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## The CHANGE Study: Methods and Sample Description for a Cross-Sectional Study of Heroin Cessation in New York City

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**ABSTRACT** *The CHANGE (Cessation of Heroin: A Neighborhood Grounded Exploration) Study aimed to understand factors associated with the initiation and maintenance of sustained heroin cessation from the perspective of users themselves and specifically set out to document the correlates of natural recovery. The CHANGE Study was a case-control study conducted in New York City from 2009 to 2011. Cases were former heroin users, abstinent for 1–5 years in the past 5 years. Controls used heroin at least weekly during the past 5 years and were (1) continuous heroin users without a quit attempt of  $\geq 2$  weeks' duration or (2) relapsed heroin users who were currently using and had a quit attempt of  $\geq 2$  weeks' duration during the past 5 years. Recruitment and data collection methods are described along with limitations and a brief description of the study sample. In contrast to many studies of drug use and cessation, the CHANGE Study was designed to model success (i.e., initiation and maintenance of heroin cessation) and not failure.*

**KEYWORDS** *Heroin, Heroin career, Cessation, Relapse, Opiates, Case-control study*

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In 2013, almost 8.9 million (1.8 %) individuals in the USA reported using heroin in their lifetime and 681,000 (0.3 %) reported using heroin in the past year.<sup>1</sup> Heroin dependence is a chronic and relapsing condition,<sup>2</sup> with an estimated 517,000 heroin-dependent individuals in 2013 (SAMHSA, 2014). Illicit drug use results in substantial morbidity and mortality globally and accounted for approximately 20 million disability-adjusted life years (DALYs) in 2010.<sup>3</sup> Opioid dependence accounted for 45.8 % of those DALYs,<sup>3</sup> and North America had the highest opioid dependence DALY rate.<sup>4</sup> In the USA, the economic burden of heroin use is substantial; heroin addiction cost the USA \$21.9 billion in 1996,<sup>5</sup> and the direct and indirect costs of heroin poisonings in the USA were estimated to be \$4.6 billion in 2009.<sup>6</sup>

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The cessation of drug use (also called recovery, remission, and sobriety) is the ultimate goal for many interventions. Recovery has been described as a process that takes years before cessation is complete, with relapses often occurring along the way.<sup>7,8</sup> Cyclical patterns of use, non-use, and treatment are common.<sup>2,7-12</sup> These patterns may be related to a variety of factors including opportunity and availability of the drug, detention/incarceration, and treatment (by type, duration, quality), among other factors.

With some exceptions,<sup>11,13-15</sup> studies of heroin cessation have generally been conducted within treatment samples.<sup>7,8,16-20</sup> Indeed, much of the extant literature about heroin cessation has focused on the role of treatment. There are three main treatment modalities available for heroin abuse: pharmacotherapy (e.g., methadone, buprenorphine, etc.), behavioral therapy, and 12-step programs [e.g., Narcotics Anonymous (NA)]. These modalities have varying degrees of success. Many studies have been conducted to evaluate different treatment modalities and pharmacotherapies and thus are mostly concerned with drug-free outcomes. However, interim milestones, such as cessation of heroin with continuation of other drug use, may be important in understanding the process of cessation.

The large body of work that has focused on the role of treatment in heroin cessation has, to an extent, obscured the possibility of “natural recovery” (i.e., cessation without treatment). It has been postulated by some that heroin cessation could only occur in the context of substance use treatment. Another hypothesis is the prospect of natural or “spontaneous” recovery.<sup>21-26</sup> Natural recovery is a change in behavior by an individual without the aid of formal interventions.<sup>21</sup> The concept of natural recovery has been considered taboo.<sup>27</sup> Researchers who have examined it often contend that natural recovery is not an uncommon phenomenon, but previous research efforts appear to have been biased by (1) the large body of research on treatment outcomes<sup>28-30</sup> where the sampling was in treatment settings which by definition takes individuals who have not recovered spontaneously and (2) the difficulty in finding people who have stopped using heroin on their own.<sup>31</sup>

The CHANGE (Cessation of Heroin: A Neighborhood Grounded Exploration) Study aimed to understand factors associated with the initiation and maintenance of sustained heroin cessation from the perspective of users themselves and specifically set out to document the correlates of natural recovery. Here, we describe the methods for the CHANGE Study and provide a brief description of the study sample.

## **METHODS/DESIGN**

### **Study Design and Setting**

The CHANGE Study was a case-control study conducted in New York City (NYC) from 2009 to 2011. The purpose of the study was to identify factors associated with initiating and sustaining heroin cessation. Participants were recruited in 38 economically disadvantaged neighborhoods throughout four boroughs of NYC (Bronx, Brooklyn, Manhattan, and Queens). The identification and selection of neighborhoods have been previously described.<sup>32</sup>

### **Recruitment**

Participants were recruited using a three-pronged approach: street intercept, walk-in, and referral from another participant. For street intercept recruitment, experienced outreach staff approached individuals in target neighborhoods.

Interested individuals were asked questions about their background and drug use. Those who reported lifetime heroin use were invited to make an appointment to undergo further eligibility screening at a research storefront or on a mobile vehicle stationed in a target neighborhood. For those who were hesitant or not immediately available, hand cards with study information were distributed and outreach staff encouraged individuals to call the toll-free study telephone number for more information and/or pass on hand cards to individuals who may have been interested in the study (and eligible). Interested individuals who approached us or “walked in” to either the research storefront or mobile recruitment vehicle and inquired about the study were provided with study information, pre-screened, and offered an appointment to return. Lastly, an individual could have approached study staff after receiving a referral coupon from a friend who had already participated in the study. Participants were remunerated \$5 for each friend who brought in a coupon and was found eligible.

Once at the storefront or mobile vehicle, pre-screened individuals underwent full eligibility screening with a 10-min survey that gathered detailed background and drug use information. Potential participants provided a urine sample for heroin, methadone, and cocaine testing with one-step test strips for opiates, methadone, and cocaine (Innovacon, Inc., China) to confirm self-reported drug use or abstinence. At the time of urine collection, participants were asked whether they had used opioids or cough/cold medicine in the last 3 days. They were also asked if they had eaten poppy seeds or drank tonic water in the last 3 days. These questions were used to identify possible false-positive urine tests among the former drug users. Written informed consent was required for eligibility screening, including the urine testing.

### **Eligibility Criteria**

Common eligibility for study inclusion into the case and control groups included history of chronic heroin use (defined as  $\geq$  weekly use for  $\geq 1$  year); age  $\geq 27$  years; lived or spent at least half their time in a target NYC neighborhood; and written informed consent for the study, which included a questionnaire and blood (or oral samples) for HIV testing.

### **Case and Control Definitions**

Cases were former heroin users who had reported being abstinent in the year prior to enrollment and up to 5 years continuously in the last 5 years. They also provided a negative opiate urine test or a positive opiate urine test with evidence for possible false-positive results or use of other opiates ( $N=322$ ). There were two control groups: (1) continuous and (2) relapsed heroin users. Continuous heroin users reported using heroin at least weekly during the past 5 years and had either reported never trying to quit or reported never quitting for a minimum of 2 weeks ( $N=345$ ). Relapsed heroin users reported being abstinent at least once for a period of 2 weeks or more during the past 5 years but had relapsed and were currently using heroin ( $N=509$ ). The 2-week period of cessation for relapsers was chosen to take into account heroin pharmacology. The onset of heroin withdrawal generally occurs 8–12 h after the last dose, peaking after 48–72 h.<sup>33</sup> Many individuals try to stop using heroin but have difficulty dealing with withdrawal. By defining a cessation attempt as 2 or more weeks with no heroin use, we were controlling for withdrawal as a correlate of cessation relapse. To be eligible, both relapsed and continuous heroin users were required to provide a positive heroin urine test if they reported heroin use in the past 2 days.

### **Data Collection**

Eligible participants underwent a second written informed consent and completed a structured interview that included questions about drug use, cessation attempts, motivations to quit, and tools and strategies utilized to quit heroin. At the conclusion of enrollment, all participants were given three referral coupons to give to three friends with whom they used drugs. Each participant received \$30 and a roundtrip MetroCard for the local subways and buses. Those who returned to the storefront for HIV blood test results received \$5 and a roundtrip MetroCard.

### **Measures**

Measures were identified based on a close review of the extant literature. In addition, in-depth interviews with 31 current and former heroin users describing predictors and processes that hinder or promote sustained heroin abstinence informed measure selection and development.<sup>34</sup> Descriptions of selected key measures follows.

### **Demographic and Socioeconomic Characteristics**

Demographic variables included sex, race/ethnicity (i.e., Black, Hispanic, White, or Other), age, sexual identity (i.e., heterosexual or homosexual/gay/lesbian/bisexual), educational attainment, and marital status. Main income sources in the past 6 months included employment, public assistance, informal economy, income from someone else, and illegal activities. Employment was defined as having a full- or part-time job, owning a business, or having temporary work. Public assistance included income from government benefits including public assistance, welfare, and other state or federal benefits such as food stamps, disability, or unemployment. The informal economy category refers to money received from recycling cans, returning bottles for deposits, windshield wiping, or panhandling. Income from someone else refers to money from a parent, friend, relative, or spouse. The illegal activities category included theft, robbing, stealing, or conning, selling drugs, and sex for money. We asked about total legal (“on the books” and before taxes) and total untaxed (“off the books”) income in the past year. Because the income distribution was limited, we categorized the income variables as no income or  $\leq$ \$5000, \$5000–\$10,000, and  $>$ \$10,000 per year. Table 1 summarizes the demographic and socioeconomic characteristics of the entire sample.

### **Drug Use Careers**

We asked about lifetime and recent (past 3 months) use along with age of onset of use of a variety of drugs, drug combinations, and routes of administration. With respect to heroin use, we asked about sniffing or snorting heroin alone or in combination with cocaine, injecting heroin alone or combination with cocaine (i.e., speedball) or amphetamine, and smoking heroin alone or in combination with marijuana or crack. We also asked about other opiates including street methadone (i.e., not prescribed to the user from a program) and other narcotics. In addition to the heroin/heroin combination variables, we asked participants whether they had smoked cigarettes, smoked marijuana/hash, sniffed/snorted or injected cocaine, injected or smoked crack (including “ready rock” or freebase cocaine), or snorted, smoked, or injected methamphetamine. We also asked whether participants had used PCP, LSD, ecstasy, other hallucinogens (e.g., mushrooms, peyote, mescaline), or inhalants (e.g., sniffing glue, “locker room,” poppers, nitrous oxide). For all relevant prescription drugs (i.e., tranquilizers, downers, or barbiturates; speed, amphetamines, or stimulants; and steroids), interviewers made sure to clarify we were

**TABLE 1 Sociodemographic characteristics of 1176 former, continuous, and relapsed heroin users: New York City, 2009–2011**

	Full sample (N=1176)	
	<i>n</i>	%
Mean age (SD)	46.3	8.2
Sex		
Male	839	71.3
Female	329	28.0
Transgender	3	0.3
Race/ethnicity		
Hispanic/Latino	484	41.1
Black	562	47.7
White	97	8.2
Other or multi-racial	28	2.4
Sexual orientation		
Straight/heterosexual	1062	90.2
Gay, lesbian, bisexual, or other	114	9.7
Place of birth		
New York City	764	64.9
Puerto Rico	148	12.6
Continental USA	223	18.9
Other	36	3.1
Marital status		
Single, never married	716	60.8
Married, living as married	224	19.0
Divorced, separated, widowed	225	19.1
Other	2	0.2
Educational attainment		
Less than high school	519	44.1
High school diploma/GED	440	37.4
Some college or more	210	17.8
Main income source		
Public assistance	167	14.2
Another person's income	545	46.3
Illegal activities	42	3.6
Employment	117	9.9
Informal economy	288	24.5
Total legal income		
>\$10,000 per year	83	7.1
≤\$10,000 per year	232	19.7
≤\$5000 per year	757	64.3
No income	98	8.2
Total illegal income		
>\$10,000 per year	75	6.4
≤\$10,000 per year	165	14.0
≤\$5000 per year	622	52.8
No income	303	25.7

interested in drugs that were not prescribed by a doctor. We also asked about lifetime and current drug of choice. Table 2 summarizes lifetime use of specific drugs, drug combinations, and routes of administration for the entire sample.

### **Heroin Cessation**

Heroin cessation was the outcome of interest. Respondents were asked if they had ever had a cessation attempt  $\geq 2$  weeks. If they had, they were then asked about the date and duration of the first, most recent, and longest cessation attempts. Due to concerns of recall bias, inquiries focused on the first and most recent cessation attempts. We assessed internal and external motivations for cessation, tools and strategies used to quit, and strategies employed for sustained cessation. Because cessation is often a stressful endeavor, we asked respondents about possible negative feelings during their cessation attempts and whether they experienced craving for heroin or other drugs. If they reported having experienced drug cravings, we asked about their duration, intensity, and frequency of cravings. We also asked about the role of religion/spirituality in the cessation attempt, specifically assessing whether religion/spirituality had helped with cessation, whether the respondent became more religious/spiritual when trying to stop or when they stopped using heroin, and whether they converted to a religion to help them quit. Among those who had reported experiencing a relapse, we asked about reasons for their relapse(s).

### **Drug Treatment**

Respondents were asked if they had ever been in drug treatment and if they were currently in treatment. For the first, most recent, and longest treatment experiences, we assessed date of entry, age at entry, heroin use frequency and quantity prior to entry, amount of money spent on heroin prior to entry, whether methadone was used, perception of helpfulness for heroin cessation, and duration of abstinence. Motivations for treatment entry were queried for the first and most recent cessation attempts.

We asked about the use of pharmacotherapy including methadone, L- $\alpha$ -acetylmethadol (LAAM), buprenorphine, naltrexone, slow-release oral morphine, and clonidine for the first and most recent cessation attempts. For those using pharmacotherapy, we asked about treatment duration, initial and current dosage, respondents' perception of whether pharmacotherapy helped with heroin cessation, and intentions to stop using pharmacotherapy.

Treatment program components were assessed, such as whether counselors or sponsors, group sessions, family therapy, and/or urine testing was a part of the treatment program. We asked whether the treatment program offered additional services (e.g., medical care, mental health services, HIV testing), and Narcotics Anonymous (NA) participation was also assessed. For NA as well as each program component or additional service, we asked whether respondents thought it was helpful for initiating and sustaining cessation for the first and most recent cessation attempts. Treatment program satisfaction included items such as comfort with counselor(s) and program participants, convenience of location and hours, satisfaction with one-on-one sessions, and comfort with program rules. For those who had never been in treatment, we ascertained reasons for not seeking treatment.

Incarceration is a common experience for illicit drug users and has been shown to be associated with cessation as well as relapse.<sup>2,35-37</sup> We ascertained whether participants had ever been incarcerated, and for those who had been to jail or prison, we asked about their most recent incarceration. We asked about services offered prior to release from the most recent incarceration such as appointments, referrals, or information for finding a health care provider, information for finding a mental health care provider, discharge planning, aftercare support, medication, assistance or information for applying for public assistance or Medicaid, and case management. We also asked about health services they received post-incarceration and whether they have difficulty accessing health and social services.

**TABLE 2** Lifetime use of specific drugs, drug combinations, and routes of administration among 1176 former, continuous, and relapsed heroin users: New York City, 2009–2011

	Lifetime use	
	<i>n</i>	%
Any heroin	1176	100.0
Any cocaine	1156	98.2
Any crack	1152	97.9
Any methamphetamine	154	13.1
Sniff/snort heroin	1160	98.6
Cigarettes	1127	95.8
Sniff/snort cocaine alone	1122	95.3
Marijuana or hash	1101	93.5
Smoke crack	979	83.2
Inject heroin	648	55.1
PCP	647	55.0
LSD	508	43.2
Street methadone	471	40.0
Inject cocaine and heroin	431	36.6
Inject cocaine	399	33.9
Barbiturates	350	29.9
Sniff/snort cocaine and heroin	319	27.1
Ecstasy	315	26.8
Smoke heroin and crack	237	20.1
Hallucinogens	168	14.3
Narcotics or other opiates	119	10.1
Inhalants	85	7.2
Snort methamphetamine	71	6.0
Smoke heroin	66	5.6
Smoke methamphetamine	64	5.4
Smoke marijuana and heroin	60	5.1

## DISCUSSION

The CHANGE Study sample is a highly impoverished group of former, continuous, and relapsed heroin users that is diverse with respect to sex, race/ethnicity, sexual orientation, and educational attainment. In addition to heroin, the vast majority of CHANGE participants had smoked cigarettes and used cocaine, marijuana, and crack in their lifetime. More than half (55 %) had injected heroin in their lifetime, and 36.5 % had injected speedballs (heroin and cocaine together). Methamphetamine use was rare, with only 13 % reporting any use.

The purpose of this case-control study is to characterize factors associated with initial and sustained cessation of heroin use among persons who report a history of chronic heroin use within economically disadvantaged, predominantly racial/ethnic minority neighborhoods in New York City (NYC). Groundbreaking studies in the 1960s, 1970s, and 1980s provided mostly descriptive data on the natural history of drug abuse with samples drawn from drug abuse treatment and the criminal justice system.<sup>9,12,22,38–46</sup> Natural recovery is less well studied,<sup>11,13,14,31,47</sup> especially recently, and data are sparse on the factors associated with sustained heroin cessation, particularly among street-recruited samples.



The CHANGE Study focused on cessation of heroin use specifically, as opposed to cessation of all drugs or cessation of drug injection for three primary reasons. First, there is ample evidence that the determinants of use of various drugs are different.<sup>48–50</sup> Therefore, a study attempting to assess determinants of multiple drug use patterns (e.g., cessation of heroin and cocaine) simultaneously would be likely to produce results that are difficult to interpret and less likely to suggest fruitful avenues for intervention. Second, in focusing on heroin use and cessation, the CHANGE Study was designed to consider the use of other drugs as potentially important correlates of heroin cessation. Although studies have demonstrated that poly-substance use is associated with a greater likelihood of morbidity and mortality than the use of one substance alone,<sup>51,52</sup> in order to understand complex patterns of substance use, we first must systematically assess heroin use alone and recognize that the determinants of heroin use and cessation are likely quite different than those of other drugs. Third, a study that tried to rigorously assess the determinants of multiple-drug cessation would need a prohibitively large sample size to include all the relevant groups of interest (e.g., cessation of two drugs, cessation of drug A but not drug B, cessation of drug B but not drug A, cessation of neither).

There are several limitations to the CHANGE Study that must be acknowledged. The CHANGE Study was a case-control study, and therefore, any temporal associations that are observed are based upon self-report. As in any study of drug use cessation, the former heroin users (i.e., the cases) have the potential to become controls (i.e., relapsers). The CHANGE sample may not be representative of all former, continuous, and relapsed heroin users as the sample was highly impoverished, with at least 93 % living below the 2009 federal poverty threshold for a single individual—\$10,956 per year<sup>53</sup> and the majority (89 %) were Black or Hispanic/Latino. A recent sample of individuals entering heroin treatment in 48 states was 79.5 % White;<sup>54</sup> similarly, 64.9 % of heroin admissions in the 2012 Treatment Episode Data Set (TEDS) were White.<sup>55</sup> However, this highly diverse sample is unique and facilitates examination of racial and ethnic differences in heroin cessation correlates.

In contrast to many studies of drug use and cessation, the CHANGE Study was designed to model success (i.e., initiation and maintenance of heroin cessation) and not failure. Future analyses of the CHANGE Study will identify factors associated with the initiation and maintenance of heroin cessation.

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## REFERENCES

1. Substance Abuse and Mental Health Services Administration. *Results from the 2013 National Survey on Drug Use and Health: detailed Tables*. Rockville, MD: Substance Abuse and Mental Health Services Administration; 2014. <http://www.samhsa.gov/data/sites/default/files/NSDUH-DetTabsPDFWHTML2013/Web/HTML/NSDUH-DetTabsTOC2013.htm>. Accessed 9 Jan 2015.
2. Darke S. *The life of the heroin user: typical beginnings, trajectories and outcomes*. Cambridge (UK): Cambridge University Press; 2011.

3. Degenhardt L, Whiteford HA, Ferrari AJ, et al. Global burden of disease attributable to illicit drug use and dependence: findings from the Global Burden of Disease Study 2010. *Lancet*. 2013; 382(9904): 1564–1574.
4. Degenhardt L, Charlson F, Mathers B, et al. The global epidemiology and burden of opioid dependence: results from the global burden of disease 2010 study. *Addiction*. 2014; 109(8): 1320–1333.
5. Mark TL, Woody GE, Juday T, Kleber HD. The economic costs of heroin addiction in the United States. *Drug Alcohol Depend*. 2001; 61(2): 195–206.
6. Inocencio TJ, Carroll NV, Read EJ, Holdford DA. The economic burden of opioid-related poisoning in the United States. *Pain Med*. 2013; 14(10): 1534–1547.
7. Hser YI, Anglin D, Powers K. A 24-year follow-up of California narcotics addicts. *Arch Gen Psychiatry*. 1993; 50(7): 577–584.
8. Hser YI, Hoffman V, Grella CE, Anglin MD. A 33-year follow-up of narcotics addicts. *Arch Gen Psychiatry*. 2001; 58(5): 503–508.
9. Vaillant GE. A 20-year follow-up of New York narcotic addicts. *Arch Gen Psychiatry*. 1973; 29(2): 237–241.
10. Simpson DD, Joe GW, Lehman WEK, Sells SB. Addiction careers—etiology, treatment, and 12-year follow-up outcomes. *J Drug Issues*. 1986; 16(1): 107–121. **Win.**
11. Biernacki P. *Pathways from heroin addiction: recovery without treatment*. Philadelphia: Temple University Press; 1986.
12. Nurco DN, Cisin IH, Balter MB. Addict careers. I. A new typology. *Int J Addict*. 1981; 16(8): 1305–1325.
13. Waldorf D, Biernacki P. Natural recovery from heroin-addiction—review of the incidence literature. *J Drug Issues*. 1979; 9(2): 281–289.
14. Waldorf D, Biernacki P. The natural recovery from opiate addiction—some preliminary findings. *J Drug Issues*. 1981; 11(1): 61–74.
15. Stall R, Biernacki P. Spontaneous remission from the problematic use of substances—an inductive model derived from a comparative-analysis of the alcohol, opiate, tobacco, and food obesity literatures. *Int J Addict*. 1986; 21(1): 1–23.
16. Hubbard RL, Craddock SG, Anderson J. Overview of 5-year followup outcomes in the drug abuse treatment outcome studies (DATOS). *J Subst Abuse Treat*. 2003; 25(3): 125–134.
17. Hser YI. Predicting long-term stable recovery from heroin addiction: findings from a 33-year follow-up study. *J Addict Dis*. 2007; 26(1): 51–60.
18. Darke S, Ross J, Teesson M, et al. Factors associated with 12 months continuous heroin abstinence: findings from the Australian Treatment Outcome Study (ATOS). *J Subst Abuse Treat*. 2005; 28(3): 255–263.
19. Darke S, Ross J, Mills KL, Williamson A, Havard A, Teesson M. Patterns of sustained heroin abstinence amongst long-term, dependent heroin users: 36 months findings from the Australian Treatment Outcome Study (ATOS). *Addict Behav*. 2007; 32(9): 1897–1906.
20. Darke S, Mills KL, Ross J, Williamson A, Havard A, Teesson M. The ageing heroin user: career length, clinical profile and outcomes across 36 months. *Drug Alcohol Rev*. 2009; 28(3): 243–249.
21. Klingemann HK, Sobell LC. Introduction: natural recovery research across substance use. *Subst Use Misuse*. 2001; 36(11): 1409–1416.
22. Preble E, Casey JJ. Taking care of business—heroin users life on street. *Int J Addict*. 1969; 4(1): 1–24.
23. Granfield R, Cloud W. Social context and “natural recovery”: the role of social capital in the resolution of drug-associated problems. *Subst Use Misuse*. 2001; 36(11): 1543–1570.
24. Bischof G, Rumpf HJ, Meyer C, Hapke U, John U. Stability of subtypes of natural recovery from alcohol dependence after two years. *Addiction*. 2007; 102(6): 904–908.
25. Sobell LC, Ellingstad TP, Sobell MB. Natural recovery from alcohol and drug problems: methodological review of the research with suggestions for future directions. *Addiction*. 2000; 95(5): 749–764.

26. Burman S. The challenge of sobriety: natural recovery without treatment and self-help groups. *J Subst Abuse*. 1997; 9: 41–61.
27. Chiauuzzi EJ, Liljegen S. Taboo topics in addiction treatment. An empirical review of clinical folklore. *J Subst Abuse Treat*. 1993; 10(3): 303–316.
28. Graeven DB, Graeven KA. Treated and untreated addicts—factors associated with participation in treatment and cessation of heroin use. *J Drug Issues*. 1983; 13(2): 207–218.
29. Klingemann HK. The motivation for change from problem alcohol and heroin use. *Br J Addict*. 1991; 86(6): 727–744.
30. Price RK, Risk NK, Spitznagel EL. Remission from drug abuse over a 25-year period: patterns of remission and treatment use. *Am J Public Health*. 2001; 91(7): 1107–1113.
31. Biernacki P. Recovery from opiate addiction without treatment: a summary. *NIDA Res Monogr*. 1990; 98: 113–119.
32. Weiss L, Ompad D, Galea S, Vlahov D. Defining neighborhood boundaries for urban health research. *Am J Prev Med*. 2007; 32(6 Suppl): S154–S159.
33. O'Brien CP. Drug addiction and drug abuse. In: Brunton LL, Lazo JS, Parker KL, eds. *Goodman & Gilman's the pharmacological basis of therapeutics*. 11th ed. New York: McGraw-Hill; 2006.
34. Weiss L, Gass J, Egan JE, Ompad DC, Trezza C, Vlahov D. Understanding prolonged cessation from heroin use: findings from a community-based sample. *J Psychoactive Drugs*. 2014; 46(2): 123–132.
35. Fox AD, Anderson MR, Bartlett G, Valverde J, Starrels JL, Cunningham CO. Health outcomes and retention in care following release from prison for patients of an urban post-incarceration transitions clinic. *J Health Care Poor Underserved*. 2014; 25(3): 1139–1152.
36. Fox AD, Maradiaga J, Weiss L, Sanchez J, Starrels JL, Cunningham CO. Release from incarceration, relapse to opioid use and the potential for buprenorphine maintenance treatment: a qualitative study of the perceptions of former inmates with opioid use disorder. *Addict Sci Clin Pract*. 2015; 10(1): 2.
37. Hser YI, Evans E, Grella C, Ling W, Anglin D. Long-term course of opioid addiction. *Harv Rev Psychiatry*. 2015; 23(2): 76–89.
38. Nurco DN, Cisin IH, Balter MB. Addict careers. III. Trends across time. *Int J Addict*. 1981; 16(8): 1357–1372.
39. Nurco DN, Cisin IH, Balter MB. Addict careers. II. The first ten years. *Int J Addict*. 1981; 16(8): 1327–1356.
40. Winick C. Maturing out of narcotic addiction. *Bull Narc*. 1962; 14(1): 1–7.
41. Smith WG, Ellinwood EH, Vaillant GE. Narcotic addicts in the mid-1960's. *Public Health Rep*. 1966; 81(5): 403–412.
42. Vaillant GE. Twelve-year follow-up of New York narcotic addicts. II. The natural history of a chronic disease. *N Engl J Med*. 1966; 275(23): 1282–1288.
43. Vaillant GE. A 12-year follow-up of New York narcotic addicts. 3. Some social and psychiatric characteristics. *Arch Gen Psychiatry*. 1966; 15(6): 599–609.
44. Vaillant GE. A twelve-year follow-up of New York narcotic addicts: IV. Some characteristics and determinants of abstinence. *Am J Psychiatry*. 1966; 123(5): 573–585.
45. Vaillant GE. A twelve-year follow-up of New York narcotic addicts. I. The relation of treatment to outcome. *Am J Psychiatry*. 1966; 122(7): 727–737.
46. Vaillant GE. The natural history of narcotic drug addiction. *Semin Psychiatry*. 1970; 2(4): 486–498.
47. Waldorf D. Natural recovery from opiate addiction—some social-psychological processes of untreated recovery. *J Drug Issues*. 1983; 13(2): 237–280.
48. Tsuang MT, Lyons MJ, Meyer JM, et al. Co-occurrence of abuse of different drugs in men: the role of drug-specific and shared vulnerabilities. *Arch Gen Psychiatry*. 1998; 55(11): 967–972.
49. Blazer DG, Wu LT. The epidemiology of substance use and disorders among middle aged and elderly community adults: national survey on drug use and health. *Am J Geriatr Psychiatry*. 2009; 17(3): 237–245.

50. Palamar JJ, Ompad DC. Demographic and socioeconomic correlates of powder cocaine and crack use among high school seniors in the United States. *Am J Drug Alcohol Abuse*. 2014; 40(1): 37–43.
51. Coffin PO, Galea S, Ahern J, Leon AC, Vlahov D, Tardiff K. Opiates, cocaine and alcohol combinations in accidental drug overdose deaths in New York City, 1990–98. *Addiction*. 2003; 98(6): 739–747.
52. Darke S, Marel C, Mills KL, et al. Patterns and correlates of non-fatal heroin overdose at 11-year follow-up: findings from the Australian Treatment Outcome Study. *Drug Alcohol Depend*. 2014; 144: 148–152.
53. U.S. Census Bureau. *Poverty thresholds* 2009; 2010. <https://www.census.gov/hhes/www/poverty/data/threshld/thresh09.html>. Accessed 11 Jan 2015.
54. Cicero TJ, Ellis MS, Surratt HL, Kurtz SP. The changing face of heroin use in the United States: a retrospective analysis of the past 50 years. *JAMA Psychiatry*. 2014; 71(7): 821–826.
55. Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration. *Treatment Episode Data Set (TEDS): Table 2.2. Admissions aged 12 and older, by race/ethnicity according to primary substance of abuse: 2012; 2013*. [http://www.samhsa.gov/data/sites/default/files/TEDS2012N\\_Web/TEDS2012NTbl2.2.htm](http://www.samhsa.gov/data/sites/default/files/TEDS2012N_Web/TEDS2012NTbl2.2.htm). Accessed 11 Jan 2015.