



Modeling the potential impact of the Dapivirine Ring for HIV Prevention

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*OPTIONS refers to PrEP as the product category (inclusive of all formulations of ARV-based HIV prevention), and refers to specific products by formulation designation and/or name (e.g. oral PrEP/TDF-FTC, topical PrEP/dapivirine ring, injectable PrEP/cabotegravir, etc).

BACKGROUND

As the dapivirine intra-vaginal ring, developed by the International Partnership for Microbicides (IPM), moves forward through regulatory review and open-label extension studies, the potential impact and cost-effectiveness of this new longer-acting HIV prevention product is unclear. There are significant knowledge gaps around the ring, most fundamentally around its potential uptake, cost, and effectiveness. This study uses mathematical modeling to explore dapivirine ring impact under different scenarios of use, alongside scale-up of HIV treatment and other prevention interventions. With no comparable products on the market, target coverage levels are informed by proxies, such as contraceptive use. Previous modeling conducted in 2017 for a document entitled, "Dapivirine Ring: The Case for Action" used more ambitious assumptions about uptake, most notably that the ring would be used by women at lower risk for HIV infection.

METHODS

This analysis uses the Goals module from the Spectrum suite of models (developed by Avenir Health¹) to create different scenarios for ART scale-up, oral PrEP, and dapivirine ring coverage. This analysis was conducted for 13 countries: Kenya, Botswana, Lesotho, Malawi, Mozambique, Namibia, Rwanda, South Africa, Swaziland, Tanzania, Uganda, Zambia, and Zimbabwe. In the scenarios, PrEP is provided to female sex workers and medium-risk women (defined in the model as women with multiple partners).

Risk group definitions:

- Low-risk = women with one partner (regardless of their partner's behavior)
- Medium-risk = women with multiple partners (who are not sex workers)
- High-risk = female sex workers

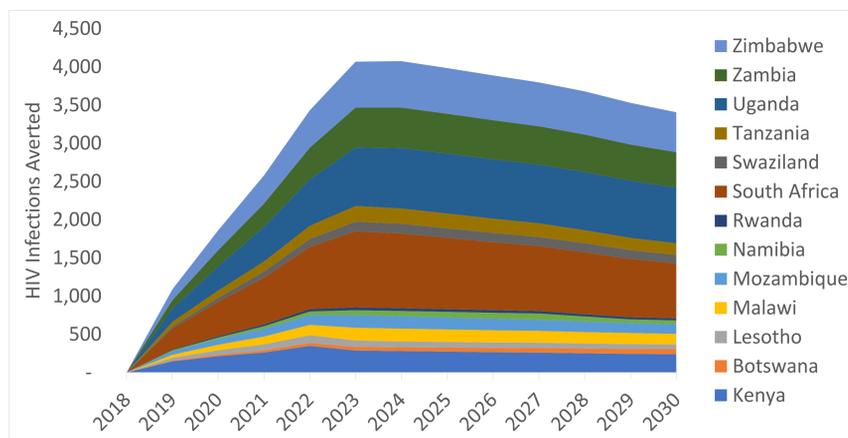
The ART scenarios include holding ART constant at 2016 coverage levels and reaching the 90-90-90 targets by 2020. Within these scenarios, adherence to the dapivirine ring is varied (from a minimum of 34% to a maximum of 90%) to represent the range of effectiveness results (from a minimum of 26% to a maximum of 68%) observed in clinical trials. In the Goals model, effectiveness is a function of both efficacy and adherence.

In all of the scenarios presented here, oral PrEP is scaled up to the same coverage level as the ring and has 62% effectiveness² (from 90% efficacy and 69% adherence). The coverage of oral PrEP and ring each peak at a modest level equivalent to one quarter of each country's modern contraceptive prevalence rate³ (mCPR) in the populations of medium-risk women and female sex workers. This ranges from 3% in Mozambique to 17% in Zimbabwe, with a median of 13%. Oral PrEP is scaled up from zero in 2015 to the target coverage level in 2023 following a linear trend. The ring is scaled up from zero in 2018 to the target coverage level in 2023. The counterfactual scenario for calculating infections averted includes scale up of only oral PrEP.

RESULTS

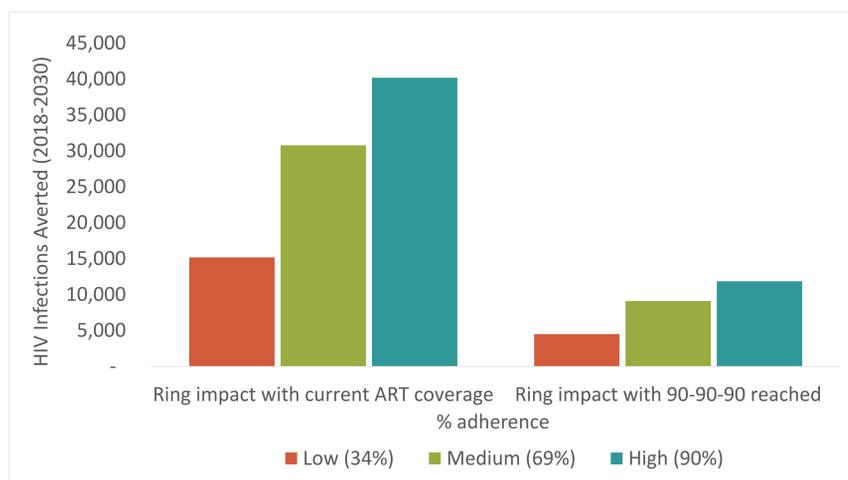
The potential impact of the ring varies substantially depending on scale-up of ART and the level of adherence to the ring. In a scenario with all 13 countries achieving the 90-90-90 targets and 52% ring effectiveness (from 75% efficacy and 69% adherence), we estimate the ring could avert nearly 39,000 new HIV infections by 2030 (Figure 1). This is additional to 68,000 infections that could be averted by oral PrEP.

Figure 1. Dapivirine ring impact per year (2018-2030) if countries achieve 90-90-90 targets



However, if the 90-90-90 targets are not reached and higher levels of ring adherence are achieved with open label use (as has been seen with oral PrEP and in early ring results from the HOPE⁴ and DREAM⁵ studies), the potential impact of the ring is much greater (see Figure 2 for an example showing South Africa). To illustrate that extreme, if ART coverage is held constant at 2016 levels and 90% ring adherence is achieved, as many as 170,000 HIV infections could be averted by 2030 (Figure 3). This is additional to 241,000 infections that could be averted by oral PrEP.

Figure 2: New HIV infections averted by dapivirine ring (2018-2030) in South Africa, under different scenarios of ART coverage and adherence

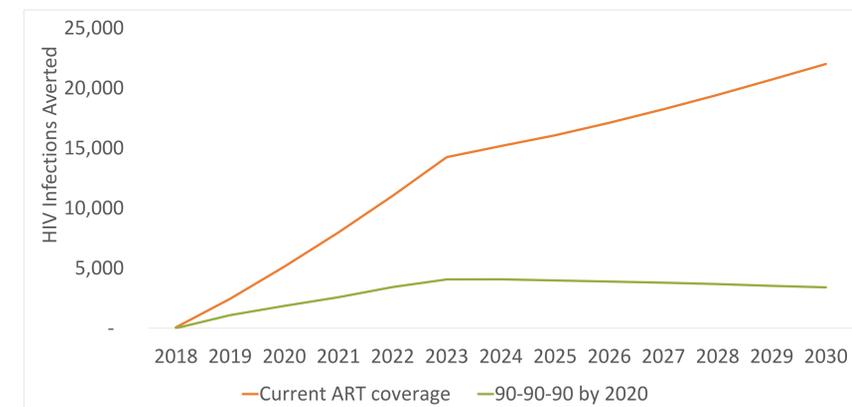


CONCLUSIONS

The dapivirine ring, as a product able to be used discreetly by women, could be a beneficial addition to the HIV prevention toolkit for bringing about epidemic control; however, our modeling suggests that its potential impact is highly variable. More understanding of the effectiveness and potential uptake of the intervention would improve our ability to estimate its possible impact.

This modeling can be used to inform the planning of implementation studies that will begin to answer these questions about effectiveness and uptake of the ring. In the meantime, these findings prompted us to conduct a stakeholder consultation to gather input on the assumptions, parameters, and research questions to be used in future modeling, in order to help ensure outcomes are realistic and responsive to the needs of countries, donors, implementers, and advocates.

Figure 3. Dapivirine ring impact per year (2018-2030) when maintaining current levels of ART coverage compared with ring impact if countries achieve 90-90-90 targets



NOTES

1. Avenir Health, Spectrum model: <http://www.avenirhealth.org/software-spectrum.php>
2. Thigpen MC, Kebaabetswe PM, Paxton LA, Smith DK, Rose CE, et al. (2012) Antiretroviral preexposure prophylaxis for heterosexual HIV transmission in Botswana. *New England Journal of Medicine*. 367:423–43.
3. Modern contraceptive prevalence rate (mCPR) is the percent of women of reproductive age who are using (or whose partners are using) a modern contraceptive method at the time of the survey. Technically, it is a ratio, not a rate. Modern methods include: sterilization, IUD, implant, oral contraceptive pills, injectable hormonal contraceptives, condoms, and emergency contraception.
4. Baeten J, Palanee-Phillips T, Mgodini N, et al. High Uptake and Reduced HIV-1 Incidence in an Open-Label Trial of the Dapivirine Ring, CROI 2018. <http://www.croi-conference.org/sessions/high-uptake-and-reduced-hiv-1-incidence-open-label-trial-dapivirine-ring>
5. Nel A, Van Nierkerk N, Van Baelen B, Rosenberg Z. HIV Incidence and Adherence in DREAM: An open-label trial of dapivirine vaginal ring, CROI 2018. <http://www.croi-conference.org/sessions/hiv-incidence-and-adherence-dream-open-label-trial-dapivirine-vaginal-ring>



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