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*Jessica Justman
Allison Goldberg
Jason Reed
Naomi Bock
Emmanuel Njeuhmeli
Anne Goldzier Thomas*



Naval Health Research Center

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*Naval Health Research Center
P.O. BOX 85122
San Diego, California 92186-5122*

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Jessica Justman, MD,*† Allison Goldberg, MPhil,† Jason Reed, MD, MPH,‡ Naomi Bock, MD,§ Emmanuel Njehumeli, MD, MPH, MBA,|| and Anne Goldzier Thomas, PhD¶

Abstract: Voluntary medical male circumcision (VMMC) is a cost-effective HIV-prevention intervention that reduces the risk of HIV acquisition in men by 60%. Although some countries are successfully scaling up VMMC, not all are doing this. When VMMC scale-up experiences are viewed in the context of models for the diffusion of innovation, some important themes emerge. Successful VMMC programs have in common locally led campaigns, a cultural tolerance of VMMC, strong political leadership and coordination, and adequate human and material resources. Challenges with VMMC scale-up have been marked by less flexible implementation models that seek a full-integration of VMMC services at public medical facilities and by struggles to achieve geographic parity in access to care. Innovation diffusion models, especially the endogenous technology model, and multiple levels of influence on diffusion—individual males and their sex partners, communities, and health systems—remind us that the adoption of a prevention intervention, such as VMMC, is expected to start out slowly and, as information spreads, gradually speed up. In addition, the diffusion models suggest that customizing approaches to different populations is likely to accelerate VMMC scale-up and help achieve a long-term, sustainable impact on the HIV epidemic.

Key Words: male circumcision, global scale-up, diffusion of innovation models

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As approaches to improving public health move along the discovery “pipeline,” evolving from investigational concepts to evidence-based, effective interventions, the challenge of implementing these interventions on a large scale has often turned out to be quite daunting. Certainly, this has been the case with family planning interventions,¹ and the hepatitis B,²

and polio vaccines.^{3,4} HIV-prevention interventions are now progressing along this pipeline, and the implementation challenges are again underscoring the presence of the gap between evidence and application.

Male circumcision, the oldest and most common surgical procedure performed on newborns and young boys for non-medical reasons, was first proposed as an HIV-prevention intervention for men over a decade ago, based on observational data.⁵ There are several plausible biologic reasons as to why the removal of the foreskin would reduce the risk of HIV acquisition among men. The foreskin has a tendency to develop epithelial disruptions, or tears, during intercourse, which may allow HIV a portal of entry, and compared with the tissue of the outer foreskin, the foreskin’s HIV target cells (Langerhans cells with CD4 receptors) are closer to the epithelial surface.^{6,7} By 2007, three randomized controlled trials conducted among young HIV-uninfected men in Africa demonstrated that voluntary medical male circumcision (VMMC) reduces the risk of HIV infection for men by 53%–60%,^{8–10} and additional studies have found that VMMC offers durable protection, with prevention benefits documented 5 years after VMMC,¹¹ and is cost saving.¹²

In response to these findings, in 2007, the World Health Organization (WHO) and the Joint United Nations Program on HIV/AIDS (UNAIDS) published recommendations supporting VMMC for HIV prevention in 13 priority countries,⁵ all in sub-Saharan Africa, with generalized HIV epidemics and low MC prevalence. Because the impact of the VMMC at the population level is thought to depend on a combination of prevailing MC and HIV prevalence rates and major modes of transmission, the WHO/UNAIDS recommendations did not endorse VMMC as an approach to HIV prevention in countries such as the United States, China, or India.

Despite the scientific evidence and the formal recommendations by WHO/UNAIDS, efforts to scale up VMMC in the priority countries have yielded mixed results,¹³ which can be attributed, in part, to the limited supply of health care resources needed for VMMC. The recognition of this shortage has spurred the development of new MC devices which require minimal or no surgery, such as the Shang Ring and PrePex, and new efficiencies, such as the WHO-recommended MOVE model,¹⁴ which increases productivity through task sharing, task shifting, diathermy for hemostasis, and prepackaged surgical instruments. Beyond supply issues, however, demand for VMMC services by sexually active men in many of the priority countries has been low, and it is unlikely that the devices alone will solve all the demand creation challenges.

From the *ICAP-Columbia, Columbia University, New York, NY; †Mailman School of Public Health, Columbia University, New York, NY; ‡Office of the US Global AIDS Coordinator, Washington, DC; §Centers for Disease Control and Prevention (CDC), Division of Global HIV/AIDS, Center for Global Health, Atlanta, GA; ||US Agency for International Development (USAID)/Global Health Bureau/Office of HIV/AIDS, Washington, DC; and ¶Naval Health Research Center, San Diego, CA.

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Correspondence to: Jessica Justman, MD, ICAP-Columbia, Mailman School of Public Health, Associate Professor of Clinical Medicine in Epidemiology, Columbia University, 722 West 168th Street, Room 1315, New York, NY 10032 (e-mail: jj2158@columbia.edu).

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Models explaining the diffusion, or adoption, of new technologies may prove to be useful in understanding the factors that contribute to the successes and challenges of accelerating the uptake of VMMC in priority countries. These models, based on the theory of innovation diffusion, largely stem from the work of Rogers¹⁵ who looked at how new technology or new consumer products, such as hybrid seeds or cell phones,¹⁶ are adopted across different populations and cultures. The basic concept is that as new technology is introduced, innovators and early adopters, who are willing to take a risk, try out the new technology. Word spreads about who used the new technology and their experience with it and more people take it up until the local population is saturated. Rogers' epidemic or logistic model¹⁵ is often represented as a symmetric S-shape adoption curve to indicate the initial slow rate of adoption, followed by a rapid rate, and then a slow rate of adoption again, as the new technology matures, the population is saturated and other technologies are introduced into the environment.

Other innovation diffusion models incorporate external sources of information that may influence acceptability,¹⁷ and the heterogeneity of the population^{18,19} into the understanding of diffusion and therefore may go further in bridging the gap between research and implementation. For example, the new product growth model incorporates the idea of external sources of information, such as mass media, by categorizing a population into 2 groups: innovators—those who adopt the new technology after learning about it from exogenous information, and imitators—those who learn directly about the new technology from early adopters. A third model, the endogenous technology choice model,²⁰ goes another step beyond the new product growth model in that it assumes that people in different circumstances make different choices about new technology based on individual preferences. For example, in theory, circumstances such as local customs or community beliefs may make one method of HIV prevention more appealing than another, but in practice, several competing factors may impact choices, as in the scale-up of VMMC.

MC SUCCESSES: CAMPAIGNS, CULTURE, AND POLITICAL LEADERSHIP

A number of countries have used campaigns to create high demand and expand access to services for a defined, short period of time. For example, in Kenya, the government launched the Rapid Results Initiatives, a series of public and clinical health campaigns for several interventions, including a VMMC Rapid Results Initiative in both 2009 and 2010, which resulted in approximately 85,000 VMMCs.^{13,21} In Tanzania, VMMC services have been successfully offered through a series of local campaigns,²² including highly mobile campaigns to remote Lake Victoria islands, where HIV prevalence is higher than that in neighboring regions.²³ Because these remote islands lack health facilities, motor boats bring tents and equipment and staff who then offer MC services.

In both Kenya and Tanzania, where tribal MC is common, VMMC is a concept that has cultural familiarity. For example, young Masai men between the ages of 15 and

20 years undergo circumcision as part of a tribal ceremony marking the coming of age. Over a year ago, Kenya achieved over one-third of its target of 860,000 VMMC procedures,⁶ well ahead of other priority countries. This success may reflect the cultural acceptance and almost universal coverage of MC among certain populations, like the Maasai,²⁴ and the Ministry of Health's (MOH's) efforts to engage traditional leaders in the Luo community to embrace MC as both a traditional practice and a public health intervention.

Political leadership has also been another key ingredient in the expansion of VMMC. In Rwanda, strong leadership by the MOH and the Ministry of Defense and a commitment to forge ahead with new devices have led to approximately 5,700 VMMC procedures performed with PrePEX, the nonsurgical device mentioned above.²⁵ In Zambia, where the majority of men are not circumcised, leadership and coordination by the MOH, for example, through its "Country Operational Plan for the Scale-Up of Male Circumcision" document,²⁶ and engagement at the district level during the development of the operational plan may well have contributed to the success of a recent MC campaign, with >60,000 procedures performed in both standing facilities and at mobile sites in August and September 2012.²⁷ South Africa and Uganda's MC programs started only recently but are now rapidly accelerating. South Africa stands out for the contribution of substantial national treasury funds specifically for VMMC. Although all countries contribute financial support, as government staff and space used for VMMC are not free, few governments budget and allocate tax revenue for this specific service.

MC CHALLENGES: INTEGRATION, PARITY, LOCAL OWNERSHIP, AND QUALITY

Rather than pointing out the countries that have had the most difficulty with their MC programs, it is perhaps more useful to point out themes common to the settings that have not realized their targets. In some locations, VMMC programs began with a strategy that called for MC services to be fully integrated within public medical facilities, rather than using dedicated mobile medical facilities. This goal of an integrated strategy may have been motivated by the possibility of broadly strengthening infrastructure within the health system. But without allocated space and staff time to provide VMMC regularly, even if not full time, the refurbished facility space and staff trained to conduct VMMC are absorbed by the larger needs of the system. Also, demand is rarely constant, so it is understandably difficult to dedicate space and staff when there is no guarantee of clients. Parity, or equity of access, has also posed a challenge in some areas. Although a focused approach is often recommended for multiple reasons, including epidemic impact, logistics, and the likelihood of achieving early successes to catalyze subsequent services, decisions about services are often political. Countries that aim to make services available in all locations at the same time struggle with substantial coordination difficulties.

Although campaigns in Kenya and Tanzania have been successful, especially among adolescents, not all large campaigns have done well. According to mathematical models, the impact on the HIV epidemic increases as the pace and scale of a VMMC campaign increases, making

a rapid and broad campaign desirable. However, such ambitious campaigns may seem to be externally driven and run the risk of losing local leadership, ownership, and eventually, buy-in of communities and then individuals.

Of course, other implementation challenges exist. Donor organizations have fluctuating political priorities and funding. Although there has been focus on the supply side of scaling up VMMC (e.g., MOVE model), demand creation has received less attention, and fear of too much demand has limited the use of mass media in some countries. Some targets may have been unrealistic. Mathematical models describing the potential impact of rapidly achieving high VMMC coverage levels are meant to galvanize commitments and action. Such coverage levels, however, should not define the success or failure of the program any more than failure to achieve antiretroviral therapy (ART) saturation would be regarded as a failure of a treatment program. Although achieving 80% MC prevalence in all WHO-defined priority countries⁹ in 5 years has the potential to dramatically reduce HIV incidence, achieving a lower level of coverage or taking a longer time to do so will still reduce HIV incidence.¹² Setting aspirational targets, such as universal access to ART or 80% coverage of MC, in all 13 countries at once is difficult at best, and risks setting the stage for a perceived failure.

PUTTING THE PIECES TOGETHER

Adoption and impact of a new HIV prevention intervention will be driven by efficacy, choice, and complexity. Some interventions may be very effective but have low rates of adoption, whereas others may be less effective but have high rates of adoption. In some instances, the choice about whether to adopt an innovation will be made by men and at other times by women, parents, or medical personnel. Some interventions will be hard to understand, some will be expensive, and some will conflict with social norms.

How do we understand the uptake of VMMC in the light of the diffusion models presented above? None of the diffusion models explain all the elements, but the endogenous technology model may offer a better fit than the other models do, because it accounts for circumstances such as local customs and individual preferences. Local customs are reflected in part by local MC prevalence, and it is not a surprise that this would play an important role in VMMC adoption. But the scale-up of VMMC will also reflect the collective individual decisions within a network, or community, of potential adopters. Instead of relying on diffusion models that focus on the uptake by individuals alone to understand VMMC, a more comprehensive view of VMMC considerations at all levels—individual, community, and within systems—may be better for explaining successful scale-up.

Individual motivations, of course, remain important. Individual perceptions of risk and benefit need to favor VMMC for an individual to choose to adopt this innovation. Related to risk perception, individual need perception has been important to vaccine uptake in general²⁸ and to polio vaccine uptake in particular.³ In the case of VMMC, men weigh their perceived need for, and the benefits of, VMMC against other wants and needs, including those related to health. But in many ways, HIV has become much less visible recently, with

wider access to ART and lower death rates. It is quite plausible that need perception around VMMC would have been quite different 10 or 15 years ago, when ART was less widely available, and at that time, VMMC may have scaled up rapidly. Improved uptake may be generated by including motivators for male circumcision beyond those related to individual risk perception, such as improved hygiene, perceptions of responsible masculine choice, perceptions of sexual partner preferences, and improved health for their female sexual partners, including a reduced risk of cervical cancer.²⁹

In the community, local buy-in is critical and is easier if a new health innovation is already familiar, as seen in Kenya, where local MC rituals make it easier to introduce the related procedure of VMMC. In addition to local customs, it is important to have strategies to increase trust in the “expert system” that is introducing the new health innovation.³⁰ Confidence in the efficacy of the MC technology, the manufacturers of MC devices, the managers of VMMC programs, and the health care providers conducting the procedures are all critical to the diffusion of MC. Finally, strong central leadership, political commitment, and efficient coordination, and sufficient human and material resources, all contribute to successful uptake.

At the health systems level, there have been challenges with integrated models of MC delivery and in some instances with placing a priority on geographic parity, as described above. In contrast, there has been some success with campaigns. Although campaigns are the antithesis of an integrated model, in that they are time limited and often vertical, the most successful campaigns make VMMC scale-up appear to expand organically from the local community. Hybrid strategies that blend an integrated model with periodic campaigns to propel the rate of adoption, while using phased approach to providing equitable access, appear promising and are starting to yield results. In addition, target setting spans both the community and the health system and plays an important role in determining successes and failures. Setting and maintaining realistic targets, especially local targets, at a pace determined by community leaders and health system stakeholders, is likely to contribute to successful scale-up.

Scaling up HIV prevention interventions is not simple. The diffusion models predict that the adoption of a prevention intervention, such as VMMC, will start out slowly, and as information spreads, adoption rates will increase, slowly, and then speed up. In a setting where the social acceptance of male circumcision is mixed, a strong information campaign might help bring acceptance to a tipping point, where adoption rates can accelerate. In a setting where social acceptance is already relatively high because of cultural and tribal customs, adoption rates may be driven by factors other than information, like perceived cost to individuals. VMMC programs in such settings may need to include some form of a subsidy to cover transportation costs or lost wages as a way to encourage men to actively seek out MC services.

Perhaps then the best strategy for scaling up VMMC lies in customizing the approach to different populations and remembering that scale-up may move more slowly than anticipated or desired, especially at first. Embracing these complexities may help to accelerate the implementation of VMMC scale-up and achieve a long-term, sustainable impact on the HIV epidemic.

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