

Adherence to the Dual Prevention Pill for HIV and Contraception: Identifying thresholds for net benefit and cost-savings using mathematical modeling

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Introduction

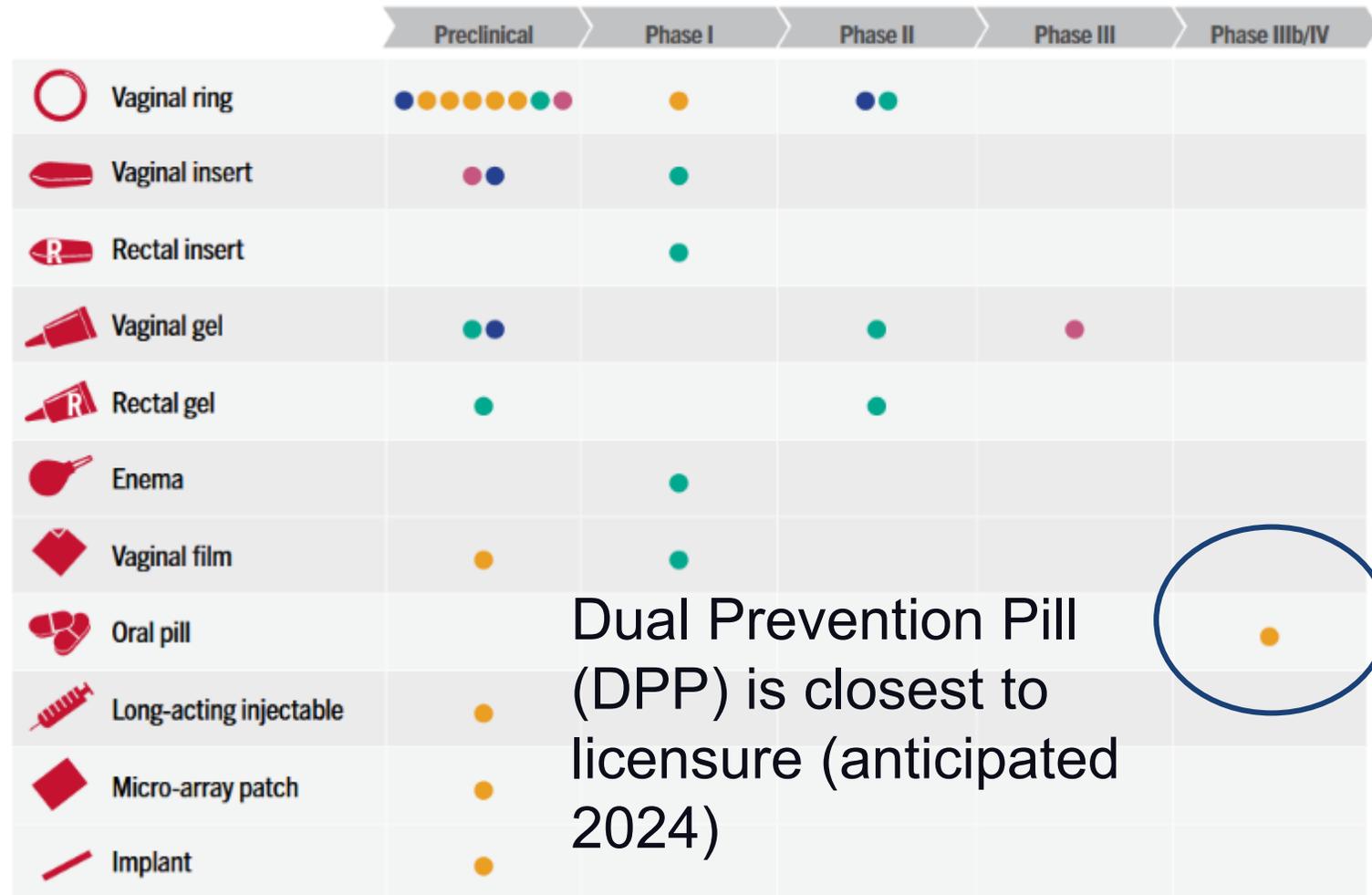
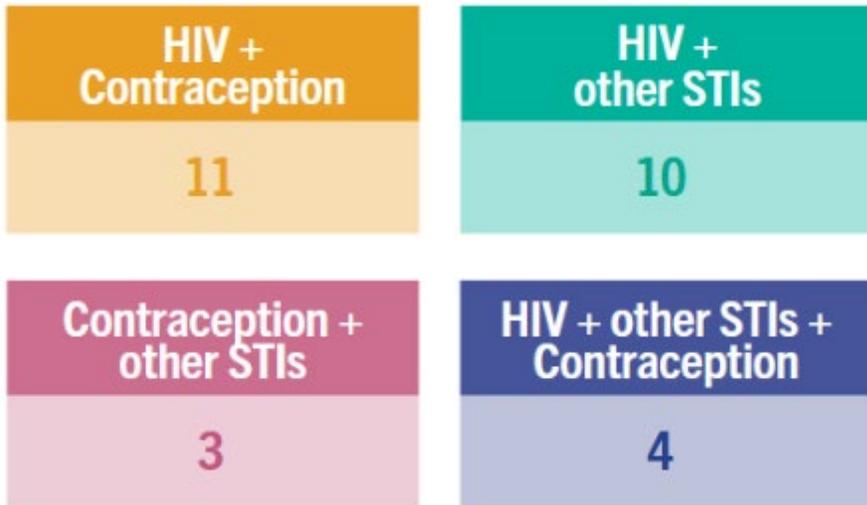
- Sub-Saharan Africa is home to:
 - 15% of all women of reproductive age
 - 25% of all women with unmet need for contraception
 - 93% of all women living with HIV
- Among women of reproductive age in sub-Saharan Africa:
 - #1 cause of death is HIV
 - #2 cause of death is maternal mortality

Introduction

- Condoms are the only marketed product that can prevent women from both unintended pregnancies and HIV
- Due to cultural factors, the majority of women in SSA are constrained to relying on condom usage as their primary preventive method, often with limited control over sexual decision-making by men
- Supplementing widely accepted contraceptives with PrEP (such as OCP or vaginal ring), could potentially assist women in SSA communities in overcoming the existing barriers

Introduction

- New multi-purpose technologies for sexual and reproductive health are under development



Source: The Initiative for MPTs (IMPT) Product Development Database; AVAC Advocates' Guide to Multipurpose Prevention Technologies (MPTs)

Introduction

- DPP Consortium is preparing the market for introduction



Study motivation and objectives

- Informed by DPP Consortium and Clinton Health Access Initiative (CHAI), we conducted cost-effective analysis demonstrating that:
 - DPP has the potential to be either cost-saving or cost-effective in populations with higher HIV risk
 - Cost-effectiveness is highly sensitive to adherence, with the potential to be net harmful if adherence is significantly reduced among current oral contraceptive pill (OCP) users
 - These results are published in the Frontiers in Reproductive Health Journal <https://doi.org/10.3389/frph.2023.1144217>
- These findings informed the need to conduct additional analysis determining adherence thresholds at which DPP is net beneficial versus net harmful among different OCP user populations

Approach - modeled populations

- We adapted EMOD-HIV results by adding maternal health parameters (including unintended pregnancy, abortion, and maternal mortality) and pregnancy-associated costs representing Nyanza region of western Kenya, Zimbabwe and South Africa
- We determined adherence thresholds at which DPP is net beneficial, cost-effective, cost-saving, or net harmful, among different OCP user populations (women ages 25 – 49, adolescent girls and young women (AGYW), sex workers, and serodiscordant)
- We assumed OCP would be 90% effective at reducing the risk of unintended pregnancy and would have no effect on HIV acquisition risk
- For the DPP, we considered a wide range of effectiveness by simulating effectiveness values ranging from 5% to 95% in 10% increments
- We use the term ‘adherence’ to refer to the percentage risk reduction due to a corresponding level of effective use

Approach: Cost-effectiveness calculations

- For each population and adherence level we estimated the disability-adjusted life-years (DALYs) averted, as well as the incremental cost of using DPP in comparison to oral contraceptive use alone (with 90% adherence) over a 30-year time horizon and 3% annual discount rate in 2021 USD
- We calculated the incremental cost-effectiveness ratio (ICER) using the equation provided below:

$$\text{ICER} = \frac{\text{DPP cost} - \text{avoided OCP cost} - \text{avoided pregnancy costs} - \text{avoided HIV treatment costs}}{\text{DALYs averted due to HIV prevention} + \text{DALYs averted due to pregnancy prevention}}$$

- We assumed the DPP would be cost-saving if it resulted in positive health impact with negative net cost; cost effective if it resulted in an $\text{ICER} \leq \text{US\$500}$, net beneficial if it resulted in positive health benefits at any cost, harmful if it resulted in negative health benefits

Assumptions for costs (2021 USD) of different HIV and contraceptive products and cost of goods sold estimates

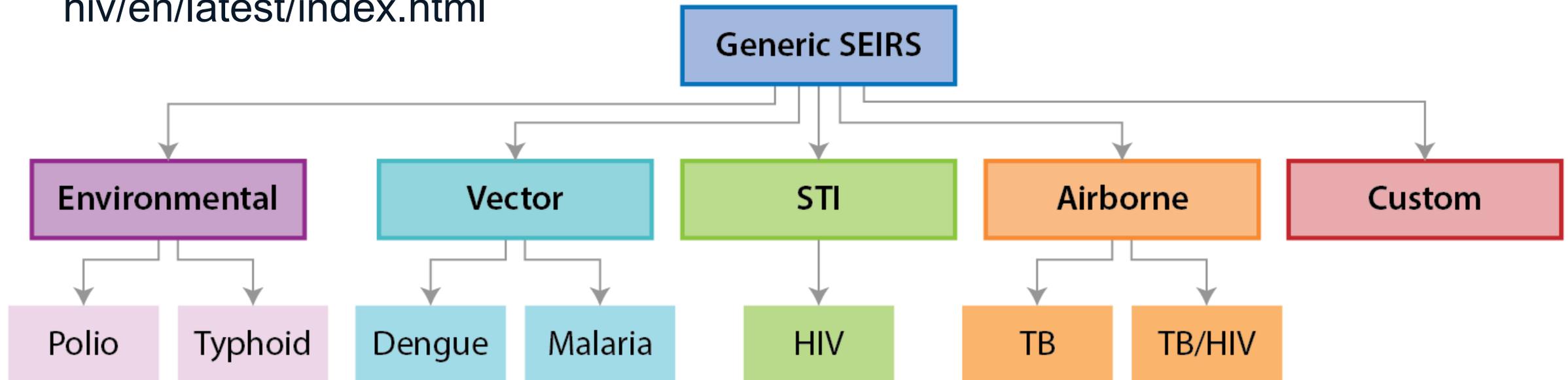
Product	Provision	Cost (per person-year)
DPP	First year of use, 2025-2027	\$166
DPP	Subsequent years of use, 2025-2027	\$145
DPP	First year of use, 2028+	\$146
DPP	Subsequent years of use, 2028+	\$125
OCP		\$12.5
Antiretroviral therapy (ART)		\$257

Cost assumptions in 2021 USD and the projected outcomes of unintended pregnancy

Health outcome	Rate of occurrence	Associated costs	Maternal deaths per 100,000 complications
Live birth	49.6%	Kenya: \$60 South Africa: \$110 Zimbabwe: \$70	Kenya: 391, South Africa: 140, Zimbabwe: 391.
Miscarriage	11.9%		
Stillbirth	1.7%		
Safe induced abortion	9.2%	Kenya: \$60 South Africa: \$100 Zimbabwe: \$70	Kenya: 152, South Africa: 26, Zimbabwe: 152.
Less safe induced abortion	10.0%	Kenya: \$60 South Africa: \$100 Zimbabwe: \$70	
Least safe induced abortion	17.6%	\$0	

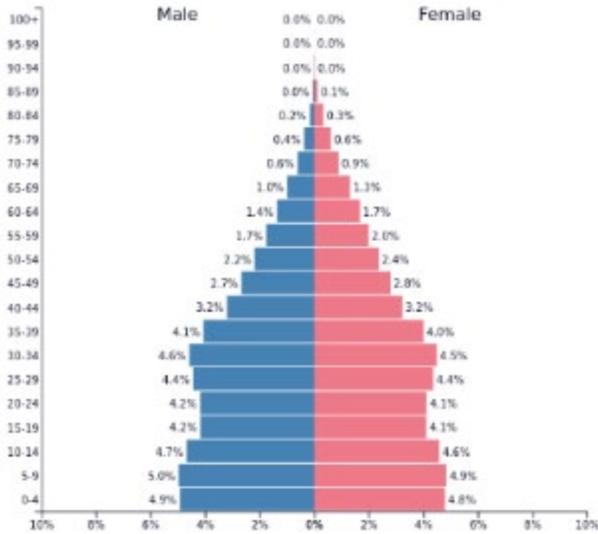
Approach: EMOD-HIV model

- Agent-based epidemiological model
- Developed and maintained by Institute for Disease Modeling (part of BMGF)
- Built into a larger codebase, EMOD, which supports several disease types
- Model source code available:
<https://github.com/InstituteforDiseaseModeling/EMOD>
- Documentation & user guide available: <https://docs.idmod.org/projects/emod-hiv/en/latest/index.html>

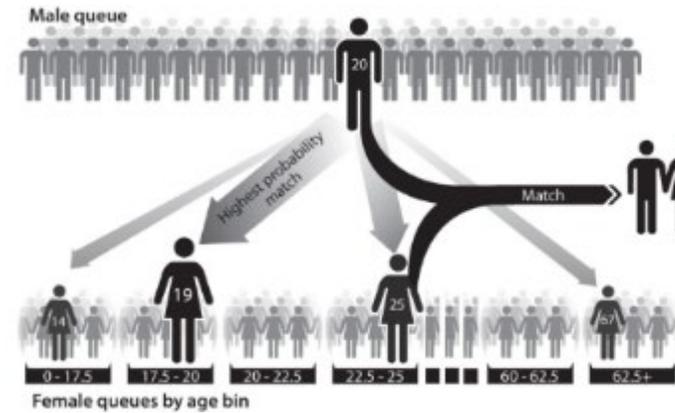


Approach - Components of the EMOD-HIV model

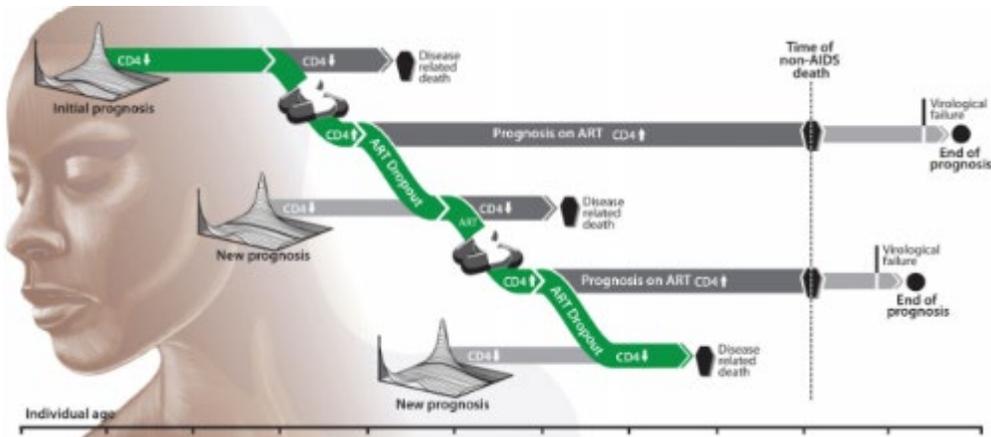
Demographics (fertility, non-HIV mortality)



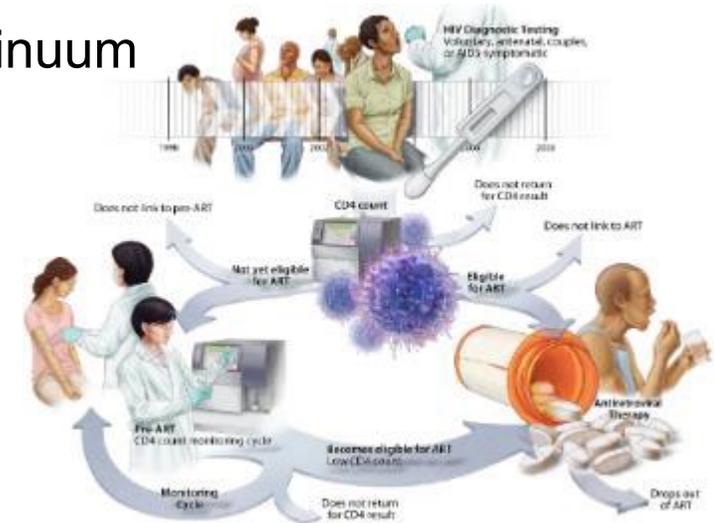
Transmission network (sexual, mother-to-child) & HIV prevention interventions



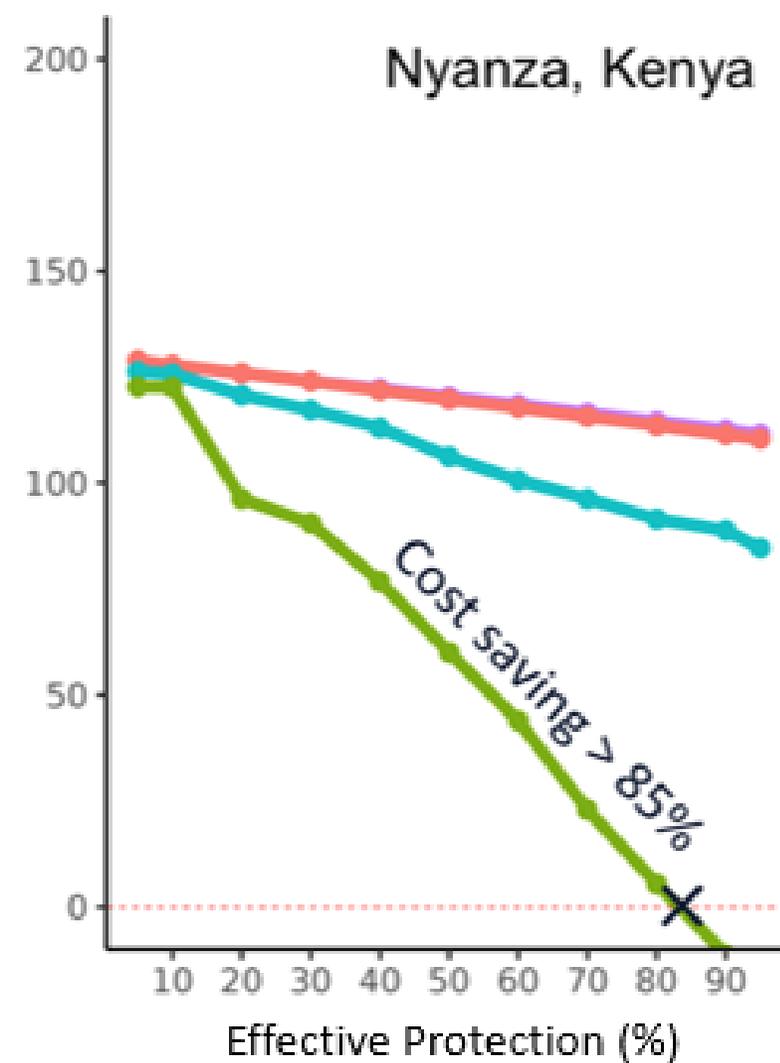
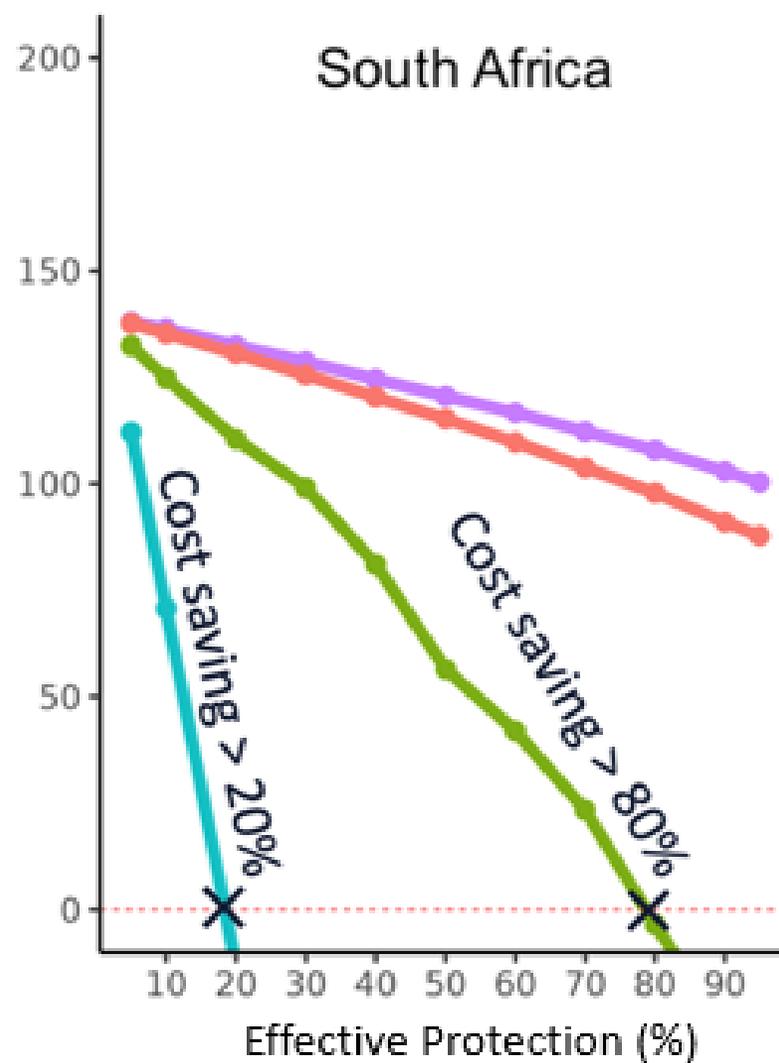
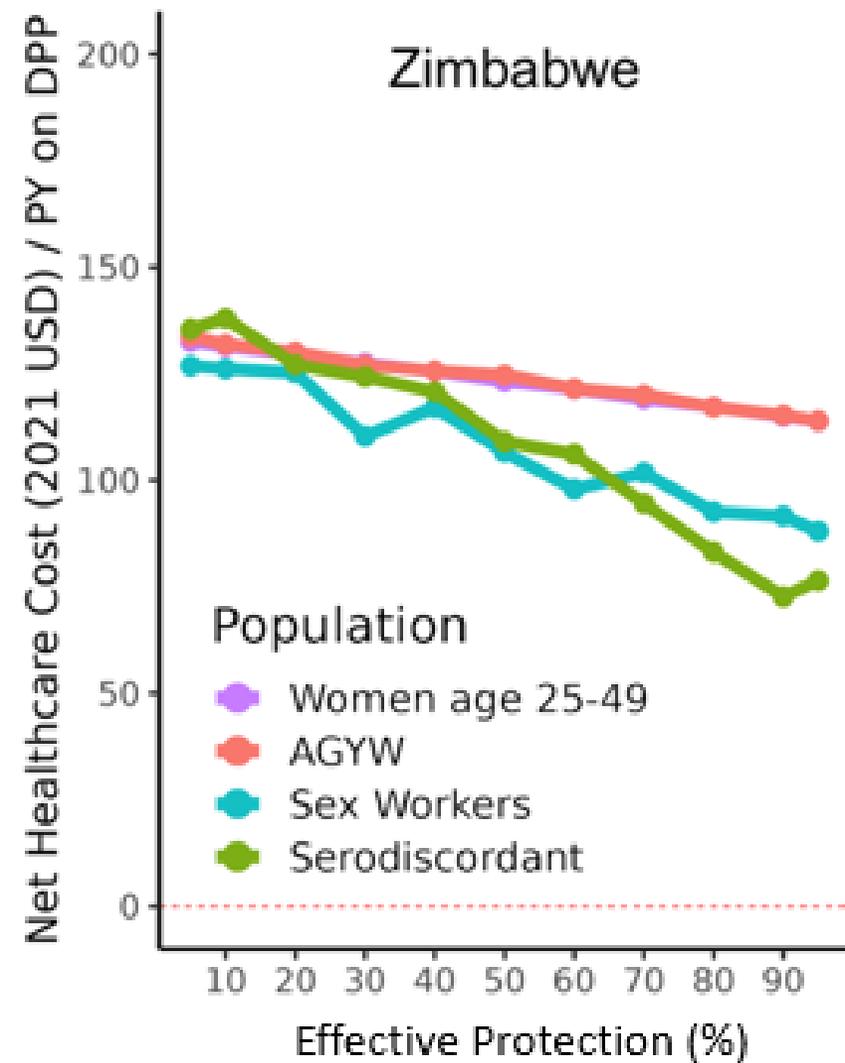
HIV disease progression & HIV treatment



Care continuum



Results



Results

Population	Country	Net-Beneficial	Cost-Effective (assuming ICER = \$500 in 2021 USD)	Cost-Saving
Female Sex Workers	South Africa	<5%	17%	19%
	Zimbabwe	9%	Never	Never
	Nyanza	34%	Never	Never
Serodiscordant Couples	South Africa	<5%	57%	79%
	Zimbabwe	29%	Never	Never
	Nyanza	6%	65%	83%
AGYW (15-24 years)	South Africa	16%	Never	Never
	Zimbabwe	63%	Never	Never
	Nyanza	65%	Never	Never
Women (25-49 years)	South Africa	18%	Never	Never
	Zimbabwe	50%	Never	Never
	Nyanza	65%	Never	Never

Key takeaways

- The DPP has the potential to provide significant health benefits by preventing HIV and unintended pregnancy
- Effective counseling and decision-making tools for users considering the DPP will be essential, as outcomes are sensitive to adherence
- More research is needed to understand real-life adherence patterns and ensure health benefits achieved from contraception alone are not lost

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