

- The following are the **number of individuals initially in each class** for Tennessee:
 - *Susceptibles: (Total population in 2015-size of four other classes= 6590726 – 1,819,581 – 70,000 – 14,000 – R_0 =FILL IN) [7]
 - *Prescription opioid users, 2015: 1,819,581 [2]
 - *Opioid addicts: 56,000
 - Original website source not found https://www.tn.gov/assets/entities/behavioral-health/sa/attachments/Prescription_For_Success_SECTION_1.pdf.
 - Several sources say 70,000 opioid addicts, such as American Addiction Centers
 - They do not say for which year
 - Assuming opioid addicts includes heroin and fentanyl users, so took 70,000-14,000=56,000
 - *Heroin/fentanyl addicts, 2015/2016 average for “Past Year Heroin Use”: 14,000 [4]
 - *Recovering addicts: won’t be able to find because we do not know the total of individuals total that have been in treatment ever in the past for our time frame*

The number of heroin users do not include fentanyl users explicitly, but we are under the assumption that those who take fentanyl are a subset of those who use heroin, and therefore, would mostly be included in these numbers. We admit the values may be slightly too low, for the cases of individuals who do fentanyl and not heroin, but we have not been able to find data for fentanyl addicts only and therefore, are working under the assumption that it would be a negligible population that does fentanyl without heroin.

- For Tennessee, the **total number of individuals taking prescription opioids** for pain [2]:
 - 2013: 1,845,144
 - 2014: 1,824,342
 - 2015: 1,819,581
 - 2016: 1,761,363
 - 2017: 1,636,374
- **Treatment admissions for prescription opioids** as primary substance of abuse in Tennessee [6]
 - 2014: 4,145
 - 2015: 4,085
 - 2016: 3,911

OR for **non-heroin opiates/synthetics** from [1]

- 2005: 1,578
- 2006: 1,529
- 2007: 1,743
- 2008: 2,022
- 2009: 2,464
- 2010: 3,384
- 2011: 3,884
- 2012: 4,203
- 2013: 4,485
- 2014: 4,530

2015: 4,326

We assume that if one were addicted to heroin in addition to prescription opioids, their heroin problem would be the primary reason for going to treatment?

- **Treatment admissions for heroin** as primary substance of abuse in Tennessee [6]: Tennessee Dept of Mental Health and Substance Abuse Services-funded admissions to substance abuse treatment services:

2014: 538

2015: 826

2016: 1,184

OR from [1]: facilities that receive state/public funding (generally referring to funding by the state substance abuse agency)

2010: 199

2011: 240

2012: 390

2013: 555

2014: 743

2015: 1,083

These numbers do not include fentanyl users explicitly, but we are under the assumption that those who take fentanyl are a subset of those who use heroin, and therefore, would mostly be included in these numbers. We admit the values may be slightly too low, for the cases of individuals who do go to treatment with the primary substance of abuse being fentanyl, but there is not data available for those numbers currently.

- **Information for moving from recovery to opioid addiction or heroin/fentanyl addiction, σ_A and σ_H : [?]**

-Available for 2011-2015

-Seems more realistic that the individuals who go back to an addiction are those who “drop out” rather than “1-number of individuals who complete the program” since the latter includes those who are incarcerated, died, transferred, etc.

-Number of “Outpatient medication-assisted opioid therapy drop-outs” = 0 for 2015 in TN (compare to NJ: 3,732) -Number of “Medication-assisted opioid detox drop-outs” = 0 for 2015 in TN (compare to NJ: 311) -For ALL substance abuse treatment programs in TN: 3,039 dropped out out of 14,916 total admissions (extrapolate ratio to opioid related therapies?)

- We use data on the number of prescription opioid overdose deaths which include natural, semi-synthetic, and synthetic opioids; however, we subtract out the number of fentanyl overdoses (fentanyl is classified as a synthetic prescription opioid), since those overdoses are counted for in their own category. This results in the following **total number of prescription opioid overdose deaths** [3]:

2013:(637-53=) 584

2014: (697-69=) 628

2015: $(848-169=)$ 679
2016: $(1,009-294=)$ 715

- We add together the heroin and fentanyl overdoses from the years 2013-2016 for the state of Tennessee. The **total number of heroin and fentanyl overdoses** for these four years are:
2013: $(63+53=)$ 116
2014: $(147+69=)$ 216
2015: $(205+169=)$ 374
2016: $(260+294=)$ 554 [3].
- The **total number of deaths, excluding overdoses** for individuals in Tennessee (took total deaths and subtracted out overdose deaths for the respective years) [5, 7]:
2013: $(63,199-584-116=)$ 62,499 out of an estimated total population of 6490795
2014: $(64,559-628-216=)$ 63,715 out of an estimated total population of 6540007
2015: $(66,329-679-374=)$ 65,276 out of an estimated total population of 6590726
2016: $(67,924-715-554=)$ 66,655 out of an estimated total population of 6649404
- For the 609,000 participants in the study, “the recent heroin incidence rate was 19 times higher among those who reported prior non-medical pain reliever (NMPR) use (0.39%) than among those who did not report NMPR use (0.02%). [?]
 $\implies (\theta_2 + \theta_3)$ 19 times greater than θ_1 ?

References

- [1] DEPARTMENT OF HEALTH AND HUMAN SERVICES: Substance Abuse and Mental Health Services Administration (2017). Treatment episode data set (teds) 2005-2015 state admissions to substance abuse treatment services. Available at: https://www.dasis.samhsa.gov/dasis2/teds-pubs/2015_teds_rpt_st.pdf (accessed 9/24/18).
- [2] Office of Information and Analytics Tennessee Department of Health. Data dashboard. Available at: <https://www.tn.gov/health/health-program-areas/pdo/pdo/data-dashboard.html> (accessed 8/14/18).
- [3] Office of Information and Analytics Tennessee Department of Health (2018). Prescription drug overdose program 2018 report. Available at: https://www.tn.gov/content/dam/tn/health/documents/pdo/PDO_2018_Report_02.06.18.pdf (accessed).
- [4] Substance Abuse and Mental Health Services Administration. Selected drug use, perceptions of great risk, past year substance use disorder and treatment, and past year mental health measures in tennessee, by age group: Estimated numbers (in thousands), annual averages based on 2015-2016 nsduhs. Available at: <https://www.samhsa.gov/data/report/2015-2016-nsduh-state-specific-tables> (accessed 11/27/17).
- [5] Tennessee Department of Health. General health data: Death statistics. Accessed at: <https://www.tn.gov/health/health-program-areas/statistics/health-data/death-statistics.html> (accessed 8/29/18).
- [6] Tennessee Department of Mental Health and Substance Abuse Services (2017). 2017 tennessee behavioral health county and region services data book. Available at: https://www.tn.gov/content/dam/tn/mentalhealth/documents/DPRF_BH_county_region_service_data_2017_FINAL.pdf (accessed 8/29/18).
- [7] United States Census Bureau (2018). National, state, and puerto rico commonwealth totals datasets: Population, population change, and estimated components of population change: April 1, 2010 to july 1, 2017. Available at: <https://www.census.gov/data/datasets/2017/demo/popest/state-total.html#partextimage500989927> (accessed 9/6/18).