Review article

INTERNATIONAL JOURNAL OF STD & AIDS

International Journal of STD & AIDS
2018, Vol. 29(14) 1432–1443
© The Author(s) 2018
Article reuse guidelines:
sagepub.com/journals-permissions
DOI: 10.1177/0956462418787896
journals.sagepub.com/home/std
SAGE

# Lessons from a decade of voluntary medical male circumcision implementation and their application to HIV pre-exposure prophylaxis scale up

**Jason B Reed[1], Rupa R Patel[2] and Rachel Baggaley[3]**

**Abstract**

Oral pre-exposure prophylaxis (PrEP) has the ability to curb HIV incidence worldwide and bring us closer to ending the HIV epidemic. Scale up of PrEP service delivery has many similar challenges to those faced by voluntary medical male circumcision (VMMC) services roll-out. This article outlines ten important lessons learned during the scale up of VMMC services in sub-Saharan Africa and their application to current oral PrEP implementation efforts to promote faster expansion for public health impact.

**Keywords**

Male circumcision, oral PrEP, implementation, HIV prevention, antiretrovirals, 90–90–90 targets

Date received: 19 January 2018; accepted: 14 June 2018

## Introduction

Thirty-six years after the identification of HIV,[1,2] the HIV epidemic has resulted in the death of 35 million people.[3] Although a highly-effective vaccine has yet to be developed, the intervening years have seen impressive advances in HIV-related diagnostics and treatment. A person with HIV today can expect to live a relatively normal lifespan if the infection is correctly diagnosed and clinically managed, primarily through treatment with antiretroviral (ARV) medications.[4,5] Early detection and successful treatment has the added benefit of preventing onward transmission of HIV to others, thereby adding to the public health benefits.[6,7]

In 2012, the prevention benefits of ARVs were further expanded when the United States Food and Drug Administration approved the use of specific ARVs, a combination of emtricitabine and tenofovir disoproxil fumarate, as pre-exposure prophylaxis (PrEP) against HIV.[8] Randomized control trials demonstrated oral PrEP to be 85–92% efficacious against HIV acquisition when taken daily,[9–12] while major demonstration projects showed oral PrEP to be 75–90% effective.[13–17] In 2015, the World Health Organization (WHO) recommended that oral PrEP be made available to those at substantial risk of HIV infection.[18,19] The Joint United Nations Programme on HIV/AIDS (UNAIDS) proposed an aspirational target of three million people to be started on oral PrEP by 2020 in order to reach the 2030 goal of an AIDS-free generation.[20] To date, service delivery of oral PrEP has yet to reach the scale to have public health impact in most settings, although PrEP services are now starting in a few countries, for a range of key populations in low- and middle-income settings (e.g. Kenya and South Africa), including among men who have sex with men (MSM) in North America, Europe and Asia.[21–37]

As the world embarks upon the initial stages of PrEP scale up, it is imperative to anticipate and

[1]HIV-Malaria-Infectious Diseases, Jhpiego, Baltimore, MD, USA
[2]Division of Infectious Diseases, Washington University in St. Louis, St Louis, MO, USA
[3]Department of HIV/AIDS, World Health Organization, Geneva, Switzerland

**Corresponding author:**
Rupa R Patel, 660 South Euclid Avenue, Campus Box 8051, St Louis, MO 63110, USA.
Email: rupapatel@wustl.edu

proactively address key programming requirements and challenges. While some learning-by-doing is desirable and inevitable, oral PrEP scale up should look for lessons learned by other prophylactic clinical interventions that have been taken from research to public health scale. We proffer that, among such HIV interventions, the scale up of voluntary medical male circumcision (VMMC), a programme that to date has reached over 15 million out of the ambitious initial target of 20.8 million males circumcised by 2016,[38] has parallels with oral PrEP. The lessons of VMMC scale up can be leveraged to improve both programme efficiencies and safety in PrEP scale up.[39,40]

To begin, a brief comparison and contrast of the two interventions provides important context. VMMC is a one-time intervention that affords a greater than 60% reduction in HIV acquisition risk for heterosexual men.[41–48] The VMMC procedure may be surgical or device based. It is permanent, as is the partial protection afforded. Interaction with the health system is limited, involving three to four appointments for a typical client. In contrast, oral PrEP can provide up to 90% reduction in HIV acquisition risk for both women and men, regardless of sexual orientation, only while the medication is taken as prescribed.[9,10] Thus, an oral PrEP user may interact with the health system repeatedly for many years, whenever they face a period of risk and they choose to take oral PrEP.

At the same time, VMMC and PrEP have much in common. Both interventions serve to keep HIV-uninfected individuals free of HIV; in turn, they do not infect others. Both VMMC and oral PrEP are clinical services provided by trained, licensed health care practitioners, often in resource-constrained settings. Both VMMC and oral PrEP have a strong evidence base supported by WHO and UNAIDS.[18,19,49] Perhaps most importantly, VMMC and oral PrEP can have a public health benefit by curbing the HIV epidemic, but that impact depends upon a high rate of uptake among those most likely to benefit. In other words, scale up among those at greatest risk is crucial for either to reduce HIV incidence.[39,40]

Here we describe the scale up of VMMC and draw parallels with oral PrEP to demonstrate how lessons learned from the former may benefit the latter. These lessons are summarized in Table 1.

## Lesson 1: Establish safety surveillance systems

Like all medical procedures, VMMC involves an inherent level of health risk to the client. While the United States President's Emergency Plan for AIDS Relief (PEPFAR) was quick to suggest definitions for common adverse events (AEs) seen in clinical trials and national programmes around AE monitoring, evaluation and corrective action remained piecemeal throughout early scale up of VMMC programmes.[50] To assist, the College of Surgeons of East, Central and Southern Africa developed a guide to standardize the recognition, grading and clinical management of AEs.[51] Although programmes had guidance on monitoring the common anticipated AEs from clinical trials, little effort was made to distinguish the most consequential AEs or to ensure that transnational surveillance systems were in place to continuously monitor, collate and evaluate the rare but most severe AEs.[52] For example, an association between VMMC and tetanus had not been anticipated. Two cases of tetanus that occurred in 2012 went unnoticed by the global community and, therefore, unrecognized as a potentially serious concern until two years later when WHO uncovered a cluster of tetanus cases in the area of Lake Victoria.[52,53] WHO called upon programmes to systematically report all tetanus cases thereafter. Collaboratively, WHO and PEPFAR instituted mandatory immediate reporting to the global level of all instances of the most substantial AEs (e.g. AEs resulting in death, permanent disability or deformity, or prolonged hospitalization).[54–56] Simultaneously, national VMMC programmes were strongly encouraged by WHO to convene oversight committees to monitor and act upon AEs occurring in their countries, to ensure rapid national awareness of such events as well as to promote client awareness of signs and symptoms that warranted heightened caution.

Although to date they have been more benign, AEs resulting from the use of oral PrEP in demonstration projects and non-research settings have occurred and will continue to occur. Rare and severe AEs associated with oral PrEP, for example, may include new onset renal insufficiency, among others.[10,13,57–67] In addition, some individuals acutely HIV infected immediately before or while taking PrEP develop resistance mutations impacting their subsequent HIV treatment options. Though modelling studies suggest that PrEP use contributes to less than 5% of the total burden of ARV resistance,[68–71] laboratory surveillance activities should monitor for drug resistance among PrEP users who seroconvert so that they may be appropriately clinically managed. Normative agencies must endeavour to issue guidance to national programmes that standardize the recognition, grading and clinical management of PrEP AEs. The most consequential of oral PrEP-related AEs, even hypothesized AEs, should be defined and surveillance systems should be created to ensure mandatory immediate reporting of AEs at the global level, including to drug manufacturers. Every country instituting an oral PrEP programme should

**Table 1.** Summary of the ten key lessons learned during voluntary medical male circumcision scale up with application to oral HIV pre-exposure prophylaxis implementation.

| Lesson | Topic | Lesson learned during VMMC scale up and its application to oral PrEP implementation |
|---|---|---|
| 1 | Establish safety surveillance systems | Normative agencies should institute mandatory immediate reporting at the global level of all instances of the most consequential adverse events related to new HIV interventions and standardize the recognition, grading and clinical management of such adverse events. |
| 2 | Engage communities and encourage government ownership | Before rolling out new HIV prevention services, community opinion leaders must be engaged to ensure buy-in of the intervention. Government ownership of the overall intervention is also critical. |
| 3 | Innovate demand creation activities | Demand creation for consumers of HIV prevention services or products should include plans to target early and late adopters, focus on subpopulations most at risk and involve novel strategies, which use multidisciplinary efforts, such as market research, behavioural economics and human-centred design-based demand creation. |
| 4 | Create service delivery models | A variety of service delivery models, such as school-, community- and mobile clinic-based services, are needed to effectively reach different populations for initial and follow-up services. |
| 5 | Coordinate complex supply chains | There should be regional and national coordination of stakeholders to develop supply chain management systems to ensure an adequate supply of all the essential commodities, including medications and laboratory supplies. |
| 6 | Utilize mathematical models to forecast impact and identify best-placed investments | Mathematical modelling to forecast the epidemiologic and economic impact provides compelling estimates for policymakers around reduced HIV incidence and cost-effectiveness and can help hone programmes to ensure the greatest impact possible. |
| 7 | Plan for sustainable programmes | It is important to develop sustainable HIV prevention programmes with the transition of implementation by external donors to national governments and this effort entails long-term financial and technical planning. |
| 8 | Anticipate technological advances | Newer prevention technologies should be embraced as they become available and current implementation efforts (i.e. both demand- and supply-related efforts) should lay the groundwork to promote more rapid roll-out of mechanisms for overcoming the different challenges that accompany newer technology. |
| 9 | Leverage programmes as gateways to other services | HIV prevention interventions can be the gateway for offering other on-site or off-site comprehensive health services (e.g. harm reduction for intravenous drug users and mental health care services) to both HIV-infected and uninfected individuals. |
| 10 | Coordinate global advocacy | There will need to be coordinated efforts by stakeholder advocates to build consensus around global and regional advocacy and key policy guidance to advance implementation worldwide. |

PrEP: pre-exposure prophylaxis; VMMC: voluntary medical male circumcision.

prioritize convening committees, at both facility and national levels, to continuously review and act upon AEs among oral PrEP users.

VMMC scale up has taught us that, once an intervention is scaled up to reach millions of people, rare and consequential AEs will occur. For oral PrEP it is important to anticipate those events now, provide guidance on their identification and management, institute surveillance systems to monitor and collate findings globally and nationally, and act upon the findings so as to refine global guidance that defines the appropriate measures to characterize those events that may occur and prevent those that may be averted.[57–59,67]

## Lesson 2: Engage communities and encourage government ownership

Following the WHO recommendation of VMMC for HIV prevention in 2007,[72,73] initial progress was slow, and countries differed in their enthusiasm for implementation. Overcoming social and cultural norms in non-circumcising communities and governments taking ownership of their VMMC programmes were hallmarks of early success.[74] In addition, local champions (e.g. parliamentarians in Zimbabwe and traditional leaders in Zambia) have been important in many settings, advocating for VMMC in their communities.[75–77] For PrEP a similar pattern is emerging, with a few countries at the forefront (e.g. Kenya and South Africa), and others showing caution.[21–25]

Engaging opinion leaders within various communities early to ensure their understanding and endorsement of the proposed HIV prevention approach is critical to broadening acceptance.

## Lesson 3: Innovate demand creation activities

Following the initial release of the WHO recommendations for VMMC in 14 African countries, a high level of latent demand[78] kept circumcision clinics fairly busy in the early period of scale up. This led to a false sense of high overall demand for circumcision and, as a result, relatively little effort was devoted to innovative demand creation activities. The early, conventional communication methodologies touted the HIV prevention benefits of VMMC and were focused primarily on likely early adopters.[79] However, as the more easily persuaded individuals were successfully reached with VMMC services, the harder-to-convince individuals remained uncircumcised. As a result, many service providers went underutilized. The Bill and Melinda Gates Foundation was pivotal in promoting and implementing novel methodologies to generate demand for VMMC among consumers, which included bringing together experts in consumer market research, communication, behavioural economics and human-centred design.[80,81]

Scale up of oral PrEP will, likewise, require more than just making services available to communities who will benefit the most. As a case in point, in the United States significant expansion of oral PrEP has taken longer than expected,[21,82] although PrEP use is currently increasing in some states. Among high-risk MSM in Washington State, those who reported ever taking PrEP increased from 5% in 2012 to 31% in 2015.[83] However, uptake of PrEP has been limited among racial and ethnic minority MSM, who often have the highest risk of acquiring HIV.[84] In addition, knowledge about the benefits of PrEP remains very limited in many parts of the world where there are those at substantial risk of HIV infection and would benefit from oral PrEP.[85,86]

VMMC scale up has taught us that it is challenging to engage healthy, HIV-uninfected people, many of whom are young, and encourage them to consider a medical intervention to prevent something that may or may not happen at some future date. Demand creation innovations in the space will be required to create and sustain demand for oral PrEP among the intended subpopulations (i.e. those most at risk of acquiring HIV infection). Market research complemented with innovative methodologies like behavioural economics and human-centred design may be beneficial to reaching harder-to-reach priority populations with sufficiently sophisticated content through messaging channels to drive demand.[80]

## Lesson 4: Create service delivery models

Developing different VMMC service delivery models enabled programmes to reach different subgroups of boys and men. Outreach programmes, whereby VMMC services are brought from the clinic setting directly to the people through mobile, temporary service locations, have reached high numbers.[74,76,87–91] Some service delivery locations have offered after-hours and weekend services to attract older males, rather than adolescents, who might otherwise forego VMMC due to employment considerations. Campaigns during holiday periods have reached younger males during school breaks.[89–91] Likewise, concerted short-term campaigns to boost awareness and intensify services for a limited period have succeeded to reach different populations.[92]

Oral PrEP may differ from VMMC in supply and demand because oral PrEP is likely to be a more integrated service than VMMC and will require longer periods of engagement with health care services. Despite the differences, lessons from VMMC still apply in the context of needing to prioritize and reach often marginalized populations. Therefore, like VMMC, it will be important to plan for creative and innovative oral PrEP service delivery and outreach models, from the start of implementation, to bring PrEP to where the individuals who need it most are.

VMMC has taught us that even a surgical procedure can be safely performed in a tent or retrofitted space, availing services to those otherwise unable or unwilling to access them. Given that oral PrEP is less invasive, service delivery points may be as varied as the populations they serve, provided that follow up for prescription refills is carefully coordinated. Different at-risk populations will likely require bespoke oral PrEP service

delivery models in order to achieve high coverage rates. In addition, concerted short-term campaigns to promote oral PrEP services may help to normalize this prevention intervention, catalyse demand and, thereby, intensify service uptake over a targeted time period.

## Lesson 5: Coordinate complex supply chains

At the outset of VMMC programmes, supply chains had to be built to deliver surgical equipment, other commodities and, in certain cases, clinical infrastructure to some of the most remote sectors of the health system. The advantages and disadvantages of utilizing reusable versus disposable supplies had to be weighed, giving consideration to issues such as the environmental impact of waste management and sustainability. The introduction of oral PrEP and the complementary laboratory testing components also will pose obstacles to supply chain management, particularly where PrEP services are delivered in non-clinical settings. While supply chains for the management of ARVs are widespread, those for laboratory testing commodities (e.g. for creatinine and hepatitis B testing) may not be readily available.[93–95]

VMMC has taught us that it is important to engage with product manufacturers, service delivery organizations and health centres, and governments to ensure that there are regional and national supply chain protocols in place to mitigate commodity stock-outs. In the case of oral PrEP, pharmaceutical companies will also need to be engaged in this process.[93–95]

## Lesson 6: Utilize mathematical models to forecast impact and identify best-placed investments

Mathematical modelling to forecast epidemiologic and economic impact was pivotal in securing political buy-in for VMMC as a priority HIV prevention intervention. Modelling was undertaken not only to show the overall curbing of the epidemic by reaching population saturation, but also, at a more granular level, models estimated the number of VMMC procedures needed to avert a single HIV infection within ten years. In sub-Saharan Africa, this number turned out to be approximately nine.[96] Results were purposefully framed in multiple ways to speak to varied audiences, and thus health policy leaders as well as economists could readily appreciate the substantial benefits of VMMC, not just nationally but also at the community and even facility levels. Following initial modelling results early in the intervention, more refined models helped to hone demand creation and service delivery models to reach individuals who were the most at risk for HIV infection in order to heighten impact and cost efficiencies.[97,98]

In this same way, mathematical modelling is being exploited, and should continue to be, to quantify the epidemiologic and economic impacts of scaling up oral PrEP. For example, recent modelling from Kenya suggests that PrEP adds additional benefit to the current HIV prevention measures employed, especially for MSM.[25,57,96,99–102] In the United States and Europe, where only high-cost, branded PrEP is currently available, PrEP could be cost effective with drug price reductions or use of generics.[103,104] However, modelling studies in the United States also predict a 70% reduction in the number of new HIV infections nationally with the use of oral PrEP and treatment as prevention.[105]

VMMC has taught us that mathematical modelling can forecast future epidemiologic and economic benefits that may affect health policy decisions today. As with VMMC, modelling the impact of PrEP highlights the importance of focusing services in geographic areas and subpopulations that stand to gain the most from PrEP services and ensure sufficient coverage among them to achieve epidemic impact.[99,101,106]

## Lesson 7: Plan for sustainable programmes

Long-term sustainability of any public health programme, VMMC, oral PrEP or others, depends upon purposeful and well-timed transfer of financial and oversight responsibilities from donors to national governments.[38] Institutional capacity building and the integration of VMMC services into routine adolescent and adult service delivery systems should remain a priority.[38,107] Only a few VMMC programmes have reached levels of maturity, by achieving predetermined circumcision coverage targets among older adolescent and adult males, such that long-term sustainability has become a topic of wide interest.[101] Much of the debate on planning for sustainability remains theoretical at this point, with smaller demonstration projects pointing out which sustainability strategies may or may not meet the mark.

For oral PrEP, as services are just beginning in a few countries, planning for the long-term financial and technological trajectory of programmes may better happen in parallel. In this way, questions about sustainable financing and programmatic oversight will not linger as excuses for failing to begin at all.

## Lesson 8: Anticipate technological advances

The lion's share of VMMC procedures performed to date have used conventional surgical methods.

However, medical manufacturers had been developing prototypes of male circumcision devices for adults that could help circumvent surgical programme challenges related to both supply and demand. Following numerous clinical trials and demonstration projects, WHO concluded that male circumcision devices could reduce rates of AEs from conventional surgical methods, offer less invasive and potentially more affordable alternatives, and facilitate greater scale up delivery efforts.[108,109] However, varying degrees of re-engineering of the devices and device-based techniques have been necessary to optimize their safe and efficient use, and ongoing uncertainties and unexpected complications have hindered wide-scale use. Some of the risks and negative consequences of new, alternative methods became known only after relatively large numbers of individuals underwent device-based circumcision (i.e. cases of tetanus), and well after there were large initial financial investments in development and research.[50–53] Early VMMC implementation efforts using older technology has laid the groundwork to implement newer technologies more rapidly when they become available and safety is assured.

Similarly with PrEP, as daily oral options are being introduced and scaled up, the research pipeline is already replete with alternative delivery methods, such as alternative oral preparations and longer-acting injectable formulations, rings and implants.[110–113] These alternatives have the potential to circumvent some of the difficulties with oral, daily formulations, namely uptake and adherence. At the same time, new PrEP delivery systems will almost certainly come with their own challenges, some known already and others yet to be discovered.

VMMC has taught us that continued investments in research and development are necessary to realize maximum benefits, which is true for PrEP alternative delivery systems, as well.[18,19] Implementation of presently available modalities and formulations are crucial to pave the way for newer alternatives. Demand creation messaging and service delivery and supply chain protocols should be adaptable to the newer technologies that lie ahead.

## Lessons 9: Leverage programmes as gateways to other services

In the 14 priority African countries where VMMC programmes have been successfully scaled up, men lag behind their female peers in accessing HIV services (e.g. timely diagnostic testing and treatment); however, VMMC programmes have been remarkably successful in reaching millions of men with HIV testing.[45,114] In general, men seek health care less often and at a later stage than women, with resultant worse health outcomes for HIV, other infections and non-communicable diseases.[115–117] Learning from their success in reaching men, VMMC programmes are now considering how they can broaden and increase their impact from HIV to include other men's health conditions and look at issues such as masculinity and gender-based violence.[38]

Similarly, for maximum impact, oral PrEP services should be integrated with other health and social services (e.g. sexually transmitted infections testing and treatment, hepatitis B and C virus screening and treatment, provision of contraception, harm reduction for injecting drug users, other substance use counselling, and evaluation and treatment for mental and emotional health illness).[118,119] Furthermore, people who seek PrEP services will likely do so because they are at risk for HIV infection, and significant proportions may already be HIV infected; thus, HIV testing conducted prior to starting PrEP can provide an earlier entry point for early diagnosis and immediate linkage of those who test HIV positive to treatment for viral suppression.[4,5]

VMMC has taught us that offering a service within a comprehensive preventative package may extend the health benefits well beyond those of the discrete service itself. Particularly for populations that rarely engage with the health sector, men in general and key populations, both VMMC and PrEP provide unique opportunities for holistic health assessments and treatment or referral for co-morbid conditions.

## Lesson 10: Coordinate global advocacy

The saying that 'there is strength in numbers' is true whether the debate centres on VMMC, oral PrEP or other biomedical interventions. More progress is made when advocates speak in a consistent voice to national policymakers and donors. While the focus on specifics of population prioritization, service delivery models, innovative techniques and funding may, and likely will, wax and wane, progress is predicated on some degree of unison.[120] Ministries of Health, international normative bodies (e.g. WHO and UNAIDS), national normative bodies (e.g. Centers for Disease Control in the United States) and other organizations (e.g. AIDS Vaccine Advocacy Coalition) played key roles in building consensus around global advocacy and key policy guidance on VMMC to encourage partner country governments to adopt and act on the guidance provided. This resulted in the creation of a clearing house with the intent to share information and resources among stakeholders.[121,122] Similar efforts for oral PrEP will be necessary to advance the agenda for implementation worldwide, including engagement with community key populations groups and networks,

such as the Asia Pacific Coalition on Male Sexual Health and others.[123]

## Conclusion

VMMC and PrEP are not one and the same. Different segments of the population can benefit differentially from these two HIV prevention interventions. Also, while VMMC is a one-time intervention with lifelong benefits largely devoid of daily adherence considerations, oral PrEP effectiveness depends upon consistent adherence. Such differences must be appreciated. Nonetheless, as VMMC and oral PrEP are both biomedical interventions intended to attract HIV-uninfected individuals in the common interest of remaining HIV-negative, there are important similarities that should be identified and leveraged as much as possible. Also, both rely upon awareness of HIV status, an aspect whose importance should not be underestimated, given the UNAIDS 90–90–90 strategy.

We have presented ten key lessons learned from over a decade of VMMC implementation efforts, which can be applied to current PrEP initiatives for faster and safer scale up and public health impact. National governments, implementers and community advocates are encouraged to delve into the learning synergies that exist to improve the effective implementation of both programmes.

### Acknowledgements

We would like to thank John Crane for his assistance in preparation of the manuscript and formatting the references.

### Declaration of conflicting interests

The authors declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: RRP receives compensation for consulting from Gilead Sciences and ViiV Healthcare. The other authors declare no competing interests.

### Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

### ORCID iD

Rupa R Patel http://orcid.org/0000-0002-0329-7036

### References

1. Centers for Disease Control and Prevention. Kaposi's sarcoma and pneumocystis pneumonia among homosexual men – New York City and California. *MMWR Morb Mortal Wkly Rep* 1981; 30: 305–308.
2. Centers for Disease Control and Prevention. Pneumocystis pneumonia – Los Angeles. *MMWR Morb Mortal Wkly Rep* 1981; 30: 250–252.
3. Joint United Nations Programme on HIV/AIDS. Fact sheet – latest statistics on the status of the AIDS epidemic, http://www.unaids.org/sites/default/files/media_asset/UNAIDS_FactSheet_en.pdf (2017, accessed 1 November 2017).
4. Ray M, Logan R, Sterne JA, et al. The effect of combined antiretroviral therapy on the overall mortality of HIV-infected individuals. *AIDS* 2010; 24: 123–137.
5. Lifson AR, Grund B, Gardner EM, et al. Improved quality of life with immediate versus deferred initiation of antiretroviral therapy in early asymptomatic HIV infection. *AIDS* 2017; 31: 953–963.
6. Cohen MS, Chen YQ, McCauley M, et al. Prevention of HIV-1 infection with early antiretroviral therapy. *N Engl J Med* 2011; 365: 493–505.
7. Cohen MS, Chen YQ, McCauley M, et al. Antiretroviral therapy for the prevention of HIV-1 transmission. *N Engl J Med* 2016; 375: 830–839.
8. United States Food and Drug Administration. Truvada for PrEP fact sheet: ensuring safe and proper use, https://www.fda.gov/downloads/Drugs/DrugSafety/PostmarketDrugSafetyInformationforPatientsandProviders/UCM312290.pdf (2012, accessed 1 November 2017).
9. Grant RM, Lama JR, Anderson PL, et al. Preexposure chemoprophylaxis for HIV prevention in men who have sex with men. *N Engl J Med* 2010; 363: 2587–2599.
10. Baeten JM, Donnell D, Ndase P, et al. Antiretroviral prophylaxis for HIV prevention in heterosexual men and women. *N Engl J Med* 2012; 367: 399–410.
11. Thigpen MC, Kebaabetswe PM, Paxton LA, et al. Antiretroviral preexposure prophylaxis for heterosexual HIV transmission in Botswana. *N Engl J Med* 2012; 367: 423–434.
12. Van Damme L, Corneli A, Ahmed K, et al. Preexposure prophylaxis for HIV infection among African women. *N Engl J Med* 2012; 367: 411–422.
13. Liu AY, Cohen SE, Vittinghoff E, et al. Preexposure prophylaxis for HIV infection integrated with municipal- and community-based sexual health services. *JAMA Intern Med* 2016; 176: 75–84.
14. Baeten JM, Heffron R, Kidoguchi L, et al. Integrated delivery of antiretroviral treatment and pre-exposure prophylaxis to HIV-1-serodiscordant couples: a prospective implementation study in Kenya and Uganda. *PLoS Med* 2016; 13: e1002099.
15. Wheeler DP, Beauchamp G, Fields S, et al. Correlates for levels of self-reported PrEP adherence among Black men who have sex with men in the 3 U.S. cities. In: International AIDS conference, Durban, South Africa, 18–22 July 2016.
16. Hosek SG, Landovitz RJ, Kapogiannis B, et al. Safety and feasibility of antiretroviral preexposure prophylaxis for adolescent men who have sex with men aged 15 to 17 years in the United States. *JAMA Pediatr* 2017; 74: 21–29.
17. Haberer JE, Kidoguchi L, Heffron R, et al. Alignment of adherence and risk for HIV acquisition in a demonstration project of pre-exposure prophylaxis among

HIV serodiscordant couples in Kenya and Uganda: a prospective analysis of prevention-effective adherence. *J Int AIDS Soc* 2017; 20: 21842.
18. World Health Organization. Guideline on when to start antiretroviral therapy and pre-exposure prophylaxis for HIV, http://apps.who.int/iris/bitstream/10665/186275/1/9789241509565_eng.pdf?ua=1 (2015, accessed 1 November 2017).
19. World Health Organization. Consolidated guidelines on HIV prevention, diagnosis, treatment and care for key populations, http://apps.who.int/iris/bitstream/10665/246200/1/9789241511124-eng.pdf?ua=1 (2016, accessed 1 November 2017).
20. Joint United Nations Programme on HIV/AIDS. On the fast-track to end AIDS, http://www.unaids.org/sites/default/files/media_asset/20151027_UNAIDS_PCB37_15_18_EN_rev1.pdf (2015, accessed 1 November 2017).
21. Mayer KH, Hosek S, Cohen S, et al. Antiretroviral pre-exposure prophylaxis implementation in the United States: a work in progress. *J Int AIDS Soc* 2015; 18: 19980.
22. Celum CL, Delany-Moretlwe S, McConnell M, et al. Rethinking HIV prevention to prepare for oral PrEP implementation for young African women. *J Int AIDS Soc* 2015; 18: 20227.
23. Venter WD, Cowan F, Black V, et al. Pre-exposure prophylaxis in Southern Africa: feasible or not? *J Int AIDS Soc* 2015; 18: 19979.
24. Veloso VG, Mesquita F and Grinsztejn B. Pre-exposure prophylaxis for men and transgender women who have sex with men in Brazil: opportunities and challenges. *J Int AIDS Soc* 2015; 18: 20010.
25. Cowan FM, Delany-Moretlwe S, Sanders EJ, et al. PrEP implementation research in Africa: what is new? *J Int AIDS Soc* 2016; 19: 21101.
26. Zablotska I, Grulich AE, Phanuphak N, et al. PrEP implementation in the Asia-Pacific region: opportunities, implementation and barriers. *J Int AIDS Soc* 2016; 19: 21119.
27. AIDS Vaccine Advocacy Coalition. National policies and guidelines, https://www.prepwatch.org/prep-resources/national-policies-guidelines/ (2017, accessed 1 November 2017).
28. Centers for Disease Control and Prevention. Preexposure prophylaxis for the prevention of HIV infection in the United States – 2014: a clinical practice guideline, https://www.cdc.gov/hiv/pdf/PrEPguidelines2014.pdf (2014, accessed 1 November 2017).
29. Colby D, Srithanaviboonchai K, Vanichseni S, et al. HIV pre-exposure prophylaxis and health and community systems in the Global South: Thailand case study. *J Int AIDS Soc* 2015; 18: 19953.
30. National AIDS & STI Control Programme. Guidelines on use of antiretroviral drugs for treating and preventing HIV infections in Kenya, http://www.faces-kenya.org/wp-content/uploads/2016/07/Guidelines-on-Use-of-Antiretroviral-Drugs-for-Treating-and-Preventing-HI....pdf (2016, accessed 1 November 2017).
31. Bekker L-G, Rebe K, Venter F, et al. Southern African guidelines on the safe use of pre-exposure prophylaxis in persons at risk of acquiring HIV-1 infection. *S Afr J HIV Med* 2016; 17: 455.
32. Republic of South Africa, National Department of Health. Guidelines for expanding combination prevention and treatment options: oral pre-exposure prophylaxis (PrEP) and test and treat (T&T), http://www.nicd.ac.za/assets/files/PrEP%20and%20TT%20Guidelines%20-%20Final%20Draft%20-%2011%20May%202016.pdf (2016, accessed 1 November 2017).
33. Republic of Uganda, Ministry of Health. Consolidated guidelines for prevention and treatment of HIV in Uganda, http://library.health.go.ug/publications/service-delivery-diseases-control-prevention-communicable-diseases/hivaids/consolidated (2016, accessed 1 November 2017).
34. Republic of Botswana, Ministry of Health. Handbook of the Botswana 2016 integrated HIV clinical care guidelines, http://www.moh.gov.bw/Publications/Handbook_HIV_treatment_guidelines.pdf (2016, accessed 1 November 2017).
35. Republic of Zambia, Ministry of Health. Zambia consolidated guidelines for treatment and prevention of HIV infection, https://aidsfree.usaid.gov/sites/default/files/zambia_hiv_gl2016.pdf (2016, accessed 1 November 2017).
36. Australian Government, Ministry of Health. Pre-exposure prophylaxis of HIV with antiretroviral medications,http://www1.health.nsw.gov.au/pds/ActivePDSDocuments /GL2016_011.pdf (2016, accessed 1 November 2017).
37. National Health Services of Scotland, Scottish Medicines Consortium. Advice SMC No. (1225/17), https://www.scottishmedicines.org.uk/files/advice/emtricitabine_tenofovir_disoproxil_Truvada_FINAL_March_2017_for_website.pdf (2017, accessed 1 November 2017).
38. World Health Organization, Joint United Nations Programme on HIV/AIDS. A framework for voluntary medical male circumcision: VMMC 2021, http://apps.who.int/iris/bitstream/10665/246234/1/WHO-HIV-2016.17-eng.pdf?ua=1 (2016, accessed 1 November 2017).
39. Ledikwe JH, Nyanga RO, Hagon J, et al. Scaling-up voluntary medical male circumcision – what have we learned? *HIV AIDS* 2014; 6: 139–146.
40. Njeuhmeli E, Hatzold K, Gold E, et al. Lessons learned from scale-up of voluntary medical male circumcision focusing on adolescents: benefits, challenges, and potential opportunities for linkages with adolescent HIV, sexual, and reproductive health services. *J Acquir Immune Defic Syndr* 2014; 66: S193–S199.
41. Auvert B, Taljaard D, Lagarde E, et al. Randomized, controlled intervention trial of male circumcision for reduction of HIV infection risk: the ANRS 1265 trial. *PLoS Med* 2005; 2: e298.
42. Bailey RC, Moses S, Parker CB, et al. Male circumcision for HIV prevention in young men in Kisumu, Kenya: a randomised controlled trial. *Lancet* 2007; 369: 643–656.

43. Gray RH, Kigozi G, Serwadda D, et al. Male circumcision for HIV prevention in men in Rakai, Uganda: a randomised trial. *Lancet* 2007; 369: 657–666.
44. Gray R, Kigozi G, Kong X, et al. The effectiveness of male circumcision for HIV prevention and effects on risk behaviors in a posttrial follow-up study. *AIDS* 2012; 26: 609–615.
45. Mehta SD, Moses S, Agot K, et al. The long-term efficacy of medical male circumcision against HIV acquisition. *AIDS* 2013; 27: 2899–2907.
46. Auvert B, Taljaard D, Rech D, et al. Association of the ANRS-12126 male circumcision project with HIV levels among men in a South African township: evaluation of effectiveness using cross-sectional surveys. *PLoS Med* 2013; 10: e1001509.
47. Kong X, Kigozi G, Ssekasanvu J, et al. Association of medical male circumcision and antiretroviral therapy scale-up with community HIV incidence in Rakai, Uganda. *JAMA* 2016; 316: 182–190.
48. Grabowski MK, Serwadda DM, Gray RH, et al. HIV prevention efforts and incidence of HIV in Uganda. *N Engl J Med* 2017; 377: 2154–2166.
49. Joint United Nations Programme on HIV/AIDS, World Health Organization, AIDS vaccine advocacy coalition. Oral pre-exposure prophylaxis: putting a new choice in context, http://www.unaids.org/sites/default/files/media_asset/UNAIDS_JC2764_en.pdf (2015, accessed 1 November 2017).
50. United States President's Emergency Plan for AIDS Relief. PEPFAR's best practices for voluntary medical male circumcision site operations: a service guide for site operations, https://www.usaid.gov/sites/default/files/documents/1864/pepfar_best_practice_for_vmmc_site_operations.pdf (2013, accessed 1 November 2017).
51. Population Services International, College of Surgeons of East, Central and Southern Africa. Adverse events action guide: for voluntary medical male circumcision by surgery, https://www.malecircumcision.org/resource-bundle/adverse-event-guide (2014, accessed 1 November 2017).
52. Dalal S, Samuelson J, Reed J, et al. Tetanus disease and deaths in men reveal need for vaccination. *Bull World Health Organ* 2016; 94: 613–621.
53. World Health Organization, Joint United Nations Programme on HIV/AIDS. A guide to indicators for male circumcision programmes in the formal health care system, http://apps.who.int/iris/bitstream/10665/44142/1/9789241598262_eng.pdf (2009, accessed 1 November 2017).
54. Grund JM, Toledo C, Davis SM, et al. Notes from the field: tetanus cases after voluntary medical male circumcision for HIV prevention – Eastern and Southern Africa, 2012–2015. *MMWR Morb Mortal Wkly Rep* 2016; 65: 36–37.
55. World Health Organization. WHO informational consultation on tetanus and voluntary medical male circumcision, http://www.who.int/hiv/pub/malecircumcision/tetanus-male-circumcision/en/ (2015, accessed 1 November 2017).
56. World Health Organization. Tetanus and voluntary medical male circumcision: risk according to circumcision method and risk mitigation, http://apps.who.int/iris/bitstream/10665/181812/1/9789241509237_eng.pdf?ua=1&ua=1 (2016, accessed 1 November 2017).
57. McCormack S, Dunn DT, Desai M, et al. Pre-exposure prophylaxis to prevent the acquisition of HIV-1 infection (PROUD): effectiveness results from the pilot phase of a pragmatic open-label randomised trial. *Lancet* 2016; 387: 53–60.
58. Defechereux PA, Mehrotra M, Liu AY, et al. Depression and oral FTC/TDF pre-exposure prophylaxis (PrEP) among men and transgender women who have sex with men (MSM/TGW). *AIDS Behav* 2016; 20: 1478–1488.
59. Fonner VA, Dalglish SL, Kennedy CE, et al. Effectiveness and safety of oral HIV preexposure prophylaxis for all populations. *AIDS* 2016; 30: 1973–1983.
60. Velloza J, Celum C, Haberer JE, et al. Depression and ART initiation among HIV serodiscordant couples in Kenya and Uganda. *AIDS Behav* 2017; 21: 2509–2518.
61. Hoornenborg E, Achterbergh RCA, Schim van der Loeff MF, et al. MSM starting preexposure prophylaxis are at risk of hepatitis C virus infection. *AIDS* 2017; 31: 1603–1610.
62. Tang EC, Vittinghoff E, Anderson PL, et al. Changes in kidney function associated with daily tenofovir disoproxil fumarate/emtricitabine for HIV preexposure prophylaxis use in the United States demonstration project. *J Acquir Immune Defic Syndr* 2018; 77: 193–198.
63. Krakower DS and Mayer KH. Renal function and tenofovir disoproxil fumarate for preexposure prophylaxis: how safe is safe enough? *J Infect Dis* 2016; 214: 983–985.
64. Gandhi M, Glidden DV, Mayer K, et al. Association of age, baseline kidney function, and medication exposure with declines in creatinine clearance on pre-exposure prophylaxis: an observational cohort study. *Lancet HIV* 2016; 3: e521–e528.
65. World Health Organization. WHO implementation tool for pre-exposure prophylaxis (PrEP) of HIV infection, module 10: testing providers, http://apps.who.int/iris/bitstream/10665/258516/1/WHO-HIV-2017.30-eng.pdf?ua=1 (2017, accessed 1 November 2017).
66. Liu AY, Vittinghoff E, Sellmeyer DE, et al. Bone mineral density in HIV-negative men participating in a tenofovir pre-exposure prophylaxis randomized clinical trial in San Francisco. *PLoS One* 2011; 6: e23688.
67. Plosker GL. Emtricitabine/tenofovir disoproxil fumarate: a review of its use in HIV-1 pre-exposure prophylaxis. *Drugs* 2013; 73: 279–291.
68. World Health Organization. WHO Implementation tool for pre-exposure prophylaxis (PrEP) of HIV infection. Module 2: community educators and advocates, http://apps.who.int/iris/bitstream/handle/10665/258507/WHO-HIV-2017.24eng.pdf?sequence=1 (2017, accessed 18 April 2018).
69. Abbas UL, Glaubius R, Mubayi A, et al. Antiretroviral therapy and pre-exposure prophylaxis: combined

impact on HIV transmission and drug resistance in South Africa. *J Infect Dis* 2013; 208: 224–234.
70. Abbas UL, Glaubius R, Hood G, et al. Antiretroviral treatment, preexposure prophylaxis, and drug resistance in sub-Saharan Africa: a consensus among mathematical models. *J Infect Dis* 2014; 209: 164–166.
71. van de Vijver DA, Nichols BE, Abbas UL, et al. Preexposure prophylaxis will have a limited impact on HIV-1 drug resistance in sub-Saharan Africa: a comparison of mathematical models. *AIDS* 2013; 27: 2943–2951.
72. World Health Organization. Male circumcision quality assurance: a guide to enhancing the safety and quality of services, http://www.who.int/hiv/pub/malecircumcision/who_hiv_mc_q_assurance.pdf (2006, accessed 1 November 2017).
73. World Health Organization, Joint United Nations Programme on HIV/AIDS. New data on male circumcision and HIV prevention: policy and programme implications, http://apps.who.int/iris/bitstream/10665/43751/1/9789241595988_eng.pdf (2007, accessed 1 November 2017).
74. Mwandi Z, Murphy A, Reed J, et al. Voluntary medical male circumcision: translating research into the rapid expansion of services in Kenya, 2008–2011. *PLoS Med* 2011; 8: e1001130.
75. Government of Zimbabwe. Extended Zimbabwe National HIV and AIDS Strategic Plan (ZNASP) 2015–2020, http://procurement-notices.undp.org/view_file.cfm?doc_id=114051 (2015, accessed 1 November 2017).
76. Ashengo TA, Hatzold K, Mahler H, et al. Voluntary medical male circumcision (VMMC) in Tanzania and Zimbabwe: service delivery intensity and modality and their influence on the age of clients. *PLoS One* 2014; 9: e83642.
77. Sgaier SK, Baer J, Rutz DC, et al. Toward a systematic approach to generating demand for voluntary medical male circumcision: insights and results from field studies. *Glob Health Sci Pract* 2015; 3: 209–229.
78. Bertrand JT, Njeuhmeli E, Forsythe S, et al. Voluntary medical male circumcision: a qualitative study exploring the challenges of costing demand creation in eastern and southern Africa. *PLoS One* 2011; 6: e27562.
79. Rogers EM. *Diffusion of innovations*. 5th ed. New York: Free Press, 2003.
80. Matheson GO, Pacione C, Shultz RK, et al. Leveraging human-centered design in chronic disease prevention. *Am J Prev Med* 2015; 48: 472–479.
81. Joint United Nations Programme on HIV/AIDS. Using market research for long-term sustainability of VMMC in Zimbabwe and Zambia, http://www.unaids.org/en/resources/presscentre/featurestories/2016/october/20161019_VMMC (2016, accessed 1 November 2017).
82. Eaton LA, Matthews DD, Driffin DD, et al. A multi-US city assessment of awareness and uptake of pre-exposure prophylaxis (PrEP) for HIV prevention among Black men and transgender women who have sex with men. *Prev Sci* 2017; 18: 505–516.
83. Hood JE, Buskin SE, Dombrowski JC, et al. Dramatic increase in pre-exposure prophylaxis use among men who have sex with men in King County, Washington: erratum. *AIDS* 2016; 30: 1689.
84. Cahill S, Taylor SW, Elsesser SA, et al. Stigma, medical mistrust, and perceived racism may affect PrEP awareness and uptake in black compared to white gay and bisexual men in Jackson, Mississippi and Boston, Massachusetts. *AIDS Care* 2017; 29: 1351–1358.
85. Smith DK, Mendoza MC, Stryker JE, et al. PrEP awareness and attitudes in a national survey of primary care clinicians in the United States, 2009–2015. *PLoS One* 2016; 11: e0156592.
86. Blumenthal J, Jain S, Krakower D, et al. Knowledge is power! Increased provider knowledge scores regarding pre-exposure prophylaxis (PrEP) are associated with higher rates of PrEP prescription and future intent to prescribe PrEP. *AIDS Behav* 2015; 19: 802–810.
87. Mahler H, Searle S, Plotkin M, et al. Covering the last kilometer: using GIS to scale-up voluntary medical male circumcision services in Iringa and Njombe regions, Tanzania. *Glob Health Sci Pract* 2015; 3: 503–515.
88. Curran K, Njeuhmeli E, Mirelman A, et al. Voluntary medical male circumcision: strategies for meeting the human resource needs of scale-up in southern and eastern Africa. *PLoS Med* 2011; 8: e1001129.
89. Montague C, Ngcobo N, Mahlase G, et al. Implementation of adolescent-friendly voluntary medical male circumcision using a school based recruitment program in rural KwaZulu-Natal, South Africa. *PLoS One* 2014; 9: e96468.
90. Kaufman ZA, DeCelles J, Bhauti K, et al. A sport-based intervention to increase uptake of voluntary medical male circumcision among adolescent male students: results from the MCUTS 2 cluster-randomized trial in Bulawayo, Zimbabwe. *J Acquir Immune Defic Syndr* 2016; 72: S292–S298.
91. George G, Govender K, Beckett S, et al. Factors associated with the take-up of voluntary medical male circumcision amongst learners in rural KwaZulu-Natal. *Afr J AIDS Res* 2017; 16: 251–256.
92. Wambura M, Mahler H, Grund JM, et al. Increasing voluntary medical male circumcision uptake among adult men in Tanzania. *AIDS* 2017; 31: 1025–1034.
93. Supply Chain Management System. Voluntary medical male circumcision: a guide to safer health care waste management practices, https://www.ghsupplychain.org/sites/default/files/2017-02/scms_vmmc_wasteguide.pdf (2016, accessed 1 November 2017).
94. Edgil D, Stankard P, Forsythe S, et al. Voluntary medical male circumcision: logistics, commodities, and waste management requirements for scale-up of services. *PLoS Med* 2011; 8: e1001128.
95. Supply Chain Management System. Voluntary medical male circumcision kits: the journey so far and the path ahead, https://www.ghsupplychain.org/sites/default/files/2017-03/17Summit_VMMCKits.pdf (2017, accessed 1 November 2017).

96. Njeuhmeli E, Forsythe S, Reed J, et al. Voluntary medical male circumcision: modeling the impact and cost of expanding male circumcision for HIV prevention in eastern and southern Africa. *PLoS Med* 2011; 8: e1001132.
97. Kripke K, Opuni M, Schnure M, et al. Age targeting of voluntary medical male circumcision programs using the decision makers' program planning toolkit (DMPPT) 2.0. *PLoS One* 2016; 11: e0156909.
98. World Health Organization. Models to inform fast tracking voluntary medical male circumcision in HIV combination prevention: report from World Health Organization and UNAIDS meeting, 23–24 March 2016, http://apps.who.int/iris/bitstream/handle/10665/259706/WHO-HIV-2017.39-eng.pdf;jsessionid=BD6A9527F5D7990F4EA5FBB37F1CB64C?sequence=1 (2017, accessed 18 April 2018).
99. Walensky RP, Park J-E, Wood R, et al. The cost-effectiveness of pre-exposure prophylaxis for HIV infection in South African women. *Clin Infect Dis* 2012; 54: 1504–1513.
100. Mugo NR, Ngure K, Kiragu M, et al. The preexposure prophylaxis revolution; from clinical trials to programmatic implementation. *Curr Opin HIV AIDS* 2016; 11: 80–86.
101. Alsallaq RA, Buttolph J, Cleland CM, et al. The potential impact and cost of focusing HIV prevention on young women and men: a modeling analysis in Western Kenya. *PLoS One* 2017; 12: e0175447.
102. Cremin I, McKinnon L, Kimani J, et al. PrEP for key populations in combination HIV prevention in Nairobi: a mathematical modelling study. *Lancet HIV* 2017; 4: e214–e222.
103. McKenney J, Chen A, Hoover KW, et al. Optimal costs of HIV pre-exposure prophylaxis for men who have sex with men. *PLoS One* 2017; 12: e0178170.
104. Nichols BE, Boucher CAB, van der Valk M, et al. Cost-effectiveness analysis of pre-exposure prophylaxis for HIV-1 prevention in the Netherlands: a mathematical modelling study. *Lancet Infect Dis* 2016; 16: 1423–1429.
105. Yaylali E, Farnham P, Jacobson E, et al. Impact of improving HIV care and treatment and initiating PrEP in the United States, 2015–2020. In: *Conference on retroviruses and opportunistic infections*, Boston, MA, USA, 22–25 February 2016.
106. Cremin I, Morales F, Jewell BL, et al. Seasonal PrEP for partners of migrant miners in Southern Mozambique: a highly focused PrEP intervention. *J Int AIDS Soc* 2015; 18: 19946.
107. Njeuhmeli E, Gorgens M, Gold E, et al. Scaling up and sustaining voluntary medical male circumcision: maintaining HIV prevention benefits. *Glob Health Sci Pract* 2016; 4: S9–S17.
108. World Health Organization. Use of devices for adult male circumcision for HIV prevention in East and Southern Africa, http://apps.who.int/iris/bitstream/10665/112737/1/9789241507165_eng.pdf?ua=1&ua=1 (2013, accessed 1 November 2017).
109. World Health Organization. WHO Technical Advisory Group on innovations in male circumcision: meeting reports, 30 September–2 October 2014, http://apps.who.int/iris/bitstream/handle/10665/171780/9789241508803_eng.pdf?sequence=1 (2015, accessed 18 April 2018).
110. Nel A, Van Niekerk N, Kapiga S, et al. Safety and efficacy of a dapivirine vaginal ring for HIV prevention in women. *N Engl J Med* 2016; 375: 2133–2143.
111. Baeten JM, Palanee-Phillips T, Brown ER, et al. Use of a vaginal ring containing dapivirine for HIV-1 prevention in women. *N Engl J Med* 2016; 375: 2121–2132.
112. HIV Prevention Trials Network. HPTN 083: a phase 2b/3 double blind safety and efficacy study of injectable cabotegravir compared to daily oral tenofovir disoproxil fumarate/emtricitabine (TDF/FTC), for pre-exposure prophylaxis in HIV-uninfected cisgender men and transgender women who have sex with men, https://www.hptn.org/research/studies/hptn083 (2017, accessed 1 November 2017).
113. Gunawardana M, Remedios-Chan M, Miller CS, et al. Pharmacokinetics of long-acting tenofovir alafenamide (GS-7340) subdermal implant for HIV prophylaxis. *Antimicrob Agents Chemother* 2015; 59: 3913–3919.
114. World Health Organization, Joint United Nations Programme on HIV/AIDS. Joint strategic action framework to accelerate the scale-up of voluntary medical male circumcision for HIV prevention in Eastern and Southern Africa: 2012–2016, http://files.unaids.org/en/media/unaids/contentassets/documents/unaidspublication/2011/JC2251_Action_Framework_circumcision_en.pdf (2011, accessed 1 November 2017).
115. Braitstein P, Boulle A, Nash D, et al. Gender and the use of antiretroviral treatment in resource-constrained settings: findings from a multicenter collaboration. *J Womens Health* 2008; 17: 47–55.
116. Ochieng-Ooko V, Ochieng D, Sidle JE, et al. Influence of gender on loss to follow-up in a large HIV treatment programme in Western Kenya. *Bull World Health Organ* 2010; 88: 681–688.
117. Mberu B, Wamukoya M, Oti S, et al. Trends in causes of adult deaths among the urban poor: evidence from Nairobi urban health and demographic surveillance system, 2003–2012. *J Urban Health* 2015; 92: 422–445.
118. Mayer KH, Chan PA, Patel RR, et al. Evolving models and ongoing challenges for HIV pre-exposure prophylaxis implementation in the United States. *J Acquir Immune Defic Syndr* 2018; 77: 119–127.
119. Calabrese SK, Krakower DS and Mayer KH. Integrating HIV preexposure prophylaxis (PrEP) into routine preventive health care to avoid exacerbating disparities. *Am J Public Health* 2017; 107: 1883–1889.
120. Glassman A, Chalkidou K, Giedion U, et al. Priority-setting institutions in health: recommendations from a center for global development working group. *Glob Heart* 2012; 7: 13–34.

121. AIDS Vaccine Advocacy Coalition. PrEPWatch, https://www.prepwatch.org/ (2017, accessed 1 November 2017).
122. Family Health International 360, World Health Organization, Joint United Nations Programme on HIV/AIDS, et al. Expanding global access to information and resources on male circumcision for HIV prevention, https://www.malecircumcision.org/ (2016, accessed 1 November 2017).
123. Asia Pacific Coalition on Male Sexual Health. APCOM, https://apcom.org/ (2017, accessed 1 November 2017).