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"I've been to more of my friends' funerals than I've been to my friends' weddings": Witnessing and responding to overdose in rural Northern New England

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Abstract

Overdose is a leading cause of death among people who use drugs (PWUD), but policies to reduce fatal overdose have had mixed results. Summaries of naloxone access and Good Samaritan Laws (GSL) in prior studies provide limited information about local context. Witnessing overdoses may also be an important consideration in providing services to PWUDs, as it contributes to Post Traumatic Stress Disorder (PTSD) symptoms, which complicate substance use disorder treatment. We aim to estimate the prevalence and correlates of witnessing and responding to an overdose, while exploring overdose context among rural PWUD. The Drug Injection Surveillance and Care Enhancement for Rural Northern New England (DISCERNNE) mixed-methods study characterized substance use and risk behaviors in 11 rural Massachusetts, Vermont, and New Hampshire counties between 2018 and 2019. PWUD completed surveys (n = 589) and in-depth interviews (n = 22). Among the survey participants, 84% had ever witnessed an overdose, which

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CONTRIBUTORS

All authors contributed to the study design. A. Drew, K. Nolte, P. Dowd, L. Del Toro-Mejias and E. Bianchet conducted the qualitative data analysis, while E. Romo conducted the quantitative data analysis. All authors contributed to the data interpretation and drafted the initial manuscript. T. Stopka and P. Friedmann provided study oversight. All authors provided critical feedback and approved the final version of the article.

CONFLICT OF INTEREST

The authors have no conflicts of interest to report.

HUMAN PARTICIPANT PROTECTION

The Baystate Health Institutional Review Board (IRB) approved the study protocol.

was associated with probable PTSD symptoms. Overall, 51% had ever called 911 for an overdose, though some experienced criminal legal system consequences despite GSL. Although naloxone access varied, 43% had ever used naloxone to reverse an overdose. PWUD in Northern New England commonly witnessed an overdose, which they experienced as traumatic. Participants were willing to respond to overdoses, but faced barriers to effective overdose response, including limited naloxone access and criminal legal system consequences. Equipping PWUDs with effective overdose response tools (education, naloxone) and enacting policies that further protect PWUDs from criminal legal system consequences could reduce overdose mortality.

Keywords

Naloxone access; opioid overdose; New England; Good Samaritan Laws; rural health

INTRODUCTION

Overdose is a leading cause of death among people who use drugs (PWUD),[1] but policies to reduce fatal overdose have had mixed results.[2,3] Both fatal and non-fatal overdoses have increased over the past two decades with disproportionate rises in rural areas.[4,5] PWUDs commonly witness and reverse overdoses.[6] Witnessing overdoses may also be an important consideration in providing services to PWUDs, as it contributes to Post Traumatic Stress Disorder (PTSD) symptoms,[7] which complicate substance use disorder (SUD) treatment.[8,9]

Policies to reduce overdose fatalities include Good Samaritan Laws (GSL), which provide some legal immunity when calling 911 during an overdose, and naloxone access laws, which increase access to a rescue medication. Limited evidence supports that GSL reduce overdose mortality.[2] Naloxone is effective at reversing opioid overdose,[10,11] yet a recent systematic review suggests existing naloxone access laws may be insufficient to reduce fatal overdose.[3] Despite GSL, PWUD have reported hesitancy calling 911, fearing criminal legal consequences.[12] The reasons for these mixed results are uncertain, and policy studies may miss important local contexts, like rurality, that influence effectiveness.[13]

Most research on overdose prevention focuses on urban areas,[7,14,15] and may not include the perspective of PWUDs.[16] Much existing research in rural communities focuses on Appalachia,[4,5,17] where policies, harm reduction access and drug supply may differ from rural communities in other parts of the country. Reviews of naloxone access and GSL have summarized prior studies, but provide limited information about local context.[2,3] The current study is a mixed-methods investigation of rural PWUDs in New England to examine the prevalence and context of witnessing opioid overdoses, calling 911 and administering naloxone.

METHODS

The Drug Injection Surveillance and Care Enhancement for Rural Northern New England (DISCERNNE) study was a cross-sectional, mixed-methods study in 11 rural counties along the Connecticut River Valley in Massachusetts (MA), New Hampshire (NH), and Vermont (VT). DISCERNNE aimed to characterize the risk environment and epidemiology

of overdose and injection-mediated infectious diseases through audio computer-assisted self-interviews (ACASI) and qualitative in-depth interviews with PWUDs. The Good Reporting of A Mixed Methods Study (GRAMMS) checklist guided this report.[18]

Recruitment

Respondent-driven sampling (RDS) methods were employed to recruit participants between May 2018 and October 2019 across 11 study sites selected in consultation with local public health officials and service providers.[19] Eligibility criteria were: (1) age ≥ 18 years, (2) spent most of the last 30 days in the study area, (3) used opioids to get high or injected any drug in the last 30 days, and (4) able to provide informed consent. Research staff recruited RDS seeds through street outreach and at harm reduction sites. The 51 seeds enabled recruitment of 538 additional participants (total n=589); the current analyses include 578 participants with complete data for the primary outcome (ever having witnessed an overdose).

Semi-structured, in-depth interviews with 22 participants occurred between April 2018 and August 2019. Purposive sampling enrolled a sample reflective of the drug-using community by sex, age, and opioid use patterns. The qualitative sample for the current analyses is restricted to 16 participants who also completed the survey.

Data Collection

Audio computer-assisted self-interview (ACASI) survey—A 90-minute ACASI survey collected self-reported information on socio-demographics, substance use patterns, injection and sexual risk behaviors, overdose history, addiction treatment, healthcare access, mental health, infectious disease history, and social networks. ACASI facilitates confidential and accurate responses to sensitive questions.[20] Participants received $40 for the survey and infectious disease testing, and $10 per referred, eligible peer.

In-depth interviews—The 45-to-90-minute, in-depth, semi-structured interviews followed an interview guide that explored experiences and perspectives in the following domains: 1) personal narrative of substance use; 2) the injection drug use, overdose, HCV and HIV epidemics; 3) injection and sexual risk behaviors; 4) local laws and policies; and 5) local health care, SUD treatment, and syringe exchange services. The following prompt elicited stories about witnessing overdose: “Tell me about your most significant experience with someone else overdosing?” Probes further inquired whether they called 911 and administered naloxone. Interviews were recorded and transcribed verbatim. Participants received $25 for their time.

Measures

Outcome measures—The primary outcome was a positive response to the survey question: “Have you ever seen someone overdose?” Of those who affirmed they had seen someone overdose (n=483, 83.6%), the ACASI assessed secondary outcomes with the questions: “Have you ever called 911 because someone overdosed?” and “Have you ever used naloxone or Narcan on someone to reverse an overdose?” The question on naloxone was only asked of participants who reported ever witnessing an overdose and ever obtaining an overdose reversal kit or naloxone.

Potential Correlates—Sociodemographic correlates included gender, age, sex, race/ethnicity, education, employment, homeless status, recent incarceration, health insurance status, and state of residence.

Substance-related factors were: drug of choice (past 30 days); injection history (currently inject [past 30 days] at least daily, currently inject < daily, ever injected but not currently, never injected); obtained syringes from a syringe services program (SSP) in the past 30 days; obtained syringes from a pharmacy in the past 30 days; proximity to the nearest SSP (live within walking distance, not within walking distance/don't know); and ever received methadone or buprenorphine.

Overdose-related factors included ever surviving an overdose, knowing someone who died of an overdose in the past six months, ever having training to recognize and respond to an overdose, ever receiving an overdose reversal kit or prescription for naloxone, and currently having naloxone.

Behavioral factors included psychological distress[21] and PTSD symptoms.[22] The 6-item Kessler (K6) scale measured nonspecific psychological distress. Total scores ranged from 0 to 24, and a score ≥ 13 was defined as serious psychological distress.[20] The 5-item Primary Care PTSD Screen for DSM-5 (PC-PTSD-5) assessed probable PTSD. Total scores ranged from 0 to 5, and a score ≥ 4 was defined as probable PTSD. [21]

Analysis

Quantitative analysis—After calculating descriptive statistics, modified Poisson regression models were run to identify factors associated with the three binary outcomes.[23,24] Bivariate modified Poisson models first examined the crude associations between each potential correlate and the overdose outcome. Factors significant at $p<0.10$ were entered into a multivariable model. Variance inflation factors (VIF) assessed multicollinearity in the final modified Poisson model for each outcome of interest; no VIFs exceeded 5.0, thus no variables were removed. All analyses were performed using Stata version 14 (StataCorp LP, College Station, TX).

Qualitative analysis—A risk environment framework guided initial coding and analysis.[25] The interview guide informed codebook development. A five-member coding team reviewed and coded three initial interview transcripts, meeting weekly to refine codes, revise the codebook, and review applications of codes to text segments, reconciling differences until consensus was achieved. Using a content analysis software program (Dedoose version 8.0.35, Dedoose, Los Angeles, CA), two team members double-coded the remaining transcripts. Five authors reviewed exported reports that included text segments for the following three codes: *Overdose, Narcan, and Good Samaritan Law*. Pseudonyms are used to protect participants' identities in the manuscript.

Mixed methods analysis—Key findings from the quantitative data were drawn from the multivariable analyses of the overdose outcome variables. We unpacked and contextualized the quantitative findings by analyzing narratives from the qualitative interviews. Finally, the analytical approach identified narratives that reflected the quantitative findings.[26] Emergent

qualitative findings that offered nuanced contextual insight to the key quantitative findings were identified.

RESULTS

Participant Characteristics

Heroin was the most common drug of choice (59.3%), and about half of participants injected daily (45.7%) (Table 1). Most had ever received some form of medication for opioid use disorder (MOUD) (59.0% buprenorphine, 40.1% methadone). A minority got their syringes from an SSP (21.8%) or a pharmacy (27.0%) in the last 30 days. Many participants reported symptoms of serious psychological distress (62.6%) or screened positive for probable PTSD (45.5%).

Half the sample had themselves survived an overdose (51.2%), and nearly all knew someone who died of an overdose in the prior six months (85.8%). Half reported they were trained to recognize and respond to an overdose (54.8%), two-thirds had ever received an overdose reversal kit or naloxone (67.3%), and half currently had naloxone (49.5%) at the time of the survey. Participant characteristics by the secondary outcomes (ever called 911 because someone overdosed and ever used naloxone to reverse an overdose) are available in Appendix A.

The qualitative sub-sample was similar to the quantitative survey sample except everyone used either heroin (81.3%) or fentanyl (18.8%) as their drug of choice, and more screened positive for probable PTSD (75%) (Table 1).

Among all quantitative survey respondents (n=578), 83.6% had ever witnessed an overdose, 50.7% reported having ever called 911 when someone overdosed, and 43.3% reported ever having used naloxone to reverse an overdose. Nearly one-third 31.7% reported all three behaviors.

Mixed-Methods Results

Figure 1 juxtaposes the prevalence of each overdose outcome with exemplar qualitative narratives from the in-depth interviews to add context for the quantitative findings.

Covariates that were significant at a $p<0.1$ level in bivariate analyses were considered for inclusion in multivariable models (Appendix B). Key findings from the multivariable models for each overdose outcome (Table 2) are incorporated below in the discussion of mixed-methods findings, with participant narratives from qualitative analysis providing further context. Salient findings from quantitative analyses indicated that witnessing overdose was common and traumatic; naloxone access was variable; and overdose response training was associated with witnessing and responding to an overdose. Two emergent findings, which provided more in-depth understanding, arose from qualitative analyses and went beyond the key quantitative findings; these were: predictability of overdose and criminal legal system consequences from calling 911, despite GSL.

Witnessing overdose was common and traumatic—Of surveyed participants, 83.6% witnessed an overdose, and nearly everyone knew someone who had died of an overdose in the last six months – often many people. Only 16.3% of survey participants and one interview participant (Josh, 24M NH: Figure 1, Quote E) reported never having witnessed an overdose, which he attributed to being private about his use and not wanting to be around others during drug injection activities.

Witnessing an overdose was associated with PTSD symptoms (adjusted prevalence ratio [aPR]: 1.10, 95% confidence interval [CI]: 1.02–1.19), having survived an overdose (aPR: 1.12, 95% CI: 1.03–1.21), having been trained to recognize and respond to an overdose (aPR: 1.11, 95% CI: 1.02–1.20), and having received naloxone (aPR: 1.13, 95% CI 1.00–1.28) (Table 2). The frequency of overdoses and associated fatalities were described as increasing over the years. As Matt, a 24-year-old male from NH (24M NH), describes in Figure 1 (Quote A), often PWUD witness many overdoses. Matt also described increasing numbers of opioid-related overdose deaths in his local community,

> Overdoses have been crazy. Five, six years ago you didn't hear of that many overdoses. Just this year I've lost eight friends.

Indeed, within many narratives, multiple losses to overdose were a primary life event experienced, as Amanda (31F MA) described,

> I've been to more of my friends' funerals than I've been to my friends' weddings or the birth of their children…In the last two years I've been to 17 different funerals because of overdoses, and that's ridiculous.

The association of PTSD symptoms with witnessing an overdose from the multivariable analysis did not specifically ask whether trauma symptoms were related to witnessing an overdose, although the trauma of witnessing an overdose was clear within the narratives. Witnessing an overdose was often vividly described as a time when participants reported 'being scared,' 'freaking out,' 'panicking,' or 'freezing.' Christopher (28 M VT) described (Figure 1, Quote B) himself 'freezing' when responding to an overdose and connected this to 'getting PTSD' after previously witnessing a fatal overdose.

Predictability of overdose.—An emergent qualitative finding was predictability of overdose where many described 'overdose risk periods' when overdoses were more common and even anticipated. Interview participants' contacts frequently experienced fatal overdose after returning to the community, waiting for opioid use disorder (OUD) treatment, or trying to qualify for treatment. The death of friends and family members was most often described as occurring after returning to the community from incarceration or abstinence-based treatment programs. Less frequently, additional 'risk periods' for fatal overdose included the individuals were on a waitlist or had a future appointment to enter treatment. Three participants reported that fatal overdoses happened after someone decreased use but needed additional support and had to use opioids to qualify for treatment. As Amanda (31F MA) described:

> A few of those overdoses were people who were having really, really hard time keeping clean, staying clean. They wanted to get help, um, but the clinics and the

> rehabs require you're dirty to go into them… I know of at least four people that only bought and used that day to get into the treatment facility, and it ended up killing them.

Losing people to overdose when they were using to try to qualify for services that only accepted those actively using drugs, was particularly tragic as participants recognized they died because of seeking help. Participants also discussed watching those in 'overdose risk periods' often suffer multiple overdoses. Sometimes someone with a non-fatal overdose would later have a fatal overdose. Others described the futility they felt watching people overdose multiple times while they were waiting for treatment.

Naloxone access was variable

Witnessing an overdose was associated with receiving an overdose reversal kit or naloxone (aPR: 1.13, 95% CI: 1.00–1.28). Although two thirds of participants reported ever receiving naloxone, interview participants described naloxone access as highly variable, with greater perceived need over the last few years. Many, like James (47M NH), had no idea where they might access naloxone:

> I wouldn't know where to find any [naloxone]…. I've had a couple of cans. I've given them away, you know…. Like I've given them away to people that really need them. Myself, like, I, I, I've overdosed once and I, and I, you know…I'm not looking to die.

Many began carrying naloxone as increasing numbers of overdoses occurred, as described by Ashley (28F MA):

> You don't know where you even run into an overdose nowadays, so I try to always have [naloxone] on me… Uh, it's not so easy to get [naloxone]. You can get it once a week here [at the syringe services program]…and the [recovery agency] is supposed to have it, but they don't always have it.

Both James and Ashley wanted to have naloxone on hand if they saw someone overdose. Like James, many participants provided their naloxone to others perceived to be at higher risk, attempting to distribute a scarce resource based on need. Many participants reported challenges obtaining naloxone from local agencies or having an insufficient supply during an overdose. Those who had naloxone available mentioned that the doses they had were not enough. They would often try to augment responses to overdoses with other methods.

Overdose response training was associated with witnessing and responding to an overdose

Ever having been trained to recognize and respond to an overdose was associated with each overdose outcome: witnessing an overdose (aPR: 1.10, 95% CI: 1.02–1.19), calling 911 because someone overdosed (aPR: 1.28, 95% CI: 1.07–1.53), and administering naloxone (aPR: 1.25, 95% CI: 1.06–1.49). Although the multivariable results indicated that those trained to respond to an overdose were more likely to witness and respond, the temporal sequence of these events was unknown. Witnessing an overdose may prompt people to seek out training, or those trained to respond to an overdose may have felt more comfortable calling 911 and administering the naloxone they had received.

Those who had witnessed an overdose reported responding using whatever tools and training were available. They provided CPR, a sternal rub, naloxone, transportation to the hospital, 911 calls, or sought help from bystanders. Others reported folk methods such as throwing water on people, putting them in a cold shower, or giving them stimulants. Jessica (24F NH) summarized the multiple strategies she has seen work at different times:

> I carried a 180-pound man into a shower before and threw him in cold water, and that's what got him out. Most of the time… you can tell when someone's going to start ODing- Like right after they shoot up, you can just tell by the way they are acting, their eyes and everything. If you stand them up and start like throwing cold water on them, that usually will wake them up. Make them walk around. Make them talk to you… One time I even made someone take a crack hit to get them out of it. Like that works sometimes too… someone's ODing… give then… a big crack blast and then they come out of it a little bit.

Lisa proudly recounted her three overdose "saves" (Figure 1, quote C) and the flowers that the rescued people send her each year in appreciation. However, throughout the interviews, even for those who did call 911, there was a reluctance to do so. Melissa (38F VT) described such reluctance to call 911 after multiple doses of naloxone failed to revive her friend:

> We panicked. We tried Narcan three times. It didn't work. (Cries)…Hours passed and finally someone on the same street that I live on, um, I had to go ask for help. I didn't know what to do. And they called the ambulance to come get her. It was too late…Hours had passed. We tried the cold shower, we tried everything. It didn't work.

Calling 911 because someone overdosed was associated with incarceration in the last six months (aPR: 1.35, 95% CI: 1.18–1.55), ever receiving methadone (aPR: 1.20, 95% CI: 1.03–1.40), probable PTSD symptoms (aPR: 1.19, 95% CI: 1.00–1.40), and having been trained to respond to an overdose (aPR: 1.28, 95% CI: 1.07–1.53).

One participant, Melissa (38F VT), described administering naloxone soon after release from incarceration, but had received overdose response training from the study team. Although the temporal sequence related to the multivariable findings cannot be determined, the in-depth interviews suggest that some incarceration experiences could be the result of calling 911. Ashley (28F MA) describes a scenario where the overdose victim ended up going to jail after her 911 call.

> I had Narcan'd him twice. I couldn't get him to come to. I had to drag him… stand in the middle of the road, and wave people down. Um, honestly like he was dead. If I didn't make my mom call 911 and wave someone for CPR, he, he would've died…. If I didn't find an off duty EMT who was just driving by, he, he would've died… when CPR started, he actually had started to come, come alive…move a little. But once the EMTs got there… they got him awake, and he, he was kind of hostile… He refused medical attention and …then he actually ended up in jail. He had a warrant from like three, four years ago

Others like Jason (39M MA; Figure 1, Quote D) didn't hesitate to call 911, but perceived a culture in which many and especially younger people would "just sit there and watch

somebody flop and like laugh and keep walking." Many interviewees relayed a similar perception that not calling 911 was often related to a lack of empathy for others or selfishness.

Criminal legal system consequences tied to calling 911, despite Good Samaritan Laws (GSL).—Despite GSL, only half of participants who witnessed an overdose reported calling 911. Criminal legal system consequence following 911 calls was described by many as the primary reason not to do so. Some participants appreciated GSL and recounted greater likelihood that overdose witnesses would call 911. However, the majority of interview participants themselves feared consequences of calling 911 or described others' fears, despite knowing about GSL. Specific concerns and limitations of GSL included lack of protecting for those who had outstanding warrants, were on probation or parole, or had large amounts of drugs on them when they were at an overdose scene. Overdose bystanders generally attempted to help, except when they feared law enforcement. David (29M MA), who had called 911 during a prior rescue, recounted an overdose when he did not call. David describes what happened after he administered naloxone:

> They (friends) made me sit there and wait with them until they, until their pupils got a little bigger…they didn't want the cops to come…they may have had warrants at the time.

One interviewee also described delays in emergency care, while responders awaited law enforcement arrival. Brittany (28F VT) described waiting over an hour after a 911 call when she and her fiancé overdosed and a friend administered naloxone:

> And the first responder was sitting at the end of the road right next to the fucking house I was at, but they can't be on the scene until an officer's there. Because officers didn't show up for over an hour, neither did emergency personnel.

Brittany described this scene as an example of how GSL would not protect you because they didn't want to disturb a crime scene by responding to a medical emergency. Others described a culture of leaving when someone overdoses due to concerns about law enforcement, despite the GSL. As James (47M NH) described:

> The thing of it is you can't get in trouble for calling 911. They just don't want the cops to know they're associated with using or they're on probation and they don't get in trouble or go back to jail. So they don't call. Nope, they don't call. They run. You're on your own.

DISCUSSION

This mixed-methods study had three key findings: witnessing overdose was common and traumatic, naloxone access was variable, and overdose response training was associated with witnessing and responding to an overdose. Two emergent findings, predictability of overdose and criminal legal system consequences from calling 911 despite GSL, provided greater context to key findings but could not be assessed in multivariable analysis.

Witnessing overdose was common and traumatic among rural PWUD in our study. The qualitative interviews described common overdose risk periods, which were predictable

to PWUD. The high prevalence of ever witnessing an overdose (84%) was within the range of estimates in previous studies of urban PWUD[15,27–30], but higher than estimates from prior studies of rural PWUD.[4] Witnessing an overdose was associated with PTSD symptoms. However, our survey measured general experiences of PTSD symptoms and not PTSD symptoms explicitly related to overdose. In urban samples, “overdose traumas” have emerged as a validated form of trauma associated with PTSD symptoms for PWUDs and first responders.[7] Knowing the overdose victim, the commonality of witnessing an overdose, and powerlessness from naloxone scarcity may further compound PWUDs’ overdose trauma. Although our study could not establish the temporal sequence of witnessing an overdose and experiencing PTSD symptoms, it supports the salience of “overdose trauma” and related PTSD among rural PWUDs.

Although most participants reported ever having obtained naloxone, access to naloxone in the rural settings we studied was often limited, consistent with findings from another recent national study.[31] In the absence of naloxone, participants responded with both evidence-based practices and folk methods. This finding is consistent with observations in both urban[28–30,32] and rural settings,[33] where ineffective folk practices (e.g., cold shower, shaking, inflicting pain) are common. The frequency of folk practices use based on rurality is unknown. Administering naloxone was associated with having been trained to respond to an overdose, which suggests that formal training programs for rural PWUD are effective. Although these data cannot confirm whether people sought training prior to administering naloxone, the association is consistent with studies showing the utility of training interventions for PWUD and bystanders.[11,34] However, factors other than knowledge alone and training influence the decision to administer naloxone and call 911.

Consistent with estimates from previous studies (21–68%),[29,35–38] 51% who witnessed an overdose reported calling 911. They also reported criminal legal system consequences or fear of these consequences from calling 911, despite GSL. Findings from our qualitative interviews depicted experiences with concerns about warrants and arrests resulting from an overdose call, which created conflict in their choices to respond to overdoses. Formal or informal policies requiring police officer arrival on scene prior to EMS response contributes to delays in overdose reversal and possibly death. These findings suggest that GSL are necessary but insufficient to encourage PWUDs to activate EMS in response to an overdose; the interpretation and application of these laws by local law enforcement is equally important. Future research should examine the risk and benefits of sending paramedics and other alternative responders to overdose emergencies without police.

These findings also point to an opportunity to recognize the efforts of PWUD in addressing the overdose epidemic. It was incredibly powerful for Lisa (Figure 1: C) to be recognized by those whose lives she saved. However, notably absent from interviews was recognition by emergency or social service providers of PWUDs who reversed overdoses. Official recognition of PWUDs as primary responders to overdoses and critical to preventing fatalities could improve community relations and increase others’ willingness to respond to overdose. Given networks of PWUD in rural areas are often closely tied, an overdose death could also provide an opportunity to provide grief support, overdose reversal kits, and

overdose response education. A proactive response may allow for grief processing while preventing additional overdose deaths.

This study has several limitations. First, the cross-sectional design cannot establish temporality. Second, the RDS may not have yielded a representative sample, and thus findings may not be generalizable to the population of rural PWUDs in Northern New England. Finally, selection of participants for the qualitative interviews ensured a varied distribution of experiences, but the wide geographic and topical areas limited the likelihood that saturation was achieved in all areas. That said, all interview participants had known someone who overdosed in the past six months.

CONCLUSIONS

PWUDs in rural New England frequently witness and respond to overdoses. Witnessing overdose is associated with PTSD symptoms. PWUDs are willing and able to respond to overdoses, but their access to naloxone is still variable. Often PWUDs are heroes, saving people from overdose. Equipping PWUDs with overdose prevention tools and training has the potential to improve overdose outcomes in isolated rural communities. Opportunities to improve naloxone distribution to this population include routinely distributing additional naloxone to: anyone who overdoses or witnesses an overdose; harm reduction programs; pharmacies; people awaiting SUD treatment; people in addiction treatment; people about to be discharged from inpatient treatment or incarceration; and those who live or congregate in known overdose hotspots. Communities and researchers should explore whether medical and social service first responders may be preferable to police in overdose situations, potentially helping to ease reluctance to call 911. More effective health and legal policy would fully protect people who call 911 during overdoses from punitive legal responses, ensuring that GSL truly encourage people to save lives in all instances.

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We want to thank Randall Hoskinson, Jr. and Linda M. Kinney for their contributions to study coordination, recruitment and data collection.

APPENDIX

Appendix A.

Survey Participant Characteristics by Overdose Response in rural Northern New England, 2018–2019.

Characteristic	Ever called 911 because someone overdosed (n=293)	Never called 911 because someone overdosed (n=187)	Ever used naloxone to reverse an overdose (n=250)	Never used naloxone to reverse an overdose (n=99)
Location - no. (%)				
State				
Vermont	144 (49.2)	105 (56.2)	141 (56.4)	44 (44.4)
New Hampshire	108 (36.9)	61 (32.6)	69 (27.6)	37 (37.4)
Massachusetts	41 (14.0)	21 (11.2)	40 (16.0)	18 (18.2)
Sociodemographics - no. (%), median (IQR)				
Female gender	124 (42.3)	69 (36.9)	101 (40.4)	41 (41.4)
Age (years) - median (IQR)	34 (29–42)	34 (28–41)	34 (28–41)	34 (28–42)
White race	268 (91.5)	169 (90.4)	229 (91.6)	92 (92.9)
Education: High school or higher	220 (75.1)	135 (72.2)	189 (75.6)	73 (73.7)
Employment: Full/part-time	100 (34.1)	67 (35.8)	81 (32.4)	35 (35.4)
Homeless in past 6 mo.	182 (62.1)	102 (54.6)	160 (64.0)	55 (55.6)
Incarcerated in past 6 mo.	107 (36.5)	38 (20.3)	83 (33.2)	27 (27.3)
Have health insurance	252 (86.0)	150 (80.2)	207 (82.8)	90 (90.9)
Substance use - no. (%)				
Drug of choice				
Heroin	187 (63.8)	114 (61.0)	172 (68.8)	70 (70.7)
Fentanyl/carfentanil	11 (3.8)	6 (3.2)	8 (3.2)	4 (4.0)
Opioid painkillers	20 (6.8)	12 (6.4)	13 (5.2)	7 (7.1)
Buprenorphine	14 (4.8)	8 (4.3)	10 (4.0)	4 (4.0)
Methadone	3 (1.0)	1 (0.5)	1 (0.4)	0 (0.0)
Cocaine/crack	44 (15.0)	29 (15.5)	34 (13.6)	9 (9.1)
Methamphetamine	9 (3.1)	7 (3.7)	6 (2.4)	2 (2.0)
Other[a]	8 (2.7)	11 (5.9)	7 (2.8)	3 (3.0)
Injection drug use - no. (%)				
Injection history				
Currently inject (past 30 days): at least 1x daily	152 (51.9)	85 (45.5)	155 (62.0)	46 (46.5)
Currently inject (past 30 days): less than daily	94 (32.1)	52 (27.8)	67 (26.8)	32 (32.3)
Ever injected, but not currently (past 30 days)	16 (5.5)	17 (9.1)	12 (4.8)	10 (10.1)
Never injected	31 (10.6)	32 (17.1)	16 (6.4)	11 (11.1)
MOUD - no. (%)				
Ever received methadone	148 (50.5)	62 (33.2)	127 (50.8)	45 (45.5)
Ever received buprenorphine	188 (64.2)	111 (59.4)	174 (69.6)	69 (69.7)

Characteristic	Ever called 911 because someone overdosed (n=293)	Never called 911 because someone overdosed (n=187)	Ever used naloxone to reverse an overdose (n=250)	Never used naloxone to reverse an overdose (n=99)
Syringe Sources - no. (%)				
Got syringes from SSP (past 30 days)	68 (23.2)	37 (19.8)	71 (28.4)	22 (22.2)
Got syringes from pharmacy (past 30 days)	86 (29.4)	45 (24.1)	82 (32.8)	29 (29.3)
Proximity to nearest SSP (self-report)				
Live within walking distance	121 (41.3)	61 (32.6)	113 (45.2)	32 (32.3)
Not within walking distance/Don't know	155 (52.0)	109 (58.3)	124 (49.6)	57 (57.6)
Mental Health - no. (%)				
Kessler 6 total score: ≥ 13	197 (67.2)	109 (58.3)	162 (64.8)	61 (61.6)
PC-PTSD-5 total score: ≥ 4	161 (55.0)	74 (39.6)	133 (53.2)	45 (45.5)
Overdose/Naloxone - no. (%)				
Ever survived overdose(s)	179 (61.1)	90 (48.1)	163 (65.2)	43 (43.4)
Know someone who died of overdose (past 6 mo.)	267 (91.1)	161 (86.1)	225 (90.0)	87 (87.9)
Ever trained to recognize/respond to overdose	197 (67.2)	87 (46.5)	176 (70.4)	52 (52.5)
Ever got overdose reversal kit or naloxone	234 (79.9)	114 (61.0)	----	----
Currently have naloxone	165 (56.3)	91 (48.7)	187 (74.8)	69 (69.7)

Note: MOUD = medication for opioid use disorder; SSP = syringe services program

[a]Drugs in "Other" category include: prescription anxiety drugs, synthetics, gabapentin, clonidine, and other (unspecified)

Appendix B.

Bivariate Associations Between Participant Characteristics and Each Opioid Overdose Outcome, rural Northern New England, 2018–2019.

	Ever witnessed an overdose	Ever called 911 because someone overdosed	Ever used naloxone to reverse an overdose
Characteristic	**Prevalence Ratio (95% CI)**	**Prevalence Ratio (95% CI)**	**Prevalence Ratio (95% CI)**
Location			
State			
Vermont (reference)	Ref.	Ref.	Ref.
New Hampshire	1.08 (1.01–1.17) *	1.11 (0.95–1.29)	0.85 (0.73–1.00) *
Massachusetts	0.97 (0.85–1.10)	1.14 (0.93–1.41)	0.90 (0.75–1.10)
Sociodemographics			
Female gender	0.99 (0.92–1.07)	1.09 (0.94–1.26)	0.98 (0.86–1.13)
Age (per 10 years)	1.00 (0.96–1.03)	1.02 (0.95–1.09)	1.00 (0.94–1.07)
White race (vs. Non-White)	1.08 (0.93–1.24)	1.05 (0.81–1.37)	0.95 (0.76–1.19)
HS graduate or higher (vs. < HS)	1.01 (0.93–1.10)	1.06 (0.90–1.26)	1.03 (0.88–1.20)
Full/part-time employment	0.95 (0.88–1.02)	0.97 (0.83–1.13)	0.96 (0.83–1.11)

Characteristic	Ever witnessed an overdose Prevalence Ratio (95% CI)	Ever called 911 because someone overdosed Prevalence Ratio (95% CI)	Ever used naloxone to reverse an overdose Prevalence Ratio (95% CI)
Homeless in past 6 mo.	1.09 (1.01–1.17) *	1.13 (0.97–1.32)	1.11 (0.96–1.28)
Incarcerated in past 6 mo.	1.05 (0.97–1.13)	1.33 (1.16–1.52) *	1.08 (0.94–1.24)
Have health insurance	1.02 (0.92–1.14)	1.22 (0.96–1.55)	0.85 (0.73–1.00) *
Substance use			
Drug of choice			
Heroin/fentanyl/carfentanil (reference)	Ref.	Ref.	Ref.
Opioid painkillers	0.83 (0.69–1.00) *	1.00 (0.76–1.33)	0.92 (0.66–1.28)
Buprenorphine/methadone	0.97 (0.83–1.13)	1.05 (0.78–1.41)	1.03 (0.75–1.42)
Cocaine/crack/methamphetamine	0.89 (0.80–0.98) *	0.96 (0.79–1.16)	1.11 (0.94–1.30)
Other[a]	0.82 (0.62–1.07)	0.54 (0.26–1.10) *	0.94 (0.59–1.50)
Injection drug use			
Injection history			
Currently inject (past 30 days): at least 1x daily	1.26 (1.10–1.45) *	1.30 (1.00–1.71) *	1.30 (0.94–1.80)
Currently inject (past 30 days): less than daily	1.14 (0.98–1.32) *	1.31 (0.99–1.73) *	1.14 (0.81–1.61)
Ever injected, but not currently (past 30 days)	1.05 (0.84–1.30)	0.99 (0.64–1.52)	0.92 (0.56–1.51)
Never injected (reference)	Ref.	Ref.	Ref.
MOUD			
Ever received methadone	1.15 (1.07–1.23) *	1.32 (1.14–1.52) *	1.07 (0.93–1.22)
Ever received buprenorphine	1.14 (1.06–1.24) *	1.09 (0.93–1.27)	1.00 (0.87–1.16)
Syringe Sources			
Got syringes from SSP (past 30 days)	1.00 (0.92–1.10)	1.07 (0.91–1.26)	1.08 (0.94–1.24)
Got syringes from pharmacy (past 30 days)	1.00 (0.93–1.09)	1.10 (0.95–1.28)	1.04 (0.90–1.19)
Proximity to nearest SSP (self-report)			
Live within walking distance	1.03 (0.96–1.11)	1.13 (0.98–1.31) *	1.14 (1.00–1.30) *
Not within walking distance/Don't know	Ref.	Ref.	Ref.
Mental Health			
Kessler 6 total score: ≥ 13	1.06 (0.98–1.14)	1.16 (0.99–1.36) *	1.04 (0.90–1.20)
PC-PTSD-5 total score: ≥ 4	1.15 (1.07–1.24) *	1.28 (1.10–1.49) *	1.12 (0.97–1.29)
Overdose/Naloxone			
Ever survived overdose(s)	1.23 (1.14–1.33) *	1.24 (1.06–1.45) *	1.27 (1.10–1.48) *
Know someone who died of overdose (past 6 mo.)	1.35 (1.14–1.59) *	1.22 (0.93–1.62)	1.07 (0.84–1.35)
Ever trained to recognize/respond to overdose	1.20 (1.10–1.30) *	1.46 (1.23–1.73) *	1.29 (1.09–1.52) *
Ever got overdose reversal kit or naloxone	1.28 (1.16–1.42) *	1.51 (1.23–1.85) *	----
Currently have naloxone	1.16 (1.08–1.25) *	1.13 (0.97–1.30)	1.08 (0.92–1.26)

Note: CI = confidence interval; HS = high school; MOUD = medication for opioid use disorder; SSP = syringe services program

[a]Drugs in "Other" category include: prescription anxiety drugs, synthetics, gabapentin, clonidine, and other (unspecified)

[*]P<0.1

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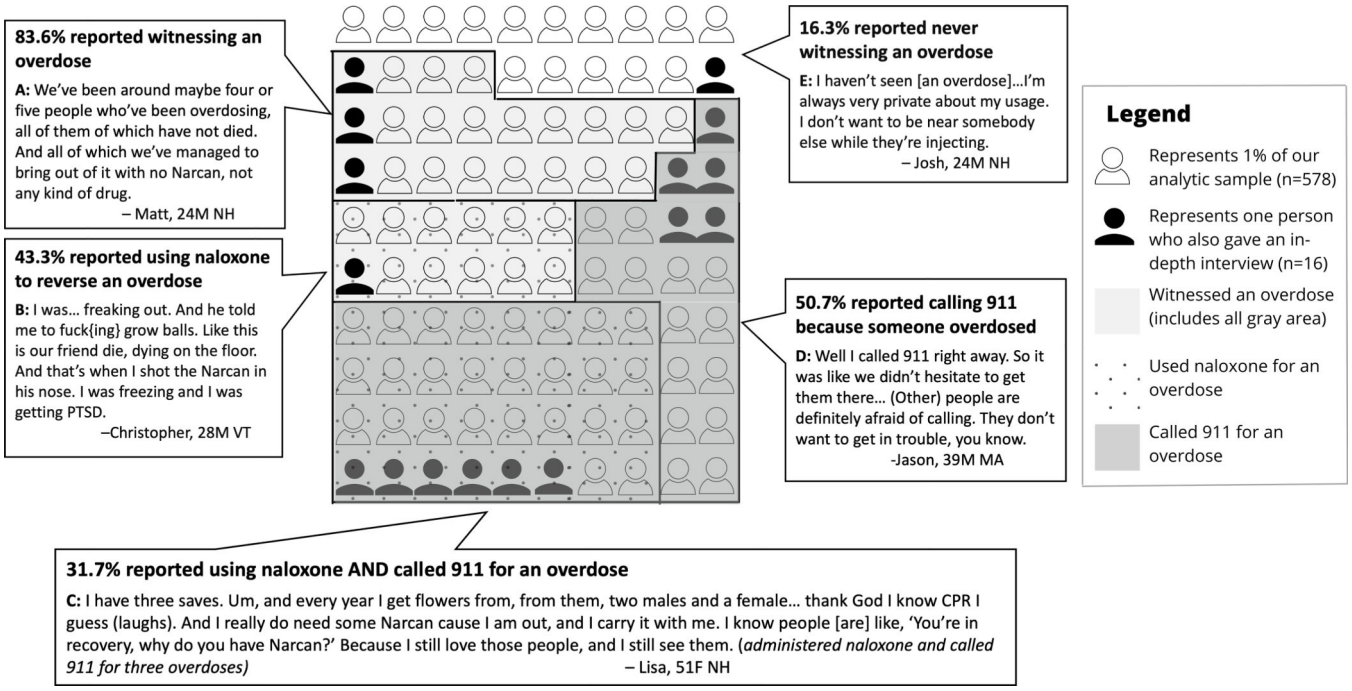

Figure 1:

Witnessing and responding to overdose in people who use drugs in rural Northern New England, 2018–2019

Table 1.

Survey and In-depth Interview Participant Characteristics by Opioid Overdose Status in rural Northern New England, 2018–2019.

	Quantitative Sample (n = 578)			Qualitative Sample (n=16)
Characteristic	**Ever witnessed an overdose (n=483)**	**Never witnessed an overdose (n=95)**	**Total (n=578)**	
Location - no. (%)				
State				
Vermont	249 (51.6)	56 (59.0)	305 (52.8)	5 (31.3)
New Hampshire	170 (35.2)	22 (23.2)	192 (33.2)	7 (43.8)
Massachusetts	64 (13.3)	17 (17.9)	81 (14.0)	4 (25.0)
Sociodemographics - no. (%), median (IQR)				
Female gender	196 (40.6)	39 (41.1)	235 (40.7)	8 (50.0)
Age (years) - median (IQR)	34 (28–42)	34 (28–42)	34 (28–42)	29.5 (27–35)
White race	440 (91.1)	83 (87.4)	523 (90.5)	15 (93.8)
Education: High school completion or higher	357 (73.9)	69 (72.6)	426 (73.7)	13 (81.3)
Employment: Full/part-time	167 (34.6)	39 (41.1)	206 (35.6)	6 (37.5)
Homeless in past 6 mo.	285 (59.0)	44 (46.3)	329 (56.9)	9 (56.3)
Incarcerated in past 6 mo.	147 (30.4)	23 (24.2)	170 (29.4)	6 (37.5)
Have health insurance	405 (83.9)	78 (82.1)	483 (83.6)	12 (75.0)
Substance use - no. (%)				
Drug of choice				
Heroin	303 (62.7)	40 (42.1)	343 (59.3)	13 (81.3)
Fentanyl/carfentanil	17 (3.5)	6 (6.3)	23 (4.0)	3 (18.8)
Opioid painkillers	32 (6.6)	12 (12.6)	44 (7.6)	0 (0.0)
Buprenorphine	23 (4.8)	2 (2.1)	25 (4.3)	0 (0.0)
Methadone	4 (0.8)	3 (3.2)	7 (1.2)	0 (0.0)
Cocaine/crack	73 (15.1)	20 (21.1)	93 (16.1)	0 (0.0)
Methamphetamine	16 (3.3)	6 (6.3)	22 (3.8)	0 (0.0)
Other[a]	19 (3.9)	9 (9.5)	28 (4.8)	0 (0.0)
Injection drug use - no. (%)				
Injection history				
Currently inject (past 30 days): at least 1x daily	239 (49.5)	25 (26.3)	264 (45.7)	8 (50.0)
Currently inject (past 30 days): less than daily	147 (30.4)	33 (34.7)	180 (31.1)	3 (18.8)
Ever injected, but not currently (past 30 days)	33 (6.8)	11 (11.6)	44 (7.6)	3 (18.8)
Never injected	63 (13.0)	25 (26.3)	88 (15.2)	2 (12.5)
MOUD - no. (%)				
Ever received methadone	210 (43.5)	22 (23.2)	232 (40.1)	7 (43.8)
Ever received buprenorphine	300 (62.1)	41 (43.2)	341 (59.0)	12 (75.0)
Syringe Sources - no. (%)				
Got syringes from SSP (past 30 days)	106 (22.0)	20 (21.1)	126 (21.8)	5 (31.3)

	Quantitative Sample (n = 578)			Qualitative Sample (n=16)
Characteristic	**Ever witnessed an overdose (n=483)**	**Never witnessed an overdose (n=95)**	**Total (n=578)**	
Got syringes from pharmacy (past 30 days)	131 (27.1)	25 (26.3)	156 (27.0)	3 (18.8)
Proximity to nearest SSP (self-report)				
Live within walking distance	183 (37.9)	30 (31.6)	213 (36.9)	5 (31.3)
Not within walking distance/Don't know	266 (55.1)	53 (55.8)	319 (55.2)	8 (50.0)
Mental Health - no. (%)				
Kessler 6 total score: ≥ 13	309 (64.0)	53 (55.8)	362 (62.6)	9 (56.3)
PC-PTSD-5 total score: ≥ 4	237 (49.1)	26 (27.4)	263 (45.5)	12 (75.0)
Overdose/Naloxone - no. (%)				
Ever survived overdose(s)	270 (55.9)	26 (27.4)	296 (51.2)	7 (43.8)
Know someone who died of overdose (past 6 mo.)	430 (89.0)	66 (69.5)	496 (85.8)	16 (100.0)
Ever trained to recognize/respond to overdose	285 (59.0)	32 (33.7)	317 (54.8)	9 (56.3)
Ever got overdose reversal kit or naloxone	350 (72.5)	39 (41.1)	389 (67.3)	15 (93.8)
Currently have naloxone	257 (53.2)	29 (30.5)	286 (49.5)	8 (50.0)

Note: MOUD = medication for opioid use disorder; SSP = syringe services program

[a]Drugs in "Other" category include: prescription anxiety drugs, synthetics, gabapentin, clonidine, and other (unspecified)

Table 2.

Multivariable Associations Between Participant Characteristics and Each Opioid Overdose Outcome, rural Northern New England, 2018–2019.

Characteristic	Ever witnessed an overdose Adjusted Prevalence Ratio (95% CI)[a,b]	Ever called 911 because someone overdosed Adjusted Prevalence Ratio (95% CI)[a,c]	Ever used naloxone to reverse an overdose Adjusted Prevalence Ratio (95% CI)[a,d]
Location			
State			
Vermont (reference)	Ref.	N/A	Ref.
New Hampshire	1.06 (0.98–1.15)	N/A	0.87 (0.71–1.07)
Massachusetts	0.89 (0.78–1.01)	N/A	0.89 (0.74–1.07)
Sociodemographics			
Female gender	0.96 (0.88–1.03)	1.01 (0.88–1.17)	0.93 (0.81–1.07)
Age (per 10 years)	1.02 (0.97–1.06)	1.05 (0.97–1.13)	1.02 (0.95–1.10)
Homeless in past 6 mo.	1.03 (0.95–1.11)	N/A	N/A
Incarcerated in past 6 mo.	N/A	1.35 (1.18–1.55)*	N/A
Have health insurance	N/A	N/A	0.94 (0.79–1.12)
Substance use			
Drug of choice			
Heroin/fentanyl/carfentanil (reference)	Ref.	Ref.	N/A
Opioid painkillers	0.87 (0.72–1.05)	1.14 (0.83–1.57)	N/A
Buprenorphine/methadone	1.01 (0.83–1.22)	1.07 (0.78–1.47)	
Cocaine/crack/methamphetamine	0.97 (0.87–1.09)	0.94 (0.75–1.17)	N/A
Other[e]	0.80 (0.56–1.13)	0.98 (0.53–1.82)	N/A
Injection drug use			
Injection history			
Currently inject (past 30 days): at least 1x daily	1.07 (0.92–1.24)	1.11 (0.81–1.50)	N/A
Currently inject (past 30 days): less than daily	1.03 (0.87–1.20)	1.17 (0.86–1.58)	N/A
Ever injected, but not currently (past 30 days)	0.98 (0.77–1.24)	N/A	N/A
Never injected (reference)	Ref.	Ref.	N/A
MOUD			
Ever received methadone	1.01 (0.94–1.10)	1.20 (1.03–1.40)*	N/A
Ever received buprenorphine	1.03 (0.94–1.12)	N/A	N/A
Syringe Sources			
Proximity to nearest SSP (self-report)			
Live within walking distance	N/A	1.14 (0.98–1.33)	1.08 (0.92–1.28)
Not within walking distance/Don't know	N/A	Ref.	Ref.
Mental Health			
Kessler 6 total score: ≥ 13	N/A	1.03 (0.86–1.23)	N/A
PC-PTSD-5 total score: ≥ 4	1.10 (1.02–1.19)*	1.19 (1.00–1.40)*	N/A

Characteristic	Ever witnessed an overdose Adjusted Prevalence Ratio (95% CI)[a,b]	Ever called 911 because someone overdosed Adjusted Prevalence Ratio (95% CI)[a,c]	Ever used naloxone to reverse an overdose Adjusted Prevalence Ratio (95% CI)[a,d]
Overdose/Naloxone			
Ever survived overdose(s)	1.12 (1.03–1.21) *	1.12 (0.96–1.31)	1.24 (1.07–1.44) *
Know someone who died of overdose (past 6 mo.)	1.13 (0.96–1.33)	N/A	N/A
Ever trained to recognize/respond to overdose	1.11 (1.02–1.20) *	1.28 (1.07–1.53) *	1.25 (1.06–1.49) *
Ever got overdose reversal kit or naloxone	1.13 (1.00–1.28) *	1.11 (0.91–1.35)	N/A
Currently have naloxone	1.01 (0.93–1.10)	N/A	N/A

Note: CI = confidence interval; MOUD = medication for opioid use disorder; SSP = syringe services program

[a] From modified Poisson models for each overdose outcome

[b] n = 494

[c] n = 385

[d] n = 303

[e] Drugs in “Other” category include: prescription anxiety drugs, synthetics, gabapentin, clonidine, and other (unspecified)

* P<0.05