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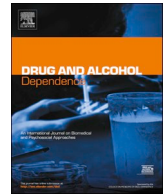
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Opioid initiation and injection transition in rural northern New England: A mixed-methods approach



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ABSTRACT

Background: In rural northern New England, located in the northeastern United States, the overdose epidemic has accelerated with the introduction of fentanyl. Opioid initiation and transition to opioid injection have been studied in urban settings. Little is known about opioid initiation and transition to injection drug use in rural northern New England.

Methods: This mixed-methods study characterized opioid use and drug injection in 11 rural counties in Massachusetts, Vermont, and New Hampshire between 2018 and 2019. People who use drugs completed audio computer-assisted self-interview surveys on substance use and risk behaviors (n = 589) and shared personal narratives through in-depth interviews (n = 22). The objective of the current study is to describe initiation of opioid use and drug injection in rural northern New England.

Results: Median age of first injection was 22 years (interquartile range 18–28 years). Key themes from in-depth interviews that led to initiating drug injection included normalization of drug use in families and communities, experiencing trauma, and abrupt discontinuation of an opioid prescription. Other factors that led to a transition to injecting included lower cost, increased effect/ rush, greater availability of heroin/ fentanyl, and faster relief of withdrawal symptoms with injection.

Conclusions: Trauma, normalization of drug use, over-prescribing of opioids, and abrupt discontinuation challenge people who use drugs in rural northern New England communities. Inadequate opioid tapering may increase transition to non-prescribed drug use. The extent and severity of traumatic experiences described highlights the importance of enhancing trauma-informed care in rural areas.

1. Introduction

Opioid use and misuse are a major public health problem in rural areas of the United States (Han et al., 2015). Non-prescription opioid use and overdose deaths have increased significantly in rural regions of the Northeast, the Midwest, and Appalachia (Brady et al., 2015; Kolodny et al., 2015; Paulozzi et al., 2015). In rural northern New England, the introduction of fentanyl accelerated the opioid epidemic (Somerville et al., 2017). Hepatitis C virus (HCV) rates (Stopka et al., 2017, 2019a,b) and other comorbidities of drug injection, including infectious endocarditis and osteomyelitis (Wurcel et al., 2016, 2018), have similarly increased.

Previous research on opioid initiation and transition to injection has primarily been conducted in urban settings (Lankenau et al., 2012; Mars et al., 2014), and has implicated experiences with trauma and family history of substance use as causative factors (Lawson et al., 2013; Sansone et al., 2009; Taplin et al., 2014). However, the risk environment for opioid initiation and transition to injection in urban settings may meaningfully differ from the risk environment in rural settings. The risk environment framework developed by Rhodes (2002) proposes that four types of environmental factors - physical, social, economic, and policy - work together to influence the risk of drug-related harms. Subsequent work examining the overdose risk environment added health services and criminal justice interventions as

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additional environmental factors (Fadenelli et al., 2019). These factors operate at both micro and macro levels. Research has already highlighted some differences between urban and rural risk environments, showing that rural communities suffer a disproportionate burden of opioid misuse and have limited access to substance use treatment (Oser et al., 2011; Palombi et al., 2018). However, very little research has explored the rural risk environment for opioid initiation and transition to injection. Qualitative research in rural Appalachia found that prescription opioids were widely used, and the transition from non-injection to injection drug use followed, on average, three years after initiation (Draus and Carlson, 2006; Young and Havens, 2012). However, little is known about opioid initiation and transition to injection drug use in rural northern New England, a region which has experienced similarly high rates of opioid use disorder (OUD) and related comorbidities.

The goal of the current study was to assess the risk environment for opioid initiation and transition to injection among people who use drugs (PWUD) in rural northern New England. We employed mixed methods, between 2018 and 2019, in rural communities of Massachusetts, Vermont, and New Hampshire.

2. Materials and methods

The Drug Injection Surveillance and Care Enhancement for Rural Northern New England (DISCERNNE) study characterized opioid use and drug injection in 11 rural counties abutting the Connecticut River Valley in Massachusetts, Vermont, and New Hampshire (Fig. 1) using mixed methods (Cresswell and Plano Clark, 2017). The study included an epidemiologic, policy, and legal scan (Stopka et al., 2019a,b); in-depth qualitative interviews with stakeholders ($n = 31$) and PWUDs (n

$= 22$); audio-computer assisted self-interviews (ACASI) with PWUDs, with a focus on risk environment measures and behavioral risks (e.g., sociodemographic, substance use, and social network characteristics) ($n = 589$); and HIV, HCV, and syphilis testing among ACASI participants. The current mixed-methods study analyzes data from our in-depth interviews ($n = 22$) and ACASIs ($n = 589$) with PWUD to explore initiation of opioid use and drug injection in rural northern New England.

2.1. Recruitment

Recruitment was conducted at 11 study sites selected in consultation with local public health officials and service providers. Field staff recruited 51 seeds through street outreach and at harm reduction agencies, and 538 participants were referred to the study through respondent driven sampling methods. Participants eligible for the ACASI were at least 18 years old, spent more than half of the past 30 days living in the study area, used opioids “to get high” or injected any drug in the past 30 days, and were able to provide informed consent. We sought to obtain an in-depth interview sample reflective of the larger PWUD community by sex, age, and opioid use patterns. The qualitative sample was recruited at the same time and in the same locations as the ACASI sample using purposive sampling approaches to reach a wide variety of participants with injection experience. In addition to the ACASI inclusion criteria, eligibility to participate in the in-depth interviews also included people who injected in the past year, but not in the past month. The (BLINDED) Baystate Health Institutional Review Board approved study protocols (IRB#: 1094092-30). All study records were confidential and securely stored. Documentation that contained identifying information (consent form, locator form, receipt) were stored separately from survey and interview data. To protect confidentiality, participants were assigned a study ID number. Pseudonyms were assigned to refer to each in-depth interview participant.

2.2. ACASI survey

Survey participants completed a 90-minute audio computer-assisted self-interview (ACASI) survey ($n = 589$). Use of an ACASI increases accurate reporting of substance use and other sensitive behaviors as it allows participants privacy in responding and has greater perceived confidentiality than other survey methods (Gribble et al., 2000; Simoes et al., 2006). The ACASI collected information on the participants’ sociodemographic characteristics, substance use patterns, risk behaviors, and substance use treatment engagement, such as self-help groups, outpatient counseling, residential treatment, detox, sober house, and MOUD. PDF, TJS, and ALD led ACASI data collection, and LMK and ER were in the field. The quantitative analysis about age of first injection in this paper focuses on participants who reported they had injected in the last 30 days and answered the question about age of first injection ($n = 417$). We also present results for questions on age at first injection and demographic characteristics (age, gender, state of residence, and current MOUD treatment). Survey recruitment occurred between May 2018 and October 2019. Participants received \$40 upon completing ACASI and infectious disease assessment.

2.3. In-depth interviews

Four interviewers (TJS, LMK, ER, and PDF) conducted twenty-two semi-structured in-depth key informant interviews with PWUD. Of the 22 participants interviewed, 16 also participated in the ACASI survey. Participants engaged in 45–90 minute audio-recorded interviews to provide an understanding of both micro and macro dimensions of risk environments related to the opioid epidemic. The interview guide explored personal narratives focused on: 1) substance use; 2) injection drug use; and 3) overdose. LMK transcribed recordings for analysis. Interview recruitment occurred between April 2018 and August 2019. Participants received \$25 upon completing an in-depth interview.

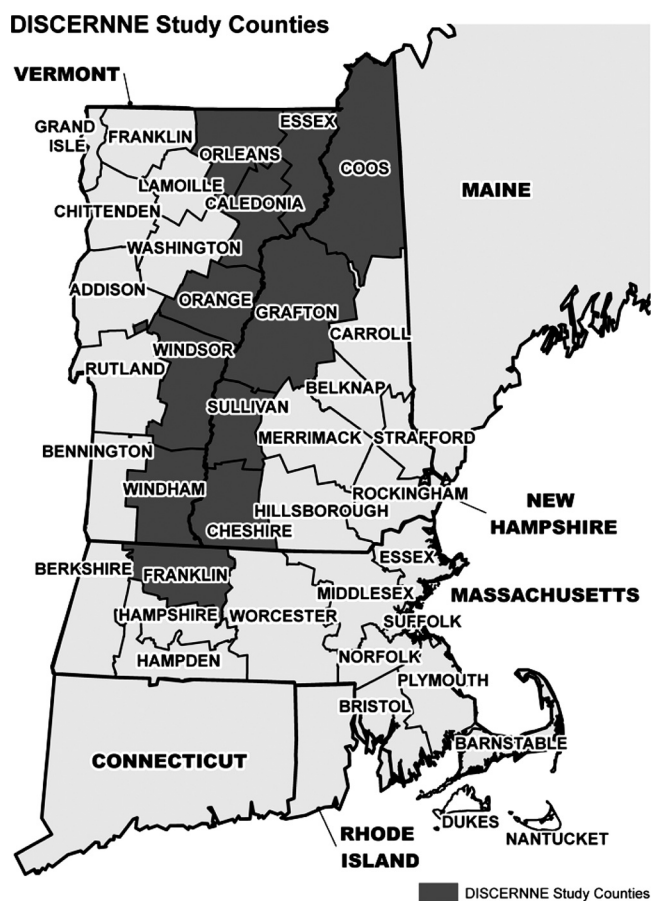


Fig. 1. Drug Injection Surveillance and Care Enhancement for Rural Northern New England (DISCERNNE) Study Counties, 2018–2019.

An interdisciplinary team with expertise in public health, medicine, nursing, addictions, and epidemiology collaborated using an established thematic analysis strategy (Braun and Clarke, 2012). Team members initially independently coded three interview transcripts and met weekly to reach consensus on coding structure and process. Two team members coded each subsequent transcript in Dedoose version 8 (SocioCultural Research Consultants, 2018) and achieved consensus through triangulation of observations. For the current study, final analyses were guided by the risk environment framework and focused on text segments tied to the following codes: *initiation* and *drug transition/pathway*; *parent/caregiver substance use*; *family*; *community changes*; *precipitating event*; *trauma/mental health*; *opioid prescription abruptly discontinued*; and *pain management*. A community engagement studio (Joosten et al., 2015) was held to present findings to a group of PWUD, elicit feedback, and validate findings. This provided a more reflective understanding of the initial findings to guide analysis. PWUD strongly endorsed the preliminary themes and subthemes presented here and provided additional suggestions for future analyses.

3. Results

In-depth qualitative interview participants (n = 22) and the ACASI quantitative sample (n = 589) generally shared demographic characteristics (Table 1). From the ACASI, a majority of participants reported heroin as their drug of choice (n = 351, 60 %) followed by cocaine/crack (n = 95, 16 %), opiate pain killers (n = 44, 7 %), buprenorphine (n = 25, 4%), street fentanyl (n = 23, 4%), and methamphetamine (n = 23, 4 %). Among participants currently injecting drugs (n = 453), the drugs most commonly injected in the past 30 days included heroin (n = 395, 87 %), street fentanyl (n = 267, 59 %),

Table 1
Characteristics of DISCERNNE In-Depth Interview and ACASI Survey Study Participants in Rural Northern New England, 2018-2019.

	In-Depth Interview Participants (N = 22)		ACASI Survey Participants (N = 589)	
	%	N	%	N
Age				
18–25	13.6	3	14.8	87
26–39	72.7	16	53	312
40 and older	13.6	3	32.3	190
Race: White			90.3	532
Ethnicity: Non-Hispanic			95.2	561
Gender: Female	54.5	12	41.3	243
State				
New Hampshire	31.8	7	33.8	199
Vermont	50	11	52.3	308
Massachusetts	18.2	2	13.9	82
Ever Injected	95.4	21	84.7	499
Age at Injection Initiation ^a				
10–13	0	0	4.6	19
14–17	16.7	2	18.9	79
18–25	50	6	43.7	182
26–39	33.3	4	26.1	109
40 and older	0	0	6.7	28
Currently Injecting (past 30 days)	77.3	17	76.9	453
Currently in MOUD Treatment (past 30 days)	54.5	12	33.8	199

DISCERNNE = Drug Injection Surveillance and Care Enhancement for Rural Northern New England, ACASI = audio computer-assisted self-interviews, MOUD = medication for opioid use disorder

^a age at injection initiation is for injection of any substance: in-depth interview participants were not directly asked age and 8 interview participants did not describe within interviews, percentage based on number of responses (N = 12). Survey assessed age of injection initiation for those that had injected in the last 30 days, 36 respondents were missing data, (N = 417).

Table 2
Opioid Use Initiation Characteristics of In-Depth Interview Study Participants in Rural Northern New England, 2018-2019.

	In-Depth Interview Participants (n = 22)	
	%	N
Age at First Opioid Use ^a		
10–13	23.8	5
14–17	28.6	6
18–25	38.1	8
26–39	0	0
40 and older	9.5	2
History of Family Drug Use	90.1	20
History of Trauma ^b	90.1	20
Prescribed Opioids for Medical Issues	54.5	12
Years Injecting Drugs ^c		
0–4 years	23.5	4
5–9 years	11.7	2
10 or more years	35.3	6

^a for age at first opioid use, 1 participant did not indicate age, percentage based on number of responses (N = 21).

^b history of trauma was tabulated from any mention of physical, sexual, or emotional trauma within interviews (N = 21).

^c years injecting percentages based on those currently injecting (N = 17), missing age at initiation of injecting for 5 participants.

cocaine/crack (n = 227, 50 %), speedball (heroin and cocaine) or screwball (heroin and methamphetamine) (n = 148, 33 %), opiate pain killers (n = 116, 26 %), methamphetamine (n = 115, 25 %), and buprenorphine (n = 115, 25 %). The qualitative interview sample was nearly equally split between males (n = 10) and females (n = 12), with ages ranging from 23-55 years. Table 2 features characteristics of in-depth interview participants related to qualitative themes of their experiences. Half (n = 11) of interview participants first used opioids between 10–17 years old (Table 2), either medically prescribed or non-medically. Only two (9.1 %) initiated opioid use after age 25. The majority of in-depth interview participants had histories of family drug use (n = 20, 90.1 %), histories of trauma (n = 20, 90.1 %), and were prescribed opioids early in their opioid use experience (n = 12, 54.5 %) (Table 2).

3.1. Pathways to injection: themes from qualitative in-depth interviews

Normalization of drug use, experiencing trauma, having pain, and having their opioid prescription abruptly discontinued were key features of the risk environment for transition to injection drug use (Fig. 2). These themes represent commonalities across interviews, although no single pathway to injection was described.

3.1.1. Normalization of drug use within the family and community

Normalization of drug use within the family and community was an important feature of the micro-social environment. Every interview participant (n = 22, 100 %) reported normalization of drug use within the family or community as being influential in opioid initiation or injection (Fig. 2). Normalization within the family included awareness of drug use by parents or other family members. Initiation tied to family norms included family members providing opioids or other drugs at an early age. Mike (a 28-year-old male [28 yo M]) said:

I got really close to my older sister. She was like 10 years older than me. I moved in with her... when I was 12 years old and, because we were really close... it was like going from not being exposed to anything in the world to getting exposed to everything all at once. I started, I had probably every drug my sister had ever done when I was there experimented by the age of 13. So, it was non-stop. It was crazy.

Being provided drugs early in adolescence was often connected to progressive use including later transitions to injecting.

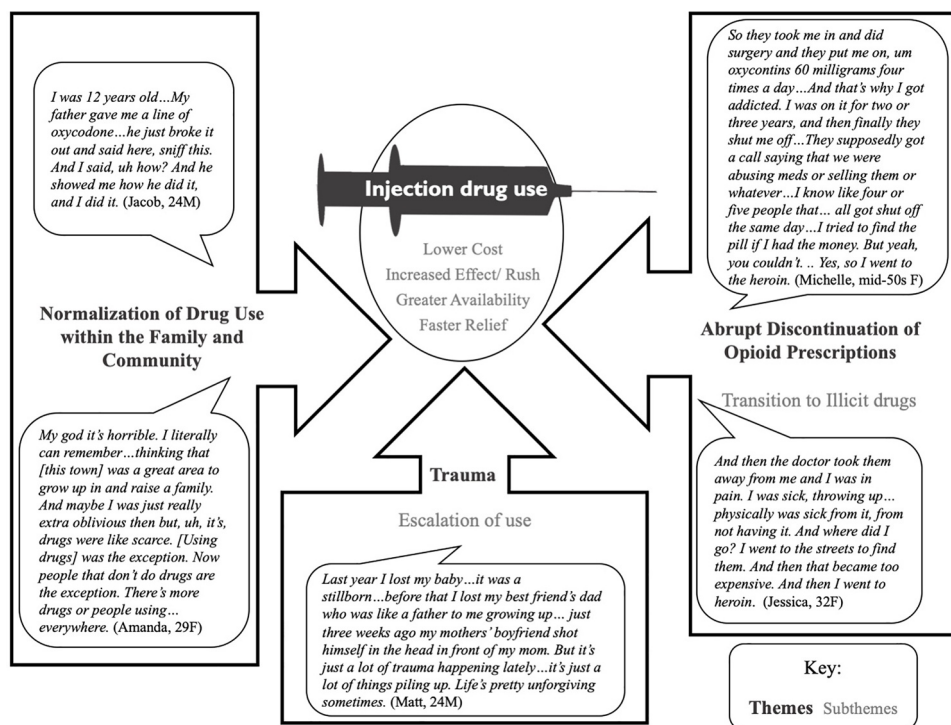


Fig. 2. Thematic analysis of opioid use initiation and transition to injection drug use among people with recent opioid use or injection drug use history in rural Vermont, New Hampshire and Massachusetts, 2018-2019 (N = 22).

Even when opioids were not used within the family, growing up around alcohol and cannabis desensitized interviewees to opioids. Jessica (32 yo F) described that:

There was drug use and alcoholism in my family... it had a huge impact... it was normal you know, to go into my mom's top drawer and grab her bag of weed for her.

Access to substances through a family member was a key to initiation. Ashley (28 yo F) was not interested in opioids early on, but began stealing prescriptions:

I started smoking pot when I was 8½-years-old. Um, that later led to stealing my dad's... Percocet and trading them for my weed. I didn't know what they were, I just knew someone liked them.

Ashley also described being caught stealing pills and her father "wanting to be cut into the deal."

Drug use was accepted in the communities of interviewees, creating a micro-social environment that was characterized by easy access, drug houses, and open use. "Everybody uses drugs" was a common refrain. Participants mentioned that "three fourths of people in town use (Mike, 28 yo M)," "people who don't do drugs are the exception (Amanda, 29 yo F)," "everybody's becoming a drug dealer these days it seems (Matt, 24 yo M)," and you "can't walk 20 feet down the street without finding someone you can get drugs from (Sarah, 28 yo F)." Some connected the ubiquity to high rates of opioid prescribing. As Jacob (24 yo M) described, "two of the biggest pill pushers in the state [are here]."

3.1.2. Trauma

Exposure to trauma was a ubiquitous feature of the micro-physical environment. Twenty of the 22 participants described experiencing some type of trauma. Trauma consistently influenced opioid initiation, escalation of use, and transition to injection. Traumatic events included deaths of loved ones by suicide or overdose, incarcerations, sexual abuse, violent crime, rape, homelessness, divorce, foster care placement, custody loss, and miscarriage. Chris (29 yo M) said:

I had a lot of pain growing up... I had lost one friend to a drug overdose. I was, uh, 16. He took, uh, a bunch of OxyContin, like a whole bottle of it. Like on purpose... (when) I grew up there was a lot of death around. There

was a lot of drugs and the drugs, you know, blocked out the pain. So all my friends used so I did too, you know. My friend comes up and says here try this. It makes me feel better. I'm like all right.

Substance use was also a coping mechanism for trauma as Emily (23 yo F) described:

My mom and dad got divorced about when I was 10. I am the one that took it the worst, so when I started drinking, smoking weed, smoking cigarettes. Just acting out... that all happened until I was about 15. Then I got my first like actual serious relationships, and I was with this kid for almost six years. And that's when I first tried heroin and coke together, so I was speedballing most of the time. That's what I've always done with it. But just the divorce really fucked me up...

Traumatic experiences also influenced escalation of drug use. Compounded trauma was frequent, as when Matt (24 yo M) experienced the stillbirth of his child, a death, and a suicide within a year (Fig. 2). In his words, "I've never confronted my emotions... as soon as I lost my baby, I went, dove headfirst into the drugs to just mask everything, to just not feel anything." Additional events that led to escalation included death of a mother, father, sister, or close friend and depressive states. Mike's (28 yo M) substance use escalated after the loss of his mother:

Once she [my mother] died I tried to kill myself. Like I was buying, I was doing double, triple of what I normally would do... I just never left my apartment. I... had all my dealers just come stay at my house. I wouldn't want to leave my place, nothing, just wanted to stay in my room, blinds down, and just get high all the time.

Similarly, snorting opioids no longer alleviated Brittany's (28 yo F) dysphoria after she lost custody of her children:

I was lonely. I was depressed. I didn't have my kids. My man was in jail... I snorted a bag of dope. I didn't feel it. That pissed me off. So then I got another bag... I had needles. I got my own. And that's when I took a half a bag of dope... that's when I first injected... I put a tie on my arm, and like it took me a little bit to find a vein because I had never done it before...

When experiencing depressive feelings, injecting often became an efficient way to get relief.

3.1.3. Abrupt discontinuation of opioid prescriptions

Of the 22 participants, twelve described receiving prescription opioids after an accident, injury, or illness; two-thirds of these reported that their provider's abrupt discontinuation of their opioid prescription influenced their transition to non-prescribed opioids. Matt (24 yo M) had some exposure to opioids before receiving a prescription:

I was smoking marijuana, and people I was around doing that had some Percocet, asked if I wanted to snort some, and 'Sure! I'll try that.' And it was an every once in a while thing. And then I got into a car accident and, uh, hit my head on the windshield really hard and was prescribed Vicodin. And I started taking them as prescribed and then just started abusing them. And, uh, it just got out of control pretty quick.

Relatively easy access to prescription opioids was an important component of the micro-social environment. Regardless of duration, the experience of using prescription opioids was implicated in experimentation and transitions to non-prescribed opioids. Experiencing relief or euphoria later led to seeking out opioids. As Lisa (51 yo F) described:

My first significant memory [of using opioids] is when I had my wisdom teeth out. I believe I was about 19 at the time... That's when I realized okay, I like this... I remember very specifically I, just feeling wonderful in my mom's recliner.

Although Lisa's regular use of opioids occurred after multiple traumatic events, this early memory of relief led her to seek out opioids to cope with pain and depression. Decreasing availability and doses of prescribed opioids were common. For example, Lisa initially received "90 morphine [pills] with three refills" after a complicated wisdom tooth removal. Many were treated with opioids for chronic pain and then suddenly experienced abrupt discontinuation of opioid prescriptions leading to a transition to non-prescription opioid use. This sudden change in opioid prescribing practices was an important feature of the micro-health services/ criminal justice intervention environment. Jessica (32 yo F) had her opioid prescription abruptly stopped by her clinician (Fig. 2) and was surprised to experience withdrawal. She reported she was then advised to "go to rehab" where she learned "you could get cheaper drugs." She lost custody of her child when she went to treatment, and opioids helped her cope.

Similar to other participants, Josh (30 yo M) felt forced to use heroin for pain management when his prescriber abruptly discontinued his opioid prescription:

Honestly I actually fucking hated and despised myself that I even switched to it, but can't deal with the fucking pain and function at work and get all the shit done that I need to without something for the pain, so I'm kind of caught in this god damn cycle of I need something for the pain so I can support myself and my family. But I really don't want to be on heroin, but I can't get the prescription pills back because they don't see me as a case that actually needs them.

Josh felt that he was mislabeled as an "addict" instead of someone forced to use heroin for pain.

3.2. Transition to injection drug use

Among the PWUD who participated in the ACASI survey, the median age of first injection was 22 years (range 10–60; interquartile range 18–28 years). Age at injection initiation is depicted in a "age at event curve" (Fig. 3) overlaid with case summaries from four in-depth interviews with PWUD. The quantitative survey estimates age of first injection in a larger sample of people who have injected in the past 30 days ($n = 417$) from rural northern New England, and the four narratives suggest overlapping pathways to injection consistent with opioid initiation and injection transition themes. The reported timing of injection initiation is similar in our quantitative and qualitative analyses. From the shape of Fig. 3, injecting typically begins between the late teens and mid-30 s in this rural sample, with a smaller group of ACASI participants initiating injection before the teen years or after age 40.

In addition to normalization, trauma, pain, and abrupt

discontinuation of opioid prescriptions, other contextual factors tied to the transition to injection included: *lower cost, increased effect/rush, greater availability of heroin/ fentanyl, and faster relief of withdrawal symptoms.* James (47 yo M) and others were leery of injecting at first:

She's like, 'you can't do it that way [James]...' for the cost and how quick you can get better, you know... (I thought) 'Jesus, [James], what are you doing... but I mean I was sick. The mind's set just to get over being sick. I mean come on man. I can't, I'm freezing, I'm cold, I'm sneezing, my whole body aches. What is this gonna do? I'm hurting. And then woosh. She injected me with it, and within 20 s I was like 'wooo hooo.' I feel so much better. Oh my God... I had extra energy.

These sensations led James to transition solely to injecting. Cost was also a factor for him:

How much did that cost us?... Like \$10 a day, that's it? I can come up with \$10 a day. Ten dollars for you, \$10, \$20 a day, we could do that. It wasn't \$20 a day within a month. We were up to 70, 80 bucks a day, you know?... I'd been addicted to it since.

As the street supplies of diverted prescription opioids decreased and costs rose, injecting was cost efficient and provided immediate relief. This change in the supply and cost of prescription opioids relative to heroin/fentanyl was an important feature of the micro-economic environment.

The *greater effect or rush* led many to stop swallowing or snorting. Dan (29 yo M) had been snorting opioids but tolerance led him to inject:

Well anyway my best friend started saying to me, he's like... you really want to feel it, because I wasn't really getting what I wanted... from snorting it... He did it all up for me, put it in a spoon, did it, cooked it, everything, put it into the syringe, hit me with it... I felt it like crazy... So that's when I started buying Oxycontin like regularly more than I was supposed to but not really spending as much money.

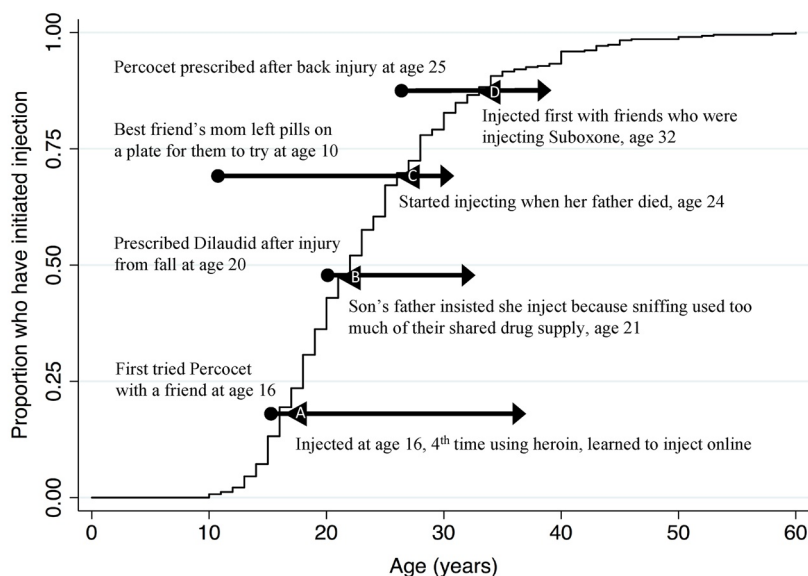
Participants consistently described their first injection of an opioid as vivid and remarkable, and the majority continued injecting.

4. Discussion

This mixed-methods study presents novel findings on the risk environment for opioid use initiation and transition to injecting in rural northern New England between 2018 and 2019. Key features of the rural risk environment included: normalization of drug use in families and communities, opioid initiation and escalation related to trauma, and abrupt discontinuation of opioid prescriptions by their clinician. Both separately and together, these three features of the risk environment were most salient to opioid initiation and the transition to injection among rural PWUDs.

Normalization of drug use and misuse was prevalent during first use of drugs, with the majority of participants connecting initial use to drugs from their or a friend's parent. Drugs were often diverted from or offered by family members. Previous research has similarly described the influence of family and peer groups in pathways toward injection (Parolin et al., 2016; Taplin et al., 2014), but have not as explicitly identified community-wide norms as important features of the micro-social risk environment in rural areas. Although peer group norms have previously been described, our analysis of initiation demonstrated more reference to broader contexts of norms such as community or town.

Exposure to trauma was nearly universal among our participants. Trauma, including domestic violence, sexual abuse, loss of family or friends, serious accidents, and loss of custody, permeated their lives. Most participants in these rural counties recounted traumatic experiences as they explained their transition to injection drug use. Previous urban studies have focused on associations between trauma and opioid use initiation (Sansone et al., 2009; Taplin et al., 2014), and qualitative analyses have found that social context and interactions are associated with injection initiation (Guise et al., 2017). Maternal alcohol and drug use has been associated with childhood trauma among people who inject drugs, which in turn is associated with earlier age at injection (McGovern et al., 2018; Taplin et al., 2014). Our results extend these



Participant	Description and age at interview	Other context and themes
▲	Jen, 38-year-old female	Normalization: All siblings are addicted to opioids Trauma: Multiple family deaths and assaults, rape, history of sex work and incarceration
▲	Jessica, 32-year-old female	Normalization: Father was alcoholic, had access to mother's weed Trauma: Overdosed on cocaine, lost custody of son Pain & Abrupt Discontinuation: Prescriber stopped opioid after 3-4 months, had withdrawal, then sent to treatment where she learned how to take other drugs
▲	Ashley, 28-year-old female	Normalization: Started stealing her father's Percocet and trading for marijuana, when he found out he ordered her to sell them for cash Trauma: Post-Traumatic Stress Disorder, history of sex work
▲	Jason, 37-year-old male	Pain & Abrupt Discontinuation: Finished prescription in one quarter of the time after he hurt his back moving furniture

Key

- Age and context at opioid initiation
- ▲ Age and context at first injection. Letter to correspond with participant details in table
- Time between opioid initiation & interview
- Age at interview

Fig. 3. Age at event curve for age of transition to injection among survey participants who have injected drugs in the past 30 days and contextual findings from qualitative interviews in rural northern New England, 2018-2019. This figure combines an event curve for age of first drug injection from the survey sample who have injected drugs in the past 30 days (N = 417) and adds context from in depth interviews of four individuals whose narratives represent a range of trajectories and themes from initial use of opioids to injection.

findings to the lives of rural PWUDs and highlight the role of trauma as a potent feature of the risk environment with lasting impact throughout participants' drug use trajectory.

Although the escalation of drug use during times of trauma in our narratives most likely indicates that individuals were seeking relief from emotional and physical pain, the resulting increase in risk behavior demonstrates greater risk for overdose and infection. It remains possible that depressive symptoms and a lack of regard for the amount of drugs used represents a form of undeclared suicidality. Although associations have been made between pain and suicidality (Fishbain et al., 2014), the relationship of seeking relief from trauma with opioids and its relationship to suicidality needs further study.

The association of prescription opioid use, either medically or nonmedically, with subsequent opioid use has been well-described (Grau et al., 2007; Lankenau et al., 2012; Mars et al., 2014; Rose et al., 2018). Factors associated with prescription opioid initiation, misuse,

and overdose include potentially inappropriate opioid prescribing, such as multiple prescribers and co-prescription of opioids and benzodiazepines (Rose et al., 2019; Sun et al., 2017). The role of the over-prescription of opioids as a feature of the urban risk environment has also been well-studied (Ciccarone, 2018; Grau et al., 2007). Strong associations exist among inappropriate opioid prescribing, risk for overdose, and all-cause mortality (Rose et al., 2018, 2019; Stopka et al., 2017). Additionally, abrupt discontinuation of opioid prescriptions and inadequate tapering is known to lead to transitions to heroin and fentanyl use and elevated overdose risk (Brady et al., 2015; Mars et al., 2014; Somerville et al., 2017; Mark and Parish, 2019). Our findings extend these features of the risk environment to a rural setting, with instances of opioid initiation following car accidents, athletic injuries, wisdom tooth extraction, and back injuries. Participants reported receiving opioid prescriptions with large numbers of pills over long periods of time (i.e., several months to years), which were then stopped

suddenly. These abrupt discontinuations were often associated with being “red flagged” after someone reported they were misusing opioids (Mark and Parish, 2019). Withdrawal symptoms led them to seek street opioids with often devastating effects.

Our findings have several limitations. First, we focused on rural communities along the Connecticut River Valley of northern New England. Access to many OUD prevention and treatment resources is limited in these communities (Stopka et al., 2019a,b), but expanding research locations might have provided differing insights into different populations of rural PWUD. Second, while our 22 in-depth interviews reached thematic saturation, we only completed one to five interviews in each community of focus. More nuanced understanding of local risk environments might have been possible with additional data collection in each of these sites. Third, while limited racial and gender diversity in this study reflect the local population, it may not reflect experiences of rural people of color or transgender populations. Fourth, our varied perspectives (public health, medicine, nursing, addictions, and epidemiology) influenced our coding, analysis, and interpretation of findings, which could have been augmented by additional expertise.

Despite these limitations, normalization of drug use, trauma, and abrupt discontinuation of opioid prescriptions characterize the risk environment for opioid use disorder initiation and transition to injection use in rural northern New England. These findings can help to inform interventions that incorporate a unified intervention approach to addiction, trauma, mental health, and pain. The Hub and Spoke model in Vermont provides a wide range of services to PWUD (Rawson et al., 2019), and New Hampshire recently established treatment Doorways across the state (Wickham, 2019). These care models aim to offer effective treatment closer to home. Both systems are currently focused on substance use treatment, while our findings indicate the need for integrated mental health, substance use, and pain care. Greater access to comprehensive treatment in rural areas is needed to address the high prevalence of trauma, pain, and mental health comorbidities among rural PWUD. Current services are focused on PWUD; however, greater access to comprehensive health and social services and, in particular, mental health services that address trauma, could prevent substance use initiation or progression to injection. Future research that examines these components of the rural structural risk environment and its relationship to injection initiation is recommended.

5. Conclusions

Our findings elaborate on key features of the risk environment for opioid initiation and transition to injection in rural northern New England. The normalization of drug use in families and communities, experience of trauma, and the prescription and then abrupt discontinuation of opioids have contributed to the current rural opioid crisis. The normalization of drug use in participants’ families and communities suggests that public health and clinical providers should invest in effective family and community-level interventions in rural communities. The extent and severity of traumatic experiences in our rural sample highlights the importance of enhancing access to treatment and harm reduction programs that focus on trauma-informed and holistic models. Inappropriate opioid prescribing and tapering practices in rural communities underscore the need for clinical practice improvement for opioid prescribing, tapering, and transition to medication for opioid use disorder. As part of a comprehensive system of integrated mental health, substance use, and pain care, interventions in these areas will address the risk environment and might begin to heal rural communities, including their citizens struggling to overcome the opioid crisis.

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Contributors

The authors listed are responsible for the content and preparation of this manuscript. TJS and PDF designed the study and supervised data collection. ALD supervised field staff including LMK. TJS led qualitative data collection and analyzed interviews. KN led interview analysis and coordinated development of the manuscript. ALD analyzed interviews and developed Figs. 2 and 3. ER analyzed interviews and conducted ACASI analysis. LMK conducted interviews and analyzed interviews. All authors contributed to the writing and have approved this manuscript.

Declaration of Competing Interest

The authors report no declarations of interest.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:<https://doi.org/10.1016/j.drugalcdep.2020.108256>.

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