



Research paper

Injection-site vein loss and soft tissue abscesses associated with black tar heroin injection: A cross-sectional study of two distinct populations in USA



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ABSTRACT

Background: Injection-site vein loss and skin abscesses impose significant morbidity on people who inject drugs (PWID). The two common forms of street heroin available in the USA include black tar and powder heroin. Little research has investigated these different forms of heroin and their potential implications for health outcomes.

Methods: A multiple-choice survey was administered to a sample of 145 participants seeking services at reduction facilities in both Sacramento, CA and greater Boston, MA, USA. Multivariate regression models for reporting one or more abscesses in one year, injection-site veins lost in six months, and soft tissue injection.

Results: Participants in Sacramento exclusively used black tar (99%), while those in Boston used powder heroin (96%). Those who used black tar heroin lost more injection-site veins ($\beta = 2.34$, 95% CI: 0.66–4.03) and were more likely to report abscesses (AOR = 7.68, 95% CI: 3.01–19.60). Soft tissue injection was also associated with abscesses (AOR = 4.68, 95% CI: 1.84–11.93). Consistent venous access (AOR: 0.088, 95% CI: 0.011–0.74) and losing more injection sites (AOR: 1.22, 95% CI: 1.03–1.45) were associated with soft tissue injection.

Conclusion: Use of black tar heroin is associated with more frequent abscesses and more extensive vein loss. Poor venous access predisposes people who inject drugs to soft tissue injection, which may constitute a causal pathway between black tar heroin injection and abscess formation. The mechanisms by which black tar heroin contributes to vein loss and abscess formation must be further elucidated in order to develop actionable interventions for maintaining vein health and decreasing the abscess burden. Potential interventions include increased access to clean injection equipment and education, supervised injection facilities, opioid substitution therapy, and supply chain interventions targeting cutting agents.

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Introduction

The prevalence of heroin use in the U.S. has increased significantly over the past decade. In 2012 nearly 670,000 people injected heroin, which represents a doubling of the number reported in 2002 (Substance Abuse and Mental Health Services Administration, 2013). While it is generally well recognised that mortality among heroin injectors is significantly higher than that

of the general population (Degenhardt et al., 2011), it is less well known that, in addition to blood-borne viruses and overdoses, bacterial skin and soft tissue infections (SSTI) are major causes of disease and disability for people who inject drugs (PWID) (Binswanger, Kral, Bluthenthal, Rybold, & Edlin, 2000; Stein & Sobota, 2001). SSTIs include cellulitis, skin abscesses, and other associated pathological processes such as systemic sepsis, endocarditis, necrotizing fasciitis, and abscesses of the visceral organs, musculoskeletal system, and central nervous system (Gordon & Lowy, 2005). Hospitalization rates for opioid-related SSTIs doubled from 1993 to 2010 (Ciccarone, Unick, Cohen, Mars, & Rosenblum, 2016). These preventable infections pose a significant burden of morbidity on PWIDs and substantial costs to health systems (Ciccarone et al., 2001; Stein & Sobota, 2001). The

Abbreviations: AOR, adjusted odds ratio; CA, California; CI, confidence interval; HIV, human immunodeficiency virus; HCV, hepatitis C virus; MA, Massachusetts; PWID, people who inject drugs; SSTI, skin and soft tissue infection.

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prevalence of abscesses among PWID is estimated to be between 17–37% in different populations (Binswanger et al., 2000; Fink, Lindsay, Slymen, Kral, & Bluthenthal, 2013; Smith, Robinowitz, Chaulk, & Johnson, 2015). SSTIs account for 49% of hospitalizations among PWID, and these infections were significantly more expensive than hospitalizations for other complaints (Stein & Sobota, 2001). Another study found that, 17% of all community-acquired SSTIs were associated with injection drug use (Zervos et al., 2012).

Though theoretically preventable (Varaga, Chitwood, & Fernandez, 2006; Vlahov, Sullivan, Astemborski, & Nelson, 1992), there has been relatively sparse research aimed at understanding targetable risk factors for SSTIs among PWID (Phillips & Stein, 2010; Takahashi, Merrill, Boyko, & Bradley, 2003). This dearth of research is partially due to the challenges in accurately assessing the prevalence of SSTIs among PWID, owing to the absence of monitoring mechanisms, high rates of self-care (Ciccarone et al., 2001; Smith, Robinowitz, Chaulk, & Johnson, 2014; Pollini et al., 2010), and generally poor access to health services, all of which limit detection within the formal health system (Gordon & Lowy, 2005). Data on skin cleaning and hand washing prior to injection are limited and mixed: some studies have shown negative correlations between these hygiene practices and SSTI rates (Ciccarone et al., 2001; Phillips & Stein, 2010), while others have shown no effect (Binswanger et al., 2000). One well-demonstrated risk factor for SSTIs is soft tissue injection, which includes subcutaneous and intramuscular injection, often referred to collectively as “skin popping” (Binswanger et al., 2000; Ciccarone et al., 2001; Lloyd-Smith, Wood, Zhang, Tyndall, & Montaner, 2008). While soft tissue injection has been associated with increased SSTI risk and venous injection may be protective (Binswanger et al., 2000; Ciccarone et al., 2001), the relationships between injection-site vein loss and soft tissue injection or infection rate has not been investigated (Ciccarone & Harris, 2015; Rhodes, Briggs, Kimber, Jones, & Holloway, 2007). “Injection-site vein loss” refers to the occlusion of a vein previously used for injection, making it inaccessible to further phlebotomy. This is a common occurrence for PWID, but its mechanism and health implications are poorly characterized in the literature. One study did note that overtime PWID use an increasing number of injection sites, and the greater number of sites is correlated with higher rates of complications (Darke et al., 2001).

Beyond modifiable injection behaviours, structural factors, including the characteristics of the substances injected, appear to have important implications for SSTI formation. Injection of cocaine or heroin-cocaine combinations has been shown to be an independent risk factor for SSTIs (Murphy et al., 2001; Phillips & Stein, 2010), while methamphetamine injection is associated with lower rates of SSTIs than both heroin and heroin-cocaine combinations (Ciccarone et al., 2001; Phillips & Stein, 2010). Within the U.S., there is a marked heterogeneity in the geographic distribution of different types of heroin, owing to control of territories and traffic routes by illicit drug networks (Ciccarone, 2009). In recent decades, black tar heroin sourced from Mexico has become the most prevalent variety of heroin in the western United States, while the eastern United States are typically supplied with a more refined powdered heroin, sourced primarily from Colombia (Darke et al., 2001; Passaro, Werner, Mcgee, Mac Kenzie, & Vugia, 1998). Powder heroin is readily water-soluble and more easily divided and prepared for injection. Conversely black tar heroin is a viscous substance that is gummy and non-water-soluble, requiring additional handling and heating to prepare in an injectable solution. A single-site cross sectional study showed no difference in abscess rates based on substance injected (Binswanger et al., 2000); however this study was not designed to detect this difference as it assessed a population PWID who predominantly

used black tar heroin and had uniformly high abscess rates, therefore no conclusion about the effect of black tar heroin on SSTI rates could be reached. A recent study using national hospital admission and Drug Enforcement Administration data found a regional association between increased hospitalization rates for SSTI and regions with predominant black tar heroin compared to regions with powder heroin (Ciccarone et al., 2016). Otherwise, no published studies are available that describe the effect of heroin type in determining SSTI and vein loss rates. Ethnographic evidence suggests that black tar heroin predisposes people to more rapid vein “collapse” and more frequent SSTIs (Bourgeois et al., 2006), but no empirical evidence for this risk factor exists.

Based on the clinical observations of the authors working with PWID in both Boston, MA and Sacramento, CA, a stark difference was noted between the two populations in terms of vein access, abscess rates, and substances injected. We hypothesized that a population of PWID residing on the west coast (Sacramento, CA) would have higher rates of abscesses and vein loss when compared to a population of PWID on the east coast (greater Boston, MA), and that the difference in these outcomes would be associated with behavioural and/or structural risk factors, prominently including type of injection and type of heroin injected.

Methods

Design and participants

Between December 2014 and February 2015, we administered a structured cross-sectional survey to two samples of PWID: one in Sacramento, CA, and one in Boston/Cambridge, MA. Participants were recruited by offering the survey to every client engaging in services at harm reduction facilities during specified survey days. Two facilities were utilized in each location and these accounted for nearly all of the needle exchange services in the two metropolitan areas. Inclusion criterion was self-reported heroin injection in the preceding month. Exclusion criteria were inability to speak English fluently and being less than 18 years of age. A \$5 gift card to a local chain pharmacy was offered to participants for their time and participation.

Ethical approval and research oversight were provided by IRBs of University of California, Davis Health System and Harvard T.H. Chan School of Public Health.

Survey and procedure

Core survey questions were developed to address the major hypothesis. These questions were then revised and expanded based on preliminary qualitative interviews with PWID, feedback from harm reduction staff, and a series of dedicated pilot surveys (not included for analysis) followed by an interview to obtain feedback and elucidate interpretations and implications of phrasing, questions, and answer choices directly from members of the study population. Each of these steps was performed similarly in both study locations. Surveys were administered using a one-on-one interview format to ensure completeness and consistency of data collected. Participant responses were recorded on paper by the enumerator using a multiple-choice format. Scripted explanations were used to assist participants' understanding of questions and identify their preferred answer choices.

The primary outcome was self-report of at least one abscess in the preceding year. Secondary outcomes were self-reported number of injection-site veins lost in preceding six months and soft tissue injection, both of which were hypothesized predictors of abscesses and were included as both outcomes and covariates in separate models in order to better understand their role as putative risk factors. Based on preliminary qualitative interviews and pilot

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