SUPPLEMENTAL DIGITAL CONTENT

Let B denote the behavioral pattern and let N denote the number of sexual partners. Additionally, let $\mathbf{C}$ denote a vector of partnership characteristics that includes the numbers of sexual acts with HIV-infected partners who are not virally suppressed, n_{jk}, where j is an index for sexual partner and k is an index for type of sexual act (not to be confused with behavioral pattern). The model relies on the following probabilities:

$$P(B) \tag{1}$$

$$P(N|B) \tag{2}$$

$$P(\mathbf{C}|N, B) \tag{3}$$

The modeling exercise estimates the probability distributions using various data sources, as explained in the Data subsection.

Each individual's conditional probability for infection is a function of N and $\mathbf{C}$:

$$P(I = 1|N, \mathbf{C}) = (1 - \prod_j \prod_k (1 - \pi_k)^{n_{jk}})(1 - \epsilon)^{\delta} \tag{4}$$

Here, j is an indicator for sexual partner, k is an index for type of sexual contact, I is a Bernoulli-distributed random variable with a value of 1 if the individual becomes infected, π_k is the per-act probability of infection associated with type k, n_{jk} is the number of acts of type k with partner j, ϵ is PrEP efficacy, and δ is an indicator taking a value of 1 if the individual accessed PrEP in the last year and 0 otherwise. The expression assumes independence across all acts, that the per-act probability of infection is constant within type, and that PrEP efficacy is constant.

By definition, $P(I|N, \mathbf{C}) = P(I|N, \mathbf{C}, B)$. Thus, the product of (1), (2), (3), and (4) is the joint distribution $P(I, \mathbf{C}, N, B)$. Summation over margins of the joint distribution provides the numerators and denominators of the quantities of interest:

$$P(B = b|I = 1) = \frac{P(I = 1, B = b)}{P(I = 1)}$$

For example, the numerator is the sum of $P(I, \mathbf{C}, N, B)$ over all $\mathbf{C}$ and N.