Demand for medical male circumcision for HIV prevention: the influence of economic and psychological factors and their policy implications

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Abstract

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Background: Male Circumcision (MMC) of adolescent boys and men is an effective and potentially cost-effective intervention for the prevention of HIV. Most high HIV burden, low MMC prevalence countries in sub-Saharan Africa have fallen short of WHO/UNAIDS targets for the uptake of MMC for 2016, despite significant demand generation efforts. The aim of this dissertation project was to apply economic and psychology decision theories to study the incentives that drive the uptake of MMC for HIV prevention.

Methods: The study was conducted in Mukono and Buikwe districts among predominantly fishing communities at landing sites on the northern shores of Lake Victoria, in Uganda. We conducted 11 focus group discussions and six key informant interviews to explore the economic and psychological factors affecting the uptake of MMC for HIV prevention. Based on the factors identified, we designed and executed a stated-preference discrete choice experimental (DCE) survey, coupled with measurement of psychological factors among 406 self-reported heterosexual, uncircumcised, HIV-negative men between 18-45 years-old. We used mixed logit, latent class logit and parameter-covariate mixed logit models to

estimate preferences for MMC attributes, and to examine the extent to which preferences are influenced by psychological factors.

Results: The demand for MMC was conceptualized as a process of valuation formation—based on psychological factors (HIV threat perceptions, subjective beliefs about MMC outcomes, and normative expectations), and action—based on economic factors (preferences for MMC service attributes). Socioeconomic characteristics and personality traits could explain differences in how people respond to factors at each stage of this process. In the DCE, marginal utilities (μ; se) were highest for accessing services at permanent health facilities (2.138; 0.214), and incentives: voucher vs none (0.512; 0.153) and cash vs none (0.968; 0.174). Marginal disutility (μ; se) was highest for device MMC (-1.674; 0.265). There was significant heterogeneity in preferences for accessing services at permanent health facilities (partly explained by subjective probability of pain during the MMC procedure), number of week-days during which services were available at facilities, device circumcision (partly explained by difference in the subjective probability of infection and pain from the MMC procedure, expected time away from work and sex after the MMC procedure), cash incentives and price/value of incentive compensation.

Conclusion: Preferences were strongest permanent health facilities, surgical circumcision and incentives. Heterogeneity in preferences for these MMC service attributes exists and was only partly explained by the sociodemographic characteristics and subjective beliefs about MMC outcomes. MMC service delivery should be optimized based on individual preferences for these attributes. Further research should identify more demographic, and other non-observable influences on preferences, e.g., social influences and non-observable personality traits, that could be used to channel demand creation interventions accordingly.

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DEDICATION

to my daughters, Celine and Camille

to the memory of my mother, Teddy Mbaguta-Muganwa (RIP)

1 Factors influencing the uptake of medical male circumcision for HIV prevention: results from qualitative interviews, and implications for policy and choice survey design

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Abstract

Introduction: Most high-HIV-burden countries have fallen short of WHO/UNAIDS targets for medical male circumcision (MMC) for HIV prevention. We explored the economic and psychological factors affecting the uptake of MMC for HIV prevention.

Methods: Factors were identified through 11 focus group discussions and 6 key informant interviews conducted in Mukono and Buikwe districts in central Uganda, in August 2016.

Results: The demand for MMC was conceptualized as a process of valuation formation—based on psychological factors, and action—based on economic factors. Men form a personal valuation of MMC based on their perceptions about the threat of HIV, subjective beliefs about the beneficial and adverse outcomes of MMC, and normative expectations regarding MMC. The decision to take-up MMC is facilitated or impeded by their preferences for the attributes of available MMC services i.e., factors that describe how MMC services are delivered within the context of the existing health system. Beliefs about the outcomes of MMC influence preferences for the attributes of MMC services. Socioeconomic characteristics and personality traits may explain differences in how people respond to factors at each stage of this process.

Conclusion: Psychological factors (HIV threat perceptions, beliefs about MMC outcomes, and normative expectations), and economic factors (preferences for MMC service attributes) influence the uptake of MMC for HIV prevention. We propose a conceptual framework that will form the basis of choice survey to quantify the relative impact of these factors on demand for MMC.

Key words: medical male circumcision; demand; economics; psychology

1.1 Introduction

Medical male circumcision (MMC) of adolescent boys and adults is an effective and potentially cost-effective public health strategy to reduce the risk of female-to-male HIV transmission (1, 2). In 2011, UNAIDS/WHO set a target of 20.3 million circumcisions in 14 high priority countries in sub-Saharan Africa by 2016 (3). Despite reported high acceptability of MMC (4, 5), only 58% of this target had been achieved by the end of 2015 (6). Routine monitoring data also show that utilization of MMC services is concentrated among low-risk men, i.e., younger adolescents who had not experienced sexual debut, reported consistent condom use, and regularly tested for HIV (7).

Qualitative and acceptability studies have identified barriers and facilitators of MMC (4, 8). However, these studies did not apply formal decision theory, hence limiting their ability to project the impact of demand creation policies. Two studies applied utility maximization theory from economics: (1) to identify preferences for the benefits (9), and (2) to identify preferences for harmful outcomes of MMC and service design attributes (10). Standard economic theory ignores psychological and environmental constraints to behavior, hence limiting its ability to explain variability in choice. Studies that applied social-psychological theories (the Health Belief Model, Social Cognitive Theory, Integrative Behavioral Model) focused on the role of psychological factors e.g., attitudes, affect, values, norms and beliefs as antecedents to behavior (11-14). These studies do not capture the external (to the individual) factors that influence utilization of MMC services (15). This limitation is partially addressed in Price *et al.,* (16) who applied the transtheoretical (TTM) model to identify both internal and external factors along the behavior change pathway to MMC in Zambia.

In this paper, we draw on economic and socio-psychology decision theories to elucidate factors affecting the demand for MMC for HIV prevention in Uganda. We sought to (1) identify the psychological factors influencing MMC decisions, (2) to identify the external factors influencing the utilization of MMC services, (3) examine the relationship between the psychological factors affecting MMC decisions and the external factors influencing the utilization of MMC services, and (4) propose a joint economics-psychological

conceptual framework to inform the design of a quantitative choice survey and analysis of demand creation policies.

1.2 Methods

We conducted focus group discussions (FGDs) and key informant (KI) interviews in central Uganda in August 2016. Participants were recruited from two fishing communities—Katosi and Ssi-bukunja in Mukono and Buikwe districts respectively. HIV incidence is substantially higher in the fishing communities compared to the general population in Uganda (6.04 versus 0.56 per 100 person-years at risk) (17). The prevalence of circumcision in the fishing communities is approximately 22% (slightly below the national average of 26%) (18). Interviews in Katosi were conducted at Katosi fish landing site and Kojja Health Centre IV. Interviews in Ssi-bukunja were conducted at Ssi Health Centre IV. At the time of the interviews, facility-based MMC services were provided routinely at Kojja Health Centre IV and we encountered a mobile outreach van at Ssi Health Centre IV. MMC was performed using surgical methods.

1.2.1 Interview/discussion guides

The topic guides were based on factors identified in previous studies. They covered perceptions about HIV risk and HIV consequences, how these have evolved over time, and their impact on HIV prevention. Topic guides also explored different aspects of MMC decisions, including the MMC decision triggers, benefits and risks, facilitators and barriers from individual and community perspectives, and access to MMC services. All questions were open-ended. We probed for factors that were identified in past literature but were not mentioned in the discussion. For instance, we also explored the role of future expectations of HIV-related and non-HIV-related mortality, and of health and financial wellbeing on HIV prevention decisions.

1.2.2 Sample

The FGDs included men and women above 18 years who provided written consent. Groups were stratified by sex, age (above and below 30) and circumcision status (their own status for men, their regular partner's status for women). We aimed to conduct four discussions with women and up to eight with men,

each with between 8 and 10 members, and 10 KIIs with people in the community involved in mobilization and provision of circumcision services.

1.2.3 Procedures

We recruited a convenience sample of FGD participants using two strategies. At Katosi fish landing site, we made announcements on a mobile public-address system inviting participants to the discussions. Community health workers conducted a combination of door-to-door, and snowball recruitment in the study areas. On the FGD days, participants gathered at pre-specified locations—an unused market stall at the fish landing site, and at the health centers. They were screened and sorted by our strata. To ensure privacy at the fish landing site, discussions were conducted far apart from each other and from the general waiting area. At the health centers, we used private rooms.

All FGDs were conducted in Luganda, the local language of the area, by trained moderators fluent in English. Two moderators alternated between leading the discussion and taking notes to minimize fatigue. FGDs were audiotaped. We provided refreshments during the FGD and an incentive payment equivalent to US$3 to each participant.

We conducted KI interviews with a convenience sample of community health workers, peer educators, and surgeons involved in mobilization and provision of circumcision services. Two interviews were conducted in Luganda, and the rest in English by the primary author. All interviews were conducted in private and audiotaped. We provided an incentive payment equivalent to US$8 to each KI.

1.2.4 Ethical considerations

The study was approved by the Institutional Review Boards (IRB) of the University of Washington and Mbarara University of Science and Technology. The Uganda National Council for Science and Technology (UNCST) provided final clearance for the study. All study participants provided written informed consent.

1.2.5 Analyses

Local language audio scripts were transcribed and translated into English by the moderators. Transcripts were imported into and analyzed using MAXQDA 12© (VERBI Software GmbH), using a thematic approach. We designed a coding scheme *a priori* with themes based on the factors identified in previous literature. We deductively coded all transcripts using the coding scheme and inductively allowed for new themes and sub-themes to develop as data were analyzed.

1.3 Results

We achieved saturation with eleven FGDs: 7 with men and 4 with women. The FGDs lasted between 2-3 hours. The characteristics of the FGD participants are summarized in Table 1. We conducted KI interviews with six health workers: 3 clinical officers who routinely perform MMC, and three community health workers (CHWs). Interviews lasted between 1-1.5 hours.

1.3.1 HIV threat perceptions

HIV was viewed as highly prevalent in the community and participants were generally aware of the consequences of HIV such as divorce, separation of families, orphaning of children, poverty, and stigmatization. There was less consensus on the extent to which HIV preventive behaviors were practiced. Some participants suggested that the uptake of HIV testing, and use of condoms had increased:

> *"Yes, the disease exists although I am not sure to what extent because there is an increased number of people using protection"* (male, above 30 years, uncircumcised)

> *"They accept that it exists, and they take time to go and test."* (male, above 30 years, circumcised)

--while others suggested, that high HIV risk behaviors had persisted including non-use or inconsistent use of condoms, casual sex, multiple sexual partnerships, and prostitution. Three sub-themes emerged

explaining the persistence of high HIV risk behaviors. First, misperception of the individual risk of acquiring HIV, related either to misconceptions regarding HIV transmission risk:

> *"One fears nothing at all in getting HIV because even if he knows that that girl is sick, he can be like, no way, HIV is only awake during [the] day but asleep at night."* (male, below 30 years, circumcised)

> *"What I think [is that] a person who is HIV positive can only infect one person out of ten that he has had a sexual encounter with. That encourages others to have extra-marital affairs"* (male, above 30 years, uncircumcised)

--or to a tendency to underestimate risk among those who had survived past exposures:

> *"The other thing is, in case a person tests negative after engaging in sex with a person suspected to be HIV positive, that makes them think that they are safe and [that] HIV is not real."* (male, above 30 years, uncircumcised)

Secondly, the morbidity or morality consequences of HIV were no longer a deterrent to risky behavior. This was, in many cases, related to the perception that HIV was "*merely a fever*":

> "*What I think is that they are not afraid because now they say that it is merely a fever. The other thing people say is, everyone will die. We are all to be buried so we have to eat stuff as much as we can [sic] . . .* " (male, below 30, circumcised)

Improved access to antiretroviral therapy (ART), and the expectation of a long and productive life with HIV had lessened fear, and reduced incentives for HIV preventive behaviors:

> *"People are no longer afraid of getting HIV and the reason for their confidence is that they know that TASO [The AIDS Support Organization] which gives out drugs is there; they now know that one can live [another] 30 years. For instance, if one is 40 years old, they can live for thirty more years if they take drugs."* (male, above 30 years, circumcised)

This was exacerbated by perceived increase in the prevalence of other causes of illness (e.g., cancer) without readily available treatments, or that are perceived as "*not as easily preventable or treatable*" as HIV:

> *"The common feeling is that you rather suffer from HIV than cancer or diabetes…one can prevent HIV but we don't know how to prevent other diseases…treatment for HIV is free and readily available however other diseases are treated at a high cost, you may fail to find antimalarials at X health center but find ARVs"* (male, above 30 years, uncircumcised).

A perceived higher (compared to AIDS) hazard of death on the lake has created a fatalistic attitude about the future among fishermen:

> *"I think that people don't take the consequences of getting HIV seriously … We fishermen usually come from wherever with money. The types of jobs we do, it seems like we have already risked our lives. What I mean is that the way we look for money, we are always at risk, like a soldier in battle. When you come from wherever, you don't care about getting it since you come with a lot of excitement and with money. You would not care much because the types of jobs that we do are risky to our lives."* (male, above 30 years, circumcised)

Finally, participants mentioned other (non-perceptual) factors perpetuating high-HIV-risk behaviors, including poverty:

> *"Prevailing circumstances force them to do certain things, for instance a young girl widowed at an early age without any financial support will resort to using her body to get what to eat…young boys easily date older [widowed] women because they have been told that they inherited wealth and have a car, so you end up infected because of poverty" (Male, under 30 years, uncircumcised)*

--and the daily-cash-flow nature of the local fishing business, which has led to excessive alcohol consumption.

"The biggest problem in this community like R8 (another respondent) has said is fishermen. When he gets to the lake and gets money, he comes back here and spends it on women. They don't value money anymore. In fact, even if she has an illness, he never thinks about that especially when he is in a bar and takes some alcohol. If possible the Government should find means of reducing alcohol [consumption] because it is the worst thing in the community. One would be sensible but after taking some alcohol the mind distorts."

1.3.2 MMC outcome expectations

Participants acquired information about potential benefits and risks of circumcision from health workers, partners, or peers. Benefits were viewed as motivators for MMC, and fell into three sub-themes: (1) disease related benefits i.e. prevention of HIV and STIs (for self and partner), (2) benefits related to sex and sexuality (sexual satisfaction for self and partner, attractiveness to women and ability to last longer during sex which in turn was perceived to make circumcised men more desirable to women), and (3) personal hygiene. In general, among the circumcised participants, the older males (above 30 years) tended to focus on the disease prevention and personal hygiene benefits. The younger men (below 30 years) tended to focus on the sex and sexuality benefits:

"*I think circumcision is very good, previously I used to take a shorter time but nowadays the woman is very happy. After two rounds, I'm able to satisfy the lady so that is an achievement.*" (male, below 30 years, circumcised)

And even when mentioned by those below 30 years, disease prevention benefits were valued in the context of sex and sexuality:

"*I won't say that we shall hit on every girl but to some of us that have been hitting on girls a lot, it will benefit us. This is because if he dates a lady and they have intercourse once, he still has a chance of not getting HIV.*" (male, below 30 years, circumcised)

Many uncircumcised men expressed doubt about, or did not value the HIV prevention benefits because it did not eliminate risk:

"…am reluctant because in it does not cure but just reduces the risk…" (male, below 30 years, uncircumcised)

--because of high HIV rates even among circumcised populations:

"…what frustrates me is the fact that despite the increase in number of people who are circumcised HIV has remained high so I feel it doesn't change anything." (male, above 30 years, uncircumcised)

--a view corroborated in the key informant interviews:

"Those who have not gotten the knowledge we are sharing are still naïve. They say the risk is the same. So, they ask us, in Mbale, circumcision is what qualifies you to be a Mugisu, but there are people dying of HIV, so why do you say that circumcision can prevent HIV by 60%?" (KI – community health worker)

Others uncircumcised men believed that it did not prevent HIV but STDs, or prevented HIV but through prevention of STDs:

"I feel that circumcision has helped to prevent other conditions such as STDs that is why I feel it is important …although I don't trust that circumcision prevents HIV, it at least prevents STDs." (male, above 30 years, uncircumcised)

"Yes, circumcision does [reduce the risk of HIV] because it reduces STDs hence reducing the risk of HIV infection." (male, above 30 years, uncircumcised)

Others suggested that circumcision had increased the spread of HIV, because it lowered incentives to use other prevention methods:

"I feel that circumcision has increased risk of HIV infection because it brings about laxity in the use of condoms. Some people misunderstand the value of circumcision and end up abusing it by engaging in unprotected sex." (male, above 30 years, uncircumcised)

Several circumcised men and their partners mentioned that the initial trigger for getting circumcised was being diagnosed with an STI:

> "*The reason he decided he got small wounds, at the foreskin of the penis. He would get rashes. When we went to the hospital, they told him that we both had syphilis, that he had to get circumcised and get injections. So, he accepted to be circumcised*." (female, above 30 years, partner circumcised)

Perceived negative outcomes were a barrier to getting circumcised. Two themes emerged: 1) longer term fears related to sex and sexuality; and 2) immediate fears related to the risk of complications from the procedure. Men expressed concern about infertility. Circumcised men suggested this was associated with infection due to improper wound care, or risk of injury to the penis if the procedure was not performed well:

> *"We hear rumors that one might become barren, although I think that the main cause of that is people don't take good enough care for themselves which makes the wound septic. If that vein which supports the penis is injured, I am sure that your manpower would reduce. So, the problem with circumcision is if you don't take good care of yourself and the penis wounds become septic, you would lose your manpower."* (male, below 30 years, circumcised)

In several groups, there was a belief that circumcision could reduce a man's penis size, and "*sexual power*" or libido:

> *"I have not yet because I know a friend whose sexual libido decreased after circumcision*." (male, below 30 years, uncircumcised)

This barrier was more commonly mentioned among the uncircumcised, than circumcised men.

Although improved sexual performance was perceived as a benefit by most participants, some men (in both circumcised and uncircumcised groups) cited the possibility of reduced sexual pleasure because of reduced penis sensitivity as a negative outcome of circumcision:

> *"Personally, I feel circumcision is good but the problem I always experience is whenever I am with my woman it is the woman enjoying yet me I take time. There is a change in my sensitivity during sex; it's the woman who enjoys not me…*" (male, above 30 years, circumcised)

> "*what I have heard is that circumcised people do not enjoy, they lack the sensitivity*" (male, above 30 years, uncircumcised)

--a view corroborated by the female partners of men who were uncircumcised:

> "*Some of the disadvantages we hear people talk about why our husbands do not go for circumcision, we hear when a person is circumcised…they say that a circumcised man cannot reach orgasm, they say he takes long to get sexual satisfaction if he is circumcised*." (female, above 30 years, partner uncircumcised)

Fears of procedure-related complications were frequently mentioned in our discussions. Fear of pain was mentioned by both circumcised and uncircumcised men:

> "*The challenge that I see is, you invite pain upon oneself. Why should I expose myself to pain yet I'm not sick? That is what I am worried about*" (male, above 30 years, uncircumcised)

And some participants were afraid of pain due to injections:

> "*The time I came [to get circumcised], I feared injections. Those injections were so painful that I thought the surgical blade would be even more painful.*" (male, above 30 years, circumcised)

Participants expressed fears about the risk of bleeding and infections:

"*I fear the pain and [I am] afraid of the complications, I am still waiting to identify an expert. I like it a lot and have made consultations and wouldn't want to expose my body to [an] unqualified person.*" (male, above 30 years, uncircumcised)

Circumcised (unlike uncircumcised) men associated the risk of bleeding and infections either with surgeon expertise, or an individual's ability to care for the wound after the procedure.

There were concerns about the amount of time it would take to heal and the consequent lost income due to absence from work and disutility of abstinence from sex during this period:

"*I would like to get circumcised but the healing period is long for a married person . . . if that period would be shortened, then I would be willing to seek circumcision.*" (male, above 30 years, uncircumcised).

1.3.3 Normative expectations (social influence)

Men drew motivation for circumcision either from direct pressure from their peers, or from their own desire to fit into a social group.

"*…others will just come because of peer pressure…we had just started actively in Kayunga…so someone comes and says, they have chased me, I can't play with them so I have come for circumcision.*" (KI – Surgeon providing circumcision service)

Female partners exerted a strong influence on men's MMC decisions in several ways. They were sources of information on the benefits of MMC:

"*When I joined village health team I had to be an example. I came back and taught my husband the advantages of circumcision, he accepted. I took him to the health center and doctors continued to teach him he accepted to get circumcised.*" (female, above 30 years, partner circumcised)

--or by directly making it a precondition to a relationship (or marriage), sometimes related to their own religious expectations:

> "*Like for me, I am a Muslim lady. I found my husband not circumcised then I told him I will not be with you if you are not circumcised. I still had it in mind that a Muslim woman should have a circumcised man*." (female, above 30 years, partner circumcised)

Women preferred circumcised men because of reported increased their sexual satisfaction:

> "*Another thing I know about a circumcised man, when you are having sex, you enjoy more than with the uncircumcised [man] . . . before I had an uncircumcised man and wouldn't get satisfied but now no more.*" (female, above 30 years, partner circumcised)

This benefit that was also picked upon by men, who cited it as a motivator for getting circumcised:

> "*I understand circumcision as cleanliness and as 'sweet thing' for ladies; you see they like that thing without that foreskin*" (male, above 30 years, circumcised)

Some women whose husbands were circumcised suggested that mutual sexual satisfaction following circumcision reduced the likelihood of infidelity:

> "*I would here that my husband got married here, got married there, he put a wife the other side [sic]; but ever since he was circumcised, I have not heard about this in 3 years. I have never met him with 'so and so' [sic]. So, circumcision strengthens the family. An uncircumcised man truthful he doesn't satisfy [me]. I had one but we would not satisfy each other. He would go off and I remain there . . . fine, he is the family owner, and I have nothing to do. But now we live in our situation when each one of us is satisfied*." (female, above 30 years, partner circumcised)

--And others were concerned about the potential for an increased likelihood of infidelity:

> "*When a woman gets a circumcised man, she doesn't want to leave, and when your husband sleeps with a woman whose husband is not circumcised, she can't leave him. It is bad on my side*

because I want to have him alone yet a man can't allow." (female, above 30 years, partner circumcised)

This concern was also expressed among women with uncircumcised partners:

"*What I hear my husband say often is that if he is circumcised, fellow men tell him that he won't be able to perform well sexually and he can't reach orgasm. It creates fear in me that if my husband can't reach orgasm, can't it cause adultery in our marriage? Because if we have intercourse and he doesn't get satisfaction, won't he go and sleep with other many women?*" (female, above 30 years, partner uncircumcised)

Furthermore, depending on their own preferences for sexual abstinence or how much they relied on men as the primary source of family income, women modified the importance that men placed on the length of the healing period. One male participant suggested that some women were unwilling to abstain from sex for the duration of the healing period.

Parents, political, cultural and religious leaders were also identified as potentially having a positive or negative influence on attitudes towards circumcision.

"*And then there are religious leaders…this one I will give an example. In one district, we got problems when we had just launched, where one person said, no, my sheep, not there, that is a wrong decision, don't go for circumcision. And people said yes.*" (KI – Surgeon providing circumcision service)

Other misconceptions and beliefs as barriers

Men were suspicious about circumcision because of a commonly held belief that foreskins were being sold:

"The biggest myth that we have been fighting with was where the community believes that when we circumcise, they know I have collected all their prepuces and I am taking them to make lipstick for women." (KI – Surgeon providing circumcision service)

"*We've been scared off by rumors that there is export of the foreskin to make artillery.*" (male, below 30 years, uncircumcised)

1.3.4 MMC service attributes

Participants identified two circumcision service delivery models—outreach (mobile) and static (fixed) facility models. Three sub-themes emerged as influential to MMC decisions: 1) distance to circumcision facilities, 2) the ability to contact a health worker anytime in case of procedure-related complications and 3) availability of the service when men eventually decided to get circumcised. The outreach model was valued because it brought services closer to where men lived. This was important for people who lived on the islands or close to landing sites, far away from fixed health facilities:

"*I live on the shores of Nansagazi and I cannot move on foot up to Ssi, if they hadn't come here in our community, I wouldn't have gone there. They came here to our community, educated us and then I got circumcised here*." (male, below 30 years, circumcised)

The temporary nature of outreach clinics was perceived as a disadvantage. Participants valued the ability to access care anytime they wished. Flexibility of access was important for those who were either constrained by time or who were still undecided about circumcision (for these, the outreach service could relocate before they made the decision to get circumcised). Participants valued the ability to contact health workers anytime post-procedure especially if they experienced complications. Additionally, uncertainty about when services were available was a concern for people who had tried previously to access services at fixed health facilities but failed:

"At a mobile camp like this one, we are walking away tomorrow but there are men who take long to decide, and by the time we leave here, we leave some men who want circumcision and they have come and we can't, we have closed, we are telling them we shall come back" (KI – Surgeon providing circumcision service)

This view was echoed by some participants:

"*The location is ok but we are constrained by one day in a week, we would prefer that it is daily*" (male, above 30 years, uncircumcised)"

We observed differing preferences about the impact of HIV testing requirements on circumcision decisions. Participants expressed anxiety and fear of knowing one's HIV status, and suggested that mandatory HIV testing may be a deterrent to accessing services. Rather than the anxiety about testing, some participants reported that a positive result might change their minds about circumcision. For others, a positive HIV test would not have any impact on their decision to get circumcised because they perceived other advantages. These views are expressed in this discussion among uncircumcised men below 30 years,

"*Personally, if I am tested and found negative, I can accept to be circumcised but when they find me positive, I can be like, why should I still circumcise? There is nothing else to save. I would have to just turn and walk away*"

"*When I find out that I am positive, they can still circumcise me. Of course, this is something I already picked interest in and there is no way I can refuse to be circumcised only because I have been found positive*"

FGD participants expressed a preference for well-trained and experienced health workers who were caring and polite. The majority reported a strong preference for male surgeons while a smaller number would accept female surgeons. KIs acknowledged that this was an often-encountered concern, but suggested that most eventually agreed to circumcision irrespective of the gender of the surgeon, if they were convinced of the benefits of circumcision and the skill of the surgeon.

Participants valued shorter waiting time at health facilities. Waiting times were perceived to be associated with the skill level of the surgeon. Acceptable waiting times varied between 30 minutes to two hours. However, for those that made it to the health facilities, waiting time did not affect the decision to get circumcised.

Privacy was of perceived as being of utmost importance among participants because they were either shy about circumcision or viewed getting circumcised (or the community knowing that they were, or were not circumcised) as embarrassing. Some preferred to arrange for the procedure to be done completely privately. For others, the main concern was a separation of counseling sessions and waiting areas by age. Older men preferred their services to be separated from those of younger men.

There was a general lack of knowledge about circumcision using devices. Among those who had been exposed to information about the devices, some suggested that the extra visit to the clinic and the extra week required to heal was a barrier to circumcision with devices compared to circumcision with surgery. They also believed that pain would be more intense and last longer with devices.

> "*I thought it (device) might cause me so much pain while I am at home that I may have to remove it myself. Don't you see that then I wouldn't have fulfilled its initial intention?*" (male, above 30 years, circumcised)

These issues were corroborated with key informants, who suggested that their clients mostly preferred surgery because it was a one-time procedure, but expressed fears about undergoing surgical procedures in general, bleeding, and injections. Devices were preferred because they did not require anesthetic injections; there wasn't bleeding, and they produced a more favorable cosmetic appearance. Most men were put off by having to wear the device for a week, and the consequent extra week required to heal.

Preferences around payment for circumcision services were complicated because services at public health facilities are traditionally free. The cost was widely viewed as a barrier due to low incomes or because the service was perceived as having been paid for by the Government. However, some participants expressed a willingness to pay for services. They rationalized payment as motivation to health workers, a means to improve conditions in health facilities, because they appreciated the service received, and to avoid potential negative consequences of circumcision. The amounts people were willing to pay ranged from UGX 2,000 (approximately US$0.6) to UGX 20,000 (US$9).

There were differing views on the importance of financial incentives. Some participants viewed them as an important motivator while others did not. They were rationalized either as compensation for lost income during recovery, transport facilitation to reach circumcision facilities, or subsistence while waiting at health facilities:

> *"Some of us have been working but now our work rate [has] declined since we couldn't do heavy work anymore; whenever we tried we would feel pain. So, in those 40 days, they could dig in their wallets and get us something.*" (male, above 30 years, circumcised)

> "*You might come here to circumcise very early in the morning, starve from here and yet you know no one around here…although with circumcision it is me who benefits, by the time you leave, things wouldn't be good; remember you don't have transportation back home and yet you are limping. Therefore, I wish they could say, after being circumcised you will be given some money for transport to take you back home," or they can serve you some lunch before you leave.*" (male, below 30 years, circumcised).

One participant suggested that people should be paid for their foreskins, an association with the belief that foreskins are used to make cosmetics. This was corroborated by a key informant:

> "*From the time we started, it wasn't easy, because like we said, people think you are taking away their prepuces for lipstick. Everyone who wanted to come for circumcision was like, "nfunira wa" [translated as: "how do I benefit?"] How much are you giving me for my prepuce?*" (KI – Surgeon providing circumcision services)

The most commonly mentioned incentive was money, ranging from UGX 20,000 (US$6) to UGX 200,000 (US$60). Participants valued other forms of incentives such as food and drinks while at health facilities, and actual transportation. The need to frequently change underwear was viewed as a burden, and one participant suggested that they should be provided with underwear:

"*My husband wanted to go for circumcision. They told him circumcision requires hygienic things . . . you are told to use underpants. You must change underpants every day. I saw him discouraged. If they can be given underpants, it can attract them. My husband said as I have a few underpants that means it requires that I first work get money and buy underpants.*" (female, above 30 years, partner uncircumcised)

1.4 Discussion

1.4.1 Summary of qualitative findings

We identified factors across four major themes that influence decision to take up MMC for HIV prevention (Figures 1.1 & 1.2; Appendix A). First, HIV threat perception, a well-recognized tenet of health behavior models (19), could motivate the uptake of MMC for HIV prevention. HIV threat perceptions are influenced by individuals' beliefs about their risk of acquiring HIV, their underlying risk behaviors and misperceptions about HIV. While people were aware of the consequences of HIV, we found that the importance of these consequences has been lessened by increased access to freely available HIV treatment (risk compensation) and competing causes of morbidity and mortality. Secondly, participants had several beliefs about the benefits and adverse outcomes of MMC. The belief that MMC could prevent HIV was the primary motivating benefit of MMC. However, other outcomes such as improvement in hygiene, sexual performance, and social desirability were also important motivators for MMC. Fears about long-term effects related to sex and sexuality (such as the risk of infertility, loss of libido and loss of penis sensitivity) and short-term procedure-related events (pain, infection and bleeding, time away from work, and involuntary sexual abstinence) were barriers to seeking circumcision. Normative beliefs as conceptualized in the Theory of Planned Behavior (20) and the social interaction models in economics (21), arose out of an innate desire to be like others, to have others' approval, or to conform to societal expectations. We also found that religious and cultural beliefs facilitated or prevented men from getting circumcised, while political, cultural and religious leaders were identified as potential agents of behavior change. These psychological factors are similar to those identified in previous qualitative studies reviewed by Djimeu (8) and others published after this review (22-26).

We further characterized objective attributes that influence the uptake of MMC services. These attributes describe the way MMC services are provided in the community. Participants expressed varied preferences over MMC service delivery models, health worker characteristics (training, attitudes and gender), health facility quality (waiting times and privacy), ancillary services such as HIV testing, and other factors such as cost of the procedure, and availability of incentives. Only recently (16) have these factors been characterized from the individual perspective. This is important because matching individuals' preferences with the provision of MMC services is an important strategy to increase the utilization of MMC services. We identified potential interactions between the psychological factors and preferences for MMC attributes. For instance, individual preferences for permanent health facilities was influenced by individual beliefs about the likelihood of experiencing procedure-related complications. Choices regarding the method (device versus surgical) of circumcision were rationalized based on beliefs about procedure-related outcomes.

1.4.2 Conceptual framework

Based on the findings, we propose a conceptual framework for the uptake of MMC for HIV prevention (Figure 1.2) that combines these economic and psychological factors. A logical entry-point are social interactions through which people acquire information about HIV and MMC (27). They form a personal valuation of MMC for HIV prevention based on their perceptions about the threat of HIV, beliefs about the beneficial and harmful outcomes of MMC, and societal expectations (norms) regarding MMC. This valuation leads the individual to have an orientation (favorable or unfavorable) towards MMC. A favorable orientation does not necessarily lead to circumcision. They seek MMC services that suit their preferences by considering the attributes of available services. Characteristics of available services (defined by the presence or absence of service attributes) facilitate or impede the utilization of MMC services (16). Preferences for MMC service attributes could be influenced by endogenous beliefs about the harmful outcomes of MMC, and societal expectations (norms) regarding MMC.

Exogenous sociodemographic and personality characteristics may explain the differences in the individuals respond (or value the factors) at different stages of this process. Our qualitative data show that

age could influence HIV threat perceptions, subjective beliefs about MMC outcomes, and preferences for some MMC service attributes. For instance, older people perceive a low risk for HIV. Disease prevention benefits were more frequently mentioned among older participants, while younger participants tended to focus on sexuality-related outcomes. Older men were also more sensitive to privacy at health care facilities. Income affected preference for incentives, and cost of MMC.

The motivation to get circumcised was, in some cases, based on perceived protection of partners from HIV and cervical cancer. It is conceivable that individual differences in social preferences (i.e. the extent to which people consider the wellbeing of others in their own decisions) (28) influence the importance placed on such outcomes. Shyness and embarrassment—facets of self-consciousness (29) —were qualifiers for preferences for privacy and anxiety about HIV testing. Underlying levels of this personality trait may influence individual preferences for these MMC service attributes.

Extroverts prefer seeking and enjoying social interactions. Levels of extroversion affect sensitivity to social stimuli and reward cues, which lead to differences in behavioral response (30). It is possible that extroverts value conformity to social norms more than introverts, while lack of privacy is less likely to have an influence on utilization of MMC services for extroverts. Conscientiousness describes a propensity to follow socially prescribed norms for impulse control, being task- and goal-directed, delaying gratification, and following norms and rules (31). Several facets of conscientiousness related to health behaviors (32) could be relevant to MMC decisions. More dutiful individuals (those who prefer to follow norms and rules) might value conformity to social norms. Individuals exhibiting high levels of self-control or those who are future oriented (delay gratification) may have a higher valuation of future (uncertain) HIV prevention benefits of MMC. Conversely, those who are not future oriented (or have low levels of self-control) perhaps place a higher value on short-term harmful outcomes than long term benefits.

Self-efficacy (perceived control) refers to the individual's belief in his capability to overcome barriers to behavior (27). We can assume that an individual must expend effort (perhaps mental, physical or financial) to overcome barriers to MMC, and that there are positive returns to effort (i.e., the more effort he

expends, the more likely to get circumcised). For people of low self-efficacy, the marginal return to effort is lessened which lowers their desired level of effort (33, 34). Individuals with low self-efficacy have less incentive to take up MMC.

1.4.3 Implications

We see two implications of our framework: 1) the characterization of potential interventions to increase uptake of MMC; and 2) development of surveys to (a) quantify the impact of factors affecting the uptake of MMC and (b) analyze the potential impact of interventions to increase the uptake of MMC (Figure 1.2). Interventions can be classified into demand-side interventions which target psychological (internal) factors (i.e., interventions that address barriers or leverage facilitators related to beliefs), and supply-side interventions which target external factors (i.e. interventions that are aimed at strengthening service delivery).

Demand-side interventions can be either non-financial or financial. The main non-financial policy instrument is information provision in order to reorient societal beliefs regarding HIV risk and MMC outcomes. The primary benefit of MMC is reduction in risk of HIV infection in the future, and most MMC information campaigns have focused on this benefit. However, it is well known that people underestimate benefits of preventive interventions (35) because of externalities of *learning by observation* (36). Indeed, the opportunity to get treated for other STIs was a more frequently mentioned trigger for getting circumcised. In this scenario, messaging campaigns should focus on benefits that are more immediate and personalized (e.g., cleanliness, sexual appeal) (16). Information campaigns that targeting the reduction in perceived threat of HIV caused by risk compensation due to anticipated treatment availability would require carefully thought-out messages that do not create the perception that either HIV treatments are not effective or not available, and avoid stigmatization of people living with HIV. Competing occupational or disease hazards are unlikely to respond to informational strategies, most likely requiring structural interventions, including improvements in care for other diseases (and wider health system improvements) or provision of safer working conditions (e.g., safer boats to fishermen). The incorporation of normative expectations in the framework suggests two considerations. First, peers and female

partners, and political, religious and cultural leaders could be agents of change (37). Secondly, policymakers need to be mindful of the potential for social multiplier effects where social norms are favorable and conformity to these norms is a dominant factor. Conversely, group behavior may be non-responsive to interventions when conformity to social norms is dominant (21).

The second major demand-side policy instrument is financial, involving either price reductions, subsidies or monetary incentives. Randomized studies find significant price effects, but low absolute uptake rates in general (38-41). These studies based the incentive amounts on the financial cost and the opportunity cost of MMC, with the maximum subsidy or incentive amount ranging between $6 to $15. We hypothesize that (1) the amount and types of incentives used in these studies might be too low to offset the financial and opportunity costs of circumcision (the incentive amounts mentioned by our FGD participants were higher, ranging from $6 - $60), (2) some participants could be insensitive to price (for moral reasons), and (3) others could be more concerned about barriers unrelated to financial or opportunity cost for instance, fears related to adverse outcomes of circumcision and cultural or religious beliefs. Therefore formative research to quantify the relative importance of these factors, and characterize variability in preferences for payment and incentives could improve the design of incentive-based interventions.

Supply-side interventions aim to strengthen service delivery through expansion of the reach, and quality of services (42, 43). This has been achieved through task-shifting (and task-sharing), use of pre-bundled surgical kits with disposable instruments, use of multiple surgical bays (42), strategic campaign and outreach services, ensuring the availability of essential commodities required to undertake MMC (44), and the introduction of circumcision devices (45). We have qualitatively characterized preferences for these strategies from the potential user's perspectives. Future research should quantitatively determine preferences for these attributes of MMC services, such that they can be matched with the supply of circumcision services.

Our model allowed for exogenous sociodemographic and personality traits as potential decision modifiers. While not directly amenable to policy solutions (i.e., modifiable), these factors could allow for targeting of interventions to individuals or groups of individuals with similar preferences.

Figure 1.2 shows the structure of the planned survey to identify factors affecting uptake of MMC. We will use a stated preference discrete choice experiment to determine preferences for objective MMC attributes (46). To infer HIV threat perceptions, we will measure probabilistic expectations for HIV prevalence, HIV transmission, access to HIV treatment and mortality. We will measure probabilistic expectations about beneficial and adverse outcomes of MMC, and normative expectations. We will use psychometrically validated scales to measure personality traits. We will adapt the utility maximization from economics as our unifying analytical framework primarily for its empirical convenience. The framework has well-documented metrics and methods (e.g., demand simulation, consumer surplus, willingness-to-pay) for policy analyses (47).

1.4.4 Study limitations

Our inclusion criteria and strata cover a broad range of opinions including younger and older men and women, those circumcised (or with circumcised partners) and those who were not (or with partners who were not), as well as several knowledgeable key informants. However, focus group participants are inherently non-representative of the population and subject to reporting biases. The study was conducted in an area with a unique health and economic profile. As such, while the conceptual model is helpful, the findings could be unique to this population. We attempted to mitigate this by stratification, and inclusion of opinions from experienced providers. Circumcision devices were largely unknown even among the circumcised men because the method had not been rolled out with in this community. We were thus unable to gather representative opinions about preferences of devices compared to surgery. This might present difficulties in determining preferences for the method of circumcision.

1.5 Conclusion

We described a conceptual framework in which individuals form personal valuations of MMC based on HIV threat perceptions, and outcome and normative expectations regarding MMC. They then seek MMC services that suit their own preferences. Sociodemographic characteristics and personality traits affect how individuals respond to these factors. The framework permitted us to characterize potential strategies to influence demand for MMC and will form the basis for a choice survey to quantify the relative importance of factors affecting uptake of MMC. This analytical framework will facilitate a more rigorous analysis of interventions to increase uptake of MMC than was previously possible.

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Tables

Table 1: FGD participants by strata, Mukono and Buikwe Districts, Uganda

		Male	Female	Total by age and circumcision status	Total by age
18 – 30 years	Circumcised	18	8	26	44
	Uncircumcised	9	9	18	
> 30 years	Circumcised	18	9	27	56
	Uncircumcised	20	9	29	
Total by gender		65	35		100

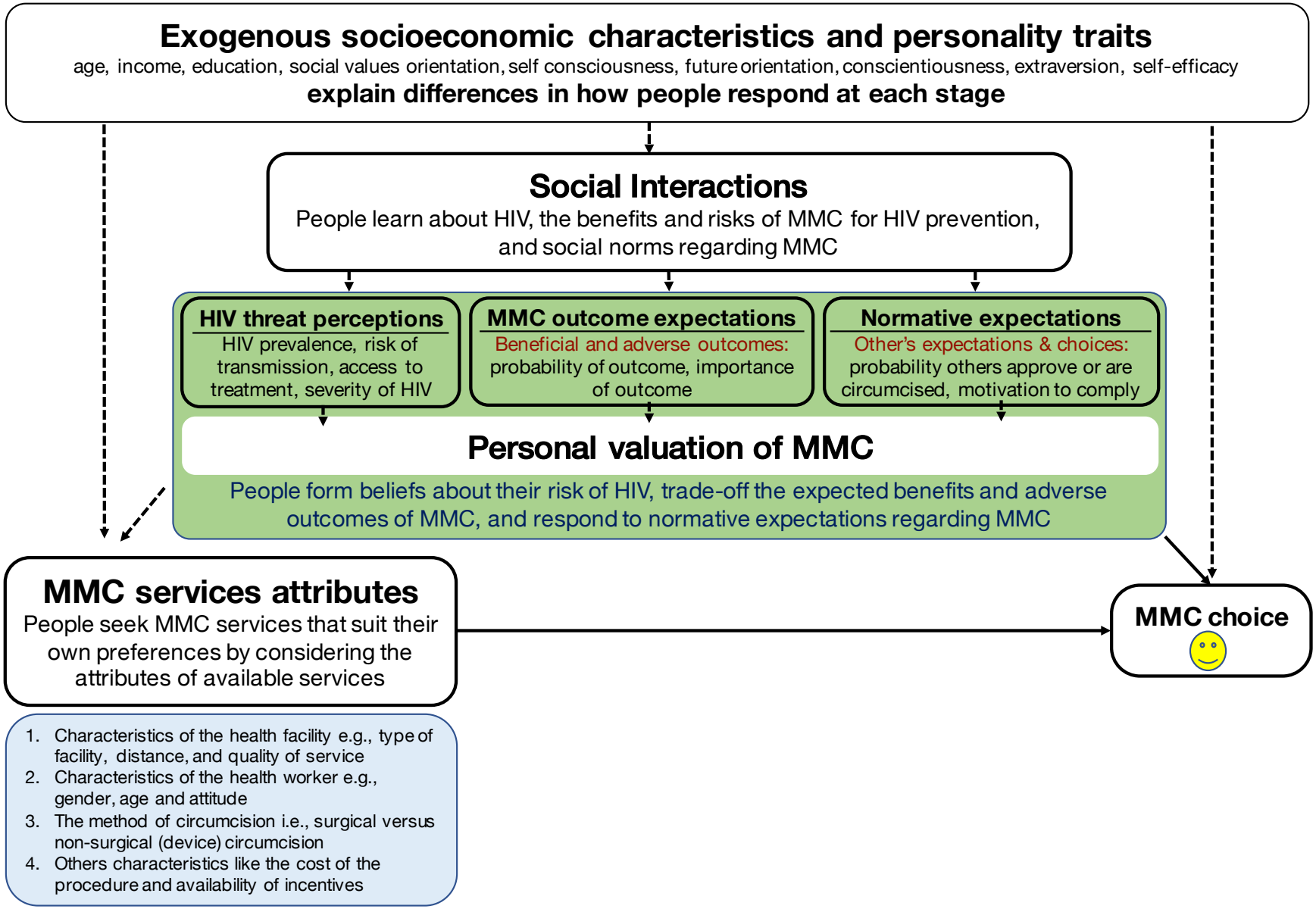

Figure 1.1: Conceptual framework of the uptake medical male circumcision for HIV prevention.

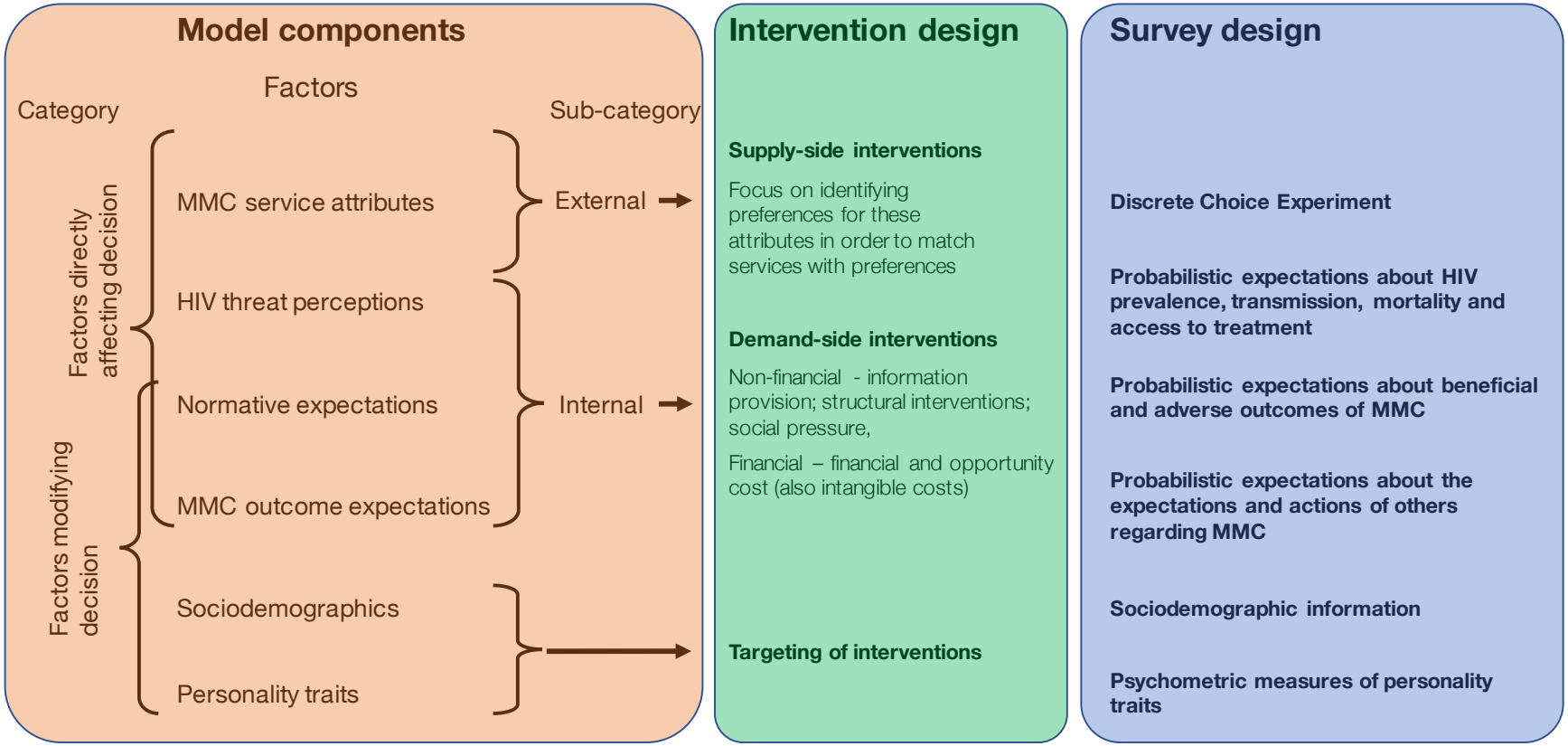

Figure 1.2: Implications of the conceptual framework for intervention and survey design

2 Preferences for the attributes of medical male circumcision for HIV prevention: a discrete choice experiment among uncircumcised men in fishing communities in Uganda

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Abstract

Objective: Medical Male Circumcision (MMC) is a potentially cost-effective strategy for prevention of HIV transmission. Several high-HIV-burden countries in sub-Saharan Africa will fall short of WHO targets for MMC. To inform demand creation, we examined preferences for MMC service attributes, and the role of subjective beliefs about HIV and outcomes of MMC in determining preferences.

Methods: We conducted a discrete choice experiment among 406 self-reported heterosexual, uncircumcised, HIV-negative men between 18-45 years-old in a high-HIV prevalence fishing community in Uganda. We used mixed logit models to estimate utilities for seven attributes: accessing MMC services at permanent versus temporary health facilities, distance travelled to access MMC services (1km, 5km, 15km), number of week-days during which MMC services were available at facilities (1, 3 and 5 days), privacy during counselling and waiting to get circumcised (complete, some, none), device versus surgical circumcision, incentives for getting circumcised (none, voucher and cash), and price/value of incentive (a continuous variable with positive values indicating price and negative values indicating value of incentive).

Results: Marginal utilities (μ; se) were highest for accessing services at permanent health facilities (2.138; 0.214), and incentives: voucher vs none (0.512; 0.153) and cash vs none (0.968; 0.174). Marginal disutility (μ; se) was highest for device MMC (-1.674; 0.265). There was significant heterogeneity in preferences for accessing services at permanent health facilities (partly explained by subjective probability of pain during the MMC procedure), number of week-days during which services were available at facilities, device circumcision (partly explained by difference in the subjective probability of infection and pain from the MMC procedure, expected time away from work and sex after the MMC procedure), cash incentives and price/value of incentive compensation.

Conclusion: Preferences were strongest permanent health facilities, surgical circumcision and incentives. MMC service delivery should be optimized based on individual preferences for these attributes.

2.1 Introduction

Medical Male Circumcision (MMC) of adolescent boys and men is an effective intervention for the prevention of female-to-male HIV transmission (1). Njeuhmeli *et al.,* (2) projected a potentially high return-on-investment of scaling-up MMC to 80% coverage in 13 priority-countries in sub-Saharan Africa (SSA) with high-HIV and low-circumcision prevalence. In 2011, the WHO/UNAIDS set a target of performing 20.3 million circumcisions in the priority countries by 2016. However, by 2015, an estimated 11.7 million adolescent boys and men had been circumcised, representing 58% of this target (3).

Economic evaluations have shown that MMC is highly cost-effective when compared to no MMC (4-9), and also to a portfolio of biomedical HIV prevention interventions (10). However, qualitative studies have documented intangible (psychological and socio-cultural) costs that impede acceptability of circumcision (11) and are often not captured in economic evaluations. Quantitative studies have also shown that demand for MMC is lower than projected in economic evaluations, is highly price elastic (12, 13), and is concentrated among lower risk individuals (14). Yet, these quantitative studies elucidated neither the factors influencing demand for MMC, nor the price (or compensation) required to generate the demand necessary to achieve the MMC coverage targets.

Interventions to increase uptake of MMC have centered around enhancing MMC service delivery, for instance through task-shifting, use of strategic campaign and outreach services, and the introduction of circumcision devices (15). Other strategies involved the implementation of financial and other behavioral incentives (16). Understanding individual preferences for the components of these interventions could lead to better MMC demand creation strategies (15).

We designed a discrete choice experiment (DCE) to study the demand for MMC. Discrete choice experiments are increasingly applied in resource-limited settings to value health interventions (17, 18). They are advantageous over other economic valuation methods because of their ability to identify the characteristics of goods that influence choices (19). They are also attractive in settings without readily available revealed preference data. To our knowledge, only two studies have applied choice experiments

to study MMC: one to determine preferences for the benefits of MMC (20), and the other to determine preferences for harms and MMC service attributes (21). Our study differs from these in two ways. First, because beneficial and harmful outcomes of circumcision are uncertain, decisions are based on subjective priors (beliefs) that vary among individuals (22): we explicitly account for these subjective beliefs. Second, we examine possible interactions between the subjective beliefs about outcomes of circumcision and preferences for MMC service attributes.

2.2 Methods

2.2.1 Study setting

The study was conducted in Mukono district, among predominantly fishing communities at landing sites on Lake Victoria, Uganda. The incidence and prevalence of HIV are higher in fishing communities compared to non-fishing communities (23, 24). Residents of fishing communities exhibit a high-HIV-risk profile characterized by high rates of multiple sexual partnerships, alcohol consumption before sex, and non-marital sexual partnerships. The prevalence of circumcision among non-Muslim men in fishing communities is also lower than in the non-fishing communities (23).

2.2.2 Conceptual model

We followed an *a priori* study process as shown in Figure 2.1. We conducted qualitative interviews in August 2016 to develop a conceptual model of the demand for MMC. We defined decision-relevant factors, which were grouped into four domains: (a) HIV threat perceptions, (b) circumcision outcome expectations, (c) social norms, and (d) MMC service-design attributes. We also defined demand moderating factors including sociodemographic characteristics and personality traits. The decision-relevant factors were either internal (unobserved) factors that arise out of individuals' psyche (i.e., subjective beliefs about HIV threat, outcome expectations and social norms regarding circumcision) or external (observed) MMC service-design attributes. In this paper, we focus on the preferences for MMC service-design attributes, the role of HIV threat perceptions, and the role of circumcision outcome expectations in determining the MMC decision.

2.2.3 Selection of attributes and attribute-levels

We initially identified 12 influential MMC service-design attributes in the qualitative interviews, which were narrowed to focus on the most influential to the MMC decision, and the most relevant for MMC demand creation policy or intervention design (25). The relative importance of the attributes to men's MMC decision was inferred by the extent of mention in the qualitative interviews. Policy-relevance was inferred through discussions with circumcision surgeons and community health workers involved in mobilization for circumcision. Attribute levels were based on the qualitative interviews and plausibility for intervention or service design. The justification for inclusion and exclusion of attributes is detailed in the table in Appendix B.

The final list of seven attributes and their levels included: (1) accessing MMC services at permanent versus temporary health facilities, (2) distance travelled to access MMC services (1km, 5km, 15km), (3) number of week-days during which MMC services were available at facilities (1, 3 and 5 days), (4) privacy during counselling and waiting to get circumcised (complete, some, none), (5) device versus surgical circumcision, (6) incentives for getting circumcised (none, voucher and cash), and (7) price/value of incentive (a continuous variable with positive values indicating price and negative values indicating value of incentive) (Table 1).

2.2.4 Design of the DCE

Response format, alternatives and choice tasks per respondent

We used the *pick one* format because it was simple to implement, imposed a lower cognitive burden, and mimicked real-life decision-making (26). We used a 2-alternative design (i.e., circumcision service options 1 and 2) and included an opt out (neither) alternative (Figure 2.2). This approach permitted the estimation of unconditional demand and enhanced the conceptual validity of our experiment given that MMC is voluntary (26).

We projected that our primary econometric model would be a panel mixed-logit with 24 parameters (i.e. 12 means and 12 standard deviations). This required at least 12 repeated choice tasks per respondent to

satisfy the model degrees of freedom (27). For attribute level balance, we required at least 12 choice tasks per respondent (i.e., the lowest common multiple of the number of levels per attribute that also satisfied the model degrees of freedom) (26).

D-efficient experimental design

We generated a D-efficient experiment in Ngene v1.1.2 (ChoiceMetrics Ltd) (28). We generated a preliminary design using small priors (±0.0001), with the sign indicating our prior hypotheses about the directionality of the effect (Table 1: column 5). When unsure of the sign, we used a prior of zero. We applied design restrictions to enhance the plausibility of the choice scenarios (29). If an alternative had the attribute "temporary health facility", the distance was either 1km or 5km, and if it was "permanent health facility" then distance was either 5km or 15km. If an alternative had "no incentive", then the price attribute was greater than or equal to zero (indicating the alternative was either free or had a positive cost), and if the incentive attribute was either "voucher" or "cash", then the price attribute was less than 0, indicating a negative cost.

In February 2017, we conducted a pilot survey of 40 men. We estimated a panel conditional logit model and used the parameter estimates and standard errors (Table 1: column 6) as Bayesian priors for the final design (Appendix C). The use of Bayesian priors permits the generation of a design that relies less on the accuracy of the priors (28). The final design assumed a panel conditional logit model because finding designs for a panel mixed logit model was computationally difficult. Bliemer and Rose (27) show that efficient designs for panel conditional logit models are also efficient enough for panel mixed logit models. The final design had 36 choice scenarios in 3 blocks of 12 choice tasks each (Appendix D). The D-error for this design was 0.06, and required sample size of 123 respondents per block (30). An example of the choice task is shown in Figure 2.2.

2.2.5 Questionnaire

We collected sociodemographic information, HIV threat perceptions, and expectations about outcomes of circumcision. We adapted an approach from Kerwin (31) to elicit subjective expectations about HIV

prevalence, HIV transmission risk and HIV mortality, and non-HIV mortality. This approach directly asked about “number of individuals out of 100” expected to experience an outcome. Expectations about the outcomes of circumcision were elicited using an approach from Delavande and Kohler (32). This approach used visual aids (beans and pots) to elicit subjective beliefs about the likelihood of occurrence of beneficial and harmful outcomes of circumcision. Both approaches have been validated in low literacy settings in Malawi (12). Prior to the discrete choice experiment, we provided a verbal explanation of circumcision. We provided a brief video describing the procedure of circumcision using devices. We asked respondents to assume all other attributes were the same across choice options.

The questionnaire was translated into Luganda, the predominant local language of the area and independently back translated. The two translators jointly reviewed the translations to resolve discrepancies. The questionnaire was programmed onto Open Data Kit (ODK) 2.0 (33) on Android® tablets. Each respondent was randomly allocated to one of the three choice blocks.

2.2.6 Survey procedures

The main survey was conducted between March and April 2017 in Ntenjeru sub-country in Mukono district, which is divided into 9 parishes with 111 villages and has a population of about 40,000 people, approximately 50% of whom are male (34). We randomly selected 7 villages for the study, and included self-reported heterosexual, uncircumcised, HIV-negative men aged between 18-45 years, who consented to the study. Trained community health workers identified respondents who fit the inclusion criteria. Trained research assistants administered the questionnaire in private to randomly selected respondents either at their homes or at their workplaces. The interviews lasted between 60-90 minutes and included an incentive payment equivalent to US$2 per participant.

2.2.7 Ethical considerations

The study was approved by the Institutional Review Boards (IRB) of the University of Washington and Mbarara University of Science and Technology. The Uganda National Council for Science and Technology (UNCST) provided final clearance for the study. All study participants provided written

consent. Data were encrypted and uploaded daily onto an online server at the University of Washington's Global Medicines Program.

2.2.8 Analytical strategy

The DCE econometric framework follows random utility theory (35), in which utility is a latent construct composed of representative utility (a function of attributes in the choice experiment and the decision maker) and 2) a stochastic utility (unobserved to the analyst).

$$U = V + \varepsilon$$

Respondent, n faced a choice among three alternatives, $j = \{a, b, c\}$ in twelve choice scenarios $t = 1 \ldots 12$. His indirect utility function was defined as:

$$U_{njt} = x_{njt}\beta + z_n\lambda_j + \varepsilon_{njt}$$

β is a vector of generic utility coefficients for attributes in the DCE, x_{njt}, and λ_j is a vector of coefficients for characteristics of the decision maker, z_n. ε_{njt} is independent and identically Gumbel distributed over decision maker, choice scenario and alternative. Individuals choose the alternative that maximizes utility

In primary analyses, we estimated mixed logit (MXL-1) and latent class (LC) models that incorporate random preference heterogeneity. In the mixed logit model, individual-specific utilities are unobserved to the analyst, and assumed to be randomly distributed within the population. We assumed that utilities were distributed multivariate normal. The latent class model assumes that individuals belong to latent classes (unobserved to the analyst), in which utilities are homogeneous. We used a multinomial logit model to determine class membership. We estimated LC models ranging from 2 to 5 classes and selected the model that minimized the Bayesian Information Criterion (BIC). For MXL-1, we computed the probability that utilities were greater than equal to zero. For both MXL-1 and LC, we computed the price elasticity as the percentage change in choice probabilities of a 10% change in price.

We translated the estimates into marginal willingness-to-pay (MWTP) for attributes. MWTP reflects the change in price required to keep overall utility constant given a marginal change in the level of an attribute. It is computed as a ratio of marginal utility of the attribute and marginal utility of price. In MXL-1,

simulation of a ratio of two random utilities may yield undefined or unrealistic MWTP distributions. We followed the approach of Train and Weeks (36) by estimating the model in WTP-space. This involved re-parameterizing the model by multiplying the attribute coefficients by the price coefficient such that the ratio of attribute to price coefficients was estimated directly. This has the advantage that parameters of the MWTP distributions are obtained directly and more efficiently. For MXL-1, we computed the probability that MWTPs were greater than equal to zero.

In secondary analyses, we estimated a parameter-covariate mixed-logit (MXL-2) model. Sociodemographic characteristics, HIV threat perceptions, and subjective beliefs outcomes of circumcision were incorporated as individual specific variables with alternative specific coefficients to reflect their impact on the probability of choosing circumcision service options 1 or 2 (versus the neither option), and as interactions with the attributes.

We constructed three variables to represent HIV threat perceptions: (1) a subjective estimate of the HIV-prevention benefit of MMC (2) subjective extrinsic mortality, and (3) subjective intrinsic mortality. The subjective estimate of HIV-prevention benefit of MMC is the difference in subjective probability of HIV between circumcised and uncircumcised states. It was computed as the respondent's estimate of the prevalence of HIV among women they were attracted to, multiplied by their estimate of the HIV transmission probability without condom use multiplied by the complement of their estimate of the likelihood that circumcision would protect them from HIV. Subjective extrinsic mortality, defined as the portion of mortality that is not due to HIV (i.e., the portion of mortality that is not affected by the HIV prevention benefits of MMC) (37), was the subjective 10-years mortality among if one was HIV negative. Subjective intrinsic mortality, defined as that portion of mortality that can be affected by the HIV prevention benefits of MMC (37), was computed as the difference in the respondent's subjective estimate of 10-year mortality if one had HIV and if one did not have HIV.

All models were coded and estimated in R 3.4.0 (38) using open source code developed by the Choice Modelling Center (CMC) at the University of Leeds (39). The log-likelihood for the mixed logit models was

approximated by simulation using 2000 modified Latin hypercube sample (MLHS) draws per respondent and random coefficient (40).

2.3 Results

2.3.1 Descriptive summary

We interviewed a total of 406 respondents. The mean (standard deviation) age and years of schooling were 27.0 (6.7) and 7.0 (3.2) years respectively (Table 2). The median monthly income was US$26.7. The majority lived in urban areas (64%) and half (50%) were married. Most participants belonged to the Baganda tribe (67%), were Catholic (48%), and worked in fishing or fishing related businesses (38%).

HIV threat perceptions and beliefs about outcomes of circumcision are summarized in Tables 3 and 4. The mean subjective prevalence of HIV was 63% in general (response to the question: out of 100 women in your village, how many do you think are HIV positive?), and 51% among prospective sexual partners (response to the question: out of 100 women in your village that you find attractive, how many do you think are HIV positive?). The mean subjective probability of acquiring HIV if one had sex with an HIV positive partner was 73% without a condom, and 14% with a condom. The mean subjective 10-year mortality for HIV-negative individuals was 44%. The mean subjective 10-year mortality was 25% if one was HIV-negative, 38% if one was HIV-positive and on treatment, was 38%, and 44% if one was HIV-positive and not on treatment. Participants believed circumcision would lower their risk of HIV infection by 61%.

Participants believed surgical circumcision carried a 14% higher risk of bleeding, 2% higher risk of infection, 20% lower risk of pain during the procedure and 9% higher risk of pain during healing compared to device circumcision. Participants expected that surgical circumcision would require an additional 9 days to heal, an additional 4 days away from work, and an additional 5 days away from sex compared to device circumcision.

2.3.2 Regression analyses

Primary analyses

Results of MXL-1 are shown in Table 5. The alternative specific constant (ASC) was positive and highly statistically significant. Preferences for all the attributes were directionally consistent with our prior hypotheses, and were statistically significant ($p < 0.05$) except distance of 5km (versus 1km) which was not statistically significant. Respondents preferred permanent health facilities, more week-days during which MMC services were available at facilities, and incentives (vouchers and cash). Longer distances traveled to access MMC services, lack of privacy during counselling and waiting to get circumcised, device circumcision, and higher prices (or lower incentive payment) were associated with disutility. Standard deviations for the ASC, permanent health facility, number of week-days for circumcision, no privacy, device circumcision, cash incentives, and price were all statistically significant ($p < 0.05$). A 10% price increase (or decreased incentive compensation) was associated with a 1.44% increase in the probability of choosing the neither option.

The means and standard deviations of MWTP distributions are shown in Table 5. The mean MWTP (μ; se) was highest for permanent health facility (-54.3; 16.5) and device circumcision (61.6; 18.3). Standard deviations were statistically significant ($p < 0.05$) for permanent health facility, number of week-days for circumcision, device circumcision, cash incentives.

Table 6 shows the results of estimation of LC of between 2 – 5 classes. The 3-class model had the lowest BIC. Preferences and MWTP estimates are shown in Table 7. Individuals in class 1 had strong preferences for permanent health facilities, increased number of days available for circumcision, and incentives. They disliked travelling longer distances and device circumcision, and were price insensitive. Those in class 2 preferred permanent health facilities, more week-days during which MMC services were available at facilities, and incentives (although to a different extent than those in class 1). They disliked travelling longer distances, although this was only statistically significant for the 15km distance. They disliked device circumcision but to a much

lesser extent than those in class 1. Unlike those in class 1, they were sensitive to price. Individuals in class 3 had a strong preference for device circumcision and had the highest sensitivity to price.

Class membership was predicted by education level and place of residence. Those who had completed at least a primary education were less likely to belong to classes 1 and 2, compared to class 3. Those residing in an urban (versus rural) area were more likely to belong to class 2. Most respondents were predicted to belong to classes 1 (37.1%) and 2 (47.8%).

A 10% price increase (or decreased incentive compensation) was associated with the following changes in choice probabilities: in class 1, a 1.27% decrease in the probability of choosing the neither option; in class 2, a 3.06% increase in the probability of choosing the neither option; in class 3, a 4.57% increase in the probability of choosing the neither option; and overall (averaging over the classes), a 1.05% increase in the probability of choosing the neither option.

Secondary analyses

Results from MXL-2 are shown in Table 8. The marginal utilities were in the same direction as our a priori hypotheses and were statistically significant ($p < 0.05$), except for distance. Being Catholic (versus others) was associated with a higher the probability of circumcision. Residence in an urban (versus rural) area and longer perceived time away from work after circumcision were associated with lower probability of circumcision. A higher difference in subjective 10-year survival if one was HIV positive versus if one was HIV negative, an indicator of belief about the severity of HIV, was associated with a higher likelihood of choosing circumcision.

Higher perceived risk of pain during the procedure was associated with a higher preference for MMC at permanent (versus temporary) health facilities. Older age and residence in an urban area were associated with lower preference for longer distances to access MMC services. Higher differences in the risk of infection and pain, and time away from work and sex between device

and surgical circumcision were associated with higher preference for device circumcision over surgical circumcision.

2.4 Discussion

2.4.1 Summary of findings

We found that respondents had a strong baseline preference for circumcision, and preferred permanent health facilities, more week-days during which MMC services were available at facilities and incentives for MMC. They disliked traveling longer distances access MMC services, less privacy during counselling and waiting for MMC, device circumcision, and higher price (or less incentive compensation). We found substantial heterogeneity in preferences for these attributes, and identified sociodemographic characteristics and subjective beliefs about HIV and circumcision that contribute to this heterogeneity. We also obtained markedly different patterns of preferences across three latent classes. Our MWTP estimates indicated that permanency of health facilities was the most preferred attribute, and device circumcision was the least preferred attributes: accessing MMC services from a temporary (versus permanent) health facility was valued approximately 54 times as negatively as a dollar increase in price, and switching from device to surgical circumcision was valued approximately 62 times as positively as a dollar decrease in price.

2.4.2 Interpretation

Our choice experiment assessed three policy options that could influence the demand for MMC: the MMC service delivery models, the potential introduction of device circumcision, and the role of incentives and financial cost of circumcision. MMC services are provided either at static health facilities or as outreach services (15). We captured trade-offs between three attributes that characterize these service delivery models: permanency of the facility, distance to the facility, and availability of MMC services whenever they were sought (indicated by the number of week-days on which circumcisions were performed). Of these, permanency of the health facility was the most highly-valued attribute, followed by distance, and then number of week-days on which circumcisions were performed. Men were willing to pay more (or willing to give up more incentive compensation) to access services at a permanent health facility, than

they were willing to pay to avoid travelling longer distances, or to increase the number of week-days on which circumcisions were performed.

Accessing services from permanent, as opposed to temporary, health facilities was valued approximately 8-times, and 4-times greater than a decrease in distance from 15km to 1km, and 5km to 1km respectively. The relative valuation of these attributes is not surprising: in our qualitative work, the importance of permanent health facilities was driven primarily by fear of procedure-related complications. Although the infrequent availability of services at health facilities was a concern, people could tailor their schedules to match the days that services were provided. Distance was mostly a concern for those who lived far away from health facilities. There is significant variability in the preference for permanent health facilities demonstrated by the approximately 10% of individuals who dislike or are neutral about accessing services from permanent health facilities in the mixed logit model, or those who are indifferent between permanent and temporary health facilities in class 3 of the latent class model.

Circumcision devices have been promoted for their potential to resolve implementation challenges and their potential appeal to men (41). However, we found that men, on average, disliked device circumcision. Several attributes of devices did not appeal to men in our qualitative interviews, for example, the requirement for tetanus immunizations and multiple clinic visits. Current evidence indicates a high risk of tetanus with device circumcisions (42). The WHO recommends immunization with tetanus-toxoid-containing vaccine (TTCV). Men would require 4 clinic visits—two for vaccination, 1 for device placement and 1 for device removal, creating a significant barrier. However, a proportion of individuals prefer circumcision devices evidenced by the 34% of individuals in the mixed logit model and the 15.1% of individuals in class 3 of the latent class model.

Incentives and price were highly-valued components of our hypothetical MMC services. Our findings suggest that incentives could increase the demand for MMC, with cash-based incentives being more likely to generate higher demand than voucher-based incentives. Individuals were, on average, price sensitive, albeit with significant variability. Individuals in class 1 preferred to receive an incentive (cash

more than vouchers) but, conditional on the incentive did not care about price. Individuals in class 2 responded both to incentives (cash more than vouchers) and price, while those in class 3 did not respond to incentives, but responded to price.

Subjective beliefs about the HIV prevention benefits of circumcision did not significantly affect the probability of choosing circumcision. By contrast, Bridges *et al.,* (20) directly manipulated MMC benefits in a conjoint survey, and found that people were more likely to choose circumcision because of its HIV prevention benefits. Our HIV prevention benefit variable was constructed from subjective beliefs about the efficacy of circumcision for HIV prevention, subjective beliefs about the prevalence of HIV and per-coital HIV transmission risk. This likely more accurately captures the individual's assessment of the benefit of MMC. It is possible that people who perceived themselves as low risk for HIV either because they perceived a low prevalence of HIV in the community or a low per-coital transmission risk may not choose circumcision for its HIV prevention benefits. In addition, since HIV is not directly observed, they may underestimate the prevention benefits of circumcision (43). The implication is that even though people may correctly identify and value the efficacy of circumcision for HIV prevention, they may still not choose circumcision. Understanding the interactions between subjective beliefs about the HIV prevention benefits of MMC and perceptions about the risk of HIV may lead to identification of potentially better messaging strategies. For example, messaging could focus on helping individuals recognize their own underlying risk of HIV rather than the HIV prevention benefits of circumcision.

A higher perceived extrinsic mortality, an indicator of a fatalistic attitude about life expectancy, did not significantly lower the incentive to get circumcised. Consistent with theory, a higher perceived intrinsic mortality, an indicator of severity of HIV, increased the incentive to get circumcised. This is consistent with theory, and has been demonstrated in other studies applying the socio-psychological models of behavior (44). We only studied one dimension of HIV severity—mortality risk. It is possible that other dimensions, such as impacts on quality of life, may have stronger effects on circumcision decisions.

Preference for permanency of health facilities was modified by beliefs about the likelihood of pain during circumcision. This is consistent with the information from our qualitative interviews in which permanent health facilities were perceived to be better equipped to handle procedure-related complications. The disutility associated with longer distances to access MMC services was higher among younger men (less than 35 years) and those residing in rural areas. In terms of policy, this suggests that services could be brought closer to younger men who live in rural areas. The disutility of device circumcision was partly explained by subjective beliefs about the difference in risk of infection and pain, and expected time away from work comparing device and surgical circumcision. Identification of these effects is important because, in addition to the increased tetanus risk, epidemiological studies show that men are more likely to experience moderate or severe adverse events following device circumcision, mainly displacements or pain-related removals (45).

2.4.3 Strengths and limitations

This study has some important strengths. We followed best practices for the development of choice experimental surveys (19, 25), including the development of a conceptual framework for demand for MMC, and identification of relevant attributes and attribute levels using qualitative methods. Rather than assume that beneficial and harmful outcomes of circumcision are evaluated with certainty, or directly manipulating them in the choice experiment, we elicited subjective beliefs about these outcomes. This approach has two benefits (22). First, it is theoretically more consistent with the individual's decision calculus, and second, from a policy perspective, we can identify decision-relevant misperceptions or beliefs that could be corrected.

Our findings should be interpreted in light of several limitations. Our sample was drawn from a single sub-county in Uganda, potentially limiting the generalizability of our findings. The length of the survey and complex nature of the questions likely imposed a high cognitive burden on the respondents, and may have induced non-compensatory heuristics in evaluating the choice tasks (46). Given that our analytical framework assumes compensatory decision rules, our results may be biased (47). Device circumcision was a relatively new approach in the community: only a few men had prior knowledge about it. We

provided a verbal explanation of, and a brief video describing the procedure before the choice experiment.

Preferences in stated choice experiments may not reflect actual preferences in real life (48). We excluded important attributes that may influence demand for MMC for HIV prevention, for instance gender of the provider, HIV testing requirements and facility waiting times. To the extent that these are correlated with included attributes, our marginal utility estimates may be biased (49). We mitigated this by asking respondents to assume these attributes were the same across all choice options.

2.4.4 Implications for policy

Policy-makers should ensure that MMC services are available at permanent health facilities. Men are, on average, willing to travel longer distances to access MMC services at permanent health facilities. However, our findings support the continued implementation of MMC outreach services, specifically targeting the more educated (≥ 7 years of schooling), and those who reside in rural areas. Longer distances to access MMC services appears to be more of a concern for younger men, and those who reside in rural areas, suggesting that outreach services have a role for these men. Addressing men's concerns about pain after the procedure could lead to higher acceptability of MMC outreach services.

To maximize MMC uptake given resource constraints, policy-makers should prioritize surgical methods for MMC. The high disutility associated with MMC using devices should be a concern. The introduction of devices will likely require physical improvements in the devices themselves, and associated circumcision and pain management techniques. Beyond structural changes, enhancing the acceptability of circumcision using devices would require carefully crafted training covering personal hygiene and pain management, and adjustment of perceptions about the differences in adverse outcomes between surgical and device circumcision. However, there is a potential role for targeting circumcision using device towards more educated men perhaps because of better knowledge, or better perceived ability to manage pain or infection risk, or to cope with time away from work.

Although controversial for a voluntary procedure, incentive payments could be implemented to increase the utilization of MMC services. However, policy-makers should be mindful of the variability in preferences for incentives and price. Individuals in class 1 of our latent class model i.e., those who are likely less educated have strong preferences for incentives, but are insensitive to the price of MMC/value of the incentive to get circumcised. These individuals would most probably not accept MMC without some form of incentive. Those in class 3 (likely more educated and to reside in rural areas) are insensitive to the type of incentive, but respond to the price of MMC. For these individuals, policy-makers could focus on ensuring the availability of low-cost MMC services.

2.5 Conclusion

Preferences were strongest permanent health facilities, surgical circumcision and incentives. MMC service delivery should be optimized based on individual preferences for these attributes. Heterogeneity in preferences for these MMC service attributes exists and was only partly explained by the sociodemographic characteristics and MMC outcome expectations in our data. Individualized or targeted demand generation strategies could maximize the uptake of MMC and societal welfare (50). However, individualization of programmatic interventions like MMC could be costly. We recommend that policy-makers should provide MMC service choices that reflect the variability in preferences for the most important attributes. Further research should focus on identifying more demographic and other factors that influence these preferences, for instance, social influences and non-observable personality traits, that could then be used to channel interventions accordingly.

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Tables

Table 2.1: Attributes, levels, coding, variable label in model, and priors used in the generating the final experimental design

Attribute	Levels	Coding	Variable label	Hypothesis for pilot design	Priors for final design
Type of health facility	Temporary (outreach)	Dummy	temphc (reference)		-
	Fixed (permanent)		permhc	+/-	N (0.18, 0.01)
Distance (in km) to health facility [a]	1	Dummy	dist1 (reference)		-
	5		dist5	-	N (-0.03, 0.009)
	15		dist15	- -	N (-0.06, 0.009)
Number of days in the week on which circumcisions are performed	1, 3, 5	Linear	avail	+	N (0.05, 0.006)
Level of privacy during counselling and waiting	By yourself	Dummy	verypriv (reference)		-
	Men within your age group		somepriv	-	N (-0.13, 0.022)
	All age groups together		nopriv	- -	N (-0.15, 0.026)
Method of circumcision	Surgery	Dummy	surgery (reference)		
	Device		device	+/-	N (-0.61, 0.036)
Incentive	None	Dummy	none (reference)		-
	Voucher		voucher	+	N (0.39, 0.13)
	Cash		cash	+ +	N (0.58, 0.19)
Cost of procedure or amount of incentive payment for procedure [b] (US$)	-12, -8, -4, 0, 4, 8	Linear [b]	price	-	N (-0.07, 0.006)

[a] if temporary health facility, then distance was 1 or 5 and if fixed facility then distance was 5 or 15

[b] if none then cost was ≤ 0 and if voucher or cash, then cost was < 0

Table 2.2: Demographics summary (N = 406)

Variable	Value
Age, mean (sd)	27.01 (6.69)
Years of schooling, mean (sd)	6.97 (3.18)
Net monthly income[a] in USD, median	26.67
	N (%)
Net monthly income[a] above $60	347 (85%)
Lives in urban area	258 (64%)
Marital status	
Married	205 (50%)
Never married	150 (37%)
Other marital status	51 (13%)
Muganda	274 (67%)
Religion	
Catholic	194 (48%)
Protestant	155 (38%)
Other religion	57 (14%)
Occupation – fishing/fishing related	154 (38%)

[a] income net of expenditure

Table 2.3: Beliefs about HIV and efficacy of circumcision for HIV prevention (N = 406)

Variable	Mean (sd)
HIV transmission probability without condom use	0.73 (0.23)
HIV transmission probability with condom use	0.14 (0.19)
Overall prevalence of HIV	0.63 (0.23)
Prevalence of HIV in those respondent is attracted to	0.51 (0.28)
10-year mortality if HIV negative	0.38 (0.27)
10-year mortality if HIV positive, and not on treatment	0.44 (0.31)
10-year mortality if HIV positive, and on treatment	0.25 (0.24)
Probability that your peers would get circumcised	0.64 (0.22)
Probability that your partner would encourage you to get circumcised	0.69 (0.29)
Probability that your peers would encourage you to get circumcised	0.63 (0.25)
Likelihood that circumcision will protect you from HIV	0.61 (0.24)
Net reduction in risk of HIV due to circumcision [a]	-0.23 (0.20)

[a] Computed as the difference in probability of HIV between circumcised and uncircumcised states. The probability of HIV in circumcised state was computed as the prevalence of HIV in those respondent is attracted to, multiplied by the HIV transmission probability without condom use times the likelihood that circumcision will protect you from HIV. The probability of HIV in the uncircumcised state was computed as prevalence of HIV in those respondent is attracted to, multiplied by the HIV transmission probability without condom use.

Table 2.4: Beliefs about circumcision-type outcomes (N = 406)

Variable	Device, mean (SD)	Surgery, mean (SD)	Difference, mean (SD)
Risk of bleeding	0.31 (0.27)	0.45 (0.30)	-0.14 (0.32)
Risk of infection	0.35 (0.28)	0.37 (0.27)	-0.02 (0.27)
Probability of pain during procedure	0.64 (0.34)	0.44 (0.36)	0.20 (0.45)
Days away from work	24.19 (27.10)	28.37 (33.10)	-4.17 (18.98)
Days away from sex	68.42 (43.10)	73.77 (44.25)	-5.35 (27.18)

Table 2.5: A mixed logit model in utility space (estimating marginal utility distributions) and in willingness-to-pay (WTP) space (estimating marginal WTP distributions)

Attribute	Utility space			WTP space		
	Mean, est (se)	SD, est (se)	MU ≤ 0	mean, est (se)	SD, est (se)	MWTP ≤ 0
Alternative specific constant (ASC)[a]	2.081*** (0.331)	2.705*** (0.204)	0.22	-	-	
Type of health facility						
Temporary health facility	Ref					
Permanent health facility	2.138*** (0.214)	1.694*** (0.161)	0.10	-54.3*** (16.5)	-38.5*** (10.7)	0.92
Distance (in km) to health facility						
1	Ref					
5	-0.274 (0.170)	0.006 (0.081)	1.00	16.6† (7.0)	-1.3 (2.3)	<0.01
15	-0.465** (0.169)	-0.026 (0.321)	0.96	19.2** (7.4)	7.7 (6.2)	0.01
Number of week-days for circumcision	0.209*** (0.028)	-0.282*** (0.036)	0.23	-4.9*** (1.8)	-7.1*** (2.0)	0.75
Privacy of counselling and waiting						
By yourself (very private)	Ref					
Men of your age only (some privacy)	-0.233† (0.099)	0.047 (0.122)	1.00	11.1** (4.6)	-3.4 (4.0)	<0.01
Everyone (not private)	-0.374*** (0.097)	0.352† (0.163)	0.86	10.6** (4.3)	7.0 (5.7)	0.07
Method of circumcision						
Surgical circumcision	Ref					
Device circumcision	-1.674*** (0.265)	-3.949*** (0.312)	0.66	61.6*** (18.3)	-96.8*** (26.5)	0.26
Incentive						
None	Ref					
Voucher	0.512*** (0.153)	0.139 (0.173)	0.00	-20.4† (8.7)	12.1 (7.5)	0.95
Cash	0.968*** (0.174)	0.859*** (0.156)	0.13	-34.6** (12.8)	22.7*** (7.1)	0.94
Cost or monetary value of your incentive	-0.062*** (0.013)	0.097*** (0.009)	0.74	-	-	
Number of parameters	22			22		
LL	-2688.2			-2706.0		
AIC	5420.4			5456.1		
BIC	5563.2			5598.9		

[a] Constrained to be the same for circumcision service options 1 and 2

SD: Standard Deviation. Significant standard deviation implies significant heterogeneity in the preference for the attribute. The sign of the can be interpreted as positive)

MU: marginal utility; MWTP: marginal willingness-to-pay; LL: log-likelihood; AIC: Akaike Information Criterion; BIC: Bayesian Information Criterion

'***' p < 0.001, '**' p < 0.01, '†' p < 0.05, '·' p < 0.1

MU ≤ 0: The proportion of individuals for whom the attribute is associated with disutility or zero marginal utility (they either dislike or are indifferent to the attribute)

MWTP ≤ 0: The proportion of individuals who attach a zero or negative marginal willingness-to-pay to the attribute.

Table 2.6: Latent class modelling results

Number of classes	Number of parameters	Log likelihood	AIC	BIC
2	25	-3063.7	6177.7	6339.9
3	39	-2763.2	5605.6	5858.8
4	53	-2728.1	5562.3	5906.3
5	67	-2657.5	5449.1	5984.0

Table 2.7: Latent class model (3 class model) in utility space (estimating class-specific marginal utilities) and in willingness-to-pay (WTP) space (estimating class-specific marginal WTP)

Attributes	Utility space			WTP		
	Class 1, est (se)	Class 2, est (se)	Class 3, est (se)	Class 1, est (se)	Class 2, est (se)	Class 3, est (se)
Utility model						
Alternative specific constant (ASC)[a]	-0.184 (0.433)	1.659*** (0.265)	-1.161 (0.842)	-	-	-
Type of health facility						
Temporary health facility	Ref	Ref	Ref	Ref	Ref	Ref
Permanent health facility	3.226*** (0.593)	1.193*** (0.157)	0.679 (0.361)	121.7 (120.1)	-27.5*** (6.6)	-8.5 (7.4)
Distance (in km) to health facility						
1	Ref	Ref	Ref			
5	-0.817*** (0.257)	-0.232 (0.158)	0.125 (0.384)	-30.8 (28.2)	5.3 (3.9)	-1.6 (4.8)
15	-0.927† (0.423)	-0.370† (0.157)	-0.056 (0.347)	-34.9 (31.6)	8.5† (4.0)	0.7 (4.5)
Number of week-days for circumcision	0.269** (0.090)	0.155*** (0.022)	-0.105 (0.067)	10.2 (9.8)	-3.6*** (0.9)	1.3 (1.0)
Privacy of counselling and waiting						
By yourself (very private)	Ref	Ref	Ref	Ref	Ref	Ref
Men of your age only (some privacy)	-0.306 (0.282)	-0.194† (0.079)	0.502† (0.253)	-11.5 (13.2)	4.5† (2.1)	-6.3 (4.6)
With everyone (not private)	-0.386 (0.242)	-0.290*** (0.077)	0.095 (0.187)	-14.6 (14.2)	6.7** (2.3)	-1.2 (2.5)
Method of circumcision						
Surgical circumcision	Ref	Ref	Ref	Ref	Ref	Ref
Device circumcision	-4.648*** (0.493)	-0.272** (0.086)	3.460*** (0.414)	-175.3 (179.3)	6.3† (2.5)	-43.5† (17.4)
Incentive						
None	Ref	Ref	Ref	Ref	Ref	Ref
Voucher	1.488*** (0.446)	0.299† (0.120)	-0.602 (0.479)	56.1 (45.1)	-6.9 (3.7)	7.6 (5.2)
Cash	1.843*** (0.459)	0.655*** (0.141)	-0.675 (0.425)	69.5 (58.7)	-15.1** (5.4)	8.4† (4.0)
Cost or monetary value of your incentive	0.027 (0.028)	-0.043*** (0.008)	-0.080† (0.038)			
Class allocation model						

Intercepts	1.365*** (0.297)	0.944** (0.319)	
Level of education			
Less than primary (< 7 years of schooling)	Ref	Ref	
Completed at least primary (≥ 7 years of schooling)	-0.847† (0.355)	-0.953† (0.360)	
Place of residence			
Rural area	Ref	Ref	
Urban area	0.134 (0.326)	1.266*** (0.328)	
Posterior class membership probability	0.371	0.478	0.151
LL		-2763.8	
AIC		5605.6	
BIC		5858.8	

[a] Constrained to be the same for circumcision service options 1 and 2

LL: log-likelihood; AIC: Akaike Information Criterion; BIC: Bayesian Information Criterion

Class 3 was the reference

'***' p < 0.001, '**' p < 0.01, '†' p < 0.05, '·' p < 0.1

Table 2.8: Parameter-covariate mixed logit model in utility space (estimating marginal utility distributions)

Attributes and other variables	Mean, est (se)	SD, est (se)
Alternative specific constant (ASC)[a]	3.712*** (0.841)	3.031*** (0.359)
Type of health facility		
Temporary health facility	Ref	
Permanent health facility	1.601*** (0.356)	1.688*** (0.178)
Distance (in km) to health facility		
1	Ref	
5	-0.924*** (0.265)	0.007 (0.071)
15	-1.058*** (0.283)	-0.275. (0.163)
Number of week-days for circumcision	0.206*** (0.028)	-0.269*** (0.039)
Privacy of counselling and waiting		
By yourself (very private)	Ref	
Men of your age only (some privacy)	-0.223* (0.098)	-0.159 (0.137)
Everyone (not private)	-0.358*** (0.096)	-0.335* (0.154)
Method of circumcision		
Surgical circumcision	Ref	
Device circumcision	-1.515*** (0.253)	3.677*** (0.319)
Incentive		
None	Ref	
Voucher	0.496*** (0.153)	0.200 (0.172)
Cash	0.980*** (0.176)	0.824*** (0.141)
Cost or monetary value of your incentive	-0.066*** (0.012)	-0.102*** (0.012)
Interaction terms		
Interactions with the ASC		
Age < 35 years	Ref	
Age ≥ 35 years	-1.655* (0.737)	
Less than primary education (< 7 years of schooling)	Ref	
At least primary education (≥ 7 years of schooling)	0.283 (0.370)	
Other tribe	Ref	
Muganda tribe	-0.999* (0.446)	
Other religion	Ref	
Catholic	0.708* (0.355)	
Rural residence	Ref	
Urban residence	-1.050* (0.450)	
Subjective estimate of the HIV prevention benefit of MMC	1.044 (0.954)	
Subjective extrinsic mortality	-0.432 (0.642)	
Subjective intrinsic mortality	2.395*** (0.658)	
Risk of infection	1.536** (0.527)	

Risk of pain during procedure	-1.104** (0.396)
Weeks away from work	-0.045* (0.021)
Interactions with attributes	
Permanent health facility x Risk of pain during procedure	0.483. (0.260)
Distance = 5km x Age ≥ 35 years (vs Age < 35 years)	1.427** (0.477)
Distance = 5km x Resides in an urban area (vs rural area)	0.726* (0.292)
Distance = 15km x Age ≥ 35 years (vs Age < 35 years)	1.442*** (0.443)
Distance = 15km x Resides in an urban area (vs rural area)	0.591* (0.298)
Device circumcision x Risk of infection	-2.868*** (0.586)
Device circumcision x Weeks away from work	-0.189*** (0.049)
Device circumcision x Weeks away from sex	-0.154*** (0.038)
Device circumcision x Risk of pain during procedure	-2.131*** (0.504)
Number of parameters	42
LL	-2637.3
AIC	5358.6
BIC	5631.2

[a] Constrained to be the same for circumcision service options 1 and 2

SD: Standard Deviation. Significant standard deviation implies significant heterogeneity in the preference for the attribute. The sign of the can be interpreted as positive)

LL: log-likelihood; AIC: Akaike Information Criterion; BIC: Bayesian Information Criterion

'***' p < 0.001, '**' p < 0.01, '†' p < 0.05, '·' p < 0.1

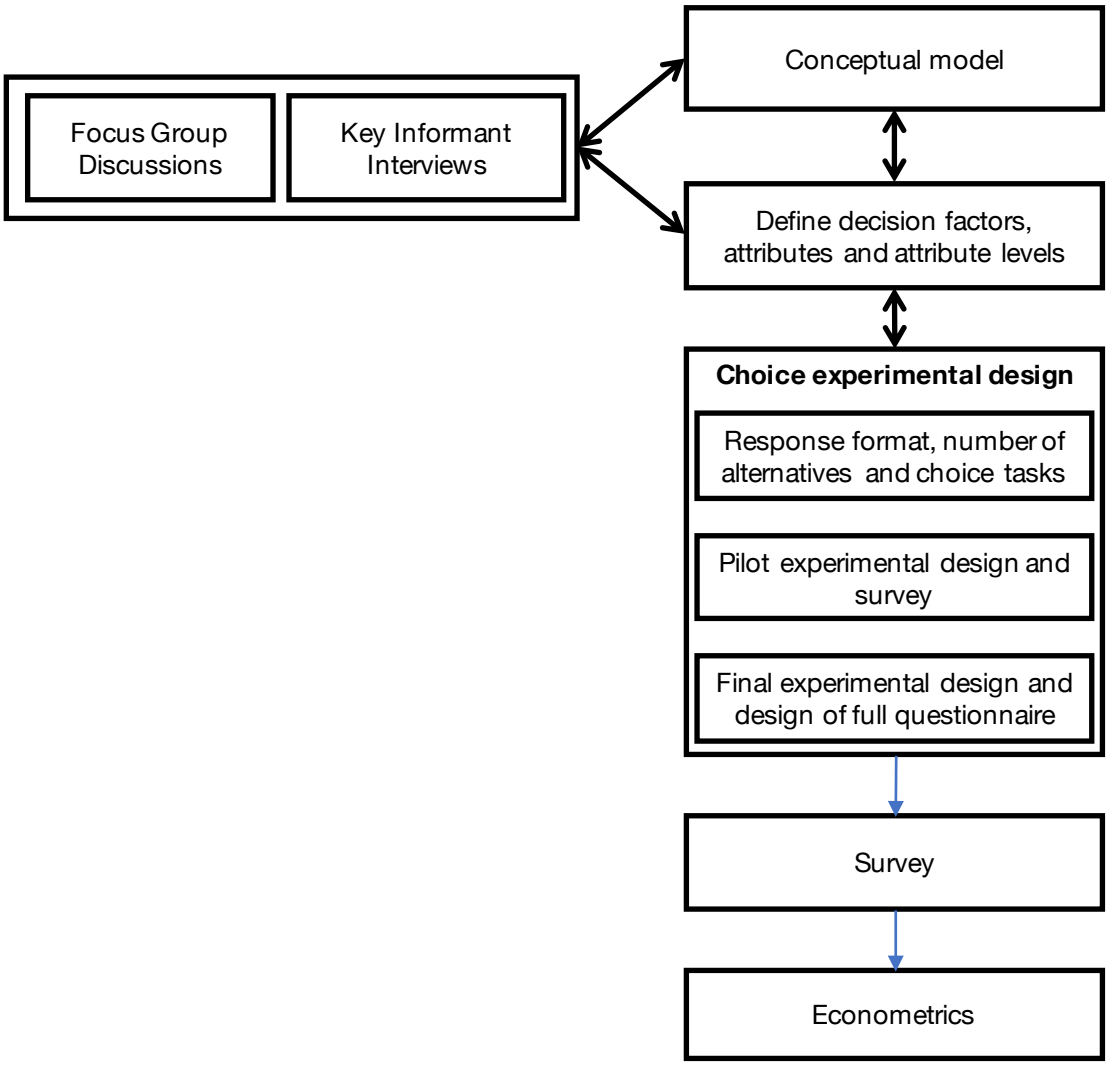


Figure 2.1: A schematic of the study process

In this part of the interview, we are going to explore some issues that will help us to understand whether and why some men choose circumcision for HIV prevention.

Safe Male Circumcision (SMC) is being promoted because it offers some protection against men acquiring HIV from women. SMC does not provide 100% protection against HIV, it compliments, abstinence, condom use and reduced number of sexual partners. There are currently two methods of circumcision: surgery and the device.

Surgery is a one-off procedure in which the surgeon will anesthetize you with an injection, cut off the fore skin and bandage the wound. You will be discharged to take care of the surgical wound at home. With the device, the surgeon will apply anesthetic cream on your penis and insert a ring-like device. You will then be discharged and return to the clinic after one week to have the ring removed. Thereafter, you take care of your wound from home. There is always a chance that you can experience infections and bleeding with both methods of circumcision. You should not have sex for about 5 to 6 weeks until the wound is healed. This period is typically 1 week longer if you are circumcised with the device. However, some people say that they prefer the appearance of the penis after circumcision with devices compared to surgery.

I will ask questions about your beliefs about circumcision or the chance that certain events related to circumcision will occur if you get circumcised. I will also ask you how issues related to circumcision may make it difficult or easy for you to get circumcised.
<<<<QUESTIONS ABOUT BELIEFS ABOUT CIRCUMCISON>>>>

I will now present to you some scenarios in which we will vary the ways in which you can access SMC services. Our SMC services will be described by the methods of circumcision available, where you may get circumcised from (the type of facility and distance of the facility from your home), the number of days in a week when you will find the surgeons available at the facility, privacy and whether you will receive an “incentive” and the cost of circumcision to you. There are other characteristics of SMC services that you might consider important for you to choose circumcision. Please assume that these are the same for each

of the choices. Now, please consider carefully each of these characteristics together, and decide whether you would choose to circumcise or not.

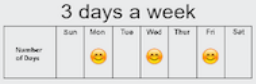
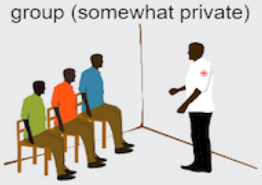
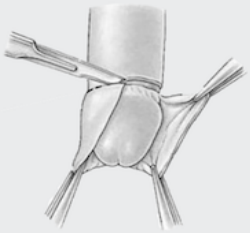
	SERVICE 1	SERVICE 2	Neither
Type of facility and distance from your household	Temporary outreach facility, 1 km away 	Permanent health center, 15 km away 	--
Number of days in the week on which circumcisions are performed	5 days a week 	3 days a week 	-
Privacy of counselling and waiting	Only with men of your age group (somewhat private) 	Together with men of all ages (not private) 	-
Method of circumcision	Surgery 	Device 	-
How much you pay or receive for the service	Free to you and you don't get any money or voucher 	Voucher worth UGX 15,000 	

Figure 2.2: An example of the choice task

3 Appendices

3.1 Appendix A: Decision dimensions, domains and factors

Category (description)	MMC decision-relevant factors (with additional quotes)
Internal	
HIV threat appraisal (a product of the individual perception of their risk of HIV and their perception of the severity of HIV)	Perceived prevalence of HIV "*In this community, the problem of HIV is still big because when we go to health facility we find many people seeking HIV treatment*" (male, above 30, uncircumcised) "*I believe that HIV is on the decline. During routine testing outreach activities, usually out of a total of two hundred people tested only five are positive; so, if what they do is accurate, HIV is reducing in Katosi. I have observed that most people have negative results.*" (male, above 30 years, uncircumcised) Sexual risk behaviors "*Since this virus mainly spreads through partying, the risk in that is that in the type of partying at this landing site, majority take alcohol which makes one determined to do such an action without a condom.*" Misperceptions about HIV and HIV transmission leading to risk behavior "*It is common among school going youth that they do not believe that HIV exists among them*" (male, above 30 years, uncircumcised) "*HIV has become weaker. In 1992, if one got HIV it would be a big scare but that is no more because the virus is weaker*" (male, above 30 years, circumcised) Risk behaviors and perceptions about severity of HIV "*In my view, they don't take it as an illness here in town X. If one gets money like Respondent 5 said, all they do is partying! Now when they start partying one wouldn't mind whether they get the illness or not and the outcomes of that illness, people in this community no longer take them serious*" (male, above 30 years, uncircumcised) Potential risk compensation due to expectations about access to HIV treatment "*The level of infidelity has increased; people intentionally engage in extra marital affairs because they know that they can seek treatment. They do not use condoms for protection because they know that in case they end up positive treatment is readily available*" (male, below 30 years, uncircumcised) Mortality due to HIV *"…since we are at the landing site and most people are fishermen, they know they won't die of HIV but the lake. It makes people fornicate because he knows he won't die of HIV but the lake*." (female, above 30 years, partner circumcised) Mortality due to other causes *"I think the main reason why people in our community don't protect themselves is the rise of these other illnesses that have been the main causes of death such as diabetes, cancer and hypertension. Currently people do not die of HIV a lot, so it's a small portion which bothers protecting themselves because they say, HIV doesn't kill instantly and besides, so and so died of cancer. So they no longer fear HIV because it doesn't kill instantly*" (male, below 30 years, circumcised)
Circumcision outcomes	Reduction in risk of HIV and other sexually transmitted diseases

expectations (based on subjective *probability* of outcome and the *importance* attached to outcome)	"*It is one of the easiest ways unlike abstaining which is easier said but we can be tempted. Since HIV rates are HIV that is the reason why many people are also getting circumcised to prevent HIV*." (male, above 30 years, circumcised) "*I feel that circumcision has helped to prevent other conditions such as STDs that is why I feel it is important…*" (male, below 30 years, circumcised) Protect partner from HIV "*It benefits them because if I sleep around but don't get bruises or get infected, then my partner whom I left at home would benefit because I wouldn't have brought her the illness*" (male, below 30 years, circumcised) Improved hygiene "*Personally, I feel so comfortable. You see some people take about three days minus bathing and by the time you unfold that foreskin, what you see might be unpleasant*" (male, above 30 years, circumcised)" Sexual appeal "*I understand circumcision as cleanliness and as 'sweet thing' for ladies; you see they like that thing without that fore skin*" (male, above 30 circumcised) Sexual pleasure "*I wouldn't get circumcised to prevent HIV but to enjoy sex and reduce risk of bruising during sex with unlubricated woman*" (male, below 30, uncircumcised) "*She benefited from it instead because after being circumcised, I can now play the full 90 minutes of the game. Before being circumcised however, this foreskin was giving me a hard time especially during penetration*" (male, below 30, circumcised) Infertility "*Yes, but I just hear about it so I am not sure if it's true. We were told that some people fund it (circumcision) with an aim of reducing our manpower such that we don't have many children. That's what I hear but if it's true, then it is very bad*" (male, below 30 years, circumcised) Loss of libido Reduced sensitivity Fear of bleeding "*I heard of a case who experienced over bleeding so they had to redo the procedure*" (male, uncircumcised, over 30 years) Risk of infection "*something scared me…I supported a team of twenty people to mobilize the community but one of the people who was circumcised developed an infection that lasted a period of five month before healing, so I lost trust in the personnel, I felt that some were not well qualified*" (male, above 30 years circumcised) Fear of pain during procedure and while healing "*I would like to get circumcised but I am told that the morning erection is very painful when you look at your wife*" (male, above 30 years, uncircumcised) Time away from work while healing "*I feel that circumcision has helped…though our fear is how to sustain your family during the healing period*" (male, above 30 years, uncircumcised) Abstinence from sex while healing

	"*There is another category that says that they can't forego sex for more than two days so when you tell them to abstain for a month they consider that unbearable*" (male, above 30 years, circumcised)
Normative expectations regarding circumcision (refers to the extent to which getting circumcised is viewed as socially acceptable: based on the subjective probability that referent individuals in social group approve of circumcision (or would get circumcised) and the individual's motivation to comply with referent	Peers (close friends) "*I had a job but we used to work in a group, so, whenever we went to bathe I would go with my colleagues but I noticed that my colleagues were different, that's how I decided to go and circumcise*." (male, below 30 years, circumcised) Female partner "*I befriended a girl but she rejected me, insisting that she wanted a circumcised person (laughter)*" (male, below 30 years, uncircumcised) "When I joined village health team I had to be an example. I came back and taught my husband the advantages of circumcision" (female, above 30 years, partner circumcised) "*There are some partners whom if you told that you are to be circumcised, she could ask you, how long will that take you to heal? If you tell her that it's about a month and a half, she would ask you, do you think I am not human? Do you expect me to wait until you heal? Don't go there*" (male, below 30 years, circumcised) Parents "The parents; there is no way a circumcised parent who knows the benefits of circumcision can stop you from going in for circumcision. In fact, he strongly advises you to go and circumcise because he knows the benefits in there." (male, below 30 years, circumcised) Political leader "*In my area, our chairperson also counsels people, if someone is hesitant he has a way of talking to him and convince him to agree and seek medical circumcision*" Village (cultural) leaders or elders in the community "*…also, those elders in the community…when the elder speaks, the community will always listen and influences them positively*" "In our culture, we are not allowed to come here (health facility)" Religion/Religious leader "What I can add is religion. You see in the XXX faith they say that a person who will circumcise and deduct his body, he will not enter God's kingdom. So, you might find yourself very religious and then that forces you not to go and circumcise" (male, above 30, circumcised) Health worker "*I decided to circumcise because doctors told us that a circumcised person has some chances of not getting HIV or any illnesses that transmit through intercourse…also my peers made me attracted it…those that had done felt . . . so of course they said that it is so good to circumcise*"
External	
health system/service factors (refers to the health service or health system constraints that may facilitate or impede	Type of health facility: outreach versus fixed "*Outreaches help to bring service closer, most people from far places would otherwise pay ten thousand to get to Kojja HC*" (male, circumcised, over 30 years) "*Those [outreach facilities] cannot because they do not take good care of you. In fact, they can choose to relocate after circumcising you*" (male, under 30, circumcised) Distance of facility

access to circumcision services)	"*If they hadn't come here in our community, I wouldn't have gone there. They came here to our community, educated us and then I got circumcised here. They had taken some time offering circumcision at XXX but I wouldn't go there but because they came nearer, I picked interest and went there*" (male, above 30 years, circumcised) How often services are available *"…ensure that the staff are available daily. Currently, it is offered on Tuesdays only. That has led to some people missing their appointments*" (male, above 30 years, uncircumcised) HIV testing "*what is likely to happen, when someone is told that they will test him, he is bound to get scared and give up on circumcision*" (male, below 30, uncircumcised) Privacy "*To avoid these children from spreading secrets, because I may come and don't want a child to see me or other people in the community to know that I was circumcised, but if a young boy sees me he won't keep that a secret. In fact, it's the first thing he would talk about immediately when he gets home*" (male, above 30, uncircumcised) Health worker characteristics "*It is best suited to be handled by men; I do not see why women should be there yet procedure is conducted on men*" (male, above 30 years, uncircumcised) "…friendly and patient, if the person has a rude facial expression it can scare off clients." (female, below 30, partner uncircumcised) "*Personally, I prefer that it's my usual health worker because he knows the person he is performing the procedure on. If he personally knows you then he will be careful and not focus on completing the number*." (male, above 30, circumcised) Waiting times "…the problem I see is getting here and they tell you to wait for two hours." "if am assured of being attended to, I would mind waiting because that is the reason as I came." Incentives Payment for services "*if it costs money it would be a burden because our income is not so fine*" (male, below 30 years circumcised) "*…well, health workers are paid salaries so why should I pay them?*" (male, above 30 uncircumcised) "*I would say it is okay to give…just to make them love the work that they do…*" (male, below 30 circumcised) "*…as long as I don't get any pain. If they give me medicine to reduce the pain, they take good care of me and if my wound would heal in time then I can pay*" (male, above 30 uncircumcised)

3.2 Appendix B: Justification for the inclusion and exclusion of attributes and rationale for the attribute levels for included attributes (To be added)

Description of attribute	Description of levels	Justification of attributes and levels
Included attributes		
MMC site options	Fixed (permanent) sites – permanent structures located within existing health facilities that offer MMC services on a continuous basis Outreach sites can be permanent structures (e.g., primary clinics or schools) modified for MMC service purposes, or temporary structures to increase available space so more clients can receive VMMC services	PEPFAR best practices for MMC site operations lists three MMC site options for implementing MMC programs – fixed sites, mobile sites and outreach sites (51). In our qualitative interviews, participants expressed varied preferences (and justifications thereof) for these sites. For example: "*Outreaches help to bring service closer, most people from far places would otherwise pay ten thousand to get to Kojja HC*" (male, circumcised, over 30 years) "*Those [outreach facilities] cannot because they do not take good care of you. In fact, they can choose to relocate after circumcising you*" (male, under 30, circumcised) We restricted our choice experiment to permanent facilities and temporary facilities because, from the user's perspective, there is no distinction between the mobile sites and outreach sites.
Distance one has to travel to access MMC services	1km 5km 15km	Long distance to health facilities is a well-recognized barrier to access to health services in general in low-income countries (52). In our qualitative interviews, this was an often-cited barrier to accessing MMC services: "*If they hadn't come here in our community, I wouldn't have gone there. They came here to our community, educated us and then I got circumcised here. They had taken some time offering circumcision at XXX but I wouldn't go there but because they came nearer, I picked interest and went there*" (male, above 30 years, circumcised)
Number of week-days during which MMC services were available at facilities	1 3 5	Past qualitative work has shown that men who had decided to get circumcised, sometimes found that services were not available at health facilities when they eventually visited them (53). This challenge was corroborated among the participants in our qualitative interviews: *"…ensure that the staff are available daily. Currently, it is offered on Tuesdays only. That has led to some people missing their appointments*" (male, above 30 years, uncircumcised). The levels were chosen to reflect the minimum, maximum and an arbitrary middle value, in order to maximize variability in choices

Privacy during counselling and while waiting to get circumcised	Complete privacy – when you visit the clinic, you get counselled and you wait by yourself Some privacy - when you visit the clinic, you get counselled and you wait to get circumcised in a group of men of a similar age to you; we separate younger men from older men No privacy - when you visit the clinic, you get counselled and you wait with wait for the procedure with everyone; there is no age segregation	Privacy (or lack-of) is a well-recognized indicator of the quality of health services from the user perspective, and has been shown to impact decisions to access health services in general and MMC specifically (53). It is an important target for improvements in MMC service delivery. The levels reflect the fact that our FGD participants were more concerned about separation of services by age.
The method of MMC	Surgical circumcision Device circumcision	The most widely used methods of circumcision are surgical but the WHO has recently approved several circumcision devices (54). There is interest among policy-makers in the introduction of devices for circumcision and their potential for resolving supply side challenges as well as their potential appeal among men (41). Knowledge about circumcision devices among the participants in our qualitative interviews was minimal. However, circumcision surgeons informed us that prior to circumcision, men are educated about the relative advantages of surgical and device circumcisions, and where available, are given a choice between the two methods.
Incentives for MMC	None Voucher Cash	Incentives were mentioned extensively by participants in the FGD. In addition, although potentially controversial perhaps because the coercive undertones, given the voluntary nature of the procedure, we believe they are still important economic policy instruments, especially where there are significant opportunity costs, and intangible (psychological and socio-cultural) costs to an intervention. Incentives are normally cash, vouchers or lottery based incentive. Lottery-based incentives were difficult to implement in the context of our choice experiment. We restricted our experiment to voucher and cash incentives because they cover they types of incentives mentioned by the FGD participants and were simple to implement in our choice experiment.
Cost/value of incentive	Incentive worth US$12 Incentive worth US$8 Incentive worth US$4 Free to you and no incentive US$0 You pay US$4 You pay US$8	Cost is a well-known barrier to accessing health services in general (52). Indeed, for many participants in our FGDs, this was a significant barrier to MMC. Like incentives, attaching a positive cost to MMC in a setting where health services are provided freely is controversial. Some FGD participants expressed a willingness-to-pay for MMC and provided various rationalizations for the payments. The maximum

		amount mentioned was approximately US$9. Although the maximum was mentioned in our FGDs was US$60, we restricted out levels to a maximum incentive compensation of US$12 for feasibility and plausibility.
Excluded attributes		
HIV testing required prior to circumcision	-	Participants in our qualitative interviews expressed strong and varied opinions about the impact of HIV testing requirements in their decisions to get circumcised: "*what is likely to happen, when someone is told that they will test him, he is bound to get scared and give up on circumcision*" (male, below 30, uncircumcised) However, providers and policy-makers suggested that HIV testing prior to circumcision was voluntary; and circumcision services were offered irrespective of whether a client had tested or not.
Health worker attitudes	-	Health worker attitudes are a well-recognized indicator of quality of health services from the user perspective, and have been shown to impact decisions to access -health services in general. We excluded this attribute because across all our 11 focus groups, there was a dominant preference for good provider attitudes.
Gender of the health worker	-	Gender was identified as a barrier to MMC in past qualitative work, and was corroborated by the participants in our focus group discussions (FGDs). We excluded this attribute because policy-makers suggested that restricting to male surgeons was an infeasible policy option.
Waiting time	-	Waiting time is a well-recognized indicator of quality of health services from the user perspective, and have been shown to impact decisions to access health services in general, and MMC specifically. In our FGDs, although waiting time was identified as important, it ultimately did not impact decisions about whether to circumcise or not, rather choices about which provider to go to for circumcision
Justifications are based on past literature and our own qualitative interviews which are reported in a separate paper		

3.3 Appendix C: Ngene® code to generate the final experimental design

```
Design
;alts = alt1*, alt2*, none
;rows = 36
;block = 3
;eff = (mnl,d,mean)
;rdraws = gauss(5)
;bdraws = halton(100)
;rep = 500

;cond:
if(alt1.incentive=0, alt1.price>=0),
if(alt2.incentive=0, alt2.price>=0),

if(alt1.incentive=[1,2], alt1.price<0),
if(alt2.incentive=[1,2], alt2.price<0),

if(alt1.facility=0, alt1.distance<=5),
if(alt2.facility=0, alt2.distance<=5),

if(alt1.facility=1, alt1.distance>=5),
if(alt2.facility=1, alt2.distance>=5),

if(alt1.facility=0, alt1.available>3),
if(alt2.facility=0, alt2.available>3)

;model:
U(alt1)  =   permhc.dummy[(n,0.18,0.01)]*facility[0,1] +
             dist.dummy[(n,-0.03,0.009)|(n,-0.06,0.009)]*distance[1,5,15] +
             avail[(n,0.05,0.0057)]*available[1,3,5] +
             device.dummy[n,(n,-0.61,0.036),(n,0.2,0.01)]*device[0,1] +
             priv.dummy[(n,-0.13,0.022)|(n,-0.15,0.026)]*privacy[0,1,2] +
             incentive.dummy[(n,0.39,0.13)|(n,0.58,0.19)]*incentive[0,1,2] +
             price[(n,-0.07,0.006)]*price[-12,-8,-4,0,4,8] /

U(alt2)  =   fac*facility +
             dist*distance +
             avail*available +
             meth*method +
             priv*privacy +
             inc*incentive +
             pr*price /

U(none)  =   neither[(n,-4.1,0.04)]

$
```

3.4 Appendix D: Final experimental design

task	facility1	distance1	available1	method1	privacy1	incentive1	price1	facility2	distance2	available2	method2	privacy2	incentive2	price2	block
1	0	1	5	0	1	0	0	1	15	3	1	2	1	-4	1
2	1	5	5	1	1	0	8	1	15	1	0	2	1	-12	1
3	1	5	3	0	1	2	-12	0	5	5	1	2	0	8	1
4	1	15	5	0	0	1	-12	1	5	1	1	1	2	-4	1
5	0	5	5	0	1	2	-12	1	5	3	1	2	0	8	1
6	1	15	3	0	0	1	-8	0	1	5	1	1	2	-8	1
7	1	5	1	0	2	2	-12	1	15	5	1	1	1	-4	1
8	1	5	3	1	2	1	-8	0	5	5	0	1	0	4	1
9	0	5	5	1	0	0	8	1	5	3	0	2	2	-12	1
10	1	15	3	1	2	0	8	1	5	3	0	0	1	-12	1
11	1	15	1	0	1	1	-4	1	5	5	1	0	0	0	1
12	1	5	1	1	1	0	4	1	15	5	0	0	2	-8	1
1	1	15	1	0	2	2	-12	1	5	5	1	0	0	8	2
2	0	1	5	1	0	2	-8	1	15	1	0	2	1	-8	2
3	1	15	3	1	0	2	-8	0	1	5	0	1	1	-8	2
4	1	15	1	1	0	1	-4	1	5	5	0	2	2	-12	2
5	1	5	1	1	2	0	0	0	5	5	0	1	2	-4	2
6	0	1	5	0	2	1	-8	1	15	3	1	0	0	4	2
7	1	15	5	1	1	2	-8	1	5	1	0	2	0	4	2
8	0	5	5	1	1	0	0	1	5	3	0	0	1	-4	2
9	0	1	5	1	2	0	4	1	15	3	0	1	2	-8	2
10	1	15	5	0	0	1	-12	0	1	5	1	1	2	-4	2
11	1	5	5	1	2	2	-4	1	15	1	0	0	1	-12	2
12	1	5	5	0	0	2	-4	1	15	1	1	1	0	0	2
1	0	5	5	0	2	1	-4	1	5	1	1	0	2	-12	3

2	1	15	3	0	1	1	-12	0	1	5	1	0	2	-4	3
3	1	5	3	1	2	0	8	0	5	5	0	0	1	-12	3
4	1	5	3	0	1	1	-12	0	5	5	1	2	0	8	3
5	1	15	1	1	1	2	-4	0	1	5	0	2	0	0	3
6	1	15	1	1	0	2	-8	1	5	5	0	1	0	4	3
7	0	1	5	0	0	0	4	1	15	5	1	1	1	-8	3
8	1	5	1	1	0	1	-8	1	15	5	0	2	2	-8	3
9	1	5	5	0	1	1	-4	1	15	1	1	0	2	-12	3
10	1	5	3	0	0	0	4	1	15	3	1	2	1	-8	3
11	1	15	5	1	2	0	0	1	5	1	0	0	1	-4	3
12	0	5	5	0	2	2	-4	1	5	3	1	1	0	0	3