Number of items at facility	Amortization period	Estimated construction/purchasing price	Notes
Operating theatre				
Anaesthesia equipment				
Laboratory				
Sterilizer				
Refrigerators				

Portable refrigerators/cooling boxes				
Furniture/beds				
Overall facility/structure				

D. EMERGENCY TRANSPORTATION VEHICLES

Equipment for *Entire Facility*

	Number of items at facility	Amortization period	Estimated purchasing price	% of time used for transportation of male circumcision complications (estimated)	Notes
Bicycle					
Motorcycle					
Jeep					
Ambulance					

E. MAINTENANCE AND UTILITY COSTS

Equipment for *Entire Facility*

	Annual cost	Notes
Building maintenance		
Utilities Cost		
Emergency Vehicle Maintenance		

II. CIRCUMCISION PROCEDURE, INCLUDING COUNSELING & TESTING

A. GENERAL

☐ Provided here ☐ Not provided here, referred to: _____

1. Average number of MC clients each month: ☐

2. How many visits does an MC client have on average to obtain both counselling and testing and the procedure? ☐

3. Is informed consent obtained (risks/benefits of procedure, other ways to reduce risk of HIV infection)? ☐

B. DRUGS, SUPPLIES, AND CONSUMABLES

4. What supplies are used? Are there any other drugs/supplies they receive? *(Write in)*

Drug or Supply	% of MC clients receiving this drug/supply	Number	Unit cost	Notes
Sutures				
Needles				
Bandages				
Analgesic				
Gloves				
Antiseptic				
Gentian violet/sterile marker pen				

5. What percentage undergo a physical exam? ☐

C. LAB TESTS

Skip if there are no lab facilities:
6. What percentage of MC clients receive the following lab tests during their circumcision visits?

Lab Tests	% of MC clients receiving this test	Number	Unit Cost	Notes
RPR Syphilis				
HIV				

II. CIRCUMCISION PROCEDURE, INCLUDING COUNSELING & TESTING (Page 2)

D. STOCK-OUTS

7. Have you experienced stock-outs, or difficulties with obtaining supplies, with any of the supplies listed above? If yes, how often?

E. CLINICAL STAFF TIME

8. Who provides counselling prior to the circumcision procedure at the facility? How long does the average visit last? Who provides circumcision at the facility? How long does the average visit last?

Pre-surgical visit	No. of minutes spent with client
Counselor	
Nurse/Midwife	
General Physician	
Surgeon	
Auxiliary/Attendant	
Anaesthetist	
Lab Technician	
Other	

Surgical Visit	No. of minutes spent with client
Counselor	
Nurse/Midwife	
General Physician	
Surgeon	
Auxiliary/Attendant	
Anaesthetist	
Lab Technician	
Other	

F. COMMENTS

III. POST-CIRCUMCISION CARE—NORMAL

A. GENERAL

☐ Provided here ☐ Not provided here, referred to: _____

1. Average number of post-MC clients each month: ☐

2. How many post-care visits does an MC client have on average? ☐

3. What is included as part of post-circumcision care?

B. DRUGS, SUPPLIES, AND CONSUMABLES

4. What supplies are used? Are there any other drugs they receive? *(Write in)*

Drug or Supply	% of MC clients receiving this drug/supply	Number	Unit cost	Notes

5. What percentage undergo a physical exam? ☐

6. Are gloves used? ☐ Yes ☐ No

C. LAB TESTS

Skip if there are no lab facilities:
7. What percentage of MC clients receives the following lab tests during their follow-up visits?

Lab Tests	% of MC clients receiving this test	Number	Unit cost	Notes

III. POST-CIRCUMCISION CARE—NORMAL (Page 2)

D. CLINICAL STAFF TIME

8. Who provides post-circumcision care at the facility? How long does the average visit last?

Post-surgical visit #1	No. of minutes spent with client
Counselor	
Nurse/Midwife	
General Physician	
Surgeon	
Auxiliary/Attendant	
Anaesthetist	
Lab Technician	
Other	

Post-surgical visit #2	No. of minutes spent with client
Counselor	
Nurse/Midwife	
General Physician	
Surgeon	
Auxiliary/Attendant	
Anaesthetist	
Lab Technician	
Other	

Post-surgical visit #3	No. of minutes spent with client
Counselor	
Nurse/Midwife	
General Physician	
Surgeon	
Auxiliary/Attendant	
Anaesthetist	
Lab Technician	
Other	

E. COMMENTS

IV. POST-CIRCUMCISION CARE—COMPLICATIONS

A. GENERAL

☐ Provided here ☐ Not provided here, referred to: _____

1. Average number of post-MC clients requiring management of complications each month: ☐

2. How many post-care visits does an MC client with complications have on average? ☐

3. In your opinion, what percentage of patients do you think return to the facility for treatment of complications?

4. What percentage of patients do you treat for MC-related complications who did not receive the procedure at this facility?

B. DRUGS, SUPPLIES, AND CLINICAL STAFF TIME

4. What percentage of MC clients experience **infection**? ☐

5. What drugs and supplies are used to treat this complication? *(Write in)*

Drug or Supply	% of MC clients receiving this drug/supply	Number	Unit cost	Notes

6. Who provides care for this complication at the facility? How long does the average visit last?

Visit #1 for the complication	No. of minutes spent with client
Counselor	
Nurse/Midwife	
General Physician	
Surgeon	
Auxiliary/Attendant	
Anaesthetist	
Lab Technician	
Other	

Visit #2 for the complication	No. of minutes spent with client
Counselor	
Nurse/Midwife	
General Physician	
Surgeon	
Auxiliary/Attendant	
Anaesthetist	
Lab Technician	
Other	

Visit #3 for the complication	No. of minutes spent with client
Counselor	
Nurse/Midwife	
General Physician	
Surgeon	
Auxiliary/Attendant	
Anaesthetist	
Lab Technician	
Other	

7. What percentage of MC clients experience **excessive bleeding**? [ ]

8. What drugs and supplies are used to treat this complication? *(Write in)*

Drug or Supply	% of MC clients receiving this drug/supply	Number	Unit cost	Notes

9. Who provides care for this complication at the facility? How long does the average visit last?

Visit #1 for the complication	No. of minutes spent with client
Counselor	
Nurse/Midwife	
General Physician	
Surgeon	
Auxiliary/Attendant	
Anaesthetist	
Lab Technician	
Other	

Visit #2 for the complication	No. of minutes spent with client
Counselor	
Nurse/Midwife	
General Physician	
Surgeon	
Auxiliary/Attendant	
Anaesthetist	
Lab Technician	
Other	

Visit #3 for the complication	No. of minutes spent with client
Counselor	
Nurse/Midwife	
General Physician	
Surgeon	
Auxiliary/Attendant	
Anaesthetist	
Lab Technician	
Other	

10. What percentage of MC clients experience **excessive pain**? [ ]

11. What drugs and supplies are used to treat this complication? *(Write in)*

Drug or Supply	% of MC clients receiving this drug/supply	Number	Unit cost	Notes

12. What **other complication** do MC clients experience? (*Write in*)

13. What percentage of MC clients experiences this complication? [ ]

14. What drugs and supplies are used to treat this complication? *(Write in)*

Drug or Supply	% of MC clients receiving this drug/supply	Number	Unit cost	Notes

15. Who provides care for this complication at the facility? How long does the average visit last?

Visit #1 for the complication	No. of minutes spent with client
Counselor	
Nurse/Midwife	
General Physician	
Surgeon	
Auxiliary/Attendant	
Anaesthetist	
Lab Technician	
Other	

Visit #2 for the complication	No. of minutes spent with client
Counselor	
Nurse/Midwife	
General Physician	
Surgeon	
Auxiliary/Attendant	
Anaesthetist	
Lab Technician	
Other	

Visit #3 for the complication	No. of minutes spent with client
Counselor	
Nurse/Midwife	
General Physician	
Surgeon	
Auxiliary/Attendant	
Anaesthetist	
Lab Technician	
Other	

16. What **other complication** do MC clients experience? (*Write in*)

17. What percentage of MC clients experiences this complication? [ ]

18. What drugs and supplies are used to treat this complication? *(Write in)*

Drug or Supply	% of MC clients receiving this drug/supply	Number	Unit cost	Notes

19. Who provides care for this complication at the facility? How long does the average visit last?

Visit #1 for the complication	No. of minutes spent with client
Counselor	
Nurse/Midwife	
General Physician	
Surgeon	
Auxiliary/Attendant	
Anaesthetist	
Lab Technician	
Other	

Visit #2 for the complication	No. of minutes spent with client
Counselor	
Nurse/Midwife	
General Physician	
Surgeon	
Auxiliary/Attendant	
Anaesthetist	
Lab Technician	
Other	

Visit #3 for the complication	No. of minutes spent with client
Counselor	
Nurse/Midwife	
General Physician	
Surgeon	
Auxiliary/Attendant	
Anaesthetist	
Lab Technician	
Other	

C. LAB TESTS

Skip if there are no lab facilities:
20. Do MC clients with complications receive any lab tests?

Lab Tests	% of MC clients receiving this test	Number	Unit cost	Notes

D. COMMENTS

APPENDIX C. EXAMPLES OF INDIRECT COSTS

Capital costs	
Equipment	Other
Autoclave	Beds
Dental equipment	Office furniture
Examination & surgery equipment	Generator and incinerator
Physiotherapy equipment	Pharmacy equipment
Recurrent costs	
Personnel	Non-personnel
Management	Building maintenance cost
District hospital administrator	Utilities cost
Health inspector	Emergency vehicle maintenance
Assistant health inspector	
Support staff	
Senior pharmacy technician	
Pharmacy technician	
Lat technologist	
Assistant HR officer	
Technical officer	
Senior health assistant	
Health assistant	
Radiographic assistant	
Lab assistant	
Driver	
Accountant	

APPENDIX D. ASSUMPTIONS USED FOR UNIT COST ESTIMATION OF COMPREHENSIVE PACKAGE OF SERVICES

Communications

Counseling

	Pre-Circumcision	*Circumcision*	*Post-Circumcision*	*Circumcision Follow-up*
Time spent by counselor (minutes)	20	10	10	10

Testing

	Data Inputs
Commodity costs	
ELISA test	$2.34
Rapid test	$2.46
Share of tests that are Rapid Tests	80%
subtotal	$2.43
Laboratory technician costs	
Staff time per test (minutes)	10
Cost of staff time per test	$1.26
Share of MC clients tested	50%
Contribution to Unit Cost (unweighted)	$3.69
Contribution to Unit Cost	$1.85
Lab technician staff time per test (minutes)	10

Training

Training of surgical staff	
Number of training days (doctors)	1
Number of training days (nurses)	2
Number of doctors trained	20
Number of nurses trained	40
Number of staff days (doctors)	20
Number of staff days (nurses)	80
Cost of workshop	
Cost per person per training day	$68
Number of training days	100
Subtotal	$6,831
Cost of staff time	
Hours of doctors time	160
Hours of nurses time	640
Cost of doctors staff time	$1,476
Cost of nurses staff time	$4,841

Total	$13,147
Training of counselors	
Number of training days (counselors)	3
Number of counselors trained	50
Number of staff days (counselors)	150
Cost of workshop	
Cost per person per training day	$68.31
Number of training days	150
Subtotal	$10,246
Cost of staff time	
Hours of counselors time	1,200
Cost of counselors staff time	$2,447
Total	$12,693
Total Annual Training Costs	**$25,840**
Total Annual Training Costs (excl staff costs)	**$17,076**

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