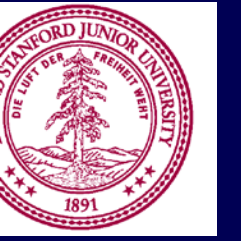


HIV Testing and Treatment in Highly Endemic Regions: Implications for Epidemic Control

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ABSTRACT

Background:

Despite increased access to antiretroviral therapy in sub-Saharan Africa, linkage from HIV testing to treatment sites and retention in care is inadequate. Understanding the mortality and epidemiologic implications of lack of linkage to care and loss to follow-up (LTFU) is important when considering universal scale up of HIV testing and treatment.

Methods:

We developed a computer simulation of the HIV epidemic and HIV disease progression in South Africa to compare the outcomes of the present scale up (Status Quo) with scenarios of universal testing and treatment alone, with improved linkage to care (from 67% to 100%), with prevention of loss to follow-up (from 20% loss to 0% loss), or both (Comprehensive HIV Care). We present outcomes in months of life gained, reduction in HIV infections, reduction in HIV deaths, and HIV death rate. We used probabilistic sensitivity analysis to estimate uncertainty in our estimates, and discounted future life years at 3% annually.

Results:

Compared with the Status Quo, universal testing and treatment was associated with a gain of 12.0 (11.3-12.2) months for the entire population, 35.3% (32.7%-37.5%) fewer infections, 27.7% (24.5%-28.3%) fewer deaths from HIV, and an HIV-specific mortality rate that was 29.5% (26.3%-30.0%) lower over the 10-year time horizon. Improving linkage to care, preventing LTFU, and Comprehensive HIV care provided substantial additional benefits: life expectancy gains compared with the Status Quo were 16.1, 18.6, and 22.2 months, and new infections were 55.5%, 51.4%, and 73.2% lower, respectively. The HIV prevalence at the end of 10 years was 17.2%, 15.6%, and 13.8% with the Status Quo, universal testing and treatment, and Comprehensive HIV Care, respectively. In probabilistic sensitivity analysis, we found that Comprehensive HIV Care reduced new HIV infections by 69.7%-76.7% under a broad set of assumptions.

Conclusions:

Universal testing and treatment could substantially reduce the HIV death toll and new HIV infections. However, scaling up linkage to care and prevention of loss to follow-up provides nearly twice the benefits of universal testing and treatment alone.

BACKGROUND

HIV is one of the leading challenges to health in the world, and the burden of disease is disproportionate in southern Africa.

Implementers seek approaches that will reduce the mortality from HIV while at the same time reduce the burden of disease.

Universal testing and treatment was recently promoted as an approach that will reduce prevalence through reduced incidence.

With the limited resources for scaling up HIV care in Africa, assessing the relative impact of approaches to increase access to antiretroviral therapy is critical.

METHODS

We developed a stochastic HIV disease and transmission model in an adult population similar to that in South Africa where HIV transmission is predominantly heterosexual.

We designed the model to reflect the current pace of scale up in South Africa, including the rate of HIV testing, rate of connection to care, treatment initiation thresholds, and rates of loss to follow-up.

In addition to the Status Quo, we tested the transmission and health benefits of four strategies:

- Universal testing and early treatment (Test & Rx)
- Universal testing, improved linkage to care, and early treatment (Test & Link & Rx)
- Universal testing, early treatment, and prevention of loss to follow-up (Test & Rx & LTFU)
- Universal testing, improved linkage to care, early treatment, and prevention of loss to follow-up (Comprehensive Care)

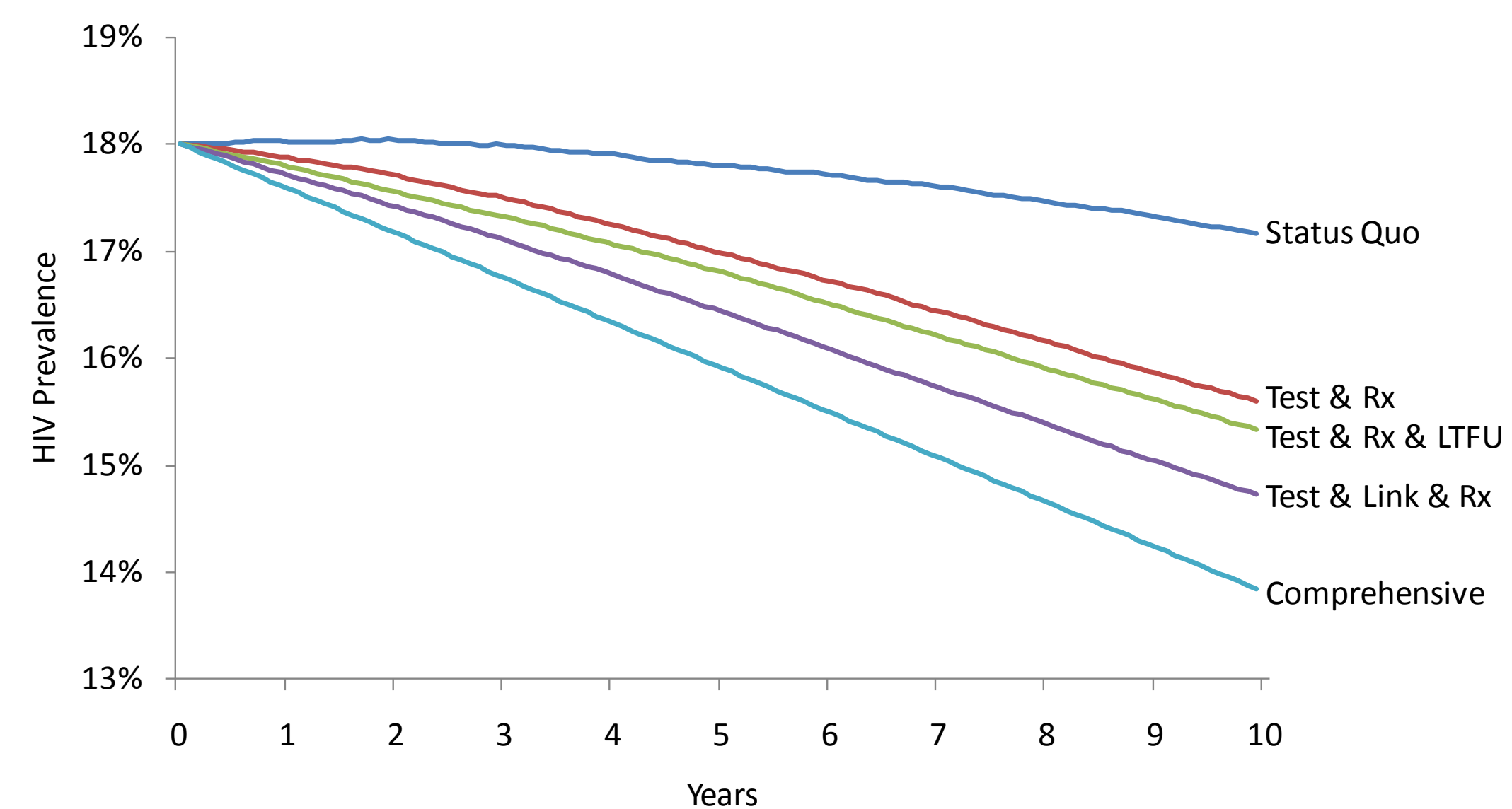
We measured two primary outcomes: reduction in HIV deaths and reduction in new HIV infections by the end of 10 years compared to the status quo.

We discounted benefits at 3% annually, and performed a probabilistic sensitivity analysis.

Scale-up Strategy	Months of life gained, per person (95% uncertainty bounds)	Reduction in HIV infections, % (95% uncertainty bounds)	HIV death rate, per 1000 person years (95% uncertainty bounds)	Population growth, compared with Status Quo, % (95% uncertainty bounds)
Status Quo	Comparator	Comparator	11.4 (9.5-12.9)	Comparator
Test & Rx	12.0 (11.3-12.2)	35.3 (32.7-37.5)	8.0 (6.6-9.5)	3.9 (3.6-3.9)
Test & Link & Rx	16.1 (15.4-16.2)	55.5 (51.8-58.2)	6.2 (5.1-7.5)	5.7 (5.4-5.8)
Test & Rx & LTFU	18.6 (17.0-18.9)	51.4 (48.0-54.2)	6.0 (4.9-7.3)	6.4 (6.0-6.5)
Comprehensive Scale Up	22.2 (21.8-22.5)	73.2 (69.7-76.7)	4.2 (3.2-5.1)	8.2 (7.9-8.3)

Comparative Benefits of Scaling Up HIV Testing and Treatment Gains in life expectancy accrue to both infected and uninfected individuals, and result partly from the growth in the size of the population with fewer deaths of women in childbearing age. Uncertainty bounds reflect the 95% limit of the relative benefits in the probabilistic sensitivity analysis. Because three of the metrics used in this table use the Status Quo as a comparator, the uncertainty bounds are not symmetrically distributed.

Projected Prevalence of the HIV Epidemic Under Different Testing and Treatment Strategies



RESULTS

Result 1:

Compared with Status Quo, universal Testing & Treatment was associated with a gain of 12.0 months in the entire population and 35.3% fewer new HIV infections.

Result 2:

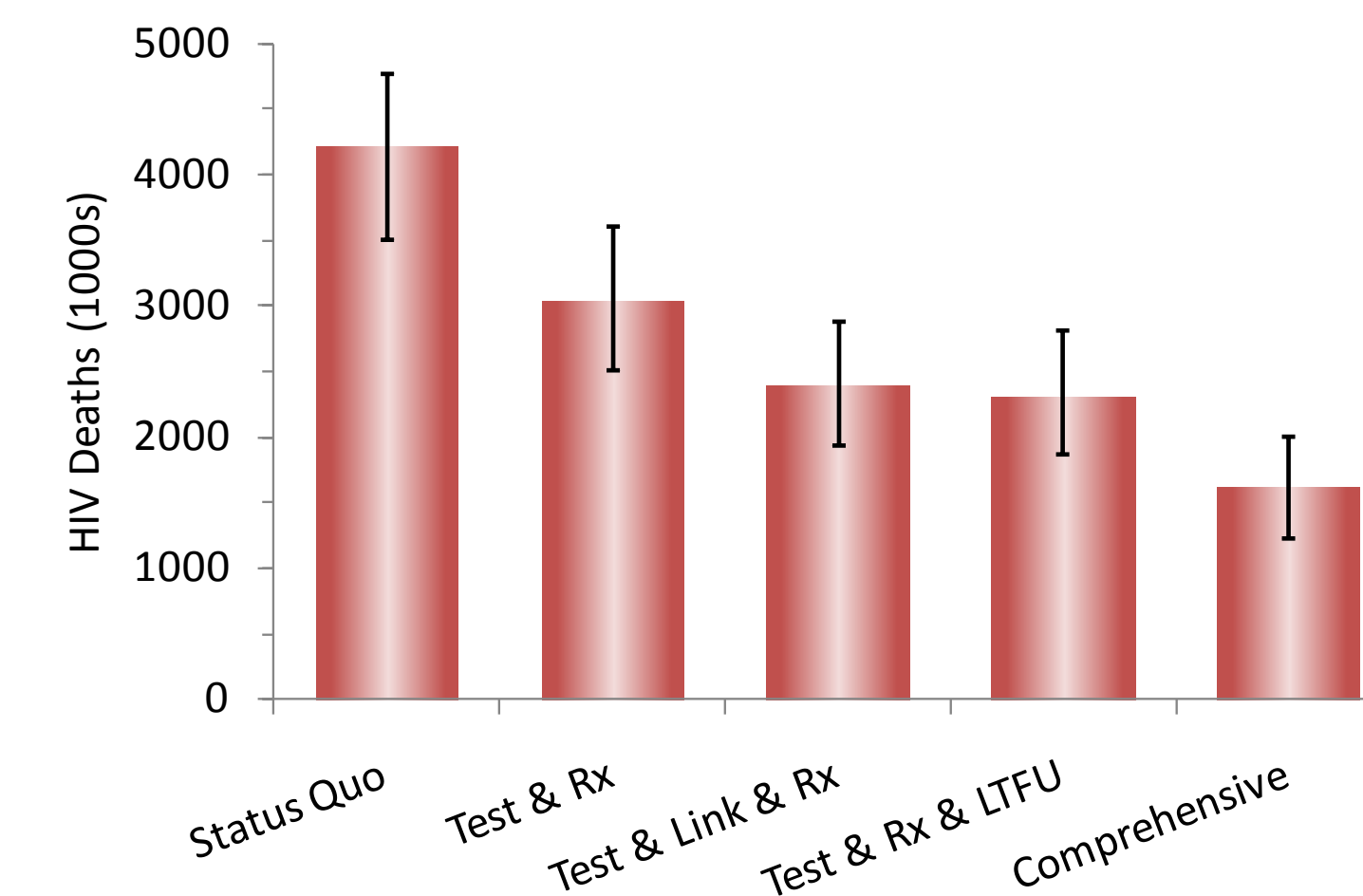
Improving Linkage and LTFU increased the life expectancy gains to 16.1 and 18.6 additional months compared with the Status Quo, and reduction in infections to 55.5% and 51.4%, respectively.

Result 3:

Comprehensive care was associated with a life expectancy gain of 22.2 months, 73.2% fewer infections, and a final HIV prevalence 3.4% lower than the Status Quo over ten years.

Result 4:

Probabilistic sensitivity analysis suggests that Comprehensive Care reduced new HIV infections by 69.7%-76.7% compared with the Status Quo under a broad set of assumptions.



Projected number of HIV deaths over ten years, scaled to the population of South Africa. The Status Quo, reflecting the current pace of treatment increase, is compared with universal testing and treatment strategies. The error bars reflect the 95% uncertainty bounds generated from the probabilistic sensitivity analysis.

CONCLUSIONS

1. Scaling up universal testing and treatment may substantially reduce HIV prevalence while simultaneously reducing HIV-related mortality in highly endemic regions.
2. Improving linkage to care and preventing loss to follow-up may reduce more than twice the HIV-related deaths and new infections over ten years compared with testing and treatment alone.
3. The mortality and transmission benefits have synergistic benefits – scaling up multiple aspects of HIV care simultaneously provides more benefits than the sum of each aspect individually. This is because each individual who enters long-term treatment reduces HIV spread by more than one infection over his or her lifetime.
4. Even under the most comprehensive scale up of HIV care, the burden of disease over the next decade is expected to remain substantial.

ACKNOWLEDGMENTS

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