The University of Alabama at Birmingham

Repeat HIV Testing during Pregnancy in Kenya: An Economic Evaluation

Anna Joy Rogers[1*], DrPH, MA, Janet M. Turan[1], PhD, MPH, Ellen F. Eaton[2], MD, and Stephen T. Mennemeyer[1], PhD
[1]Department of Health Care Organization and Policy, University of Alabama at Birmingham School of Public Health; [2]Department of Medicine, University of Alabama at Birmingham School of Medicine
*rogersaj@uab.edu

INTRODUCTION

Repeat HIV testing during late pregnancy may identify women who seroconvert after an initial negative HIV test early in pregnancy, allowing these women to adopt lifelong antiretroviral therapy (ART) for the sake of their own health as well as to prevent mother-to-child transmission of HIV [1]. We evaluated the cost-effectiveness of repeat HIV testing during late pregnancy in Kenya, hypothesizing that retesting would be cost-effective when compared to initial HIV testing alone due to health benefits accrued by mother and child.

METHODS

We used TreeAge (TreeAge Software Inc, Williamstown, MA) to model a decision tree (Figure 1) with the initial decision node comparing the alternative HIV testing strategies (a single antenatal HIV test early in pregnancy, or the initial antenatal HIV test plus a repeat HIV test three months later) and the successive chance nodes representing antepartum possibilities including maternal seroconversion, maternal ART uptake, fetal HIV acquisition, facility delivery, and mortality during delivery.

At delivery of the infant, each branch culminates in a state-transition model that jointly tracks the mother-infant pair (Figure 2). All inputs were drawn from the literature and were varied across their range or distribution in univariate and probabilistic sensitivity analyses.

- **Analytic horizon:** 10 years
- **Markov cycle length:** 1 month
- **Study perspective:** Government payer
- **Discount rate:** 3% (costs, effectiveness)
- **Currency:** 2016 US dollars

Figure 1: Decision Tree

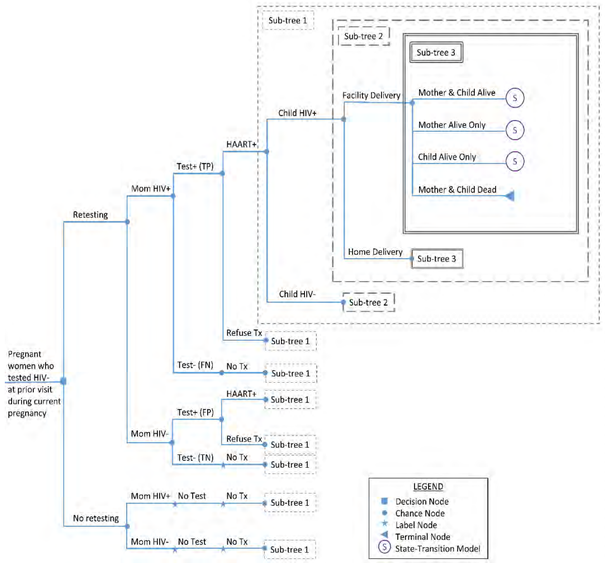
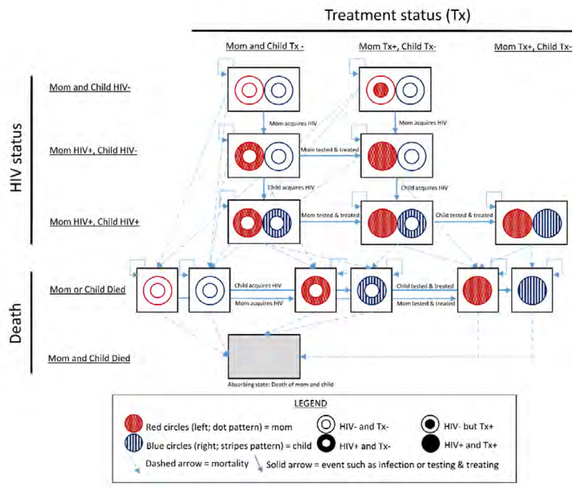


Figure 2. State-transition Model



RESULTS

In the base case, the addition of repeat HIV testing during pregnancy to an initial HIV test produces an incremental cost-effectiveness ratio of $1,098/QALY (Table 1). This strategy is very cost-effective for the Kenyan setting using a threshold of $1,367/QALY [2,3]. The retesting strategy also resulted in fewer cases of infant HIV transmission antenatally (504) and postnatally through breastfeeding (253) in our hypothetical cohort of 100,000 women, suggesting a 93.1% excess (95% CI: 77.5%, 110.2%) of perinatal HIV transmissions in the no-retesting strategy compared to the retesting strategy. It also resulted in fewer deaths among both mothers (178) and children (30) over a 10 year time frame. The total excess cost of adding repeat HIV testing would be $16 per woman when accounting for both testing and long-term treatment costs. The cost per infant HIV infection averted is $2,203 and the cost per mother or infant death averted is $8,018..

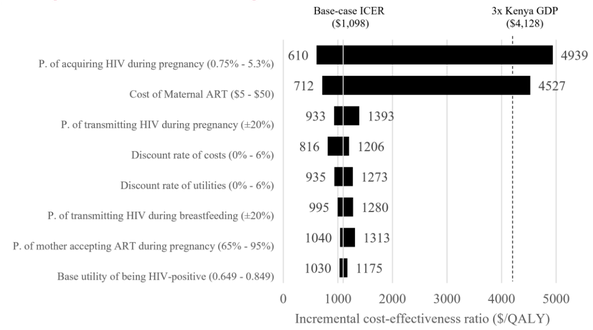
Table 1. Model Outcomes from Base-case analyses

Outcome	Strategy 1 (No Retesting)	Strategy 2 (Retesting)	Excess in Strategy 2
Costs, $	12,753,297	14,421,207	1,667,909
Quality-adjusted Life Years (QALYs)	1,627,557	1,629,076	1,518
Child HIV infections during pregnancy	609	105	-504
Child HIV infections during breastfeeding	1583	826	-253
Maternal deaths	3,996	3,818	-178
Child deaths	8,496	8,466	-30

All costs and effects are per 100,000 women and 100,000 infants modeled; deaths may be due to background mortality or HIV-related causes.

In univariate sensitivity analyses, results were robust to changes in all but a few key variables. Probability of maternal HIV acquisition during pregnancy was a key determinant of cost-effectiveness; retesting was no longer cost-effective for cumulative incidence rates during pregnancy below 1% (Figure 3). The model was also sensitive to the cost of antiretroviral therapy for the mother; when the monthly cost exceeded $45 retesting was no longer cost-effective.

Figure 3: Tornado Diagram



In probabilistic sensitivity analyses, results were cost-effective 73.4% of the time. In 22.6% of the scenarios, repeat HIV testing was both more costly and less effective and thus dominated. In 100% of the scenarios, retesting averted infant HIV infections, with 23.6% of the scenarios estimating over 1,000 averted infections. On average, the models found that retesting was associated with 784 fewer infections per 100,000 women, which came at an average cost of $1,778,677.

CONCLUSIONS

- ❑ Late pregnancy repeat HIV testing was cost-effective for the Kenyan setting at $1,098/QALY when considering the benefits of 757 averted perinatal HIV transmissions and 208 reduced maternal and child deaths.
- ❑ Infant HIV infections were averted in 100% of the scenarios.
- ❑ Study strengths: Use of a stochastic model and a unique state-transition model that allows for joint tracking of maternal and child outcomes.
- ❑ Study limitations: Did not model potential horizontal HIV transmissions averted, use of nevirapine during labor, or cesarean deliveries to reduce transmission. These omissions possibly rendered our estimates conservative.

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1. Joint United Nations Programme on HIV/AIDS (UNAIDS). Countdown to zero: Global plan towards the elimination of new HIV infections among children by 2015 and keeping their mothers alive. Geneva: UNAIDS; 2011.
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3. The World Bank. Kenya GDP per capita 2016; http://data.worldbank.org/indicator/NY.GDP.PCAP.CD.

ACKNOWLEDGEMENTS:
National Institute of General Medical Sciences (T32GM008361)
National Center for Advancing Translational Sciences (1TL1TR001418-01)
Infectious Disease Society of America (Medical Scholarship)

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