

Parameter assumptions from calculations done from literature information:

$$\beta_A = 0.000273$$

$$\beta_P = 0.000777$$

$$\mu = 0.00868$$

$$\mu_A = 0.00775$$

$$\mu_H = 0.0271$$

$$\theta_2 = 3\theta_1$$

$$\theta_3 = 16\theta_1$$

$$\nu = 0.0155$$

$$\zeta = 0.0241$$

$$P_0 = 0.0553$$

$$A_0 = 0.00148$$

Using MultiStart to obtain 7 values:

$$[\alpha \ \theta_1 \ \epsilon \ \gamma \ \sigma \ H_0 \ R_0]$$

Parameter	Description	Units
$\mu$	natural mortality rate	$\frac{1}{\text{year}}$
$\mu_A$	opioid addict overdose death rate	$\frac{1}{\text{year}}$
$\mu_H$	heroin addict overdose death rate	$\frac{1}{\text{year}}$
$\alpha$	prescription rate	$\frac{1}{\text{year}}$
$\beta_A$	illicit addiction rate from the black market	$\frac{1}{\text{year}}$
$\beta_P$	illicit addiction rate from availability of excess pills	$\frac{1}{\text{year}}$
$\theta_1$	heroin addiction rate for susceptible individuals	$\frac{1}{\text{year}}$
$\epsilon$	rate of finishing prescription addiction-free	$\frac{1}{\text{year}}$
$\gamma$	opioid addiction rate from prescription	$\frac{1}{\text{year}}$
$\theta_2$	heroin addiction rate for prescription opioids users	$\frac{1}{\text{year}}$
$\sigma$	relapse to addiction	$\frac{1}{\text{year}}$
$\zeta$	rate of stable recovery for opioid addict	$\frac{1}{\text{year}}$
$\theta_3$	heroin addiction rate for opioid addicts	$\frac{1}{\text{year}}$
$\nu$	rate of stable recovery for heroin addict	$\frac{1}{\text{year}}$
$\omega$	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	-
Prescription opioid users (includes those addicted)	1,845,144	1,824,342	1,819,581	1,761,363	1,636,374	-
Opioid addicts	<i>48,674</i>	<i>48,163</i>	<i>48,000</i>	<i>42,000</i>	<i>39,020</i>	-
Non-addicted prescription opioid users	<i>1,823,581</i>	<i>1,803,006</i>	<i>1,798,317</i>	<i>1,642,757</i>	<i>1,619,088</i>	-
Heroin addicts	-	14,000	14,000	19,000	-	-
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