



**PREVENTING HIV THROUGH SAFE  
VOLUNTARY MEDICAL MALE CIRCUMCISION  
FOR ADOLESCENT BOYS AND MEN IN  
GENERALIZED HIV EPIDEMICS**

**WEB ANNEX 2.3 PART 1**

**WHO GUIDANCE ON VOLUNTARY MEDICAL MALE  
CIRCUMCISION FOR HIV PREVENTION AMONG  
ADOLESCENT BOYS AND MEN: LITERATURE  
REVIEWS FOR PICO QUESTIONS 1–3**



**Preventing HIV through safe voluntary medical male circumcision for adolescent boys and men in generalized HIV epidemics: recommendations and key considerations. Web Annex 2.3 Part 1. WHO guidance on voluntary medical male circumcision for HIV prevention among adolescent boys and men: literature reviews for PICO questions 1–3**

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# WEB ANNEX 2.3 PART 1 WHO GUIDANCE ON VOLUNTARY MEDICAL MALE CIRCUMCISION FOR HIV PREVENTION AMONG ADOLESCENT BOYS AND MEN: LITERATURE REVIEWS FOR PICO QUESTIONS 1–3

**WHO guidance on voluntary  
medical male circumcision (VMMC)  
for HIV prevention amongst  
adolescent boys and men**

**Literature reviews for PICOs 1, 2 & 3**

**Full Report**

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## WHO guidance on voluntary medical male circumcision (VMMC) for HIV prevention amongst adolescent boys and men: Literature reviews for PICOs 1, 2 & 3

### Full Report

## BACKGROUND

This report forms the basis of the updating of WHO guidance on voluntary medical male circumcision (VMMC) for HIV prevention amongst adolescent boys and men in generalized HIV epidemics. Systematic Review Solutions Ltd. [hereafter referred to as “SRS”] was commissioned by the WHO to perform systematic identification and compilation of currently available evidence on the factors beyond evidence for the health effects of VMMC, including values and preferences, acceptability, resource use, health equity, and feasibility, on three PICO questions. These factors are vital in the Grading of Recommendations Assessment, Development and Evaluation (GRADE) Evidence-to-Decision (EtD) framework.

## METHODS

### 1. Systematic literature searching

Search Dates: We searched the literature since the scale up of the VMMC intervention in the wake of the WHO and UNAIDS 2007 recommendation covering the period from 1 January 2007 to 2 September 2018

Databases: CINAHL, Embase, LILACS, MEDLINE, PsycINFO

Search strategies were developed by a trained Information Specialist. The full strategies are enclosed in the **Appendices**. Terms such as “acceptability” and “feasibility” were not included as in the search strategy. Their inclusion could have reduced the number of abstracts identified, and potentially missed studies that reported on aspects of acceptability and feasibility without specifying this terminology.

### 2. Study selection

A quasi-systematic review approach was applied. One reviewer screened all literature search results and full-text articles of potentially eligible titles or abstracts were retrieved for further assessment. The same reviewer assessed the full texts against eligibility criteria (below) and studies reporting measures on relative values and preferences, acceptability, resource use, equity/ethics and feasibility of VMMC as an HIV prevention method published in an English-language peer-reviewed journal were included.

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### 3. Eligibility criteria

**PICO Question 1:** Male circumcision to reduce risk of HIV acquisition through heterosexual exposure

**Population:** HIV uninfected uncircumcised men and adolescent boys at risk of HIV infection through heterosexual intercourse

**Intervention:** Voluntary medical male circumcision (VMMC)

**Included evidence:**

- Of relative values and preference placed on the following outcomes: HIV infection of circumcised male, HIV infection of female sexual partner, HIV infection in the community, and complications of circumcision (e.g. more importance placed on complications of the procedure than benefit of reduction in the risk of HIV in males and their partners)
  - Synthesize evidence separately for populations whose values and preferences are being elicited – adolescent boys, adult men, women (sexual partners of men undergoing VMMC), and the community
- Of the variability in the aforementioned outcome valuations (e.g. one subgroup assigned different relative values, or within a subgroup the range of values or standard deviations)
- Cost data of VMMC – costs for individuals and cost for coverage programs separately synthesized noting the currency of cost data.
- Also note the variability in cost estimates (e.g. range, standard deviation, etc), and obvious study validity and generalizability limitations corresponding to the cost estimations.
- Of subgroups or subpopulations who may be disadvantaged in receipt of VMMC
- Of subgroups in whom VMMC may be less effective for non-physiologic reasons (e.g. drug addicts)
- Regarding subgroups of males, their partners, health policy makers, healthcare funding organizations who find VMMC unacceptable and why
- Investigating constraints or barriers in implementing VMMC recommendations and what those constraints are and why

**Excluded evidence:**

- Population already has HIV
- Reason for circumcision is medical and not to prevent HIV in healthy sexually active heterosexual males

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## **PICO Question 2: Device-based versus conventional surgical VMMC**

**Intervention:** Device-based VMMC

**Population:** HIV uninfected uncircumcised men and adolescent boys at risk of HIV infection through heterosexual intercourse

### **Include evidence:**

- Of relative values and preference placed on the following outcomes: adequate removal of the foreskin, cosmesis, pain (in preparation for, during or after procedure, while wearing or removal of device), inconvenience and odor while wearing the device, complications of the procedure, procedure time, period of post-procedure sexual abstinence, burden of required follow-up visits, and time to return to normal daily activities
  - Synthesize evidence separately for populations whose values and preferences are being elicited – adolescent boys, adult men, women (sexual partners of men undergoing VMMC), and the community
- Of the variability in the aforementioned outcome valuations (e.g. one subgroup assigned different relative values, or within a subgroup the range of values or standard deviations)
- Cost data of device based VMMC and conventional surgical VMMC (the latter might have been obtained for Q1) – costs for individuals and cost for coverage programs separately synthesized noting the currency of cost data.
- Also note the variability in cost estimates (e.g. range, standard deviation, etc), and obvious study validity and generalizability limitations corresponding to the cost estimations.
- Of subgroups or subpopulations who may be disadvantaged in receipt of device-based VMMC
- Of subgroups in whom device-based VMMC may be less effective for non-physiologic reasons (e.g. drug addicts)
- Regarding subgroups of males, their partners, health policy makers, healthcare funding organizations who find device-based VMMC unacceptable and why
- Investigating constraints or barriers in implementing device-based VMMC recommendations and what those constraints are and why

### **Excluded evidence:**

- Population already has HIV
- Reason for circumcision is medical and not to prevent HIV in healthy sexually active heterosexual males

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- Evidence pertains to conventional surgical VMMC (which is covered in Q1 above)

### **PICO Question 3: VMMC in younger adolescent boys versus delayed VMMC**

**Population:** HIV uninfected uncircumcised boys aged 10-14 years at a future risk of HIV infection through heterosexual intercourse

**Intervention:** VMMC (device based or conventional surgical) at ages 10-14 years when genitalia are not yet physically mature or foreskin not retractable

#### **Included evidence:**

- Of relative values and preference placed on the following outcomes: adequate removal of the foreskin, cosmesis, psychological distress, pain (in preparation for, during or after procedure, while wearing or removal of device), inconvenience and odour while wearing the device, complications of the procedure, procedure time, burden of required follow-up visits, and time to return to normal daily activities
  - Synthesize evidence separately for populations whose values and preferences are being elicited – adolescent boys, their parents/guardians, and the community
- Of the variability in the aforementioned outcome valuations (e.g. one subgroup assigned different relative values, or within a subgroup the range of values or standard deviations)
- Are there stakeholders who find VMMC between 10 -14 years of age unacceptable and why
- Investigating constraints or barriers in implementing VMMC (between 10 – 14 years of age) recommendations (that are uniquely different from constraints and barriers identified in PICO 1 and 2 because of younger age criterion) and what those constraints are and why

#### **Excluded evidence:**

- Population already has HIV
- Reason for circumcision is medical and not to prevent HIV in healthy sexually active heterosexual males

## **4. Evidence synthesis**

Since the objectives were to conduct literature reviews of the other factors in the GRADE evidence-to-decisions framework for the three PICO questions (i.e. values and preference, resource requirements and costs, health equity, acceptability, and feasibility), no formal risk of bias assessment was performed; a scoping and targeted narrative evidence synthesis approach was used to present findings.

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## 5. Results

### Literature search results

	No. of references
PICO 1	861
PICO 2	1800
PICO 3	1856
Records from electronic sources for 3 PICOs	4517
Included references from e-sources	112
Additional references from other sources	14
Nominated reference (recently published, outside of systematic literature search period)	1
<b>TOTAL no. of references included in report</b>	<b>127</b>

## EVIDENCE SYNTHESIS

### PICO 1: Voluntary medical male circumcision (VMMC) vs. no VMMC for reducing risk of HIV acquisition through heterosexual exposure

<b>Population</b>	<ul style="list-style-type: none"> <li>HIV uninfected uncircumcised men and adolescent boys at risk of HIV infection through heterosexual intercourse</li> </ul>
<b>Intervention</b>	<ul style="list-style-type: none"> <li>VMMC (i.e. complete removal of the foreskin)</li> </ul>
<b>Comparator</b>	<ul style="list-style-type: none"> <li>No VMMC</li> </ul>
<b>Outcomes</b>	<ul style="list-style-type: none"> <li>Incidence of HIV infection in circumcised men and adolescent boys</li> <li>HIV incidence in female sexual partners of circumcised males</li> <li>HIV incidence in community</li> <li>Complications of VMMC</li> </ul>

## VALUES & PREFERENCES

**GRADE EtD criterion: Is there important uncertainty about or variability in how much people value the main outcomes?**

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What is the relative importance that men, women and community place on the outcomes (HIV infection of circumcised male, HIV infection of female sexual partner, HIV infection in the community, complications)? Is there important uncertainty and variability in assigned relative importance?

### Summary

Due to lack of research evidence (N=0) on relative importance that men, women or community place on the outcomes (HIV infection of circumcised male, HIV infection of female sexual partner, HIV infection in the community, complications), it is not possible to assess if there are any important uncertainties and variabilities in the assigned relative importance. However, studies providing indirect evidence on the key factors behind the decision to undergo VMMC are available (refer to section 'Acceptability').

## ACCEPTABILITY

### GRADE EtD criterion: Is the intervention acceptable to key stakeholders?

Are there stakeholders (adult males, their partners, communities, health policy makers, healthcare funding organizations) who:

- think that the balance of benefits and harms does not favour VMMC because of higher costs or higher values for safety concerns?
- find VMMC morally, religiously, or ethically unacceptable?

### Summary

A total of 70 included studies (conducted in Botswana, China, Dominican Republic, Haiti, India, Jamaica, Kenya, Lesotho, Malawi, Papua New Guinea, Rwanda, South Africa, Swaziland, Tanzania, Thailand, Uganda, Zambia, Zimbabwe) assessed acceptability of VMMC {Adams, 2015; Albert, 2011; Brito, 2009; Brito, 2010; Chikutsa, 2015; Chikutsa, 2015; Chiringa, 2016; Cook, 2016; DeCelles, 2016; Dévieux 2015; Evens 2014; Francis 2012; George 2014; George 2017a; Gilbert 2018; Gurman 2015; Hatzold 2014; Herman-Roloff 2011; Hoffman 2015; Huang 2013; Ikwegbue, 2015; Jayeoba 2012; Jiang, 2013; Jiang, 2015; Jones, 2014; Kaufman MR, 2016; Kaufman ZA, 2016; Kaufman MR, 2018; Kelly, 2013; Khumalo-Sakutukwa, 2013; Kibira, 2015; Kibira, 2017; Kong, 2014; Lanham, 2012; Lilleston, 2017; Lukobo, 2007; Macintyre, 2014; MacLaren, 2013; Maraux, 2017; Marshall, 2016; Mati, 2016; Mavhu, 2011; Miiro, 2017; Montano, 2014; Moyo, 2015; Mwanga 2011; Nakyanjo 2018; Nevin 2015; Osaki 2015; Peltzer 2014; Plotkin 2013; Price 2014; Rennie 2015; Rupfutse 2014; Sahay 2014; Shacham 2014; Siegler 2012; Skolnik 2014; Ssekubugu 2013; Sullivan 2009; Tapera 2017; Tieu 2010; Tynan 2013; Walcott 2013; Wang 2016; Westercamp 2012; Wilcken 2010; Wirth 2016; Yang

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2012; Zulu 2015}. The age of the participants in the included studies ranged from 10 to 86 years and the sample sizes ranged from 20 to 4874 participants.

The study designs of the included studies are as follows: *cluster randomized trial* {Cook, 2016; Kaufman ZA, 2016}; *qualitative study* {Adams, 2015; Brito, 2010; Chikutsa, 2015; Chiringa, 2016; DeCelles, 2016; Evens 2014; George 2014; George 2017a; Gilbert 2018; Herman-Roloff 2011; Kibira, 2017; Lanham, 2012; Lilleston, 2017; Lukobo, 2007; Macintyre, 2014; Moyo, 2015; Mwangi 2011; Nevin 2015; Tynan 2013; Wilcken 2010; Wirth 2016}; *mixed-methods study* {Albert, 2011; Hatzold 2014; Miiro, 2017; Montano, 2014}; *cross-sectional study* {Brito, 2009; Chikutsa, 2015; Chiringa, 2016; Dévieux 2015; Francis 2012; Gurman 2015; Hoffman 2015; Huang 2013; Ikwegbue, 2015; Jayeoba 2012; Jiang, 2013; Jiang, 2015; Jones, 2014; Kaufman MR, 2018; Kelly, 2013; Khumalo-Sakutukwa, 2013; Kibira, 2015; Kong, 2014; MacLaren, 2013; Maraux, 2017; Marshall, 2016; Mati, 2016; Mavhu, 2011; Nakyanjo 2018; Osaki 2015; Peltzer 2014; Plotkin 2013; Price 2014; Rennie 2015; Rupfutse 2014; Sahay 2014; Shacham 2014; Siegler 2012; Skolnik 2014; Ssekubugu 2013; Sullivan 2009; Tapera 2017; Tieu 2010; Walcott 2013; Wang 2016; Westercamp 2012; Yang 2012; Zulu 2015}; and *systematic review* of VMMC services for male adolescents in sub-Saharan Africa {Kaufman MR, 2016}.

The majority of the included studies (n=62) assessed acceptability of VMMC in males; 29 studies assessed acceptability of VMMC by females; one study explored acceptability of VMMC by communities {Rupfutse 2014}; two studies assessed acceptability of VMMC by healthcare providers {Albert 2011; Dévieux 2015}; one study explored acceptability of VMMC by policy-makers {Mwangi 2011}.

Many included studies were qualitative studies and employed the cross-sectional design. Some studies used a convenience sample thus limiting the extrapolation of results to the general population. Some studies used self-administered questionnaire for collecting data leading to social desirability bias and recall bias. Some studies had small sample size. In some studies the survey response rates were low.

## **Perspectives from males and females**

### ***Overall acceptability and willingness to undergo VMMC***

Acceptance rate and willingness to undergo VMMC in males and females were reported in 13 studies {Albert, 2011; Brito, 2009; Brito, 2010; Hatzold 2014; Huang, 2013; Jiang, 2013; Kong, 2014; Maraux,

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2017; Mati 2016; Peltzer 2014; Siegler 2012; Marshall, 2016; Zulu, 2015}. These studies collected data between year 2007 and 2015 with men and women aged between 15 to 50 years (please refer to the table below for further detail). In one study in the Dominican Republic, the overall acceptability of VMMC was 29%; the number of men willing to be circumcised increased to 67% after an information session explaining the benefits of the procedure. 74% of men reported that they would be willing to circumcise their sons after hearing that information {Brito, 2009}. Another study in South Africa found that 73.7% of women reported a preference for circumcised partners and a total of 95.8% preferred to have their male children circumcised; when the respondents were asked if they have an uncircumcised partner whether they would accept that he undergo circumcision, 93.0% replied yes {Maraux, 2017}.

Study ID	Country	Age range	Year of data collection	Acceptability	
				Man	Women
Albert 2011	Uganda	18 years or older	2008	40% - 62%	-
Brito 2009	Dominican Republic (Altagracia province)	18 - 50 years	2008	67%	-
Brito 2010	Dominican Republic (Altagracia province)	18 - 50 years	2007 - 2008	50%	>50%
Hatzold 2014	Zimbabwe	15 - 49 years	2010 - 2013	49%	71.10%
Huang 2013	China	18 - 45 years	2009 - 2010	45.20%	-
Jiang 2013	China	18 - 50 years	2009	37.30%	-
Kong 2014		15 - 49 years	2010 - 2011	44%	-
Maraux 2017	South Africa	15 - 49 years	2007 - 2012	-	73.7% - 93%
Mati 2016	Uganda	15 years or older	2011	-	67%
Peltzer 2014	South Africa	15 - 49 years	unclear	15-24 years, 45.7%; 25-49 years, 28.3%;	15-24 years, 60.6% 25-49 years, 63.3%
Siegler 2012	Northern Tanzania	18 - 50 years	2008	28% - 84%	-
Marshall 2016	South Africa	18 - 49 years	2015	84.90%	-
Zulu 2015	Zambia	18 years or older	2012 - 2014	96%*	94%*

\*These are the percentages of a subgroup population whom underwent VMMC

Findings of a qualitative study showed that about half the men and the majority of women in the Dominican Republic were accepting of VMMC {Brito, 2010}. Between 40% and 62% of uncircumcised men in Uganda were willing to consider VMMC for themselves {Albert, 2011}; survey participants preferred circumcision at younger ages (i.e., 0-9 years), rather than during adolescence or adulthood, and almost all circumcised men supported circumcision of their sons {Albert, 2011}.

In Zimbabwe, 49% men reported willingness to undergo VMMC; 71.1% of women who had heard about VMMC reported being supportive of their male partner being circumcised; 76.8% of both male

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& female respondents reported willingness to have their son circumcised; and 75% of those who had heard about VMMC would recommend VMMC to their peers {Hatzold 2014}.

A study conducted in China found that, of the 1304 participants, 589 (45.2%) reported acceptance of VMMC. Among the participants who refused VMMC (n =715 out of a total 1304), the majority (93.3%) believed that VMMC would not be effective, 2.9% worried about the reduction in sexual ability and 2.9% had concerns about the cost of VMMC surgery {Huang 2013}. Another study in China identified the rates of willingness to accept VMMC ranged from 25.6% (147/575) in Guangxi to 41.1% (308/750) in Chongqing and 44.0% (255/579) in Xianjiang (overall rate: 37.3% (n=710)) {Jiang 2013}.

Forty four percent (2,516) of uncircumcised men were willing to be circumcised in a study in Uganda and 27.3 % of uncircumcised men indicated their willingness to adopt the procedure in the future and 26.3 % men were unwilling to accept the procedure even it is offered free {Kong 2014}. Also in Uganda, a survey revealed 67 % (n=3276) of married women were supportive of VMMC (i.e. they were willing to recommend VMMC to their male relatives) {Mati 2016}. Another survey conducted in South Africa reported that, among 15-24 years old, 45.7% indicated that they would consider being circumcised compared to 28.3% among 25-49 years old males; 60.6% of 15-24 years old and 63.3% of 25-49 years old females indicated that they would be supportive of their partners getting circumcised {Peltzer 2014}.

In Northern Tanzania, acceptability of providing sons with VMMC varied from 28 to 84 %, depending on hypothetical contingencies: without any contingencies, only 28 % of respondents were willing to provide VMMC to their sons despite stated benefits of partial protection against HIV; given a VMMC procedure that would maintain the appearance of Maasai traditional practitioner male circumcision (appendage below the glans of the penis), 56 % stated willingness to provide VMMC. If the contingency was Maasai traditional leadership support for VMMC; 84 % indicated willingness to provide VMMC {Siegler 2012}.

In one study, 84.9% (79.2% to 89.5%) of uncircumcised adult men in South Africa reported that they were willing to be circumcised {Marshall, 2016}. Post-VMMC survey, a component of the prospective cluster-randomized Spear and Shield study, which consists of weekly, 90-minute sexual risk reduction/VMMC promotion sessions in Zambia {Zulu 2015}, found that 96% of participants (n=245) indicated they would recommend VMMC to a friend and 94% (n=150) of female partners reported they would recommend VMMC {Zulu 2015}.

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### ***Facilitators and barriers to acceptability of VMMC***

A wide array of facilitators and barriers to acceptability of VMMC are summarized below. The 3 most common themes of facilitators reported were: knowledge of HIV/STI prevention, improved penile hygiene, and improved sexual activity/pleasure; the 3 most common barriers were fear of pain and injury, complications/adverse effects, and time off work (**Table 1**).

### ***Perspectives from adolescent males and females***

A comprehensive systematic literature review identified a total of 29 Studies that focused on VMMC services of younger men/adolescent males {Kaufman 2016}. The authors considered broad age group (10 to 24 years old) as “adolescents” or “young males”. Barriers to acceptability were: (1) structural factors, such as the need to take time off from work, traveling far distances, timing of recruitment (less likely to respond to VMMC recruitment when engaged in sports and during school exam periods); (2) disregard for privacy (need for private waiting rooms); (3) fear of pain and HIV testing (feared a positive result and subsequent stigma); (4) a desire for elements of traditional non-medical methods of circumcision (unwillingness due to religious and/or cultural reasons, notions of manhood, and social disapproval). Facilitators were: (1) parental involvement (parents provided with information on the procedure and its advantages) and shared decision-making between parents and male adolescents; (2) perceived benefits of VMMC e.g. improved hygiene, increased ability to sexually satisfy partners, to have access to more women, more likely to be sexually active if they were circumcised because they believed they were impervious to STIs, no need to use condoms after VMMC; (3) understanding of VMMC (knowledge about the procedure and its protective effects, including impact on prevention of HIV/STDs for both men and women) {Kaufman MR, 2016}.

Qualitative data demonstrated both “Make the Cut” (MTC) and “Make the Cut+” (MTC+) as acceptable and as offering an effective approach toward increasing VMMC uptake among males in Zimbabwe {DeCelles 2016}. Both MTC and MTC+ consisted of a 60-minute interactive, soccer-themed educational session delivered by circumcised male community leaders (“coaches”). MTC targeted men ages 18–30 from Bulawayo soccer teams whereas MTC+ targeted secondary school boys ages 14–19 in Bulawayo. Qualitative findings show that the curriculum offers a feasible approach toward VMMC promotion. Participants cited the “Coach’s Story”, a motivating personal story from the facilitator about his experience undergoing and recovering from VMMC, as a motivational component of the curriculum. Both MTC and MTC+ participants expressed appreciation for their coaches. Amongst MTC participants, older men were reported to lack motivation to undergo VMMC because they believed that HIV testing and VMMC would make little difference at

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their age. For MTC+ participants, they particularly valued their coaches' openness and honesty when discussing VMMC. MTC+ participants also shared that they highly valued the coach accompaniment to the VMMC clinic and paid transport {DeCelles 2016}.

A cluster-randomized trial assessing the effectiveness of MTC+ in Zimbabwe found strong evidence that it increased the odds of VMMC uptake by approximately 2.5 fold (odds ratio = 2.53; 95% confidence interval, 1.21 to 5.30); restricting to participants who did not report being already circumcised at baseline, MTC+ increased VMMC uptake by 7.6% (12.2% vs 4.6%, odds ratio = 2.65; 95% confidence interval, 1.19 to 5.86) {Kaufman ZA, 2016}.

A more recent mixed-methods (quantitative and qualitative) approach to explore the acceptability of VMMC in Uganda identified the following key facilitators and barriers: (1) family and social support, where the attitudes of family and peers as well as their encouragement were central to the decision to become circumcised; (2) crucial role of coaches, with explanation of information regarding circumcision including the healing process and the discussion of the myths or misconceptions; (3) health benefits of improving genital hygiene and reducing the risk of being infected with HIV. Barriers to uptake include: fear of pain, loss of contact with their coaches, and influence of family/social circles (some family members who threatened not to care for the boys if they underwent the procedure) {Miiro 2017}.

A recent qualitative study involving adolescent females and post-VMMC adolescent males from South African, Tanzania and Zimbabwe reported that adolescent female participants were supportive of male peers' decisions to seek VMMC, and the females participants' beliefs regarding VMMC benefits were: the protection against HIV infection, sexually transmitted infections, and cervical cancer in the female sexual partners of circumcised males. For adolescent males, sexual partners' preference regarding VMMC influenced their decision and female encouragement was a motivating factor {Kaufman MR, 2018}.

### **Communities' perspectives**

One study assessed acceptability of VMMC by village heads in the Mazowe district, Zimbabwe. Prevention of HIV, sexually transmitted diseases and cervical cancer in female partners were raised as benefits of VMMC {Rupfute 2014}. One barrier to uptake of VMMC was highlighted as the inappropriateness of male circumcision among the Shona who are mainly Christians since male circumcision is culturally and religiously practised by Muslims and/or Nyanja people; adverse effects of VMMC such as excessive pain, excessive swelling, disfigurement of the male sexual organ, long

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abstinence period, reduction of sexual performance and pleasure, as well as death, were also mentioned as barriers {Rupfutse 2014}.

### **Providers' perspectives**

Two studies assessed acceptability of VMMC by healthcare providers {Albert, 2011; Dévieux, 2015}. One study reported that approximately 76% healthcare professionals in Haiti believed that their male patients would accept circumcision for the prevention of HIV/STIs {Dévieux, 2015}, with just over half of the healthcare providers (59%) believing that VMMC should be offered at no cost to the patient. However, it is worth noting that, when asked about effect of VMMC on sexual pleasure or risk of penile cancer, 40% of healthcare providers did not know the answer {Dévieux, 2015}. In another study, participants (adult males) in Uganda stated preference of circumcision at younger ages (i.e., 0-9 years) rather than during adolescence or adulthood, and a similar observation was also reported amongst healthcare providers {Albert, 2011}.

### **Policy-makers' perspectives**

One study assessed acceptability of VMMC by key informants who are viewed as policy-makers in Tanzania {Mwanga 2011}. Adherence to traditional customs was found to be the most important factor, which influence people to undergo circumcision in traditionally circumcising communities such as the Kurya of Mara region. In addition, religion was mentioned to influence circumcision, where it was reported that both Muslims and Christians are required by their religious faiths to get circumcised so as to adhere to religious purity. Despite of having a few Muslims in the study sample (11%), it was pointed out by many informants, predominantly Christians, from traditionally non-circumcising communities that Islamic faith insists on its believers to get circumcised. The majority of Key Informants (94%) said that, if the services should be paid for, the amount should not exceed roughly USD \$3 per person. Otherwise they suggested that the government should provide VMMC services free of charge due to prevailing economic hardships facing many Tanzanians particularly those living in rural areas with no reliable sources of income. Alternatively, payment in kind (equivalent of the cost of farm produce) was also suggested.

### **Key points**

The overall evidence suggests that men and women in general are accepting of VMMC for themselves/partners/children. Ten of the 13 studies involved participants between the age of 18 and 50 years; and the other three studies involved some participants beyond the age of 50 years. One study stratified acceptability by age and found more younger male are accepting of VMMC (15-

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24 years, 45.7%) than the older group (25-49 years, 28.3%) {Peltzer 2014}. None of the other studies reported acceptability by age group. Most of the evidence is derived from qualitative and cross-sectional study designs and a potential source of bias one should be concerned about is volunteer bias. Of all the eligible individuals, only those who agreed to undergo VMMC or agreed to participate in the survey/study had their views captured and analysed. Thus, those who decided not to answer the questionnaires/provide feedback or be enrolled in the study may be systematically different from those who did, thereby limiting our confidence in assessment of acceptability of the procedure. Knowledge of intervention benefits (reduced risks of HIV/STI) is a common facilitator to acceptability of VMMC, as well as improved hygiene and increased sexual pleasure/activity. Evidence also pointed to a number of barriers, with fear of pain, complications, financial loss and time constraints being the common issues that impacted on the acceptance of VMMC, thus reducing its uptake. Village heads from an ethnic community in Zimbabwe highlighted several barriers to acceptability such as religion factors, pain and swelling, organ disfigurement, long abstinence period, reduced sexual performance and pleasure. Key informants within a policy environment felt that the cost of VMMC per person should not exceed USD \$3 and also suggested an in-kind payment. Healthcare providers felt that VMMC should be done at younger ages (0-9 years) and should be offered at no cost, especially to those in rural areas.

## RESOURCE USE

**GRADE EtD criteria: (1) How large are the resource requirements? (2) What is the certainty of evidence for resource requirements?**

(1) How large are costs for VMMC for: (i) individuals; (ii) coverage programs?

(2) We did not specifically address any questions on criterion 2; obvious limitations in costing evidence, associated variability in cost estimation, and its applicability to other geographic regions (and different costs for various VMMC approaches) where reported are summarized below.

### Summary

#### **Costs per HIV infection averted (HIA) & Costs per VMMC procedure**

Nine studies reported data on cost per VMMC procedure for individuals (adults or adolescents) {Alfonso, 2016; Bautista-Arredondo 2018; Binagwaho, 2010; Galárraga, 2009; Galarraga, 2017; George, 2017b; Marseille, 2014; Tchuenche, 2016b; Torres-Rueda, 2018}. The estimated costs per VMMC procedure ranged from USD \$23 to \$191 in various countries located in African continent and are summarized in **Table 2**. The lowest (USD \$23) and the highest (USD \$191) costs per VMMC procedure in adults were reported in Uganda (Rakai region) and Tanzania (Njombe), respectively.

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The cost per HIV infection averted (HIA) in adults ranged from USD \$117 (Kenya) {Marseille, 2014} to \$4949 (Rwanda) {Binagwaho, 2010} (**Table 2**). The cost per HIA in adolescents ranged from USD \$804 to \$3932 {Binagwaho, 2010; Tumwesigyea, 2013}. The slight variability in the estimates for cost per HIA reported in the included studies may be attributed to the variable prevalence rates of HIV infections in different countries in Africa. Also, many of the included studies used data on specific regions within a country in Africa and thus may limit generalizability.

A few studies {Bautista-Arredondo 2018; Galárraga 2009; Uthman 2010; White 2008} reported cost data for a larger population across Africa and thus have better generalizability. A systematic review of 5 VMMC studies in South Africa, Uganda, Lesotho, Swaziland and sub-Saharan Africa reported the cost per VMMC procedure in South Africa at USD \$55 {Galárraga 2009}. The costs per HIA by the intervention targeted at 15–49 year old age group, over various duration of time, were as follows: 2 years, USD\$1806 (1327–3554); 5 years, USD\$974 (691–1964); 10 years, \$431 (308–842); 20 years, \$195 (143–356); 30 years, \$132 (100–232); 40 years, \$104 (81–179); and 50 years, \$89 (71– 150) {White 2008}. One study reported that In Malawi, South Africa, Swaziland, Tanzania, and Uganda, the lowest cost per HIA could be achieved by circumcising males aged 15–34 {Kripke, 2016a}. A systematic review {Uthman, 2010} on adult VMMC for prevention of heterosexual acquisition of HIV in men provided compelling evidence that VMMC intervention in adults is cost-effective and potentially cost-saving. The cost per HIA reported in this systematic review ranged from US\$174 to US\$2808 {Uthman, 2010}.

One study {Tumwesigyea, 2013} stated that the lower costs in Uganda can be explained by lower costs of personnel, consumables, capital costs, maintenance and utility (personnel US\$ 6.68, consumables US\$8.84, capital US\$0.36 and maintenance US\$0.41) compared to Southern Africa (personnel US\$15.50, consumables US\$11.98, capital US\$2.07 and maintenance and utility US\$3.10).

Data on the average cost per VMMC client in 107 facilities in Kenya, Rwanda, South Africa, and Zambia were recently published {Bautista-Arredondo 2018}. Average VMMC unit cost ranged from US\$66 in Kenya to US\$160 in South Africa. Staff costs represented the largest components of VMMC unit cost in all countries, with circumcision kits and HIV test kits contributing to the second largest shares. Further data on the breakdown of costs for staff associated with VMMC service delivery indicated that nurses dominated the provision of VMMC in Rwanda, South Africa, and Zambia while physicians played important roles in Kenya and South Africa {Bautista-Arredondo 2018}. This does not imply that the nurse domination of the provision of VMMC was supported by cost savings.

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Cost savings on personnel were attributed to task shifting from physicians to clinical officers at both mobile camps and static centers in Uganda {Alfonso 2016}. In cases where surgeons without previous experience of adult circumcision, cost savings on static service center surgeries were attributed to efficiency gains from clinicians completing a guided training at the beginning of program implementation {Alfonso 2016}. Compared to the cost of disposable kits (USD \$15.60–US\$20.80), use of re-usable kits (US\$8.46) in Uganda resulted in savings of 46-59% {Kuznik, 2012}.

Association of VMMC total costs with supply-side factors across 107 facilities in Kenya, Rwanda, South Africa, and Zambia were explored {Bautista-Arredondo 2018}. Staff experience and VMMC outreach were positively associated with VMMC unit cost, whereas level of service provision (primary health care facilities vs. hospitals), and the delegation of tasks to less specialized staff (task shifting) were negatively associated with cost per VMMC client.

One study provided client out-of-pocket costs and found that the average transport costs for respondents was US\$9.20; eight clients (4%) reported wages lost and indirect expenditures were childcare (one client) and miscellaneous items such as food or medicine (20 clients) {Tchuenche 2016a}.

One study reported costs of VMMC program over the first 5 years at \$919 million (95% PI: 726 to 1 245) in sub-Saharan Africa {Auvert 2008}. Another study reported costs of USD \$61 for a mobile program (\$72 for more remote locations) compared to \$34 for a typical fixed-site program in Uganda; costs for community mobilization, HIV testing, the initial medical exam, and staff for performing VMMC operations were similar for both programs {Larson 2015}.

### **Key points**

The per-procedure costs for VMMC ranged from \$23-\$191. The cost per HIV infection averted (HIA) in adults ranged from USD \$117 to \$4949. The cost per HIA in adolescents ranged from USD \$804 to \$3932. Supply-side factors including level of service provision (primary health care facilities vs. hospitals), implementation of task-shifting, staff experience and VMMC outreach have been reported to associate with variations of VMMC costs; in other words, improvement of these factors leads to reduction of VMMC cost. No obvious limitations in study validity and generalizability corresponding to the cost estimations were noted.

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### **GRADE EtD criterion: (3) Does the cost-effectiveness of the intervention favour the intervention or the comparison?**

Subsequent to the 2007 WHO recommendations for VMMC, findings from relevant evidence syntheses and modelling studies (as provided by the WHO and by our literature search) are summarised below.

#### **Summary on cost-effectiveness estimates**

VMMC is listed as 1 of 44 surgical procedures as essential on the basis that they address substantial needs, are cost-effective, and can feasibly be implemented, by the World Bank Disease Control Priorities Third Edition (DCP3) {Debas 2015}. Findings from 10 references are summarized below {Binagwaho, 2010; Galárraga 2009; George 2017; Kaufman, 2016; Kripke, 2016a; Kripke, 2016b; Kuznik, 2012; Marseille, 2014; Torres-Rueda 2018; WHO 2017}.

One study conducted in Tanzania reported that the Intervention arm (demand strategy) as compared to standard care had lower cost per HIA: Njombe (USD \$1424 vs. \$1917); Tabora (USD \$2212 vs. \$3018) {Torres-Rueda, 2018}. Another reported that, if the horizontal APHIA-II program and the diagonal NRHS program are implemented in a setting with half the incidence of Nyanza, Kenya, cost-effectiveness ranges from \$234.58 to \$316.64 per HIA. In settings with HIV incidence 50% higher than in Nyanza, the cost per HIA ranges from \$78.18 to \$108.02" {Marseille, 2014}. One study compared VMMC services via different demand creation strategies in South Africa (KwaZulu-Natal): (1) recruited by school outreach teams from Monday to Thursday; Friday and Saturday to undergo VMMC; (2) recruited by both school outreach teams and peer recruiters from Monday to Friday; Saturday to undergo VMMC; costs per circumcision were USD \$90.09 and USD \$60.60, respectively {George 2017b}. One study reported that VMMC was cost-effective even at a higher cost of US\$69 per circumcision and the cost-effectiveness in Lesotho and Swaziland were reported to be USD \$292 and USD \$176 respectively {Galárraga 2009}.

A comprehensive report {WHO 2017} provided the following findings:

#### DMPPT model version 2

In Malawi, South Africa, Swaziland, Uganda and Tanzania, a scenario in which circumcision was scaled up from the pre-intervention prevalence to 80% over the period 2014–2018 in separate five-year age strata was run and the impact and costs projected forward over a 15-year period. Broadly similar results were obtained in each of the five countries.

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1. The lowest estimated numbers of circumcisions per HIA over 15 years were in the 20–24-, 25–29- and 30–34-year age strata, with minor differences between these three strata.
2. The numbers of circumcisions per HIA in other age strata were considerably greater, particularly at the extremes of the age ranges (10–14 and 45–49 years).
3. While the 10–14-year age stratum contributed little to the total number of HIAs over the 15-year time frame, a greater impact would be realized over the longer term.

An updated analysis using the DMPPT 2 model was conducted to estimate the impact of circumcisions performed to end 2014 over 14 priority countries in East and Southern Africa (Botswana, Ethiopia, Kenya, Lesotho, Malawi, Mozambique, Namibia, Rwanda, South Africa, Swaziland, Tanzania, Uganda, Zambia and Zimbabwe). The circumcisions performed by end 2014 were projected to avert 240 000 new HIV infections by 2025 compared with 1.1 million by 2025 if coverage had reached 80% by 2015 and was maintained through 2025. The age stratum 10–19 years represented 66% of circumcisions performed by 2014 and was projected to contribute 52% of the total number of HIAs by 2025. The estimated median cost per HIA of US\$ 4400, calculated in the specific context of ART scale-up, compared favourably with the costs of other prevention interventions (treatment as prevention, prevention of MTCT of HIV) that had been estimated without taking account of the new UNAIDS treatment scale-up goals.

#### Incremental Analysis model

1. In South Africa, the projected annual risk of HIV infection for a circumcised and uncircumcised man: The model projected annual HIV incidence over the period 2013–2058 (45 years) for an uncircumcised and circumcised male aged 0, 15, 20, ..., 40 years in 2013. The greatest reduction in annual HIV risk occurred for circumcisions performed about age 25 years, which corresponded to the age of highest HIV incidence. The greatest reduction in direct lifetime HIV risk is seen among young men, although the impact is delayed by 15 years for circumcision performed at age 0. The indirect effects (secondary and higher order transmissions) were proportionately less for circumcisions performed at older ages compared with those performed at younger ages.
2. Between four and five circumcisions were required to prevent one HIV infection for procedures performed at ages 0, 10, 15 and 20 years; however, the number rose steeply for older age groups. This was due to the falling HIV incidence in older men and the lack of time for the benefit of prevented secondary and higher order transmissions to be realized.

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3. Compared with circumcisions performed at other ages, those performed at 15, 20 or 25 years were near optimal with respect to the number of circumcisions required to prevent one HIV infection, the discounted cost per HIA, net saving, amortization period and financial rate of return.
4. The financial savings due to circumcision accrued over very long time periods and could help contain the cost of the HIV response. The one-off cost per HIA of circumcision performed at younger ages was similar to the annual cost of antiretroviral medication for HIV treatment.
5. Since people living with HIV infection have a near normal life expectancy while under treatment, the cost savings from circumcision can be many times higher than the costs of the circumcision procedure.

#### ASM model

A very similar conclusion was reached by use of the ASM model applied to the populations of Zambia and Zimbabwe, which considered scale-up scenarios starting in 2010 to reach 80% coverage in specified five-year age groups by 2017 and then projected impact forward through 2025. In both countries, the most immediate impact was derived from circumcision in older age strata, but over the 15-year time frame considered circumcising younger men (under age 30 years) had greater absolute impact on the number of HIAs and resulted in fewer circumcisions per infection averted and lower costs per infection averted. Impact was estimated to increase further beyond 2025.

Impact of scaling up to 80% circumcision coverage in specific five-year age strata over seven years (2011–2017) and maintained through 2050 compared with baseline scenario of no VMMC programme (example from ASM model applied to Zambia) as per cost/HIV infection averted (USD\$):

Targeted age groups: 10-14 (\$1759), 15-19 (\$1045), 20-24 (\$888), 25-29 (\$1117), 30-34 (\$1396), 35-39 (\$1561), 40-44 (\$2187), 45-49 (\$3300)

#### Goals model

Impact of VMMC programmes in four countries (Lesotho, Malawi, South Africa and Uganda) in the context of expanding ART to the 90–90–90 treatment coverage goal by 2020, as well as several scenarios under which the goal was not reached. Across all four countries, scaling up VMMC was projected to reduce HIV incidence, adding to the reductions attributable to expanding treatment to the 90–90–90 targets. While this required additional short-term costs, total annual costs were projected to be lower from 2020.

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Adolescent VMMC was concluded to be highly cost-effective for the base case scenario but this high cost-effectiveness is not robust to small changes in the input variables. Adult VMMC is neither cost-saving nor highly cost-effective when considering only the direct benefit for the circumcised man {Binagwaho, 2010}.

Effectiveness of Make-The-Cut-Plus (MTC+) (a single, 60-minute, sport based intervention to increase VMMC uptake targeting secondary school boys (14–20 years)) - Implementing MTC+ with 565 intervention participants cost a total of \$1121.83 or \$1.99 per participant. Forty-one of these participants went for VMMC, resulting in a cost of \$27.36 per client in the intervention arm. The approximate cost per additional VMMC client was \$45.31 among all participants or \$48.61 among participants not reporting being circumcised at baseline {Kaufman, 2016}.

For clients Ages 20–29 in Zimbabwe, under a base scenario in which, by 2018, the country achieves 80% circumcision coverage among males ages 10±19 and lower levels of coverage among men above age 20, the greatest contribution to HIV incidence reduction comes from circumcising males between the ages of 15 and 19. Increasing coverage among males ages 20–24 and 25–29 increases the contribution of these age groups to HIV incidence reduction {Kripke, 2016a}. In South Africa and Tanzania, the lowest cost per HIV infection averted would be achieved by circumcising males ages 15–34; in Malawi and Uganda, the lowest cost per HIV infection averted would be attained by focusing either on males ages 15–34 or ages 15–49; and in Swaziland, focusing on the age groups 15–29, 15–34, or 15–49 would be most cost-effective {Kripke, 2016b}.

Cost implications of the use of re-usable equipment that is sterilized after each use versus the use of single-use disposal kits were evaluated in Uganda, and a re-usable circumcision kit resulted in a net saving of USD \$7.14–\$12.34 or 46-59% {Kuznik, 2012}.

### **Key points**

Evidence from the 10 cost-effectiveness studies conducted across various countries or regions including Rwanda, South Africa, Uganda, Lesotho, Swaziland, Zimbabwe, Malawi, Tanzania, Kenya and Saharan Africa, covering time horizon from 2005 to 2057, suggested that the cost-effectiveness of the intervention favoured the intervention. Further findings from cost-effectiveness analyses in other low- and middle-income countries are still needed to obtain a comprehensive understanding of cost-effectiveness in diverse cultural and economic settings.

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## EQUITY

### GRADE EtD criterion: What would be the impact on health equity?

Are there:

- Subgroups or subpopulations that who may be disadvantaged in receipt of VMMC?
- Subgroups or subpopulations in which VMMC may be less effective for non-physiologic reasons?

### Summary

A total of three studies (with 4810 men and women aged  $\geq 18$  years and conducted in Malawi, South Africa and China) indicating health inequalities were included {Dione, 2013; Hoffman, 2015; Huang, 2013}. All three were cross-sectional studies (2 were surveys and one was a mixed methods study) but in one {Dione, 2013} the questionnaire was self-reported (subject to socially desirable responses), thus affecting the validity of the results. Equity characteristics as stratified by PROGRESS-PLUS were: ethnicity, place of residence, socioeconomic status, and personal characteristics (drug users) as illustrated below. In addition to the aforementioned three studies, we were also able to draw inference on equity from Siegler 2012 and Golub 2016, which we will discuss in more detail in the subsequent sections.

One study was conducted in a rural setting in Malawi {Dione, 2013} and included participants belonging to ethnicities such as, Chewa (31%), Tumbuka (28%), Yao (24%), Ngoni (5%), and Lomwe (4%); with an average age of  $41.49 \pm 16.99$  years. In this study, 14% of participants reported that VMMC decreases the chances of HIV infection whereas 35% reported that VMMC increased the HIV infection. Greater percentage of Yaos (who traditionally circumcise), reported that VMMC decreases HIV transmission in comparison to other ethnic groups. Among Yaos, those in the southern region were much more likely to have positive attitudes towards VMMC compared to those in the central region. A greater percentage (73- 74%) of the central and the northern region respondents had negative opinions of VMMC whereas only 20% of the southern region respondents had negative opinions of VMMC.

The other two were conducted in an urban setting {Hoffman, 2015; Huang, 2013}. In one study conducted in South Africa {Hoffman, 2015}, participants, aged between 18 to 86 years, were predominantly unemployed (61.5%) with two-thirds (70.2%) having a total monthly household income of less than R3000 (\$288). A majority (88.8%) of respondents believed that circumcision is an acceptable practice, thus showing no difference across socio-demographic characteristics, for

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example, income, marital status, education, age and gender. The third study conducted in China {Huang, 2013} reported including male drug users of Han ethnicity (92.5%), having a high school (junior or senior) level of education or beyond (82.8%), married (46.3%), aged between 18 to 45 years and employed (43.9%); 2.9% had concerns about the cost of VMMC surgery {Huang, 2013}.

The Siegler (2012) study conducted in Northern Tanzania, indicated acceptability of providing sons with VMMC varied from 28 to 84 %, depending on hypothetical contingencies: without any contingencies, only 28 % of respondents were willing to provide VMMC to their sons; and that number increased to 84%, if the Maasai traditional leadership support VMMC. This indicates that traditional community values towards VMMC plays an important role affecting equity.

### Key points

Traditional community value is a key factor directly affecting acceptability of VMMC, thus indirectly impact on equity. Those who reside in communities where VMMC is not supported are negatively impacted in terms of equity (Dione 2013, Siegler 2012). However information on which communities have non-supportive traditional values towards VMMC is limited; and available evidence from the 3 included studies show: (1) that people belonging to ethnic groups other than Yaos in rural Malawi might be disadvantaged; (2) Yaos in the central region of rural Malawi might be more disadvantaged compared to those in Southern region; (3) People in central or northern region of rural Malawi may be more disadvantaged due to negative attitudes towards VMMC; (4) In urban South Africa, no obvious health inequity was observed across socio-demographic characteristics; (5) In male drug users (injection drugs) in urban China belonging to Han ethnicity, a majority might be disadvantaged due to beliefs that VMMC would not be effective, would reduce sexual ability and surgery would be expensive. One study had issues of validity as the responses were from self-reported questionnaire. People who reside in locations remote from VMMC facilities are also likely to be disadvantaged (Golub 2016), although it is not entirely clear if these remote settings are rural.

## FEASIBILITY

### GRADE EtD criterion: Is the intervention feasible to implement?

With regards to implementing VMMC recommendations, are there concerns about:

- legal or bureaucratic constraints?
- important barriers to implementation or its sustainability for any reason?
- misuse or abuse of recommendation?
- health care ethics?

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## Summary

A total of 8 included studies (conducted in India, Zambia, Tanzania, Uganda, Kenya, Dominican Republic and Sub-Saharan Africa) assessed feasibility of implementing VMMC {Brito, 2010; Carrasco, 2016; Debas, 2015; Golub 2016; Miiro, 2017; Mwanga 2011; Price 2014; Sahay 2014}. Four studies included only adults (participants, healthcare providers or key informants) with age ranging between 18 -59 years, to assess constraints of reaching adult males for VMMC {Brito, 2010; Mwanga 2011; Price 2014; Sahay 2014}. One study only included uncircumcised adolescent school boys aged 13 and over {Miiro, 2017} and two studies included both adults and adolescents with ages ranging from 12 to 79 years {Carrasco, 2016; Golub 2016}. A systematic review reported including partners of males undergoing VMMC {Carrasco, 2016}. One study provided a general overview of surgeries including circumcision and discussed the reasons for the limited range of services {Debas, 2015}. The sample size of the 8 included studies ranged from 36 to 2350 participants. The study designs of the included studies are as follows: four cross-sectional studies (3 interviews & 1 survey) {Mwanga 2011; Price 2014; Sahay 2014}; one systematic review {Carrasco, 2016}; one narrative review {Debas, 2015}; an observational study {Golub 2016}; and one mixed methods study {Miiro, 2017}. Two studies assessed barriers and constraints of VMMC implementation faced by healthcare providers/key informants {Brito, 2010; Mwanga 2011}. In a study that was survey-based, self-reporting of questionnaire may be subject to socially desirable responses affecting the validity of the results {Brito, 2010}. One study reported using a sampling methodology (purposive/snowballing) that may result in results not being generalizable {Sahay, 2014}.

## Barriers and facilitators

### Barriers

1. *Individual/interpersonal barriers*: “Fear of pain caused by the procedure (during and/ or after the procedure); VMMC not helpful/needed because of: Low HIV risk perception (whether real or not); Partial and not full protection; and wish to maintain the status quo (particularly married couples); Fear of decreased sexual performance, infertility, deformity, etc.; Concerns around sexual abstinence after the procedure; Lost wages/time away from work and resulting lost wages; Not being able to take time /enough time away from work; Female partner lack of support for circumcision (particularly women in stable relationships; Cost associated with VMMC (i.e. transportation); Lack of peer support (particularly among young men); Lack of knowledge about VMMC as protective against HIV; Fear of the unknown and irreversibility of circumcision” {Carrasco, 2016}.

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2. *Community Barriers*: “VMMC perceived as practiced by other cultures/ religions or not being part of one’s culture/religion; Lack of trust in information provided by VMMC demand creation campaigns and/or myths/conspiracy theories about the use of the removed foreskin or the ultimate outcomes of VMMC; Circumcision perceived as appropriate for youth and not older men; Stigma against circumcised men and circumcision; Circumcision as a threat to masculinity” {Carrasco, 2016}.
3. *Barriers identified by healthcare providers*: “Lack of trained personnel to perform the procedures; Lack of information about VMMC in the community; Lack of surgical equipment; Cost of the procedure; Lack of continuous electricity or running water in some of the clinics; Lack of physical space for surgical theaters in some of the clinics” {Brito, 2010}.
4. *Barriers due to perceptions on VMMC service*: “Supply side barriers (Negative perceptions of health system, female providers, low quality services, not knowing VMMC is free, whether VMMC is available at a local clinic; Fear of compulsory HIV testing (and HIV stigma)” {Carrasco, 2016}.
5. *VMMC service related barriers*: “VMMC service issues: 23 participants were on their first attempt, 12 on their 2nd, 4 on their 3rd and 1 on his 4th attempt to receive a circumcision” {Price, 2014}; Shortage of medical personnel and training available to healthcare personnel {Debas, 2015}; and distance of the VMMC facility {Golub, 2016}.
6. *Barriers due to religion*: “Any mass level propagation of circumcision as an HIV prevention program would face major resistance from the religious sections of the non-circumcising communities for reasons of communal identity. Support from healthcare providers was also not observed as scepticism regarding trial results conducted abroad prevailed among them and they could not disassociate their social values and religious leanings. Training to bring attitudinal change among health care providers is recommended” {Sahay 2014}.

### Facilitators

Healthcare providers recommended VMMC for the following reasons: to improve hygiene; to treat phimosis; and to prevent infections in both men and women and had a better knowledge of the health benefits of VMMC than non-medical participants” {Brito, 2010}. Another study reported that, to increase demand for circumcision services, all of the key informants suggested that it should be affordable. If the services should be paid for, 94% said that the amount shouldn’t exceed roughly USD \$3 per person. Otherwise they suggested that the government should provide male circumcision free of charge due to prevailing economic hardships facing many Tanzanians particularly those living in rural areas with no reliable sources of income. Alternatively payment in kind (equivalent of the cost of farm produce) was also suggested” {Mwanga 2011}

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### Specific issues in sustaining for adolescents:

1. Challenges that contributed to the low confirmed uptake of VMMC in adolescent school boys:  
“(i) Coaches found it difficult to obtain parental consent for VMMC because of misconceptions about circumcision or about the time this would take from education; (ii) School administrators only allowed the Make The Cut intervention to happen after normal school hours, resulting in low attendance; (iii) Participants were most likely to undergo VMMC during the holiday time so they would not need to miss classes or exams but the intervention had initially been implemented in this school more than two months before the end of the term, resulting in some boys losing interest. Also, it was difficult for the coaches to communicate with boys during the holiday period to follow and encourage them” {Miuro, 2017}.
2. Facilitators for VMMC uptake: “Coaches conducted home visits with boys who expressed an interest in being circumcised to actively engage with their parents. To assist in facilitating discussions with parents, coaches created and shared a short video of Make The Cut to both educate parents on VMMC and act as a discussion starter; Coaches conducted in-person visits with school personnel to arrange for the Make The Cut sessions to happen during morning class periods; Coaches implemented Make The Cut after exams, but before the end of the term. This reduced the time between implementation and uptake and avoided the need for communication with the boys during holiday time” {Miuro, 2017}.

**Key points:** Evidence from 8 studies on feasibility of implementing VMMC suggested the following: (1) Strategies to decrease barriers in implementation of VMMC in adolescent boys: engaging and educating parents and school personnel on VMMC; and implementation of strategy after exams; (2) Strategies to decrease barriers in implementation of VMMC in adults: mitigating barriers related to people’s negative perception of VMMC such as fear of pain, loss of sexual pleasure, deformity, infertility, & loss of wages; mitigating barriers related to VMMC service provided such as long waiting, shortage of medical professional and lack of training; mitigation of religious barriers through education and attitude change; mitigating barriers due to social beliefs such as social stigma, conspiracy theories, cultural factors, & threat to masculinity. No obvious serious threats to validity or generalizability identified in included studies, but the snowballing sampling strategy in one study may result in limitation of generalizability. None of the studies reported on legal, ethical constraints or misuse of recommendations.

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### Acceptability

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1 **Table 1. Facilitators and barriers to acceptability in males and females**

Botswana			
Year*	Study ID	Facilitators	Barriers
2009	Jayeoba 2012	<ul style="list-style-type: none"> <li>■ Cost (free of charge)</li> </ul>	<ul style="list-style-type: none"> <li>■ Pain</li> <li>■ Complications during/after procedure</li> </ul>
2013	Wirth 2016	<ul style="list-style-type: none"> <li>■ Increased cleanliness</li> <li>■ Fashionable</li> </ul>	<ul style="list-style-type: none"> <li>■ Not reported</li> </ul>
2016	Tapera 2017	<ul style="list-style-type: none"> <li>■ Health/hygiene benefits</li> <li>■ Sexual satisfaction</li> <li>■ Traditional/cultural values</li> </ul>	<ul style="list-style-type: none"> <li>■ Not reported</li> </ul>

‘Year\*’ denotes ‘Data collection year’

China			
Year*	Study ID	Facilitators	Barriers
2009	Jiang 2013	<ul style="list-style-type: none"> <li>■ Improve partners’ hygiene</li> <li>■ Redundant foreskin</li> <li>■ Enhance sexual pleasure</li> <li>■ Prevention of penile cancer</li> <li>■ Protection against HIV and STDs</li> <li>■ Better penile appearance</li> <li>■ Traditional or religious reason</li> </ul>	<ul style="list-style-type: none"> <li>■ Not necessary or not effective</li> <li>■ Concern about potential danger associated with surgery</li> <li>■ Concern about reducing sexual ability</li> <li>■ Concern about expensive surgery cost</li> </ul>
2009 - 2010	Huang 2013	<ul style="list-style-type: none"> <li>■ Having phimosis</li> <li>■ Prevention of penile cancer</li> <li>■ Protection against HIV and STIs</li> <li>■ Improve partners’ hygiene</li> <li>■ Enhance sexual pleasure</li> <li>■ Better penile appearance</li> <li>■ Traditional or religious reason</li> </ul>	<ul style="list-style-type: none"> <li>■ Not necessary or not effective</li> <li>■ No idea of benefits of VMMC</li> <li>■ Concern about potential danger associated with surgery</li> <li>■ Concern about reducing sexual ability</li> <li>■ Concern about expensive surgery cost</li> </ul>
2009 - 2010	Jiang 2015	<ul style="list-style-type: none"> <li>■ HIV/STI prevention</li> </ul>	<ul style="list-style-type: none"> <li>■ Not reported</li> </ul>
2009 - 2010	Yang 2012	<ul style="list-style-type: none"> <li>■ HIV/STI prevention</li> <li>■ Improve sexual partners’ hygiene</li> <li>■ Remove redundant foreskin</li> <li>■ Prevent penile cancer</li> </ul>	<ul style="list-style-type: none"> <li>■ Not reported</li> </ul>
2011 - 2012	Wang 2016	<ul style="list-style-type: none"> <li>■ Reduced risk of HIV/STIs</li> </ul>	<ul style="list-style-type: none"> <li>■ Expensive</li> <li>■ Pain</li> <li>■ Severe surgical complications</li> <li>■ Erectile dysfunction</li> <li>■ Perceived as strange by peers or their female sex partners</li> <li>■ Embarrassment</li> </ul>
Unclear	Sullivan 2009	<ul style="list-style-type: none"> <li>■ Protection from HIV infection</li> </ul>	<ul style="list-style-type: none"> <li>■ Not reported</li> </ul>

‘Year\*’ denotes ‘Data collection year’

Dominican Republic			
Year*	Study ID	Facilitators	Barriers
2007 -	Brito	<ul style="list-style-type: none"> <li>■ Not reported</li> </ul>	<ul style="list-style-type: none"> <li>■ Uncircumcised penis more natural</li> </ul>

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2008	2010		<ul style="list-style-type: none"> <li>■ Equated the removal of the foreskin to losing a part of the body</li> <li>■ The majority of men believed that women prefer their partners uncircumcised</li> <li>■ Fewer than half considered the foreskin as a barrier against lacerations of the glans and hence protective against HIV</li> </ul>
2008	Brito 2009	<ul style="list-style-type: none"> <li>■ Improves hygiene</li> <li>■ Reduces STI/HIV</li> <li>■ Reduces penile cancer</li> </ul>	<ul style="list-style-type: none"> <li>■ Decreased sexual pleasure</li> </ul>

'Year\*' denotes 'Data collection year'

India			
Year*	Study ID	Facilitators	Barriers
2009 - 2011	Sahay 2014	<ul style="list-style-type: none"> <li>■ Religious faith</li> <li>■ Beliefs regarding its hygienic benefits</li> </ul>	<ul style="list-style-type: none"> <li>■ Cost of the operation</li> <li>■ Pain associated with the procedure</li> </ul>

'Year\*' denotes 'Data collection year'

Jamaica			
Year*	Study ID	Facilitators	Barriers
2011	Walcott 2013	<ul style="list-style-type: none"> <li>■ Penile hygiene</li> <li>■ Protection from STIs"</li> </ul>	<ul style="list-style-type: none"> <li>■ "Should not change the way God made the penis"</li> <li>■ "Surgery may damage the penis"</li> </ul>

'Year\*' denotes 'Data collection year'

Kenya			
Year*	Study ID	Facilitators	Barriers
2008 - 2009	Westerca mp 2012	<ul style="list-style-type: none"> <li>■ HIV prevention</li> <li>■ Condom use less necessary</li> </ul>	<ul style="list-style-type: none"> <li>■ Belief that VMMC is not a part their culture</li> <li>■ Length of recovery</li> </ul>
2012	Evens 2014	<ul style="list-style-type: none"> <li>■ Not reported</li> </ul>	<ul style="list-style-type: none"> <li>■ Financial issues including missing work, losing income during the procedure and healing and family survival during the recovery period</li> <li>■ Fear of pain during and after the procedure both barriers identified by circumcised and uncircumcised men</li> <li>■ Others: the abstinence period, voluntary counselling and testing as part of VMMC services, female partners' opinions of circumcision, sexual function after VMMC, potential adverse events, cultural concerns, and access to and quality of VMMC services</li> </ul>
2012	Macintyre 2014	<ul style="list-style-type: none"> <li>■ Stigma against not being circumcised</li> <li>■ Protection against disease including HIV</li> <li>■ Cleanliness</li> </ul>	<ul style="list-style-type: none"> <li>■ Not aligned with culture</li> <li>■ Old age</li> <li>■ Sexual activity ("no need to undergo circumcision "because they were no longer having sex")</li> <li>■ Social influences (family and community relationships)</li> <li>■ fears related to service delivery: low quality of care; absent, disrespectful or even unqualified clinicians; lack of drugs or equipment; excessive distance to service delivery sites</li> </ul>
Unclear	Herman- Roloff 2011	<ul style="list-style-type: none"> <li>■ Improve hygiene</li> <li>■ Social pressure</li> <li>■ HIV/STI protection</li> <li>■ Sexual performance and satisfaction</li> </ul>	<ul style="list-style-type: none"> <li>■ Too much time away from work</li> <li>■ Cultural and religious values</li> <li>■ The possibility of adverse effect</li> <li>■ The post-surgical abstinence period</li> <li>■ A desire to maintain the status quo</li> </ul>

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			<ul style="list-style-type: none"> <li>■ Increased promiscuity</li> </ul>
Unclear	<b>Lanham 2012</b>	<ul style="list-style-type: none"> <li>■ Reduced HIV risk</li> <li>■ Improved hygiene</li> <li>■ Fewer penile problems</li> </ul>	<ul style="list-style-type: none"> <li>■ Not reported</li> </ul>

Lesotho			
Year*	Study ID	Facilitators	Barriers
2013	<b>Skolnik 2014</b>	<ul style="list-style-type: none"> <li>■ HIV protection (self and partner)</li> </ul>	<ul style="list-style-type: none"> <li>■ Long wait time and female staff</li> <li>■ Mixing young and old clients</li> <li>■ HIV testing</li> <li>■ Fear of pain and injection</li> <li>■ Long healing time or abstinence</li> <li>■ Safety concerns</li> <li>■ Preference for traditional circumcision</li> <li>■ Lack of transport/lack of full coverage against HIV/not knowing where to go/poor service/staff attitude</li> </ul>

‘Year\*’ denotes ‘Data collection year’

Malawi			
Year*	Study ID	Facilitators	Barriers
2008	Rennie 2015	<ul style="list-style-type: none"> <li>■ Less time and expense would be involved in clinic-based circumcisions as compared to those done traditionally in the village, which often involve elaborate, expensive ceremonies and community celebrations</li> <li>■ Clinic-based circumcision had better access to proper anaesthetics and procedures than traditional male circumcision, and will allow the wound to heal faster</li> <li>■ Effectiveness of male circumcision for HIV prevention</li> </ul>	<ul style="list-style-type: none"> <li>■ Fear/expect that the procedure will involve a great deal of pain</li> <li>■ The wound will be a hindrance</li> <li>■ Do not believe that male circumcision can reduce a man’s risk of contracting HIV</li> <li>■ VMMC may result in greater infection because it would encourage reduced condom use and increased sexual risk-taking</li> <li>■ Would promote promiscuity, and men choosing to be circumcised would be stigmatised as immoral</li> <li>■ Fear that VMMC would promote premarital sex and sexual immorality</li> <li>■ Too invasive and the health benefits too insufficient to warrant adoption</li> </ul>
2008 - 2009	Shacham 2014	<ul style="list-style-type: none"> <li>■ Reduced risk of STIs/HIV</li> <li>■ Enhanced sexual pleasure for female partners</li> <li>■ Religion/culture</li> </ul>	<ul style="list-style-type: none"> <li>■ Pain</li> <li>■ Cost</li> <li>■ Increased risk of HIV</li> <li>■ Encouragement of premarital sex</li> </ul>

‘Year\*’ denotes ‘Data collection year’

Papua New Guinea			
Year*	Study ID	Facilitators	Barriers
2009	Kelly, 2013	<ul style="list-style-type: none"> <li>■ Cultural acceptability</li> </ul>	<ul style="list-style-type: none"> <li>■ Sexual risk compensation (false sense of security)</li> <li>■ Religion: goes against Christian faith</li> <li>■ Cultural: new practice that is culturally inappropriate</li> </ul>
2009 - 2011	Tynan 2013	<ul style="list-style-type: none"> <li>■ Prevention of STI (HIV) and cervical cancer</li> <li>■ Reduction of STI/HIV cases</li> <li>■ Referrals made to access proper medical services</li> <li>■ Entry point to VCT (voluntary counselling and testing)</li> </ul>	<ul style="list-style-type: none"> <li>■ Funds: costs; young men would not have cash to access services due to poor employment options</li> </ul>

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2011 - 2012	MacLaren, 2013	<ul style="list-style-type: none"> <li>■ Proves manhood (sociocultural practice)</li> <li>■ Have more sexual partners, sexual pleasure</li> <li>■ Makes a man's body grow strong and penis grow bigger (sociocultural beliefs)</li> <li>■ Reduced risk of HIV</li> <li>■ Overall health benefit</li> </ul>	<ul style="list-style-type: none"> <li>■ not a part of their cultural practice/tradition</li> <li>■ decreases sexual pleasure</li> </ul>
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South Africa			
Year*	Study ID	Facilitators	Barriers
2012	Ikwegbue 2015	Not reported	<ul style="list-style-type: none"> <li>■ Sexual problems</li> </ul>
2012 - 2013	George 2014	<ul style="list-style-type: none"> <li>■ Not reported</li> </ul>	Individual barriers: <ul style="list-style-type: none"> <li>■ Pain associated with the procedure and adverse events</li> <li>■ Low perception of HIV risk</li> <li>■ Individual fears about the procedure were identified as prominent barriers to undergoing circumcision</li> </ul> Social barriers: <ul style="list-style-type: none"> <li>■ The fear of HIV testing (subsequent results &amp; stigma)</li> <li>■ The need to abstain from sex during the six-week healing period</li> <li>■ Family disapproval of the procedure</li> <li>■ Experience of peers</li> </ul>
2012 - 2013	George 2017	<ul style="list-style-type: none"> <li>■ Reduced risk of STIs</li> <li>■ Improved hygiene</li> </ul>	<ul style="list-style-type: none"> <li>■ Self-efficacy to use condoms</li> </ul>
2013	Hoffman 2015	<ul style="list-style-type: none"> <li>■ Improve hygiene</li> <li>■ Health benefits</li> <li>■ Cultural or religious reasons</li> </ul>	<ul style="list-style-type: none"> <li>■ Fear of infection, pain and loss of performance</li> <li>■ Religion</li> <li>■ Time off work</li> <li>■ Reaction of peers</li> </ul>
2015	Marshall 2016	<ul style="list-style-type: none"> <li>■ Reduced risk of HIV</li> <li>■ Tradition/religion</li> <li>■ Hygiene</li> </ul>	<ul style="list-style-type: none"> <li>■ Culture</li> <li>■ Fear of the procedure, pain or injury</li> <li>■ Time constraints</li> </ul>

‘Year\*’ denotes ‘Data collection year’

Swaziland			
Year*	Study ID	Facilitators	Barriers
2010	Gurman 2015	<ul style="list-style-type: none"> <li>■ Being tested for HIV in last 12 months</li> <li>■ Knowledge about circumcision</li> <li>■ Importance of plowing season to daily schedule</li> <li>■ Getting circumcised will raise man’s status in his community</li> <li>■ Man will enjoy sex more if circumcised</li> <li>■ Erections last longer for circumcised men</li> <li>■ Women prefer sex with a circumcised man</li> </ul>	<ul style="list-style-type: none"> <li>■ Sex is more painful for a circumcised man”</li> <li>■ Christian man should not get circumcised”</li> <li>■ Circumcision makes penetration more painful</li> <li>■ Circumcision will leave a wound that will never heal</li> <li>■ Getting circumcised takes too much time away from work</li> <li>■ Time required to abstain after circumcision is too long</li> </ul>
2013 - 2013	Adams 2015	<ul style="list-style-type: none"> <li>■ Not reported</li> </ul>	<ul style="list-style-type: none"> <li>■ Fear of pain only a minor barrier</li> <li>■ Threat to masculinity: Circumcision was perceived as a threat to men’s ability to function sexually, thereby indirectly threatening his ability to maintain his family and, consequently, his manhood</li> </ul>

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- Concerns of loss of sexual pleasure
- Fear of botched surgeries
- The futility of VMMC: VMMC only partially protective, circumcised men are still required to use condoms and therefore individual men could not see the value of circumcision
- Fear of the unknown and irreversibility of circumcision
- Suspicion towards the origins of HIV and western health interventions

‘Year\*’ denotes ‘Data collection year’

Tanzania			
Year*	Study ID	Facilitators	Barriers
2010	Francis 2012	Not reported	<ul style="list-style-type: none"> <li>■ Anticipation of pain during circumcision</li> <li>■ Fear of losing part of the body</li> <li>■ Cost</li> </ul>
2011	Plotkin 2013	<ul style="list-style-type: none"> <li>■ Increased virility and a more attractive penis</li> <li>■ VMMC within marriage as a favourable option for reducing risk of HIV acquisition</li> </ul>	<ul style="list-style-type: none"> <li>■ Cultural reasons/pressure from parents</li> <li>■ Fear of penile injury from erections during the recovery period</li> <li>■ Concern about loss of income in the recovery period</li> </ul>
2014	Osaki 2015	<ul style="list-style-type: none"> <li>■ Denial of sex/refusing to have sexual intercourse by female partners</li> <li>■ Avoid embarrassment from female sexual partners</li> <li>■ Mothers as Decision-making roles</li> </ul>	<ul style="list-style-type: none"> <li>■ Multiple concurrent partnerships (infidelity)</li> </ul>

‘Year\*’ denotes ‘Data collection year’

Thailand			
Year*	Study ID	Facilitators	Barriers
2008	Tieu 2010	<ul style="list-style-type: none"> <li>■ Knowledge of VMMC (informational pamphlet containing description of the procedure, costs, risks, and benefits, recent circumcision trial results)</li> </ul>	<ul style="list-style-type: none"> <li>■ Fear of pain and other risks of surgery</li> <li>■ Having no time for surgery because of work constraints</li> <li>■ Beliefs that they were not at risk for contracting HIV and other STDs</li> <li>■ Lack of knowledge about male circumcision and its role in HIV prevention</li> <li>■ Time required away from work for the surgery and postoperative healing</li> <li>■ Association of circumcision with good genital hygiene</li> </ul>

‘Year\*’ denotes ‘Data collection year’

Uganda			
Year*	Study ID	Facilitators	Barriers
2004 - 2006	Ssekubugu 2013	<ul style="list-style-type: none"> <li>■ Prevention and healing of sexually transmitted infections (STIs)</li> <li>■ Access to HIV and other ancillary care</li> <li>■ Penile hygiene</li> <li>■ Peer influence</li> </ul>	<ul style="list-style-type: none"> <li>■ Pain</li> <li>■ Medical complications</li> <li>■ Infertility</li> <li>■ Lack of empirical efficacy</li> <li>■ Waiting time before resumption of sex</li> <li>■ Religion</li> </ul>
2008	Albert 2011	<ul style="list-style-type: none"> <li>■ Not reported</li> </ul>	<ul style="list-style-type: none"> <li>■ Concerns about the medical procedure</li> <li>■ Religious or cultural identity</li> <li>■ Influence on post-procedure risk behaviours</li> </ul>
2008	Wilcken 2010	<ul style="list-style-type: none"> <li>■ Protection of HIV/STDs</li> <li>■ Religious reasons, improved hygiene and</li> </ul>	<ul style="list-style-type: none"> <li>■ Cultural reasons</li> <li>■ Fear of complications</li> </ul>

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		cultural reasons	<ul style="list-style-type: none"> <li>■ Religious reasons</li> <li>■ Opposition of the partner or parents</li> <li>■ Accessibility of services</li> <li>■ Costs</li> </ul>
2010 - 2011	Kong 2014	<ul style="list-style-type: none"> <li>■ Not reported</li> </ul>	<ul style="list-style-type: none"> <li>■ Fear of pain or injury</li> <li>■ Did not think they were at risk of HIV infection</li> <li>■ Against their traditional or religious beliefs</li> <li>■ Circumcised men may still get HIV</li> <li>■ Their partner objected to VMMC</li> <li>■ Concern of reduced libido or sexual satisfaction</li> <li>■ Men were too busy for surgery</li> <li>■ Already HIV infected</li> </ul>
2011	Kibira 2015	<ul style="list-style-type: none"> <li>■ Higher perceived risk of HIV</li> <li>■ Protective against HIV</li> </ul>	<ul style="list-style-type: none"> <li>■ Not reported</li> </ul>
2011	Mati 2016	<ul style="list-style-type: none"> <li>■ Religion (Muslim &gt; Catholics)</li> <li>■ Ethnicity (Itesa &lt; Baganda)</li> <li>■ Knowledge of reduced HIV risk</li> <li>■ Ability to negotiate condom use</li> <li>■ Ability to refuse sex</li> </ul>	<ul style="list-style-type: none"> <li>■ Not reported</li> </ul>
2012	Lilleston 2017	<ul style="list-style-type: none"> <li>■ Sharing experiences with friends</li> </ul>	<ul style="list-style-type: none"> <li>■ Pain</li> <li>■ Healing period</li> <li>■ Religion among Christians</li> <li>■ Fears of infection after surgery related to poorly executed circumcisions</li> <li>■ Lack of access to post-procedure treatment and follow-up</li> <li>■ Provider's (female) gender</li> <li>■ Direct financial costs (e.g., private clinicians who charge for the procedure and transportation costs to get to the clinic)</li> <li>■ Indirect opportunity costs (e.g., time away from work)</li> </ul>
2013	Nevin 2015	<ul style="list-style-type: none"> <li>■ Increased protection from HIV and other STIs</li> <li>■ Cleaner and more hygienic: (1)VMMC improves general hygiene of the penis, including the reduction of foul odours; (2)VMMC reduces the transmission of STIs via improved cleanliness due to the removal of the foreskin)</li> <li>■ Improved sexual performance and desirability</li> </ul>	<ul style="list-style-type: none"> <li>■ Increases a recipient's libido</li> <li>■ Loss of income due to missed employment and subsequent failure to fulfil familial obligations</li> <li>■ Fisher folk require longer recovery periods after circumcision due to strenuous activity and submersion in potentially unsanitary water</li> <li>■ Both men and women reported concerns of spousal fidelity post circumcision abstinence and may contribute to early resumption of sexual activity or increased sexual network</li> </ul>
2013 - 2015	Gilbert 2018	<ul style="list-style-type: none"> <li>■ Not reported</li> </ul>	<ul style="list-style-type: none"> <li>■ Fear</li> <li>■ Long healing time</li> <li>■ Economic impact</li> </ul>
2015	Kibira 2017	<ul style="list-style-type: none"> <li>■ Not reported</li> </ul>	<ul style="list-style-type: none"> <li>■ Influence of sexual partners</li> <li>■ Reduce the risk of HIV/STIS</li> <li>■ Personal hygiene</li> <li>■ Positive community perception of male circumcision</li> <li>■ Enhance sexual performance and expected to better satisfy their partners</li> </ul>
2015	Nakyanjo 2018	<ul style="list-style-type: none"> <li>■ Reduced risk of HIV and STIs</li> <li>■ Improved penile hygien</li> <li>■ Improved sexual desire and</li> </ul>	<ul style="list-style-type: none"> <li>■ Behavioural: riskier sexual behaviours, increased sexual desire leading them to seek extra-marital relationships, extra-marital relationships if they thought they had lower risk of HIV infection</li> </ul>

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pleasure	<ul style="list-style-type: none"> <li>■ Wound healing period and sexual abstinence</li> <li>■ Time off work and loss of income</li> <li>■ “Blame game”: if an HIV-negative man gets circumcised but acquires HIV; results in domestic violence or separation</li> </ul>
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Zambia			
Year*	Study ID	Facilitators	Barriers
2003	Lukobo 2007	<ul style="list-style-type: none"> <li>■ Reduced risk of STIs/HIV</li> <li>■ Offered at no or minimal Costs</li> </ul>	<ul style="list-style-type: none"> <li>■ Ethnic and religious groups (Lunda, Luvale, Muslims and Chawa)</li> <li>■ Pain associated with the procedure and the healing process</li> <li>■ Length of time for healing</li> <li>■ Cost</li> </ul>
2012	Jones 2014	<ul style="list-style-type: none"> <li>■ HIV prevention</li> <li>■ Increased endorsement by female partner</li> </ul>	<ul style="list-style-type: none"> <li>■ Not reported</li> </ul>
2012	Price 2014	<ul style="list-style-type: none"> <li>■ HIV/STI prevention</li> <li>■ Hygiene, being clean</li> <li>■ Prevents cervical cancer</li> <li>■ Female pleasure/male sexual performance</li> <li>■ Prevents cracks, bruises, and abrasions</li> </ul>	<ul style="list-style-type: none"> <li>■ Wound care and healing</li> <li>■ Pain and injections</li> <li>■ Adverse events and outcomes</li> <li>■ Service issues</li> </ul>
2012 - 2014	Zulu 2015	<ul style="list-style-type: none"> <li>■ Sexual satisfaction</li> </ul>	<ul style="list-style-type: none"> <li>■ Not reported</li> </ul>
Unclear	Cook 2016	<ul style="list-style-type: none"> <li>■ Women’s attitudes and increased women’s acceptance</li> </ul>	<ul style="list-style-type: none"> <li>■ Not reported</li> </ul>

‘Year\*’ denotes ‘Data collection year’

Zimbabwe			
Year*	Study ID	Facilitators	Barriers
2009	Mavhu 2011	<ul style="list-style-type: none"> <li>■ HIV prevention</li> <li>■ Knowledge of VMMC</li> <li>■ Informed about VMMC health benefits</li> </ul>	<ul style="list-style-type: none"> <li>■ Disbelief that VMMC protects against HIV</li> <li>■ Cultural issues</li> <li>■ Fear of pain and/or adverse effects</li> </ul>
2010 - 2013	Hatzold 2014	<ul style="list-style-type: none"> <li>■ Not reported</li> </ul>	<ul style="list-style-type: none"> <li>■ Fear of pain</li> <li>■ Not believing that they were at risk of HIV</li> <li>■ Fear of an HIV test</li> <li>■ Lack of partner support/partner refusal</li> <li>■ Perceived high costs</li> </ul>
2012	Moyo 2015	Not reported	<ul style="list-style-type: none"> <li>■ Perceived challenge to masculinity</li> <li>■ Post-circumcision stigma</li> <li>■ Lack of reliable and adequate information and perceptions about the appropriateness of VMMC</li> <li>■ Fear of HIV testing associated with VMMC</li> <li>■ Fear of the possibility of irreversible accidents and mistakes during the operation</li> <li>■ Recuperation period unwanted interruption</li> </ul>
2013	Chikutsa	<ul style="list-style-type: none"> <li>■ Cleanliness</li> </ul>	<ul style="list-style-type: none"> <li>■ Ability to achieve a good erection</li> </ul>

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	2015a	<ul style="list-style-type: none"> <li>■ Protective effect against STIs/HIV</li> <li>■ Improves sexual performance</li> </ul>	<ul style="list-style-type: none"> <li>■ Fears of losing fertility</li> <li>■ Lead to marriage breakdown due to the prolonged healing period before resumption of intercourse</li> <li>■ VMMC associated with illness and disability</li> <li>■ Boosts a man's sexual appetite</li> </ul>
Unclear	Chikutsa 2015b	<ul style="list-style-type: none"> <li>■ HIV/STI prevention</li> <li>■ Knowledge of a place offering VMMC services</li> <li>■ Improves genital cleanliness</li> </ul>	<ul style="list-style-type: none"> <li>■ Time off work</li> <li>■ Painful procedure</li> </ul>
Unclear	Chiringa 2016	<ul style="list-style-type: none"> <li>■ Reduced risks of STIs/HIV</li> <li>■ Sexual pleasure</li> <li>■ Religious purposes</li> </ul>	<ul style="list-style-type: none"> <li>■ Unsatisfactory sexual performance</li> <li>■ Fear of pain and the unknown</li> <li>■ Ancestors' permission and being shunned by the community</li> <li>■ Sociocultural factors: being viewed as worthless, shameful and tainted as promiscuous</li> <li>■ Psychological factors: infection and delayed healing, being ashamed and dehumanised, stigmatised and discriminated and fear of having an erection during treatment period</li> <li>■ Socio-economic factors: not having time as it will take their time from work, complications may arise leading to spending money on treatment</li> </ul>
Unclear	Khumalo - Sakutukwa 2013	<ul style="list-style-type: none"> <li>■ HIV protection</li> <li>■ Health and sexual benefits</li> </ul>	<ul style="list-style-type: none"> <li>■ Cultural barriers</li> <li>■ Local barriers</li> <li>■ Health risks with procedure</li> </ul>
Unclear	Montano 2014	<ul style="list-style-type: none"> <li>■ Will give you peace of mind</li> <li>■ Will enhance sexual pleasure/enjoyment for you</li> <li>■ Available in local (including rural) clinics</li> </ul>	<ul style="list-style-type: none"> <li>■ Something you are too old for now</li> <li>■ Cause women to shun you and say your penis is different</li> <li>■ Might not heal properly—cause disfigurement</li> <li>■ Culture is against VMMC</li> <li>■ VMMC is new—not offered before in community</li> <li>■ Wife/girlfriend is against VMMC</li> <li>■ Availability of equipment and materials</li> <li>■ People describe VMMC as painful</li> <li>■ VMCC is not free</li> <li>■ Lack of knowledge on how VMMC prevents HIV</li> </ul>
Unclear	Rupfutse 2014	<ul style="list-style-type: none"> <li>■ Having a circumcised relative/friend</li> <li>■ Encouragement by a friend or relative</li> <li>■ Discussing circumcision with female partner</li> </ul>	<ul style="list-style-type: none"> <li>■ Fear of pain</li> <li>■ Long abstinence period</li> <li>■ Being too old for VMMC</li> <li>■ Partner infidelity during abstinence</li> <li>■ Being HIV positive</li> <li>■ Fear of reduced sexual performance</li> </ul>

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**Table 2. Cost range and context**

Reference ID	Country	Cost per HIV infection averted (Adults)	Cost per HIV infection averted (Adolescents)	Cost per VMMC procedure (Marginal costs)
Alfonso, 2016	Uganda			USD \$23 (mobile camp); USD \$35 (static service center)
Bautista-Arredondo, 2018	Kenya, Rwanda, South Africa, and Zambia			Average cost per VMMC client (VMMC unit cost): USD \$66 in Kenya; USD \$75 in Rwanda; USD \$95 in Zambia; USD \$160 in South Africa
Binagwaho, 2010	Rwanda	USD \$4949	USD \$3932	USD \$59
Bollinger, 2009	Botswana	USD\$689		
Galárraga, 2009	South Africa, Uganda, Lesotho, Swaziland, Saharan Africa	South Africa: USD \$181; Uganda: USD \$1269-\$3,911; Lesotho: USD \$292; Swaziland: USD \$176; Saharan Africa: USD \$1806 over 2 years; \$195 over 10 years, \$89 over 20 years		USD \$55
Galarra, 2017	Kenya*			USD \$66.3 (95% CI 39.5-93.1)
George, 2017b	South Africa (KwaZulu-Natal)			USD \$73.42
Marseille, 2014	Kenya (Nyanza)	USD \$117.29 - \$184.84 (APHIA II vs NHRS programs)		USD \$29.32-\$46.20 (APHIA II vs NHRS programs)
McGillen, 2018	Zimbabwe	USD\$2100 + 3250 (VMMC program)		
Tchuenche, 2016b	South Africa			Sites with outreach services: USD \$138.50 (SD=\$15.70) Sites without outreach services: USD \$130.10 (SD=\$8.22)
Torres-Rueda, 2018	Tanzania	Njombe (USD\$1424 vs. \$1917); Tabora (USD\$2212 vs. \$3018) (intervention arm (demand strategy) vs standard care )		Njombe (USD\$130 vs \$191); Tabora (USD\$62 vs \$70) (intervention arm (demand strategy) vs standard care )
Tumwesigyea, 2013	Uganda	USD \$413 for the target year of 2015; USD \$537 for a target year of 2020; USD \$753 for a target year of 2025.	USD \$804	
Uthman, 2010	Sub-Saharan Africa	USD \$178 - \$2808		
White, 2008	Sub-Saharan Africa	USD \$ 1806 (1327–3554), \$974 (691–1964), \$431 (308–842), \$195 (143–356), \$132 (100–232), \$104 (81–179), and \$89 (71–150) (Over 2, 5, 10, 20, 30, 40 and 50 years, respectively)		

\*Part of the 'Optimizing the Response of Prevention: HIV Efficiency in Africa' (ORPHEA) project

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## PICO 2: Device-based versus conventional surgical VMMC

<b>Population</b>	<ul style="list-style-type: none"> <li>▪ HIV uninfected uncircumcised men and adolescent boys at risk of HIV infection through heterosexual intercourse</li> </ul>
<b>Intervention</b>	<ul style="list-style-type: none"> <li>▪ VMMC (i.e. complete removal of the foreskin) with a device (any type or a specific type)</li> </ul>
<b>Comparator</b>	<ul style="list-style-type: none"> <li>▪ Conventional surgical VMMC</li> </ul>
<b>Outcomes</b>	<ul style="list-style-type: none"> <li>▪ Adequate removal of the foreskin</li> <li>▪ Cosmesis</li> <li>▪ Pain (in preparation for, during or after procedure, while wearing or removal of device)</li> <li>▪ Inconvenience and odour while wearing the device</li> <li>▪ Complications of the procedure</li> <li>▪ Procedure time</li> <li>▪ Period of post-procedure sexual abstinence</li> <li>▪ Burden of required follow-up visits</li> <li>▪ Time to return to normal daily activities</li> </ul>

## VALUES & PREFERENCES

**GRADE EtD criterion: Is there important uncertainty about or variability in how much people value the main outcomes?**

What is the relative importance that adult men, adolescent boys, female sexual partners of men or community undergoing device-based (any & specific device) VMMC place on the main outcomes? Is there important uncertainty and variability in assigned relative importance?

### Summary

No evidence was retrieved on the relative values and preference placed on the aforementioned outcomes by adult men, adolescent boys, female sexual partners of men or community undergoing device-based VMMC. However, there were several studies that were indirectly informative to the study question by reporting key factors for the decision to undergo device-based VMMC (refer to section 'Acceptability').

## ACCEPTABILITY

**GRADE EtD criterion: Is the intervention acceptable to key stakeholders?**

Are there stakeholders (adolescents, adult males, their partners, communities, health policy makers, healthcare funding organizations etc.) who:

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- think that the balance of benefits and harms does not favour device (any & specific)-based VMMC because of higher costs or higher values for safety concerns?
- find device (any & specific)-based VMMC morally, religiously, or ethically unacceptable?

## Summary

A total of 20 studies reporting acceptability of device-based VMMC were included. The studies were conducted in different countries/regions including Kenya, Mozambique, Zambia, Uganda, Zimbabwe, Botswana, Malawi, and South Africa. Common types of devices used for VMMC were PrePex (n=13 studies) [Cummings 2016; Feldblum 2014; Fram 2016; Galukande 2014; Kasprzyk 2016; Kigozi 2014; Kohler 2016; Mavhu 2016; Milovanovic 2016; Musiige 2016; Mutabazi 2012; Tshimanga 2016a; Tshimanga 2016b] and ShangRing (n=7 studies) [Barone 2012; Feldblum 2016; Fram 2016; Kanyago 2013; Kigozi 2013; Sokal 2014a; Sokal 2014b]. Alisklamp, a disposable device, was used by one study [Musau 2011]. These studies collected data between year 2011 and 2014 predominantly with participants aged between 18 to 54 years. Please see table below for further detail of individual studies.

Study ID	Age range	Year of data collection
Barone 2012	18 - 54 years old	2011
Cummings 2016	18 - 49 years	2013
Feldblum 2014	18 - 49 years	unclear
Feldblum 2016	18 - 49 years	unclear
Fram 2016	10 - 49 years	2014
Galukande 2014	18 - 49 years	2012
Kanyago 2013	15 years or older	2011
Kasprzyk 2016	18 years or older	2012
Kigozi 2013	18 years or older	2012
Kigozi 2014	18 years or older	2012 - 2013
Kohler 2016	18 - 49 years	2014
Mavhu 2016	18 years or older	2014
Milovanovic 2016	15 years or older	2013 - 2014
Musau 2011	18 - 45 years	unclear
Musiige 2016	18 - 49 years	2013
Mutabazi 2012	21 - 54 years	2011
Sokal 2014a	18 - 54 years	2012
Sokal 2014b	18 - 54 years	2011
Tshimanga 2016a	18 years or older	2011 - 2012
Tshimanga 2016b	13 - 17 years old	2013 - 2014

Study designs varied from randomized controlled trials [Barone 2012; Feldblum 2016; Kanyago 2013; Mutabazi 2012; Sokal 2014b<sup>18</sup>; Tshimanga 2016b<sup>20</sup>], to observational as well as qualitative studies [Cummings 2016; Feldblum 2014; Fram 2016; Galukande 2014; Kasprzyk 2016; Kigozi 2013; Kigozi

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2014; Kohler 2016; Mavhu 2016; Milovanovic 2016; Musau 2011; Musiige 2016; Soka 2014a<sup>17</sup>; Tshimanga 2016a<sup>19</sup>].

Study sample size ranged from 50 to 2250. Study group ages ranged from 10 to 54. Two studies reported the acceptability of device-based VMMC amongst adolescent boys [Fram 2016; Tshimanga 2016a<sup>19</sup>]. Nineteen studies assessed the acceptability of device-based VMMC amongst adult males; of which, five also evaluated providers' acceptability of device-based VMMC [Barone 2012; Feldblum 2014; Kohler 2016; Soka 2014a; Sokal 2014b]. No data were available from female sexual partners, communities, policy-makers or funders.

No major issues in regards to methodological limitations or generalisability of study findings were identified. Of note, reporting of methods used to assess acceptability was unclear in four studies [Kanyago 2013; Kigozi 2013; Kohler 2016; Musau 2011] but this is not regarded as a threat to study validity.

### **Adolescent boys' perspectives**

Two studies assessed adolescent boys' acceptability to device-based VMMC [Fram 2016; Tshimanga 2016a<sup>19</sup>]. In one study of 661 males aged 10-49 in Zimbabwe, 200 respondents preferred surgical VMMC and remaining 461 preferred PrePex; sample of 598 respondents in Zambia showed similar results (249 preferred surgery; 349 preferred PrePex) [Fram 2016]. Overall, adolescent boys were very satisfied with the PrePex procedure in another study conducted in Zimbabwe [Tshimanga 2016a<sup>19</sup>]; 96.9% and 96.1% of interviewed participants reported being "very" or "extremely" satisfied during interviews at 14 and 60 days post device application, respectively.

Pain, healing time and time off from work or school were identified as barriers to uptake of device-based VMMC [Fram 2016]. Disruption to daily routines/activities was also highlighted by adolescent boys, where they agreed that device-based VMMC affected their ability to sit, to walk, to sleep, to do housework, to participate in sports, and their school attendance [Tshimanga 2016a<sup>19</sup>].

Adolescents' preferred procedure types were also explored amongst the Zambian respondents in Fram 2016. For the age group 10-14 (n=261), 26% chose surgical VMMC, 36% preferred PrePex, 16% preferred Shang Ring, and 23% preferred Unicirc. Similar results were observed in the age group 15-19 (n=200) (23% preferred surgical VMMC, 37% preferred PrePex, 19% preferred Shang Ring, 23%

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preferred Unicirc). However, it is worth noting that preferences for device types did not vary significantly by the two age groups ( $P > 0.05$ ) [Fram 2016].

### **Adult males' perspectives**

Across the studies, overall satisfaction with device-based VMMC was high and participants often stated that they were “satisfied” or “very satisfied” with the procedure and the results [Barone 2012; Cummings 2016; Feldblum 2014; Feldblum 2016; Kanyago 2013; Kasprzyk 2016; Kigozi 2013; Kohler 2016; Musau 2011; Musiige 2016; Mutabazi 2012; Sokal 2014a; Sokal 2014b; Tshimanga 2016a; Tshimanga 2016b], and that they would recommend device-based VMMC to others (e.g. family member or male friends) [Barone 2012; Cummings 2016; Feldblum 2014; Galukande 2014; Mavhu 2016; Milovanovic 2016; Musau 2011; Musiige 2016; Mutabazi 2012; Sokal 2014a; Sokal 2014b].

Several studies provided comparative evidence. Majority (74%) of participants in the Shang Ring group reported that they were highly satisfied with their procedure, compared with 60.0% of patients in the forceps-guided surgical VMMC group, but this was not statistically significant (RR: 1.38, 95% CI: 0.94 to 2.02,  $P = 0.10$ ); the proportion of satisfied patients was significantly higher in the device-VMMC group (77.3%) versus surgical-VMMC group (58.3%) (RR: 1.65, 95% CI: 1.04 to 2.60,  $P = 0.03$ ) [Kanyago 2013]. In another study, the proportions of men reporting that they were satisfied or very satisfied were 99.1% in the Shang Ring group and 100% in the dorsal slit group [Kigozi 2013]. One study stated an acceptance rate of 76% of device-based VMMC over the dorsal slit surgery approach when offered a free choice of VMMC method [Kigozi 2014]. One study found that 91 of 92 patients (99%) in the PrePex group were satisfied with the aesthetics of circumcision compared with 55 of 55 patients (100%) in the surgical group; 91 of 92 (99%) patients in the PrePex group would recommend the procedure compared with 54 of 55 patients (98%) in the surgical group [Mutabazi 2012]. One study conducted in Zambia reported that, at the 60-day visit, significantly more men in the Shang Ring group compared with the conventional surgical VMMC group were “very satisfied” with cosmetic appearance, 95.7% versus 85.9% ( $P = 0.02$ ) in Kenya, and 96.8% versus 71.3% ( $P < 0.01$ ) in Zambia [Sokal 2014b]. Another study found that, when men in the surgical-VMMC group were asked about satisfaction with their circumcision, in the 90-day post-procedure interview almost all men (50 out of 51) indicated that they were satisfied, with about 94% (48 out of 51) indicating that they were “very” or “extremely” satisfied; 99% of men from the PrePex group (109 out of 110) indicated that they were satisfied, with about 88% indicating that they were “very” or “extremely” satisfied. This difference in satisfaction between the two groups was, however, not statistically significant ( $P > 0.05$ ) [Tshimanga 2016a].

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Willingness to undergoing device-based VMMC in Zambian males aged 10-49 (n=992) was reported by one study [Fram 2016]: 25% for surgical VMMC, 35% for PrePex-VMMC, 16% for ShangRing, and 23% for Unicirc. In Zimbabwean men (ages 13-49; n=661), 30% chose surgical VMMC and the remaining 70% were willing to undergo PrePex-VMMC [Fram 2016].

Reported facilitators to undergo device-based VMMC include: comfort levels with wearing the device [Cummings 2016], ease of procedure [Sokal 2014b<sup>18</sup>], maintain routine daily activities [Cummings 2016; Kohler 2016], less pain than expected [Feldblum 2014; Feldblum 2016; Sokal 2014a<sup>17</sup>], improved hygiene [Feldblum 2014; Feldblum 2016; Mutabazi 2012; Sokal 2014a<sup>17</sup>], quick procedure time [Feldblum 2016; Sokal 2014a<sup>17</sup>], no stitches [Feldblum 2016; Sokal 2014a<sup>17</sup>], better safety than surgical approach [Milovanovic 2016], fast healing process [Mutabazi 2012], and overall cosmetic result/appearance [Feldblum 2014; Feldblum 2016; Mutabazi 2012; Sokal 2014a<sup>17</sup>].

Pain during the procedure [Fram 2016], during the device wear period [Cummings 2016; Feldblum 2016] during device removal [Feldblum 2014; Musiige 2016; Sokal 2014a<sup>17</sup>], and during healing time [Fram 2016] were identified as barriers to uptake of device-based VMMC. Adult males from one study reported that, they would have opted for surgical VMMC if they had known the extent of pain (23.2% respondents), and 9.4% of the study respondents would have decided not to be circumcised at all [Mavhu 2016]. Discomfort or pain with erections [Cummings 2016; Feldblum 2016; Musau 2011; Sokal 2014a<sup>17</sup>] was also raised by adult males.

Odor was another common theme as barrier to acceptability [Feldblum 2014; Kohler 2016; Mavhu 2016; Musiige 2016]. One study reported that a small number (2.2%) of study participants would not recommend device-based VMMC to others because of odor [Kohler 2016]. Another study found that 9.6% respondents would have chosen surgical VMMC over device-based VMMC if they had known about the odor [Mavhu 2016], of whom 1.4% stated that they would have decided not to be circumcised at all [Mavhu 2016]. Extreme unfavorable description of odor was reported by one participant, stating that “it smelled like rotten eggs” and that “it’s a bit of a problem” [Musiige 2016].

Other barriers included difficulties with hygiene maintenance [Cummings 2016] and with urinating [Cummings 2016], lengthy procedure time [Milovanovic 2016], perceived concerns on safety [Milovanovic 2016], long healing time [Fram 2016; Milovanovic 2016], time off from work or school being too long [Fram 2016], and inconvenience with the need to return for device removal [Galukande 2014] or follow-up visits [Milovanovic 2016].

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### Providers' perspectives

Of the six studies reporting acceptability to device-based VMMC amongst health providers, ease/simplicity of procedure was the most common facilitator [Barone 2012; Feldblum 2014; Kohler 2016; Soka 2014a; Soka 2014b]. In particular, providers working in a rural tent site in Malwai reported relative ease of device (PrePex) placement and said that it was “easier to place PrePex than to do surgery in the small treatment area inside the tent” [Kohler 2016]. One study reported the following facilitator to acceptability of Shang Ring: better cosmetic results, fewer complications, and less bleeding [Sokal 2014a<sup>17</sup>]. A large proportion of providers would prefer device-based over surgery-based VMMC [Feldblum 2014; Soka 2014a; Soka 2014b].

In terms of barriers to acceptability, one study reported providers' reluctance to recommend the Shang Ring device because they perceived “it was sometimes too painful” [Barone 2012]. Another study highlighted a slow healing process as a barrier to acceptability by providers [Soka 2014a].

### Key points

High satisfaction rates among adult men and adolescent boys were reported. Common barriers were pain and odor. From providers' point of view, ease of procedure is a key facilitator to acceptability. Views from female sexual partners, the wider communities, policy-makers and funders are currently unknown. The existing evidence suggests that device-based VMMC is acceptable amongst adolescent and adult males. Further research to obtain views from other stakeholders is warranted.

## RESOURCE USE

**GRADE EtD criteria: (1) How large are the resource requirements? (2) What is the certainty of evidence for resource requirements?**

- (1) How large are costs for device-based VMMC (any device, specific device) and conventional surgical VMMC for: (i) individuals; (ii) coverage programs?
- (2) We did not specifically address any questions for criterion 2; obvious limitations in costing evidence, associated variability in cost estimation, and its applicability to other geographic regions where appropriate are summarized below.

### Summary

Seven cost-analysis studies were included. The studies covered eastern and southern geographical regions in Africa: Kenya, Mozambique, Uganda, South Africa and Zambia.

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All the studies referred to costs for VMMC coverage programs. The U.S. dollar was used as currency unit to calculate the cost data. The overall costs to perform one circumcision using device-based VMMC ranges from \$18.21 to \$65. Costs of device-based VMMC by countries/regions are illustrated in **Table 3**.

Included studies also provided information on cost drivers. One report provided the breakdown of direct cost components, where the cost of clinician time was higher with surgery-based (dorsal slit) VMMC as compared to Shang Ring-VMMC, reflecting the longer duration of the surgical procedure (24.3 minutes on average, versus 13.4 minutes for the Shang ring). Cost of disposable medical supplies was higher with the Shang ring, where the unit cost of the device and associated supplies outweighed the costs of scalpel, sutures, and dressings used in the dorsal slit technique. The cost of reusable instruments was similar for the 2 techniques [Bratt 2013]. Similarly, a study found that, although consumable supply costs for surgery-based VMMC were higher than device-based (PrePex) VMMC (\$9.13 vs. \$5.33 on average) on the procedure day, the device-based VMMC method is associated with post-procedure visit and utilization of certain supplies (e.g., dressing tray for device removal, clean gloves, handrub, gauze, scalpel, etc. [Obiero 2013].

One study found that the two largest contributors to the unit cost were consumables and staff. For surgical VMMC, consumables (\$30.36) and staff (\$14.90) contributed a combined 81% to the unit cost; for device-based VMMC, consumables (\$30.87), including PrePex device, and staff (\$14.90 - \$17.83) contributed a combined 80% to the unit cost [Njeuhmeli 2014]. Another study reported that consumables (\$24.33) contributed 48% of the total cost of PrePex-VMMC, versus 31% (\$18.77) of the forceps-guided scalpel-based VMMC [Kim 2015].

Similar findings were reported by other studies. One found that the largest unit cost driver was consumables, which were estimated at \$27.92 (Zimbabwe) and \$30.92 (Mozambique) for device VMMC and \$29.66 (Zimbabwe) and \$10.07 (Mozambique) for surgical circumcision [Schutte 2016]; the second largest contributor to the unit costs in both country studies was personnel costs. In Zimbabwe, personal costs were \$16.38 and \$22.69 per VMMC for the device and surgery, respectively. In the Mozambique study, personnel costs were estimated at \$3.95 for the PrePex and \$3.89 for surgical VMMC. Consequently, in the study in Zimbabwe, consumable supplies costs and personnel costs together contributed to 96% of the PrePex and surgical VMMC unit costs. In Mozambique, these 2 cost categories contributed to 86% and 63% of the unit costs for PrePex and surgery [Schutte 2016].

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### Key points

Consumables and staffing costs are the two key cost drivers for VMMC. Compared with surgical method, the device-based approach reflects shorter duration of the procedure and thus is associated with lower cost of clinician time; but the additional costs of device itself and associated medical supplies as well as costs with subsequent device removal inflates the overall cost of device-based approach. The cost for device-based VMMC varied depending to the type of device used. The existing evidence focused on the use of PrePex and Shang Ring, and thus the costs of other VMMC devices remain unclear

### GRADE EtD criterion: (3) Does the cost-effectiveness of the intervention favour the intervention or the comparison?

Findings from previous relevant evidence sources are summarised below.

### Summary

The direct unit cost of surgical based and device-based VMMC are roughly equivalent, but the overall average cost-effectiveness is very sensitive to resource utilisation rates (see example in the following paragraph). Relative to surgical based approach, device-based VMMC generates greater cost reduction as the resource utilisation increases, which results in a more apparent cost saving over surgical based approach. However, the threshold of minimum resource utilisation for activating apparent cost saving remains unclear.

For example, if 10% of all VMMC is done by PrePex at a mixed site, where both types of interventions are provided, the overall cost of surgical method and PrePex is similar (US\$59.62 and US\$59.53 respectively); whereas the unit cost of PrePex VMMC is reduced to US\$51.10, at a hypothetical PrePex only site (Kim, 2015). Findings are consistent across a number of studies, for example, Njeuhmeli (2014) found at mixed site with 16% PrePex, the total unit cost per VMMC is US\$60.58, which is higher than that of the surgery only site (US\$55.83), due to underutilisation of resources. However, as the site capacity utilisation improves, the per unit cost difference between sites diminishes.

Duffy 2013 is a cost-analysis study investigated future cost saving as a result of HIV Infection Averted (HIA). The study is conducted in Uganda reporting average unit cost and cost-effectiveness information of the PrePex device compared to surgical approach amongst adult males aged 18 years and above, who were recruited via a convenient consecutive sampling method. The sample size was 10625, including 10000 surgical-VMMC and 625 clients. Despite its large sample size, this study was

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done in a fixed location, high surgical VMMC volume urban site and extrapolation of findings to a low volume rural site or mobile surgical VMMC model needs to be done with caution. Besides, the unit costs and the cost-effectiveness are very sensitive to resource utilisation rates, this study did not evaluate the unit cost of demand creation. Finally, this study was performed from a service provider perspective and does not take into account the client time required or the costs incurred by the client receiving the service.

The study assessed the cost-effectiveness of device (PrePex) compared to the surgery. Cost-effectiveness was determined by comparing the unit cost of a circumcision with the estimated discounted savings of future care and treatment costs avoided from those HIV infections averted as a result of the circumcision.

Findings of each method were:

- Surgical costs \$430 (19\*\$22.63) for each HIV Infection Averted (HIA), with future cost savings of \$6,970 (\$7,400–\$430);
- PrePex costs \$580 (19\*\$30.55) for each HIA, with future cost savings of \$6,820 (\$7,400–\$580).

PrePex has a unit cost 35% higher than the current surgical method and after future cost savings are taken into account, it is 2% less cost-effective than the surgical approach  $[(6,970-6,820)/6,970]$ .

### Key points

Overall, in terms of direct unit cost, device-based VMMC using PrePex could be viewed as cost-effective based on consistent findings of several cost-effectiveness studies (Bratt 2013, Duffy 2013, Kim 2015, Njeuhmeli 2014, Obiero 2013, Schutte 2016, Tshimanga 2016), especially if VMMC was to scale up, device-based VMMC could substantially lower average total cost than surgical based approach, for the former uses staff and other fixed resources more intensely (Bratt, 2013).

Comparing the cost of performing circumcisions to the future cost savings of potentially averted HIV infections, PrePex-VMMC is only slightly less cost-effective than the surgical method. However, since the study was executed in a fixed urban site with high surgical VMMC, findings may not be generalisable to other populations and thus further research into the cost-effectiveness of device/PrePex VMMC in other settings (e.g. low VMMC volume, rural site) is needed.

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## **EQUITY**

### **GRADE EtD criterion: What would be the impact on health equity?**

Are there:

- Subgroups or subpopulations that who may be disadvantaged in receipt of device (any & specific)-based VMMC?
- Subgroups or subpopulations in which device (any & specific)-based VMMC may be less effective for non-physiologic reasons?

We did not identify any evidence on the impact of device-based VMMC on health equity.

## **FEASIBILITY**

### **GRADE EtD criterion: Is the intervention feasible to implement?**

With regards to implementing device (any & specific)-based VMMC recommendations, are there concerns about:

- legal or bureaucratic constraints?
- important barriers to implementation or its sustainability for any reason?
- misuse or abuse of recommendation?
- health care ethics?

We did not identify any studies investigating constraints or barriers in implementing device-based VMMC recommendations.

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### Acceptability

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**Table 3. Costs of device-based VMMC by countries/regions**

Reference ID	Country	Device	Cost per procedure (USD)
Bratt 2013	Zambia	Shang Ring	\$18.21
Kim 2015	South Africa	PrePex	\$51.10 – \$59.53
Obiero 2013	Kenya	PrePex	\$44.54 – \$49.02
Schutte 2016	Mozambique	PrePex	\$40.66
Njeuhmeli 2014	Zimbabwe	PrePex	\$57.45 – \$60.58
Schutte 2016			\$45.50
Tshimanga 2016			\$45.99
Vandament 2016			\$35 – \$65

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### PICO 3: VMMC in younger adolescent boys versus delayed VMMC

<b>Population</b>	<ul style="list-style-type: none"> <li>▪ HIV uninfected uncircumcised boys aged 10-14y at a future risk of HIV infection through heterosexual intercourse</li> </ul>
<b>Intervention</b>	<ul style="list-style-type: none"> <li>▪ VMMC (device based or conventional surgical) at ages 10-14 when genitalia are not yet physically mature or foreskin not retractable</li> </ul>
<b>Comparator</b>	<ul style="list-style-type: none"> <li>▪ Delaying VMMC until later (aged <math>\geq 15</math> years)</li> </ul>
<b>Outcomes</b>	<ul style="list-style-type: none"> <li>▪ Adequate removal of the foreskin</li> <li>▪ Cosmesis</li> <li>▪ Psychological distress</li> <li>▪ Pain (in preparation for, during or after procedure, while wearing or removal of device)</li> <li>▪ Inconvenience and odour while wearing the device</li> <li>▪ Complications of the procedure</li> <li>▪ Procedure time</li> <li>▪ Burden of required follow-up visits</li> <li>▪ Time to return to normal daily activities</li> </ul>

### VALUES & PREFERENCES

**GRADE EtD criterion: Is there important uncertainty about or variability in how much people value the main outcomes?**

What is the relative importance that young adolescent boys, their parents/guardians, and the community place on the main outcomes? Is there important uncertainty and variability in assigned relative importance?

#### Summary

No evidence was retrieved on the relative values and preferences placed on the aforementioned outcomes by young adolescent boys, their parents/guardians, or the community in regards to VMMC at 10-14 years of age. However, indirect evidence on the key factors behind the decision to undergo VMMC at this age range is available (refer to section 'Acceptability').

### ACCEPTABILITY

**GRADE EtD criterion: Is the intervention acceptable to key stakeholders?**

Are there stakeholders (young adolescent boys, their parents/guardians, health policy makers, healthcare funding organizations) who:

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- think that the balance of benefits and harms favours VMMC at ages of 10 to 14 years?
- think that the balance of benefits and harms favours delayed VMMC at age  $\geq 15$  years?

### Summary

Four studies reporting measures of acceptability were included. All were cross-sectional by design and data were collected via structured interviews. Sample size ranged from 359 to 1526. These studies covered various geographical regions across Africa (Rwanda, South Africa, Tanzania, and Zimbabwe) [Gasasira 2012; Patel 2018; Wambura 2011] as well as India [Madhivanan 2008]. Across the studies, ages ranged from 10 to 59 years. Three studies assessed parents' acceptability of VMMC in their children [Gasasira 2012; Madhivanan 2008; Wambura 2011] and two assessed acceptability of VMMC in young and older adolescent boys [Gasasira 2012; Patel 2018]. No data were available from providers, policy-makers or funders. Sampling methods employed by the three studies varied (one used probability proportional to size (PPS) sampling [Gasasira 2012], three were convenience sampling [Madhivanan 2008; Patel 2018; Wambura 2011]) and no gross methodological limitations were obvious. In terms of generalisability, one study used a nationally representative sample [Gasasira 2012] and another exerted efforts to assure representative of various ethnicities and geographic contexts across study sites [Patel 2018]. Findings from a small study (n=795) were obtained among a convenience sample of women attending a reproductive health clinic in India [Madhivanan 2008]; for the smallest study (n=359), since it was designed to explore the acceptability of VMMC in a traditionally circumcising culture, findings were obtained from males and females in selected areas of Tanzania [Wambura 2011]. Results from these two studies may, therefore, not be generalizable to other populations [Madhivanan 2008; Wambura 2011].

### Young adolescents' perspectives

One study provided findings on perceived motivations to undergo VMMC amongst young (10-14 years) and older (15-19 years) adolescents [Patel 2018]. The most common reasons cited were: protection from HIV/STIs, to improve hygiene, and suggested/advised by parents or school.

Pain was a common barrier to uptake of VMMC at younger age (less than 19 years). One study reported that [Gasasira 2012], while majority of the men aged above 29 years did not want to be circumcised because of older age, younger men were afraid of pain, particularly those less than 19 years old. In another study, the most common concern about undergoing VMMC amongst younger (10- 14 years) and older adolescents (15-19 years) was also pain from the procedure or injection (younger: 44.5%; older: 66.4%) [Patel 2018].

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Other barriers to undergoing VMMC amongst younger and older adolescents were: duration of healing time (2.3% in younger and 4.5% in older adolescents). Sexual abstinence during wound healing was also raised as a significant concern (0.5% younger and 2.3% in older adolescents;  $P < 0.05$ ). Recovery from procedure was perceived as “hard” or “very hard” in 13.1% younger and 8.4% older adolescents, respectively ( $P = 0.004$ ) [Patel 2018].

### Parents’ perspectives

Reduction of HIV risk was identified as a potential facilitator of acceptability to VMMC. One study found that [Gasasira 2012], after informing the respondents that studies have shown that circumcision done by trained professionals reduces the risk of HIV infection by 60%, majority of the men supported their son’s VMMC (79%), and 89% of them preferred to do it at younger age (below 15 years).

One study reported that [Madhivanan 2008], amongst parents who had circumcised sons (median age: 8 years, range: 1 month to 17 years), the reasons to undergo VMMC were religion, advice from doctor, health reasons, “wanting her child to look like his father”. For participants who had not circumcised their children, motivations to change their mind about having their children circumcised were: prevention of HIV infection, knowledge of healing time, knowledge of procedure, minimal pain. Setting (performed in a safe hospital), costs (if free of charge) and cultural acceptance were also highlighted as important factors in determining acceptability of VMMC.

Reported barriers to circumcising male children included: religion, lack of knowledge about male circumcision, age (intended to circumcise their children when they were older), parents considered the procedure unnecessary, and financial reasons [Madhivanan 2008].

Another study found that, 165 (97.1%) males and 179 (94.7%) females supported VMMC for their sons. Of these, 107 (64.8%) males and 130 (72.6%) females preferred prepubertal circumcision (12 years or less) while 58 (35.2%) males and 49 (27.4%) females preferred postpubertal circumcision (above 12 years) in the medical setting. Reasons for prepubertal circumcision in the medical setting were faster wound healing time, less bleeding and pain, and no loss of production time during the wound healing period [Wambura 2011].

### Key points

There is currently limited evidence on acceptability of VMMC to adolescent boys (both young and

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old) and their parents. A number of barriers and facilitators to implementing VMMC in younger adolescents have been reported, with pain and HIV protection being the most cited, respectively. Overall, the existing evidence suggests that for adolescent boys and their parents, VMMC between 10 to 14 years of age may be acceptable if concerns on pain and knowledge of peri- and post-procedural care are weighed against the benefits of HIV prevention.

## RESOURCE USE

**GRADE EtD criteria: (1) How large are the resource requirements? (2) What is the certainty of evidence for resource requirements? (3) Does the cost-effectiveness of the intervention favour the intervention or the comparison?**

### Summary

Costs are not likely to vary by timing of the procedure (between 10-14 years vs.  $\geq 15$  years). As such, we did not specifically review cost data for this particular question. However, available costing information from the DMPPT2.0 model, a simple compartmental model implemented in Microsoft Excel 2010 to analyze the effects of age at circumcision on program impact and cost-effectiveness, assessing the cost-effectiveness of VMMC age-targeting strategies over a 15-year period in Malawi, South Africa, Swaziland, Tanzania, and Uganda [Kripke 2016], is summarized below.

#### Cost effectiveness as "Discounted cost per HIV infection averted", thousands in USD (2014–2028)

10–49 \$4.6 in Malawi; \$2.7 in South Africa; \$1.2 in Swaziland; \$5.8 in Tanzania; \$1.5 in Uganda;  
 15–49 \$3.5 in Malawi; \$2.2 in South Africa; \$0.9 in Swaziland; \$4.1 in Tanzania; \$1.1 in Uganda;  
 10–24 \$6.1 in Malawi; \$3.6 in South Africa; \$1.4 in Swaziland; \$7.8 in Tanzania; \$2.1 in Uganda;  
 15–24 \$4.3 in Malawi; \$2.5 in South Africa; \$1.0 in Swaziland; \$4.9 in Tanzania; \$1.4 in Uganda;  
 10–29 \$5.1 in Malawi; \$3.0 in South Africa; \$1.2 in Swaziland; \$6.8 in Tanzania; \$1.7 in Uganda;  
 15–29 \$3.7 in Malawi; \$2.2 in South Africa; \$0.9 in Swaziland; \$4.3 in Tanzania; \$1.2 in Uganda;  
 10–34 \$4.7 in Malawi; \$2.7 in South Africa; \$1.1 in Swaziland; \$6.1 in Tanzania; \$1.6 in Uganda;  
 15–34 \$3.5 in Malawi; \$2.1 in South Africa; \$0.9 in Swaziland; \$4.0 in Tanzania; \$1.1 in Uganda.

#### Total cost, millions in USD (2014-2018)

10–49 \$676 in Malawi; \$1,021 in South Africa; \$37 in Swaziland; \$309 in Tanzania; \$723 in Uganda;  
 15–49 \$522 in Malawi; \$806 in South Africa; \$29 in Swaziland; \$204 in Tanzania; \$523 in Uganda;  
 10–24 \$506 in Malawi; \$673 in South Africa; \$26 in Swaziland; \$243 in Tanzania; \$531 in Uganda;  
 15–24 \$352 in Malawi; \$458 in South Africa; \$18 in Swaziland; \$139 in Tanzania; \$330 in Uganda;

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10–29 \$559 in Malawi; \$755 in South Africa; \$30 in Swaziland; \$261 in Tanzania; \$581 in Uganda;  
 15–29 \$406 in Malawi; \$541 in South Africa; \$22 in Swaziland; \$156 in Tanzania; \$379 in Uganda;  
 10–34 \$602 in Malawi; \$841 in South Africa; \$33 in Swaziland; \$278 in Tanzania; \$62 in Uganda;  
 15–34 \$449 in Malawi; \$627 in South Africa; \$25 in Swaziland; \$174 in Tanzania; \$428 in Uganda.

From the DMPPT2.0 model, focusing VMMC on the age group 15 - 34 years is one of the most cost-effective options in all countries. Over a 15-year time frame, inclusion of males ages 10–14 years only leads to a small increase in HIV infections averted, and results in a higher cost per HIV infection averted.

Additional information from a Age Structured Mathematical (ASM) model, a population-level, deterministic, compartmental model of heterosexual HIV transmission consisting of coupled nonlinear differential equations that stratify the population into compartments according to sex, circumcision status, age (five-year strata: 0–4 years, 5–9 years, ... 95–99 years), sexual risk, HIV status, and stage of infection) applied to Zambia on the impact of scaling up to 80% circumcision coverage in specific five-year age strata over seven years (2011–2017) and maintained through 2050 compared with baseline scenario of no VMMC programme [WHO 2017]:

Cost/HIV infection averted (USD\$) by targeted age group):

Ages 10-14, 1,759

Ages 15-19, 1,045

Ages 20-24, 888

Ages 25-29, 1,117

Ages 30-34, 1,396

Ages 35-39, 1,561

Ages 40-44, 2,187

Ages 45-49, 3,300

From the ASM model, focusing VMMC on ages 20–24 years is the most cost-effective options. Comparing cost per HIV infection averted between age group 10-14 years and age group 15-19 years, starting VMMC at younger age results in a higher cost per HIV infection averted (\$1759 vs. \$1045).

**Key points summarized from modelling reports**

As for other HIV prevention strategies, cost-effectiveness of VMMC in younger adolescent boys

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should be viewed as an intervention that only needs to be provided once and leads to a lifetime benefit. Thus, by focussing only on short-term benefits may miss the point of this highly cost-effective HIV prevention method whose effects last a lifetime. It is worth noting that the majority of males between 10–14 years of age are not highly sexually active and thus there is a time lapse before the benefit of VMMC is shown, when they have a higher risk of exposure to HIV. In addition, although findings on short-term impact might suggest that circumcising younger adolescent boys ages 10–14 should not be a program priority, turning this group of stakeholders away would mean refusing services to approximately 35% of clients currently accessing VMMC services and could be viewed as problematic by implementers, given the limited demand for VMMC to date among older males. Such a policy would likely have unintended consequences, such as loss to follow-up, or worse, creating a negative perception of VMMC within the community. It is also worth noting that circumcising males ages 10–14 years is likely to be more cost-effective than circumcising older males, who appear to require more complex demand-creation efforts.

## EQUITY

### GRADE EtD criterion: What would be the impact on health equity?

Evidence was not specifically reviewed because it is unlikely that a few years of age difference would modify considerations of equity relevant for PICO Q1.

## FEASIBILITY

### GRADE EtD criterion: Is the intervention feasible to implement?

With regards to implementing VMMC recommendations for boys with ages 10-14 years, are there unique concerns about the following that are not concerns for boys  $\geq$  15 years of age (i.e. constraints or barriers that are uniquely different from those identified in PICO 1 and PICO 2 because of younger-age criterion):

- legal or bureaucratic constraints?
- important barriers to implementation or its sustainability for any reason?
- misuse or abuse of recommendation?
- health care ethics?

## Summary

One qualitative study (in-depth, semi-structured interviews) was included.

Tobian 2018 is a qualitative study in which in-depth, semi-structured interviews were conducted with providers (VMMC counselors, nurses, midwives) who delivered information to adolescent males seeking VMMC services and with facility managers who oversaw the provision of VMMC services to adolescent males in Tanzania, South Africa & Zimbabwe [Tobian 2018]. Overall, facility

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managers and providers agreed that VMMC training needs to incorporate thorough adolescent-specific recommendations to be effective. In addition to counseling, providers reported that it was their responsibility to deliver the following services: HIV testing (84.8%); family planning, including provision of condoms (48.5%); STI testing and treatment (42.4%); and other general health services (45.5%).

For the overall counselling approach for adolescents, many providers felt it was important to hold back some details perceived to be irrelevant (eg, sexual health and HIV) for clients aged <15 years. These topics could be broached with older adolescents if the provider deemed it appropriate. Facility managers in all 3 countries indicated that their facilities generally conducted group counseling sessions according to age and engagement in sexual activity, often grouping younger adolescents (aged <15 years) separately from those aged >15 years."

For younger adolescents (<15 years old), providers and facility managers largely believed that very young boys (10–12 years) "don't know much yet" and have fewer sexual experiences, so the counseling does not have to address sexual issues in detail or at all. Amongst older adolescents, providers and facility managers generally felt it was more appropriate to address sexual topics with older adolescents (>15 years) because they were more likely to have started experimenting with their sexuality, although a few providers thought sexual content was only appropriate for those aged ≥18 years"

Providers and facility managers expressed the need for refresher trainings to keep abreast of accurate and comprehensive information regarding HIV and VMMC via age-appropriate HIV health education and counseling approaches. The lack of adolescent-specific training and limited training or refresher courses was highlighted.

The main limitation of this qualitative study is, by nature, the lack of generalisability beyond the included study participants. The study also failed to account for cultural differences among countries or between sites within countries.

### **Key points**

Existing evidence points to the need for improvements in provider training and counselling on the younger adolescent males and adolescent-specific guidelines (e.g. on condom use, HIV counseling in general and specific to disclosing HIV-positive test results to younger clients) are warranted.

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## References for PICO 3

### Acceptability

1. Gasasira RA, Sarker M, Tsague L, et al. Determinants of circumcision and willingness to be circumcised by Rwandan men, 2010. *BMC public health*. 2012;12:134.
2. Madhivanan P, Krupp K, Chandrasekaran V, Karat SC, Reingold AL, Klausner JD. Acceptability of male circumcision among mothers with male children in Mysore, India. *AIDS (London, England)*. 2008;22(8):983-988.
3. Patel EU, Kaufman MR, Dam KH, et al. Age Differences in Perceptions of and Motivations for Voluntary Medical Male Circumcision among Adolescents in South Africa, Tanzania, and Zimbabwe. *Clinical Infectious Diseases*. 2018;66:S173-S182.
4. Wambura M, Mwangi JR, Mosha JF, Mshana G, Mosha F, Changalucha J. Acceptability of medical male circumcision in the traditionally circumcising communities in Northern Tanzania. *BMC public health*. 2011;11:373.

### Resource use

1. Kripke K, Opuni M, Schnure M, et al. Age Targeting of Voluntary Medical Male Circumcision Programs Using the Decision Makers' Program Planning Toolkit (DMPPT) 2.0. *PloS one*. 2016;11(7):e0156909.
2. Models to Inform Fast Tracking Voluntary Medical Male Circumcision in HIV Combination Prevention: report from World Health Organization and UNAIDS meeting, 23–24 March 2016. Geneva, Switzerland: World Health Organization; 2017. Licence: CC BY-NC-SA 3.0 IGO.

### Feasibility

1. Tobian AAR, Dam KH, Van Lith LM, et al. Providers' Perceptions and Training Needs for Counseling Adolescents Undergoing Voluntary Medical Male Circumcision. *Clinical Infectious Diseases*. 2018;66:S198-S204.

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## APPENDICES

### 1. Search strategy for PICO 1

Database	Search String
CINAHL	(No N1 Circumci*) OR (Non NO Circumci*) OR Uncircumci* Limiters - Published Date: 20070101-20181231
Embase	1. ("No Circumci*" OR "Non Circumci*" OR "Not Circumci*" OR Uncircumci*).ti,ab. 2. Limit 1 to yr="2007 -Current"
LILACS	tw:((No Circumci*) OR (Non Circumci*) OR (Not Circumci*) OR Uncircumci*) AND (Instance:"Regional") AND ( db:("LILACS") AND Year_Cluster:( "2007" OR "2008" OR "2009" OR "2010" OR "2011" OR "2012" OR "2013" OR "2014" OR "2015" OR "2016" OR "2017" OR "2018"))
MEDLINE	1. ("No Circumci*" OR "Non Circumci*" OR "Not Circumci*" OR Uncircumci*).ti,ab. 2. Limit 1 to yr="2007 -Current"
PsycINFO	1. ("No Circumci*" OR "Non Circumci*" OR "Not Circumci*" OR Uncircumci*).ti,ab. 2. Limit 1 to yr="2007 -Current"

### 2. Search strategy for PICO 2

Database	Search String
CINAHL	#3 #1 AND #2 Limiters - Published Date: 20070101-20181231 #2 (MH "Disposable Equipment") OR (MH "Minimally Invasive Procedures") OR (MH "Surgical Stapling") OR TI ( Changshu OR Clamp* OR Collar* OR Cutter* OR Disposable OR Device* OR Equipment* OR Instrument* OR Plastibell* OR PrePex* OR ShangRing* OR Stapl* OR UniCirc* OR "Minimal Surgical" OR "Minimally Invasive" OR "Minimum Surgical" OR "Mini Invasive" ) OR AB ( Changshu OR Clamp* OR Collar* OR Cutter* OR Disposable OR Device* OR Equipment* OR Instrument* OR Plastibell* OR PrePex* OR ShangRing* OR Stapl* OR UniCirc* OR "Minimal Surgical" OR "Minimally Invasive" OR "Minimum Surgical" OR "Mini Invasive" ) #1 (MH "Circumcision") OR TI ( Circumcis* OR Circumciz* OR VMMC ) OR AB ( Circumcis* OR Circumciz* OR VMMC )
Embase	1. Circumcision/ OR (Circumcis* OR Circumciz* OR VMMC).ti,ab. 2. Circumcision Device/ OR Disposable Equipment/ OR Minimally Invasive Procedure/ OR Minimally Invasive Surgery/ OR Surgical Equipment/ OR Stapler/ OR

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	<p>Surgery.fs. OR (Changshu OR Clamp* OR Collar* OR Cutter* OR Disposable OR Device* OR Equipment* OR Instrument* OR Plastibell* OR PrePex* OR ShangRing* OR Stapl* OR UniCirc* OR "Minimal Surgical" OR "Minimally Invasive" OR "Minimum Surgical" OR "Mini Invasive").ti,ab.</p> <p>3. 1 AND 2</p> <p>4. Limit 3 to yr="2007 -Current"</p>
LILACS	<p>tw:((Circumcis* OR Circumciz* OR VMMC) AND (Changshu OR Clamp* OR Collar* OR Cutter* OR Device* OR Disposable OR Equipment* OR Instrument* OR Plastibell* OR Prepex* OR Shangring* OR Stapl* OR Unicirc* OR "Minimal Surgical" OR "Minimally Invasive" OR "Minimum Surgical" OR "Mini Invasive")) AND (Instance:"Regional") AND ( db:("LILACS") AND Year_Cluster:("2007" OR "2008" OR "2009" OR "2010" OR "2011" OR "2012" OR "2013" OR "2014" OR "2015" OR "2016" OR "2017" OR "2018"))</p>
MEDLINE	<p>1. Circumcision, Male/ OR (Circumcis* OR Circumciz* OR VMMC).ti,ab.</p> <p>2. Disposable Equipment/ OR Minimally Invasive Surgical Procedures/ OR Surgical Equipment/ OR Surgical Fixation Devices/ OR Surgical Instruments/ OR Surgical Staplers/ OR (Instrumentation OR Methods OR Surgery).fs. OR (Changshu OR Clamp* OR Collar* OR Cutter* OR Disposable OR Device* OR Equipment* OR Instrument* OR Plastibell* OR PrePex* OR ShangRing* OR Stapl* OR UniCirc* OR "Minimal Surgical" OR "Minimally Invasive" OR "Minimum Surgical" OR "Mini Invasive").ti,ab.</p> <p>3. 1 AND 2</p> <p>4. Limit 3 to yr="2007 -Current"</p>
PsycINFO	<p>1. Circumcision/ OR (Circumcis* OR Circumciz* OR VMMC).ti,ab.</p> <p>2. (Changshu OR Clamp* OR Collar* OR Cutter* OR Disposable OR Device* OR Equipment* OR Instrument* OR Plastibell* OR PrePex* OR ShangRing* OR Stapl* OR UniCirc* OR "Minimal Surgical" OR "Minimally Invasive" OR "Minimum Surgical" OR "Mini Invasive").ti,ab.</p> <p>3. 1 AND 2</p> <p>4. Limit 3 to yr="2007 -Current"</p>

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### 3. Search strategy for PICO 3

Database	Search String
CINAHL	#3 #1 AND #2 Limiters - Published Date: 20070101-20181231 #2 (MH "Adolescence") OR TI ( Adolescen* OR Boys OR Highschool* OR Juvenile OR Pupil OR Pupils OR Teen* OR Young OR Youth* ) OR AB ( Adolescen* OR Boys OR Highschool* OR Juvenile OR Pupil OR Pupils OR Teen* OR Young OR Youth* ) #1 (MH "Circumcision") OR TI ( Circumcis* OR Circumciz* OR VMMC ) OR AB ( Circumcis* OR Circumciz* OR VMMC )
Embase	1. Circumcision/ OR (Circumcis* OR Circumciz* OR VMMC).ti,ab. 2. Adolescence/ OR Adolescent/ OR Juvenile/ OR (Adolescen* OR Boys OR Highschool* OR Juvenile OR Pupil OR Pupils OR Teen* OR Young OR Youth*).ti,ab. 3. 1 AND 2 4. Limit 3 to yr="2007 -Current"
LILACS	tw:((Circumcis* OR Circumciz* OR VMMC) AND (Adolescen* OR Boys OR Highschool* OR Juvenile OR Pupil OR Pupils OR Teen* OR Young OR Youth*)) AND (instance:"regional") AND ( db:("LILACS") AND year_cluster:("2007" OR "2008" OR "2009" OR "2010" OR "2011" OR "2012" OR "2013" OR "2014" OR "2015" OR "2016" OR "2017" OR "2018"))
MEDLINE	1. Circumcision, Male/ OR (Circumcis* OR Circumciz* OR VMMC).ti,ab. 2. Adolescent/ OR Minors/ OR (Adolescen* OR Boys OR Highschool* OR Juvenile OR Pupil OR Pupils OR Teen* OR Young OR Youth*).ti,ab. 3. 1 AND 2 4. Limit 3 to yr="2007 -Current"
PsycINFO	1. Circumcision/ OR (Circumcis* OR Circumciz* OR VMMC).ti,ab. 2. Limit 1 to (Adolescence <13 to 17 Years> and (180 School Age <Age 6 to 12 yrs> or 200 Adolescence <Age 13 to 17 yrs>)) 3. (Adolescen* OR Boys OR Highschool* OR Juvenile OR Pupil OR Pupils OR Teen* OR Young OR Youth*).ti,ab. 4. 1 AND 3 5. 2 OR 4 6. Limit 5 to yr="2007 -Current"



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