



Equity of overdose education and naloxone distribution provided in the Kentucky HEALing Communities Study

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HIGHLIGHTS

- Strategies to reduce opioid overdose death are not consistently equitably delivered.
- Specific strategies to increase naloxone availability for males are necessary.
- Naloxone distribution proportionally reached racial and ethnic groups.
- Differences in recipient demographics across settings may reflect care biases.

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ABSTRACT

Background: Opioid overdoses differentially affect demographic groups. Strategies to reduce overdose deaths, specifically overdose education and naloxone distribution (OEND), are not consistently delivered equitably.

Methods: The HEALing Communities StudySM (HCS) is a cluster-randomized trial designed to implement evidence-based practices, including OEND, to reduce overdose deaths across communities. Individuals receiving OEND in eight Kentucky counties between January 2020 and June 2022 provided demographics and overdose history. Recipient characteristics were compared to opioid overdose decedent characteristics to evaluate whether OEND was equitably delivered to the target population. Recipient characteristics were also analyzed based on whether OEND was delivered in criminal justice, behavioral health, or health care facilities.

Results: A total of 26,273 demographic records were analyzed from 137 partner agencies. Most agencies were in behavioral health (85.6 %) or criminal justice sectors (10.4 %). About half of OEND recipients were male (50.6 %), which was significantly lower than the 70.3 % of overdose decedents who were male, ($p < 0.001$). OEND recipients tended to be younger than overdose decedents, but there were not significant differences in race/ethnicity between OEND recipients and overdose decedents. Over 40 % of OEND recipients had overdosed, and 68.9 % had witnessed a prior overdose. There were notable differences across facility types, as males and Black individuals accounted for fewer OEND recipients in addiction treatment facilities compared to jails.

Conclusion: Although OEND recipients' demographics resembled those of decedents, specific attention should be paid to ensuring equitable OEND access. Variation in OEND uptake by facility type may reflect biases and barriers to care.

IRB Approval: This study protocol (Pro00038088) was approved by Advarra Inc., the HEALing Communities Study single Institutional Review Board.

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1. Introduction

1.1. Background

The dramatic rise in drug overdose rates over the past two decades is not equal across age, race, and sex groups (Spencer et al., 2022). Age-adjusted opioid overdose death rates for males are more than double that of females, and individuals 35–44 years old have higher rates than all other age groups (Centers for Disease Control and Prevention, National Center for Health Statistics 2023). Additionally, between 2018 and 2019, opioid overdose deaths among non-Hispanic Blacks rose 40 % faster than non-Hispanic Whites, such that age-adjusted rates are now similar between the groups (43.2 per 100,000 vs. 41.0 per 100,000). It is not clear whether these differences are directly related to substance use patterns or inequities in care (Kariisa et al., 2022).

These disparities persist even in relatively homogenous states like Kentucky, where opioid overdoses increased 45 % in 2020 (Slavova et al., 2021). While the demographics of Kentucky overdose decedents are reflective of the overall population (i.e., over 80 % non-Hispanic White), statewide trends resemble those across the U.S. For example, between 2016 and 2020, the age-adjusted rate for opioid-involved overdose in non-Hispanic Black Kentuckians nearly tripled to a rate of 38.1 per 100,000, now similar to the rate for non-Hispanic White Kentuckians (41.5 per 100,000) (Slavova et al., 2023). As Kentucky presently ranks 4th in the nation in opioid-related overdose deaths, it is critical that, as evidence-based interventions are scaled up, they are designed to reach those populations who are most affected.

Although overdose education and naloxone distribution (OEND) is a powerful community-level intervention to reduce drug overdose deaths (Moustaqim-Barrette et al., 2021; Naumann et al., 2019; Walley et al., 2013; Winhusen et al., 2020), community-based OEND programs may not always reach high-risk populations equitably. For example, a statewide study in Massachusetts found naloxone distribution rates were significantly lower for racial/ethnic minorities (i.e., Hispanic and non-Hispanic Black) compared to non-Hispanic White residents (Nolen et al., 2022). A separate study of 575 people who use drugs in New York City found significantly lower naloxone training and possession rates in Black compared to White participants (OR 0.4, 95 % CI 0.22–0.72) (Khan et al., 2023). As communities continue to work to scale up OEND, it is critically important to consider whether expansion efforts are implemented equitably.

1.2. Study purpose

The HEALing (Helping to End Addiction Long TermSM) Communities StudyTM (HCS) is a multi-state, parallel-group, cluster randomized waitlist-controlled trial that tests whether a community-engaged strategy to implement evidence-based practices can reduce opioid overdose deaths across 67 communities in four states (Consortium, 2020). One key evidence-based practice is OEND, which was initially implemented in eight Kentucky counties (the first group of communities randomized to the intervention) using a “Hub with Many Spokes” strategy (i.e., a central naloxone hub that provided training, technical assistance, and naloxone to partnering agencies) (Knudsen et al., 2023) based on the Exploration, Preparation, Implementation, and Sustainment model (Aarons et al., 2011). The purpose of this study was to describe the populations served by the “Hub with Many Spokes” strategy used in the HCS in Kentucky and compare populations served to the demographics of opioid overdose decedents in these communities.

2. Material and methods

2.1. Study context

The methodology of the HCS has been described elsewhere (Consortium, 2020). In Kentucky, HCS communities include 16 counties

accounting for over 40 % of the state’s population. Eight of these counties were randomized to start the intervention first (i.e., receiving the intervention from January 2020–June 2022) and were included in this analysis (the second wave of counties are now receiving the intervention). In each county, community coalitions of local leaders—typically based around Kentucky Agency for Substance Abuse Policy (KY-ASAP) boards—selected OEND strategies for implementation at high-risk venues or with at-risk populations as previously defined (Chandler et al., 2023). Coalitions were required to select at least one active OEND strategy (i.e., proactively offering OEND with in-person education) in behavioral health, criminal justice, or healthcare settings; passive OEND strategies (e.g., OEND by referral or self-request and naloxone availability for immediate use in overdose hot spots) were also allowed. Agencies were prioritized based on the anticipated need and impact as assessed by the community coalition. A dedicated team of implementation facilitators invited priority organizations to informational meetings about the Kentucky OEND model, during which OEND workflows were designed to meet organizational needs while aligning with the state’s regulatory requirements.

The Kentucky OEND model used a university-based central coordinating center (the “hub”) to dispense naloxone to community-prioritized partner organizations (the “spokes”) for further distribution. Partner agencies were classified using the Opioid-overdose Reduction Continuum of Care Approach (ORCCA) (Winhusen et al., 2020) as behavioral health, criminal justice, or health care sectors. Within behavioral health and criminal justice, additional venue types were assigned; these included addiction treatment and recovery facilities, community-based social service agencies, first responder stations, mental/behavioral health treatment facilities, syringe service programs, community supervision agencies, jails, or other.

2.2. Data collection

Partner agencies were asked to implement a process to collect demographic information from OEND recipients. Individuals that received OEND were asked to self-report age category, race, ethnicity, sex, history of overdose (personal and witnessed), and how they identified (e.g., concerned community member, family member, person who takes/uses opioids, etc.) modeled after demographic questions used by a multistate online OEND training resource (Simmons et al., 2018). Provision of anonymous demographic information was not required to receive OEND, and recipients could skip any questions. Demographics were collected using the Research Electronic Data Capture (REDCap) platform (Harris et al., 2019; Harris et al., 2009), and all demographic records from partner agencies between January 2020 and June 2022 were included. Of note, the Kentucky HCS implemented additional OEND strategies not included in this analysis, primarily direct delivery of OEND by study staff and remote/mail-order self-OEND for individuals under community supervision.

Opioid overdose decedent demographics from 2020 were obtained from the Kentucky Office of Vital Statistics, with postmortem toxicology results obtained from the Kentucky Medical Examiners’ Office. Data were extracted on May 10, 2023 and are provisional and subject to change. To align categories across data sets, race for this study was categorized as African American/Black, White, or Other, where Other represented categories of American Indian, Alaska Native, Asian, Native Hawaiian, Pacific Islander, Mixed Race/Ethnicity, or Other. NCHS Rural Urban Classification Codes (RUCC) (Ingram and Franco, 2014) were used to classify counties as rural (RUCC 4–7) or urban (RUCC 1–3).

2.3. Statistical analysis

Descriptive statistics were used to characterize self-reported demographics of individuals that received OEND. Group counts and rates among OEND recipients were stratified by ORCCA type. Bivariate comparisons between group rates (i.e., OEND recipients and county

demographics, OEND receipt by ORCCA type) were assessed using Chi-square tests with a significance level of 0.05. Analyses were conducted in SAS v.9.4 (SAS Institute Inc., Cary, NC).

2.4. Institutional review board approval

The study protocol (Pro00038088) was approved by Advarra Inc., the HCS single Institutional Review Board.

3. Results

3.1. Recipient characteristics

In total, 26,273 demographic records were collected from 40,822 naloxone distribution events (64.4 %). The first distribution event occurred in April 2020, thus records were collected between April 2020 and June 2022. Records were obtained from 137 of 145 implementing agencies across the eight counties, with a range of 10-45 agencies implementing OEND per county. Almost two thirds of agencies were in urban counties, but approximately half of OEND recipients (51.9 %) were from rural counties. Most recipients (85.6 %) received OEND in behavioral health agencies, followed by criminal justice (10.4 %) and health care (4.0 %). Addiction treatment and recovery facilities (32.9 %), syringe service programs (31.7 %), community-based social service agencies (16.5 %), and jails (9.6 %) were the most common venue types represented. The distribution of agencies and responses by ORCCA type and county is presented in Table 1. Additional information regarding the number of OEND recipients per ORCCA type for each county is available in Supplementary Table S1.

3.2. Comparison of respondent characteristics with county overdose decedents

Table 2 compares self-reported characteristics of OEND recipients to the demographic breakdown of opioid overdose decedents among the

Table 1

Distribution of agencies and recipients who received overdose education and naloxone distribution in eight HEALing Communities Study™ Kentucky counties, January-June 2022

	Number of Agencies (n=137)	Number of Recipients (n=26,273)
Opioid-overdose reduction continuum of care approach sector (Consortium, 2020)		
Behavioral health	91 (66.4 %)	22490 (85.6 %)
Addiction treatment and recovery facility	48 (35.0 %)	8636 (32.9 %)
Community-based social service agency	22 (16.1 %)	4335 (16.5 %)
First responder station	4 (2.9 %)	460 (1.8 %)
Mental/behavioral health treatment facility	11 (8 %)	527 (2.0 %)
Syringe service program	5 (3.6 %)	8322 (31.7 %)
Other	1 (0.7 %)	210 (0.8 %)
Criminal Justice	15 (10.9 %)	2739 (10.4 %)
Jails	8 (5.8 %)	2535 (9.6 %)
Other	7 (5.1 %)	204 (0.8 %)
Health Care	32 (23.4 %)	1044 (4.0 %)
Agency Community		
Rural	53 (38.7 %)	13634 (51.9 %)
Boyle	11 (8.0 %)	2568 (9.8 %)
Floyd	11 (8.0 %)	1200 (4.6 %)
Franklin	14 (10.2 %)	1051 (4.0 %)
Madison	17 (12.4 %)	8815 (33.6 %)
Urban	85 (62.0 %)	12639 (48.1 %)
Boyd	14 (10.2 %)	4325 (16.5 %)
Clark	10 (7.3 %)	641 (2.4 %)
Fayette	45 (32.8 %)	4363 (16.6 %)
Kenton	16 (11.7 %)	3310 (12.6 %)

Table 2

Self-reported demographics of overdose education and naloxone distribution recipients in HEALing Communities Study™ Kentucky counties compared to overdose decedent demographics, January-June 2022

	OEND recipients (n=26,273)*	Opioid overdose decedents (n=374)	p value
Sex (n=23,601)			
Female	11,657 (49.4 %)	111 (29.7 %)	<0.001
Male	11,944 (50.6 %)	263 (70.3 %)	
Age Category (n=24,144)			
16-24	1,449 (6 %)	23 (6.1 %)	<0.001
25-34	7,010 (29 %)	91 (24.3 %)	
35-44	8,444 (35 %)	110 (29.4 %)	
45-54	4,866 (20.2 %)	82 (21.9 %)	
55-64	1,919 (7.9 %)	50 (13.4 %)	
65+	456 (1.9 %)	18 (4.8 %)	
Race (n=24,221)			
African American/Black	1,763 (7.3 %)	Suppressed†	0.389
White	21,962 (90.7 %)	344 (92 %)	
Other‡	496 (2 %)	1-5 (0 %) [‡]	
Ethnicity (n=23,660)			
Hispanic	432 (1.8 %)	7 (1.9 %)	0.948
Non-Hispanic	23,228 (98.2 %)	367 (98.1 %)	
Prior Overdose (n=23,993)	9,802 (40.9 %)		
Witnessed Overdose (n=23,999)	16,544 (68.9 %)		
Self-identification (n=23,601)	23,601 (0 %)		
Concerned Community Member	4,257 (18 %)		
Family Member of Someone who Takes/Uses Prescription Narcotics/Heroin	2,797 (11.9 %)		
Friend	1,377 (5.8 %)		
I Take/Use Prescription Narcotics/Heroin	11,545 (48.9 %)		
Relates to My Work	1,552 (6.6 %)		
Other	2,073 (8.8 %)		

* Recipients could skip questions, so individuals receiving OEND totals may not add to 26,273.

† Includes Asian/Native Hawaiian/Other Pacific Islander, Native American/Alaska Native, Mixed Race-Ethnicity, and Other Unspecified Race

‡ Data not presented due to Kentucky Office of Vital Statistics data suppression rules.

eight Kentucky counties served by the HCS in the first study wave. Significantly fewer OEND recipients were male (50.6 % vs. 70.3 %, p<0.001) when compared to opioid overdose decedents. There was also a significant difference in age distribution (p<0.001), with more OEND recipients aged 25-44 and fewer OEND recipients aged 55 or older. Most OEND recipients had witnessed an overdose (68.9 %), and 40.9 % had overdosed themselves. Nearly half (48.9 %) of respondents best identified as “someone who takes or uses prescription narcotics or heroin.”

3.3. Comparison of recipient characteristics by venue

Table 3 describes demographics of individuals who received OEND at the four most common ORCCA venue types (addiction treatment facilities, community-based social service agencies, jails, and syringe service programs), which accounted for 91.5 % of recipients. There were significant differences in all categories of recipient demographics across venue types. Males were more common recipients of OEND in jails (63.5 %) and SSPs (56.0 %), whereas females were more common in addiction treatment facilities (54.2 %) and community-based social service agencies (55.8 %). Individuals aged 35-44 were the largest group in each of the non-jail settings, accounting for 33.8 % to 38.5 % of OEND recipients. The most common age group in jails was 25-34-year-olds (34.3 %). Non-Hispanic Black individuals made up a smaller percentage of addiction treatment facilities’ OEND recipients (4.3 %) compared to other venues (range 6.9 % in community-based agencies to 14.0 % in

Table 3
Self-reported overdose education and naloxone distribution recipient demographics from common agency venue types, January-June 2022

	Addiction treatment facilities (n=8,636)	Community-based agencies (n=4,335)	Jails (n=2,739)	Syringe service programs (n=8,322)	p value
Sex					<0.001
Female	4,224 (54.2 %)	2,064 (54.8 %)	859 (36.5 %)	3,460 (44.0 %)	
Male	3,575 (45.8 %)	1,704 (45.2 %)	1,495 (63.5 %)	4,399 (56.0 %)	
Age category					<0.001
16–24	444 (5.5 %)	228 (6.0 %)	227 (9.4 %)	409 (5.2 %)	
25–34	2,580 (31.9 %)	1,075 (28.3 %)	832 (34.3 %)	2,037 (25.7 %)	
35–44	3,111 (38.5 %)	1,385 (36.4 %)	742 (30.6 %)	2,675 (33.8 %)	
45–54	1,353 (16.7 %)	795 (20.9 %)	453 (18.7 %)	1,881 (23.8 %)	
55–64	519 (6.4 %)	258 (6.8 %)	135 (5.6 %)	753 (9.5 %)	
65+	79 (1.0 %)	62 (1.6 %)	34 (1.4 %)	162 (2.0 %)	
Race					<0.001
African American/Black	345 (4.3 %)	268 (6.9 %)	337 (14.0 %)	597 (7.5 %)	
White	7,562 (93.6 %)	3,524 (90.8 %)	1,980 (82.3 %)	7,278 (91.6 %)	
Other	169 (2.1 %)	89 (2.3 %)	89 (3.7 %)	70 (0.9 %)	
Ethnicity					<0.001
Hispanic	155 (2.0 %)	63 (1.6 %)	54 (2.4 %)	78 (1.0 %)	
Non-hispanic	7,728 (98.0 %)	3,795 (98.4 %)	2,229 (97.6 %)	7,700 (99.0 %)	
Prior overdose	2,912 (36.2 %)	1,013 (26.7 %)	744 (31.9 %)	4,555 (57.5 %)	<0.001
Witnessed overdose	5,073 (62.9 %)	2,202 (58.1 %)	1,287 (55.2 %)	6,904 (87.2 %)	<0.001
Self-Identification					<0.001
Concerned community member	1,547 (19.3 %)	1,197 (31.6 %)	645 (27.6 %)	697 (8.9 %)	
Family member of someone who takes/uses prescription narcotics/heroin	869 (10.8 %)	749 (19.8 %)	364 (15.6 %)	547 (7 %)	
Friend	326 (4.1 %)	417 (11.0 %)	104 (4.5 %)	447 (5.7 %)	
I take/use prescription narcotics/heroin	3,568 (44.4 %)	889 (23.5 %)	395 (16.9 %)	5,995 (76.6 %)	
Relates to my work	966 (12.0 %)	182 (4.8 %)	727 (31.1 %)	43 (0.5 %)	
Other	757 (9.4 %)	354 (9.3 %)	100 (4.3 %)	96 (1.2 %)	

*Recipients could skip questions, so individuals receiving individual category totals may not add to the total in the column header. Percentages are taken as the total of responses for a given variable.

†Includes Asian/Native Hawaiian/Other Pacific Islander, Native American/Alaska Native, Mixed Race-Ethnicity, and Other Unspecified Race

jails).

4. Discussion

4.1. Context

The findings from this study suggest that the “Hub with Many Spokes” strategy as implemented in the Kentucky HCS provided access to naloxone that was generally reflective of the demographics of the target population in communities where it was implemented. However, specific variation (notably differences in the distribution across sex and age categories) warrants additional explanation. The majority (95 %) of recipients accessed OEND through the behavioral health and criminal justice sectors, consistent with the intent to target high-risk individuals and settings in the HCS. Additionally, over two-thirds of individuals had witnessed an overdose, over 40 % had overdosed themselves, and nearly half reported taking/using prescription narcotics or heroin.

Males overall represented a significantly smaller proportion of individuals receiving OEND compared to opioid overdose decedents. Multiple studies have found females at risk of overdose are approximately 2-3 times more likely to report carrying naloxone (Madah-Amiri et al., 2019; Tobin et al., 2018). However, a separate analysis of 97 individuals receiving methadone treatment in Baltimore suggested that males were not less likely to carry naloxone (Kozak et al., 2023), perhaps owing to more portable formulations increasing males’ acceptance of carrying naloxone (Khatiwoda et al., 2018). Unfortunately, no studies we found report males being more likely to carry naloxone, which may represent an opportunity for improvement as males are more likely to die from an opioid overdose.

OEND recipients who self-reported demographics were more likely to be in a younger age group compared to opioid overdose decedents.

This may be a consequence of differences in specific opioids contributing to overdose death and likely antecedent drug use. While synthetic opioids other than methadone (SOTM; i.e., fentanyl and analogues) are the leading cause of opioid overdose death in the overall population and among older adults, the predominance relative to other opioids is lower in older adults. For example, the age-adjusted rate of overdose from SOTM in older adults 1.54 times that of most prescription opioids (2.85 per 100,000 vs. 1.84 per 100,000) (Kramarow and Tejada-Vera, 2022); in contrast, the SOTM overdose rate is 4.45 times higher than the overdose rate from other opioids in the general population (17.8 per 100,000 vs. 4.0 per 100,000) (Spencer et al., 2022). This suggests that prescription opioids, more commonly accessed through the healthcare system and with a different risk profile compared to SOTM, may be a larger driver of overdoses in older adults. The venues primarily targeted in the HCS (Table 3) may not be equally effective in reaching this population, which may be better addressed through the health care system. Given the increasing rate of overdose death among older adults, strategies to reduce risk, such as deprescribing opioids, coprescribing naloxone, and screening for and treating existing opioid use disorder, remain critical (Dufort and Samaan, 2021).

The lower rates of males and Black people receiving OEND in addiction treatment facilities is concerning, specifically considering increasing overdose deaths in these non-exclusive populations. Multiple studies suggest that males may have shorter wait times to enter opioid use disorder treatment and have longer retention (Guerrero et al., 2021; Marsh et al., 2021; Mauro et al., 2022). Some addiction treatment organizations (and community-based social service agencies) in this study included clinics only serving women or specializing in maternal care. Disparate treatment outcomes among Blacks are largely attributed to lower access to addiction treatment (Goedel et al., 2020; Parlier-Ahmad et al., 2022; Schiff et al., 2020), which may explain the lower prevalence

of Black OEND recipients in addiction treatment facilities compared to other venues.

While the predominance of Black and male recipients in jails (and syringe service programs) aligns with existing demographic reports of those venues (Carson, 2021; Des Jarlais et al., 2015), it is still troublesome. Racial disparity in the U.S. criminal justice system, specifically related to drug policy, has been documented for decades (Camplain et al., 2020; Daniels et al., 2021; Langan, 1995). While Black Americans make up only 13 % of the population and use drugs at similar rates to other races, Black people make up nearly 1 in 3 drug arrests and account for 40 % of prisoners for drug offenses (Alliance, 2015). Males are more likely to be imprisoned for drug-related offenses and receive longer sentences than females (Hinojosa et al., 2004; Pryor Jr. et al., 2017). The combination of these disparities with the lower prevalence of Black and male recipients in addiction treatment settings—plus the general increasing prevalence of Black, male populations in overdose mortality reports—suggests urgent need for improved racial and sex parity in substance use disorder management. Encouragingly, the ability to deliver OEND to these individuals at least reduces immediate harm related to post-release opioid overdose (Saloner et al., 2020).

It is also notable that, although 62 % of agencies were in urban communities, 51.7 % of recipients were in rural communities. This likely is a result of two factors. First, a single particularly active agency in one rural county had more OEND recipients (n=6,623) than any other single county. Second, a highly active agency in an urban county provided OEND to several thousand recipients, but their demographic data were not included in this analysis due to data quality issues.

4.2. Limitations

This study has limitations. Primarily, agencies implementing OEND were not required to obtain demographic information, OEND recipients were not required to provide demographic information, and individual questions could be skipped. Indeed, 35.6 % of individuals who received OEND did not provide any demographic information, and those were not included here. The response rates for individual questions were all at least 89.8 % among those providing demographic data, and there is no reason to believe specific groups may have disproportionately refused to answer a given question. It is also possible, albeit unlikely, that individuals could have completed the demographic questions and subsequently refused or otherwise not received naloxone. Additionally, the race descriptions of African American/Black, White, and Other do not allow for meaningful comparisons of other racial groups, specifically Alaska Natives, Asians, Native Americans, Native Hawaiians, or Other Pacific Islanders. Asians, Native Hawaiians, and Other Pacific Islanders account for 2.7 % of the population in the study counties, and Native Americans and Alaska Natives account for 0.3 % of the population. Given the low prevalence of illicit drug use in Asian communities and the small percent of Native American/Alaska Native residents in the counties included in the Kentucky HCS, we are unable to draw conclusions regarding the equity of OEND regarding these populations. Finally, we did not assess naloxone use to reverse an overdose (only the capacity for such use); it is possible that the demographics of bystanders who respond to an opioid overdose may not match those of individuals who overdose (e.g., a female bystander responding to a male overdose). While this represents an inherent limitation in any study that aims to assess equity of OEND, the HCS was designed specifically to increase capacity for OEND in high-risk populations and settings, which is reflected in the self-reported characteristics of individuals who received OEND. Notably, 68.9 % of OEND recipients in our study reported previously witnessing an overdose, compared to reported rates of 7.6–14.5 % in other studies (Doe-Simkins et al., 2014; Heavey et al., 2018).

4.3. Conclusion

In conclusion, OEND recipients in the Kentucky HCS generally

resembled high risk groups within the HCS counties. However, the differences in uptake of OEND by venue—specifically a lower rate of male and Black recipients in addiction treatment facilities, but a higher rate of these populations in jails—may be reflective of ongoing barriers to treatment of opioid use disorders and suggest specific attention to equity is required when implementing strategies to combat the ongoing opioid crisis.

CRedit authorship contribution statement

Douglas R. Oyler: Conceptualization, Methodology, Validation, Resources, Writing – original draft, Writing – review & editing. **Hannah K. Knudsen:** Conceptualization, Methodology, Validation, Resources, Writing – review & editing, Project administration. **Carrie B. Oser:** Conceptualization, Methodology, Validation, Resources, Writing – review & editing. **Sharon L. Walsh:** Conceptualization, Methodology, Validation, Resources, Writing – review & editing, Supervision, Funding acquisition. **Monica Roberts:** Validation, Resources, Writing – review & editing. **Shawn R. Nigam:** Software, Formal analysis, Data curation, Writing – review & editing. **Philip M. Westgate:** Formal analysis, Writing – review & editing. **Patricia R. Freeman:** Conceptualization, Methodology, Validation, Resources, Writing – review & editing, Supervision.

Declaration of competing interest

The authors have no conflicts of interest.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.dadr.2023.100207.

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