Evaluating the Potential Impact and Cost-Effectiveness of Dapivirine Ring Pre-exposure Prophylaxis 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

The monthly dapivirine intravaginal ring is a potential biomedical prevention option for women that is currently under development. As the ring moves forward through regulatory review and open-label extension studies, the potential impact and cost-effectiveness of this new prevention method are unclear. We used mathematical modeling to explore the ring's impact and cost-effectiveness in different implementation scenarios alongside scale-up of other HIV prevention interventions. This modeling represents a second phase of analysis, following a preliminary phase of modeling in 2017. Given knowledge gaps about the ring related to its uptake, delivery costs, and effectiveness in real-world settings, we conducted an expert stakeholder consultation. This consultation elicited plausible parameter ranges and explored scenarios to bookend impact, cost, and cost-effectiveness. Respondents offered a wide, and often divergent, range of input, emphasizing the degree to which we do not yet know what the actual values of these parameters will be in non-research settings.

METHODS

Model

- Used the Goals model to simulate scenarios of PrEP (oral and ring) implementation in Kenya, South Africa, Uganda and Zimbabwe among
  - medium-risk women ages ≤21 or >21 years
  - female sex workers (FSWs)

Base parameters

- Assumed Oral PrEP effectiveness of 71%, moderate oral PrEP coverage (see Table 2 for coverage levels), and maximum oral PrEP coverage reached in 2030
- Assessed results over 18 years, 2018—2035.
- Unit costs (Table 1) for oral PrEP in Zimbabwe and Uganda were adapted from a costing study conducted in Kenya[1], since published primary costing data from these countries are not yet available. South Africa had its own costing study which was used for South Africa[2].
- Unit costs for the ring assumed $7/ring; 12 rings/year, service delivery costs the same as oral PrEP, and HIV testing was the only lab test required

Risk group definitions:

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

Table 1 . Total unit cost in US$ for oral PrEP, the ring, and antiretroviral treatment per client per year, by country

	Oral PrEP	Ring	ART
Kenya	$202	$189	$257
Zimbabwe	$121	$157	$254
Uganda	$133	$154	$445
South Africa	$160	$152	$286

Coverage levels

- High, moderate, and low coverage levels were set in each country (Table 2) with maximum ring coverage levels reached in 2035.
  - Maximum level of PrEP (oral and/or ring) coverage considered in the medium-risk women was equal to modern contraceptive use minus condom use in each of the two age groups, and no PrEP method (oral or ring) achieved more than half that value.

Table 2: PrEP (oral or ring) coverage values by risk group and country

	Kenya (%)	Zimbabwe (%)	Uganda (%)	South Africa (%)
High				
Female sex workers	27	27	27	27
Medium-risk women >21	23	28	11	20
Medium-risk women ≤ 21	12	14	10	19
Moderate				
Female sex workers	18	18	18	18
Medium-risk women >21	15	18	7	13
Medium-risk women ≤ 21	8	9	7	12
Low				
Female sex workers	9	9	9	9
Medium-risk women >21	8	9	4	7
Medium-risk women ≤ 21	4	5	3	6

RESULTS

Bookend scenarios

We developed bookend scenarios of ring impact: the highest impact scenario included ART held constant at 2017 levels, high ring coverage, and 70% ring effectiveness; the lowest impact scenario included ART reaching 90-90-90 by 2020, low ring coverage, and 30% ring effectiveness. Figure 1 shows the plausible range of absolute and relative impact for each of these scenarios. For cost-effectiveness, in South Africa, for example, the cost per HIV infection averted ranged from $16,000 for the highest impact scenario to $121,000 for the lowest impact scenario.

Figure 1a: Range of potential impact of dapivirine ring in percent of new HIV infections averted (2018—2035) in Kenya, Uganda, South Africa, and Zimbabwe (#)

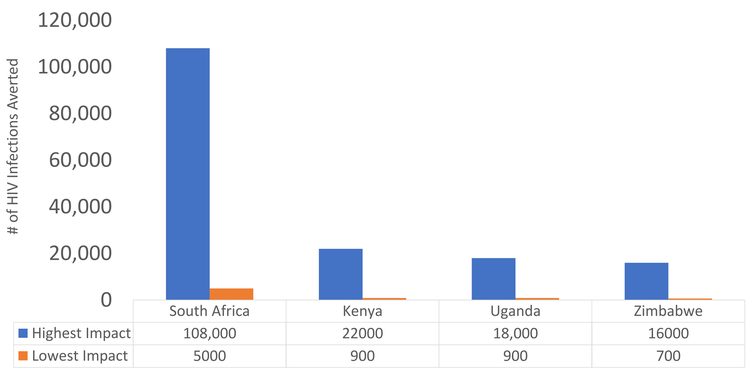
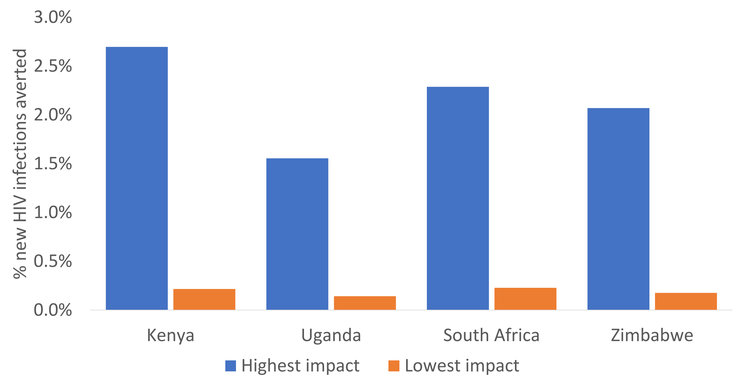


Figure 1b: Range of potential impact of dapivirine ring in percent of new HIV infections averted (2018—2035) in Kenya, Uganda, South Africa, and Zimbabwe (%)



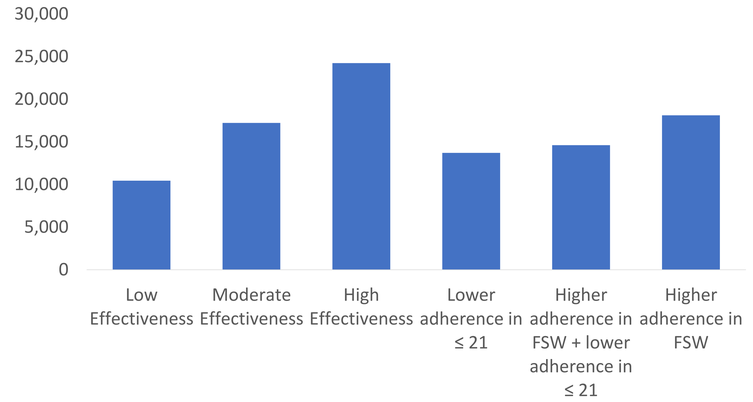
Effectiveness/adherence scenarios:

HIV infections averted are directly correlated with the level of ring effectiveness used in the scenario. Ring effectiveness/adherence scenarios are outlined in Table 3. This series of scenarios assumed moderate ring coverage, and that ART scale-up reaches the 90-90-90 targets by 2020. Oral PrEP effectiveness was not varied. Figure 2 outlines the scenarios that varied effectiveness overall and by risk group. These are compared with the moderate effectiveness scenario (50% effectiveness). In South Africa, given the relative incidences in the risk groups included in the model, reduced adherence in younger women was projected to have a greater impact on new HIV infections than increased adherence among FSWs. This parallels the results seen when increasing ring coverage in FSWs or reducing ring coverage in younger women.

Table 3: Dapivirine ring effectiveness scenarios.

	Ring Effectiveness		
	FSW (%)	Med >21 (%)	Med ≤ 21 (%)
Low ring effectiveness	30	30	30
Medium ring effectiveness	50	50	50
High ring effectiveness	70	70	70
Lower ring adherence in younger women	50	50	30
Higher adherence in FSW + lower adherence in younger women	70	50	30
Higher ring adherence in FSW	70	50	50

Figure 2: New HIV infections averted from dapivirine ring by effectiveness scenario, South Africa (2018—2035)



CONCLUSIONS

Given the persistently high rates of HIV infection among women despite the scale-up of ART and voluntary medical male circumcision, new HIV prevention methods for women are needed.

Depending on a number of factors explored in this poster, the dapivirine vaginal ring may provide additional impact on control of the HIV epidemic. Greater understanding of the real-world cost and potential uptake of the intervention would improve our ability to estimate its possible impact and cost-effectiveness. However, ultimately the purpose of the ring is to increase uptake of HIV prevention to prevent HIV acquisition, not necessarily to maximize cost-effectiveness. Because the ring is a new product category, there are many unknowns. Implementation research and demonstration and pilot projects are needed to improve our understanding of the ring's potential impact and to devise strategies to maximize it. This modeling exercise offers a wide range of scenarios that incorporate the considerable uncertainty about ring uptake, consistency of use and effectiveness, as well as oral PrEP and HIV treatment use over the next two decades. Even amid this uncertainty, however, it is clear that for the greatest impact, implementers and donors should invest in maximizing uptake and adherence to the ring among women who are in need of HIV prevention and who are unlikely to consistently use other primary prevention interventions.

REFERENCES

1. Phanitsiri S, Kiragu M, Nnakabonge I, Wachihi C, Tagar E, Kimani P, et al. The unit cost of delivering oral PrEP as part of a combination HIV prevention package: results from the IPCP-Kenya demonstration project. Poster presented at: ICASA 2017. 19th International Conference on AIDS and STIs in Africa; 2017 4-9 Dec; Abidjan, Cote d'Ivoire.
2. Jamieson L, Meyer-Rath G, Gomez G, Johnson LF. The impact of differential uptake by HIV risk group on the effect and cost-effectiveness of PrEP in different population in South Africa. Presented at IAEN 2018. 10th International AIDS Economic Network Pre-Conference; 2018 20-21 July; Amsterdam, Netherlands. Available from: http://www.iaen.org/documents/D2_Lise_Jamieson.pptx

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