Estimating County-Level Opioid Use Disorder (OUD) Prevalence



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Opioid use disorder (OUD)

Opioid use disorder (OUD) is defined in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) as a problematic pattern of opioid use leading to clinically significant impairment or distress.

OUD prevalence estimates are needed at the county-level to adequately improve treatment and recovery services nationally (e.g., distributing buprenorphine, naloxone).

The [abatement] agreement identifies as key factors (1) the total volume of opioids; (2) number of overdose deaths; and (**3) number of individuals with OUDs.***

*Alexander GC, Mansour O. Distribution of Abatement Funds Arising From US Opioid Litigation. JAMA. 2022;328(19):1901. doi:10.1001/jama.2022.19667

College of Source: https://www.cdc.gov/drugoverdose/training/oud/accessible/index.html

Substance Use Disorder

Drug Use Disorder | Opioid Use Disorder | Alcohol Use Disorder in the Past Year

NSDUH asked respondents aged 12 or older about the effects of their drug or alcohol use on their lives in the 12 months before the interview.



National Survey on Drug Use and Health (NSDUH)



Substance Use Disorder (SUD)

48.7 million (17.3%)

Among people aged 12 or older, about 17% had an SUD in the past year.



About 1 in 10 people had a DUD in the past year.

Opioid Use Disorder (OUD)

6.1 million (2.2%)

Among people aged 12 or older with a past year DUD, a little over 1 in 5 had an OUD, or about 2% overall.

Alcohol Use Disorder (AUD) 29.5 million (10.5%) About 1 in 10 people had an AUD in the past year.

classified as having an SUD if they had an AUD or a DUD in the past year.







Substance use disorder (SUD) is characterized by impairment caused by the recurrent use of alcohol or other drugs (or both), including health problems, disability, and failure to meet major responsibilities at work, school, or home. Respondents were classified as having an SUD in the past year if they met criteria specified in the *Disgnostic and Statistical Manual of Mental Disorders*, Sth edition.² Respondents who used marijuana, cocaine, heroin, hallucinogens, inhalants, methamphetamine, or prescription psychotherapeutic drugs were classified as having a **drug use disorder (DUD)** if they had a disorder related to any of these substances that they used in the past year. Respondents were classified as having an **opioid use disorder (OUD)** if they had a disorder related to their use of heroin or prescription pain relievers in the past year. Respondents who used alcohol in the past year were classified as having an **alcohol use disorder (AUD)** if they met criteria for an AUD in the past year. Respondents were:

Alcohol Use Disorder is only SUD available at Substate Regions

Alcohol Use Disorder in the Past Year Among Individuals Aged 12 or Older, by Substate Region: 2016-2018





NSDUH Substate Estimates. Accessed May 26, 2025. https://datatools.samhsa.gov/saes/substate

What are the options for estimating county-level OUD in the general population?

Why now?



States participating in data linkage projects





Example Indicators for OD2A

Requirement 1: Linking fatal to nonfatal data

+ Indicator 1.1. Percentage of Fatal Overdoses with Prior Nonfatal Overdose

The percentage of people who died of an unintentional or undetermined intent drug overdose with evidence of experiencing a nonfatal overdose within 12 months of the date of death

+ Indicator 1.2. Count of Prior Nonfatal Overdoses before Fatal Overdose

The number of nonfatal overdoses reported within 12 months before the date of death, reported in aggregate as the median number and interquartile range

+ Indicator 1.3. Percentage of Nonfatal Overdoses with Later Fatal Overdose

Percent of people who experienced a nonfatal overdose who subsequently experienced an unintentional or undetermined intent fatal overdose within 12 months of the nonfatal overdose

+ Indicator 1.4. Days between Nonfatal and Fatal Overdose

The number of days between the date of the fatal overdose and the date of the most recent nonfatal overdose reported in aggregate as median number and interquartile range



Planned data linkages by state

OD2A Requirements=(1 AND 2) AND [(1 or 2) AND 3]							Social Determinants					
	Non-Fatal (1)			Fatal (2)			Other (3)		Level (3)			
State	Emergency Department	Hospital Discharge	Emergency Medical Services	State Unintentional Drug Overdose Reporting System	Vital Records	National Violent Death Registry System	Medical Examiner	Prescription Drug Monitoring Program	Criminal Justice	Individual	Area	Total
Alaska		1		1	1					1	1	5
Arizona		1			1						1	3
California	1				1					1	1	4
Colorado	1				1			1				3
Hawaii			1	1				1		1		4
Illinois		1			1			1		1	1	4
Indiana	1		1		1			1	1			5
Kentucky			1		1				1			3
Minnesota		1	1		1				1	1		5
Nebraska		1	1		1			1		1		5
New York		1			1			1		1	1	5
North Carolina	1			1						1		3
Oklahoma		1		1	1			1		1	1	6
Oregon		1	1	1	1	1		1		1	1	8
Pennsylvania		1		1				1	1			4
Rhode Island		1	1				1	1	1			5
Tennessee		1		1	1			1	1		1	6
Vermont			1		1			1	1	1		5
Washington			1		1			1			1	4
Wisconsin	1				1			1	1		1	5
Total	5	11	10	5	16	1	1	14	8	10	10	92



Capture-Recapture: "Salmon Cannon"



Source: https://www.theguardian.com/environment/2019/aug/15/salmoncannon-fish-dam



https://aws.amazon.com/blogs/aws/a ws-lake-formation-now-generallyavailable/



Home Products Components



PassagePortal™ Model F

The most capable fish passage solution ever made



Capture-Recapture (2-way): "Deeper Dive"



Method: *Lincoln–Peterson

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Source: Seber GAF. The Estimation of Animal Abundance, and Related Parameters. New York, NY: Hafner Press; 1973.

Capture-Recapture (3-way): "Deeper Dive"



College of Pharmacy Barocas et al. found that a minimum of 4 databases were required for stable estimates

Capture-Recapture "Data Lakes": 2 published studies from MA and KY

Estimated Prevalence of Opioid Use Disorder in Massachusetts, 2011–2015: A Capture–Recapture Analysis

Joshua A. Barocas, MD, Laura F. White, PhD, Jianing Wang, MSc, Alexander Y. Walley, MD, MSc, Marc R. LaRochelle, MD, Dana Bernson, MPH, Thomas Land, PhD, Jake R. Morgan, PhD, Jeffrey H. Samet, MD, MA, MPH, and Benjamin P. Linas, MD, MPH

7 healthcare databases

- 1. All Payer Claims Data,
- 2. Treatment Admissions,
- 3. Inpatient hospitalizations,
- 4. Death certificates,
- 5. Births
- 6. EMS
- 7. Prescription Monitoring Program (PMP)
- At least 4 were optimal!
- Stratified by county, age group (11-25, 26-44, 45+), sex

The prevalence of opioid use disorder in Kentucky's counties: A two-year multi-sample capture-recapture analysis

Katherine Thompson^{a,1}, Joshua A. Barocas^{b,*,1}, Chris Delcher^{c,d}, Jungjun Bae^{c,d}, Lindsey Hammerslag^e, Jianing Wang^f, Redonna Chandler^g, Jennifer Villani^g, Sharon Walsh^{h,i}, Jeffery Talbert^{e,j}

4 healthcare databases

- 1. Medicaid claims,
- 2. EMS,
- 3. PMP,
- 4. Death certificates
- Stratified by county, age group (18-34, 35-54, 55-64), sex



	Medicaid	KASPER	Vital Statistics	Emergency Medical Services (EMS)
Age		11 year	s or older	
Definition	1 medical claim with an OUD diagnosis code	At least 1 buprenorphine prescription	Opioid-related deaths	An EMS response for an opioid overdose
			~	

- Individuals are matched across the datasets.
- Stratified by county, age group (18-34, 35-54, 55-64), sex



Known and unknown estimates (CY 2018)





Findings



County-level OUD Prevalence (2019)

Estimated OUD Prevalence (%) in Kentucky

>0-2.84

2.85-4.15

4.16-6.07

6.08-9.26

9.27-17.69

Appalachian Region

6.6% (2018)

nce (%) among 18–64 year olds in Kentucky counties, 2019 (base map). The map demonstrates the estimated OUD prevalence by county in 2019. The dark black outline denotes the Appalachian region. Counties with a significant increase (n = 31) in OUD between 2018 and 2019 are shown with an red arrow; counties with a significant decrease (n = 29) are shown with a green arrow; other counties did not have a significant change. Cutpoints for rate categories were determined using Jenks Natural Breaks Optimization in ArcGIS.



Meet the Current Team





Staci Hepler Associate Professor & Assistant Chair Department of Statistical Sciences

David M. Kline Associate Professor, Biostatistics and Data Science



Brian White Biostatistician III - Wake Forest School of Medicine | Statistics





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Methods development and application in multiple states

Original Contribution



American Journal of Epidemiology, 2024, **193**, 959–967 https://doi.org/10.1093/aje/kwae018 Advance access publication date March 6, 2024

Estimation of the prevalence of opioid misuse in New York State counties, 2007-2018: a bayesian spatiotemporal abundance model approach

Julian Santaella-Tenorio 💿 *†^{,1}, Staci A. Hepler 💿 †^{,2}, Ariadne Rivera-Aguirre 💿 ¹, David M. Kline 🍈 ³, Magdalena Cerda 🌔 ¹

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BIOMETRIC PRACTICE

Biometrics WILEY

Estimating the burden of the opioid epidemic for adults and adolescents in Ohio counties

David Kline¹ 💿 🕴 Staci A. Hepler² 💿

Journal of the Royal Statistical Society Series A: Statistics in Society, 2023, **186**, 43–60 https://doi.org/10.1093/jrsssa/qnac013 Advance access publication 31 January 2023 **Original Article** ROYAL STATISTICAL SOCIETY MAI EVIDENCE I DECISIONS Series A Statistics in Society

An integrated abundance model for estimating county-level prevalence of opioid misuse in Ohio

Staci A. Hepler^{1,†}, David M. Kline^{2,†}, Andrea Bonny³, Erin McKnight³ and Lance A. Waller⁴

ORIGINAL ARTICLE Estimating Prevalence of Opioid Misuse in North Carolina Counties From 2016 to 2021 An Integrated Abundance Model Approach

David M. Kline,^a Brian N. White,^a Kathryn E. Lancaster,^b Kathleen L. Egan,^b Eva Murphy,^c

William C. Miller,^d and Staci A. Hepler^c



Current Approaches + New Ideas (CRC and Abundance) for Counties

<u>Method</u>	<u>Linkage</u>	<u>County</u> <u>estimate</u>
1) National Survey on Drug Use and Health (NSDUH)*	No	State-based
(2) NSDUH + Multiplier ^{*†}	No	State-based
(3) Multiplier + Overdose adjustment**	No	County-based
(4) Capture-Recapture (linkage required)	Yes	County-based
(5) Bayesian Integrated Abundance Model	Yes/No	State/County- based
(6) Bayesian Benchmark Multiplier	No	State/County- based

2022;110:103780.001:10.1010/J.010gp0.2022.103780

**Keyes KM et al. What is the prevalence of and trend in opioid use disorder in the United States from 2010 to 2019? Using multiplier approaches to estimate prevalence for an unknown population size. Drug and Alcohol Dependence Reports. 2022;3:100052. doi: 10.1016/j.dadr.2022.100052

⁺ Barocas JA, White LF, Wang J, et al. Estimated Prevalence of Opioid Use Disorder in Massachusetts, 2011-2015: A Capture-Recapture Analysis. American Journal of Public Health. 2018;108(12):1675-1681. doi:10.2105/AJPH.2018.304673



Linked PDMP and Death Certificate Data (via CDC's OD2A)

2019	Washington State	
(A) Opioid-involved deaths	705	
(B) Buprenorphine Rx	44,983	80 linked
ODs in PDMP (within year)	80/44,983 (0.17%)*	in both
PDMP in Ods (within year)	80/705 (11.3%)**	

**State Unintentional Drug Overdose Reporting System (SUDORS) 6.9% of fatal overdoses with evidence of SUD treatment

*Unknown county residence not included (< X%)

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People with OUD (no.) variability by methods in WA state (2019)





Estimated county-level prevalence of opioid misuse (in the general population)



Bayesian Integrated Abundance models

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armacy

State-level NSDUH improving, but county still not available

The estimated prevalence of people misusing opioids remains higher than NSDUH-based estimates of OUD but more similar in 2021.



Note: Estimated prevalence of people misusing opioids was estimated using Bayesian abundance model. Estimates were provided by Brian White (Wake Forest University), David Kline (Wake Forest University), and Staci Hepler (Wake Forest University). 2018-2019 NSDUH estimates are not comparable to 2021-2022 NSDUH estimates.



Bayesian Integrated Abundance models





<u>Method</u>

- National Survey on Drug Use and Health (NSDUH)*
 (2) NSDUH + Multiplier^{*†}
- (3) Multiplier + Overdose adjustment**
- (4) Capture-Recapture (linkage required)
- (5) Bayesian Integrated Abundance Model
- (6) Bayesian Benchmark Multiplier

State/county Interactive OUD dashboard

- Predicting opioid use with machine learning models in KY and CA
- Social Network Analysis of Opioid Prescribing Networks in KY
- Small-area stimulant prescribing and social determinants in KY



Questions? Chris.Delcher@uky.edu

Special thanks to the Washington State and Wake Forest teams:

Workshop at: Council of State and Territorial Epidemiologists (CSTE) 2025 CSTE Annual Conference, Grand Rapids, Michigan June 8, 2025

