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Optimizing investment in HIV testing services, ART, and PrEP to reduce HIV incidence in South Africa

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BACKGROUND

- Despite scale-up of HIV testing, ART, and PrEP, there are over 140,000 new HIV infections in South Africa each year.
- Our objective was to estimate the optimal distribution of resources to HIV testing, ART, and PrEP to reduce HIV transmission and increase life expectancy in South Africa over 5 years.

METHODS

- We used the CEPAC model to simulate 3 subcohorts reflecting the South African population over the age of 15: high-incidence adolescent girls and young women (HI-AGYW), high-incidence men who have sex with men (HI-MSM), and the remaining general population (GEN).
- We modeled 36,750 combinations of levels of HIV testing, ART coverage, and oral PrEP coverage, including their current day levels (status quo, **Table 1**).
- We identified the "optimal" combinations of interventions from the single best and top 3% best-performing strategies for two separate outcomes individually and together over 5y: 1) reducing HIV transmissions and 2) maximizing population life-years (LY).
- We used current budget constraints ($8.6 billion/5y) while not decreasing ART or PrEP coverage below current levels.

Table 1. Selected model input parameters

Model Input	Subcohort HI-AGYW	HI-MSM	GEN	Source(s)
Population size, thousands	1,325	204	42,228	Country Operational Plan PEPFAR South Africa 2022 Strategic Direction Summary
HIV prevalence, %	9.44	29.02	18.22	
HIV incidence, %	3.00	3.00	0.38	
Diagnosed, %	82	80	94	UNAIDS
On ART among diagnosed, %	64	58	75	UNAIDS
Testing frequency (mean interval between tests in months)	14	14	29	Yapa Clin Infect Dis 2022 calibration
PrEP coverage at model start (%)	7	24	n/a	Johnson JAIDS 2022
Oral PrEP effectiveness, %	41	50	n/a	Hanscom JAIDS 2016
Costs* – baseline / scale-up beyond status quo (all subcohorts)				
HIV testing	$10 / $11 (per test)			Investment case 2014/15-2016/17, Barnabas Lancet Global Health 2020, Hendrickson Lancet HIV 2025, Smith Lancet HIV 2015
ART coverage	$265 / $167 (per PY)			
PrEP coverage	$71 / $50 (per PY)			

PY: person-year. *Costs in 2023 USD.

Optimizing investments in HIV testing, ART, and PrEP could avert up to 162,000 HIV infections in South Africa over the next 5 years with no additional funding.

RESULTS

With current levels of HIV testing, ART, and PrEP, we projected 714,900 incident HIV infections over 5y. Optimizing allocation of the current HIV budget in South Africa could avert 162,000 infections (**Table 2**).

Table 2. Base case and sensitivity analysis results: single best performing strategy by outcome

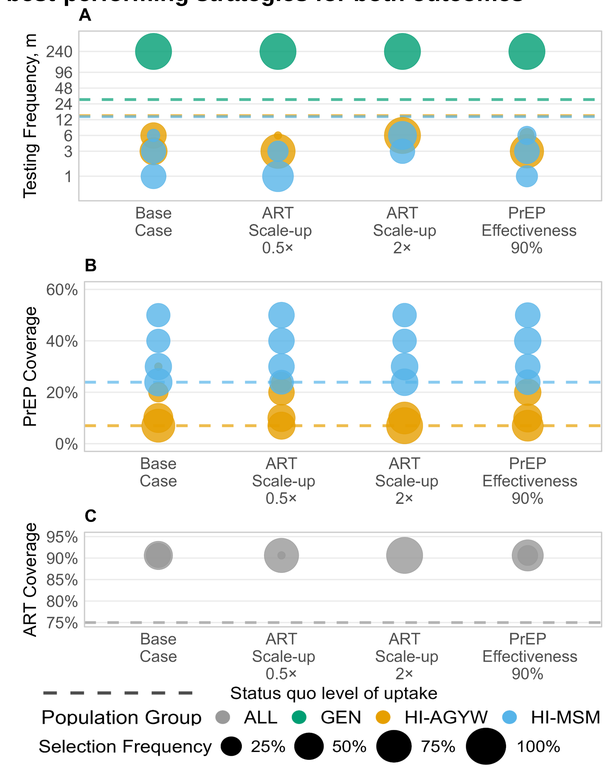
	Testing frequency, m (every 1-240m) HI-AGYW	HI-MSM	GEN	ART coverage, (70-95%)	PrEP coverage, % (7-50%) HI-AGYW	HI-MSM	ΔInfections vs. Status Quo (5y)	ΔLY vs. Status Quo
Base case								
Status Quo	14	14	29	75	7	24	-	-
Min Inc*	3	3	240	91	20	30	-162,000	46,500
Max LY*	24	1	240	91	7	24	-88,300	47,900§
ART scale-up costs = 0.5x base case ($84/PY beyond status quo)								
Min Inc	3	3	240	91	40	40	-169,800	45,600
Max LY	24	3	120	92	7	24	-119,800	87,300
ART scale-up costs = 2x base case ($334/PY beyond status quo)								
Min Inc	6	3	240	91	10	30	-144,800	46,500
Max LY	24	1	240	91	7	24	-88,300	47,900
PrEP effectiveness increased to 90% (base case: 41% HI-AGYW, 50% HI-MSM)								
Min Inc	6	3	240	91	40	50	-173,100	43,500
Max LY	24	1	240	91	7	24	-86,900	48,000

m=months. ΔInfections: Decrease in incident infections. ΔLY: Population-level life years gained.
*Min Inc values represent strategies that achieved the lowest HIV incidence, while Max LY values represent strategies that maximized life years gained among all simulated combinations.
§On a baseline of 198 million LYs, 47,900 LYs (0.02% increase) were added for the population of 44 million over 5y.

RESULTS (CONTINUED)

- Best-performing strategies that both reduced HIV incidence and maximized life expectancy included scaling back HIV testing amongst GEN (to once every 20y) and using those resources to scale up ART coverage (to >90%), increase testing frequency among HI-AGYW and HI-MSM (to <12m), and increase PrEP coverage.
- Optimal HIV testing frequency and PrEP coverage among high-incidence individuals under current budget constraints were sensitive to the cost of scaling-up ART and PrEP effectiveness. **(Fig.1)**

Figure 1. Distribution of levels of interventions: top 3% best-performing strategies for both outcomes



CONCLUSIONS

Prioritizing scaling up population-level ART coverage and increasing HIV testing and PrEP coverage among high-incidence groups, while scaling back on HIV testing in the lower-incidence general population could avert up to 162,000 HIV infections and increase life expectancy in South Africa over the next 5 years without increased investment.

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