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Heroin-related overdose: The unexplored influences of markets, marketing and source-types in the United States

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Abstract

Heroin overdose, more accurately termed ‘heroin-related overdose’ due to the frequent involvement of other drugs, is the leading cause of mortality among regular heroin users. (Degenhardt et al., 2010) Heroin injectors are at greater risk of hospital admission for heroin-related overdose (HOD) in the eastern United States where Colombian-sourced powder heroin is sold than in the western US where black ‘tar’ heroin predominates. (Unick et al., 2014) This paper examines under-researched influences on HOD, both fatal and non-fatal, using data from a qualitative study of injecting drug users of black tar heroin in San Francisco and powder heroin in Philadelphia Data were collected through in-depth, semi-structured interviews carried out in 2012 that were conducted against a background of longer-term participant-observation, ethnographic studies of drug users and dealers in Philadelphia (2007–12) and of users in San Francisco (1994–2007, 2012). Our findings suggest three types of previously unconsidered influences on overdose risk that arise both from structural socio-economic factors and from the physical properties of the heroin source-types: 1) retail market structure including information flow between users; 2) marketing techniques such as branding, free samples and pricing and 3) differences in the physical characteristics of the two major heroin source forms and how they affect injecting techniques and vascular health. Although chosen for their contrasting source-forms, we found that the two cities have contrasting dominant models of drug retailing: San Francisco respondents tended to buy through private dealers and Philadelphia respondents frequented an open-air street market where heroin is branded and free samples are distributed, although each city included both types of drug

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sales. These market structures and marketing techniques shape the availability of information regarding heroin potency and its dissemination among users who tend to seek out the strongest heroin available on a given day. The physical characteristics of these two source-types, the way they are prepared for injecting and their effects on vein health also differ markedly. The purpose of this paper is to examine some of the unexplored factors that may lead to heroin-related overdose in the United States and to generate hypotheses for further study.

Keywords

USA; Heroin; Heroin overdose; Drug markets; Heroin distribution; Heroin marketing; Heroin purity; Injection drug use

1. Introduction

Overdose is the leading cause of mortality among regular and dependent heroin users (Degenhardt et al., 2010). The vast majority of overdoses, whether fatal or non-fatal, occur after intravenous injection, which in pharmacodynamic terms delivers a drug all at once as a ‘bolus’ and is the most concentrated and efficient way to introduce opiates into the bloodstream (Shafer and V, 1991). Recent national rises in heroin-related overdose, linked to an explosion in prescription opioid use, (Unick et al., 2013; Mars et al., 2014) have made it an urgent public health issue. The purpose of this paper is to examine, using qualitative methods, some of the unexplored factors that may lead to heroin-related overdose, both fatal and non-fatal, in the United States and to generate hypotheses for further study. To this end, we contrast risk environments of heroin consumption and distribution in San Francisco with those of Philadelphia, each city exemplifying one of the two predominant rival source forms of street heroin in the USA. Though this ethnographic tale of two cities is not intended to yield statistical generalizations applicable to all US metropolises, we hope to draw attention to previously overlooked risks for overdose.

Overdose is an idea with a long history (as early as 1690 Locke talks of honey ‘over dose’ (Oxford English Dictionary, 1971)) and one that remains current in the language of both drug users and professionals in the drugs field. While the most clear-cut cases of heroin overdose might be described uncontroversially as heroin-induced respiratory depression with hypoxia (White and Irvine, 1999; Darke and Zador, 1996), more often than not they are significantly more complicated, leading many in the field to point out that ‘heroin overdose’ as a generic description is an inaccurate simplification (Darke and Zador, 1996; Mirakbari, 2004; Zador, 1999). Taken literally to mean a dose in qualitative or quantitative excess of tolerance, the overdose model could be said to posit retrospectively an unverifiable *safe dose threshold* beneath which the adverse event would not have occurred. Thus while telling us little more than that an event is heroin-related, the heroin overdose designation elides the complexities of heroin tolerance, especially as it relates to polydrug use and the context of use. For this reason, we prefer the term ‘heroin-related overdose’ (HOD).

Users who return to heroin after a period of abstinence are at a high risk of overdosing, eg after a period of incarceration or treatment (Darke and Hall, 2003; Binswanger et al., 2007). This makes sense in terms of the tolerance-overdose model since we know that tolerance

rapidly decreases with abstinence (White et al., 1999 a). However in many study samples, the majority of HODs occur in older (male) long-term addicts who otherwise might be expected to have a high tolerance, with fatal cases often revealing relatively low blood morphine concentrations (Darke et al., 2002; Warner-Smith et al., 2002). Medical examinations of addict HOD deaths often reveal blood morphine levels similar to those of addicts who died from other causes such as homicide (Warner-Smith et al., 2002).

Such results hint at the complexity of heroin tolerance. For example, tolerance to the dangerous respiratory effects of heroin does not develop at the same rate as tolerance to its euphoric effects and these different shades of tolerance also decrease at different rates (White and Irvine, 1999). Also, there is a direction of study suggesting a Pavlovian conditioning relationship between context of use and tolerance (Adams et al., 1969; Siegel, 1976; Siegel and MacRae, 1984). In this tradition, Gutierrez-Cebollada et al. combine pharmacological and contextual factors in their study of familiar and unfamiliar settings for heroin injecting, finding that unfamiliar settings are an independent risk factor for overdose (Gutierrez-Cebollada et al., 1994). An explanation for this is that associated environmental cues at the time of opiate administration affect tolerance by prompting opposite attenuating physiological responses in the body (Siegel, 1976). Changing the environment could therefore leave the body less prepared for the dose, ie, less tolerant (Ehrman et al., 1992).

Regarding social contexts more broadly, a growing literature looks at drug-related harm in terms of the ‘structural risk environment’, a phrase coined by Rhodes to locate health risks beyond individual behavior, ranging in scope from the immediate local environment to the larger political economy underlying the structure of social relations (Rhodes, 2009). This useful approach brings back into the discussion risk determinants frequently obscured by an ideology of individual responsibility. For example, high levels of drug law enforcement are linked to increased risk of overdose deaths; under such conditions users witnessing HOD are often disinclined to seek professional assistance, fearing a police encounter (Mirakbari, 2004; Davidson et al., 2002; Bourgois and Schonberg, 2009; Bohnert et al., 2011). It has also been observed that under conditions of especially aggressive policing, addicts are even further marginalized and may ‘pursue drugs with a self-destructive intensity akin to devotion, as if they had nothing left to lose’ (Bourgois and Schonberg, 2009; Bourgois et al., 1997; Koester, 1994). Self-destructive behavior is not necessarily intentionally suicidal but may be favoring short-term benefits despite long-term costs (Baumeister and Scher, 1988).

Another significant variable is that HOD usually involves more than one drug (McGregor et al., 1998). Interactions with sedatives, especially benzodiazepines and alcohol, are well-established and very frequently implicated in HOD deaths since they exacerbate the respiratory depression caused by heroin (White and Irvine, 1999; Darke and Zador, 1996; Gutierrez-Cebollada et al., 1994). Although sedatives are respiratory depressants in their own right, it remains unclear whether their interaction with heroin is additive or synergistic (COMMENTARIES – Comments on White and Irvine’s, 1999). It is clear, however, that combining CNS depressants with heroin significantly increases risk for HOD. As well as sedatives, heroin is often mixed with cocaine and injected as a ‘speedball’ (Morrison et al., 2000). Much less is understood about the pharmacodynamics of this mixture than about that of either drug on its own. Animal studies suggest that the effect of heroin and cocaine in

combination is unique and different from either drug alone, (Garrido et al., 2007) with increased neurotoxicity compared with heroin and cocaine used sequentially (Cunha-Oliveira et al., 2010). Epidemiological findings suggest that speedballs may play a role in heroin overdose risk but this is less well established than that of sedatives (O'Driscoll et al., 2001).

Unintentional polypharmacy can occur when street heroin is adulterated with other drugs, sometimes to increase recovery of the drug or to intensify its effects (Strang et al., 1997). Fentanyl, a synthetic and much more powerful opiate has long been implicated in overdose outbreaks (Wong et al., 2008). A number of drug overdose deaths were attributed to fentanyl from 1979 onwards, usually in combination with at least one other drug (Hibbs et al., 1991). It is difficult to determine from post-mortem data whether fentanyl or its chemical homologs were sold as heroin or as fentanyl although ethnographic data suggests the former (Fernando, 1991). Singer gives account of users intentionally seeking out fentanyl sold as heroin when warned by the police that it had caused overdoses, on the assumption that they could experience a powerful effect but would not overdose themselves (Singer, 2006). Even before fentanyl, Preble and Casey, in their classic 1969 ethnography of hustling for heroin in New York City, mention that 'A report on the street that a heroin user died of an overdose of heroin results in a customer rush on his dealer for the same bag' (Preble and C, 1969). However the intentional seeking of overdose-implicated heroin and its health implications have received little attention elsewhere in the literature.

Characteristics of the US heroin market and differences in the products sold have also been considered in relation to health risks. For a summary, see Ciccarone (2009) (Ciccarone, 2009). The US heroin market is currently divided between Mexican-sourced heroin in the West (predominantly 'black tar' or BTH) and Colombian-sourced powder heroin (PH) in the East. 'Gunpowder' heroin (GPH) has also been appearing on the West Coast in the last few years and takes various forms: a solid which crumbles; chunks and powder or all powder. It is believed to originate from Mexico. Data from the Drug Enforcement Administration's System to Retrieve Information from Drug Evidence (STRIDE) database suggests that black tar heroin has a much larger market share than gunpowder heroin, at least until 2008.

To date certain health risks have been studied in relation to these contrasting source-types and their preparation: HIV prevalence among injecting drug users is much higher in cities with PH than in cities where BTH is endemic; the heat required to dissolve BTH combined with the need to rinse needles of residue between shots probably accounts for the variation in HIV prevalence (Ciccarone and Bourgois, 2003). In addition, BTH appears to induce venous scarring (Rich et al., 1998) and is associated with specific infections: wound botulism, (Passaro et al., 1998; Werner et al., 2000) necrotizing fasciitis, (Kimura et al., 2004) tetanus (Bardenheier et al., 1998) and other skin and soft tissue infections (Binswanger et al., 2000; Ciccarone et al., 2001; Harris and Young, 2002; Murphy et al., 2001). However, with the exception of Unick et al. discussed below, (Unick et al., 2014) differential overdose risks from BTH and PH have received little, if any, attention.

With the exception of Ciccarone and Bourgois (2003), very few publications discuss the differences in preparing BTH and PH for injection. Other publications address the injection

of BTH alone but investigate the risk of viral transmission, rather than overdose, so focus on sharing behaviors, heating, syringe hygiene and cross contamination, rather than dose or speed of injecting eg Koester et al. (2005) and Clatts et al. (1999). Passaro et al. (1998), consider injecting patterns for BTH among patients with botulism and those without, and include estimated self-report survey data on the size of doses injected by each group (Passaro et al., 1998). However, there was no ethnographic observation involved and no questions about number of syringes used.

The structure and location of illicit drug markets have been studied by a number of researchers both in the US and beyond, and found to be influenced by a number of factors: drug source countries; trafficking routes; the introduction of new products; distributors; consumer demand; neighborhood gentrification; policing patterns and available technology (Wendel and Curtis, 2000; Hoffer, 2006; Curtis and Wendel, 2000; Coomber, 2004; May and Hough, 2004; Rosenblum et al., 2013). The contrasting impact of these market structures on users, dealers and local residents and the health risks posed within single market models have been the subject of research (Curtis and Wendel, 2000; Curtis et al., 1995) but there has been minimal comparison of users' risk behaviors and health across these market models or in relation to overdose.

The role of heroin market conditions, specifically price and purity, in overdose have also received some consideration. Studies have linked a fall in heroin prices to increases in emergency department episodes/mentions and increases in mean purity of street samples to rises in fatal HOD (Eck JEaGJ. S, 2000; Caulkins and Padman, 1993; Darke et al., 1999). Interestingly, fluctuation within a wider range of street heroin purity, particularly when around a higher mean purity level, was also found to be an independent predictor of fatal overdose (Darke et al., 1999). The role of purity in explaining overdose requires caution though as even large purity variations have been able to account for only a minority of HOD variance (Darke et al., 1999; Rutenber and Luke, 1984).

Recent quantitative research from the multi-method Heroin Purity and Price Outcomes study (PI: Ciccarone) found contrasting relationships between fatal and non-fatal HOD incidence and price and purity. Using national level data on hospital admissions for HOD and the Drug Enforcement Administration's data on price, purity and heroin markets between 1992 and 2008, Unick et al. found that Colombian-sourced powder heroin was particularly implicated in overdose: each 10% increase in the market share of Colombian-sourced heroin was associated with a 4% (95% CI 2%, 7%) increase in number of overdoses reported in hospitals ($p = 0.001$) *independent of purity*. Further, each \$100 decrease in the price per gram pure of Mexican-sourced heroin (largely BTH with some GPH) resulted in a 3.7% increase in the number of heroin overdoses reported in hospitals while the same price drop in powder heroin resulted in a 5.7% overdose increase (Unick et al., 2014).

The calculation of 'price per gram pure' allows comparison of how much heroin people can buy for a given price allowing for different levels of adulteration and refinement. For instance if one person bought a gram of heroin that was 50% pure for \$20 and someone else bought a gram of heroin that was 25% pure for \$15, the prices per gram pure would be \$40 and \$60 respectively. This method is particularly helpful when comparing different heroin

source-types. Limitations in the precision of the data gathered on price and purity by the Drug Enforcement Administration's System to Retrieve Information from Drug Evidence (STRIDE) dataset are discussed elsewhere (Horowitz, 2001; Rosenblum et al., 2014).

This paper arises from a qualitative study based in San Francisco and Philadelphia. The two cities were chosen for their contrasting heroin source-types. During the research, we found that they also have contrasting dominant models of drug retailing, with the San Francisco respondents tending to buy through private dealers and Philadelphia respondents usually frequenting an open-air street market. This aspect of the paper's data arose incidentally and consequently its findings are exploratory in nature. San Francisco and Philadelphia are not directly comparable as cities: they differ in terms of size, class composition, economic profile, the ethnicities of their populations and the degree of their segregation (Mars et al., 2014; Rosenblum et al., 2013). Inspired by Unick et al.'s startling discovery that PH appears to present a significantly greater risk of overdose than BTH, we approached our qualitative data with a new curiosity, not as epidemiologists holding constant all known factors or attempting to generalize at a national level from two local case studies, but rather as anthropologists generating thought-provoking hypotheses for further study.

2. Methods

This study uses ethnographically embedded qualitative interviews that are then set against a wider picture derived from national epidemiological datasets. Data was collected through in-depth, semi-structured interviews that were carried out against a background of longer-term participant-observation, ethnographic studies of drug users and dealers in Philadelphia (2007–12) and of drug users in San Francisco (1994–2007, 2012). The ethnographic project in Philadelphia and San Francisco (Bourgois and Hart, 2011; Bourgois et al., 2004, 2006) provided a privileged insertion into networks of users and informed the preparation of the interview guide and the recruitment priorities and sites. The ethnographic methodology is discussed in further detail in the book *Righteous Dopefiend* (Bourgois and Schonberg, 2009).

For the interviews a targeted sampling strategy was used, largely informed by the ethnographic work, with purposive recruitment and some snowballing, sampling techniques often used to access hidden populations (Barendregt et al., 2005). To be eligible for the study interviewees had to be at least 18 years old and self-reported current heroin injectors living in either San Francisco or Philadelphia. Interviewees were recruited through targeting sampling strategies (Watters and Biernacki, 1989); some snowball sampling helped recruit for diversity eg more women or youth participants. Particular effort was made to recruit women given that they are less prevalent among this population and to balance sampling of longer-term users (more than 3 years' use) with more recent users (up to 3 years' use). The goal was to obtain a sample of the hidden population of typical street-based users in both cities.

Interviewees were recruited face-to-face in areas of known open-air drug markets in both cities and through needle exchanges. To compensate for their time respondents were offered

small cash sums of \$15–20 per interview or for taking the researchers on a ‘tour’ of the local heroin scene. All participants were interviewed once in 2012.

Consistent with participant-observation techniques, the semi-structured interviews were conducted by the ethnographers (FM, GK and PB) and PI (DC) at the moment of recruitment in the natural environment of the users. Interviews, for example, were conducted near syringe exchanges, in shooting galleries, parks, on corners where users purchase drugs, in cars on the way to and from purchasing drugs, and in transiently-occupied apartments. This anthropologically-informed qualitative strategy reduced social desirability bias. Interviews usually lasted 1–1.5 h each. Although the interviews were open-ended, an interview guide was used that included questions on the respondents’ involvement in drug use, their initiation into opiates and injecting, experience of obtaining drugs, methods of administration, history of drug-related health events including overdose as well as contact with clinical services and criminal justice. At the end of the interviews participants were asked if they wanted information on treatment options and needle exchange. All the interviews were audio recorded and transcribed verbatim. Transcriptions were verified against the audio recordings for accuracy.

Twenty-two current heroin injectors were interviewed in Philadelphia and 19 in San Francisco. NVivo software was used to assist with data organization and retrieval (QI, 2012). Hypotheses generated from the ethnography were tested in the interviews and were revised iteratively as the interviews and coding progressed. The first and second authors (SGM and JF) carried out all of the coding which was reviewed by the senior author (DC). ‘Open coding’, described by Strauss and Corbin, was carried out to identify concepts and categories and systematically apply them throughout the transcripts (Strauss and Corbin, 1990). The study protocol was approved by the University of San Francisco California and the University of Pennsylvania IRBs and the data (and its collection) are protected by two Federal Certificates of Confidentiality issued by NIH/NIDA.

3. Results

Our findings suggest previously unconsidered influences on overdose risk that arise from structural factors and the physical properties of the heroin source-types. These fall into three categories: 1) retail market structure including the availability of product information to users; 2) marketing techniques including branding, free samples and pricing and 3) the two major heroin source-forms, the ways in which they are prepared for injection and their effects on vein health. First, however, we consider the characteristics of the interviewees.

Among the Philadelphia sample, 8 were women and 14 were men. Sixteen had used for more than 3 years and 6 for 3 years or less. Most were unemployed and either homeless or insecurely housed. Users like Jack commonly participated in the peripheral economy around the main drug market selling syringes or showing customers from outside the neighborhood where to buy high quality heroin. Born in Philadelphia, Jack is 25 year old and lives with his parents, apart from his young daughter, after losing his job and home to his heroin habit. Injecting in abandoned houses or by the disused train tracks, he has so far overdosed three times. Al, a haggard-looking man in his early 50s, also born in the city, is unemployed and

has spent some time homeless. He shares heroin purchases and a room with man who is working and able to pay their rent. Using heroin for 18 years, he supports his heroin habit by showing customers to corners as they arrive from the rail transit stop. He has never overdosed to the point of requiring hospitalization.

In the San Francisco sample, 12 were women and 7 were men, among whom 15 had used for more than 3 years and 4 for 3 years or less. Many of the older users lived in Single Room Occupancy (SRO) hotels located in the downtown area while some of the younger ones lived in the city's large park. Several, like 26 year old Finn, supported themselves by selling marijuana to tourists. In an attempt to get away from heroin in his hometown outside California, he came to the city and has lived homeless ever since. He was able to resist the poor quality heroin on offer in the open street markets until meeting a high potency supplier and picked up his habit once more. Fifty-nine year old Darlene was born in San Francisco and lives in a downtown SRO. Using heroin since she was 14, she displays an air of confidence and a ready sense of humor. She has spent many years as a sex worker but her present source of income is undisclosed. She has overdosed only once in her early days of heroin injecting.

Across both cities some of the interviewees had completed high school but few had any college education. Sources of income common to both places included public sector benefits, construction, panhandling, shoplifting and sex work. The Philadelphia injectors had almost all grown up in and around that city and begun their drug using careers there while most (14 out of 19) of the San Francisco users were migrants from around the country. Interviewees' accounts of overdose or 'falling out' covered a wide range of experiences including unconsciousness requiring hospitalization and/or naloxone; episodes where CPR breathing by another person was needed; instances when they had recovered with lay treatments such as ice, cold water or slapping or in which recovery was unassisted and spontaneous.

3.1. Market structures

Sales of heroin in the two cities represent different retail models. Philadelphia's heroin sales are largely conducted in 'open' markets outside particular city locales. The term 'open' here refers to its location outside and its unrestricted access to customers. However, 'open' does not suggest that its presence is tolerated by law enforcement and dealers do attempt to conceal their activity. It is a competitive environment with dealers working rival 'corners', calling out their brand names to potential customers. Crowds of people visit the market daily, with lines sometimes forming at corners selling the most sought after heroin brands of the moment, only to be hurried away by dealers keen to avoid police attention. Syringe sellers wait nearby, offering to find the best quality heroin for out-of-town customers in return for a cash tip or a share of the purchase. Fuller ethnographies of the largest of these markets can be found in Mars et al., 2014 and Rosenblum et al., 2014 (Mars et al., 2014; Rosenblum et al., 2013).

Walking through San Francisco's traditional drug dealing areas, the ethnographers were struck by the new buildings, conversions of existing housing into higher rent properties and the whiter profile of the population compared with earlier visits. Pills of many varied opioids

were much more freely available on the streets than heroin. The regular San Francisco users interviewed typically favored private dealers in a 'closed' market model, resorting to the open market only in desperation; prices set by private dealers reputedly vary according to purity. Private dealers are spread across the city, some living with and serving the downtown SRO population, others in quieter residential neighborhoods. This more protected but less accessible market encourages users of BTH to buy larger volumes at a time than in Philadelphia, sometimes pooling their money for the purpose. These two models create different opportunities for consumers to share information on the strength or quality of heroin available on a given day and to act upon that knowledge, influencing overdose risk behavior.

Philadelphia's largest open-air street market where the interviewees buy most of their heroin and in which many were initially recruited to the study is located in an impoverished inner city neighborhood with a large Puerto Rican population. The physical environment is dominated by abandoned factories that are often used for drug transactions and drug use as well as sex work. The high levels of poverty and drug use and the availability of extensive disused housing stock have led to the development of an enormous density of unlicensed, unregulated recovery houses close to the drug market (Fairbanks, 2009). Fairbanks, in his detailed ethnography of the phenomenon describes how the subsistence living experienced by people in the recovery houses and the poor prospects offered in a deregulated low-wage service sector often led them to relapse (Fairbanks, 2009).

Philadelphia's main drug market has a reputation for selling the cheapest, most plentiful and highest quality heroin in the city. Some users reported buying heroin by cell phone in other parts of the city at higher cost, which required an introduction by a third party. Smaller scale open street dealing existed in other parts of the city too but ethnic segregation played a part in deterring the respondents, many of whom were white, from buying there (for further discussion see Rosenblum et al., 2013). Most lacked access to private vehicles and considered this prohibitive to buying heroin in other neighborhoods, although several were quite mobile. One 51 year old female using for approximately 25 years in Philadelphia explained her choice, typical of many:

Q: Did you cop [buy] anywhere else in the city?

A: *No.*

Q: Just in [name of neighborhood with open drug market]?

A: *Yeah [same neighborhood].*

Q: Why?

A: *Because everybody said that's where the good shit was.*

In San Francisco, smaller open-air markets still exist downtown but have shrunk under the twin effects of intensive gentrification and the attendant increase in policing. However, most experienced injecting drug users describe the quality of BTH on general sale there as very poor. This 26 year old man who had been using for approximately three years on and off talked about how he bought heroin:

Q: Can you cop heroin off the street?

A: You can but it's fuckin' garbage. Like granted all the connections that I have I met them on the street. But as soon as I realized that they were the ones that had the good shit I fuckin' went and got their number and now they don't deal on the street anymore because they have enough clientele that calls them up on a regular basis that they don't have to go and you know hustle in the street no more.

Experienced San Francisco users generally had established connections with more reliable sources, whether downtown or in residential parts of the city, resorting to the open air markets only when their usual contacts could not be reached. This 25 year old man described the situation:

Q: So how do you choose where to buy your heroin every day?

A: Whoever answers the phone really but quality has a lot to do with it. If I can't get a hold of anybody with anything good I'll go to the [open street market] and get shitty dope just to get well [relieve withdrawal symptoms].

These contrasting market structures grow not only from the drug supplies that sustain them but also property values, policing patterns, racial segregation (Rosenblum et al., 2013) and other factors yet to be understood. Philadelphia's open street market and San Francisco's private dealing shape the relationships between buyers and sellers and enable the use of particular marketing techniques which in turn, influence the flow of information and ultimately overdose risk.

3.2. Marketing techniques

In Philadelphia, PH is sold in tiny clear plastic bags inside which nestle small, usually blue wax paper bags ink-stamped with often playful or darkly humorous brand names such as 'Hellfire', 'Cartel' or 'Poison'. Each brand is sold at a different location or 'corner', competing for customer loyalty on the reputation of strength. The price remains consistent across brands at \$10 a bag. In Philadelphia's highly competitive market, some brand names endure while others disappear, soon to be replaced.

Brands in the legitimate economy are often used to create the impression of a consistent product, and likewise in heroin sales they can mask dilution of a product that has gained a strong reputation. This may have been achieved through the distribution of free samples, the purpose of which is not to recruit new users, a long held urban myth [as in a lyric from Tom Lehrer's satirical song 'The Old Dope Peddler': "He gives the kids free samples/because he knows full well/that today's young innocent faces/will be tomorrow's clientele" (Lehrer, 1953)], but to entice savvy users to try the brand. After distribution of these free samples, users often describe heroin brands as 'falling off': brands reputed to have high potency would be diluted to the point at which they were no longer attractive to injectors, although users report some brands remaining consistent. This 50 year old man who had been injecting heroin for 30 years on and off explained:

Ninety percent of the dope out in the street's crap. If you ask around and you network you'll find out what's out what's hot. Now, what might be good one day

doesn't stay good; there's sort of like a cycle. They'll come out with a strong product, it'll be strong for a week, maybe two, maybe longer but not much longer and then it'll fall off. So they have all the customers coming and they cut back and make more money but they're selling junk.

In San Francisco BTH is packaged in a variety of ways, including foil wrapping, plastic bags and previously balloons. Reports of being robbed or sold fake drugs in the open street market were frequent. Without brands, with very rare free samples and the higher quality heroin apparently limited to known dealers rather than the open streets, regular San Francisco heroin users rely more on their own experience of trusted contacts for quality than moment-to-moment networking and word-of-mouth. This 44 year old woman using about 5 years gave her account:

Q: Okay. And how do you choose where to buy the heroin every day?

A: *[Downtown neighborhood], the same place.*

Q: You always go to the same dealer?

A: *Yeah, the same person I would call him.*

Q: How long have you been going there?

A: *Four to five years.*

Q: Oh yeah?

A: *Yeah, same person.*

Q: Huh. So he's good, he's consistent?

A: *Yeah, yeah he's consistent.*

Q: Is he standing in a corner or do you have to call him?

A: *No I call him and he comes outside.*

3.2.1. Consumer knowledge and information dissemination—Between the Philadelphia dealers, with their incentive to increase profit by including less heroin and more adulterants, and consumers in their desire to find the highest potency heroin and therefore greatest value for money, a game ensues. Users employ a range of information-gathering strategies in pursuit of their goal. This 25 year old man using for 8–9 years explained:

Q: So let's say you find a good brand you know let's say –

A: *Obamacare's good.*

Q: Obamacare's pretty good right now. How many days will you stay brand loyal before you –?

A: *Until it's – till that day when it's yeah or if I hear it's bad. If people say it 'fell off', that's the term they use.*

Q1: It fell off? So you won't waste your money?

A: *No way. I always ask, I always no matter what. Even if I'm down here I'll ask dudes I know down there what the best shit is, what they did today you know what's good, what's not good.*

Q: So it's like reading the newspaper, you're just checking the news every day?

A: *Yeah pretty much. Yeah.*

Q: Every day?

A: *Yeah.*

Q: So you're not very brand loyal?

A: *No, whatever's the best shit I get.*

Although general media sources such as newspapers are mentioned as information sources, the Philadelphia users interviewed largely relied on face-to-face communications and experience. Among ordinary users, cell phone ownership was unusual, although a street suboxone seller who also used heroin received the word by text message, as this fieldnote recounts:

*... a few days ago there was a slew of overdoses that made the newspapers in Camden and Philadelphia that were apparently caused by the adulteration of heroin, brand name Hellfire, with fentanyl. In fact, [***] eagerly shows us his cell phone where he has received a text message from a friend advising him to "go check out Hellfire because people have been overdosing" from it. As many dopefiends and sellers have done in the past, [***] finds it extraordinary that people crowd to the spots to purchase the heroin that other people are overdosing from. And he himself, of course, would do the same thing.*

Similarly a 38 year old Philadelphia man using for 18 years described reports of overdoses as 'like an advertisement to us'.

In San Francisco, the dominance of private sales and the scarcity of open street markets of reliable quality and safety create a social geography of dealing and information dissemination that is quite different to Philadelphia's. The highly intensive policing and lack of unused space such as abandoned buildings or disused railway tracks characteristic of the city's valuable real estate make it harder for users to congregate near San Francisco's drug markets. Cell phone ownership among these respondents was more common, allowing them to contact private dealers who are dispersed through the city, some selling in multiple locations, and are not fixed to a 'corner', further limiting opportunities for information sharing.

3.2.2. The pursuit of overdose—The unsettling idea that cases of overdose are an 'advertisement' for the quality of heroin was repeated frequently in both San Francisco and Philadelphia. A significant difference between the two cities, however, is the structural ease with which Philadelphia users in the open market can locate these overdose-implicated heroin sources. A female heroin injector in Philadelphia aged 38 using heroin for 18 years described this:

I: So how did you choose where to buy heroin every day? How would you decide to go ...

S: Well, it's really easy here. Usually, early in the morning, between five and seven, you get a sample. [...] But usually when they say – this is gonna sound really sick – “Dude just fell out [overdosed] on Maggie’s dope.” “Where’s that at?” You know what I mean? Usually, if they’re close to death, that’s how I would decide.

The competitive nature of Philadelphia’s market with brands and free samples, its location out on the street and the presence of users nearby who could be asked or observed after trying the heroin themselves all contribute to this information sharing about recent overdoses and their implicated brands.

In San Francisco, where experienced users typically rely on a small number of trusted dealers to whom access is limited by cell phone or pager, heroin selection is restricted by what those dealers have on offer on a particular day. This 49 year old San Francisco woman described her experience with heroin from a private dealer:

I’m laying on the bathroom floor, the cat is licking my face and I was like – and they’re saying, “Wow I want some of that.” I could hear people say that! Like, oh my God, you people are sick you know! And a lot of people did it, we all did it. There was only a little bit of it but we had a good time.

Such closed market heroin transactions are conducted privately by arrangement, effectively isolating larger numbers of users from each other. A narrower range of heroin products is on offer. The San Francisco users eager to buy more of the particular heroin in the quotation above would need an introduction to the dealer who was its source, which might or might not be forthcoming from the user. Alternatively they might pool money for a known customer to make the purchase but this takes time during which the supply could change. Customers in open markets have more information on which to calculate their dose and so may be more aware of the strength of heroin they are about to use while customers in the closed markets are more reliant on the word of their dealer regarding the product’s strength.

Pricing strategies also may influence overdose risk. The constant price of heroin at \$10 a bag in the Philadelphia street market means that the brands compete on potency, where greater potency equates with better value for money. Not only is purity higher on average than in San Francisco but users with smaller disposable incomes are able to afford the same quality of heroin as wealthier users so price is not a factor in their choice. In San Francisco, prices reportedly reflect potency, thus limiting poorer users’ access to higher potency heroin. Some gave accounts of buying heroin in nearby Oakland where the quality (ie potency) was reputedly higher but this usually depended on access to a private vehicle, also excluding the poorest interviewees. The price-sensitive San Francisco market may therefore offer some protection from overdose to users who are unable to afford the highest potency heroin.

The pursuit of overdose-implicated heroin raises the question of suicidal intent. Although one user mentioned a clear suicide attempt using heroin and benzodiazepines, most explained that, despite seeking out heroin with a reputation for causing overdose, they did not want to die. As discussed above, tolerance to the different effects of opiates develops at

varying rates so that tolerance to the euphoric effects of heroin precedes tolerance to its respiratory depressive effects. This means that as his or her tolerance develops, the user will need a larger amount of heroin to feel the euphoria of their early use while not necessarily being equally tolerant to the effects of respiratory depression. This Philadelphia male aged 25 using 8–9 years, alluded to this narrow margin between euphoria and overdose which encouraged him to take considerable risks. He stated “I’ve got a daughter, I’m not really trying to die” but described why he pursued such heroin.

Q: So what is it about overdosing that makes that attractive? Is it being on the edge or –?

A: *It means it’s good. I mean it’s like the feeling you get I guess it’s like before you like fall out, like I’ve overdosed 3 times and [smiles and laughs] before you fall out it’s like you know a really good feeling. It’s like the best feeling.*

Thus in Philadelphia’s street market the pursuit of overdose-implicated brands through word-of-mouth information exchange between users results from open competition between dealers on reputed potency; disused space in which to congregate; and a system of pricing based on volume, not quality, that makes more potent heroin better value for money for users. In San Francisco, location and price are not constant so are also considerations alongside potency in users’ buying decisions. San Francisco users also expressed a desire for heroin involved in overdose but private dealing and the absence of brands makes tracing any particular batch of heroin products slower and more difficult.

3.3. Physical differences between black tar and powder heroin

PH and BTH are the products of different manufacturing, refinement and distribution processes, requiring of the user different minimum techniques of preparation for injection. These may play a role in the differential overdose risk independent of purity. While PH requires no more than cold water to dissolve, BTH, which often comes as a solid lump, must be heated first, being described as ‘difficult to work with’ (28 year old male using heroin for 1 year in San Francisco). The ethnographers observed, and users have confirmed, that the viscous BTH requires a larger quantity of water to go into solution, is difficult to break up, sticky and can easily collect dust and other contaminants. While the ethnographers observed that 30–40 units of water were used for a single shot of PH in Philadelphia, 50–90 units (1 unit = 10 μ L) were reported for BTH in San Francisco, at times filling 2 syringes for a single dose. A 21 year old woman using for a year in San Francisco (here denoted as ‘A1’; her boyfriend is ‘A’) explained:

Q: How many units do you usually have in a single shot?

A1: It depends on how much water I use like for to cook it. So like I’ll do like a 2 shot and I’ll put 60 units of water in there to cook and sometimes I lose some because the heroin absorbs the water so I’ll come back with like –

A: *It just cooks out the water.*

A1: *It just cooks out the water, whatever. And so I’ll come back with like 50 unit shot but like I’ve had as much as like an 80 unit shot, a 90 unit shot but it’s the same amount of heroin, you know.*

This dilution of the dose may offer BTH injectors some protection from overdose, slowing its injection so that the user's response to the heroin's strength may become apparent before the full dose is administered, whether injecting alone or enabling one user to warn others when injecting together. PH can be injected faster and more easily, reducing any delay in the onset of its effect.

Among the heroin injectors interviewed, loss of access to veins was often reported as a problem. In Philadelphia, serious vein loss was observed among heroin users who also injected cocaine and to a much lesser extent among injectors of PH alone. Wounds and scars witnessed by the ethnographers among BTH injectors in San Francisco were dramatically more severe than any they had seen on the East Coast among either PH or PH and cocaine users. This corresponded with users' self-reports. Injectors who had traveled and experienced both PH and BTH reported much more vein damage from BTH. This 25 year old man interviewed in San Francisco had been using heroin for approximately 10 years, starting on the East Coast with PH:

... I injected in the same place for like 4 years before I blew it out ... So like up until I started doing tar I shot in the same place and as soon as I started doing tar I started losing veins like flies, like dropping like flies.

The extreme venous scarring experienced on the West Coast among BTH injectors could slow or impede the delivery of the heroin bolus, potentially reducing the overdose risk. BTH is also dark in solution making it difficult for injectors to 'register' where blood is observed flowing back in the syringe barrel, a technique used to determine that the needle is inside a vein. This impedes injection efficiency.

Particular heroin source-types may also lend themselves to certain marketing techniques. By its powdery nature, Colombiansourced heroin may be especially suited to the manipulations of branding since it is quicker and easier to adulterate than BTH. According to the users' accounts (above), branding seems to produce frequent undulations in heroin purity and this may be another contributing factor to overdose risk as injectors' tolerance fluctuates with these purity variations. The frustrations of BTH for injectors in its preparation and physical effects conversely seem to provide some protection from overdose, while PH's ease of use and adulteration may increase HOD risk.

3.4. Limitations

In common with other qualitative research using relatively small, non-random samples, it is unknown how generalizable are our findings. Although we know that the two heroin source types are widely distributed on their respective sides of the Mississippi River, observed practices such as using more than one syringe to administer a single dose of BTH may be local or widespread. The move to the use of telecommunications to distribute heroin through private dealers is well established but it is unclear how typical Philadelphia's street market is of others around the country; a broader sample of cities could tell us more. Although our goal was to recruit a 'typical street based' user sample in both cities, our sampling was not random and bias may have been introduced. Respondent-Driven Sampling aims to yield a representative sample from small samples and while validated for some studies and

populations may have limitations in reaching the most stigmatized and hidden populations (Rudolph et al., 2011; Burt et al., 2010). Sampling biases could also result from the targeted recruitment of the most socially excluded population of homeless or precariously housed heroin injectors as their methods of acquiring information about heroin strength may differ from those with more resources. The study was designed to examine the use and purchase of black tar and powder heroin, which was pursued to the point of saturation, but the data about drug market models emerged fortuitously and was analyzed retrospectively after data collection was complete. The former findings are therefore more robust while the latter would benefit from further study. However, all reported findings were triangulated across multiple data sources.

4. Discussion

The pursuit of overdose-implicated heroin arises from both physiological responses to repeated use of the drug and structural features of its sale and marketing. The margin between euphoric and fatal doses of heroin narrows as tolerance develops to its euphoric effects faster than its respiratory depressive effects, making the search for euphoria increasingly perilous.

‘Open’ and ‘closed’ markets shape the availability and dissemination of information between drug users and dealers regarding the strongest product available on a given day. The pursuit of this knowledge is particularly important in markets, like Philadelphia, where the price remains largely constant since stronger heroin represents better value for money. Markets like San Francisco’s, where price reportedly corresponds more closely to purity, could provide some protection to poorer users from overdose.

The San Francisco users interviewed distrusted the quality and reliability of their open street market, leading them to favor private dealers. Without Philadelphia’s competition between multiple corners, with no free samples or brands, San Francisco users buy what their more trusted private dealers are selling. Any pursuit of overdose-implicated heroin would be impeded by this ‘closed’ market, which isolates users from each other, insulates dealers from users who are not their customers and makes any particular heroin product harder to trace. It also may be that private BTH dealers are motivated to protect their regular clients from overdose with information and warnings about strength.

As noted above, heroin overdoses are often attributed to polydrug use. When considering the influence of market conditions such as price and purity on heroin overdose the usual focus has understandably been on heroin itself but the proximity of the sale of other drugs which increase heroin overdose risk and fluctuations in their supply may be important factors in the production of the geography of heroin-related overdose and deserves further study. The price per pure gram of heroin may also predict the likelihood of polydrug use. Unick et al. found that falls in the price per pure gram of heroin increased overdose risk (Unick et al., 2014). It may be that such real falls in heroin prices encourage users to supplement or counterbalance its effect with other drugs such as sedatives or stimulants.

Unintentional polydrug use also appears in the presence of fentanyl-laced heroin. It is possible that the presence of fentanyl in powder heroin explains the increased overdose risk

presented by powder heroin found in the paper by Unick et al. as it would increase potency without increasing purity on the STRIDE measures. However, without systematic data to study, we can only speculate about the role of fentanyl in these events. The question of whether access to naloxone is better in BTH cities than PH has also been raised but not thoroughly researched. Although access to naloxone appears to be strong in San Francisco, a BTH dominant city, provision is also robust in Chicago and New York, both PH dominant cities, for example. We do not believe naloxone variation explains the quantitative finding on powder heroin risks (see Unick et al., 2014).

The differential effects of BTH and PH on injectors' veins and the quantities of water required by these two variants may change the pharmacodynamics of the injected heroin bolus, slowing down or speeding up its delivery and potentially its overdose risk. Scarred veins, particularly notable among the San Francisco users, and the larger quantity of water sometimes split between syringes, may transport injected heroin less efficiently.

Unlike solid, sticky BTH, the powdery quality of East Coast heroin makes it particularly amenable to rapid adulteration, lending itself to the vicissitudes of quality that branding attempts to mask. Frequent undulations in heroin quality due to competition and profiteering on brand reputation could be responsible for fluctuating tolerance making its users more vulnerable to overdose. The unusually high availability of detoxification opportunities offered to Philadelphia's drug users through its many recovery houses located close to the temptation of 24 hour drug sales may also pose particular risk of low tolerance and relapse (Fairbanks, 2009). It is possible that San Francisco users who are driven to buy poor quality heroin in the open market when they cannot reach their regular dealers are exposed to similar undulations of purity and tolerance. These questions might be usefully studied in the future.

There are implications for intervention based on our findings. Tailored interventions need to be developed for each urban setting based on good social science and local needs (Messac et al., 2013). Given the structural risks posed by powder heroin and associated market dynamics, structural interventions are a necessary counterbalance. Expanded distribution of peer-distributed naloxone is a clear evidence based suggestion (Doe-Simkins et al., 2009) albeit one that needs more penetrance nationally (Wheeler et al., 2012c). Harm Reduction, both a philosophy and a movement born of indigenous need, (Ciccarone, 2012) would advocate for involvement of folks 'close to the ground', ie users and care providers, to create local strategies to reduce harm. 'Top down' approaches favored by public health may backfire with their well-intentioned posters warning locals of high potency heroin. Generally accepted harm reduction strategies for dealing with waves of high potency heroin include not injecting alone; having naloxone nearby; using a 'taster' shot or simply dividing doses into higher dilutions.

This study draws its evidence from two cities. Although they exemplify the two major heroin source-types, it is unclear the extent to which their market structures are typical of other cities selling these heroin products and the extent to which these findings are generalizable. Preliminary research suggests that branding is found only on the East Coast where PH is sold. Further research to determine the types of markets and marketing

techniques found in major urban areas around the country is planned in our current project Heroin In Transition.

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