Effects of Integrating ShangRing into Routine Voluntary Medical Male Circumcision: *Lessons from Active Adverse Event Surveillance in Tanzania*

CONTENTS

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Implementation of active adverse event surveillance (AAES) for ShangRing circumcision in Tanzania was conducted by IntraHealth International in collaboration with the Ministry of Health, Community Development, Gender, Elderly and Children (MOHCDGEC), the President's Office of Regional Administration and Local Government (PORALG), the National AIDS Control Program (NACP), Afya *Plus* and Regional and Council Health Management Teams (R/CHMTs) in the supported regions. This project has been supported by the President's Emergency Plan for AIDS Relief (PEPFAR) through the Centers for Disease Control and Prevention (CDC) under the terms of CoAg# NU2GGH001927.

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ACRONYMS

AAES	Active Adverse Event Surveillance
AE	Adverse Event
ASRH	Adolescent Sexual and Reproductive Health
CDC	Centers for Disease Control and Prevention
CHMT	Council Health Management Team
DC	District Council
HC	Health Center
HIV	Human Immunodeficiency Virus
HPV	Human Papilloma Virus
HSV-2	Herpes Simplex Virus-2
HW	Health Worker
MC	Municipal Council
MOHCDGEC	Ministry of Health, Community Development, Gender, Elderly and Children
NACP	National AIDs Control Program
NIMR	National Institute for Medical Research
PAES	Passive Adverse Event Surveillance
PEPFAR	President's Emergency Plan for AIDS Relief
PI	Principal Investigator
PORALG	President's Office - Regional Administration and Local Government
PS	Public School
R/CHMTs	Regional/Council Health Management Teams
RCT	Randomized Controlled Trials
RHMT	Regional Health Management Team
SNU	Sub-National Unit (District Council)
SOPs	Standard Operating Procedures
SR	ShangRing Device
STDEV/SD	Standard Deviation
TC	Town Council
TMDA	Tanzania Medicines and Medical Devices Authority
TOTs	Trainers of Trainers
TWG	Technical Working Group
VEO	Village Executive Office
VMMC	Voluntary Medical Male Circumcision
WHO	World Health Organization

EXECUTIVE SUMMARY

Introduction

In the absence of a vaccine or cure, HIV prevention by a variety of interventions will be needed to stop the HIV epidemic. Male circumcision (MC) reduces the risk of heterosexually acquired HIV infection in men by approximately 60% [1-3]. Accelerated scale up of male circumcision is important for timely halting of new HIV infections especially for males aged 15-34 years. Medical circumcision devices have the potential to speed up the roll out of MC by making the procedure quicker and easier than surgical circumcision, while remaining just as safe. In 2012 the World Health Organization (WHO) published a framework for clinical evaluation of pre-qualified male circumcision devices outlining three assessment phases that countries should fulfill before endorsing device for widespread use in national MC programs for HIV prevention that include: pilot evaluation studies, active adverse event surveillance (AAES), and passive adverse event surveillance (PAES).

Following a successful implementation of ShangRing pilot evaluation study in Tanzania, IntraHealth International and Afya *Plus* supported the implementation of AAES to assess the effects of rolling out ShangRing circumcision in Tanzania and provide evidence to inform the MOHCDGEC and PORALG on whether to incorporate the use of ShangRing circumcisions as an alternative to conventional surgical male circumcisions in routine clinical settings for circumcision of adolescent and adult men aged 10 years and above.

Objectives

1. To determine adverse event (AE) rates based on diagnosis and reporting from AAES.
2. To increase understanding of known AEs and detect any new or rare AEs associated with ShangRing based on accumulation of a larger sample in addition to those in earlier pilot studies.
3. To understand operational challenges and opportunities for incorporation of ShangRing circumcision into routine service delivery.
4. To generate consumption data for different device sizes to guide forecasting of different ShangRing device sizes to be procured to meet Tanzania's VMMC program needs.
5. To document the training needs of health care providers to provide circumcision using ShangRing device for boys and men aged 10 years and above.
6. To strengthen capacity of national trainers of trainers (TOTs) on integration of ShangRing circumcision.

Methods

The AAES team used quantitative methodologies for data collection and analysis to assess the effectiveness of ShangRing training for service providers and service delivery through static and campaign models. Pre- and post-training assessments were conducted to gather information on changes in providers' knowledge and skills before and after the training on ShangRing circumcision. Client files were used to collect client level data. Data entry was done through Epi Info (version 7.2.2.6) and later exported to Stata (version 158) for analysis.

Key Findings

- Of the 1,295 clients who opted for ShangRing circumcision, 1,077 (83%) clients were circumcised with the ShangRing device; 218 clients were screened out due to ineligibility.
- A total of 8 (0.7%) adverse events (AEs) were recorded: 6 mild, 1 moderate, 1 severe.
- Types of AEs:
  - Swelling (1)
  - Displacement (7)
- All the clients returned for the facility for post-circumcision follow-ups and all devices were removed on the following days:
  - Before day 7 = 6 (0.5%)
  - On day 7 = 1,061 (98.6%)
  - Beyond day 7 = 10 (0.9%)
- Training of ShangRing providers:
  - A total of 23 VMMC providers were trained on ShangRing circumcision,
  - The pre and post test results demonstrated significant improvement on providers' knowledge, attitudes, and self-efficacy.
  - A total of 22 (96%) mid-level service providers were certified on ShangRing circumcision.
  - Service providers were able to screen clients for ShangRing eligibility as per the WHO ShangRing prequalification report.
- Storage, handling, and disposal of ShangRing devices are done like other plastic medical devices.
- Simple incinerators at the public health facilities are sufficient for complete destruction of the single-use ShangRing device and measuring tapes.
- Ring openers and cutters are reusable and can be destroyed together with other metal surgical waste.

Conclusion

Results from this AAES show that ShangRing circumcision is feasible and safe for males aged 10 years and above and can be scaled up to reach large numbers of men through routine health care settings in Tanzania.

INTRODUCTION

Male circumcision (MC) is one of the oldest and most common surgical interventions, and the only lifetime HIV prevention method that has demonstrated 60% protection for circumcised men from acquiring HIV from a female partner compared to uncircumcised men [1-5]. Additional benefits for male circumcision have been found in female partners of circumcised men – the prevention of genital herpes simplex virus-2 (HSV-2), human papillomavirus (HPV) infection, and a lower incidence of bacterial vaginosis, Trichomonas infection, and genital ulceration [6]. Therefore, scale-up of male circumcision is a key component in a comprehensive response for HIV epidemiological control in areas with high HIV prevalence, low male circumcision coverage, and a predominantly heterosexual HIV epidemic.

The use of a collar compression device on the proximal part of the foreskin causes vascular obstruction to reach haemostasis. The distal foreskin is removed, but the device remains and therefore no sutures are required [7]. ShangRing's circumcision device would potentially be more acceptable and could increase uptake of male circumcision services, especially among adult men who do not prefer injectable anaesthesia and suturing from conventional surgery [8-9].

In 2012 the World Health Organization (WHO) established a program for prequalification of male circumcision devices to promote and facilitate access to safe, appropriate, and affordable male circumcision devices of good quality in an equitable manner [10]. In the same year, the WHO prequalified the ShangRing device for medical use and published a framework which outlines the criteria for clinical evaluation of medical devices for male circumcision and assessment phases that countries must accomplish before endorsing any device for integration and widespread use in their national male circumcision programs for HIV prevention [11-12]. These assessments fall into three phases namely: pilot evaluation phase, active adverse event surveillance (AAES), and passive adverse event surveillance (PAES) [13].

In alignment with this WHO framework of clinical evaluation for MC devices, the Ministry of Health, Community Development, Gender, Elderly and Children (MOHCDGEC) and the President's Office - Regional Administration and Local Government (PORALG), in collaboration with IntraHealth International and Afya *Plus,* supported the implementation of a pilot evaluation of ShangRing devices in 2019 with the National Health Research Ethics Committee (NatHREC) research protocol. Based on findings from the pilot evaluation phase [14] and results from other AAES in other African countries, ShangRing circumcision has demonstrated safety and high acceptability among males aged 13 years and above and all cadres of service providers [13-19]. In response, the Tanzania National VMMC technical working group (TWG) endorsed the implementation of active surveillance to assess opportunities and potential clinical and operational challenges associated with widespread use of ShangRing circumcision for clients aged 10 years old and above across different service delivery models in routine clinical settings.

OBJECTIVES

The main objective of the active surveillance was to assess the effects of rolling out ShangRing circumcision in Tanzania and provide evidence to inform the MOHCDGEC and PORALG on whether to incorporate the use of ShangRing circumcisions as an alternative to conventional surgical MCs in routine clinical settings for circumcision of adolescents and adult males aged 10 years and above. Other considerations, such as preference for topical anaesthesia by clients; continuous need to educate clients about abstaining from sex after device circumcision; potential for client's self-removals; and device slippage were also considered when planning for this active AE surveillance. The specific objectives were:

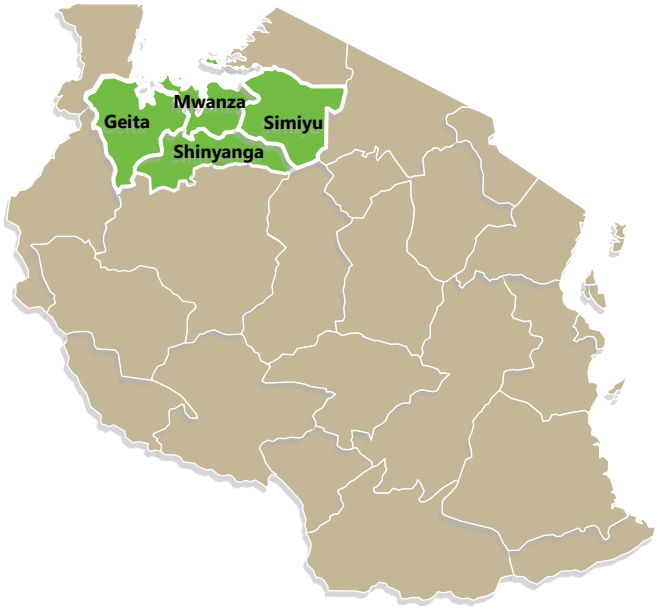
1. To determine AE rates based on diagnosis and client reporting.
2. To increase understanding of known ShangRing AEs and detect any new or rare cases.
3. To generate consumption data for different device sizes to guide forecasting of different ShangRing device sizes to be procured to meet Tanzania's VMMC program needs.
4. To understand operational challenges and opportunities for incorporation of ShangRing circumcision into routine service delivery.
5. To document the training needs of health care providers to provide circumcision using the ShangRing device for boys and men aged 10 years and above.
6. To strengthen capacity of national TOTs on integration of ShangRing circumcision in trainings, mentorships, and supportive supervision.

METHODS

Design and Setting

This AAES for ShangRing circumcision of males aged 10 years and above was a single-arm, open label prospective cohort evaluation. It was conducted in four Lake Victoria regions, namely Geita, Mwanza, Shinyanga and Simiyu, from September 2019 to May 2020 (Figure 1). These regions were selected for the AAES because they were receiving ongoing PEPFAR/CDC support for implementation of a five-year VMMC program using conventional surgical method through IntraHealth International.

Figure 1: Map of Tanzania showing regions that were covered during active AES



Coverage of active adverse event surveillance

From September 2019 to May 2020, IntraHealth in collaboration with R/CHMTs and service providers implemented AAES for the ShangRing device in seven sub-national units (SNUs) in Shinyanga, Geita, Mwanza, and Simiyu regions. During the implementation of AAES in the

supported regions, ShangRing circumcision was integrated into routine service delivery through both static sites and campaign sites. A total of 22 health facilities were engaged in screening, recruitment, ShangRing circumcision, and post-circumcision follow-up for the AAES. Of these sites, six were static and 16 were campaign sites that included eight health facility-based campaign sites and eight non-health facility campaign sites (e.g., school, privately hired premise, public local government authority (LGA) office, or warehouse). Of these, 646 (60%) clients were circumcised through static sites and the remaining 431 (40%) were circumcised through campaign sites including 224 (21%) through facility-based campaign sites and 207 (19%) at non-facility campaign sites (see Table 1).

Table 1: Number of clients circumcised with ShangRing device during active surveillance by region/SNU/site

SNU	SITE NAME	SERVICE DELIVERY MODEL			TOTAL
		Static site	Campaigns		
			Facility based	Non-Facility	
GEITA DC	*Katoto HC*	191	-	-	191
BUCHOSA DC	*Luchili Disp*	-	70	-	70
NYAMAGANA MC	*Sekoutoure Hosp*	58	-	-	58
MAGU DC	*Magu Hosp*	3	-	-	3
	Nyanguge HC	-	54	-	54
KAHAMA TC	*Kahama Hosp*	175	-	-	175
	Kinaga Disp	-	10	-	10
	Mwime Disp	-	13	-	13
	Shunu VEO	-	-	28	28
	Wame private House		-	38	38
	Zongomela Disp	-	15	-	15
USHETU DC	*Bukomela Disp*	-	4	-	4
	Igunda Disp	-	53	-	53
	Kidanha Godown	-	-	46	46
	Lugela VEO Office	-	-	26	26
	Mbuta PS	-	-	11	11
	Mweri Sec. School	-	-	8	8
	Ushetu HC	137	-	-	137
MEATU DC	*Bulyanaga VEO*	-	-	8	8
	Lubiga VEO	-	-	42	42
	Meatu DC Hosp	82	-	-	82
	Minyanda Disp	-	5	-	5
TOTAL		**646**	**224**	**207**	**1,077**

Minimum requirements for selection of ShangRing circumcision sites

- Must have health workers trained and are competent on surgical MC (the distal foreskin is removed at device placement and there is a risk of uncontrolled bleeding that may require surgical intervention).
- Must have trained providers competent in eligibility screening and ShangRing placement and removal, can identify and manage AEs and complications related to ShangRing circumcision (or are ready to release at least two health workers to attend a training on ShangRing circumcision).
- All supplies for ShangRing placement and removal must be reliably available.

- Must be equipped for emergency surgical management of immediate and post-procedure complications.
- Must have an agreed-upon referral plan to a district, regional, zonal, or other facility where providers with skills to manage rare complications are available.
- For outreach sites, provisions for maintaining communication with and assistance from the ShangRing team's mother facility are in place.

Additional site requirements for the active surveillance phase

- Must be in areas where VMMC program activities are already well-established within high-population-density catchment areas to facilitate active follow-up.
- Must have widespread coverage in multiple regions and a mix of urban and rural sites chosen to develop experience in both settings.
- Must have different levels of health care delivery (mixture of hospital, health centers and dispensaries).
- Must be equipped to offer both surgical and ShangRing device circumcisions, so that clients can freely choose.
- For outreach campaign sites, a minimum of two service providers trained on both conventional surgical VMMC and ShangRing circumcision must be deployed to the selected facility and non-facility campaign sites (these providers were retained at the campaign site for follow-up until all devices were removed).

Sampling and sample size

The sample size for the active surveillance was based on the WHO Technical Advisory Group on Innovations in Male Circumcision that recommends active follow-up of the first 1,000 clients using a new device in a programme. This active follow-up took place in the context of routine service delivery and not as an aspect of other studies such as the pilot implementation studies. The purpose is to capture all complications and AEs and ensure that their incidence is within acceptable limits. This sample size is powered to detect the occurrence of AEs, the maximum AE rate is estimated to be 2%. A minimum of 335 males are necessary for 95% confidence that the population proportion is within ±1.5% with an observed adverse event rate of 2%. Additional males were recruited to further confidence in the results, and to increase chances of capturing the rare AE.

Selection of participants for the active adverse event surveillance

Participants for this active surveillance were recruited from clients seeking VMMC services through the selected static and outreach campaign sites. Upon arrival at the study health facility, clients were grouped by age, and given separate group counselling for adults and adolescents. In groups, clients were provided with facts regarding circumcision for HIV prevention, MC for prevention of cervical cancer to female partners, post circumcision follow-up and wound care, sexual abstinence post-MC procedure, reporting of AEs, and the process for both surgical and ShangRing circumcision. After group counselling, interested clients were entered the service register and proceeded to attend individual counselling where they had enough time to ask questions and receive clarifications on both surgical and ShangRing circumcisions. This procedure is in alignment with the MOHCDGEC routine VMMC service delivery protocols. Eligible clients provided written consent by signing the client card used during routine VMMC service delivery. Clients who

preferred ShangRing circumcision were screened for eligibility, including measurement of penile circumference. Those who were not eligible or did not consent for ShangRing circumcision proceeded to conventional surgical circumcision.

To be eligible, participants had to be 10 years old and above; clients under 18 years of age had to be accompanied by a parent, guardian, or legally acceptable representative (hereafter parent); and participants had to be in good overall health and eligible for male circumcision, including being free from sexually transmitted infections (other than HIV, HIV sero-positive status not being among the exclusion criteria). Parents were provided with information on ShangRing circumcision and were required to consent to bring the minor participant back for follow-up. Participants were excluded if they had any contraindication including known allergy to lidocaine and prilocaine, bleeding disorder, active genital infection, or genitourinary abnormality that contraindicated elective surgery under local anaesthesia or circumcision.

Preparations for the active adverse event surveillance

Before the implementation of AAES, the co-investigators presented findings from the pilot study to the national VMMC technical working group meeting in August 2019. Following the review of findings from the pilot study, the national VMMC TWG and other VMMC key stakeholders endorsed the implementation of active surveillance of adverse events for ShangRing circumcision. Led by the principal investigators (PIs) from the NACP, in early September 2019 the project obtained permission from the Chief Medical Officer for two master trainers from Akeso Consultants (Quentin Awori and Jaisus Oketch from Kenya) to conduct both in-class and practical trainings through public health facilities.

Procedure

Healthy males aged 10 years and above seeking VMMC services at selected active surveillance sites were counselled, gave their consent, and were enrolled into the surveillance on the day they were circumcised using ShangRing. Participants were examined clinically and cleared for ShangRing circumcision, at which time their baseline demographics and vital signs were collected and documented in their client cards. Two service providers, both trained in and experienced with conventional surgical MC and at least one of them trained on the no flip ShangRing technique, performed the ShangRing circumcisions. HIV testing and counselling was optional for all clients; even those who did not consent to HIV testing were also circumcised using ShangRing. Participants were administered with either EMLA Cream (eutectic mixture of lidocaine 2.5% and prilocaine 2.5%), 5 gram per person 20-25 minutes before circumcision or injectable anaesthesia (a dorsal penile nerve and ring block using 1% lidocaine). After device placement and foreskin removal, clients (or their parents) were counselled on postoperative care and provided with bandages for daily changing. Clients were required to return to the VMMC site on the seventh day post-placement for device removal – or earlier if they required any support or additional information, experienced any discomfort, pain, abnormal appearances of the penis, or had concerns about anything that happened after ShangRing circumcision. At the follow-up visit a genital examination was conducted.

Participation in the active surveillance ended after device removal on the seventh day, except in cases where the provider determined that the circumcision wound was not progressing well and requested additional visits. Clients were also encouraged to come back to the facility at any time post-device removal if they had any concerns. Clients who did not return on their indicated follow-up for device removal (on the seventh day post-placement) were contacted through mobile phones or physically traced for device removal and wound assessment to ensure they were safe. Clients who made a self-removal prior to seventh day were also traced to ensure they returned to the facility for post removal assessment.

Training of Health Workers

A total of 23 health workers from Mwanza, Kagera, Simiyu and Geita regions experienced in provision of conventional surgical MC were trained on ShangRing circumcision for adolescent and adult males aged 10 years and above. The training was conducted in Geita region (Katoro Village) September 2-20, 2019, using the Illustrated Guide for Service Providers [20]. The training included a two-day in-class didactic training covering background and theory behind ShangRing circumcision, AE management, and documentation. Participants completed a one-day clinical observation of procedures performed by master trainers.

Non-participating health care workers within the selected static facilities and outreach campaign sites were sensitized on the planned ShangRing AAES to enable them to support and refer clients appropriately. These sensitizations took a maximum of two-hours with the facility management and staff in all participating health facilities. This session was integrated into routine morning clinical sessions conducted every day in all facilities. The morning sessions were attended by all health workers in the participating sites and trained health workers sensitized clients attending the selected MC sites seeking routine VMMC on the availability of ShangRing as an alternative to conventional surgical circumcision. The trained health workers were also assigned to share information with the neighbouring nonparticipating sites to ensure correct information was provided to clients who might seek services in those sites.

Data Collection and Analysis

Data collection for active surveillance was done using the regular client cards employed during routine service delivery. A device placement and removal log were also maintained to ensure timely follow-ups were carried out for all clients who were expected to return for device removal. Additional information on the ring size measured and placed for each client was also recorded on the client cards. Device event forms and AE forms were also maintained at the facility and were completed whenever necessary. Daily data and weekly reports were compiled on a summary Excel spreadsheet by the site managers and submitted weekly to the study coordinator for submission to all investigators and the MOHCDGEC PIs. This information included:

1. Total number of ShangRing circumcisions performed.
2. Total number of clients who reported AEs, including moderate, severe and notifiable AEs.
3. Detailed reports on frequency and characteristics of any new AEs, device displacement/detachment/self-removal/device malfunction, need for medical attention or intervention, and final outcomes in those experiencing AEs.

4. Total number of clients who failed to return to the facility as instructed for recommended follow-up (for device removal visit and/or AE follow-up).
5. Proportion of all men receiving VMMC services at the active surveillance sites who chose ShangRing method instead of surgical circumcision.
6. Proportion of males choosing ShangRing who were found to be clinically ineligible.
7. Distribution of device sizes among devices measured and placed.

Data collected from all regions were also entered into the Epi Info database and compared for differences or similarities within and between sites. Data cleaning was done as needed. Regional data were then merged into one Epi Info database and exported to Excel and STATA for analysis.

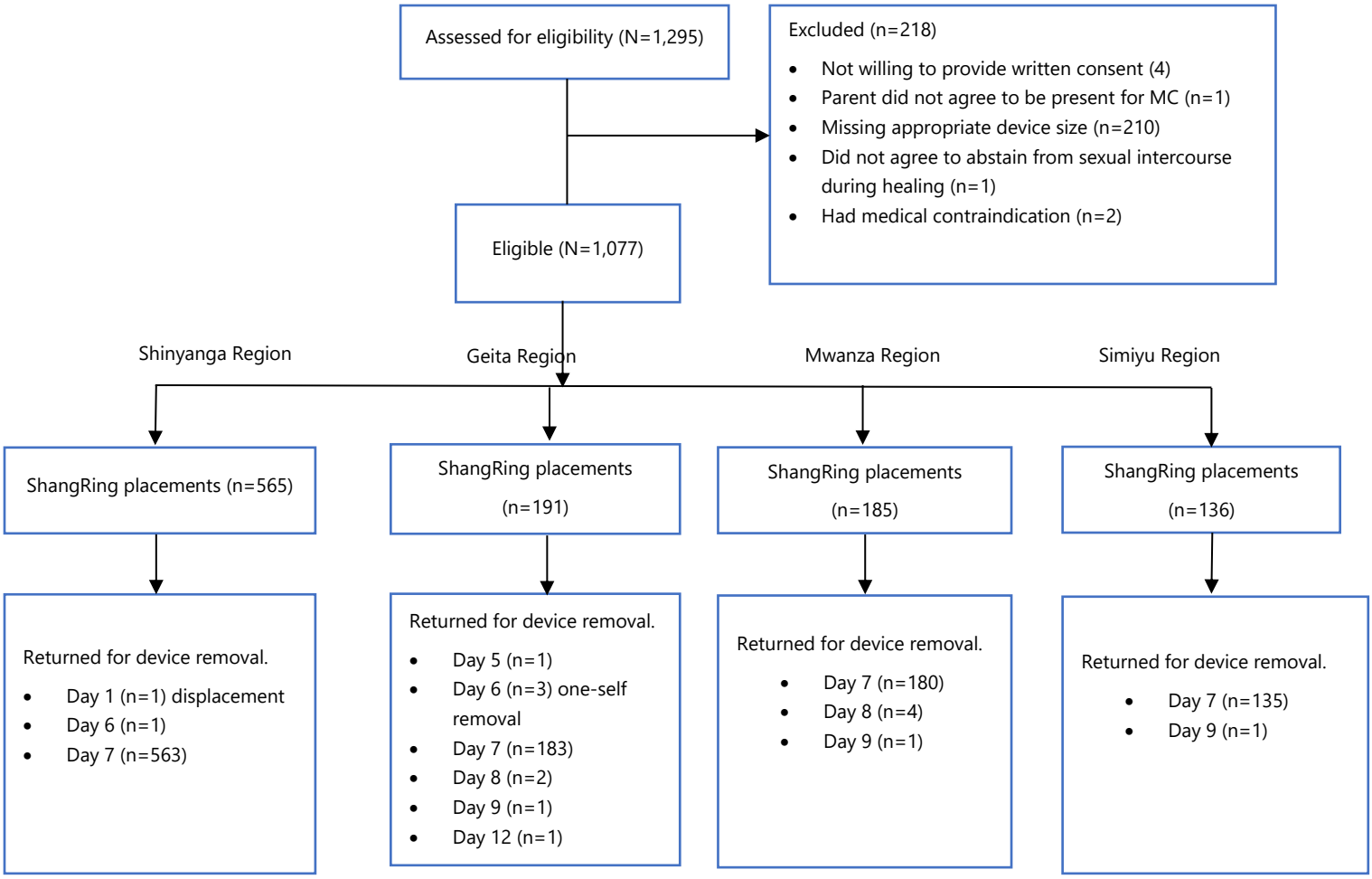
RESULTS

Uptake of ShangRing Circumcision during Active Adverse Event Surveillance

During the implementation of AAES in the selected sites, both ShangRing and conventional surgical VMMC services were offered concurrently. A total of 4,039 male clients aged 10 years and above sought VMMC services at sites participating in ShangRing AAES. Of these, 1,295 (27%) chose to be circumcised using ShangRing and the remaining 2,744 opted for surgical circumcision. Out of the 1,295 clients who chose ShangRing circumcision, 1,077 (83%) clients were circumcised using ShangRing while the remaining (218) were ineligible due to the following reasons (see Figure 2):

1. Client was not willing to provide written consent (n=4)
2. Parent for minor did not agree to be present during circumcision (n=1)
3. Site did not have the appropriate device size (n=210)
4. Client did not agree to abstain from sexual intercourse during healing (n=1)
5. Client had medical contraindication (n=2)

Figure 2: Flow diagram for clients screening and enrolment for ShangRing Active Adverse Event Surveillance



Age group distribution of active adverse event surveillance study participants

The mean age of the clients circumcised using the ShangRing device during AAES was 24.5 years (SD 9.9, range 10–88 years old). Among them, 78 (7%) were aged 10–14, 771 (72%) were aged 15-29 years, and 228 (21%) were aged 30 years or older. Of these clients, 410 (38%) were married, 661 (61%) were single, and the remaining were either divorced, co-habiting or did not reveal their marital status. See Table 2 for additional details.

Table 2: Demographic characteristics of ShangRing active surveillance

		(N=1,077)	(%)
Age Groups (Years)	10-14	78	7.2
	15-19	373	34.6
	20-24	174	16.2
	25-29	224	20.8
	30-34	80	7.4
	35-39	49	4.6
	40-44	38	3.5
	45-49	27	2.5
	50+	34	3.2
Below and above 25 Years	Below 25 Years	625	58.0
	25+ Years	452	42.0
Marital Status	Married	410	38.1
	Single	661	61.4
	Cohabiting	1	0.1
	Divorced	3	0.3
	Not revealed	2	0.2

Occurrence and classification of adverse events

Out of the 1,077 clients who were circumcised using the ShangRing device, eight clients were reported to have experienced an AE that was related to the procedure. This represents an overall AE rate of 0.7% (8/1,077), which is lower than the acceptable WHO AE rate of 2% for conventional surgical male circumcision.

Classification of adverse events by timing of occurrence

All the reported AEs occurred when the device was in situ, i.e., after client discharge from the clinic following ShangRing device placement as follows:

- The earliest AE was reported 40 minutes after client discharge. The client had left the facility and arrived at home when he realized abnormal bleeding at the wound. On returning to the facility for wound examination, it was observed that the inner skin had slipped off the ring, hence some blood vessels had opened. In this case, the ShangRing device was opened and removed, bleeding was controlled, and the client was sutured by service providers experienced in conventional surgery. The client returned for follow-up 48 hours after the procedure and then seven days later, at which time he had healed like clients who had received conventional surgery.

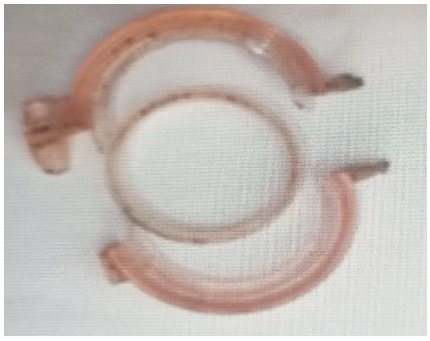
- One client returned to the clinic on the second day post-placement complaining of pain and swelling of the penis. He was assessed by the trained ShangRing provider and re-assured that it was a normal healing process. The client was not wearing any underwear and the penis was improperly positioned after circumcision, resulting in swelling. The client was reassured and provided with additional underwear and painkillers. No additional clinical intervention was

done.

- One client self-removed the ring on day 6 due to pain caused by partial ring displacement after being involved in a motorbike accident. The client could not withstand the pain and decided to remove it using a hot spoke. The client did not return for the scheduled device removal on day 7. He was traced on day 8 through mobile phone and requested to come back to the facility where he revealed that he had removed the device on day 6. The wound was dry and clean (see Photo 1). The client was also examined for other injuries that might have been caused by the accident. No additional intervention was done.

- Five clients returned to the clinic complaining of pain caused by partial spontaneous detachment where the foreskin trapped in between the inner ring and outer ring was being pulled, which caused pain. Of these clients, one returned on day 5 and four on day 6. The devices were successfully removed by the trained providers. No additional interventions were done following the removals as particle spontaneous detachment was considered part of the healing process.

Photo 1: A ShangRing device that was removed using a hot spoke on day 6 and appearance of the penis on day 8



Classification of adverse events by type and severity

Of the eight AEs that were reported, seven were classified as displacements and one was labelled as swelling. Six were classified as mild, one moderate, and one severe.

One severe adverse event. Device displacement due to slippage of part of the inner skin, that resulted in the removal of the device and conventional surgery was done instead. The 19-year-old client came back 40 minutes after circumcision, part of the inner skin had slipped off resulting in moderate bleeding. The device was removed, and circumcision was completed by the dorsal slit (DS) technique. This AE was classified as severe. (Mwime Dispensary)

One moderate adverse event. Device displacement resulted from self-removal on day 6. This 18-year-old client self-removed the ring on day 6 due to pain caused by ring displacement after being involved in a motorbike accident. He missed his day 7 follow-up visit and was traced through mobile phone and requested to return to the facility where it was found out that he had removed

the device on day 6. The wound was dry and clean. No additional intervention was done. (Katoro HC)

Six mild adverse events. A 20-year-old client came back on the second day post-placement expressing pain associated with penis swelling; he was assessed and re-assured that it was a normal healing process. Swelling of the penis, reported two days post-placement due to improper positioning of the penis. Message of proper penis positioning after circumcision was provided (no additional clinical intervention done). Five displacements were due to partial spontaneous detachment, one on day 5 and four on day 6. Upon occurrence of each partial displacement, the respective client returned to the site and requested for an early removal as the detached part of the foreskin was pulling out the rest of the skin, causing pain to the client. The provider in each case diagnosed the partial detachment being due to early healing process and made the clinically appropriate decision to remove the ring prior to postoperative day 7.

Average duration of device placement

The number of minutes required for the topical anesthetic to take effect and the time for actual device placement, including foreskin removal, were separately documented. Topical anesthetic EMLA® cream, 5 grams 5% (2.5% lidocaine, 2.5% prilocaine) was applied around the inside of the foreskin and then on the outer surface of the foreskin, covering the full shaft of the penis. The penis was then covered with a surgical glove and left for approximately 20-25 minutes and then checked if the anesthetic had taken effect. If the area was not yet numb, it was rechecked every two to five minutes, for up to an additional 30 minutes. If the topical anesthetic had not taken effect by the end of the additional 30-minute period (i.e., 50-55 minutes post-application), injectable anesthesia was used (upon client consent). The topical anesthesia duration was counted as the length of time from when the provider completed applying the cream to the full shaft of the penis to when it was confirmed to have taken effect**.**

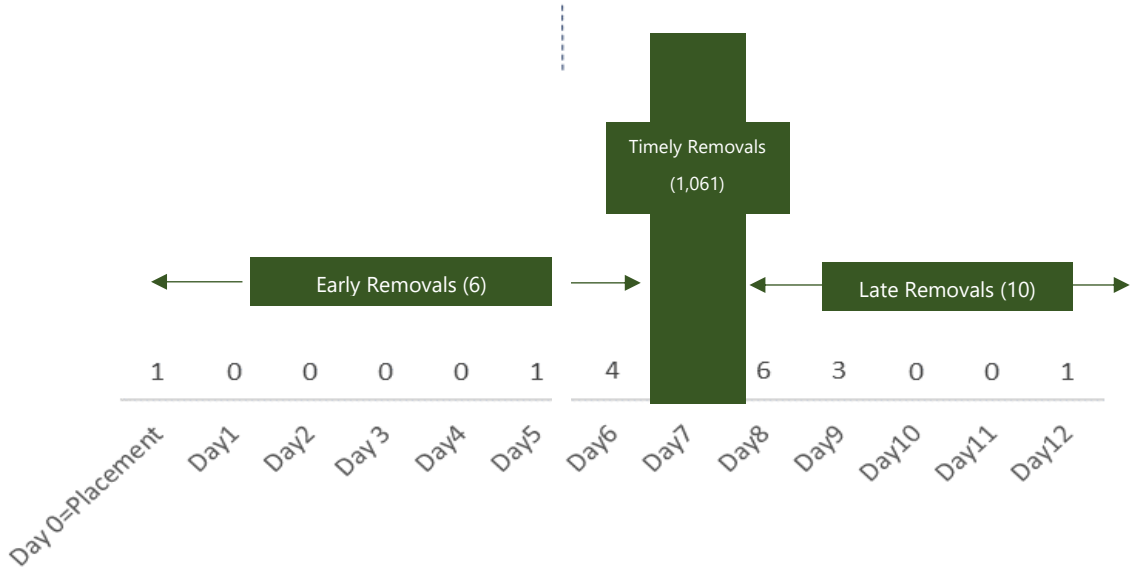
The anesthetic cream was then wiped off the penis shaft before the foreskin was held by forceps and the inner ring slipped under the foreskin to the level of the coronal sulcus. The outer ring was then clamped around the inner ring, squeezing the foreskin in between. The foreskin was then cut. The device placement duration was counted from when the foreskin was held by forceps for insertion of the inner ring to when the foreskin was removed. The device removal duration was counted from when the outer ring was opened until the inner ring was removed.

Mean duration of device placement (measured from placement of the inner ring to complete excision of the foreskin) was 9.8 minutes (SD 3.2) and did not vary substantially by facility, client age, or provider cadre and experience. Combined with topical cream activation time, the mean ShangRing procedure time ranged between 30 minutes to one hour and seven minutes – considering the minimum time for topical cream activation being 20 minutes and maximum being 55 minutes. During this AAES, all clients used topical anesthesia.

Follow-up rates and ShangRing device removals

All clients returned for device removal or post-procedure follow-up between 40 minutes and 12-days post-procedure. Of the 1,077 clients enrolled, 1,061 (98.6%) devices were removed on day 7 as recommended, six devices (0.5%) were removed before day 7 (including one that was removed 40 minutes after procedure due to device displacement as described above; and another one was removed on day 5). The remaining 10 (0.9%) devices were late removals between day 8 and day 12 post-placement (Figure 3). All clients who failed to return for removal by day 7 post-placement were reached by phone and successfully returned to the facility for device removal within five days without physical tracing.

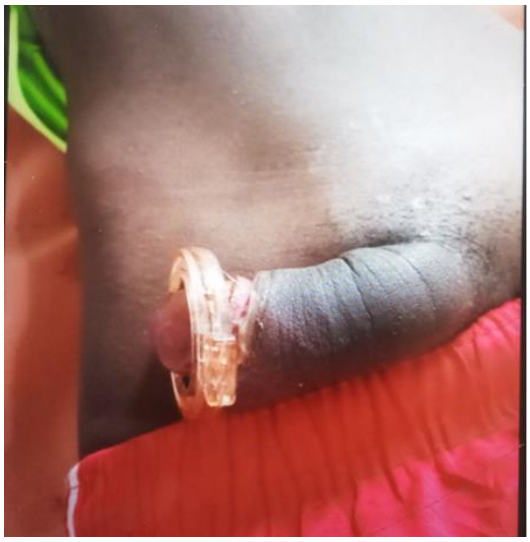
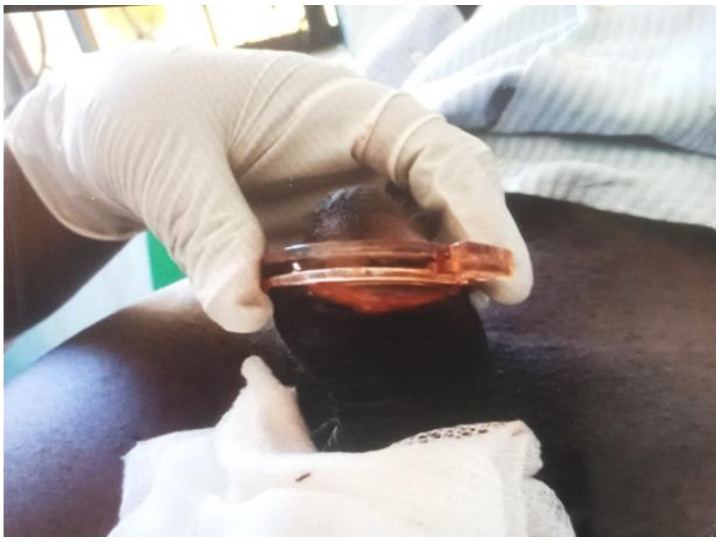
Figure 3: Number of ShangRing removals by day (since placement)



Spontaneous partial detachment

Variation on healing was observed among AAES participants – five clients who returned for device removals on day 5 (0.1%) and day six 6 (0.4%), were considered to start healing earlier than others, such that on the fifth and sixth days, respectively, part of the wound appeared healed and dry, and the device had started to detach spontaneously. As the device was detaching from the healed skin, the tissues of the unhealed part were being forcefully pulled off during movements, hence tearing tissues that were still attached to the penis skin. When the clients returned for post placement follow up visits, the provider recommended that the wound had started healing by secondary intention. This was part of the normal healing process before complete detachment. Therefore, the device was removed, primarily due to complaints of pain or discomfort caused by spontaneous partial detachment of the device (see Photo 2).

Photo 2: Appearance of ShangRing particle detachment before removal on day 5and 6 (Photo credit: Dr. Joseph Mayanga)

Utilization Data for Different Sizes of ShangRing Devices

Use of ShangRing device by size

Globally, ShangRing devices are available in 32 sizes (ranging from size Z2 to A4), with the inside diameters ranging from 9mm to 40mm to fit infants, adolescents, and adult men. In this active surveillance, a range of 15 ShangRing device sizes for adolescent and adult males were used, varying from size A4 (40mm) to size Q (20mm). The most frequently used ShangRing sizes among the 15 available for active surveillance device sizes F-31mm (18%), D-33mm (17%), E-32mm (16%), C-34 mm (15%), G-30mm (10%), and H-29mm (8%). (See Table 3).

Stockouts of certain ShangRing device sizes were reported in all AAES site facilities, especially for the highly used device sizes C to H which accounted for 84% of all devices. A total of 220 eligible clients who had chosen ShangRing were instead sent for conventional surgical circumcision due to stockout of the appropriately sized devices. Clients who missed the device sizes were not documented during the active surveillance.

Use of ShangRing device by age

A wide range of device size usage was recorded among clients aged 15-19 years (35% of all ShangRing clients). In this age range, every device size was used at least once except B-3.5 cm. The age group 25-29 years (21% of all clients) also used a wide range of sizes, from A4 to G. Otherwise, the majority of client sizes fell between 34 – 30 mm for all age categories (see Table 3).

Table 3: ShangRing device sizes used among AAES participants (10-88yrs) in Tanzania (N=1,077)

Client Age bands	Device Sizes in mm															Row Total
	A4-40	A3-39	A1-37	A-36	B-35	C-34	D-33	E-32	F-31	G-30	H-29	I-28	K-26	M-24	O-22	Q-20	
10–14	0	0	0	0	0	2	4	3	6	5	7	6	14	10	19	2	78
	0%	0%	0%	0%	0%	1%	2%	2%	3%	5%	8%	13%	29%	40%	61%	67%	7%
15–19	1	1	1	1	0	32	62	42	79	36	37	28	26	15	11	1	373
	50%	20%	17%	33%	0%	20%	34%	24%	41%	33%	44%	58%	53%	60%	35%	33%	35%
20–24	0	0	1	0	1	32	32	31	32	19	15	4	6	0	1	0	174
	0%	0%	17%	0%	50%	20%	18%	18%	16%	17%	18%	8%	12%	0%	3%	0%	16%
25–29	1	2	0	2	0	52	40	43	40	25	12	5	2	0	0	0	224
	50%	40%	0%	67%	0%	33%	22%	25%	21%	23%	14%	10%	4%	0%	0%	0%	21%
30–34	0	0	2	0	1	19	17	15	7	11	7	0	1	0	0	0	80
	0%	0%	33%	0%	50%	12%	9%	9%	4%	10%	8%	0%	2%	0%	0%	0%	7%
35–39	0	1	1	0	0	1	8	20	9	3	3	3	0	0	0	0	49
	0%	20%	17%	0%	0%	1%	4%	11%	5%	3%	4%	6%	0%	0%	0%	0%	5%
40–44	0	0	1	0	0	8	7	8	10	2	1	1	0	0	0	0	38
	0%	0%	17%	0%	0%	5%	4%	5%	5%	2%	1%	2%	0%	0%	0%	0%	4%
45–49	0	1	0	0	0	7	2	5	7	3	2	0	0	0	0	0	27
	0%	20%	0%	0%	0%	4%	1%	3%	4%	3%	2%	0%	0%	0%	0%	0%	3%
50+	0	0	0	0	0	6	8	8	5	5	1	1	0	0	0	0	34
	0%	0%	0%	0%	0%	4%	4%	5%	3%	5%	1%	2%	0%	0%	0%	0%	3%
Column Totals	2	5	6	3	2	159	180	175	195	109	85	48	49	25	31	3	1,077
	0%	1%	1%	0%	0%	15%	17%	16%	18%	10%	8%	5%	5%	2%	3%	0%	100%

Switching of ShangRing device sizes

To select an appropriate ShangRing size, service providers are trained to measure the penile circumference using the plastic disposable measuring tape through the elliptical window to assist them in selecting the appropriate ShangRing size. The training guide and WHO guidance for prequalification of ShangRing devices for male circumcision recommends switching the device size for clients one size below the measurement in cases of unavailability of a specific recommended ring size [16,19].

During the AAES the surgeon applying the ShangRing device switched a total of 59 clients (representing 5.5% of all circumcised clients) to ring sizes different from those measured with the tape by the provider at the client eligibility screening stage (see Table 4). Selection of appropriate ring sizes by the surgeon was done considering WHO and manufacturer guidance as well as instructions from the experienced ShangRing master trainers. Of these, 39 clients were switched to one size below or above the tape measurements. Fourteen clients were switched to two sizes below or above the tape measurement. The remaining six clients were documented as being switched to three (n=3), five (n=1) and eight (n=2) sizes below or above the tape measurement. These six ring resizings were attributed to provider error on initial measurement. Upon further review of data, we determined that these provider errors were not associated with a particular provider cadre, as the six devices were placed by different cadres. Instead, most of these switching occurrences happened during the training in the presence of the experienced master trainers. Table 4 below shows that the most placements and size switching occurred with ring size F (n=35), followed by sizes E (n=12) and G (n=6).

Although the AE rates during this AAES were low at 0.7%, two of the AEs occurred among clients who were switched to devices one size and two sizes above the tape measurement. Both AEs were classified as mild due to spontaneous partial displacement.

Table 4: ShangRing device switching among AAES participants aged between 10 to 88 yrs. (N=1,077)

Recommended Ring Size	Actual placement size																Total
	A4	**A3**	**A1**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**K**	**M**	**O**	**Q**	
A4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
A3	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**5**
A1	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	**6**
A	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	**2**
B	0	0	0	0	2	1	0	1	0	0	0	0	0	0	0	0	**4**
C	0	0	0	0	0	155	0	1	0	0	0	0	1	0	0	0	**157**
D	0	0	0	0	0	1	174	0	0	0	0	0	0	0	0	0	**175**
E	0	0	0	0	0	0	1	163	7	4	0	0	0	0	0	0	**175**
F	1	0	0	1	0	2	5	10	184	12	4	0	0	0	0	0	**219**
G	0	0	0	0	0	0	0	0	4	92	2	0	0	0	0	0	**98**
H	0	0	0	0	0	0	0	0	0	1	79	0	0	0	0	0	**80**
I	0	0	0	0	0	0	0	0	0	0	0	48	0	0	0	0	**48**
K	0	0	0	0	0	0	0	0	0	0	0	0	48	0	0	0	**48**
M	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	**25**
O	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31	0	**31**
Q	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	**3**
Total	**2**	**5**	**6**	**3**	**2**	**159**	**180**	**175**	**195**	**109**	**85**	**48**	**49**	**25**	**31**	**3**	**1,077**

Training

Training of health workers

Pre- and post-tests were conducted before and after the training of ShangRing providers. A significant improvement on knowledge, skills, and perceptions of health workers on ShangRing circumcision was documented on post-test compared to pre-test scores (p<.001) (Table 5). A total of 22 out of 23 trainees were certified following 100% attendance, minimum 75% scores on post-test assessment, and completion of seven device placements and five removals – achieving a perfect score for the seventh placement and fifth removal as measured on the clinical skill assessment tool by the trainers. One provider was not certified following very low scores on both pre-and post-test assessments and a slow learning pace during practical placement and removal of ShangRing. This provider was attached to an experienced TOT for continued mentorship and may be certified when re-assessed in the future. Pre-and post-tests were conducted before and after the training of ShangRing providers.

Table 5: ShangRing training pre-and post-test results summary of scores

Measurement	Pre-test	Post-test
Mean	61	83.47
Observations	23	23
T stat	-7.71	
T critical two-tail	2.07	

Training of ShangRing trainers of trainers

A total of eight national trainers experienced with conventional surgical VMMC attended a two-day in-class training as part of the process to become national TOTs on ShangRing circumcision. These TOTs will only become certified after at least 70 device placements and 50 device removals, as well as having conducted one complete training of new ShangRing providers under the supervision of a master trainer. As of February 2021, none of the trained TOTs had completed all the prerequisite to be certified as ShangRing TOTs.

PROCUREMENT AND LOGISTICS FOR ROLL OUT OF SHANGRING CIRCUMCISION

Availability and Procurement of ShangRing Devices

At the time of planning and implementing the AAES, the ShangRing device had not yet been registered in Tanzania; therefore, the project obtained a waiver from the Tanzania Medicines and Devices Authority (TMDA) for procurement and importation of 1,200 ShangRing devices for providing VMMC services during this AAES. The imported ShangRing devices were inspected by the Dar es Salaam Port TMDA inspector to examine the quality of products before actual use on the Tanzania mainland. Procurement of ShangRing devices was done via a vendor (PharmAccess-Kenya). The elapsed time from ordering the devices to their arrival in country was three months; approximately five business days were required to clear the devices from Tanzania Revenue Authority customs.

According to the information gathered from the vendor, the use of the ShangRing device is still very limited in sub-Saharan Africa as most countries are still implementing evaluation studies. Therefore, every time a country places an order for ShangRing devices, the vendor forwards it to the manufacturer. The vendor maintains a limited stock in Kenya for supplying small quantities to countries

for conducting evaluation studies. Country programs that intend to implement ShangRing circumcision should consider registering the device in-country and preordering the devices well ahead of time.

Given the AAES phase is based on serving approximately 1,000 clients, procurement of ShangRing devices for the AAES was calculated based on historical usage of ShangRing during the pilot study in May - July 2019 in Shinyanga region. During the AAES, the most frequently used ShangRing device sizes were C, D, E and F. Additional unexpired devices for sizes E and F, which were left over from the pilot study, were also used for the AAES.

Transportation, storage, and handling of ShangRing devices

Normal road transport in an open truck was used to safely transport the devices from the port in Dar es Salaam to the respective sites. As per the manufacturer's instructions, the devices were maintained at ≤50˚C and a relative humidity of ≤80% to maintain a shelf life of three years. During the AAES, ShangRing devices were adequately stored together with other VMMC supplies in the project's main warehouse and afterwards in unairconditioned mini stores at the health facilities. However, additional space was required to store the ShangRing packages, bandages, removal key openers, measuring tapes and removal cutters both in the main project's warehouse and in stores in the respective health facilities.

The ShangRing is a sterile, single use, disposable MC device supplied together with plastic disposable measuring tape. Bandages, removal cutters, and removal key openers are sold separately. General surgical dressing can be used instead of the bandages produced by the manufacturer Wuhu Snnda. General hospital supplies such as gloves, gowns, surgical masks, theatre boots/shoes, local anesthetic, and instruments (e.g., hemostatic clamps, surgical scissors) are also required for ShangRing circumcision and are not supplied with the ShangRing. These required reusable hospital supplies and equipment can be co-shared for use with other minor surgical procedures.

The measuring tape that is supplied with the devices is non-sterile and does not need to be sterilized prior to single-patient use. The instruments used for placement and removal of the ShangRing (e.g., hemostatic clamps, surgical scissors, removal cutter and removal key opener) must be cleaned and sterilized prior to each patient use.

Requirements for device use

At least two client visits are required for ShangRing device use - one to place and one to remove the device.

Placement. The facility must have an adequate supply of device sizes, accessory equipment, two trained providers, materials for a sterile procedure, and topical and injectable anesthesia. Facilities and staff experienced in standard surgical circumcision must also be immediately available on site, together with the appropriate instruments and supplies to safely convert to and complete a conventional surgical circumcision in rare cases when device placement cannot be completed. While wearing the device for seven days the client will require analgesics and access to a trained health care provider to manage device problems.

Removal. The facility must have a clean setting and have at hand all accessory equipment. The ShangRing opener is included in the manufacturer's supplies but are priced and sold separately. ShangRing devices, openers and measuring tapes do not require specialized furnaces for disposal; therefore, they can be destroyed together with other plastic medical waste at the facility.

Requirements for data management and reporting

Currently routine VMMC client cards do not capture some of the ShangRing-related data elements including 1) size of the ShangRing device measured and used; 2) list of device-related AEs such as device displacement; 3) use of topical anesthetic including indication of time since administration of the anesthetic until when anesthetic results are achieved; 4) time of device placement, and 5) device removal details are not included. Additionally, the monthly reporting tools/forms and national DHIS2 do not yet disaggregate ShangRing circumcision from the conventional surgical procedure.

DISCUSSION

This evaluation examined the safety, uptake, and overall feasibility of rolling out ShangRing circumcision in the context of routine health care settings and outreach campaigns in Tanzania based on 1,077 procedures for adolescent and adult males aged 10 years and above. Although variations on uptake of ShangRing circumcision were observed across regions/sites, client safety was generally high for all clients. Results from this AAES yielded similar results as previous studies in Uganda, Kenya, and Zambia [14-19] which showed that the device is safe to use with high client compliance for post-circumcision follow-up for device removal on day 7.

Among the 218 clients who were excluded from this active surveillance for ShangRing circumcision, 210 (97%) were found to be ineligible as the facility lacked the correct device sizes and were thus referred for conventional surgical circumcision. Two clients were ineligible due to other medical issues; six clients did not proceed with ShangRing circumcision due to ethical/consent issues. Low rates of medical ineligibility for the ShangRing device have also been reported in other field studies in Zambia (0.4%) and Kenya (0.25%), as well as with the active surveillance phase in Kenya (1%) [21]. This provides further reassurance that only a small proportion of males are expected to be clinically unsuitable for ShangRing circumcision as the device is rolled out. It highlights, however, the necessity of maintaining the availability of conventional surgical services as an alternative.

The overall AE rate in this active surveillance phase was low (0.7%), which is in line with findings from other studies across Africa; indicating that integration of ShangRing circumcision into routine VMMC services can be safe. Self-removal and displacement of the ShangRing device were the most common AEs reported during this AAES. Like results from the pilot study that was conducted earlier in Tanzania, reports on self-removals call for enhanced educational materials and counselling to be provided to clients, such as developing communication messages with visual graphics or photos to illustrate risks associated with self-removal of ShangRing devices. Early spontaneous detachment was not associated with any AEs; rather, the early spontaneous *partial* detachment should be carefully managed to avoid tissues from the wound being pulled and causing a post-operative AE case requiring the ring to be removed [15,21].

The ShangRing uptake rate of 1,295/4,039 (32%) observed in this surveillance was much lower than what was reported in the Tanzania pilot study (83%) and in previous evaluation studies in Uganda

among adults (82%) and adolescents (83%) [14, 16]. Findings from this active surveillance phase in Tanzania, however, is in line with the findings from active surveillance in Kenya at 29% [14,21]. The slow uptake of ShangRing circumcision during this active surveillance may also be in part due to the shortage of most frequently used ShangRing device sizes. At one point the health workers used their clinical acumen to not inform clients on availability of ShangRing circumcision if the available sizes may not fit them. As a result, some clients neither received information on ShangRing nor were screened for ShangRing circumcision eligibility. Also, this difference in uptake could be attributed to variations in client recruitment approaches. The selected sites were mainly offering ShangRing circumcision at static facilities only, where the overall number of clients circumcised was comparatively low. Additionally, fewer clients were enrolled for ShangRing circumcision at outreach sites following the historical experience of low follow-up rates. This may have discouraged the service providers from offering ShangRing to avoid missed follow-ups. Furthermore, in line with the diffusion of innovation behavioral theory, when people are offered something new, initially only a few (early adopters) tend to go for it, while the rest (early majority, late majority, and laggards) wait to learn more about the offering (in this case, waiting until more males experience ShangRing circumcision and share their experiences of its clinical advantages). It is also possible that in high demand campaign sites, some clients slipped through to conventional surgery without being offered information about ShangRing, resulting in underestimation of demand and uptake.

An average of five ShangRing device sizes for adolescent and adult males were used - varying from sizes A4 (40 mm) to Q (20 mm) in this evaluation. Challenges with device stockouts were reported during the pilot study in Tanzania and other earlier ShangRing studies in Uganda and Kenya. This may be a limitation to their use, although experiences with using the ShangRing in China have not suggested that this factor causes problems [8]. This was, however, the most significant logistical challenge experienced during this AAES; thus, we encourage providing a sufficiently large stock of most used device sizes and supplies in the roll out phase.

Also, during this AAES, 53 (5%) clients were switched to device sizes below or above the recommended measurement. An evaluation in Zambia in 2016 that entailed using one-half the number (every other size) of available adult ShangRing device sizes found this approach is sufficient for safe VMMC service delivery. WHO's subsequent amendment of the ShangRing prequalification in March 2019 to include availability and use of every other device size has also deemed this approach sufficient and effective for safe service delivery [17]. In the Tanzania AAES, a two-stage measurement was introduced as part of the device selection process, such that, in addition to the penis measurement that was done during the client screening stage to inform which size device to use, a second measurement was conducted by the surgeon before the procedure to confirm the measurement for selecting the the device size. All the final device size changes were made by the surgeon in the surgery room. In this AAES and the previous pilot study in Tanzania, results showed that none of the reported moderate and severe AEs were related to the switched ring sizes. This may alleviate some of the challenges around the need to stock many different devices sizes [14]. However, once the demand for ShangRing circumcisions in Africa has been established, additional analysis should be undertaken to assess safety of ShangRing device size switching.

LIMITATIONS

Findings reported here are based on 1,077 cases only; analysis and adaptation should be carefully done for further scale-up to track any rare AEs and logistical challenges that might occur. Data collection for this AAES mainly relied on current routine service delivery data collection tools that do not provide room to capture additional ShangRing use information needed (e.g., measured ring size vs. placed size). Service providers were requested to document initial measurements on top of each client card; however, some providers did not document this during screening. This might have introduced recall biases.

Also, additional qualitative information like reasons for choosing or not choosing ShangRing were not documented, which might have provided useful insights on messaging and decisions on prototypes for demand creation. The protocol did not include additional visits beyond day 7 removal, therefore any AEs occurring post-removal may have been missed if the client failed to seek help at the designated ShangRing evaluation facilities. This could result in underestimation of the AE rate.

CONCLUSIONS

Results from this AAES have shown that ShangRing circumcision is feasible and safe for males aged 10 years and above and it may be scaled up to reach large numbers of males through routine health care settings in Tanzania. Handling of ShangRing devices does not require special infrastructure and micro-stores at static sites may serve as suitable storage facilities. However, client demand and supply chain efficiency are considerations in the amount of storage space required for a health facility to offer reliable ShangRing services.

To be able to scale up ShangRing services while adhering to safety protocols, routine VMMC data collection and reporting tools should be updated to include the following additional data elements: (i) Physical examination: ShangRing device size; (ii) Consent information: circumcision technique (surgical or device); (iii) MC procedure: device size, device lot number, types of intraoperative device AEs; (iv) First follow-up: was the device removed on this visit (Yes/No), reason for removal; (v) Second follow-up: comment space to describe whether the client returned for second follow up visit;, and (vi) Post-operative AEs: types of device AEs, description of device AEs.

Furthermore, the AAES identified the need for further exploration to establish safety information for clients requiring early removal by a trained ShangRing provider. Depending on symptoms and the provider's clinical assessment of healing, an early removal may be the right treatment for ShangRing clients. Early removals at days 5 and 6 were labelled as AEs during the pilot and active surveillance because it occurred prior to the standard guidance; however, depending on how fast a client was healing an early removal did not negatively impact the overall circumcision process.

Demand creation messages on ShangRing availability and advantages are key to increase awareness in communities to scale up ShangRing VMMC services for high impact. Further assessment on usage of ShangRing device sizes by age ranges is required to assist programs with accurate quantification and procurement of sufficient stock to avoid wastage.

This AAES supports the registration of ShangRing circumcision by TMDA as a medical device. This will require changes to national training curricula, SOPs, AE classification SOPs, and national VMMC guides to include ShangRing circumcision. The costing element of VMMC in routine setting is yet to be ascertained in the Tanzania setting.

References

1. Auvert, B., Taljaard, D., Lagarde, E., Sobngwi-Tambekou, J., Sitta, R., and Puren, A. (2005). "Randomized, controlled intervention trial of male circumcision for reduction of HIV infection risk: the ANRS 1265 Trial." *PLoS medicine*, 2(11), e298.
2. Bailey, R. C., Moses, S., Parker, C. B., Agot, K., Maclean, I., Krieger, J. N., Williams, C., Campbell, R., and Ndinya-Achola, J. O. (2007). "Male circumcision for HIV prevention in young men in Kisumu, Kenya: a randomised controlled trial." *The Lancet*, 369(9562), 643-656.
3. Gray, R. H., Kigozi, G., Serwadda, D., Makumbi, F., Watya, S., Nalugoda, F., Kiwanuka, N., et al. (2007). "Male circumcision for HIV prevention in men in Rakai, Uganda: a randomised trial." *The Lancet*, 369(9562), 657-666.
4. Farley, T. M., Samuelson, J., Grabowski, M. K., Ameyan, W., Gray, R. H., and Baggaley, R. (2020). "Impact of male circumcision on risk of HIV infection in men in a changing epidemic context–systematic review and meta-analysis." *Journal of the International AIDS Society*, 23(6), e25490.
5. World Health Organization. (2007). New data on male circumcision and HIV prevention: policy and programme implications: WHO.
6. Rehmeyer, C. J. (2011). "Male circumcision and human papillomavirus studies reviewed by infection stage and virus type." *Journal of Osteopathic Medicine*, 111(s32), 11-18.
7. Preventing HIV Through Safe Voluntary Medical Male Circumcision for Adolescent Boys and Men in Generalized HIV Epidemics: Recommendations and Key Considerations. Geneva: World Health Organization; 2020 Aug. 4, Use of Device-Based Method for Male Circumcision in Context of HIV Prevention. https://www.ncbi.nlm.nih.gov/books/NBK562464/
8. Masson, P., Li, P. S., Barone, M. A., and Goldstein, M. (2010). "The ShangRing device for simplified adult circumcision." *Nature Reviews Urology*, 7(11), 638-642.
9. Sokal, D. C., Li, P. S., Zulu, R., Awori, Q. D., Combes, S. L., Simba, R. O., Lee, R., et al. (2014). "Randomized controlled trial of the shang ring versus conventional surgical techniques for adult male circumcision: safety and acceptability." *Journal of Acquired Immune Deficiency Syndromes*, 65(4), 447-455.
10. World Health Organization. (2013). Guideline on the use of devices for adult male circumcision for HIV prevention. World Health Organization.
11. World Health Organization. (2012). Framework for clinical evaluation of devices for male circumcision.
12. World Health Organization. (2015). WHO Prequalification of Male Circumcision Devices Public Report Product: ShangRing; Number: PQMC 0003-003-00. Geneva: World Health Organization.
13. World Health Organization. (2019). Overview of the WHO prequalification of male circumcision devices assessment (No. WHO/MVA/EMP/RHT/PQT/2019.02). World Health Organization.
14. Nyalali,K, N., Simbeye, D., Celestine, V., Mejia, C., Joachim, J., Mbando,S., Mphuru, L., Todd, L., et al. (2021-Unpublished). Evaluation of the acceptability and safety of the ShangRing device for male circumcision in Shinyanga, Tanzania. https://www.intrahealth.or.tz/sites/ihweb/files/attachment-files/2021cdctanzaniashangringevaluationreportapproved.pdf
15. Barone, M. A., Awori, Q. D., Li, P. S., Simba, R. O., Weaver, M. A., Okech, J. O., Aduda, A., et al. (2012). "Randomized trial of the Shang Ring for adult male circumcision with removal at one to three weeks: delayed removal leads to detachment." *Journal of Acquired Immune Deficiency Syndromes*, 60(3), e82-e89.
16. Kigozi, G., Musoke, R., Watya, S., Kighoma, N., Ssebbowa, P., Serwadda, D., Nalugoda, F., et al. (2013). "The acceptability and safety of the Shang Ring for adult male circumcision in Rakai, Uganda." *Journal of Acquired Immune Deficiency Syndromes*, 63(5), 617.

17. Feldblum, P. J., Zulu, R., Linyama, D., Long, S., Nonde, T. J., Lai, J. J., Kashitala, J., et al. (2016). "Randomized controlled trial of the ShangRing for adult medical male circumcision: safety, effectiveness, and acceptability of using 7 versus 14 device sizes." *Journal of Acquired Immune Deficiency Syndromes*, 72(Suppl 1), S30.
18. Awori, Q. D., Lee, R. K., Li, P. S., Moguche, J. N., Ouma, D., Sambai, B., Goldstein, M., and Barone, M. A. (2017). "Use of the ShangRing circumcision device in boys below 18 years old in Kenya: results from a pilot study." *Journal of the International AIDS Society*, 20(1), 21588.
19. Barone, M. A., Li, P. S., Lee, R. K., Ouma, D., Oundo, M., Barasa, M., Oketch, J., et al. (2019). "Simplifying the ShangRing technique for circumcision in boys and men: use of the no-flip technique with randomization to removal at 7 days versus spontaneous detachment." *Asian Journal of Andrology*, 21(4), 324.
20. EngenderHealth, a. W. (2017). Using the ShangRing for male circumcision: An illustrative guide for service providers. New York.
21. Odoyo-June, E., Owuor, N., Kassim, S., Davis, S., Agot, K., Serrem, K., Otieno, G., et al. (2019). "Rollout of ShangRing circumcision with active surveillance for adverse events and monitoring for uptake in Kenya." *Plos One*, 14(9), e0222942.