A Standardization Model for Estimating Populations of Persons Who Inject Drugs in US States, 2017

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Background

Need for state-level PWID population size estimates

Estimates of population sizes of persons who inject drugs (PWID) needed for US states to measure state-level **1)** surveillance rates of morbidity (e.g. newly diagnosed HCV, HIV, and other infections) and overdose mortality, **2)** disease prevalence and incidence estimates by scaling up from sample studies, and **3)** coverage of harm reduction services

Lack of current estimates

- Current US information includes national estimates from household survey data and metropolitan statistical areas estimates from analyses of multiple data sources. [1-2]
- Few state-level estimates exist and no systematic approach has been applied to multiple states.

Current methods limited for state-level estimation

- Sample study approaches yield localized estimates: Capture-recapture, service multiplier, and network scale-up methods.
- Multiple systems estimation, a big-data application of capture-recapture, cannot currently yield comprehensive state PWID estimates in US, given unavailability of robust national and state administrative databases. [3]

Methods

Earlier work

Adapted methods developed earlier for estimating men who have sex with men (MSM) population sizes in US states/counties and HCV prevalence in US states [4-5].

Figure 1. Standardization estimator

$$\hat{T}_i = (N_i \times \hat{\mu}) \times \left(\frac{\hat{\theta}_i}{\left(\frac{\sum_{i=1}^{I} (\hat{\theta}_i \times N_i)}{\sum_{i=1}^{I} N_i} \right)} \right)$$

Standardization model synthesizes national survey and local mortality data

- Anchored to weighted national current IDU prevalence among persons 18-64 years ($\hat{\mu}$) in 2017 National Survey of Drug Use and Health (NSDUH), conducted by SAMHSA
- For each state, calculated ratio of state-level narcotic overdose mortality rate ($\hat{\theta}_i$) over national average, using the 2017 National Vital Statistics System mortality microdata file (*ICD-10 codes: X42, Y12, X44, Y14*)
- State-level standardized ratio multiplied by national IDU prevalence, allocating the national PWID estimate to states ($\hat{T}_i$).
- Further demographic adjustment possible, as done for MSM and HCV estimates, but not conducted due to more significant underlying sources of error in national estimates.

Sensitivity analyses

- Overdose death distribution impacted by differential fatality of drugs present in local markets, with fentanyl major determinant. Additional analysis imputed 2017 state mortality rates, based on predictions from linear regression model of 2011-2014 trends (before surge in fentanyl-involved deaths).
- Additional analyses considered age-stratification and adjustment of published meta-analytic national 2010 estimates to 2011-2017 trends in NSDUH and mortality (*not shown*)

Results

Among persons 18-64: 928,960 (0.46%) PWID

- Ohio, Pennsylvania, West Virginia ≥ 1.00%
- Florida, Ohio, Pennsylvania ≥ 70,000 PWID

Among persons 18-40: 621,280 (0.61%) PWID

- New Hampshire, Ohio, Pennsylvania, West Virginia ≥ 1.25%
- Florida, Ohio, Pennsylvania ≥ 50,000 PWID

Sensitivity analyses

- Range of estimates narrowed when adjusting for increased mortality due to fentanyl

Figure 2. Estimated PWID 18-64 years by state, 2017

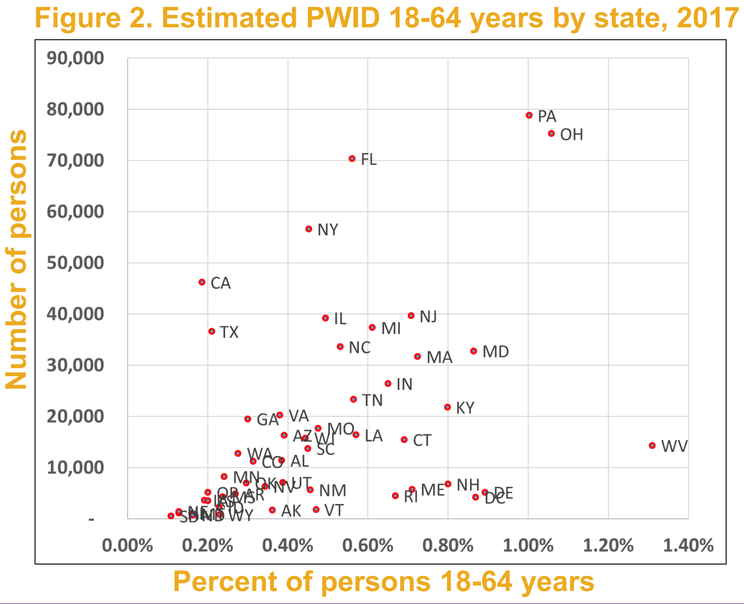

Table. Estimated, percent and number of PWID 18-64 years, by state, United States 2017

	Percent of adults		PWID	
	Primary model	Sens. Analysis	Primary model	Sens. Analysis
Alabama	0.38%	0.56%	11,450	16,760
Alaska	0.36%	0.38%	1,710	1,800
Arizona	0.39%	0.51%	16,330	21,450
Arkansas	0.27%	0.26%	4,850	4,750
California	0.19%	0.27%	46,220	68,460
Colorado	0.31%	0.37%	11,190	13,160
Connecticut	0.69%	0.74%	15,490	16,630
Delaware	0.89%	0.68%	5,200	3,970
Dist. of Columbia	0.87%	0.33%	4,220	1,600
Florida	0.56%	0.29%	70,410	36,930
Georgia	0.30%	0.34%	19,540	21,820
Hawaii	0.13%	0.12%	1,110	1,040
Idaho	0.23%	0.33%	2,310	3,370
Illinois	0.49%	0.45%	39,270	36,010
Indiana	0.65%	0.67%	26,450	27,080
Iowa	0.19%	0.22%	3,620	4,120
Kansas	0.20%	0.36%	3,510	6,290
Kentucky	0.80%	0.78%	21,820	21,370
Louisiana	0.57%	0.75%	16,390	21,460
Maine	0.71%	0.57%	5,800	4,650
Maryland	0.86%	0.74%	32,820	28,060
Massachusetts	0.72%	0.82%	31,710	35,780
Michigan	0.61%	0.66%	37,370	40,250
Minnesota	0.24%	0.24%	8,250	8,290
Mississippi	0.24%	0.36%	4,300	6,500
Missouri	0.48%	0.56%	17,720	20,730
Montana	0.16%	0.23%	1,010	1,440
Nebraska	0.13%	0.11%	1,470	1,260
Nevada	0.34%	0.31%	6,350	5,700
New Hampshire	0.80%	0.99%	6,780	8,390
New Jersey	0.71%	0.56%	39,660	31,440
New Mexico	0.46%	0.67%	5,690	8,320
New York	0.45%	0.41%	56,640	50,990
North Carolina	0.53%	0.38%	33,620	24,290
North Dakota	0.16%	0.27%	760	1,260
Ohio	1.06%	1.00%	75,250	71,190
Oklahoma	0.30%	0.52%	7,020	12,410
Oregon	0.20%	0.22%	5,140	5,650
Pennsylvania	1.00%	0.77%	78,800	60,330
Rhode Island	0.67%	0.94%	4,510	6,330
South Carolina	0.45%	0.46%	13,750	14,200
South Dakota	0.11%	0.15%	550	770
Tennessee	0.56%	0.65%	23,320	27,040
Texas	0.21%	0.24%	36,610	41,350
Utah	0.39%	0.62%	7,110	11,500
Vermont	0.47%	0.44%	1,830	1,700
Virginia	0.38%	0.39%	20,270	20,800
Washington	0.28%	0.32%	12,800	14,690
West Virginia	1.31%	1.05%	14,340	11,470
Wisconsin	0.44%	0.52%	15,790	18,570
Wyoming	0.23%	0.57%	810	2,000
Total	0.46%	0.46%	**928,960**	**928,960**

Limitations

- Anchored to national estimates that likely undercount IDU. NSDUH oversamples young persons but is limited by non-inclusion of unstably housed and incarcerated persons, and by self-report bias.
- Narcotic overdose death is imperfect IDU proxy. Given comparable underlying IDU, may vary according to local policies and interventions (e.g. naloxone distribution).
- Correction for differential drug fatality based on extrapolation. Future work should adjust 2017 estimates directly.

Conclusions

- Approach provides first systematic estimates of state-level PWID size, quantifying states with highest relative and absolute estimates, useful for epidemic and service rate calculation and resource planning.
- As national estimates and local indicators of PWID improve in the US, method provides a simple, transparent approach to updating population size estimates.
- Progress on dataset construction for additional approaches, such as MSE, needed to provide optimally-robust state estimates.

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