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## PREVALENCE AND CORRELATES OF STREET-OBTAINED BUPRENORPHINE USE AMONG CURRENT AND FORMER INJECTORS IN BALTIMORE, MARYLAND

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### Abstract

**Objectives**—There are few systematic assessments of street-obtained buprenorphine use from community-based samples in the United States. The objective of this study was to characterize the prevalence, correlates, and reasons for street-obtained buprenorphine use among current and former injection drug users (IDUs) in Baltimore, Maryland.

**Methods**—In 2008, participants of the ALIVE (AIDS Linked to the IntraVenous Experience) study, a community-based cohort of IDUs, were administered a survey on buprenorphine. Street-obtained buprenorphine represented self-reported use of buprenorphine obtained from the street or a friend in the prior three months.

**Results**—602 respondents were predominantly male (65%), African-American (91%), and 30% were HIV-positive. Overall, nine percent reported recent street-obtained buprenorphine use, and only 2% reported using to get high. Among active opiate users, 23% reported recent use of street-obtained buprenorphine. Use of buprenorphine prescribed by a physician, injection and non-

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#### Contributors

Authors BLG and SHM wrote the first draft of the manuscript and all authors contributed to and have approved the final manuscript. Authors MG, CRS, CEJ, GDK, DV, and SHM designed the study and data collection instruments. Authors BLG and MG conducted literature searches and summarized relevant previous studies. Author JA conducted the statistical analysis.

#### Conflict of Interest

As members of CRS Associates, authors CRS (deceased) and CEJ have had consulting arrangements with Takeda Pharmaceutical Co., Shire Specialty Pharmaceuticals, Schering-Plough Corporation, Orexo, Apreva, Merck and Co., AstraZeneca, CoLucid, Consumer Healthcare Products Association, and the Institute for Behavior and Health, Inc and author CRS had received honoraria and travel expenses from Reckitt Benckiser Pharmaceuticals, Inc. to make presentations on their behalf concerning buprenorphine. All other authors have no conflicts of interest to report.

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injection drug use, use of street-obtained methadone and prescription opiates, homelessness, and opioid withdrawal symptoms were positively associated, while methadone treatment, health insurance, outpatient care, and HIV-infection were negatively associated with recent street-obtained buprenorphine use in univariate analysis. After adjustment, active injection and heroin use were positively associated with street-obtained buprenorphine use. Ninety-one percent reported using street-obtained buprenorphine to manage withdrawal symptoms.

**Conclusions**—While 9% reported recent street-obtained buprenorphine use, only a small minority reported using buprenorphine to get high, with the majority reporting use to manage withdrawal symptoms. There is limited evidence of diversion of buprenorphine in this sample and efforts to expand buprenorphine treatment should continue with further monitoring.

## Keywords

buprenorphine; injection drug use; drug treatment; diversion

## 1. INTRODUCTION

In 2002, the US Food and Drug Administration (FDA) approved the use of buprenorphine for treatment of opioid dependent patients. Buprenorphine was the first drug approved in accordance with the Drug Addiction Treatment Act of 2000 (DATA 2000), legislation designed to increase availability of treatment for opioid dependent individuals by allowing physicians with a waiver from the Department of Health and Human Services to prescribe approved Schedule III, IV, and V drugs in office-based treatment settings (Drug Addiction Treatment Act, 2000). Prior to this legislation, treatment options were restricted to methadone, which could only be administered within federally-approved treatment programs, and naltrexone.

The safety and efficacy of buprenorphine for the treatment of opioid dependence has been demonstrated by multiple clinical trials (Fiellin et al., 2008; Fudala et al., 2003; Johnson, Jaffe, & Fudala, 1992; Ling et al., 1998). Buprenorphine has been associated with reductions in opiate use (Johnson et al., 2000; Mattick et al., 2003), overdose mortality (J. R. Bell, Butler, Lawrance, Batey, & Salmelainen, 2009), injection-related risk behavior and blood-borne infection transmission (Sullivan et al., 2008). With comparable efficacy to methadone (Johnson et al., 2000; Mattick et al., 2003), buprenorphine is associated with less physical dependence, a lower potential for abuse, and a ceiling effect at high doses that results in less severe physiological manifestations during overdose when compared to other opioids (Mello & Mendelson, 1985; Mello, Lukas, Bree, & Mendelson, 1988; S. L. Walsh, Preston, Stitzer, Cone, & Bigelow, 1994; S. L. Walsh, Preston, Bigelow, & Stitzer, 1995; S. L. Walsh & Eissenberg, 2003).

In Baltimore, Maryland, the public health burden of heroin use is substantial (Brady et al., 2008; Friedman et al., 2004) and the need for opioid agonist treatment has historically exceeded availability. In response, the Baltimore Buprenorphine Initiative (BBI) was initiated by the city health department to expand treatment access. BBI supports creating a base of physicians registered to prescribe buprenorphine practicing in the community (75 were registered at the time of the study in November 2008), as well as six substance abuse treatment centers that provide buprenorphine treatment, comprehensive psychosocial support, and referrals (Baltimore Substance Abuse Systems, Baltimore City Health Department, 2008).

The regulatory and clinical guidelines underlying office-based buprenorphine treatment were also designed to minimize abuse and misuse of buprenorphine. Though there have been some reports of buprenorphine diversion in specific geographic regions (Monte,

Mandell, Wilford, Tennyson, & Boyer, 2009), overall diversion nationally has been low (Cicero & Inciardi, 2005; JBS International, 2006; Smith, Bailey, Woody, & Kleber, 2007), particularly in comparison to other prescription opiates (Dasgupta et al., 2010; Davis & Johnson, 2008; Gwin Mitchell et al., 2009). In Baltimore, a series of articles in the *Baltimore Sun* in 2007 asserted that expanding access to buprenorphine through the BBI had increased abuse of the drug among the city's sizeable injection drug user (IDU) population (Schulte & Donovan, 2007). Despite these calls for concern from the popular press, there have been few systematic assessments of the use of buprenorphine obtained from the street among community-based samples. We characterize the prevalence, correlates, and reasons for street-obtained buprenorphine use in an ongoing community-based cohort of former or current IDUs in Baltimore, Maryland.

## 2. MATERIAL AND METHODS

### 2.1. Study Population

AIDS Linked to the IntraVenous Experience (ALIVE) is an ongoing cohort of current and former IDUs in Baltimore, Maryland as described previously (Vlahov et al., 1991). Briefly, 2,942 IDUs were recruited via street outreach in 1988–1989. Eligibility criteria at enrollment included being 18 years of age, a history of injection drug use in the prior 11 years, and being AIDS-free at baseline. Subsequent enrollment occurred in 1994–1995 (n=433), 1998 (n=244) and 2005–2008 (n=752). This analysis included 602 participants who completed a routine, semi-annual follow-up visit, and were administered a supplemental survey from June–October of 2008 on buprenorphine.

The interviewer-administered survey contained twenty-four questions assessing knowledge, availability, and use of buprenorphine. The questionnaire included the names buprenorphine, Suboxone, Subutex and Buprenex interspersed within a list of other drug names including amitriptyline, methadone, oxycodone and hydrocodone. Respondents were first asked whether they had heard of and used each drug. If they had used the drug, they were asked whether they had used it in the last 3 months and the last 30 days. Respondents were also asked where they usually obtained the drug: “doctor,” “friend/acquaintance,” “street/dealer” or “don't know.” Respondents were also asked if they had ever used the drug to “get high,” and if they had, whether they had done so in the last 3 months, the last 30 days, or more than one time. Finally, respondents were also asked about whether they had used buprenorphine to manage opioid withdrawal symptoms.

Participants also completed the standard ALIVE follow-up interview, which includes questions on general health (interviewer-administered) and drug and sexual behaviors in the previous six months (administered by audio computer-assisted self-interview). Information regarding the type and frequency of use of heroin, prescription opiates (e.g. oxycodone), cocaine, crack, marijuana, alcohol use, experiences of withdrawal, and drug treatment (including methadone and buprenorphine, both office-based and from a treatment program) were obtained from responses to the standard questionnaire.

### 2.2 Statistical Analysis

Descriptive statistics were used to examine participant characteristics and use of buprenorphine. Descriptive statistics are presented individually for buprenorphine and the three trade names (Suboxone, Subutex, Buprenex; Table 2), but for the majority of analyses, all four were combined because our interest was to assess any buprenorphine use. Standard proportions were used to characterize who had heard of buprenorphine and had ever and recently (past 3 months) used buprenorphine. The frequencies of the usual source of the drug and use to get high were examined. Results were compared for persons who were and were not actively injecting and for those who were using any opiates.

The main outcome of interest was recent street-obtained buprenorphine use. We defined street-obtained use as recent (in the prior three months) use of buprenorphine with a usual source other than a doctor (i.e., street, or friend). Factors associated with street-obtained buprenorphine use were examined using  $\chi^2$  tests, Fisher's exact tests, and logistic regression. Covariates were selected for inclusion in multivariate models based on previous research on use of street-obtained methadone in ALIVE (Vlahov et al., 2007) and included socio-demographic characteristics (e.g., sex, age, and race), HIV status, and recent (prior six months) drug (cocaine, heroin, crack, and marijuana) and alcohol use, recent (prior three months) street-obtained methadone and prescription opiate use, homelessness, employment, formal drug treatment (e.g., methadone or buprenorphine), incarceration, and experience of serious opioid withdrawal symptoms.

Potential effect modification by being enrolled in methadone and buprenorphine treatment programs on the association between opioid withdrawal symptoms and street-obtained buprenorphine use were examined by including interaction terms in regression models. We also conducted sensitivity analyses that 1) restricted the multivariate model to active injectors and active opiate users; and 2) considered covariates lagged one study visit. All analyses were performed using SAS version 9.2 (Cary, North Carolina).

### 3. RESULTS

#### 3.2. Characteristics of the Study Sample

Demographic and behavioral characteristics are displayed in Table 1. The majority was male (65%) and African American (91%); median age was 50 years. One-third were HIV-positive. Fourteen percent reported daily or more frequent injection and 20% reported less than daily injection. Thirteen percent reported recent homelessness. Five percent of respondents reported use of prescription opiates (i.e., oxycodone) in the prior six months. One-quarter were enrolled in methadone and 7% in buprenorphine treatment in the previous six months.

#### 3.3. Lifetime and Recent Use of Buprenorphine

A large majority (89%) reported knowledge of buprenorphine, while they were less familiar with trade names Suboxone (59%), Subutex (9%), and Buprenex (11%; Table 2). Although each drug is presented separately in Table 2, for all subsequent analyses, responses were considered as buprenorphine use if respondents reported use of buprenorphine or any of the three trade names. Seventy-four percent (n=446) reported having seen buprenorphine (in any form) sold on the street. Forty-five percent reported ever using buprenorphine (n=273), 16% reported use in the previous three months (n=95), and 11% in the prior 30 days (n=69).

#### 3.4. Street-obtained Buprenorphine Use

The majority (56%) of those who reported *ever* using buprenorphine reported that a doctor was their usual source. Twenty three percent reported obtaining buprenorphine from the street and 13% from a friend.

Of the 95 respondents who reported buprenorphine use in the prior three months, 42 (44%) reported that their usual source was a doctor, and 53 (56%) reported that their source was either the street or a friend (recent street-obtained buprenorphine use). The prevalence of recent street-obtained buprenorphine use was 9% overall (n=53/602). Recent street-obtained buprenorphine use was higher among active injectors (20%) compared with those who had not injected in the previous six months (3%) ( $p<0.001$ ). In addition, twenty-three percent of those using any opiate (heroin by injection, heroin by smoking or snorting or prescription

opiate) had recently used street-obtained buprenorphine compared to 2% who had not used any opiate.

Table 3 presents the unadjusted odds ratios of factors associated with recent (prior three months) street-obtained buprenorphine use. Compared to those who did not use street-obtained buprenorphine, those who did were significantly more likely to report in the prior six months: alcohol, marijuana, crack and active injection drug use; snorting cocaine and heroin; heroin, cocaine and speedball injection; prescription opiate use; withdrawal symptoms; and homelessness; and were significantly less likely to report methadone treatment, having health insurance, and outpatient care. They were also significantly more likely to report street-obtained methadone use in the prior three months. Persons who reported street-obtained buprenorphine were also more likely to report being in a buprenorphine treatment program in the prior six months, but this difference was not statistically significant.

Table 4 shows the adjusted odds ratios for street-obtained buprenorphine use. Use of heroin and cocaine by different routes of administration (injection, smoking, snorting) were combined into summary variables for multivariate analysis due to collinearity. After adjusting for demographic and behavioral characteristics, injection drug use in the prior six months (OR=3.10, 95% CI: 1.20, 7.98), and any heroin use (injection, snorting or smoking) in the prior six months (OR=6.62, 95% CI: 2.11, 20.7) remained significantly positively associated with street-obtained buprenorphine use. Use of prescription opiates remained positively associated with recent street-obtained buprenorphine but was of marginal statistical significance (OR=2.61, 95% CI: 0.99, 6.82) while use of street-obtained methadone in the prior three months was no longer statistically significant (OR=4.44, 95% CI: 0.83, 23.7). Street-obtained buprenorphine use remained less common among those enrolled in methadone treatment, but this association was also no longer statistically significant (OR=0.43, 95% CI: 0.15, 1.21). The associations with withdrawal symptoms (OR=0.70, 95% CI: 0.31, 1.56), buprenorphine treatment (OR=0.91, 95% CI: 0.32, 2.58), health insurance status (OR=1.03, 95% CI: 0.48, 2.23), and outpatient care (OR=0.99, 95% CI: 0.47, 2.08) diminished in magnitude and statistical significance.

In the adjusted model restricted to current injectors (data not shown), only heroin use (OR=5.88, 95% CI: 1.14, 30.19) was associated with street-obtained buprenorphine use. There were no correlates of street-obtained buprenorphine use in the model restricted to current users of any opiate (data not shown). In other sensitivity analyses, there were no statistically significant interactions between opioid agonist treatment and withdrawal symptoms (data not shown). Finally, we observed similar results when we included covariates that were lagged one study visit.

### 3.5. Self-Reported Reasons for Buprenorphine Use

Overall, thirty persons (5%) reported ever using buprenorphine to get high (Table 2). Four percent reported using buprenorphine to get high more than once. Of the 53 who reported use of street-obtained buprenorphine in the prior 3 months, 15 (25%) reported using it to get high; this represents 2% of participants overall. Overall, active injectors were more likely than former injectors to report using buprenorphine to get high in the prior three months (4.9% vs 1.3%,  $p<0.01$ ). By comparison, 13% ( $n=76$ ) reported ever using methadone to get high and 9% reported using it to get high more than once.

Among those who reported ever having used buprenorphine, nearly three-quarters (72%) reported having ever used the drug to manage their withdrawal symptoms, and half of those who used buprenorphine to manage their withdrawal symptoms reported doing so while they were waiting for treatment. For the 53 respondents reporting recent street-obtained



buprenorphine use, 91% reported ever using to manage withdrawal symptoms, and of those, 40% reported that they were waiting for treatment at the time of use.

#### 4. DISCUSSION

The results of this study demonstrate that though IDUs in Baltimore City were aware of buprenorphine being sold on the street, only 9% reported recent street-obtained use, and a minority used buprenorphine to get high. In this population, street-obtained use of buprenorphine was most common among those actively injecting or using other opiates, was primarily reported to be used to manage withdrawal symptoms, and was uncommonly used by persons in formal drug treatment programs.

There are few estimates of the street-obtained buprenorphine prevalence from community-based populations. Further, it is challenging to compare estimates across studies because of varying definitions based on diversion, misuse, or abuse, with some estimates based on the source of drug, as in our study, and others based on the purpose of use, with diversion defined as use to get high or to induce euphoria. These caveats aside, studies conducted in the US during the expansion of buprenorphine programs (2003–2007) suggested that abuse, misuse, and diversion of buprenorphine was minimal (Cicero & Inciardi, 2005; JBS International, 2006; Smith et al., 2007), and it was less common than methadone diversion (Dasgupta et al., 2010; Davis & Johnson, 2008; Gwin Mitchell et al., 2009). More recent studies have shown increasing trends of buprenorphine diversion over time (Bazazi, Yokell, Fu, Rich, & Zaller, 2011), however it is still less common than methadone (Dasgupta et al., 2010; Johanson, Arfken, di Menza, & Schuster, 2011). In our study, lifetime history of street-obtained methadone use was higher than street-obtained buprenorphine use. The more frequent use of methadone to get high may reflect its longer availability, a preference for methadone among this population of older injectors, that methadone is a full agonist and therefore more likely to produce euphoria, or that Suboxone, the most widely prescribed form of buprenorphine, if injected is more likely to precipitate withdrawal in people physically dependent upon heroin because the medication also contains naloxone. In general, our findings are consistent with prior studies demonstrating that diverted buprenorphine use has remained low since its introduction in 2003 (Cicero & Inciardi, 2005), although further study is needed as generic buprenorphine formulations without naloxone become more widespread in use.

In comparing our results with those of other studies, it is important to note that our sample included both current and former injectors and we did see higher levels of use among those who were actively injecting and using other opiates. In this population, it was important to consider both active and former users because we have previously demonstrated a high rate of relapse after injection cessation (Galai, Safaeian, Vlahov, Bolotin, & Celentano, 2003; Genberg et al., 2011; Shah, Galai, Celentano, Vlahov, & Strathdee, 2006). Those who may have recently quit injecting or stopped drug treatment may be the most at-risk for experiencing withdrawal symptoms and therefore in need of buprenorphine. In fact, although active injectors reported using street-obtained buprenorphine more often than former injectors, 11% of those using street-obtained buprenorphine reported no use of any heroin in the prior six months.

Despite the demonstration of an overall low level of buprenorphine compared to methadone, concerns remain about whether more widespread availability of buprenorphine will further increase diversion and the adverse consequences associated with diversion. However, there is little evidence to suggest this will be the case. First, while higher population-levels of diversion have been reported for methadone, there is little evidence to show that methadone diversion has increased in proportion to its availability within our cohort. In fact, we

previously demonstrated a slight decrease in street-obtained methadone use from 1988–2004 in Baltimore City (Vlahov et al., 2007), a time in which methadone treatment slots in the city doubled (Baltimore Substance Abuse Systems, Baltimore City Health Department, 2006).

Second, in countries where buprenorphine has been available for longer than the US, there has been little evidence of adverse consequences. For example, in France, there has been unregulated access to buprenorphine since the 1990s (J. Bell, 2010). While there have been reports of diversion with some reports of injected buprenorphine (Vidal-Trecan, Varescon, Nabet, & Boissonnas, 2003), levels of overdose attributable to buprenorphine remain low (Pirnay et al., 2004), and heroin overdose declined by 79% following buprenorphine expansion (Auriacombe, Fatseas, Dubernet, Daulouede, & Tignol, 2004). In Baltimore City there has been one overdose death attributable to buprenorphine through 2007, and a dramatic decrease in heroin-related overdoses between 1999 and 2006 (Office of Epidemiology and Planning, Baltimore City Health Department, 2007). Thus, in areas with widespread heroin availability, diversion of both methadone and buprenorphine may actually act as buffers to some of the adverse consequences related to heroin use. Regardless, the overall goal should be to balance the availability of opioid agonist therapies with the adverse consequences of diversion (J. Bell, 2010).

Street-obtained buprenorphine use was tightly linked with active injection drug use in this study. Indeed accounting for injection drug use in the multivariate model accounted for all other observed associations with buprenorphine except for heroin use. On the one hand, these data might reflect that persons actively injecting may be using street-obtained buprenorphine to get high. On the other hand, it is also likely that active heroin injectors would be more likely to experience withdrawal symptoms and using street-obtained buprenorphine to manage withdrawal symptoms. While our data cannot conclusively support either hypothesis, there is evidence to suggest that overall, buprenorphine in this population is not commonly used to get high, but rather to manage withdrawal symptoms. Only 5% reported using buprenorphine to get high, which is lower than levels recently reported among treatment-seeking populations in Baltimore and other areas of the US (Gwin Mitchell et al., 2009; Schuman-Olivier et al., 2010). By contrast, 75% of the participants of this cohort reported using buprenorphine to manage withdrawal symptoms and half reported that they were waiting for treatment when they used buprenorphine. Moreover, when asked, nearly all participants reported interest in receiving drug treatment. This conjecture is further supported by a previous study in this cohort that showed strong associations between street-obtained methadone use and withdrawal symptoms (Vlahov et al., 2007) and other studies that have also suggested that street-obtained buprenorphine use is more commonly related to managing symptoms rather than to get high (Bazazi et al., 2011; Gwin Mitchell et al., 2009; Schuman-Olivier et al., 2010).

These findings suggest that while drug treatment programs should be expanded to increase access to opioid agonist therapies among current and former injectors, additional efforts may be needed to monitor potential diversion. Although access to buprenorphine has expanded over the past several years, it is still possible that programs may not be reaching the most vulnerable IDUs who may lack the resources or may not be interested in enrolling in office-based or opioid treatment programs, predicating them to acquire buprenorphine on the street. Additional outreach and novel approaches to care delivery (such as mobile care, integration with needle exchange, and community-based programs) may be considered to engage the most marginalized active injectors in treatment. Increasing the number of trained and registered providers will expand access to serve a broader population of those with unmet treatment needs and should be a priority. Along with continued expansion of buprenorphine



programs, increased monitoring and surveillance as well as prescription tracking systems should be considered to limit potential diversion.

Despite many reporting using buprenorphine to manage withdrawal, street-obtained buprenorphine use was not independently associated in this study with self-report of recent withdrawal symptoms as previously seen with street-obtained methadone (Vlahov et al., 2007). However there were several limitations to the data that must be considered. In this study, only active injectors were asked about recent withdrawal symptoms. Excluding those who were not actively injecting potentially diluted the association between withdrawal and buprenorphine use since withdrawal symptoms may be experienced by those using heroin by non-injection routes. In fact, those using heroin by any route were eight times more likely to report using street-obtained buprenorphine.

There are several other important limitations of this study. First, our population was predominantly urban and African-American and a large proportion were not actively injecting at the time of the survey, potentially limiting comparability to other cohorts. Prevalence was higher in active injectors (5%), but still lower than what has been previously observed in treatment-seeking individuals in Baltimore and other parts of the US (Gwin Mitchell et al., 2009; Schuman-Olivier et al., 2010) and significantly lower than recently found in a small study of needle exchange participants in Rhode Island (Bazazi et al., 2011). The prevalence estimate of street-obtained buprenorphine use presented here likely does not reflect the entire magnitude of buprenorphine misuse, abuse and diversion. It is very likely that there is misuse of buprenorphine acquired from physicians which is not captured in our estimate of street use. We were further limited in this study by the self-reported nature of the data; however, prior work has confirmed the validity of self-reports for sensitive questions (C. A. Latkin, Vlahov, & Anthony, 1993; C. A. Latkin & Vlahov, 1998). Finally we were unable to discern the method of administration of street-obtained buprenorphine from this data.

## 5. CONCLUSIONS

In summary, 9% of the participants in this community-based cohort in Baltimore reported recent street-obtained buprenorphine use; street-obtained use was strongly associated with active injection, heroin use and street-obtained methadone use. While a small proportion of the riskiest IDUs may have been using buprenorphine to get high, the majority reported using buprenorphine to manage withdrawal. Buprenorphine and other medication-assisted therapies have been shown to significantly decrease drug use and its consequences. Yet access to buprenorphine programs seemed to be limited in this sample. These results show little evidence of buprenorphine misuse and efforts to expand buprenorphine treatment should continue with further monitoring for diversion.

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## References

- Auriacombe M, Fatseas M, Dubernet J, Daulouede JP, Tignol J. French field experience with buprenorphine. *The American Journal on Addictions*. 2004; 13(Suppl 1):S17–28. [PubMed: 15204673]

- Baltimore Substance Abuse Systems, Baltimore City Health Department. The Baltimore Buprenorphine Initiative: Second interim progress report. Baltimore, Maryland: 2008 Jun.
- Baltimore Substance Abuse Systems, Baltimore City Health Department. Drug treatment in Baltimore: 2005. Baltimore, Maryland: Baltimore City Health Department Data Snapshot; 2006.
- Bazazi AR, Yokell M, Fu JJ, Rich JD, Zaller ND. Illicit use of buprenorphine/naloxone among injecting and noninjecting opioid users. *Journal of Addiction Medicine*. 2011; 5(3):175–180. [PubMed: 21844833]
- Bell J. The global diversion of pharmaceutical drugs: Opiate treatment and the diversion of pharmaceutical opiates: A clinician's perspective. *Addiction*. 2010; 105(9):1531–1537. [PubMed: 20626373]
- Bell JR, Butler B, Lawrance A, Batey R, Salmelainen P. Comparing overdose mortality associated with methadone and buprenorphine treatment. *Drug and Alcohol Dependence*. 2009; 104(2-Jan): 73–77. [PubMed: 19443138]
- Brady JE, Friedman SR, Cooper HL, Flom PL, Tempalski B, Gostnell K. Estimating the prevalence of injection drug users in the U.S. and in large U.S. metropolitan areas from 1992 to 2002. *Journal of Urban Health: Bulletin of the New York Academy of Medicine*. 2008; 85(3):323–351. [PubMed: 18344002]
- Cicero TJ, Inciardi JA. Potential for abuse of buprenorphine in office-based treatment of opioid dependence. *The New England Journal of Medicine*. 2005; 353(17):1863–1865. [PubMed: 16251550]
- Dasgupta N, Bailey EJ, Cicero T, Inciardi J, Parrino M, Rosenblum A, Dart RC. Post-marketing surveillance of methadone and buprenorphine in the United States. *Pain Medicine*. 2010; 11(7): 1078–1091. [PubMed: 20545875]
- Davis WR, Johnson BD. Prescription opioid use, misuse, and diversion among street drug users in New York City. *Drug and Alcohol Dependence*. 2008; 92(3-Jan):267–276. [PubMed: 17913395]
- Drug Addiction Treatment Act of 2000 (DATA), Title XXXV, Section 3502 (2000).
- Fiellin DA, Moore BA, Sullivan LE, Becker WC, Pantalon MV, Chawarski MC, Schottenfeld RS. Long-term treatment with buprenorphine/naloxone in primary care: Results at 2–5 years. *The American Journal on Addictions*. 2008; 17(2):116–120. [PubMed: 18393054]
- Friedman SR, Tempalski B, Cooper H, Perlis T, Keem M, Friedman R, Flom PL. Estimating numbers of injecting drug users in metropolitan areas for structural analyses of community vulnerability and for assessing relative degrees of service provision for injecting drug users. *Journal of Urban Health: Bulletin of the New York Academy of Medicine*. 2004; 81(3):377–400. [PubMed: 15273263]
- Fudala PJ, Bridge TP, Herbert S, Williford WO, Chiang CN, Jones K. Buprenorphine/Naloxone Collaborative Study Group. Office-based treatment of opiate addiction with a sublingual-tablet formulation of buprenorphine and naloxone. *The New England Journal of Medicine*. 2003; 349(10):949–958. [PubMed: 12954743]
- Galai N, Safaeian M, Vlahov D, Bolotin A, Celentano DD. Longitudinal patterns of drug injection behavior in the ALIVE study cohort, 1988–2000: Description and determinants. *Am J Epidemiol*. 2003; 158(7):695–704. [PubMed: 14507606]
- Genberg BL, Gange SJ, Go VF, Celentano DD, Kirk GD, Mehta SH. Trajectories of injection drug use over 20 years (1988–2008) in Baltimore, Maryland. *American Journal of Epidemiology*. 2011; 173(7):829–836. [PubMed: 21320867]
- Gwin Mitchell S, Kelly SM, Brown BS, Schacht Reisinger H, Peterson JA, Ruhf A, Schwartz RP. Uses of diverted methadone and buprenorphine by opioid-addicted individuals in Baltimore, Maryland. *The American Journal on Addictions*. 2009; 18(5):346–355. [PubMed: 19874152]
- JBS International. Diversion and abuse of buprenorphine: A brief assessment of emerging indicators, final report. Substance Abuse and Mental Health Services Administration, Center for Substance Abuse Treatment; 2006.
- Johanson CE, Arfken CL, di Menza S, Schuster CR. Diversion and abuse of buprenorphine: Findings from national surveys of treatment patients and physicians. *Drug and Alcohol Dependence*. 2011; 120(1–3):190–195. [PubMed: 21862241]

- Johnson RE, Chutuape MA, Strain EC, Walsh SL, Stitzer ML, Bigelow GE. A comparison of levomethadyl acetate, buprenorphine, and methadone for opioid dependence. *The New England Journal of Medicine*. 2000; 343(18):1290–1297. [PubMed: 11058673]
- Johnson RE, Jaffe JH, Fudala PJ. A controlled trial of buprenorphine treatment for opioid dependence. *JAMA: The Journal of the American Medical Association*. 1992; 267(20):2750–2755. [PubMed: 1578593]
- Latkin CA, Vlahov D, Anthony JC. Socially desirable responding and self-reported HIV infection risk behaviors among intravenous drug users. *Addiction*. 1993; 88(4):517–26. [PubMed: 8485429]
- Latkin CA, Vlahov D. Socially desirable response tendency as a correlate of accuracy of self-reported HIV serostatus for HIV seropositive injection drug users. *Addiction*. 1998; 93(8):1191–7. [PubMed: 9813900]
- Ling W, Charuvastra C, Collins JF, Batki S, Brown LS Jr, Kintaudi P, Segal D. Buprenorphine maintenance treatment of opiate dependence: A multicenter, randomized clinical trial. *Addiction*. 1998; 93(4):475–486. [PubMed: 9684386]
- Mattick RP, Ali R, White JM, O'Brien S, Wolk S, Danz C. Buprenorphine versus methadone maintenance therapy: A randomized double-blind trial with 405 opioid-dependent patients. *Addiction*. 2003; 98(4):441–452. [PubMed: 12653814]
- Mello NK, Lukas SE, Bree MP, Mendelson JH. Progressive ratio performance maintained by buprenorphine, heroin and methadone in macaque monkeys. *Drug and Alcohol Dependence*. 1988; 21(2):81–97. [PubMed: 3416736]
- Mello NK, Mendelson JH. Behavioral pharmacology of buprenorphine. *Drug and Alcohol Dependence*. 1985; 14(4-Mar):283–303. [PubMed: 3888577]
- Monte AA, Mandell T, Wilford BB, Tennyson J, Boyer EW. Diversion of buprenorphine/naloxone coformulated tablets in a region with high prescribing prevalence. *Journal of Addictive Diseases*. 2009; 28(3):226–231. [PubMed: 20155591]
- Office of Epidemiology and Planning, Baltimore City Health Department. Intoxication deaths associated with drugs of abuse or alcohol. Baltimore, Maryland: Baltimore City Health Department; 2007.
- Pirnay S, Borron SW, Giudicelli CP, Tourneau J, Baud FJ, Ricordel I. A critical review of the causes of death among post-mortem toxicological investigations: Analysis of 34 buprenorphine-associated and 35 methadone-associated deaths. *Addiction*. 2004; 99(8):978–988. [PubMed: 15265095]
- Schulte F, Donovan D. The 'bupe' fix. *The Baltimore Sun*. 2007 Dec 16.
- Schuman-Olivier Z, Albanese M, Nelson SE, Roland L, Puopolo F, Klinker L, Shaffer HJ. Self-treatment: Illicit buprenorphine use by opioid-dependent treatment seekers. *Journal of Substance Abuse Treatment*. 2010; 39(1):41–50. [PubMed: 20434868]
- Shah NG, Galai N, Celentano DD, Vlahov D, Strathdee SA. Longitudinal predictors of injection cessation and subsequent relapse among a cohort of injection drug users in Baltimore, MD, 1988–2000. *Drug Alcohol Depend*. 2006; 83(2):147–56. [PubMed: 16364568]
- Smith MY, Bailey JE, Woody GE, Kleber HD. Abuse of buprenorphine in the United States: 2003–2005. *Journal of Addictive Diseases*. 2007; 26(3):107–111. [PubMed: 18018814]
- Sullivan LE, Moore BA, Chawarski MC, Pantaloni MV, Barry D, O'Connor PG, Fiellin DA. Buprenorphine/naloxone treatment in primary care is associated with decreased human immunodeficiency virus risk behaviors. *Journal of Substance Abuse Treatment*. 2008; 35(1):87–92. [PubMed: 17933486]
- Vidal-Treca G, Varescon I, Nabet N, Boissonnas A. Intravenous use of prescribed sublingual buprenorphine tablets by drug users receiving maintenance therapy in France. *Drug and Alcohol Dependence*. 2003; 69(2):175–181. [PubMed: 12609698]
- Vlahov D, Anthony JC, Munoz A, Margolick J, Nelson KE, Celentano DD, Polk BF. The ALIVE study, a longitudinal study of HIV-1 infection in intravenous drug users: Description of methods and characteristics of participants. *NIDA Res Monogr*. 1991; 109:75–100. [PubMed: 1661376]
- Vlahov D, O'Driscoll P, Mehta SH, Ompad DC, Gern R, Galai N, Kirk GD. Risk factors for methadone outside treatment programs: Implications for HIV treatment among injection drug users. *Addiction*. 2007; 102(Suppl 1):771–7. [PubMed: 17506154]

- Walsh SL, Preston KL, Bigelow GE, Stitzer ML. Acute administration of buprenorphine in humans: Partial agonist and blockade effects. *The Journal of Pharmacology and Experimental Therapeutics*. 1995; 274(1):361–372. [PubMed: 7542336]
- Walsh SL, Preston KL, Stitzer ML, Cone EJ, Bigelow GE. Clinical pharmacology of buprenorphine: Ceiling effects at high doses. *Clinical Pharmacology and Therapeutics*. 1994; 55(5):569–580. [PubMed: 8181201]
- Walsh SL, Eissenberg T. The clinical pharmacology of buprenorphine: Extrapolating from the laboratory to the clinic. *Drug and Alcohol Dependence*. 2003; 70(2 Suppl):S13–27. [PubMed: 12738347]

### Highlights

- We characterized street-obtained buprenorphine use among injection drug users.
- 9% of former and current injectors reported street-obtained buprenorphine use.
- Street-obtained buprenorphine use was more common among active opiate users.
- 91% reported using street-obtained buprenorphine to manage withdrawal symptoms.

**Table 1**

Demographic and Behavioral Characteristics<sup>a</sup> of 602 Study Participants from the ALIVE Cohort in Baltimore, Maryland, 2008

Age in years, median (inter-quartile range)	50 (45–54)
Male	65
African-American	91
HIV-positive	30
Any alcohol use	51
Snorted cocaine	4
Snorted heroin	15
Smoked heroin	2
Crack use	25
Marijuana use	20
Frequency of injection	
None	66
Less than daily	20
Daily or more frequent	14
Injected heroin	21
Injected cocaine	13
Injected speedball	12
Prescription opiate use <sup>b</sup>	5
Had serious withdrawal symptoms <sup>c</sup>	14
Drug treatment history	
Ever sought treatment	88
Received treatment in past 6 months	37
Methadone treatment	23
Buprenorphine treatment	7
Homeless	13
Employed	25
Incarcerated	9

<sup>a</sup>Data shown as percentages, unless otherwise noted. Risk behavior reflects responses to questions regarding activity during the prior six months;

<sup>b</sup>Prescription opiates included oxycodone (i.e., Oxycontin and Percocet);

<sup>c</sup>Only asked of active injectors.



**Table 2**  
 Knowledge and Use of Buprenorphine among 602 Injection Drug Users in Baltimore, Maryland

	Buprenorphine N (%)	Suboxone N (%)	Subutex N (%)	Buprenex N (%)	Any N (%)
Ever heard of drug	537 (89)	355 (59)	52 (9)	68 (11)	541 (90)
Seen sold on street	430 (71)	232 (39)	13 (2)	18 (3)	446 (74)
Ever used	246 (41)	112 (19)	12 (2)	9 (1)	273 (45)
Usual source <sup>a</sup>					
Doctor	124 (50)	71 (63)	9 (75)	6 (67)	152 (56)
Friend	32 (13)	8 (7)	1 (8)	2 (22)	35 (13)
Street	55 (22)	18 (16)	1 (8)	0	64 (23)
Used last 3 months	73 (12)	50 (8)	4 (1)	1 (<1)	95 (16)
Used last 30 days	47 (8)	35 (6)	3 (<1)	1 (<1)	69 (11)
year 1 <sup>st</sup> used (median)	2005	2006	2006	2003	2005
Ever used to get high	26 (4)	10 (2)	2 (<1)	1 (<1)	30 (5)
Usual source <sup>a</sup>					
Doctor	1 (4)	2 (20)	0	0	2 (7)
Friend	10 (38)	3 (30)	1 (50)	0	12 (40)
Street	15 (58)	5 (50)	1 (50)	1 (100)	18 (60)
Used to get high in last 3 months	14 (2)	7 (1)	1 (<1)	0	15 (2)
Used to get high in last 30 days	5 (1)	3 (<1)	1 (<1)	0	8 (1)
Used to get high more than once	20 (3)	8 (1)	1 (<1)	1 (<1)	23 (4)

Totals may not add to 100 because of missing, don't know, and refused responses; Individuals may be represented more than once in the "Any" column if they reported on more than one drug.

<sup>a</sup>Proportion of the usual source of drug is among those who had reported ever using/ever using to get high

**Table 3**

Unadjusted Odds Ratios (OR) of Recent Use of Buprenorphine Obtained from a Source Other than a Physician, by Socio-demographic and Recent Behavioral Characteristics<sup>a</sup> among IDUs in the ALIVE Cohort in Baltimore, Maryland, 2008

	Unadjusted OR (95% CI)
Age (5 years)	0.98 (0.95 – 1.02)
Sex	
Male	1.00
Female	0.57 (0.30, 1.09)
African-American	
No	1.00
Yes	0.59 (0.25, 1.38)
HIV status	
Negative	1.00
Positive	0.44 (0.21, 0.93)
Alcohol use	
No	1.00
Yes	4.67 (2.30, 9.46)
Marijuana use	
No	1.00
Yes	2.87 (1.59, 5.18)
Snorted cocaine	
No	1.00
Yes	5.56 (2.27, 13.58)
Snorted heroin	
No	1.00
Yes	4.77 (2.62, 8.69)
Smoked heroin	
No	1.00
Yes	3.03 (0.61, 14.97)
Crack use in	
No	1.00
Yes	2.69 (1.51, 4.78)
Injection frequency	
None	1.00
Less than daily	8.04 (3.88, 16.66)
Daily injection	8.29 (3.78, 18.14)
Injected heroin	
No	1.00
Yes	7.18 (4.00, 12.98)
Injected cocaine	
No	1.00
Yes	5.43 (2.92, 10.11)

Unadjusted OR (95% CI)	
Injected speedball	
No	1.00
Yes	4.80 (2.55, 9.07)
Prescription opiate use <sup>b</sup>	
No	1.00
Yes	6.85 (2.98, 15.75)
Street-obtained methadone (past 3 months)	
No	1.00
Yes	11.06 (2.68, 45.60)
Had serious withdrawal symptoms <sup>c</sup>	
No	1.00
Yes	3.39 (1.80, 6.37)
Any drug treatment	
No	1.00
Yes	0.85 (0.47, 1.54)
Methadone treatment	
No	1.00
Yes	0.43 (0.17, 0.99)
Had health insurance	
No	1.00
Yes	0.54 (0.29, 0.98)
Outpatient care	
No	1.00
Yes	0.53 (0.30–0.93)
Buprenorphine treatment	
No	1.00
Yes	2.10 (0.89 – 4.98)
Homeless	
No	1.00
Yes	2.82 (1.45, 5.48)
Employed	
No	1.00
Yes	1.21 (0.64, 2.26)
Jail for at least 7 days	
No	1.00
Yes	1.62 (0.69, 3.79)

<sup>a</sup>Risk behavior reflects responses to questions regarding activity during the prior six months unless otherwise noted;

<sup>b</sup>Prescription opiates included oxycodone (i.e., Oxycontin and Percocet);

<sup>c</sup>Only asked of active injectors

**Table 4**

Adjusted Odds Ratios (OR) and 95% Confidence Intervals of Recent Use of Buprenorphine from a Source Other than a Physician and Socio-Demographic and Recent Behavioral Characteristics<sup>a</sup>, among 602 Injection Drug Users (IDUs) in Baltimore, Maryland, 2008

	Adjusted OR (95% CI)
Age (per 5 years)	0.99 (0.95, 1.03)
Female	0.75 (0.35, 1.64)
African-American	1.41 (0.41, 4.78)
HIV-positive	1.08 (0.44, 2.65)
Alcohol use	2.15 (0.93, 4.98)
Marijuana use	1.37 (0.68, 2.80)
Any reported heroin use	6.62 (2.11, 20.7)
Any reported cocaine use	0.72 (0.32, 1.61)
Injection drug use	3.10 (1.20, 7.98)
Street-obtained methadone, past 3 months	4.44 (0.83, 23.7)
Prescription opiate use <sup>b</sup>	2.61 (0.99, 6.82)
Serious withdrawal symptoms <sup>c</sup>	0.70 (0.31, 1.56)
Methadone treatment	0.43 (0.15, 1.21)
Buprenorphine treatment	0.91 (0.32, 2.58)
Homeless	1.44 (0.64, 3.21)
Had health insurance	1.03 (0.48, 2.23)
Outpatient care	0.99 (0.47, 2.08)

<sup>a</sup>Risk behavior reflects responses to questions regarding activity during the prior six months, unless otherwise noted;

<sup>b</sup>Prescription opiates included oxycodone (i.e., Oxycontin and Percocet);

<sup>c</sup>Only asked of active injectors