We have built a compartmental SIS-SIRS model in discrete time. We split the population into males, general females, and female sex workers (FSWs), and we further split the FSW population as described later. The male and general female populations can only be either susceptible or infected. Infected people return to the susceptible population at a constant rate. The female sex worker population can also only be either susceptible or infected in the baseline scenario, and return from infected to susceptible at the same constant rate.

We let denote the proportions of the male, female and FSW populations that are infected, respectively. Our model for the baseline scenario is the following:

In the intervention scenario, all of the existing dynamics still apply, but FSWs move into and out of an additional category. FSWs who receive effective PPT move from whichever population they are in into the resistant population. They then leave this population at a constant rate calibrated to the half-life of the treatment they receive, and return to the susceptible population.

The FSW population is split into sub-populations based on whether they join the program, and if they join the program, in which period they receive treatment. For example, an FSW who receives treatment in the first time step would be in sub-group 1, an FSW who receives treatment in the second time step would be in sub-group 2, and so on up to G subgroups of FSWs who receive treatment. FSWs who do not join the program are in sub-group 0, but FSWs who join the program to the extent they are counted in the coverage statistics, but never receive a dose of treatment, are in the sub-group for when they would have received treatment. We assume that equal numbers of FSWs receive treatment each time step, and that FSWs do not move between groups.

We let denote the proportions of each FSW sub-population that are infected. denotes the proportion of the th FSW sub-population that are currently resistant. For sub-groups which are not receiving treatment this time step,

For the sub-group receiving treatment time step , we assume that effective treatment will be provided to , 0<δ<1, of people in that sub-population, independently of their disease status. Our equations are,

We assume that treatment happens at the end of each time step, so that FSWs who receive treatment in a given time step infect people as normal during that time step.

We also modify our infection rate for men, to account for the different infection levels among the different FSW sub-populations.

In this model, every constant except is an input. We input the levels of STI we want in the population, and fit to these levels.