

Parameter assumptions from calculations done from literature information:

$$\beta_A = 0.000273$$

$$\beta_P = 0.000777$$

$$\mu = 0.00868$$

$$\mu_A = 0.00870$$

$$\mu_H = 0.0507$$

$$\theta_2 = 3\theta_1$$

$$\theta_3 = 16\theta_1$$

$$\nu = 0.0155$$

$$\zeta = 0.0241$$

$$P_0 = 0.0553$$

$$A_0 = 0.00148$$

Using MultiStart to obtain 8 values, where $\alpha = mt + b$:

$[m \ \theta_1 \ \epsilon \ \gamma \ \sigma \ b \ H_0 \ R_0]$

Parameter	Description	Units
μ	natural mortality rate	$\frac{1}{\text{year}}$
μ_A	opioid addict overdose death rate	$\frac{1}{\text{year}}$
μ_H	heroin addict overdose death rate	$\frac{1}{\text{year}}$
α	prescription rate	$\frac{1}{\text{year}}$
β_A	illicit addiction rate from the black market	$\frac{1}{\text{year}}$
β_P	illicit addiction rate from availability of excess pills	$\frac{1}{\text{year}}$
θ_1	heroin addiction rate for susceptible individuals	$\frac{1}{\text{year}}$
ϵ	rate of finishing prescription addiction-free	$\frac{1}{\text{year}}$
γ	opioid addiction rate from prescription	$\frac{1}{\text{year}}$
θ_2	heroin addiction rate for prescription opioids users	$\frac{1}{\text{year}}$
σ	relapse to addiction	$\frac{1}{\text{year}}$
ζ	rate of stable recovery for opioid addict	$\frac{1}{\text{year}}$
θ_3	heroin addiction rate for opioid addicts	$\frac{1}{\text{year}}$
ν	rate of stable recovery for heroin addict	$\frac{1}{\text{year}}$
ω	perturbation term	dimensionless
S	proportion of susceptible individuals	dimensionless
P	proportion of susceptible individuals	dimensionless
A	proportion of susceptible individuals	dimensionless
H	proportion of susceptible individuals	dimensionless
R	proportion of susceptible individuals	dimensionless

Table 1: Number of individuals in each category, 2013-2018

	2013	2014	2015	2016	2017	2018
Total population	6,490,795	6,540,007	6,590,726	6,649,404	6,715,984	6,770,010
Population 12 and older	5,517,176	5,559,006	5,602,117	5,651,993	5,708,586	-
Heroin users	-	14,000	14,000	19,000	-	-
Heroin addicts	-	7,560	7,560	10,260	-	-
Prescription opioid addicts (includes heroin addicts)	48,674	48,163	48,000	42,000	39,020	-
Prescription opioid addicts (excludes heroin)	43,418	42,928	42,816	37,464	34,805	-
Prescribed opioid users (includes those addicted)	1,845,144	1,824,342	1,819,581	1,761,363	1,636,374	-
Prescribed opioid users (excludes those addicted)	1,828,096	1,807,287	1,802,570	1,746,478	1,622,545	-
Prescription opioid overdose deaths	-	-	679	-	-	-
Heroin/fentanyl overdose deaths	-	-	374	-	-	-
Prescription opioid treatment admissions	4,485	4,530	4,326	-	-	-
Heroin treatment admissions	555	743	1,083	-	-	-

italicized values are numbers that we estimated by extrapolating from a different year

bolded values are numbers that we estimated by information within the same year

the rest of the numbers are actual data

the numbers in **blue** are data used for parameter estimation