Cost-Effectiveness of Antiretrovirals in HIV Control in Rural Zambia: a Stochastic League Approach

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Background

Earlier ART initiation and pre-exposure prophylaxis (PrEP) have both been demonstrated to effectively prevent new HIV infections. There is, however, limited funding available for HIV prevention. Choices must therefore be made when deciding on the optimal prevention strategy.

Objective

To compare the epidemiological impact, cost-effectiveness and per budget-level economic affordability of antiretroviral-based prevention strategies.

Methods

- A deterministic mathematical model of HIV transmission was adapted and treatment was initiated at CD4 <350 cells/µl
- We predicted the effect of ART initiation at CD4 <500 cells/µl and two hypothetical PrEP scenarios: prioritized to the most sexually active, and non-prioritized in the rural area of Macha, Zambia over a 40 year period.
- We implemented an economic analysis, stochastic league tables, which enables the prediction of the optimal intervention per budget level to explore both cost effectiveness and affordability.
- We conducted a standard cost effectiveness for comparison:
  - Calculated incremental cost effectiveness ratios (ICERs)
  - ICER of <$4400 is defined as cost effective in Zambia.

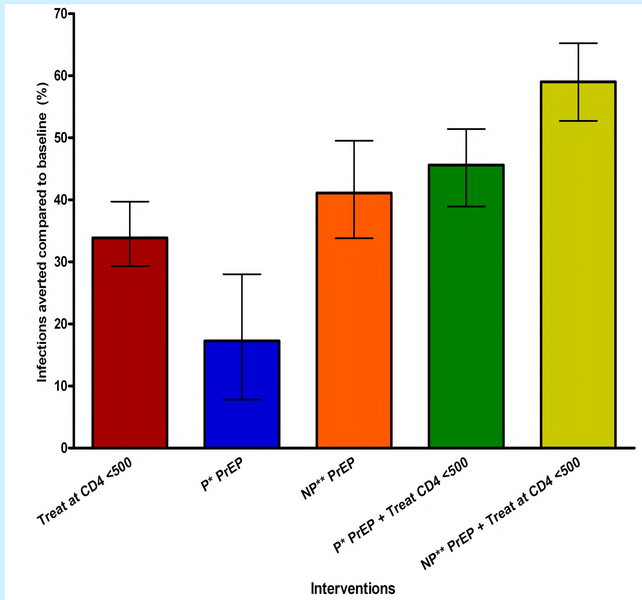
Results

- In Figure 1, it is predicted that all interventions will strongly reduce new infections over the coming 40 years.
- Only treating at CD4 <500 cells/µl is considered cost-effective. Non-prioritized PrEP plus treating at CD4 <350 cells/µl is considered borderline cost-effective (Table 1).
- Initiating treatment at CD4 <500 cells/µl would require a slight increase in budget up to $25 million, with a 96.7% probability of being the optimal intervention. (Figure 2).
- Introduction of PrEP is not included as an optimal intervention until the budget exceeds $180 million (Figure 2).

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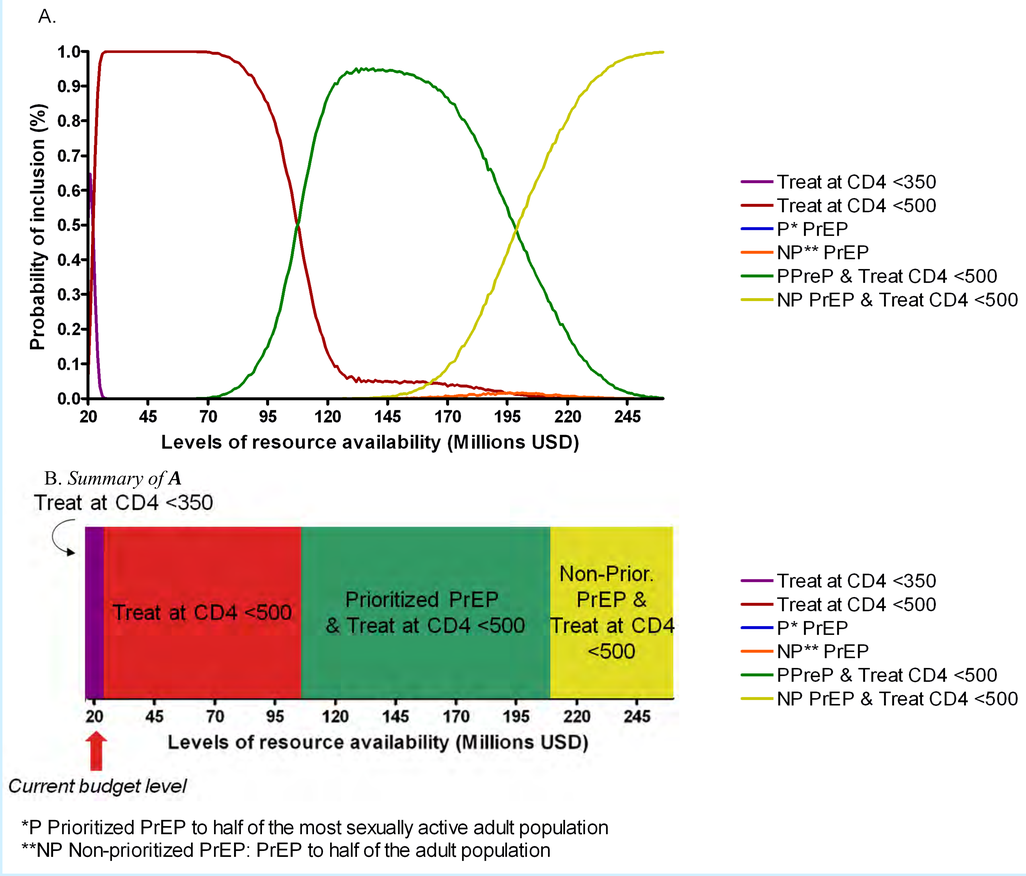
Figure 1. *Cumulative median percentage of infections averted (and interquartile range) after 40 years of implementation by intervention, compared to the baseline of treating at CD4 <350 cells/µl*



Conclusion

- Following the WHO recommendation to start at a CD4 <500 cells/µl would require only modest budget increases.
- While non-prioritized PrEP plus treatment at CD4 <500 cells/µl is borderline cost effective, our stochastic league analysis shows that it is not economically feasible and should only be considered if there is a ten-fold increase in budget.

Figure 2. *Stochastic league curves (A) and summary/interpretation (B) for six HIV prevention interventions: probability of inclusion (%) in the optimum package of HIV prevention techniques, by 40 year available budget*



*P Prioritized PrEP to half of the most sexually active adult population
**NP Non-prioritized PrEP: PrEP to half of the adult population

Table 1. *Cost-effectiveness of treatment at CD4 <500 cells/µl, PrEP interventions, and combinations thereof over 40 years*

Intervention	Total cost in $ Millions (IQR*)	QALYs gained (IQR)	Average Cost-Effectiveness Ratio (IQR)	Incremental Cost-Effectiveness Ratio (IQR)	Conclusion
Treatment available at CD4 <350 cells/µl	19.7 (17.5, 22.0)	-	-	-	-
Treatment available at CD4 <500 cells/µl	22.0 (19.8, 24.5)	40,643 (29,353, 53,676)	$62 ($46, $75)	$62 ($46, $75)	Very cost-effective
Prioritized PrEP	75.9 (50.7, 113.1)	13,611 (7,032, 24,305)	$4,103 ($2,890, $5,803)	Dominated**	Dominated**
Prioritized PrEP and treatment CD4 <500 cells/µl	78.9 (53.8, 117.6)	50,936 (38,117, 67,270)	$1,153 ($686, $1,756)	Weakly Dominated***	Weakly Dominated***
Non-prioritized PrEP	170.1 (159.1, 182.4)	40,318 (26,512, 61,199)	$3,730 ($2,454, $5,691)	Dominated**	Dominated**
Non-prioritized PrEP and treatment CD4 <500 cells/µl	173.6 (161.9, 185.8)	67,835 (48,809, 89,899)	$2,253 ($1672, $3,188)	$5,861 ($3,959, $8,483)	Borderline cost-effective

* IQR: Interquartile range; ** Less effective and more costly than the next least-expensive scenario; ***Incremental cost-effectiveness ratio is higher than the next most effective program