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Down in the Valley: Trajectories of Injection Initiation among Young Injectors in California's Central Valley

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Abstract

Background—Injection drug use initiation represents a critical point of public health intervention, as injection increases risk forblood borne infections including Hepatitis C and HIV. In this paper, weexplore pathways to injection initiation among youth (<=30) in the ruralcontext of California's Central Valley, where rates of injection drug useare among the highest in the nation.

Methods—We draw on semi-structured qualitative interviews with 20 younginjectors to examine drug use histories, including the factors that participants associated with their transition to injection drug use.

Results—The average age was 24.7 years (range: 20–30), 45% were female(n=9), and 30% were Latino (n=6). Participants described a variety ofpathways to injection, culminating in a first injection that involvedeither opioids (n=12) or methamphetamine (n=8). Among the opioid group, the majority used prescription opioids before transitioning to injection, while a smaller number transitioned to opioid injection from non-opioid recreational drug use. Injectors who first used prescription opioidsoften described growing up in affluent suburban areas and transitioned toinjection with peers, owing to a combination of factors related toindividual tolerance, cost, and shifting drug markets. In contrast, methamphetamine initiates grew up in less affluent families withhistories of substance use that exposed them to drugs at an early age. Methamphetamine users transitioned from smoking and snorting toinjection, often with family members or intimate partners, within broadercontexts of social disadvantage and stress.

Conclusions—While much of the focus on young injectors has centered onthe current opioid epidemic, our data suggest a need to consider multiple pathways toward injection initiation of different drugs. Targetedinterventions addressing the unique injection transition contexts of bothopioids and methamphetamine are urgently needed in the Central Valley ofCalifornia.

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Keywords

injection drug use; injection transitions; opioids; heroin; methamphetamine; California

Injection drug use initiation represents a critical point of public health intervention, as injection increases risk for blood borne infections including HIV, Hepatitis C virus (HCV), and other viral and bacterial infections (Bruneau, Roy, Arruda, Zang, & Jutras-Aswad, 2012). Youth are particularly vulnerable to injection-related health and social harms that can continue over the life course (Lankenau et al., 2012). Thus, innovative programs are needed to prevent transitions to injection drug use among youth across diverse contexts (Bluthenthal & Kral, 2015).

The United States (US) has the highest rates of opioid use in the world (Fischer, Keates, Bühringer, Reimer, & Rehm, 2014). In a survey of 69 countries, the US ranked first in oxycodone consumption with an average of 194.9 milligrams per capita compared to the global mean of 11.9 milligrams per capita (Pain & Policy Studies Group, 2014), and sales of prescription opioids across the US nearly quadrupled between 1999 and 2014 (CDC, 2011). Concurrently, the non-medical use of prescription opioids and related transitions to heroin use have garnered increasing academic and media attention at the national level (Cicero, Ellis, Surratt, & Kurtz, 2014; Cicero, Inciardi, & Muñoz, 2005; Dart et al., 2015; Lankenau et al., 2012; Werb, 2016a). In 2014, an estimated 4.3 million people in the US reported non-medical use of prescription pain relievers and 435,000 were current heroin users (SAMHSA, 2015). Drug overdose is the leading cause of injury death in the US, and prescription opioids play a major role in drug-related deaths. In 2013, 16,235 of the nearly 40,000 drug overdose deaths involved prescription opioids and 8,257 involved heroin (Hsu, McCarthy, Stevens & Mukamal, 2016, May). According to the Centers for Disease Control and Prevention, the age-adjusted drug overdose death rate increased from 6.2 per 100,000 persons in 2000 to 14.7 per 100,000 in 2014; during this time the rate of overdose deaths involving opioids (prescription opioids and heroin) increased 200% (Rudd, Aleshire, Zibbell, & Gladden, 2016).

Recent evidence suggests that sociodemographic and geographic patterns of opioid use are changing across the US, particularly among youth. Studies from several urban areas suggest that younger opioid injectors are more likely to have started with prescription opioids before progressing to injection compared to older users (Cicero et al., 2014; Cicero, Ellis, Surratt, & Kurtz, 2014; Lankenau et al., 2012; Mars, Bourgois, Karandinos, Montero, & Ciccarone, 2014; Peavy et al., 2012; Pollini et al., 2011). Evidence further suggests an expansion of opioid injection from urban to rural and suburban areas, with an increasing proportion of the white population initiating opioid use compared to racial and ethnic minorities (Cicero et al., 2014). Cicero and colleagues (2014) found that shifts toward heroin use were primarily due to the “high” provided by heroin, the ease of access and cheap cost of heroin compared to prescription opioids, and heroin’s ease of use compared to extraction methods required to inject some prescription opioids.

As opioid injection spreads beyond urban areas, new populations are exposed to HIV and HCV outbreaks (Havens et al., 2013; Spiller, Broz, Wejnert, Nerlander, & Paz-Bailey, 2015).

HCV rates are increasing across rural Appalachia, including an increase of 364% during 2006–2012 in West Virginia, Virginia, Kentucky, and Tennessee (Zibbell et al., 2015). HCV is considered a harbinger of HIV outbreaks, as both viruses are transmitted via similar pathways (e.g., sharing syringes). A recent HIV outbreak in rural Indiana linked to injection of the prescription opioid Opana has public health officials concerned about similar outbreaks on a national level (Conrad et al., 2015).

As the most popular psychostimulant globally (Chomchai & Chomchai, 2015), methamphetamine use also remains a significant public health concern in the US. In 2014, an estimated 1.6 million people aged 12 or older reported non-medical use of stimulants, including 569,000 people who used methamphetamine (SAMHSA, 2015). The percentage of young adults (ages 18–25) reporting current use of stimulants has remained consistent in most years between 2002 and 2013 (SAMSHA, 2015). Methamphetamine has been established in drug markets on the West Coast of the US since the 1980s, moving eastward into the Midwest and Southeast in the 1990s and early 2000s. In California, methamphetamine use has long been entrenched, particularly in low-income, non-urban contexts among white and ethnic minority populations (Gruenewald, Ponicki, Remer, Waller, et al., 2013).

Methamphetamine injectors may be especially vulnerable to health and social harms, as high risk sexual behaviors, frequent injection, and needle sharing (Kral et al., 2011) put them at disproportionate risk of blood borne infections (Miller, Kerr, Fischer, Zhang, & Wood, 2009). Research further suggests that women who use methamphetamine experience elevated risk for violence and associated health harms, including adverse reproductive harms and HIV infection (Abdul-Khabir, Hall, Swanson, & Shoptaw, 2014; Lorvick et al., 2012; Stockman et al., 2014). Media portrayals of methamphetamine have played on these harms to generate a particular kind of dehumanizing moral panic, including gendered representations of women as sexually depraved, irresponsible mothers who neglect their caretaking responsibilities and men as violent criminals who control the drug market and cajole women into using methamphetamine (Linnemann, 2010).

In the Central Valley of California, drug use has long been a prominent health concern. The region is a High-Intensity Drug Trafficking Area (HIDTA), as the I-5 drug trafficking corridor running through the Valley transports heroin, methamphetamine, and cocaine from Mexico northward through California (Office of National Drug Control Policy, 2016). In a study of 96 U.S. metropolitan statistical areas (MSAs), the Fresno MSA ranked second (2.95%) and Bakersfield MSA fourth (2.40%) in prevalence of injection drug use (Brady et al., 2008).

Fresno (population ~510,000) in Fresno County and Bakersfield (population ~364,000) in Kern County represent main urban hubs in an otherwise largely rural and agricultural region. The Central Valley is undergoing social and economic changes in the context of political neglect, concentrated poverty, health disparities, and limited access to health services (DeLugan, Hernandez, Sylvester, & Weffer, 2011). In addition to areas of concentrated poverty within the Valley's main urban areas (Cooke & Marchant, 2006), the rural Valley resembles other rural regions suffering from deteriorating socioeconomic conditions and

increasing concentrations of wealth and resources among the few that alienate the majority from the land and opportunities for prosperity (Garcia, 2010, 2014). Like other largely rural areas, the Central Valley has been affected by the relatively recent phenomenon of widespread prescription opioid abuse but within a historical context of high injection drug use rates, including widespread methamphetamine use. However, few studies have been conducted on drug use and related harms in the Valley, reflecting broader patterns of neglected social and health needs in the region.

Furthermore, despite high levels of injection drug use, syringe access in Fresno and Kern counties is extremely limited. As of early 2017, there was one syringe exchange program (SEP) in Fresno that operated only two hours per week and no SEP in Kern. Although legislation allowing nonprescription syringe sales throughout California went into effect in 2012, sales are voluntary and pharmacy participation in Fresno and Kern is limited (Pollini, Rudolph, & Case, 2015). These barriers to sterile syringe access underscore the importance of addressing patterns of injection drug use, including injection initiation.

Within this context, we explore injection trajectories among youth (<=30 years) in California's Central Valley. Our analysis is guided by a "risk environment" framework that views drug use and its associated harms as a product of social and environmental interactions at the micro-, meso-, and macro-levels of experience (Rhodes, 2002). This framework considers microlevel injection practices and drug use preferences that heighten risk for adverse health effects as influenced by meso-level social relationships that shape drug consumption and macro-level political and economic factors that structure drug availability. While traditionally used to understand HIV risk and transmission dynamics, this framework can also help explain how multiple factors interact to shape changing patterns of drug use.

To trace the specific factors shaping drug use over time, we borrow from Raikhel and Garriott's (2013) conceptualization of "addiction trajectories" that implies a direct yet highly contingent trajectory of drug use. We use "injection trajectory" to consider the multiple factors within the risk environment that shape specific transitions to injection drug use. In this context, our study considers factors such as shifting drug markets, social influences, and individual-level experiences of tolerance and pleasure seeking in drug use. Like the concept of addiction more broadly, we contend that injection trajectories "must be seen as a trajectory of experience that traverses the biological and the social, the medical and the legal, the cultural and the political" (Raikhel & Garriott, 2013). Thus, our analysis outlines the trajectories of opioid and methamphetamine injectors within the risk environment of the Central Valley, where a contingency of interrelated factors contribute to high rates of injection drug use.

Methods

In this analysis, we draw on semi-structured qualitative interviews that explored multiple dimensions of injection drug use and related health and social harms in the Central Valley. We used targeted and snowball sampling (Schensul, LeCompte, Trotter II, Cromley, & Singer, 1999; Watters & Biernacki, 1989) to recruit participants who were at least 18 years

old and reported injection drug use in the past year. In Fresno, we worked through our contacts at the SEP and local health service agencies to initiate recruitment. In Bakersfield, we worked through local agencies and used street-based recruitment in known areas where drug use occurs. We purposefully constructed our sample (Johnson, 1990) to achieve maximum variation in gender, age, drug use (opioids vs methamphetamine), and residence (urban vs rural county) in order to capture a range of experiences.

Between March and December 2015, we conducted 46 interviews, including 22 individuals in Fresno County and 24 in Kern County. Semi-structured interviews covered local drug market characteristics; personal drug use histories; injection drug-related risk behaviors; drug-related health harms including abscesses, overdose, HCV, and HIV; interactions with law enforcement and healthcare providers; and experiences of drug treatment. We also collected basic quantitative socio-demographic data. The study PI and Co-I conducted digitally recorded interviews in a private office space, which typically lasted 60–90 minutes (range: 45 minutes to four hours). Participants were reimbursed $50 and offered harm reduction materials (e.g., condoms, cookers, i.e., small containers for mixing and heating drugs to prepare for injection, and cottons to use as a filter) and referrals to local service providers. Participants provided written informed consent prior to interviews. Protocols were approved by the Pacific Institute for Research and Evaluation's Institutional Review Board.

In these 46 interviews we repeatedly heard similar information across interviews about our primary topics of interest and determined that we had reached saturation. As a best practice in qualitative research, saturation provides empirical confidence that the sample size is sufficient to adequately explore the themes of interest (Guest, Bunce, & Johnson, 2006). Interviews were transcribed verbatim and verified for accuracy by a research assistant (RA) using a structured protocol (McLellan, MacQueen, & Neidig, 2003).

As a preliminary analysis step the team wrote summaries of each interview to begin identifying major themes across interviews. Next, we independently read through three full interview transcripts and generated preliminary coding schemes based on the primary areas of interest in the interview guide (deductive) as well as emergent themes (inductive) across the interview texts (Ryan & Bernard, 2003). The team met to discuss and integrate the coding schemes into a draft codebook. Codes were arranged in a hierarchical structure by broad parent codes (e.g., drugs) and corresponding sub-codes representing more specific themes (e.g., drug market, transitions to injection).

The RA coded all transcripts in consultation with the Co-I, who checked the coding for consistency. The team discussed questions that arose during coding and refined the codebook as needed during the process. For example, we discussed refining the level of detail that codes should capture, and ultimately decided that codes should remain broad. The RA wrote additional memos about important or unique findings in select transcripts to help identify cross-cutting themes and generate a deeper understanding of the data. We used MAXQDA software to manage and analyze the data (MAXQDA, 1989–2016).

The current analysis is restricted to young injectors (<30 years) who comprised just under half (n=20, 43%) of the overall sample. We examined drug use histories, focusing on

trajectories of drug use and the factors that participants associated with their transition to injection. First, the authors read through coded segments related to “transitions,” which broadly captured drug use trajectories and the context of injection initiation. For this analysis, we classified participants into categories based on their first drug of injection: opioids (n=12) or methamphetamine (n=8). We then assessed the contexts of transitioning to injection within each of these groups using a risk environment framework to identify factors that influenced injection initiation at multiple levels. We wrote memos and outlined the primary reasons for transitioning to injection drug use among users in each group and sorted these reasons by rank order of frequency to characterize common trajectories. The research team discussed the findings and selected quotes to represent major themes. All names are pseudonyms to protect confidentiality.

Results

In our sample of 20 young injectors, the average age was 24.7 years (range: 20–30), 45% were female (n=9), and 30% were Latino (n=6, 3 women and 3 men). Past month injection drug use included heroin (70%, n=14), methamphetamine (70%, n=14), and powder cocaine (40%, n=8). Participants had injected for an average of 5.4 years (range: 1 month – 16.5 years). Those whose first injection involved opioids were more likely to be from Fresno County (9 out of 12) while methamphetamine initiates were more likely to be from Kern County (6 out of 8).

Participants described a variety of injection trajectories, culminating in a first injection that involved either opioids or methamphetamine. First, we discuss individuals who initiated opioid injection (n=12), followed by those who first injected methamphetamine (n=8). Within each of these groups, individuals tended to share similar demographic and geographic backgrounds, social class, and family experiences. Across all groups, a constellation of physical, social, and structural factors underlined transitions to injection drug use.

Trajectories to opioid injection

Individuals who first injected opioids (n=12) had an average age of 24.8, and were predominantly male (67%) and white (67%). We identified two major trajectories leading to opioid injection: the first (n=8) directly associated prescription opioid use with injection initiation, including six individuals reporting that heroin was the first drug they injected and two reporting that their first injection involved prescription opioids with later transitions to heroin injection. The second trajectory involved four individuals who transitioned to injecting heroin from other recreational drug use, and did not attribute their heroin injection to prior prescription opioid use.

Opioid injection trajectories directly associated with prescription opioids— The eight participants who directly linked their injection to use of prescription opioids generally described themselves as growing up in relatively affluent suburban areas of the Central Valley. Most reported drinking alcohol and experimenting with drugs when they were young, typically with friends, as a first stage in their drug use trajectories. Several were initially unaware of the physical effects and dependence that opioids create when they

started experimenting with prescription pills, reflecting other studies in which recreational users perceive less risk in pills compared to heroin (Daniulaityte, Falck, & Carlson, 2012; Mars, Bourgois, Karandinos, Montero, & Ciccarone, 2014). Most reported that their increased tolerance and physical dependence on prescription opioids in part prompted their progression to injection.

The majority of this group tried multiple modes of administration and types of opioids in their injection trajectories. Tyson, a 22 year old from Bakersfield, described a common trajectory in which he started swallowing Vicodin® (hydrocodone/acetaminophen) and shifted to swallowing and later smoking OxyContin® (extended release oxycodone), which he learned how to do from classmates at school. By the time he was 15, Tyson was introduced to black tar heroin (e.g., a sticky, tar-like form of heroin prevalent in the western US) by the much older “hardcore criminals” who lived in his neighborhood and told him it provided a cheaper option to get high compared to prescription opioids.

Tyson smoked heroin for about one year before one of these neighbors said, “You’re not doing that right… you need to try this.” Tyson said his neighbor pulled a syringe out of his pocket which he was “sure was already used” and injected him for the first time. Tyson said he “instantly fell backwards and became unconscious for a while,” which scared him and he did not inject again for about 6 months after that. He continued smoking until his tolerance increased and a neighbor suggested he inject an entire dime bag of heroin. Tyson said he liked the rush so much so that he transitioned to heroin injection for good. While meso-level social influences and individual tolerance and are well recognized in shaping drug use, the pursuit of pleasure is a less acknowledged but equally important dimension of drug use (Hunt, Evans, & Kares, 2007; Moore, 2008). Woven throughout our participants’ narratives of injection trajectories, the pursuit of the rush and desires to intensify their highs rendered injection as a desirable option to optimize the pleasurable effects of drugs even in light of its risks.

While most prescription opioid users transitioned to smoking heroin anywhere from months to several years before they began injecting, Derrick, a 26-year-old from Fresno, was one of two people in our sample whose first injection experience involved prescription pills. Within his first week of experimenting with OxyContin, he and his friends consulted the internet to learn how to inject the pills in order “to get higher.” Calista, 26, and from Bakersfield, also initiated injection with prescription opioids. While she was the only person in our sample who had a medical condition for which she was legitimately prescribed opioid medication, she called her prescription to Norcos® “a door” to her drug abuse and eventual transition to injection. Calista had been prescribed Norcos® (hydrocodone/acetaminophen) since age 14, which caused her to experience gastrointestinal issues from prolonged use. Prolonged opioid use and related withdrawal can cause various physical side effects in patients, including gastrointestinal issues such as nausea, vomiting, constipation (Benyamin, et al., 2008). As her addiction progressed, she tried alternative routes of administration that might cause less physical discomfort. She tried smoking pills, but she had trouble breathing. Around the time that she first injected, she described herself as suicidal and opioid-dependent. Owing to these physical, psychological, and social factors, she transitioned to injecting prescription opioids and later heroin:

> I had a friend that shot up occasionally. She showed me how to fix Dilaudids® (hydromorphone) and so I realized that that was definitely the way easier way to do them. I found out that you do the roxies and the Oxys (oxycodone) the same way and so as far as cooking them and everything, you cook them the same way. I started doing that. That became my main method to doing them. I didn't eat them anymore.

At the meso-level, friends and peers played prominent roles in injection trajectories, and frequently helped participants learn how to inject. Robbie, 25 and from Fresno, described experimenting with alcohol and drugs with friends in his teenage years. After he started selling prescription opioid medications, he gradually started using them. Robbie called prescription opioids a "perfect stepping stool" in his trajectory to first smoking and later injecting heroin. Robbie's friends told him that injecting provided a cheaper and more intense high, echoing Tyson's experience in which the pleasure-seeking dimension of drug use can lead to injection. Robbie's friend helped him inject the first time:

> I just held my arm out and, I closed my eyes and whatever. And you know, I did a fraction of what I would normally do smoking it and it got me so much higher and like a completely new level of high to where it was a totally different drug. You know? It didn't feel like the same drug and like I did, you know, hardly any in comparison. And so it saved me a lot of money and I loved the feeling. And you know, once you get the needle in your arm, especially for the first few times, it's not even a big deal.

At the macro-level, changes in local drug markets profoundly shaped the risk environment in which participants' injection trajectories unfolded. Purdue Pharma's reformulation of OxyContin to a tamper-resistant product in 2010 created a scarcity of the extended-release pills that people had become dependent upon in favor of a formulation that made it more difficult to crush, extract, and inject the oxycodone. Research has found that recreational OxyContin users preferred the original form and the reformulation contributed to changes in drug use patterns favoring heroin (Cicero, Ellis, & Surratt, 2012). Similarly, in five out of eight transition narratives among prescription opioid users, participants made direct linkages between changing market availability of OxyContin and their shift to smoking, and ultimately injecting, heroin.

Will, 27 and from Fresno, started injecting heroin with a group of friends – also all new injection initiates – within weeks of the OxyContin supply disappearing. One friend who already knew how to inject taught the entire group. Likewise, Darla, 26 and from Fresno, shifted from prescription opioids to heroin after she "finally gave up" looking for OxyContin in early 2011. She tried enrolling in a methadone program and smoked heroin on and off, but recurrent bouts of pneumonia precipitated her shift from smoking toward injecting heroin for health reasons:

> Um, the first time I injected, um, I wasn't really planning on it, and then, um, I just kind of had to fight myself on it. And I was just like, "Okay. Well, if I'm not ready to quit, then I have to do something different." And it was either snorting or, you know, or slamming [heroin]. And I tried snorting it, and it just was not working out

> for me…so I was like, "Oh, I cannot do this every time." (laughs) Um, and so then I tried, you know, slamming.

Janine, a 22 year-old female from suburban Fresno, had a long history of drug experimentation, including alcohol, marijuana, cocaine, and club drugs. She said she snorted OxyContin until "then one day there's no more Oxy to be found." She was introduced to smoking heroin through a friend, and later to injecting by friends who told her she was "wasting" her heroin by smoking it. Derrick, whose quick escalation to OxyContin injection is described above, also quickly transitioned to injecting heroin as a result of the changing drug market. Below he summarizes a common sentiment among the recreational prescription opioid users we interviewed:

> It, um, you know, everybody I talked to my age kind of remembers the time here in town where it [OxyContin] literally just sort of flooded the streets. And I think that's like a big part of the reason why there's so many kids around my age now, uh, hooked on the heroin… 'cause they kinda gave us the Oxy and then yanked it away, you know… so it's, like, it's kinda what everybody turned to.

Across these stories, transitions to opioid injection occurred within a broader risk environment in which multi-level factors shaped addiction trajectories, including macro-level changes from widespread prescription opioid availability, to an increasingly high cost of prescription opioids on the streets, and eventual drug market shifts that availed plentiful and cheap sources of heroin. The majority of this group initiated heroin injection, and clearly articulated the links between their heroin injection on an individual level and the structural changes in the drug market. As participants experienced micro-level physical addiction and growing tolerance, they often turned to injection for its ability to enhance pleasure in their drug use. At the meso-level, other injectors played a key role in transitioning, as they shared information about the efficient, cheap, and intense high that injecting provides.

Other opioid injection trajectories—The remaining group of opioid injection initiates (n=4) transitioned to injection directly from non-opioid recreational drug use. Like the individuals described above, early patterns of poly-drug use included both stimulants and depressants. However, this group did not engage in prescription opioid use as a direct antecedent to heroin injection.

Individual-level factors like mental health issues were important in injection initiation for Jordan, a 21-year-old male from Fresno. Jordan reported a history of alcohol use and recreational Xanax use, which he attributed as an initial trigger toward injection drug use. The first time he smoked heroin, he did not like the effects, but later he began to smoke it for its downer effect, to help him cope with stress, and block out negative feelings. One of his friends injected heroin, and because some of Jordan's family members were diabetic he learned the technical practice of injection through observation. Below, Jordan describes his first injection experience which, like others in our sample, highlights the centrality of pleasure in his drug use and shared cultural values around "instant gratification":

> … I liked it. I liked the instant gratification. Uh, just like a lot of things in my generation, you know, we love instant gratification. But, um, I, yeah, I, I liked the, just the rush of it. I liked the process of it.

Social influences in transitioning to injection were also important in this group. Marissa, age 25 and from Fresno, had a history of experimentation with alcohol, marijuana, cocaine, hallucinogens, methamphetamine, and prescription pills like Vicodin, but nothing "extreme" like OxyContin. She smoked heroin once in high school, but she did not see opioids as playing a significant role in her drug use trajectory. She never used opioids regularly and did not start injecting heroin until several years later when she met her boyfriend. Matt, 23 and from Fresno, also had a long history of drug use, including snorting oxycodone for about a year when he was 17; however, he claimed he never experienced withdrawal symptoms from prescription opioids. He primarily drank alcohol until friends and a boyfriend started using heroin. He smoked heroin for a year, but when he and his boyfriend broke up, he transitioned to injecting:

> And um, and he [boyfriend] had done it before we dated. And I had a best friend who did it. We both did and blacked [used black tar heroin] together for like the first time… And it was with her other friend and then I started dating this guy and we ended up smoke or smoking black for like a year. Now him and I were breaking up, that's when I started slamming with my friend, my other friend, and that was, she was dealing and stuff. So, it was like always around me.

Like the above individuals who transitioned to injecting opioids, those who did not misuse prescription opioids prior to injection nevertheless described their injection trajectories as shaped by multi-level factors within their risk environment. These individuals described how the physical progression of their addiction and social relationships with other injectors were important factors in injection initiation. However, rather than resulting directly from prescription opioid use, their transitions to injection occurred in a drug market saturated with inexpensive heroin, which offered another option for these individuals with broader drug use trajectories.

Trajectories of methamphetamine injection

Methamphetamine injection initiates (n=8) were an average age of 24.5 years, 63% were female, and 25% were Latino. In comparison to the opioid injectors, the methamphetamine injectors in our sample were more heavily female and from rural areas of the counties. Many individuals in this group grew up in families with histories of substance use that first exposed them to drugs. The majority initiated methamphetamine by smoking or snorting at a young age, and transitioned to injecting related to micro-level physical factors, including seeking the pleasure of a better "rush." However, these physical factors occurred within risk environments characterized by psychosocial stress and trauma, exposure to family and friends who injected, and broader adverse social conditions, including the widespread availability and normalization of this cheap, potent drug in rural areas of the Valley.

Methamphetamine injectors spoke about the importance of individual-level physical factors in their trajectories toward injection in a manner similar to their opioid-injecting peers. Yvette, a 21-year-old female of mixed Hispanic descent from rural Kern County, first

smoked methamphetamine before initiating injecting at age 15 because she wanted to intensify her high:

> At first it went from smoking for about a year, realizing that it wasn't giving me the same effect, like I wasn't getting high anymore. I was getting high, but it wasn't the high I wanted. Then everybody around me was using the needle and stuff, so I was like, you know what? Then the rush came, and then I was like, now I'm addicted to the rush.

Across interviews with methamphetamine injectors, the macro-level features of the risk environment included the widespread availability of methamphetamine within broader contexts of disadvantage. Like the opioid injecting group, meso-level factors proved critical in inducting participants into methamphetamine use, as family, friends, and intimate partners played significant roles in individuals' shifting patterns of drug use and injection initiation. In describing her first time injecting, Yvette said she was with a group of friends in her small, rural town who taught her how to prepare the drugs and helped her inject. Several other participants grew up in families in which parents used methamphetamine and exposed their children to drugs at a young age. Tina, age 20 and from Bakersfield, grew up around methamphetamine and felt like drugs took priority in her parent's lives:

> … everyone [was] running around trying to find drugs and they didn't ever want to hang out with me or, like, or was always trying to hide it from me. Or like, you know what I mean? Stupid stuff like that like… "I'm not stupid, you don't have to hide shit from me, but … why don't you want to hang out with me either?" I don't know, they just put it first. Drugs were always first. It always is … Still to this day it is. Especially with my mom. Drugs will always be, will be first. Just like she told me. She told me that straight up.

Within this context, Tina first smoked methamphetamine and later transitioned to snorting methamphetamine when it did not get her as high anymore. When she was 18, someone from her group of friends offered her a shot of methamphetamine and she reasoned "It can't hurt once" to try injecting.

Kevin, 24 and from Bakersfield, also grew up around methamphetamine. He first tried methamphetamine at age 11 with his dad and first injected methamphetamine years later when he was with a sex worker who injected. Paul, a 30 year old from Bakersfield, also grew up around drugs as a child; he saw his parents smoking methamphetamine and first tried it when he was 16 years old. He later transitioned to injection because he said so many of the people around him injected. After he was incarcerated on a domestic abuse charge and lost contact with his children, his hopelessness prompted him to take a friend's advice and try injecting:

> Then I kind of stopped giving a crap, and a friend of mine was making himself up one [a shot of methamphetamine] … And he goes, "Here, I'm gonna screw up your life," and I went for it.

Sandra, a 30 year old from rural Kern County, had a trajectory of drug use shaped by her childhood history of trauma, violence, and family issues that pushed her toward drug use to cope. She said she "started hanging out with the wrong people" and after smoking

methamphetamine for a period of time, she transitioned to injecting about three years ago because her boyfriend also injected. In describing her first time injecting, she linked its positive physical effects back to her emotional trauma:

> The high was like so intense … Definitely enjoyed it because I wasn't thinking about anything … I did not have not one bad PTSD moment or nothing … It just felt good to be able to breathe for a minute like that, ya know?

Like Sandra, other women started injecting methamphetamine within contexts of intimate relationships. Bernadette, 30 and from rural Fresno County, had a history of alcohol and drug use and was first given methamphetamine by her mother when she was 17. Years later, she initiated methamphetamine injection after figuring out that her boyfriend secretly injected. She initiated injection to understand how it made him feel and why he would hide his behavior from her.

Megan, 21 and from Bakersfield, also grew up in a household in which her mom used drugs. When she was young, she found her mom overdosing and swore to never try heroin. However, an abusive relationship with a boyfriend when she was a teenager started her down a path to methamphetamine use:

> I never have even thought about doing dope [methamphetamine]. I'd never tried doing dope, and it was an abusive relationship, and I would go and hang out with him over at his friends. We would go hang out in the garage with just his friends. His room's the garage. When [he] would get mad, he'd blow dope smoke through my nose and hold me down to blow it through my nose. After a while of that, I got where I wanted it, even though I didn't… that's how I got started smoking dope.

Megan said she later became "curious" about her boyfriend's injection drug use and she wanted to experience how it made him feel. She too transitioned to regular methamphetamine injection.

Woven through these narratives, macro-level factors in the risk environment including entrenched availability of methamphetamine led to widespread access and normalization of its use. Particularly in rural areas of the counties, social marginalization, lack of opportunities, and intergenerational patterns of drug use created the social and emotional conditions conducive to initiating drug use (Fast, Kerr, Wood, & Small, 2014; Gracia 2010). Meso-level social contextual factors were critically important in our participants' accounts of methamphetamine use, with factors including psychological distress, family influences, intimate relationships, and exposure to others who inject all playing a prominent role in injection trajectories. Importantly, the risk environment of methamphetamine use represented an uneven terrain differentially experienced by men and women; the role of childhood neglect, trauma, violence, and other negative life experiences permeated the injection trajectories of the women in our sample and reflect broader imbalances in gendered power dynamics. Finally, once participants tried methamphetamine, individual-level motivations to intensify one's high and find a rare opportunity for pleasure underlined transitions to injection.

Discussion

We documented multiple trajectories leading young individuals to initiate injection drug use. In the transition narratives of both opioid and methamphetamine injectors, factors at the micro-level (e.g., the physical dimensions of addiction, pleasure, emotional distress and trauma), meso-level (e.g., family and other social influences), and macro-level (e.g., drug availability) interacted within the broader context of California's Central Valley, where rates of injection drug use are among the highest in the US (Brady et al., 2008). Our discussion compares and contrasts the multi-level factors that shaped trajectories towards opioid and methamphetamine injection, which have implications for public health interventions.

Micro-level factors, including individual progression of addiction and the desire "to get higher," were important in the transition narratives among both opioid and methamphetamine injectors even though the physical effects of these drugs differ. Opioids produce physical dependency and increasingly severe withdrawal symptoms that compel individuals to escalate their use (Lankenau et al., 2010), while methamphetamine users talked about chasing the "rush" and wanting a more intense high because smoking and snorting no longer left them satisfied. Throughout our analysis, individual notions of pleasure seeking raised an often under-theorized dimension of drug use (Hunt et al., 2007). Particularly early on in drug use trajectories, pleasurable experiences may reinforce drug use patterns and social contacts who share information about the intensity of injecting may serve as a key point of initiation for others. In addition, among both groups we identified the little acknowledged role of physical health issues in transitioning. Injection represented a cleaner route of drug administration compared to smoking or snorting for those with respiratory issues and other sequelae of non-injection drug use. Such physical factors could signal key moments for interventions to prevent injection transitions.

These individual-level factors in injection transitions are shaped by risk environments in which social and structural factors bear directly on drug use trajectories. Among opioid users, transition narratives predominantly linked recreational prescription opioid use to heroin use, consistent with a growing number of recent studies (Dertadian & Maher, 2014; Lankenau et al., 2012; Mars et al., 2014). Young heroin injectors, particularly from suburban areas of the Valley, came of age in an era of prescription drug misuse. As part of broader trajectories of drug experimentation over time, participants tried different routes of pill administration (e.g., crushing pills to smoke and snort) that were popularized and shared within social networks. Social networks are important influences on injection initiation (Day, Ross, Dietze, & Dolan, 2005; Draus & Carlson, 2006), serving as key sources of injection information, including the economic rationale of achieving cheaper but better highs (Lankenau et al., 2010). However, transitions to injection among our sample were not always immediate: most injectors transitioned from abusing pills to smoking heroin for a period of time before initiating injection. Just two participants injected pharmaceutical opioids before transitioning to heroin, which differs from other samples (Lankenau et al., 2012). This delay may reflect the importance of local social influences in shaping preferences and drug use trajectories, and also suggests that there may be a critical window in which to intervene against injection initiation (Vlahov, Fuller, Ompad, Galea, & Des Jarlais, 2004).

Macro-level dimensions of the risk environment are critical in shaping drug choice in initial injection experiences and current patterns of heroin use must be understood within a broader sociohistorical context of pharmaceutical markets in the US (Lankenau et al., 2010). In the 1990s, the US Joint Commission on Accreditation of Healthcare Organizations recommended that pain should be treated as the "fifth vital sign," encouraging providers to assess patients' pain similarly to blood pressure, heart rate, respiratory rate, and temperature. In 1996, Purdue Pharma introduced OxyContin, a sustained release, high dosage formula of pure oxycodone, which the company aggressively marketed for pain management. Sales of OxyContin ballooned from $48 million in 1996 to $3.1 billion by 2010 (IMS Institute for Healthcare Informatics, 2011; Van Zee, 2009). Aggressive treatment with opioid analgesics and generous prescribing practices for even non-malignant pain also created a significant black market for recreational use (Van Zee, 2009). In 2010, Purdue Pharma introduced a tamper-resistant OxyContin formulation, which had the unintended consequence of pushing users to try other opioids, including heroin (Cicero & Ellis, 2015). As such, a growing body of literature has linked the recent surge in heroin use to aggressive prescription opioid marketing and dispensing patterns, the development of a parallel black market for diversion of opioid pills and recreational use, and subsequent shifts to heroin as a cheaper and more easily available alternative (Lankenau et al., 2012; Mars et al., 2014; Peavy et al., 2012; Pollini et al., 2011). Although widespread acknowledgement of the links between prescription opioids and heroin is relatively recent, the first suggested link between prescription opioids and heroin use dates back much earlier to 2003 in rural Ohio, an early epicenter of the US prescription drug epidemic (Siegal, Carlson, Kenne, & Swora, 2003).

Geographically, the diffusion of opioid markets across the US has also shaped patterns of injection drug use. Counties with the highest opioid prescribing rates are disproportionately located in Appalachia and the southern and western states, creating the potential for widespread diversion and recreational use (McDonald, Carlson, & Izrael, 2012). Our sample in California noted the time when OxyContin "flooded the streets" but became expensive and was "yanked away" after the 2010 reformulation. Out of the eight people who used prescription opioids prior to injecting, five directly linked their current heroin injection to changes in the OxyContin market, even if they had broader histories of drug use prior to their abuse of prescription opioids. Our findings begin to chip away at some researchers' assumptions that transitions to heroin use among recreational prescription opioid users "occur at a low rate" (Compton, Jones, & Baldwin, 2016). Instead, without directly asking questions about pharmaceutical markets, participants in our study identified these structural factors of the risk environment as critical in their individual injection trajectories.

Understanding the socioeconomic context and economic considerations underlying changing drug use patterns in the US has global relevance. Although OxyContin's addiction potential was initially downplayed by its maker Purdue Pharma, in 2007, Purdue Pharma executives pleaded guilty to federal charges of misbranding and paid $635 million in fines (Ryan, Girion, & Glover, 2016). As profit margins have declined by around 40% for Purdue Pharma since the reformulation, the company is now launching an aggressive campaign to target global drug markets outside of the US using some of the same controversial techniques to assure prescribers that "opiophobia," or fears of prescribing opioids because of abuse potential, are unfounded while also offering discounts to make OxyContin more affordable

(Ryan, Girion, & Glover, 2016). In contrast to these assertions, our study contributes to the growing body of research linking prescription opioid prescribing, misuse, and dependence with transitions to heroin use and injection and therefore serves as a warning for other countries (Weisberg, Becker, Fiellin, & Stannard, 2014).

In addition, a smaller group of individuals in our sample transitioned to heroin injection from trajectories not focused on opioid use, serving as a reminder that multiple trajectories to heroin injection persist even without the pressures of broader pharmaceutical prescribing trends. Injection trajectories are shaped by local social contexts of drug use, and social network influences play a critical role in initiating new injectors (Small, Fast, Krusi, Wood, & Kerr, 2009).

In contrast to the shifting landscape of opioid use, methamphetamine has long been entrenched and available in the western US, particularly in rural areas of California's Central Valley (Gibson, Leamon, & Flynn, 2002; Gruenewald, Ponicki, Remer, Waller, et al., 2013). Methamphetamine use spread from rural northern and southern California into the Central Valley in the 1990s (Gruenewald, Ponicki, Remer, Johnson, et al., 2013), where its production, supply, and use remain a serious public health concern (Office of National Drug Control Policy, 2016). While much of the recent focus on young injectors has centered on opioid use, our data provide a reminder that methamphetamine injection continues to enact health harms in communities.

In contrast to the more suburban and relatively higher socioeconomic status of the opioid injectors, the risk environment of methamphetamine injectors often included being raised in rural or semi-urban marginalized neighborhoods of concentrated disadvantage. Research on methamphetamine use in other similarly disadvantaged US settings like Appalachia suggest that social oppression, exclusion, discrimination, lack of opportunities, boredom, and hopelessness underlie patterns of methamphetamine use, and that the often aggressive and violent behavior of methamphetamine users – particularly men – reflect a reassertion of masculinity and male dominance in a context otherwise bereft of productive masculine roles (Brown, 2010). Similarly, meso-level social influences figured heavily in injection trajectories in our study, including the primary influences of family, friends, and intimate partners (Sheridan, Butler, & Wheeler, 2009; Small et al., 2009).

In particular, multiple participants talked about parents who used drugs during their childhoods and many first tried methamphetamine with a parent. Most reported trying methamphetamine at an early age, echoing a rapid assessment of methamphetamine in the region suggesting that three-quarters of methamphetamine users start as teenagers (Gibson et al., 2002). Garcia (2014) suggests that intergenerational heroin use among Hispanos in rural New Mexico was bound up in cultural ideas around cohesiveness and self-reliance that also reflected broader familial experiences of poverty, disadvantage, incarceration, and other negative health and social outcomes. Similar to Garcia's assertion that disconnection from the land and feelings of loss have been reconfigured as high rates of drug use and overdose, the sense of intergenerational marginalization and exclusion shared by methamphetamine users in our sample permeated their narratives of drug use and injection initiation.

While many individuals discussed growing up in contexts where drug use provided a coping mechanism for trauma, mental health issues, hopelessness, and other hardships, these psychosocial factors weighed heavily in the transition narratives of women. We found that cumulative trauma, experiences of violence, and unhealthy relationships with often abusive intimate male partners were critical factors in women's drug use trajectories. The "curiosity" to be included in intimate partners' methamphetamine use and desires to block out feelings and enjoy the pleasurable sensation of the methamphetamine "rush" may have provided temporary reprieve and restored a sense of agency among women with few other options (Lorvick et al., 2012).

Our study has limitations. Our small qualitative sample is not representative of all injection transition experiences in this region, and may not be generalizable. However, our sample represents a diversity of injection experiences within the Valley, including suburban and rural populations. As a strength, qualitative data provide rich insight into individual's experiences, including the social contexts and motivations for engagement in specific behaviors, which can effectively inform interventions. Our results reflect other injection transition literature, particularly around shifts from prescription opioid use to heroin injection and the importance of the social context of transitioning, lending confidence that the insights gained here can contribute towards appropriate prevention interventions for injection drug use.

Conclusions

Interventions to address injection drug use among young people must address the complex, multi-level individual, social, and structural factors that shape transitions to injection. Although much of the recent focus among young injectors has focused on opioid use, our data provide a reminder that methamphetamine injection continues to enact health harms in communities. While efforts are needed to curb the spread of opioid injection into suburban and rural areas, long standing patterns of methamphetamine injection in underserved, rural regions should remain a priority in research and policy.

Targeted interventions are needed to intervene early in patterns of poly-drug use to prevent injection transitions among youth (Vlahov et al., 2004). However, interventions to prevent the onset of injection are limited and appropriate prevention efforts should be developed that take into account the dynamic processes embedded within the injection trajectories of youth (Harocopos, Goldsamt, Kobrak, Jost, & Clatts, 2009). Addressing the structural dimensions of the risk environment remains a challenge; for example, macro-level diversion control efforts like product reformulation and crack downs on opioid prescribing are important but have had the unintended consequence of facilitating transitions to heroin (Cicero & Ellis, 2015). Similarly, law enforcement-led approaches designed to reduce illicit drug supplies are insufficient without an integrated public health approach that involves demand reduction through expanded drug treatment (Strathdee, Beletsky, & Kerr, 2015). Efforts to understand and modify the role of injectors who initiate others into injection are currently under evaluation and may hold promise for reducing injection initiation and/or risky injection behaviors among youth (Werb et al., 2016). In the interim, expanding harm reduction efforts to improve sterile syringe access and facilitating drug treatment entry are critical to curtail

injection-related health consequences among people who injection drugs in the Central Valley and similar geographic regions.

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