APPENDIX: MODEL EQUATIONS

$$\frac{d}{dt}S_{ij..} = -\gamma_{ij..}S_{ij..} + t_{i.}qs_{ij..}Is_{ij..} + \varphi N_{ij..} - \varphi S_{ij..} + \alpha_{i.}(Ia_{ij..} + Is_{ij..}) + nR_{ij..} + \delta_{i.}Z_{ij..}$$

$$\frac{d}{dt}E_{ij..} = \gamma_{ij..}S_{ij..} - \omega E_{ij..} - \varphi E_{ij..}$$

$$\frac{d}{dt}Is_{ij..} = \xi_{i.}\omega E_{ij..} - qs_{i.}Is_{ij..} - \varphi Ia_{ij..} - \alpha_{i.}Is_{ij..}$$

$$\frac{d}{dt}Ia_{ij..} = \omega E_{ij..}(1-\xi_{i.}) - qa_{i.}Ia_{ij..} - \varphi Ia_{ij..} - \alpha_{i.}Ia_{ij..}$$

$$\frac{d}{dt}R_{ij..} = (1-p_{i.})(1-t_{i.})qs_{i.}Is_{ij..} + (1-p_{i.})qa_{i.}Ia_{ij..} - \varphi R_{ij..} - nR_{ij..}$$

$$\frac{d}{dt}Z_{ij..} = p_{i.}(1-t_{i.})qs_{i.}Is_{ij..} + p_{i.}qa_{i.}Ia_{ij..} - \delta_{i.}Z_{ij..} - \varphi Z_{ij..}$$

Force of infection:

$$\gamma_{ij..} = \beta_{i.}c_{ij..}\sum_{k}\tau_{ijk}\frac{I_{i'k}}{N_{i'k}}$$

Population size:

$$N_{ij..} = S_{ij..} + E_{ij..} + Is_{ij..} + Ia_{ij..} + R_{ij..} + Z_{ij..}$$

Prevalence:

$$\kappa_{ij} = \frac{Is_{ij} + Ia_{ij}}{N_{ij}}$$

Mixing equation:

$$\tau_{ijk} = \varepsilon M_{jk} + (1 - \varepsilon)\left(\frac{c_{i'k} N_{i'k}}{\sum_{k} c_{i'k} N_{i'k}}\right)$$

QALYs:

$$\text{Total discounted QALYs} = \int_{y=1}^{50} \frac{1}{\exp^{ry}}\left(qaly\_ct_i \xi_i \omega_i (E_{ij}) + qaly\_seq_i (p_i (1 - t) qs_i (Is_{ij}) + p_i qa_i (Ia_{ij}))\right) \bullet dy$$

Costs:

Total discounted cost =

$$\int_{y=1}^{50} \frac{1}{\exp^{ry}}\left(\begin{array}{l} s_i test\_cost_i N_{ij} + p\_rx(test\_cost_i + rx\_cost_i) qs_i (Is_{ij}) + s_i sens \bullet p\_rx\_sc \bullet rx\_cost_i (Ia_{ij} + Is_{ij}) \\ + s_i (1 - spec) p\_rx\_sc \bullet rx\_cost_i (S_{ij} + E_{ij} + R_{ij} + Z_{ij}) + seq\_cost_i p_i (1 - t) qs_i (Is_{ij}) + seq\_cost_i p_i qa_i (Ia_{ij}) \end{array}\right) \bullet dy$$

Infections:

$$\text{Total discounted infections} = \int_{y=1}^{50} \frac{1}{\exp^{ry}} \left(\omega_i (E_{ij}) \right) \bullet dy$$

Sequelae:

$$\text{Total discounted sequelae} = \int_{y=1}^{50} \frac{1}{\exp^{ry}} \left(p_i (1 - t) qs_i (Is_{ij}) + p_i qa_i (Ia_{ij}) \right) \bullet dy$$

Where S (susceptible), E (exposed), Is (infectious and symptomatic) and Ia (infectious and asymptomatic), R (infection-conferred immunity) and Z (sequelae) are the six compartments representing six mutually exclusive health status; subscripts i, and j represent gender (i = 1 for men, i = 2 for women) and sexual activity class (j = 1 for low, j = 2 for high), respectively, unless otherwise described;[26] α is the annual screen-and-treat coverage which is the product of the screening rate (s), test sensitivity (sens), post-screening treatment rate (p_rx_sc) and treatment efficacy (rx_sucess); when the Opt-Out Testing program begins, s is equal to the product of insurance coverage (p_ins), proportion with at least one encounter (p_enc) and uptake (p_acc – proportion accepting the test). The recovery rate is represented by qs/qa_i (qs for symptomatic infections; qa for asymptomatic infections); rate of exit and entry into the population per year is represented by φ; proportion treated successfully is represented by t (the product of probability of treatment (p_rx/p_rx_sc) and treatment efficacy(rx_success)[26]; n is the waning rate for infection-conferred immunity; p is the probability of sequelae; δ represents the movement from sequelae to susceptible; the proportion of symptomatic infections is ξ; rate of

exit from the exposed state to the infectious states is ω (for simplicity, it was assumed that the time from infection to infectiousness was the same as the time from infection to symptoms);[26] the force of infection (γ) is given by the product of the per-partner transmission probability (β), the rate of sex partner change (c), and the proportion of sex partners infected – determined by the mixing matrix ($\tau_{ijk,}$ where, subscript k is the sexual activity class of the partner) and the prevalence in the associated sexual-activity classes (κ); opposite subpopulation is differentiated by an apostrophe (’); M_{jk} represents full assortative mixing (equals 1 when j=k and 0 when j≠k); Thus, when ε = 0, then mixing is random and when ε = 1, mixing is fully assortative.[23,26,52] Partnerships were balanced by adjusting the partnership rates using the relationship $c_{11}N_{11} = c_{21}N_{21}$ and $c_{12}N_{12} = c_{22}N_{22}$ with the assumption that females made the choice of partnership – male partnerships were adjusted to equate female partnerships.[52] The discount rate is represented by r, y represents year and exp is the transcendental number equal to 2.71828.[26]

Berkeley Madonna, version 8.3.9 (Robert I. Macey and George F. Oster, Berkeley, California) was used to solve the system of differential equations, which employed a fixed time step size of 0.01 year (i.e., ≈ 4 days) and approximated the system of differential equations using Runge-Kutta methods (RK4). Microsoft Excel, version 2010 (Microsoft Corporation, Redmond, WA) was used for creating the LHS table for the sensitivity analyses, and Stata version 11.1 (StataCorp LP, College Station, TX) for performing the partial rank correlation coefficient analyses.

Prevalence Results

The detail calibrated prevalences by sex and sexual activity were:

No Screening: Women (high activity, 8.84%; low activity, 0.13%)

Men (high activity, 4.85%; low activity, 0.12%).

Risk-Based Screening: Women (high activity, 4.47%; low activity, 0.066%)

Men (high activity, 2.66%; low activity, 0.059%).

Opt-Out Testing: Women (high activity, 1.98%; low activity, 0.031%)

Men (high activity, 1.24%; low activity, 0.026%).

Appendix Table 1. Summary Partial Rank Correlation Coefficients for Select Parameters

Variable/Parameter[a]	Rank coefficient[b]	*p*-values
Female pre-vaccination prevalence		
Proportion in high activity class, female	0.55	0.000
Duration of infection-conferred immunity	-0.46	0.000
Per-partner probability of transmission, male to female	0.38	0.000
Duration of asymptomatic infection, female	0.31	0.000
Duration of asymptomatic infection, male	0.25	0.000
Proportion of symptomatic infections, female	-0.21	0.000
Proportion of symptomatic infections, male	-0.12	0.000
Pre-opt-out screening coverage	0.11	0.022
Number of partners in the last year, high sexual activity females	0.10	0.025
Duration of symptomatic infection, females	0.09	0.031
Probability of post-screening treatment	-0.08	0.049
Entry-exit rate	0.04	0.078
Incremental cost-effectiveness ratio (ICER)		
Female pre-intervention prevalence	-0.65	0.000
Probability of sequelae, females	-0.41	0.000
Discount rate	0.20	0.001
Expected testing coverage, high activity class, females	-0.19	0.010
Testing cost	0.15	0.014

[a] Only variables/parameters with $p<0.10$ are presented.

[b] Presented in decreasing order of absolute magnitude—decreasing influence of the parameter on the ICER.