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Explaining the Geographical Variation of HIV Among Injection Drug Users in the United States

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Abstract

Distinct physical and chemical types of street heroin exist worldwide, but their impact on behavior and disease acquisition is not well understood or documented. This article presents a hypothesis to explain the unequal diffusion of HIV among injection drug users in the United States by examining the distribution and use of one type of heroin—"Mexican black tar." Drawing on ethnographic, clinical, epidemiological, and laboratory data, we suggest that the chemical properties of black tar heroin promote the following safer injection practices: (1) the rinsing of syringes with water to prevent clogging; (2) the heating of cookers to promote dissolution; and (3) a rapid transition from venous injection to subcutaneous or intramuscular injections.

Keywords

Black tar heroin; Geography variation; HIV; Risk factors; Heroin type

Most of the literature regarding illicit heroin use regards the substance as uniform with few variations in either chemistry or in patterns of administration by injection drug users (IDUs). Phenotypical and chemical variation in street heroin types may, however, have had a substantial role in shaping the epidemic among IDUs in the United States. Using multiple primary and secondary sources of data we have developed a hypothesis, that use of Mexican-derived heroin, commonly referred to as "black tar" heroin (BTH), may have retarded the spread of HIV in those U.S. states where it predominates.

Geographical Risk of HIV Infection

In the United States, multi-site epidemiological studies of IDUs consistently identify location in a high-seroprevalence city (i.e., large metropolitan cities in the northeastern United States) as an independent risk factor for HIV (Friedman et al., 1995; Kral et al., 1998; Montoya and Atkinson, 1996). Geographical location, consequently, has emerged as a proxy variable for behavioral, environmental, historical, and/or structural factors that still need to be explained. The importance of geography as a risk for HIV among IDUs is more compelling given the relatively even geographical pattern of diffusion of HIV among men who have sex with men (MSM) (Holmberg, 1996). In the early 1990s in New York City, for example, the estimated HIV prevalence among MSM was 29.2% while that for IDUs was 41% (Holmberg, 1996). In contrast, in a comparable metropolitan area, Los Angeles, the MSM HIV prevalence was 22.6%

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while the IDU HIV prevalence was only 3.8%. In the center of the country in Denver the HIV prevalence among MSM remained high at 25%, while the IDU population was only 3.8% HIV positive.

Initially, the HIV epidemic in the United States was expected to radiate out of its geographical epicenters, the largest being New York City (Des Jarlais et al., 1989). Public health researchers were concerned that the MSM-driven epidemic would crossover into the IDU population in the South, West, and Midwest as had already happened in the Northeast by the mid 1980s (Hahn et al., 1989; Lange et al., 1988). By the early 1990s, this crossover of HIV had taken place in the South, but it never occurred in epidemic proportions west of the Mississippi (Holmberg, 1996). Researchers have offered several hypotheses to explain the failure of HIV to spread in epidemic proportions to IDUs in the western United States. These have included: (1) differential interfaces between the MSM and IDU communities across cities (Bourgois, 1998b; Chaisson et al., 1987); (2) the absence of the phenomenon of “shooting galleries” on the West Coast early in the epidemic (Watters, 1989); (3) differential public health responses and law enforcement practices affecting overall availability of sterile injection equipment (Bourgois, 1998b; Des Jarlais et al., 1995; Friedman et al., 2001; Koester, 1994); and (4) different drugs of choice among street users, most notably cocaine (Bourgois and Bruneau, 2000; Chaisson et al., 1989). None of these possible explanations, however, claims to be definitive nor has satisfactory empirical evidence for them been published.

Heroin Type and HIV Prevalence

We obtained unpublished U.S. Drug Enforcement Agency (DEA) data on the types of heroin predominating in the 20 cities monitored by the Domestic Monitoring Program (DMP) from 1990–1993 (Drug Enforcement Agency, 1991–1993) and compared it with published HIV seroprevalence estimates for both IDU and MSM populations (Holmberg, 1996) (Table 1).[a] The majority of street heroin available in most cities west of the Mississippi River is “black tar heroin” (BTH): a dark, tacky resinous substance of Mexican origin. In contrast, heroin in East Coast cities, imported predominately from South Asia and South America, consists primarily of a white or light brown powder (Drug Enforcement Agency, 1991–1993).[b] Few cities have both BTH and powder heroin simultaneously presumably because of the logistics of smuggling and distribution networks (see Fig. 1).

Overall, across North America, IDU populations in cities with BTH had lower HIV prevalence than IDUs in cities with powder heroin. Two proximate cities, Vancouver and Seattle offer a dramatic contrast. Seattle, where only BTH was available had an HIV prevalence of 2.4%, whereas Vancouver, 225 kilometers away, where only powder heroin was available (reportedly from Southeast Asia) had an HIV prevalence of 23.2%.[c] Cities where the heroin was of mixed origin, such as New Orleans and St. Louis, had low to mid-range HIV prevalence. San Francisco’s IDU HIV prevalence of 14.3%, the highest of any U.S. city with BTH, may be due to the fact that it was the West Coast epicenter for HIV in the MSM population and there may be an overlap in the sampling of IDU and MSM populations (Holmberg, 1996; see also Watters,

[a]In addition to the HIV seroprevalence estimates presented by Holmberg (1996) we also examined CDC seroprevalence estimates for IDUs (Centers for Disease Control and Prevention, 1994). These estimates provide an even stronger ecological association between heroin type and HIV (see also Hahn et al., 1989). We present the Holmberg estimates, however, because they are not limited to intreatment IDUs. For the DEA data on drug type we selected the years 1990 through 1993 to coincide with the years of information reviewed by Holmberg and because DEA data prior to 1990 is limited.

[b]The DEA Special Testing Research Laboratory analyses heroin obtained through undercover, retail-level purchases and broad-scale enforcement seizures. It identifies a unique chemical “signature” determining country of origin (Hast, 2001). Eighty percent of the heroin identified as of Mexican origin is black tar heroin (Drug Enforcement Agency, 2000). Powder heroin in the eastern U.S. is predominately from South America with diminishing amounts imported from South Asia.

1989). In addition, a significant cocaine injection epidemic was documented in San Francisco in the late 1980s (Chaisson et al., 1989).

Significantly, in the mid-to-late 1980s, San Francisco already had the highest MSM HIV seroprevalence in the US (40.7%), yet the prevalence among IDUs never approached those of comparable East Coast cities in later years; it has been stable around 10%–14% through 1999 (Kral et al., 2001). Longitudinal data (1993–1997) from the Centers for Disease Control show overall declining HIV prevalence for IDUs entering drug treatment across the United States. Still, however, the pattern continues with Western cities having markedly lower HIV prevalence than Eastern cities (Centers for Disease Control and Prevention, 2001).

We posit that the lower HIV prevalence among Midwest and Western IDUs can be largely explained by the fact that the chemical properties of BTH oblige IDUs to modify their drug-using behavior. A triangulation of evidence from epidemiological as well as clinical and ethnographical observations suggests that at least three mechanisms in concert potentially reduce HIV survival and transmission. Firstly, and probably most importantly, BTH obliges IDUs to thoroughly rinse their syringes following each injection in order to prevent the syringe mechanism from becoming obstructed. This has the unintended consequence of reducing residual blood volume and its potential HIV load. Secondly, heating is necessary to enhance drug solubility. This reduces the probability of transmitting HIV indirectly through paraphernalia (e.g., cookers) sharing (Clatts et al., 1999). Epidemiological self-report statistics in association with serotesting suggest that indirect sharing is not a primary means of transmitting HIV in the United States, although it may transmit hepatitis C (HCV) (Bourgois, 2002; Hagan et al., 2001). Thirdly, BTH promotes rapid venous sclerosis among injectors, leading them to seek alternative routes of injection (subcutaneous and intramuscular), which may transmit less blood-borne virus (Rich et al., 1998).

Ethnographic Data

Over the past decade we have engaged in participant-observation research among street-based heroin injectors in San Francisco and New York, supplemented by fieldwork visits to Montreal and Vancouver (Bourgois, 1998a; Bourgois, 1998b). Direct observation of street-based IDUs in their natural environments (i.e., shooting encampments, apartments, public restrooms, and vacant buildings, etc.) has allowed us to develop an understanding of the dynamics of risky practices with greater precision and fuller context than is possible through a self-report epidemiological survey.

We have observed that San Francisco heroin injectors predominately inject BTH. They frequently complain that their syringes become obstructed even after a single use. The BTH leaves a residue inside needles and syringe barrels, consequently, BTH injectors in San Francisco vigorously flush water through their equipment to keep the syringe mechanism and needle from clogging. We have observed that they usually flush their syringe at least once before injection to verify function and also after injection to preserve function. Rinsing, or flushing, thus has a dual effect: a direct one, to keep syringe mechanisms working and an indirect one, the reduction of residual blood volume in the syringe. By dramatically reducing blood volume, rinsing should reduce viral load in an HIV-contaminated syringe even if the rinse water used is not sterile, since there is lower viral load in residual rinse water than residual whole blood. This, consequently, diminishes the likelihood of transmitting HIV if an HIV-contaminated syringe is reused. Population-wide we might also expect increased syringe turnover in BTH cities, as unrinsed syringes become obstructed.

[C]This HIV differential may also have been promoted by higher rates of cocaine injection in Vancouver than in Seattle (Bourgois and Bruneau, 2000).

The solubility characteristics of BTH also require heating to place it into solution. Our observations support reported findings that BTH users consistently heat heroin solutions while IDUs with other types of heroin do not (Clatts et al., 1999). Heroin solution that is cooled is often viscous and can be diffcult to inject though fine gauged needles. Hence, BTH-using IDUs heat their solutions more thoroughly.

In contrast to BTH, powder heroin dissolves easily in cool-to-warm water, and it does not leave a significant syringe residue. New York IDUs, consequently, do not complain of obstructed syringes nor do they rinse as regularly, or as thoroughly, as BTH injectors. They will sometimes flush their syringes with water to evacuate any blood that might have coagulated in the needle or syringe, but they do not engage in this rinsing practice as consistently or as iteratively as BTH injectors in San Francisco.

Early self-report surveys do not confirm the benefit of cleaning syringes with water (Chaisson et al., 1987; Marmor et al., 1987). Our ethnographic data suggests, however, that rinsing practices may be too unconsciously habitualized to be susceptible to accurate self-report. In addition, no studies have examined the intensity of rinsing practices. Rinsing by BTH users, according to our ethnographic data, is notably more universal and more vigorous than that by powdered heroin users. Furthermore, no multi-site epidemiological studies have examined the type of heroin injected and related it to the details of cleaning practices, or to the risk of HIV transmission across cities or countries.

Laboratory Data

Laboratory findings lend the weight of biological plausibility to our ethnographic observations and ecological analysis. Rinsing HIV-contaminated syringes three times with water in vitro reduces the number of syringes with recoverable virus 99% (Abdala et al., 2001). Rinsing blood-contaminated 1 mL syringes with water reported a 74% to 92% reduction in residual blood volume following a single rinse (Gaughwin et al., 1991). A laboratory testing HIV disinfectants reported, as an accidental finding, that “rinsing the syringe twice (with culture medium), probably even with water, reduces the number of culturable HIV-1 to a level below the sensitivity of our assay (Flynn et al., 1994). Rinsing with any fluid, consequently, should reduce the volume of residual blood in syringes and thereby lower the risk of HIV transmission.

Moreover, the higher temperatures and longer heating times required to put BTH into solution (compared to powder heroin) reduced levels of HIV in vitro (Clatts et al., 1999). This comparative heating data lends further plausibility to our ethnographic interpretations that BTH obstructs syringes due to its lower solubility and greater viscosity, especially when cooled. Thus, while rinsing may protect IDUs from *direct* HIV transmission (syringe sharing), heating may protect IDUs from *indirect* HIV transmission via ancillary paraphernalia (i.e., HIV-contaminated syringe A to cooker to syringe B).

Clinical Observations

Use of BTH has been associated with bacterial infections including tetanus, botulism, and gangrene as well as soft tissue infections (Ciccarone et al., 2001). Soft-tissue infections due to intramuscular and subcutaneous injection of BTH are very common in San Francisco (Ciccarone et al., 2001). Injectors who have used powder heroin prior to BTH report increased inflammation and venous scarring after switching to BTH. Our clinical and ethnographic data document that many IDUs who inject BTH lose their venous access early in their injection careers—sometimes within 6 months of initiation. Consequently, many BTH users are forced to switch to intramuscular injection. This early transition away from intravenous injection does not occur among those who use white powder heroin. In vitro evidence supports decreased

HIV transmissibility with subcutaneous/intramuscular compared to venous injection (Rich et al., 1998).

Public Health Implications

Our findings unfold an intriguing hypothesis: Has heroin type helped shaped the spread of HIV among IDUs in the United States? If so, how strong a determinant is it and how does it interact with the complex multidimensionality of IDU risk taking? Would a simple public health campaign promoting vigorous water-rinsing of used syringes be a cost-effective and realistically implementable intervention in resource-poor settings?

The HIV epidemic among IDUs is currently stable or in a pattern of decline in many areas of the United States. This has been attributed to a dying out of the infected population, a decrease in risky practices, and increased access to sterile injection equipment (Des Jarlais, 1998). We emphasize that this decline cannot be taken for granted. If BTH is as protective as our analysis suggests, then a simple change in drug distribution patterns, e.g., intrusion of powdered heroin into traditional BTH cities, may undo what was thought to be effective public health intervention.

Global conflicts, economic restructuring, and migration patterns lead to changes in the accessibility and distribution of heroin (The Economist, 2001; Moore, 2002; Singer, In Press). Mixtures of heroin types and qualities exist in most European cities and correspondingly generate multiple use patterns (Strang et al., 2001). Concerns over the future spread of HIV and other infectious diseases related to injection drug use should account for how risky injection practices are affected by the regional and global distribution patterns of specific heroin types.

RESUMEN

Aún no se ha estudiado ni documentado adecuadamente la relación entre las distintas composiciones físicas y químicas con que la heroína llega al consumidor mundial y sus métodos de inyección y el contagio de enfermedades. En este trabajo ofrecemos una hipótesis que explicaría la irregular difusión del VIH entre consumidores de drogas inyectables en los Estados Unidos basada en el análisis de la distribución de la heroína tipo “chapopote mexicano.” proponemos, utilizando datos etnográficos, epidemiológicos y de laboratorio, que sus propiedades químicas fomentan métodos de inyección más seguros. Entre ellos se destacan: (1) enjuague de la jeringa para evitar que se obstruya, (2) calentamiento del disolvente para facilitar la disolución, (3) rápida transición de inyección intravenosa a subcutánea o intramuscular.

RÉSUMÉ

Ll existe différents types physiques et chimiques d’héoïnes a travers le monde mais la façon don’t ces différences influencent les comportements de risques et la contamination n’est ni bien comprise ni bien documentée. Cet article présente une hypothése qui explique la distribution inégale du VIH chez les injecteurs d’heroine aux-Etats-Unis en examinent la distribution et l’utillisation d’un type d’héroïne: la “Mexican black tar” (‘goudron mexicain’). D’après les données ethnographiques, cliniques, épidémiologiques et de laboratoire, nous suggérons que les propriétés chimiques de cette héroïne millitent pour un usage plus sanitaire de l’injection par: (1) rinçage des seringues pour éviter qu’ils se bouchent; (2) chauffage de l’ustensile pour une meilleure dissolution, et (3) transition rapide de l’injection intraveineuse à l’intramusculaire ou la transcutanée.

THE AUTHORS

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Philippe Bourgois, Ph.D., is a cultural anthropologist who is Professor and Chair of the Department of Anthropology, History, and Social Medicine at the University of California, San Francisco. He is best known for his fieldwork among drug dealers and addicts in the U.S. inner city. His most recent book, *In Search of Respect: Selling Crack in El Barrio* (1995, with an updated second edition in 2003) won the C. Wright Mills and the Margaret Mead prizes, among others. He is currently conducting fieldwork among homeless heroin injectors and crack smokers in San Francisco with the photographer Jeff Schonberg to prepare a book for the University of California Press, *Righteous Dopefiend: Homeless Heroin Addicts in Black and White*.

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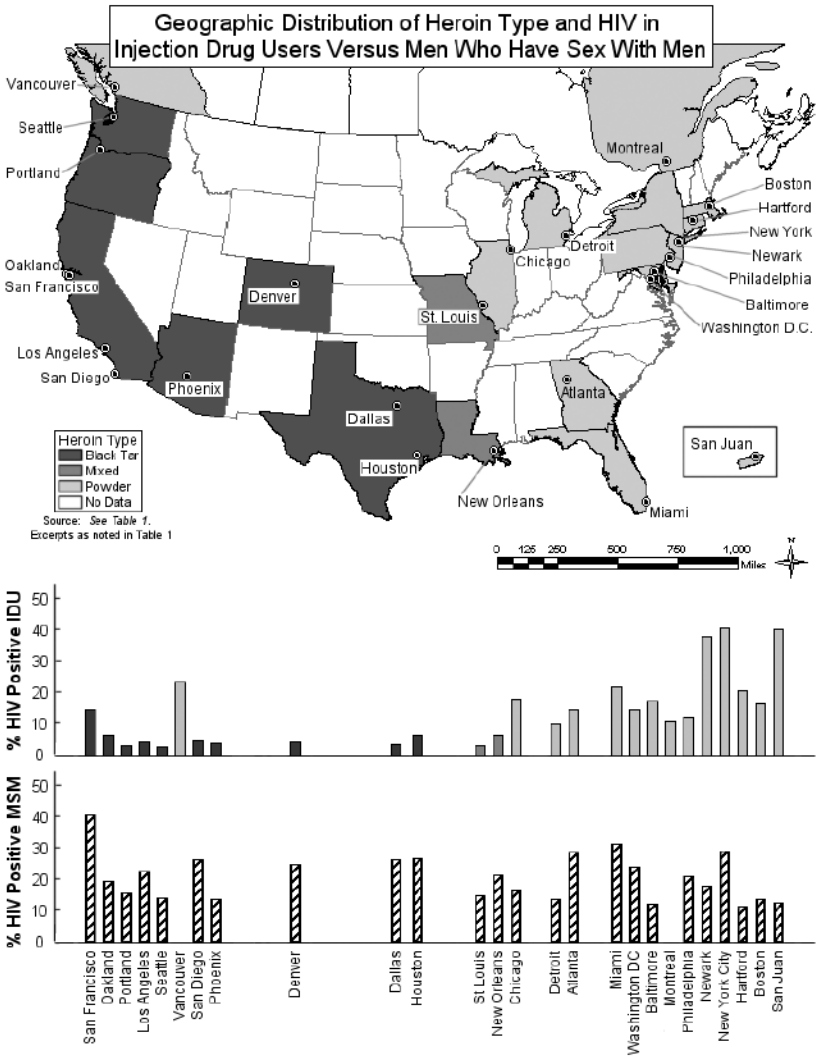

Figure 1.

Table 1

HIV seroprevalence in IDU and MSM populations and type of heroin by city.

City	IDU Population (#)(1)	HIV seroprevalence[a] HIV+ IDU (%)	HIV+ MSM (%)	Heroin type (1991–1993)[b] % Tar heroin (91–93)
NYC	168,300	41.0	29.2	0
San Juan	22,000	40.5	12.4	0
Hartford	10,200	20.6	11.2	(−)[c]
Newark, NJ	30,000	38.0	17.9	0
Vancouver		23.2[e]		(−)[c]
Miami	31,000	21.9	31.4	14
Chicago	58,100	18.1	16.2	17
Baltimore	32,000	17.1	11.9	0
Boston	28,000	16.4	13.7	0
Washington, DC	39,100	14.5	24.2	0
Atlanta	23,000	14.5	28.6	0
San Francisco	**23,000**	**14.3**	**40.7**	**94**
Philadelphia	51,400	11.9	21.0	0
Montreal		10.7[f]		(−)[c]
Detroit	35,000	9.9	13.8	0
Oakland	**21,000**	**6.3**	**19.3**	**100(+)**[c]
New Orleans	17,700	6.2	21.6	38
Houston	**65,200**	**6.1**	**27.0**	**83**
San Diego	**19,100**	**4.5**	**26.4**	**100**
Los Angeles	**88,000**	**3.8**	**22.6**	**93**
Denver	**15,700**	**3.8**	**24.8**	**100**
Phoenix	**16,000**	**3.4**	**13.6**	**100**
Dallas	**16,300**	**3.3**	**26.6**	**95**
Portland	**16,900**	**2.8**	**15.5**	**100(+)**[c]
St. Louis	**18,000**	**2.7**	**15.0**	**72**
Seattle	**17,000**	**2.4**	**14.1**	**100**
U.S. overall[d]	1,461,500	14.0	18.1	

[a] Source: Holmberg, 1996.

[b] Type of heroin. Source: Domestic Monitoring Program 1991–1993. Drug Enforcement Administration, U.S. Department of Justice. Because of observed broad patterns for drug distribution, data for type of heroin is extrapolated from the municipal to the state level. (See Fig. 1)

[c] Type of heroin determined by ethnographical experience in Hartford, Vancouver (P. Bourgois, D. Ciccarone), Oakland (D. Ciccarone), Montreal (P. Bourgois), and Portland (D. Ciccarone). Absence or presence of black tar heroin in those cities is denoted with (−/+).

[d] Does not include Canadian cities.

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