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Predictors of Having Naloxone in Urban and Rural Oregon Findings from NHBS and the OR-HOPE Study

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Abstract

Purpose.—Naloxone is an opioid antagonist that can be effectively administered by bystanders to prevent overdose. We determined the proportion of people who had naloxone and identified predictors of naloxone ownership among two samples of people who inject drugs (PWID) who use opioids in Portland and rural Western Oregon.

Basic procedures.—We used data from participants in Portland's National HIV Behavioral Surveillance (NHBS, N = 477) and the Oregon HIV/Hepatitis and Opioid Prevention and Engagement Study (OR-HOPE, N = 133). For each sample, we determined the proportion of participants who had naloxone and estimated unadjusted and adjusted relative risk of having naloxone associated with participant characteristics.

Main findings.—Sixty one percent of NHBS and 30% of OR-HOPE participants had naloxone. In adjusted analysis, having naloxone was associated with female gender, injecting goofballs (compared to heroin alone), housing stability, and overdose training in the urban NHBS sample, and having naloxone was associated with drug of choice, frequency of injection, and race in the

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Contributors

ERO, PTK, and TM are principal investigators on their respective studies and provided study leadership and oversight. GL and LL coordinated data collection and data management. LL analyzed and interpreted the data. LL and TM drafted the manuscript. All authors provided feedback on early drafts of the manuscript and all authors reviewed and approved the final manuscript.

Declaration of interest

Declarations of interest: none.

Conflict of Interest

No conflicts declared.

rural OR-HOPE sample. In both samples, having naloxone was crudely associated with SSP use, but this was attenuated after adjustment.

Principal conclusions.—Naloxone ownership was insufficient and highly variable among two samples of PWID who use opioids in Oregon. People who use methamphetamine, males, and people experiencing homelessness may be at increased risk for not having naloxone and SSP may play a key role in improving access.

Keywords

IDU; naloxone; opioids; overdose; regional

1. Introduction

Naloxone is a safe, effective mu-receptor opioid antagonist that reverses opioid overdose and is a critical tool for reducing opioid-related morbidity and mortality (Kim et al., 2009). Though early naloxone interventions in the United States (U.S.) were primarily implemented by medical providers in clinical settings, in the last decade, national efforts have turned towards getting naloxone directly into the hands of people who use opioids and people in their social and substance using networks (Beletsky et al., 2012). Research indicates that bystanders who witness an opioid overdose (often, other people who use opioids) are willing and capable of successfully administering naloxone (Clark et al., 2014; Doe-Simkins et al., 2014; Mueller et al., 2015) and are effective in reducing overdose mortality (McDonald and Strang, 2016).

In Oregon, rural populations and certain urban subpopulations may be particularly affected by opioid morbidity and mortality (National Health Care for the Homeless Council, 2017; Riggs et al., 2020; Thomas et al., 2019; Yamamoto et al., 2019). In 2018, statewide opioid-related overdose hospitalizations occurred at a rate of 21 hospitalizations per 100,000 population, but the rate among rural Western Oregon counties was as high as 30 per 100,000 and the rate in Multnomah County (where the city of Portland is located) was 27 per 100,000. Similarly, from 2016-2018 the statewide 3-year average death rate due to overdose involving any opioid was 8 per 100,000 population (Oregon Health Authority Opioid Overdose and Misuse Section, 2020), but the four year (2014-2018) average rate in rural Western Oregon counties was as high as 29 per 100,000 and the rate in Multnomah County was 24 per 100,000 (Oregon Health Authority Opioid Overdose and Misuse Section, 2020).

In 2017, the State of Oregon made it legal for lay people to carry and administer naloxone (OAR 333-055-0000) (Oregon Health Authority). However, bystander naloxone ownership among people who use opioids in Oregon may not be adequate. In the first quarter of 2020, Oregon emergency medical services (EMS) administered naloxone 932 times. In comparison, naloxone was administered by a bystander prior to EMS arrival only 123 times in the same time period (Oregon Health Authority Opioid Overdose and Misuse Section, 2020). Naloxone ownership in Oregon may also vary by numerous factors. Quantitative and qualitative studies indicate that carrying, using and receiving naloxone are associated with a

variety of characteristics and behaviors (Faul et al., 2015; Geiger et al., 2019; Heavey et al., 2018; Kenney et al., 2018; Nolan et al., 2017).

In the present study, we determined the proportion of people who had naloxone and identified predictors of naloxone ownership among two samples of people who inject drugs (PWID) who use opioids in Portland and rural Western Oregon.

2. Material and methods

2.1 Study samples

We used data from Portland's National HIV Behavioral Surveillance (NHBS) and the Oregon HIV/Hepatitis and Opioid Prevention and Engagement (OR-HOPE) Study to enumerate two samples of people who reported injection drug use (IDU) and opioid use in the past year in Oregon.

NHBS is a national program of the Centers for Disease Control and Prevention (CDC) which conducts behavioral surveillance of groups at increased risk of HIV in US cities with high HIV prevalence (Gallagher et al., 2007). NHBS sites collect data from three annually rotating populations: men who have sex with men, individuals at increased risk of acquiring HIV via heterosexual sex, and PWID. As part of the 2018 PWID cycle, data were collected from PWID in the Portland-Vancouver-Hillsboro metropolitan statistical area (MSA) from June to October. Individuals were recruited through respondent driving sampling (RDS), a variation of chain-referral sampling (Heckathorn, 1997). Using RDS methods, NHBS recruitment began with a convenience sample of initial participants (i.e., "seeds," n = 6). These individuals then recruited new participants from their social networks, who subsequently recruited new participants from *their* social networks, and so on until the target sample size was reached. The six initial NHBS seeds resulted in productive chain lengths (number of waves) ranging from 2 – 19. One seed did not recruit additional participants. Seeds and subsequent participants could recruit up to 5 peers (with some participants limited to fewer recruits to "steer" the sample in terms of certain characteristics e.g., reduce oversampling individuals experiencing homelessness) (Heckathorn, 1997). Individuals were eligible for participation in the survey if they were at least 18 years old, currently living in the Portland-Vancouver-Hillsboro MSA, English or Spanish speaking, and reported IDU in the past year. For this analysis, we only included NHBS participants who also reported opioid use in the past year.

The OR-HOPE study is a pilot program of the National Rural Opioids Initiative to address opioid use disorders, hepatitis C, and HIV in rural communities (National Institute on Drug Abuse, 2017). The OR-HOPE study included structured risk assessment surveys conducted from March 2018 to April 2019. Like NHBS participants, OR-HOPE survey participants were recruited through RDS. OR-HOPE used a large initial sample of seeds (n = 42). These seeds resulted in productive chain lengths ranging from 1 - 7. Eighteen of the seeds did not recruit additional participants. Seeds and subsequent participants could recruit up to 4 peers. Individuals were eligible for participation in the OR-HOPE survey if they were at least 18 years old, currently living in rural Lane or Douglas County, English speaking, and reported

any IDU or non-injection recreational opioid use in the past 30 days. For this analysis, we only included OR-HOPE participants who reported both IDU and opioid use in the past year.

2.2 Measures

The outcome of interest for this analysis was currently having naloxone. Participants in NHBS were asked, "Do you currently own naloxone?" and participants in OR-HOPE were asked "Do you currently have naloxone or Narcan with you or at home?" Potential predictors of interest were chosen *a priori* based on existing literature and included age (continuous) (Frank et al., 2016; Geiger et al., 2019; Nolan et al., 2017; Sumner et al., 2016), race/ethnicity (white non-Hispanic, black non-Hispanic, Hispanic, multiracial, other) (Frank et al., 2016; Kenney et al., 2018; Nolan et al., 2017; Rowe et al., 2015, 2016), sex (male, female, transgender) (Kestler et al., 2017; Madah-Amiri et al., 2019; Sumner et al., 2016; Tobin et al., 2018), education (high school education or less, beyond high school education) (Cohen and Syme, 2013; Hahn and Truman, 2015), homelessness (recently experienced homelessness) (Madah-Amiri et al., 2019; Reed et al., 2019), arrest (recently arrest/held) (Reed et al., 2019), current health insurance status (insured, not/don't know) (Frank et al., 2016), drug of choice (heroin, methamphetamine, cocaine, goofball, speedball, other) (Banta-Green et al., 2017; Fairbairn et al., 2017; Kenney et al., 2018; Madah-Amiri et al., 2019; Rowe et al., 2015), frequency of injection (>1x a day, 1x a day, >1x a week, <1x a week, never) (Heavey et al., 2018; Nolan et al., 2017), recently acquiring sterile needles from a syringe service program (SSP) (Reed et al., 2019; Rowe et al., 2016) or pharmacy (Abouk et al., 2019; Jones et al., 2016), witnessing an overdose (Kenney et al., 2018; Kestler et al., 2017; Nolan et al., 2017; Rowe et al., 2015), experiencing an overdose (Kenney et al., 2018), and receiving overdose response training (Centers for Disease Control and Prevention, 2012; Doe-Simkins et al., 2014; Neale et al., 2019).

The NHBS and OR-HOPE studies were developed independently with different primary research objectives (Gallagher et al., 2007; National Institute on Drug Abuse, 2017). As such, individual survey items addressing similar topics were not always comparable. Most notably, the reference time frame for NHBS behaviors was frequently "the past 12 months" while the reference time frame for OR-HOPE behaviors was frequently "the past 30 days" or "the past 6 months." We aligned variables to the best of our ability to facilitate reasonable comparisons across studies. A description of the variables used from each study are presented in Supplement A. Relevant time frames are also included in the results for reference.

2.3 Analysis

To describe the samples, we first summarized participant characteristics, reporting frequencies and percentages for categorical variables and medians and interquartile ranges for continuous variables. We then calculated the unweighted proportion of participants in our samples that reported having naloxone. We chose not to estimate prevalence with RDS weights because a high number of seeds and short chain-lengths indicated the OR-HOPE sample likely did not meet the assumptions required for inference; a concern corroborated by visual inspection of convergence and bottleneck plots for key variables over the OR-HOPE study period (data not shown) (Gile and Handcock, 2010).

Next, to identify predictors of currently having naloxone, we first estimated unadjusted relative risk (RR) of having naloxone associated with each hypothesized predictor. We then estimated adjusted RR (aRR) with all hypothesized predictors in the model. We used generalized linear models with log-links, Poisson distribution and robust standard errors to estimate 95% confidence intervals (CI). Statistical significance was set *a priori* at $p<0.05$ and assessed using Wald tests. Analyses were conducted separately for each sample using Stata v.16 statistical software (StataCorp., 2019).

3. Results

3.1 Study samples

Of the 647 participants recruited into the urban NHBS study, 82 were ineligible and 30 had incomplete or invalid surveys. Of the 535 participants who had eligible, complete surveys, 41 did not report opioid use in the past year and 17 did not answer the question about owning naloxone. Excluding these participants left 477 NHBS participants in the final analytic sample.

Of the 178 participants recruited into the rural OR-HOPE study, all were eligible to participate and only 1 had an incomplete or invalid survey. Of the 177 participants who had eligible, complete surveys, 28 did not report IDU in the past year and 16 did not report opioid use in the past year. All remaining OR-HOPE participants answered the question about having naloxone, leaving an analytic sample of 133 participants.

3.2 Participant characteristics

3.2.1 Sociodemographics—Participant characteristics for NHBS and OR-HOPE are summarized in Table 1. Generally, participants in both studies were young adults (median age, 34 years old), predominately white (74% NHBS, 77% OR-HOPE), and marginally more likely to be male (62% NHBS, 56% OR-HOPE). Participants in the NHBS Study were slightly more likely to have beyond a high school education than participants in the OR-HOPE (45% NHBS, 35% OR-HOPE), but high percentages of participants in both studies reported recently experiencing homelessness (75% NHBS, 68% OR-HOPE). Despite a shorter reference time, (past 6 months rather than past year), almost twice the number of participants in the OR-HOPE reported being arrested or held when compared to NHBS participants (45% NHBS, 81% OR-HOPE). Most participants in both studies (85%) were currently insured.

3.2.2 Drug of choice and injection patterns—Most NHBS participants (70%) identified heroin as their drug of choice. About half of OR-HOPE participants (50%) identified heroin as their drug of choice, and another 43% identified methamphetamine as their drug of choice. Frequency of injection appeared to vary across studies. Referring to the last 12 months, 81% of NHBS participants reported injecting more than once a day and only 7% reported injecting less than once a week. Alternatively, referring to the past 30 days, 41% of OR-HOPE participants reported injecting more than once a day and 25% reported injecting less than once a week.

3.2.3 Access to sterile needles, overdose experiences and naloxone training

—A higher percentage of NHBS participants acquired sterile needles from a syringe service program (SSP) than OR-HOPE participants (85% NHBS, 46% OR-HOPE), and a higher percentage of OR-HOPE participants acquired sterile needles at pharmacies (41% NHBS, 60% OR-HOPE). The percentage of NHBS participants who had witnessed an overdose in the past 12 months (74%) was similar to the percentage of OR-HOPE participants who had ever witnessed an overdose (77%). Referring to the past 12 months for both studies, 28% of NHBS participants and 17% of OR-HOPE participants reported experiencing an overdose themselves. When asked if they had ever received overdose training, 61% of NHBS participants and 62% of OR-HOPE participants reported that they had.

3.3 Having naloxone

Sixty one percent of NHBS participants and 30% of OR-HOPE participants reported currently having naloxone.

3.4 Correlates of having naloxone among NHBS participants

Table 2 shows the unweighted proportion of participants with a given characteristic who had naloxone and the unadjusted RR between participant characteristics and naloxone ownership. Among NHBS participants, in bivariable analysis, having naloxone was associated with drug of choice. Specifically, 75% of participants who reported goofballs (heroin and methamphetamine) as their drug of choice had naloxone and they were more likely to have naloxone compared to participants who reported heroin alone as their drug of choice. Having naloxone was also associated with frequency of injection. Participants who reported injecting less than once a week were almost half as likely to have naloxone than those who reported injecting more than once a day; only 36% of participants who injected less than once a week had naloxone compared to 65% of participants who injected more than once a day. Having naloxone was also positively associated with acquiring sterile needles from SSP and receiving overdose training; 66% of participants who acquired sterile needles from an SSP and 74% of participants who ever received overdose training had naloxone. Finally, females were more likely to have naloxone compared to males, but there was no overall association between sex and having naloxone.

In multivariable analysis (Table 3), there was an association between sex and having naloxone (global p-value = 0.02) and females remained more likely to have naloxone than males (aRR = 1.20, 95% CI: 1.05 – 1.36). Overall associations between having naloxone and drug of choice and frequency of injection were attenuated in multivariable analysis, but participants who reported goofballs as their drug of choice were still more likely to have naloxone than those who reported heroin alone as their drug of choice (aRR = 1.20, 95% CI: 1.03, 1.40). Having naloxone was also negatively associated with recently experiencing homelessness (aRR = 0.86, 95% CI: 0.74, 0.99) and positively associated with ever receiving overdose response training (aRR = 1.63, 95% CI: 1.34, 1.97).

3.5 Correlates of having naloxone among OR-HOPE participants

Among OR-HOPE participants, in bivariable analysis (Table 2) having naloxone was associated with race; no Black participants ($n = 2$) reported having naloxone.

Having naloxone was also associated with drug of choice. Participants who reported methamphetamine as their drug of choice were less likely to have naloxone compared to participants who reported heroin as their drug of choice (7% vs 47%). Currently having naloxone was also associated with frequency of injection; there were no participants who reported no injection in the past 30 days who also reported having naloxone. Finally, having naloxone was positively associated with acquiring sterile needles from SSP; 49% of participants who acquired sterile needles from an SSP reported currently having naloxone.

In multivariable analysis (Table 3), associations between having naloxone and race, drug of choice, and frequency of injection persisted (global p-values < 0.001). Participants who reported methamphetamine as their drug of choice were less likely to have naloxone than those who reported heroin as their drug of choice (aRR = 0.17, 95% CI: 0.06, 0.47).

4. Discussion

Using data from distinct urban and rural samples of PWID who use opioids in Oregon, we determined the proportion of people who have naloxone and identified predictors of naloxone ownership in each sample. In the urban NHBS sample, almost two thirds of the sample had naloxone, and having naloxone was associated with female gender, injecting goofballs (heroin and methamphetamine combined, compared to heroin alone), housing stability, and overdose training in adjusted analysis. In the rural OR-HOPE sample, less than one third of the sample had naloxone and having naloxone was associated with drug of choice, frequency of injection, and race in adjusted analysis. Participants who reported methamphetamine as their drug of choice were less likely to have naloxone than those who reported heroin as their drug of choice. Zero participants who reported no injection in the past month and zero Black participants had naloxone. Like NHBS, having naloxone in the OR-HOPE sample was crudely associated with SSP use, but this association was attenuated after adjusting for other characteristics.

Neither sample reported adequate levels of naloxone ownership. According to the U.S. Surgeon General, "F*or patients currently taking high doses of opioids as prescribed for pain, individuals misusing prescription opioids, individuals using illicit opioids such as heroin or fentanyl, health care practitioners, family and friends of people who have an opioid use disorder, and community members who come into contact with people at risk for opioid overdose*, knowing how to use naloxone and keeping it within reach can save a life" (Office of the Surgeon General, 2018). Given this guidance and the allowance of Oregon law, we would aspire for all participants in these samples to have naloxone.

Comparing the two studies, we found a greater proportion of participants in the urban NHBS sample had naloxone compared to those in the rural OR-HOPE sample. Differences in naloxone ownership across samples may be indicative of regional variation in naloxone access. Neither study collected data regarding where participants acquired their naloxone. However, data suggest PWID in Oregon use both SSPs and pharmacies to acquire sterile syringes. SSP use appeared to be more common among NHBS participants, possibly because SSPs are more accessible in a metropolitan area (Troppy et al., 2018). And though the association was attenuated in adjusted analysis (potentially because of the inclusion of

overdose training in the model), acquiring sterile syringes at an SSP was associated with naloxone ownership in crude analysis of both samples. A 2019 national survey indicated that naloxone distribution is increasingly integrated into SSPs across the country and reach of these services is particularly high on the West coast (Lambdin et al., 2020). Ensuring rural and urban communities have equitable access to naloxone through SSPs is an important next step.

Acquiring sterile syringes at pharmacies appeared to be more common in the rural OR-HOPE sample than the NHBS sample. However, there was no association between acquiring sterile syringes at a pharmacy and having naloxone in OR-HOPE. This null finding could be attributed to a scarcity of naloxone dispensing at rural pharmacies. A 2018 national study of pharmacy-based naloxone dispensing found rural counties had lower rates of naloxone dispensing, even when controlling for other factors (Guy et al., 2019). Moreover, there may be myriad systemic barriers to pharmacy-based naloxone dispensing including time constraints, billing and insurance reimbursement, and stocking issues (Gray et al., 2020). Rural communities are disproportionately affected by opioid use (Keyes et al., 2014). If SSP are not available, pharmacies become critical naloxone access points for PWID who use opioids in these areas. Efforts should be made to improve naloxone prescription and pharmacy-based dispensing across all settings.

Part of the discrepancy in naloxone ownership across studies may also be attributed to regional differences in drug of choice. Most participants in the Portland-based NHBS sample reported heroin or heroin combination substances (i.e., goofballs) as their drug of choice. Conversely, almost half of the rural Western Oregon-based sample reported methamphetamine as their drug of choice. Higher methamphetamine use in the rural sample compared to the urban sample is consistent with 2016-2018 National Survey on Drug Use and Health (NSDUH) substate regional estimates of substance use in Oregon (National Survey on Drug Use and Health, 2020). OR-HOPE participants who reported methamphetamine as their drug of choice were also substantially less likely to have naloxone than participants who reported heroin as their drug of choice. Qualitative interviews with OR-HOPE participants who reported both methamphetamine and opioid use found some participants believed that methamphetamine could prevent or reverse opioid overdose (Baker et al., 2020). Low perceived risk of overdose among people who primarily use methamphetamine is particularly dangerous in the context of rising fentanyl adulteration in both opioids and methamphetamine in the West (Shover et al., 2020). In 2019, fentanyl contributed to 9% of heroin overdoses and 4% of methamphetamine overdoses in Oregon (Oregon Health Authority). Interestingly, participants in the NHBS sample who reported goofballs (heroin and methamphetamine combined) as their drug of choice were more likely to have naloxone than participants who reported heroin alone. Further examination of rural and urban beliefs about methamphetamine and overdose prevention behaviors is warranted.

In terms of sociodemographic characteristics, female participants in NHBS were more likely to have naloxone than male participants. This is consistent with previous studies that found females had greater odds of accepting and owning naloxone than males (Kestler et al., 2017; Madah-Amiri et al., 2019; Tobin et al., 2018). Additional research is needed to better understand gender differences in perceptions of naloxone benefits and overdose risk

(Sumner et al., 2016). Concerning race, in NHBS, Black participants (compared to other race/ethnicities) had the smallest percentage of naloxone ownership, and in OR-HOPE, none of the Black participants (N = 2) had naloxone. While our NHBS results and OR-HOPE sample size are not robust enough to draw firm conclusions about racial disparities, the extant literature suggests Black PWID are less likely to know about naloxone (Nolan et al., 2017), less likely to have administered naloxone (Kenney et al., 2018), and less likely to return for naloxone refills (Rowe et al., 2015), when compared to their white counterparts. Black Oregonians represented only 5% of opioid-related overdose deaths in 2018 (Kaiser Family Foundation, 2018). However, synthetic opioid use (e.g., fentanyl) and opioid-related death (especially death associated with synthetic opioids) are on the rise among Black Americans (SAMHSA, 2020). Future naloxone research and programs to improve naloxone access should emphasize inclusion of non-white PWID.

Regarding housing stability, in the NHBS sample, participants who experienced homelessness in the past year were less likely to have naloxone than participants who had not. This is counter to findings from previous studies that found naloxone ownership was higher among individuals experiencing housing instability (Madah-Amiri et al., 2019; Reed et al., 2019). Possibly, the participants in those studies were gaining access to naloxone via housing support services. The Substance Abuse and Mental Health Services Administration (SAMHSA) encourages housing service providers to provide naloxone and overdose training (SAMHSA, 2019). Though housing is a key component of Oregon legislation pertaining to outpatient opioid treatment (OAR 415-020-0000) (Oregon Health Authority) and Multnomah County has existing services and programs that integrate housing support and naloxone distribution, our findings indicate there may be additional opportunities to disseminate naloxone to PWID who use opioids and experience homelessness in Portland. An assessment of naloxone distribution via housing support services may provide a better understanding of naloxone access for those experiencing homelessness in Portland. Housing support services in rural Western Oregon are scarce.

Neither study in this analysis established an association between naloxone ownership and overdose in the past year. Large scale studies of overdose among people who use opioids indicate that history of overdose is a strong indicator for fatal overdose (Olfson et al., 2018), and repeated overdose experiences may increase the risk of subsequent overdose mortality (Caudarella et al., 2016). As such, PWID who use opioids who have experienced an overdose should be prioritized for naloxone distribution and training. Some research suggests that emergency departments may be a promising environment for naloxone distribution after an overdose (Gunn et al., 2018). However, a randomized controlled trial of an opioid overdose prevention intervention delivered subsequent to acute care in Seattle, Washington did not demonstrate effectiveness in reducing overdose-related events (Banta-Green et al., 2019). Alternatively, naloxone leave behind (NLB) programs wherein EMS "leave behind" naloxone at the scene of an overdose may have potential for improving access (Scharf et al., 2020). Further investigation may be necessary to identify best practices for rapidly connecting PWID who have experienced an opioid overdose with naloxone and overdose prevention training.

Finally, it is worth noting there was no association between recent arrest and naloxone ownership in either sample. This is contrary to a study of 2015 NHBS data from PWID in Philadelphia which found PWID had greater odds of carrying naloxone if they had been arrested in the past year (Reed et al., 2019). A 2020 systematic review of the relationship between recent incarceration and overdose indicates that formerly incarcerated individuals have a much higher risk of opioid overdose compared to the general population, (Mital et al., 2020). This finding coupled with the results from the current analysis suggest education about risk of overdose and naloxone distribution at release from incarceration should be a priority in Oregon.

This analysis was subject to limitations. First, data were collected cross-sectionally; any observed associations cannot be interpreted as causal. Second, data were self-reported and subject to recall and social desirability bias. Third, because data came from separate studies, individual survey items addressing similar topics were not always comparable. Although we aligned variables to the best of our ability, there were key discrepancies in answer choice options and reference time frames (see Appendix A) that prevented us from making direct comparisons and testing for statistical differences by study sample (i.e., though we qualitatively observed differences between the samples, we were unable to statistically test for regional variation). Furthermore, the samples for the two studies were generated using slightly different RDS methods (e.g., different number of seeds, number of possible recruits, and chain lengths). As such, caution should be taken in comparing findings from the two samples. Furthermore, we only explored shared study features. For example, OR-HOPE participants were given access to naloxone via outreach programs. However, because there was no equivalent study component in NHBS, we did not explore an association between outreach services and naloxone ownership, nor did we control for this association in the adjusted analysis of OR-HOPE data. Fourth, both study samples were collected using RDS methods; however, it is unlikely that either study met all assumptions needed for inference to the underlying populations (Gile and Handcock, 2010). Furthermore, our analytic samples were subsets of the recruited samples. As such, our findings may not be generalizable to the larger populations of PWID who use opioids in Portland or rural Western Oregon, and caution should be taken when applying our findings to populations in other regions of the US. Fifth, our samples reflected limited representation from people of color. Further studies in populations with greater racial-ethnic diversity are greatly needed. Finally, because the OR-HOPE sample was relatively small, it is possible that we were underpowered to detect existing associations.

Conclusions

In conclusion, naloxone ownership was insufficient and highly variable among two samples of PWID who use opioids in Portland and rural Western Oregon. Our findings indicate that PWID who use opioids in rural settings may have less access to naloxone and highlight the importance of SSP and pharmacies for naloxone distribution. People who use methamphetamine, males, and people experiencing homelessness may be at increased risk for not having naloxone. Future research, programming and policy should focus on 1) a more thorough assessment of naloxone ownership disparities, especially among people of color, 2) a better understanding of the fundamental causes of naloxone ownership disparities

(e.g., lack of access points, housing instability, and/or perceptions of stimulant use), and 3) ensuring that all PWID who use opioids have access to this life-saving medication. Further investigation into the full range of overdose education and naloxone distribution (OEND) programs (e.g., outreach in incarceration settings, naloxone upon release, leave-behind naloxone, virtual training, and mailed kits) is also warranted.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Highlights

- Not enough people who inject drugs and use opioids in Oregon have naloxone.
- Naloxone ownership may be more common in urban Oregon than rural Oregon.
- People who use meth, are homeless, and males may be less likely to have naloxone.
- Distribution via syringe service programs and pharmacies may improve access.

Table 1.

Characteristics of people who reported past year injection drug use and opioid use in two studies in urban and rural Oregon

	NHBS (urban), 2018 (N = 477)			OR-HOPE (rural), 2018/2019 (N = 133)		
Characteristic	**T**	**N**	**(%)**	**T**	**N**	**(%)**
Age, median (IQR)	Current	34 yr	(28-44 yr)	Current	34 yr	(29-44 yr)
Race/Ethnicity						
Non-Hispanic White		355	(74%)		102	(77%)
Non-Hispanic Black		12	(3%)		2	(2%)
Hispanic, any race		37	(8%)		14	(11%)
Non-Hispanic multiple races		62	(13%)		4	(3%)
Non-Hispanic other		11	(2%)		11	(8%)
Sex						
Male		296	(62%)		75	(56%)
Female		174	(36%)		58	(44%)
Transgender		7	(1%)		0	(0%)
Education						
High school or less		264	(55%)		87	(65%)
Beyond high school		213	(45%)		46	(35%)
Experienced homelessness	12m	358	(75%)	6m	91	(68%)
Arrested/Held	12m	217	(45%)	6m	108	(81%)
Health insurance	Current	405	(85%)	Current	113	(85%)
Drug of choice	Current			Current		
Heroin		335	(70%)		66	(50%)
Methamphetamine		51	(11%)		57	(43%)
Cocaine or Crack		0	(0%)		1	(1%)
Goofball		64	(14%)		NA	NA
Speedball		20	(4%)		NA	NA
Other		7	(1%)		9	(7%)
Frequency of injection	12m			30d		
>1x/day		384	(81%)		55	(41%)
1x/day		33	(7%)		37	(28%)
>1x/week		27	(6%)		8	(6%)
<1x/week		33	(7%)		31	(23%)
Never		NA	NA		2	(2%)
Got sterile needles from an SSP	12m	406	(85%)	30d	61	(46%)
Got sterile needles from a pharmacy	12m	195	(41%)	30d	80	(60%)
Witnessed an overdose	12m	354	(74%)	Ever	102	(77%)
Experienced an overdose	12m	133	(28%)	12m	23	(17%)
Received overdose training	Ever	293	(61%)	Ever	82	(62%)
Have naloxone	Current	293	(61%)	Current	41	(31%)

T – reference time frame, NA – Not applicable because the study did not collect this category, SSP – syringe service program

Table 2.

Unweighted proportion of naloxone ownership and unadjusted relative risk of having naloxone associated with characteristics of people who reported past year injection drug use and opioid use in two studies in urban and rural Oregon

	NHBS (urban), 2018 (N = 477)					OR-HOPE (rural), 2018/2019 (N = 133)				
Characteristic	**T**	**N**	**(%)**	**RR**	**95% CI**	**T**	**N**	**(%)**	**RR**	**95% CI**
Age (yrs)	Current	-	-	1.00	0.99, 1.01	Current	-	-	0.99	0.96, 1.02
Race/Ethnicity (global p-value)					(0.20)					**(<0.001)**
Non-Hispanic White		233	(66%)	REF	-		30	(29%)	REF	-
Non-Hispanic Black		4	(33%)	0.51	0.23, 1.14		0	(0%)	**	**
Hispanic, any race		18	(49%)	0.74	0.53, 1.04		5	(36%)	1.21	0.56, 2.62
Non-Hispanic multiple races		33	(53%)	0.81	0.63, 1.04		1	(25%)	0.85	0.15, 4.80
Non-Hispanic other		5	(45%)	0.69	0.36, 1.33		5	(45%)	1.54	0.76, 3.16
Sex (global p-value)					(0.13)					(0.67)
Male		172	(58%)	REF	-		22	(29%)	REF	-
Female		**117**	**(67%)**	**1.16**	**1.00, 1.33**		19	(33%)	1.12	0.67, 1.86
Transgender		4	(57%)	0.98	0.51, 1.88		0	-	-	-
Education										
High school or less		154	(58%)	REF	-		23	(26%)	REF	-
Beyond high school		139	(65%)	1.12	0.97, 1.29		18	(39%)	1.48	0.89, 2.45
Experienced homelessness	12m	213	(60%)	0.89	0.76, 1.03	6m	29	(32%)	1.12	0.63, 1.97
Arrested/Held	12m	137	(63%)	1.05	0.91, 1.21	6m	38	(35%)	2.93	0.98, 8.77
Health insurance	Current	251	(62%)	1.04	0.85, 1.29	Current	38	(34%)	2.24	0.76, 6.60
Drug of choice (global p-value)	Current				**(0.03)**	Current				**(<0.001)**
Heroin		207	(62%)	REF	-		31	(47%)	REF	-
Methamphetamine		24	(47%)	0.76	0.56,1.03		**4**	**(7%)**	**0.15**	**0.06, 0.40**
Cocaine/Crack		0	-	-	-		0	(0%)	**	**
Goofball		**48**	**(75%)**	**1.21**	**1.03, 1.43**		NA	NA	NA	NA
Speedball		10	(50%)	0.81	0.52, 1.26		NA	NA	NA	NA
Other		4	(57%)	0.92	0.48, 1.77		6	(67%)	1.42	0.84, 2.41
Injection frequency (global p-value)	12m				**(0.05)**	30d				**(<0.001)**
>1x/day		248	(65%)	REF	-		20	(36%)	REF	-

	NHBS (urban), 2018 (N = 477)					OR-HOPE (rural), 2018/2019 (N = 133)				
Characteristic	**T**	**N**	**(%)**	**RR**	**95% CI**	**T**	**N**	**(%)**	**RR**	**95% CI**
1x/day		20	(61%)	0.94	0.71, 1.25		11	(30%)	0.82	0.44, 1.50
>1x/week		13	(48%)	0.75	0.50, 1.11		2	(25%)	0.69	0.20, 2.41
<1x/week		12	(36%)	**0.56**	**0.36, 0.89**		8	(26%)	0.71	0.35, 1.42
Never		NA	NA	NA	NA		0	(0%)	**	**
Got sterile needles from an SSP	12m	**266**	**(66%)**	**1.73**	**1.26, 2.35**	30d	**30**	**(49%)**	**3.22**	**1.76, 5.88**
Got sterile needles from a pharmacy	12m	124	(64%)	1.05	0.91, 1.22	30d	24	(30%)	0.94	0.56, 1.57
Witnessed an overdose	12m	225	(64%)	1.15	0.96, 1.37	Ever	35	(34%)	1.77	0.82, 3.83
Experienced an overdose	12m	89	(67%)	1.13	0.97, 1.31	12m	7	(30%)	0.98	0.50, 1.94
Received overdose training	Ever	**217**	**(74%)**	**1.79**	**1.49, 2.16**	Ever	29	(35%)	1.50	0.84, 2.68

T – reference time frame, SSP – syringe service program, NA – Not applicable because the study did not collect this category

** No participants with this characteristic currently owned naloxone, **Bold = p<0.05**

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Table 3.

Adjusted relative risk of having naloxone associated with characteristics of people who reported past year injection drug use and opioid use in two studies in urban and rural Oregon

	NHBS (urban), 2018 (N = 469)			OR-HOPE (rural), 2018/2019 (N = 133)		
Characteristic	**T**	**aRR**	**95% CI**	**T**	**aRR**	**95% CI**
Age (yrs)	Current	1.00	1.00, 1.01	Current	1.01	0.98, 1.03
Race/Ethnicity (global p-value)			(0.20)			**(<0.001)**
Non-Hispanic White		REF	-		REF	-
Non-Hispanic Black		0.62	0.27, 1.45		**	**
Hispanic, any race		0.79	0.56, 1.10		1.30	0.69, 2.47
Non-Hispanic multiple races		0.82	0.66, 1.04		0.95	0.22, 4.18
Non-Hispanic other		0.79	0.46, 1.35		1.44	0.76, 2.72
Sex (global p-value)			**(0.02)**			(0.91)
Male		REF	-		REF	-
Female		**1.20**	**1.05, 1.36**		1.03	0.61, 1.75
Transgender		0.91	0.55, 1.50		-	-
Education						
High school degree or less		REF	-		REF	-
Beyond high school		1.08	0.95, 1.24		1.37	0.83, 2.25
Experienced homelessness	12m	**0.86**	**0.74, 0.99**	6m	1.10	0.57, 2.15
Arrested/Held	12m	1.03	0.89, 1.19	6m	1.63	0.56, 4.76
Health insurance	Current	0.95	0.78, 1.17	Current	1.82	0.51, 6.50
Drug of choice (global p-value)	Current		(0.11)	Current		**(<0.001)**
Heroin		REF	-		REF	-
Methamphetamine		0.94	0.70, 1.28		**0.17**	**0.06, 0.47**
Cocaine/Crack		-	-		**	**
Goofball		**1.20**	**1.03, 1.40**		NA	NA
Speedball		0.83	0.55, 1.23		NA	NA
Other		1.35	0.70, 2.60		1.58	0.84, 2.98
Injection frequency (global p-value)	12m		(0.20)	30d		**(<0.001)**
>1x/day		REF	-		REF	-
1x/day		1.11	0.84, 1.48		1.26	0.79, 2.01
>1x/week		0.81	0.55, 1.19		1.62	0.57, 4.59
<1x/week		0.68	0.44, 1.06		0.84	0.39, 1.77
Never		NA	NA		**	**
Got sterile needles from an SSP	12m	1.35	0.96, 1.90	30d	**2.02**	**1.03, 3.96**
Got sterile needles from a pharmacy	12m	1.09	0.95, 1.25	30d	0.90	0.56, 1.46
Witnessed an overdose	12m	1.03	0.87, 1.23	Ever	1.19	0.54, 2.64
Experienced an overdose	12m	1.11	0.96, 1.28	12m	0.78	0.39, 1.54
Received overdose training	Ever	**1.63**	**1.34, 1.97**	Ever	0.88	0.50, 1.56

T – reference time frame, SSP – syringe service program, NA – Not applicable because the study did not collect this category

** No participants with this characteristic currently owned naloxone, **Bold = p<0.05**