The Cost-Effectiveness of Adding a Third HIV Test in Routine HIV Testing to Reduce the Frequency of False Positive Test Results in Sub-Saharan Africa

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UNDER WHAT CIRCUMSTANCES IS IT COST-EFFECTIVE TO ADD A THIRD TEST TO REDUCE INCIDENCE OF FALSE-POSITIVE HIV TESTS?

FOR ACTUAL HIV-NEGATIVES:

Current algorithm	Algorithm under evaluation
N	N
P → N → P	P → N → P
P → N → N	P → N → N
P → P	P → P → N → N
	P → P → P

'N' =HIV neg test result; 'P' = pos test result

Is a third test cost-effective under current epi and cost conditions?
Is it CE with expanded access to treatment, e.g. “Test and treat”?

METHODS

Excel-based CE model with SAs including Monte Carlo using @RISK

Literature – based estimates for

- Cost per person-year of ART
- Disutility due to HIV + status and ART
- Cost and test performance of HIV tests

Scenarios based on

- Prevalence of HIV
- Time on ART for False +
- Years before re-test for those who do not access ART
- ART coverage: % of people tested HIV-positive who enrol in ART

Inputs

Cohort	100,000	Range for SAs	
Prevalence	10.0%	5%	15%
Discount rate	3.0%	0.015	5%
ART coverage	36%	18%	54%
Yrs of ART for false+	6	3	9
Yrs before re-test for false + not on ART	4	2	6
Cost per ART year	$767	$537	$997
Disutility: Side-effects of ART	0.04	0.02	0.06
Disutility: HIV+ diagnosis	0.07	0.035	0.105

Test Performance

Test 1: Capillus		Range for SAs (95% CI)	
Sensitivity-tst1	99.8%	99.60%	100%
Specificity-tst1	98.8%	99.60%	100%
Test 2: Determine			
Sensitivity-tst2	97.8%	95.60%	100%
Specificity-tst2	99.4%	96.70%	100%
Test 3: SD Bioline			
Sensitivity-tst3	98.9%	98.40%	100%
Specificity-tst3	99.3%	98.95%	100%

Test Cost

	Kit	Lab tech	Total
Test 1: Capillus	$2.20	$0.10	$2.30
Test 2: Determine	$0.80	$0.10	$0.90
Test 3: SD Bioline	$1.10	$0.10	$1.20
Tie breaker: Uni-Gold	$1.60	$0.10	$1.70

Results: 10% HIV prevalence

	Number of tests	Test costs	False+ averted
Test 1	100,000	$230,000	0
Test 2 if P plus tie-breakers if P-N	12,358	$10,992	1,066.0
Test 3 if P-P, plus tie-breakers if P-P-N	**9,881**	**$13,474**	**6.4**

Incremental cost-effectiveness

DALYs averted	**2.45**
Cost per false pos averted	**$2,094**
Per DALY averted unadjusted for saved ART costs	**$5,495**
Per DALY averted adjusted for saved ART costs	**$1,568**
Cost (savings) per pt tested (+ & -)	**$0.04**
Net program costs (savings)	**$3,846**

Cost-effective in many countries, but not cost-saving assuming 36% access to ART; and 6 yrs of ART.

Results: 5% HIV prevalence

	Number of tests	Test costs	False+ averted
Test 1	100,000	$230,000	0
Test 2 if P plus tie-breakers if P-N	7,375	$6,513	1,125.2
Test 3 if P-P, plus tie-breakers if P-P-N	**4,947**	**$7,463**	**6.8**

Incremental cost-effectiveness

DALYs averted	**2.59**
Cost per false pos averted	**$1,099**
Per DALY averted unadjusted for saved ART costs	**$2,884**
Per DALY averted adjusted for saved ART costs	**Cost-saving**
Cost (savings) per pt tested (+ & -)	**($0.03)**
Net program costs (Savings)	**($2,700)**

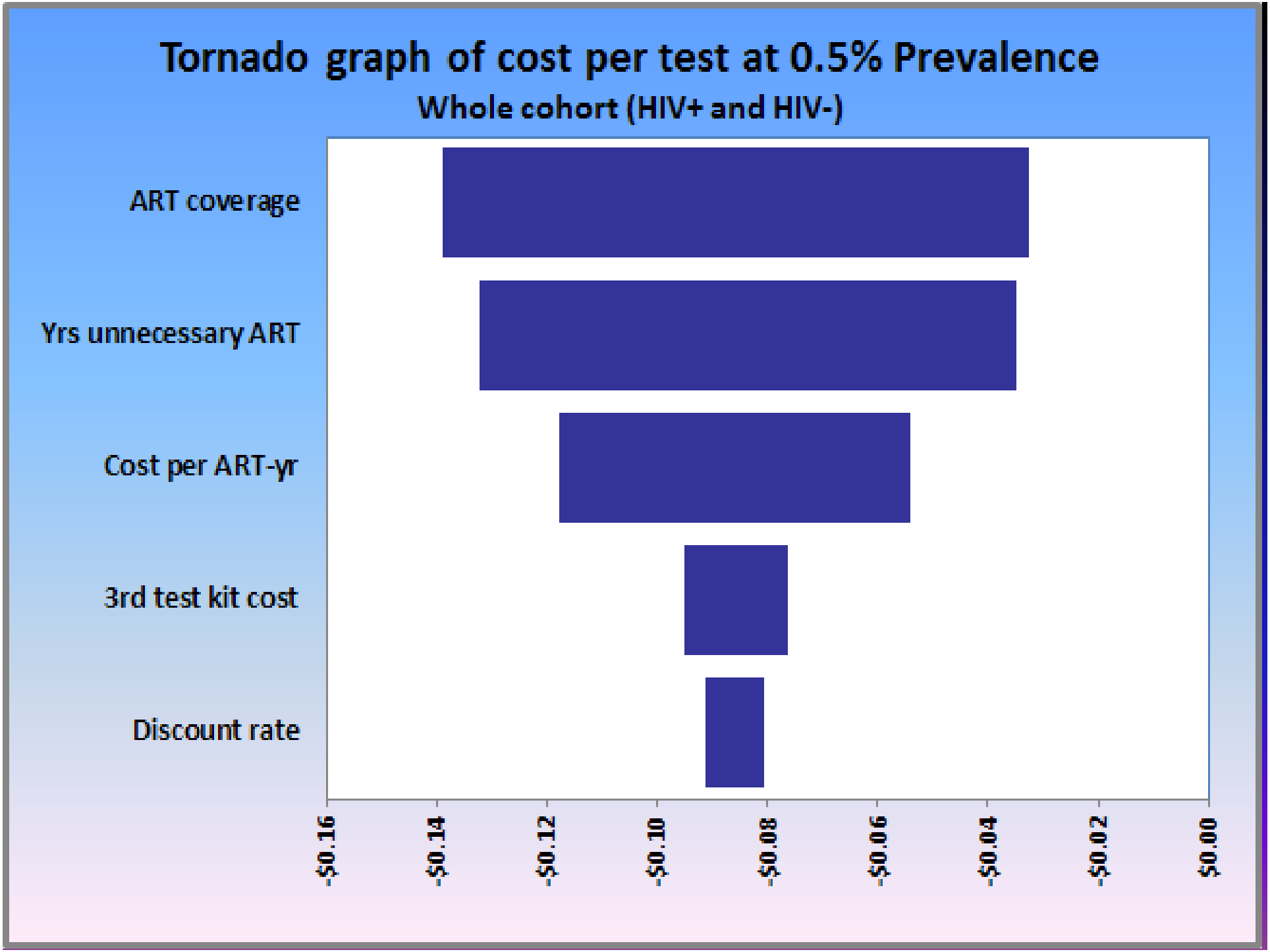
Results: 0.5% HIV prevalence

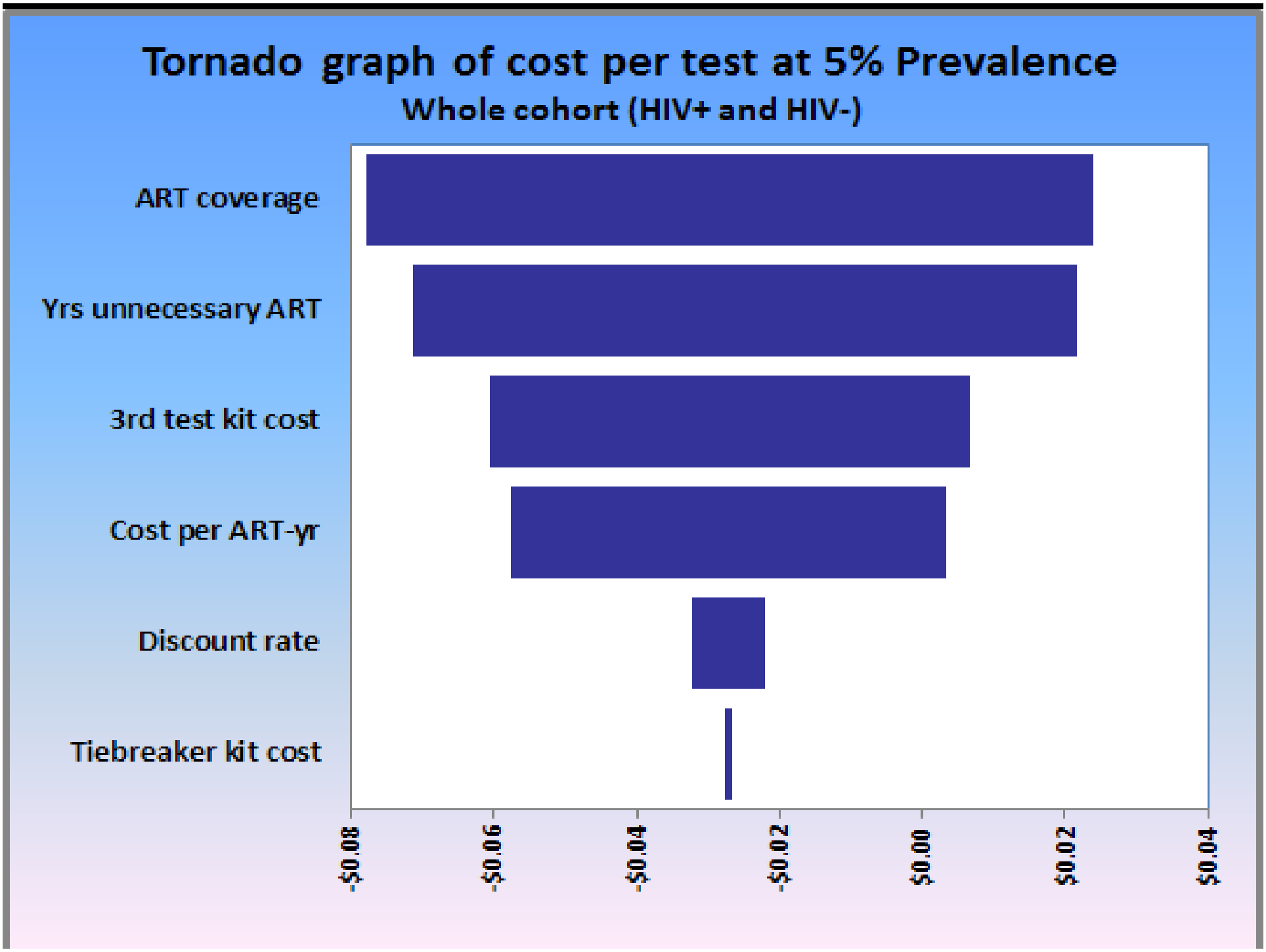
	Number of tests	Test costs	False+ averted
Test 1	100,000	$230,000	0
Test 2 if P plus tie-breakers if P-N	2,891	$2,482	1,178.5
Test 3 if P-P, plus tie-breakers if P-P-N	**508**	**$2,053**	**7.1**

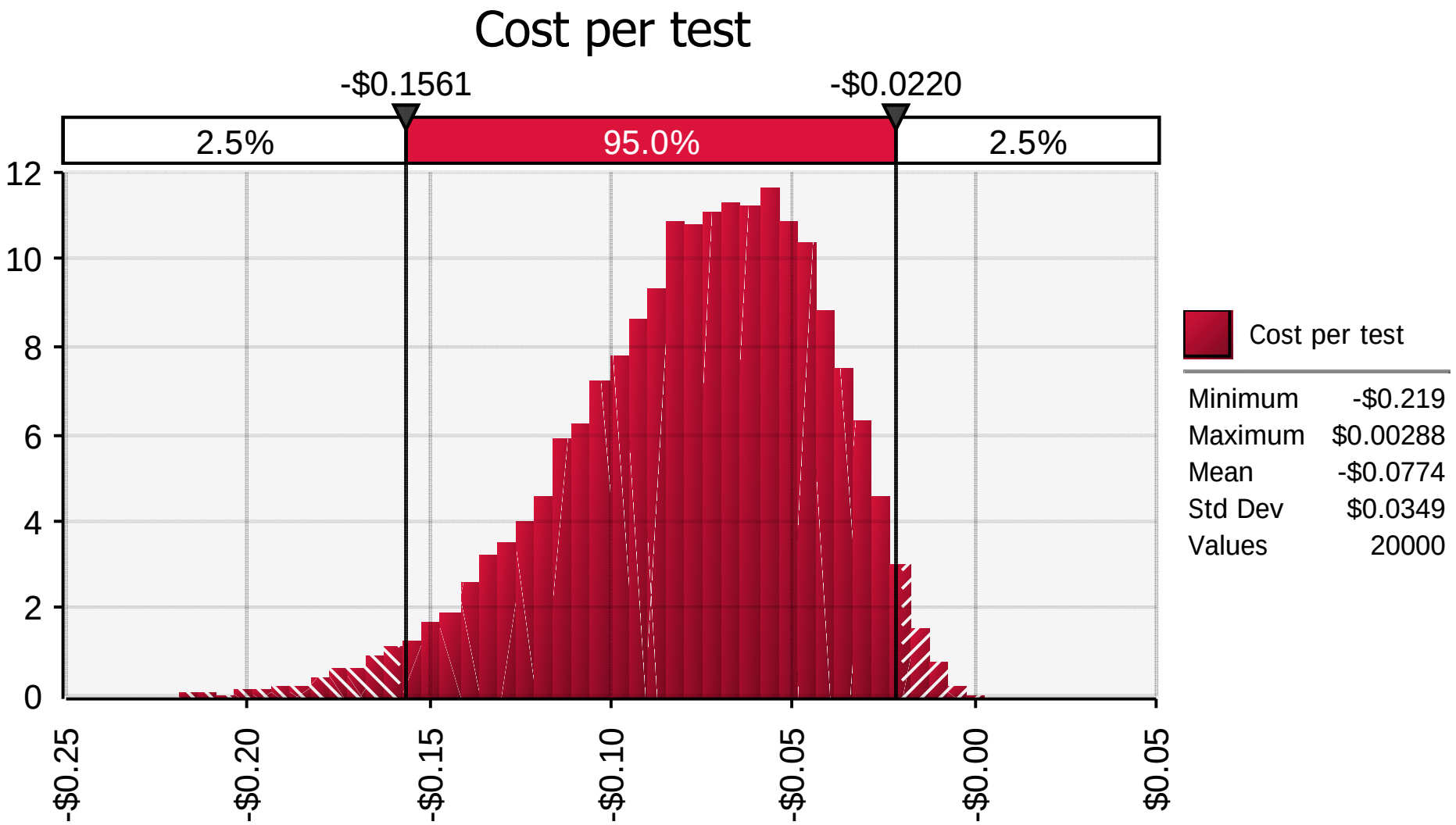
Incremental cost-effectiveness

DALYs averted	**2.71**
Cost per false pos averted	**$289**
Per DALY averted unadjusted for saved ART costs	**$757**
Per DALY averted adjusted for saved ART costs	**Cost-saving**
Net costs (savings) per person starting test sequence	**($0.09)**
Net program costs (savings)	**($8,591)**

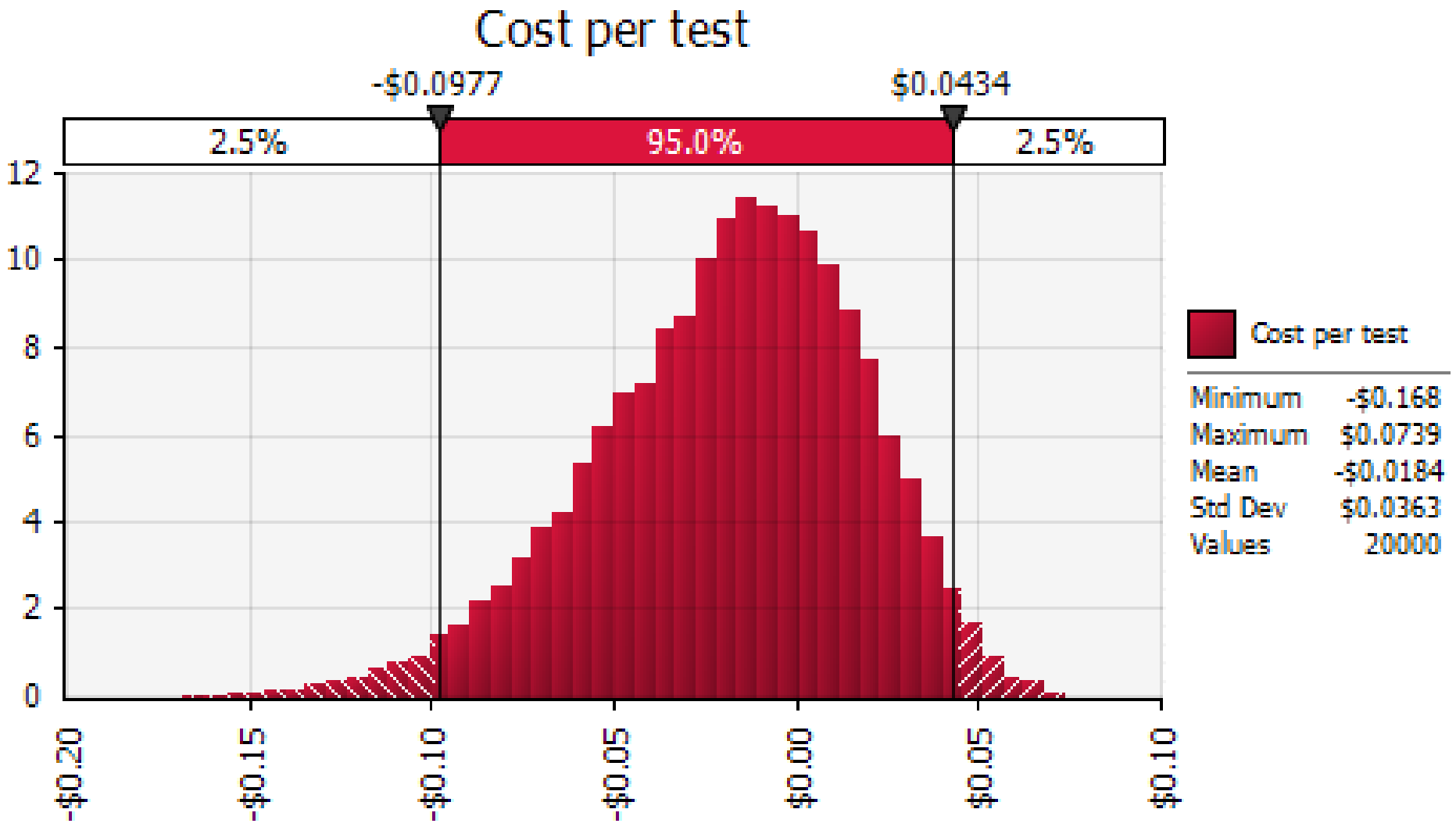
Cost-effective and cost-saving assuming 36% access to ART; and 6 yrs of ART.


Tornado graph of cost per test at 0.5% Prevalence
Whole cohort (HIV+ and HIV-)
ART coverage
Yrs unnecessary ART
Cost per ART-yr
3rd test kit cost
Discount rate
-$0.16
-$0.14
-$0.12
-$0.10
-$0.08
-$0.06
-$0.04
-$0.02
$0.00

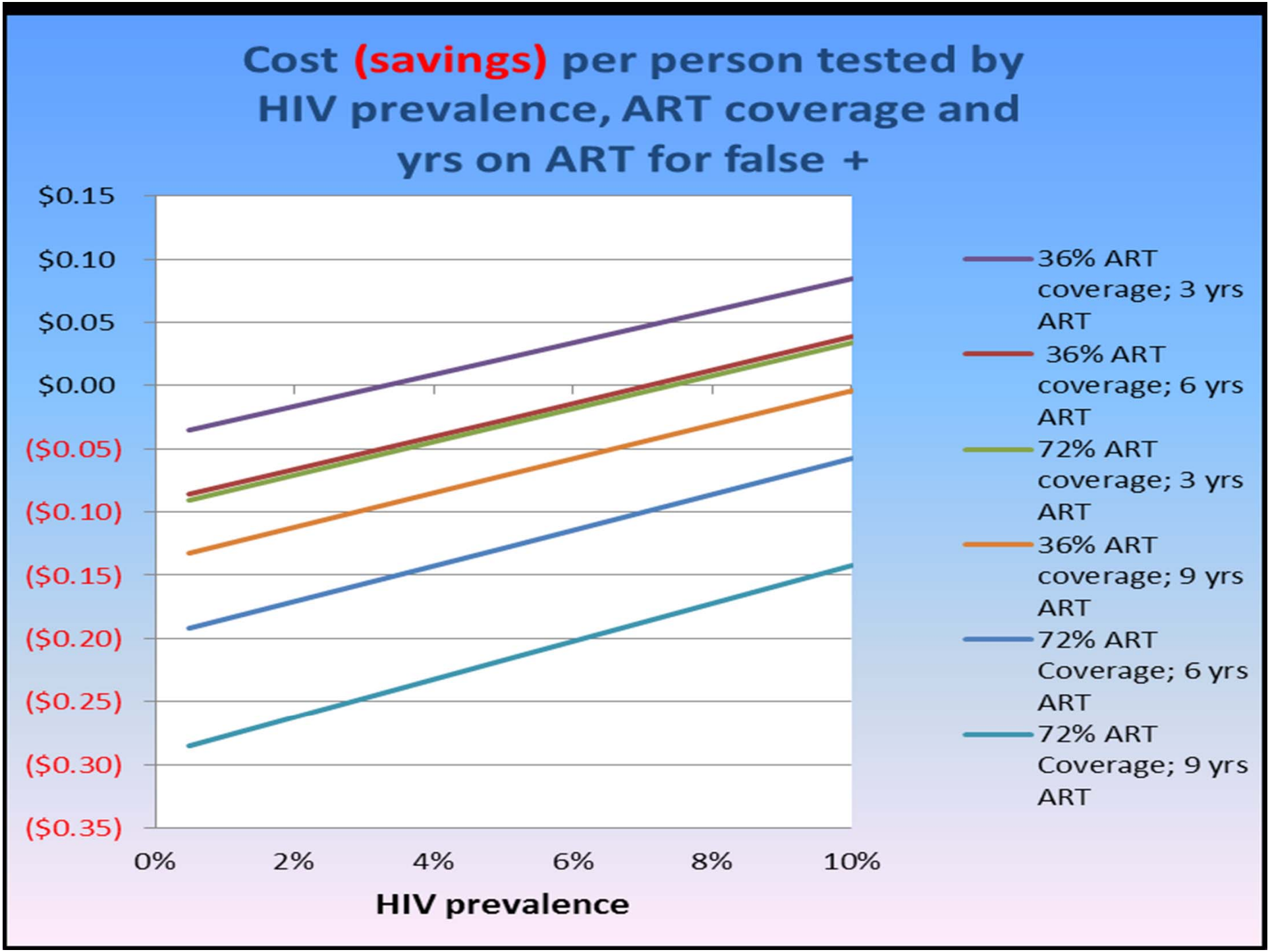

Tornado graph of cost per test at 5% Prevalence
Whole cohort (HIV+ and HIV-)
ART coverage
Yrs unnecessary ART
3rd test kit cost
Cost per ART-yr
Discount rate
Tiebreaker kit cost
-$0.08
-$0.06
-$0.04
-$0.02
$0.00
$0.02
$0.04

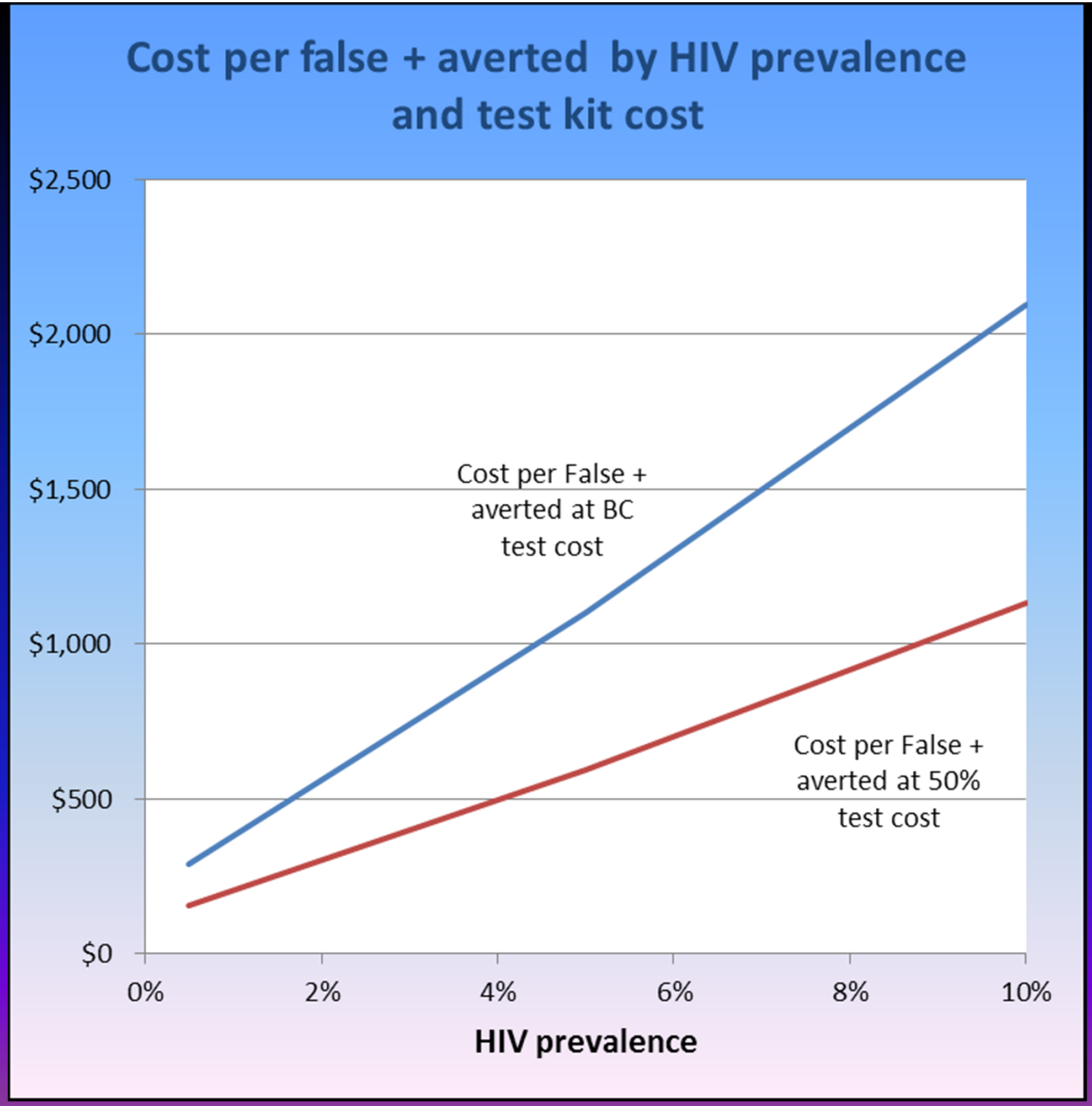


Net cost per person tested
0.5% HIV prevalence



Net cost per person tested
5.0% HIV prevalence


Cost (savings) per person tested by HIV prevalence, ART coverage and yrs on ART for false +
$0.15
$0.10
$0.05
$0.00
($0.05)
($0.10)
($0.15)
($0.20)
($0.25)
($0.30)
($0.35)
0%
2%
4%
6%
8%
10%
HIV prevalence
36% ART coverage; 3 yrs ART
36% ART coverage; 6 yrs ART
72% ART coverage; 3 yrs ART
36% ART coverage; 9 yrs ART
72% ART Coverage; 6 yrs ART
72% ART Coverage; 9 yrs ART


Cost per false + averted by HIV prevalence and test kit cost
$2,500
$2,000
$1,500
$1,000
$500
$0
Cost per False + averted at BC test cost
Cost per False + averted at 50% test cost
0%
2%
4%
6%
8%
10%
HIV prevalence

Third test is cost-effective with these combinations of inputs

Access to ART	Years of ART	HIV prevalence
1.8%	3	0.5%
36.0%	3	4.5%
50.0%	6	11.5%
72.0%	9	21.5%

Cost-effectiveness threshold:

$800 = per-capita GDP of Kenya

CONCLUSIONS – IMPLICATIONS:

- Third-test strategy is cost-saving in low-prevalence settings with high rates of access to ART.
- Such settings will be increasingly common in the context of "test and treat" featuring frequent re-tests.
- Thus, these test algorithms are worth considering as an opportunity to reduce the costs and increase the benefits of expanded access to ART.