**Comparison of Methods for Recruiting Suburban Opioid Users for Research**

**Running head: Methods for Recruiting Suburban Opioid Users**

Mary Ellen Mackesy-Amiti, Ph.D.a\*

Timothy P. Johnson, Ph.D.b

Basmattee Boodram, Ph.D.c

a Community Outreach Intervention Projects, School of Public Health, University of Illinois at Chicago, Chicago, Illinois, USA; b College of Urban Planning and Public Affairs, Survey Research Laboratory, University of Illinois at Chicago, Chicago, Illinois, USA; c Division of Community Health Sciences, School of Public Health, University of Illinois at Chicago, Chicago, Illinois, USA

Correspondence concerning this article should be addressed to Mary E. Mackesy-Amiti, School of Public Health / CHS, University of Illinois at Chicago, 1603 W. Taylor St., Chicago, IL 60612 USA. Tel. +1 312-355-4892; email: mmamiti@uic.edu

**Funding:** This study was supported by a 2017 University of Illinois at Chicago School of Public Health Seed Grant to Mary E. Mackesy-Amiti.

**Preprint v2: December 3, 2020**

Previously titled “Comparison of Methods for Recruiting Suburban Opioid Users for Studies on Hepatitis C Virus Infection Prevention”

**Comparison of Methods for Recruiting Suburban Opioid Users for Research**

Background: Increasing opioid use among young people contributes to multiple harms including overdose, and HIV and hepatitis C virus infections. Objective: We conducted a study to test and compare internet-based methods for recruiting young suburban residents for research on opioid use and risk behaviors. Methods: We used a multi-pronged advertising strategy to recruit young adults (18-29 years) residing in the suburbs surrounding the City of Chicago to an online survey to test the feasibility of using these methods to recruit people who used opioids in the past 30 days for a research study. Results: Over 1,000 survey responses were recorded during 13 weeks, of which 60% (n = 606) were valid and at least 90% complete. Survey completers were 61% male, and 65% non-Hispanic white, with a mean age of 21. Six percent of respondents (n = 34) reported misuse of prescription pain relievers in the past 30 days, and 1% (n = 6) reported recent heroin use. Of the 38 respondents who were eligible for the telephone interview, 26 (68%) indicated that they were interested in learning more about the research study, and 24 provided contact information. Conclusion: Facebook/Instagram advertising appears to be a useful online resource for identifying and recruiting suburban opioid users for research, with a cost of about $20 per subject. Craigslist and reddit, while free, are slower and less efficient as they require staff time to continually re-post, but may be worthwhile to include as part of a multi-pronged strategy.

Keywords: opioid use; internet survey; advertising; recruitment; electronic survey; social media

# **Introduction**

The U.S. opioid epidemic is a significant public health problem taking its toll in increasing rates of opioid overdose deaths (Centers for Disease Control and Prevention, 2011; Rudd, Seth, David, & Scholl, 2016; Seth, Scholl, Rudd, & Sarah, 2018), rising rates of heroin use and injection drug use (IDU) (Broz & Ouellet, 2008; Center for Behavioral Health Statistics and Quality, 2015; Centers for Disease Control and Prevention, 2001; Chatterjee et al., 2011; Kuehn, 2014; Tempalski et al., 2013), an emerging epidemic of hepatitis C virus infection (Zibbell et al., 2018; Zibbell et al., 2015), and alarming outbreaks of injection-related HIV infection (Massachusetts Department of Public Health; Strathdee & Beyrer, 2015). An estimated 3-4% of people who misuse prescription opioids (PO) initiate heroin use (Compton, Jones, & Baldwin, 2016; Jones, Logan, Gladden, & Bohm, 2015), and prior and concurrent PO misuse is common among young people who inject drugs (PWID) (Al-Tayyib, Rice, Rhoades, & Riggs, 2014; Compton et al., 2016; Jones et al., 2015; Khosla, Juon, Kirk, Astemborski, & Mehta, 2011; Lankenau et al., 2012b; Mackesy-Amiti, Donenberg, & Ouellet, 2015; Martinez, D’Amico, Kral, & Bluthenthal, 2012). In the last decade, several studies (Grau et al., 2007; Jones, 2013; Lankenau et al., 2012a; Mars, Bourgois, Karandinos, Montero, & Ciccarone, 2014; Peavy et al., 2012; Pollini et al., 2011) have linked the rise in PO misuse (National Institute on Drug Abuse & Community Epidemiology Work Group, 2011; Substance Abuse and Mental Health Services Administration, 2009), particularly among young people (Johnston, O'Malley, Bachman, & Schulenberg, 2010; Lankenau et al., 2012a; Substance Abuse and Mental Health Services Administration, 2010), with the simultaneous increase in IDU (Broz & Ouellet, 2008; Chatterjee et al., 2011; Tempalski et al., 2013) among young, mostly non-Hispanic whites from suburban and rural areas of the United States (U.S.) (Armstrong, 2007; Boodram, Mackesy-Amiti, & Latkin, 2015; Broz & Ouellet, 2008; Broz et al., 2014; Mackesy-Amiti, Donenberg, & Ouellet, 2012; Mathers et al., 2008; National Institute on Drug Abuse & Community Epidemiology Work Group, 2011; Neaigus et al., 2006; Prussing, Bornschlegel, & Balter, 2014). The design and implementation of effective harm reduction interventions must be informed by a good understanding of the risks that contribute to the harms (e.g. overdose, HCV infection) (Newcombe, O'Hare, Matthews, & Buning, 1992), including information on the distribution of risks in the population, and factors that exacerbate or ameliorate these risks. Understanding and preventing transitions from PO to heroin use and IDU, as well as understanding individual, social and community-level factors that lead to high-risk behaviors and high-risk partner contact are potentially important contributions to overdose prevention and HCV prevention in this population. Studies are needed to assess the state of overdose awareness, HCV knowledge, risk practices, and profiles of young suburban PWID.

We report a study designed to address challenges in recruiting young suburban opioid users. While fixed site syringe service programs at the University of Illinois at Chicago’s (UIC) Community Outreach Intervention Projects have served as recruiting points for past studies of young PWID (Boodram et al., 2015; Garfein et al., 2007; Iguchi et al., 2009; Mackesy-Amiti et al., 2012; Thorpe, Bailey, Huo, Monterroso, & Ouellet, 2001), these sites provide limited reach geographically and in terms of recruiting non-injecting opioid users. Respondent-driven sampling (RDS) (Burnhams et al., 2016; Heckathorn, 1997; Heckathorn, Semaan, Broadhead, & Hughes, 2002; Young, Rudolph, & Havens, 2018), is of limited use in a population with strongly clustered networks, in which most of the network members only know one another. In our most recent study of PWID that employed RDS (Mackesy-Amiti et al., 2012), although the average reported network size was ~7, the average depth of recruitment chains was only 2.6 – that is, recruitment usually stopped after 2 to 3 waves.

Other chain-referral approaches, including snowball sampling (Biernacki, 1986; Kaplan, Korf, & Sterk, 1987) and the random walk method (Bell, Erbaugh, Serrano, Dayton-Shotts, & Montoya, 2017), can be expected to have similar disadvantages in recruiting from this population. Although targeted sampling (Peterson et al., 2008; Rudolph et al., 2011; Semaan, Lauby, & Liebman, 2002), venue or time-space sampling (Muhib et al., 2001; Semaan, 2010), and adaptive allocation and cluster sampling designs (Thompson & Collins, 2002) have also been productively employed in the study of opioid and other drug users, they each suffer from concerns regarding coverage adequacy and require considerable time and effort to properly implement.

In order to reach young suburban opioid/heroin users more effectively, especially those who have not yet initiated IDU, we conducted a study designed to investigate new and potentially more efficient social media and electronic methods of survey recruitment for this hard-to-find population. We also embedded a test of different images in social media advertising campaigns. These advertisements rely heavily on images to draw attention and we were interested in testing the effect of using drug images vs. other content.

# **Methods**

## ***Procedures***

We used a multi-pronged advertising strategy to recruit young adults (18-29 years) residing in the suburbs surrounding the City of Chicago to an online survey for a study on “substance use and health”. To avoid false reporting, we did not advertise that we were seeking opioid users. The questionnaire introduction and consent page included the statement, “After you complete the survey, you may be invited to participate in a research study at the University of Illinois at Chicago.” We collected data on the number of surveys completed for each recruitment method. In addition, given the importance of recruitment messages (Choi et al., 2017; Kayrouz, Dear, Karin, & Titov, 2016; Wozney, Turner, Rose-Davis, & McGrath, 2019), we included a test of different advertising images. Using the Facebook split test design, we compared the responses to three different images that were designed to test the effectiveness of alternative appeal strategies.

The Qualtrics survey collected information about participants’ substance use, and respondents who reported recent (past 30 days) prescription opioid or heroin use were recruited for a telephone interview. Informed consent was obtained by requiring participants to click on the statement “I consent to participate” at the bottom of the introduction page that informed participants about the purpose of the survey, protection of confidentiality, and data security. To protect respondent confidentiality, IP addresses and location data were not recorded with survey responses. After completing the survey, participants had the opportunity to enter contact information for a random drawing for a $20 Amazon gift card. Contact information was kept separate from survey data, and downloaded and deleted from the server daily. The protocol for this study was approved by the University of Illinois at Chicago Institutional Review Board (#2017-0943).

## ***Recruitment***

We identified a tentative set of 11 recruitment approaches that have been used to recruit similar hard to reach populations (Casler, Bickel, & Hackett, 2013; Duncan, White, & Nicholson, 2003; Fenner et al., 2012; Guillory et al., 2018; Hendricks, Düking, & Mellalieu, 2016; Leach, Butterworth, Poyser, Batterham, & Farrer, 2017; Lord, Brevard, & Budman, 2011; Motoki et al., 2017; Nunan & Knox, 2011; Ramo & Prochaska, 2012; Thornton et al., 2016), including conventional non-electronic methods, electronic recruitment methods, and social media recruitment methods. We included approaches targeting the general population as well as those that were youth-oriented. In addition, we conducted two focus groups with syringe service program clients who met the study eligibility criteria to elicit input to further develop the list of recruitment venues/strategies. The focus group conversations highlighted the difficulties in identifying relevant public spaces, physical or virtual, that might be leveraged to recruit suburban PWID. In contrast to the city, suburban drug use occurs more frequently private in spaces, and drugs are delivered directly to private homes.

We staggered the roll-out of each recruitment method over a 3-month period to better evaluate the independent effectiveness of each. Due to inherent differences in the various methods, we did not attempt to regulate the length of time for which each method was employed. To avoid over-recruiting by any method, we initially set a quota of 125 valid survey responses for each (250 for Facebook/Instagram). Each advertisement method included a URL tag to track the source of the response, and at the end of survey we asked respondents how they learned about the study. Respondents were also encouraged to share the survey link. Advertisements were titled “Study on Substance Use & Health - Online Survey” and included the following text in the ad or on a landing page (for social media picture-based ads):

“Researchers at the University of Illinois at Chicago are conducting a survey on substance use and health for people 18 to 29 years old who live in the suburban Chicago area. The survey will ask questions about your experience with substance use, including prescription medicines, marijuana, and other drugs. You may also be asked questions about certain health issues. For most people, the survey takes about 10 minutes to complete. Participants will have a chance to win one of fifty (50) $20 Amazon gift cards. Odds of winning are approximately 1 in 20. To learn more and to access the survey click here: [link].”

### *Week 1. Craigslist*

Craigslist ads were placed in the “Volunteers” category for each Chicago area (central, west, northwest, north, south, and northeast Indiana) on a rotating basis. The ads were continually reposted and renewed to keep them appearing on the first page.

### *Week 2. Bluelight Forum*

We posted our ad in the Drug Studies sub-forum. It remained on the front page and did not need to be renewed.

### *Week 3. UIC Announce*

We submitted our ad to UIC Announcements, an online announcement system hosted by the University of Illinois at Chicago (UIC), and it remained visible for the remainder of the recruitment period. (Flat fee, $125).

### *Week 4/6. Reddit*

We began by posting in the r/SampleSize subreddit, which is specifically intended for recruiting research participants. We cross-posted to the r/Chicago and r/drugs subreddits. The r/drugs posting had to be authorized by a moderator, who requested minor changes to some of the survey questions. Specifically, the moderator requested that we use the term “psychedelics” rather than “hallucinogens” in “LSD, psilocybin, mescaline, peyote or any other hallucinogen”, remove GHB and Rohypnol from the dissociatives category (PCP, ketamine, Rohypnol or GHB), and accommodate sublingual as a route of administration (we changed “swallowing” to “orally”). We then converted the post to a paid ad (promoted post). We also sought to post in the r/opiates subreddit but the moderators did not allow it.

### *Week 6. Flyers*

We posted flyers in various locations (e.g., train stations, supermarkets, laundromats, community colleges) in the West and Southwest suburbs of Chicago.

### *Week 6/7. Facebook/Instagram*

We began a Facebook campaign with a split test to compare the performance of three images (see Fig 1 and Fig 2), with a daily budget of $20. We then continued the campaign with the best performing image with a daily budget of $30. We used a single image ad with a “Learn More” button linking to the Qualtrics survey landing page. The campaign was targeted to age 18-30 and a list of zip codes defining the Chicago suburban area. The campaign was initially configured to allow Facebook to determine the best distribution of placements for our target sample. This resulted in over 90% of placements on Instagram, and after 4 days we reached the quota of 250 valid survey responses. In order to obtain more Facebook responses, we reset the quota and resumed the campaign without Instagram.

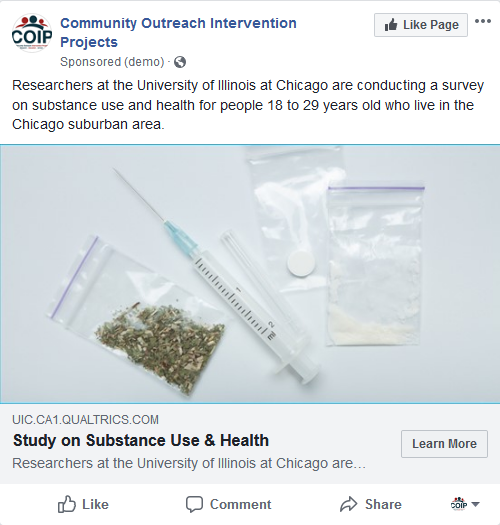


Figure 1. Facebook advertisement with drugs image

### *Week 7. Tumblr*



Figure 2. Alternative images: (a) drug icons, (b) laptop cat.

Prior to the survey campaign, we set up a Tumblr account and posted items about overdose prevention and hepatitis C. We posted the advertisement using tags: #drugs, #heroin, #pills, #overdose, #health, #survey, and #Chicago. We searched for users who had posted with tags #heroin and #Chicago and shared the post with 5 Tumblr users identified.

### *Week 7/8. Snapchat*

We submitted ads with the same three images we used for Facebook, however the drug images and drug icons were not allowed. This was a short campaign as the minimum bid for Snapchat is $50/day. The laptop cat ad (Fig 2, image (b)) ran for 2 days, then we selected two alternative images (Fig 3) for a second campaign that ran for 3 days.

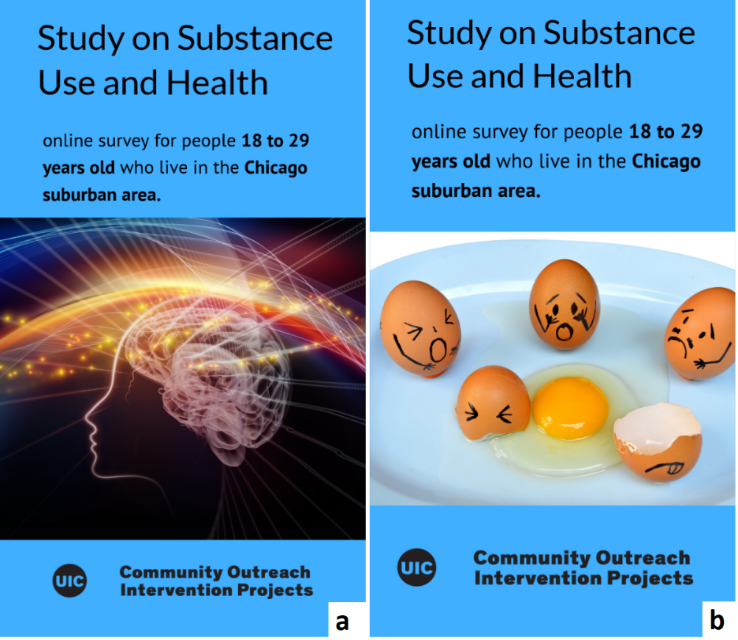


Figure 3. Snapchat ads with alternative images: a) brain, b) eggs.

### *Week 8. Twitter*

We used the drugs image (Fig 1) for the Twitter campaign and key words #drugs, #pills, #opioids, #heroin, and #Chicago. With a budget of $30/day this campaign ran for 7 days.

### *Week 10. Facebook (Round 2)*

As we neared the end of our recruiting period, and having experimented with all of the above recruitment methods, we had accumulated a total of 773 survey responses, with 566 screening eligible responses. Since we had not reached our goal of 1,000 responses, we decided to run another campaign focused on Facebook placements only, and let this run until the end of the recruitment period.

## ***Eligibility***

Individuals between the ages of 18 and 29 who lived outside of Chicago, in a zip code within a 45-mile driving distance of UIC on Chicago’s near west side, were eligible to complete the screening questionnaire. The eligible zip code area included Cook County (outside of Chicago), DuPage County, parts of Kane, Kendall, Will, and Lake counties in Illinois, and part of Lake County, Indiana (see Fig 4).

***Initial Screening***

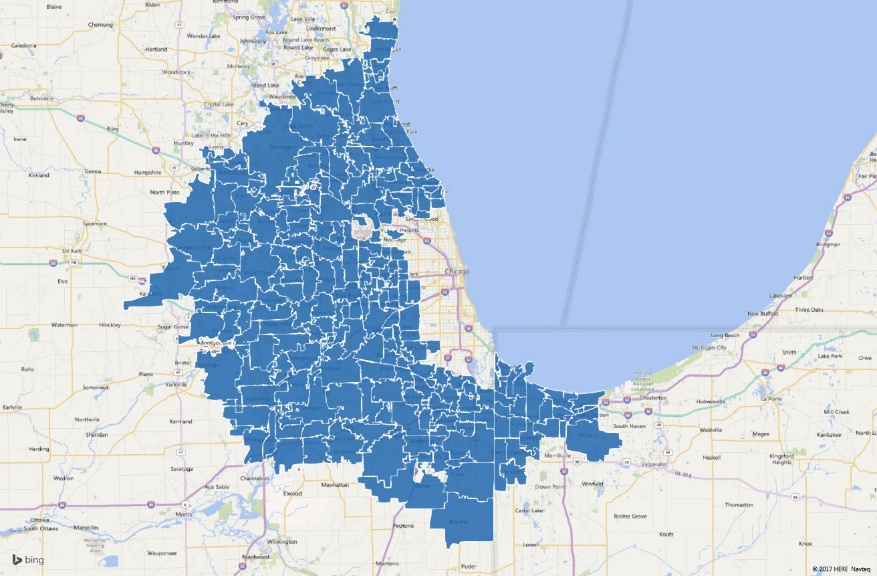


Figure 4. Sampling Area (Zip Codes)

The screening questionnaire (Multimedia Appendix 1) required 5-8 minutes to complete. It included questions about age, gender, residence (zip code), and lifetime and recent substance use (including nicotine and alcohol) and routes of administration to assess eligibility. Other questions included race/ethnicity, education, employment, and smartphone ownership. Additional questions were asked for participants who reported opioid use (heroin or prescription pain relievers) or injection drug use to assess overdose experiences, overdose and hepatitis C knowledge, syringe access, and HCV testing. Responses for age, zip code, gender, substances ever used and recency of use were required. Participants who reported any heroin use or misuse of prescription pain relievers in the past 30 days were informed that they qualified for a telephone interview and they received a unique alpha-numeric ID code. They were re-directed to a new form and asked to provide their contact information (phone number or email address). To protect confidentiality, the contact information form was not linked to the survey data. Participants were informed that they needed to write down or copy their ID code and provide it to the interviewer. Survey participants who were not selected were re-directed to a form to provide a phone number or email address for a random drawing. All screening participants received an entry into a random drawing for 1 of 50 $20 Amazon gift cards, (1/20 chance of winning).

## ***Telephone interview***

Selected participants were contacted by telephone, or directed in an email to call a toll-free number at the UIC Survey Research Laboratory. Interviewing was conducted primarily on weekday evenings and weekends to increase the probability of successful contact with respondents. In the telephone screening, the interviewer assessed the reliability of participants’ responses by repeating some questions and asking for additional details, such as a description of the substance used. If current opioid use was confirmed, the participant was asked if they would be willing to participate in a study that consisted of an in-person 90-minute interview for which they would receive $50 plus transportation expenses depending on distance to travel. Participants selected for telephone screening were offered a $5 gift card as compensation for their time, later increased to $10.

## ***Measures***

Demographic information collected included gender, age, race/ethnicity, and zip code. Using zip code data, geographic areas of South, Southwest, West, and North suburbs were defined, consistent with Cook County Department of Health administrative districts. The screening questionnaire included items to measure types of substances ever used, age of first use, modes of use (e.g. smoking, snorting, injection), recency of use, and frequency of use in the past 6 months and in the past 30 days. Lifetime substance use was assessed with two screening questions inquiring about 1) Licit and illicit substances including tobacco, alcohol, marijuana, cocaine, heroin, etc., and 2) misuse of prescription drugs, including pain relievers, sedatives, tranquilizers, etc. (“Have you ever used any of the following types of prescription drugs when they were not prescribed to you and/or that you used to get high or to avoid withdrawal symptoms? This can include using larger amounts, more often, or for longer than prescribed.)” Examples of prescription pain relievers were given (e.g. codeine, Dilaudid, Tramadol, Vicodin, Oxycontin). Participants who reported past or current injection were asked for their age at first injection for each substance injected.

## ***Analysis***

For each recruitment method employed, we computed measures of speed, cost and quality. We evaluated *speed* as the average number of valid and complete survey responses per day for the duration of each advertising campaign. For paid advertising methods, we evaluated *cost* in terms of (1) cost-per-result (i.e. click/swipe through to web site), (2) cost per completed screening, and (3) cost per interview-eligible subject identified. We evaluated *quality* for each method as (1) the total number of survey responses generated, (2) the screening survey completion rate, (3) the eligibility rate produced, and (4) sample diversity in terms of age, education and race/ethnicity.

Demographic and substance use characteristics were first examined with descriptive statistics, including means and proportions, stratified by recruitment method. ANOVA and chi-square tests of independence were used to investigate whether or not these measures differed significantly by recruitment method. For categorical variables, contrasts were computed using multinomial logistic regression.

We estimated that with at least 52 screening responses for each specific recruitment method we would have 80% power to detect medium-sized effects (d = 0.50) in continuous outcomes (e.g. time measures, age), and a 3-fold increase in the eligibility rate (e.g. 15% vs. 5%). While the population prevalence of past month opioid use was estimated at 2.5% for young adults, we anticipated that overall about 10% of the people who responded to the advertised study on “substance use and health” would report opioid use. Thus, we estimated that 1,000 screening surveys would provide the minimum sample of n = 100 for estimating the proportion who would agree to an in-person interview with a margin of error of +/-10 percentage points.

# **Results**

## Figure 5 shows a flow chart of the recruitment sampling results.

Survey responses received: n=1,011

Meets eligibility criteria: n=783

Completed survey: n=606

Interview eligible: n=38

Interview completed: n=17

Screening Incomplete (n=47) or ineligible (n=181)

Incomplete Survey n=177

No current opioid use reported (n=568)

Not interested (n=12), no contact (n=2), or no response (n=7)

Figure 5. Recruitment flow chart.

## ***Recruitment***

We began recruitment April 30, 2018 and ended July 28, 2018 (13 weeks). The final set of recruitment methods, the duration of each campaign, and the number and rate of survey responses generated by each are shown in Table 1. A total of 1,011 survey responses were recorded, of which 47 (5%) had an incomplete screening section, and 181 (18%) were ineligible on age or zip code. Of the 783 eligible responses, 177 (23%) were less than 90% complete.

Facebook ads are overrepresented as we extended the Facebook campaign near the end of the survey period, as discussed above. We include in the analysis 586 complete responses and 20

**Table 1. Characteristics of recruitment methods employed and responses received**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  | **Survey responses** | | |
| **Method** | **type** | **audience** | **duration (days)a** | **Total** | **Valid & complete** | **avg # per day** |
|  |  |  |  |  |  |  |
| Facebook ad | social media ad | general | 26 | 430 | 263 | 10 |
| Instagram ad | social media ad | youth/YA | 8 | 237 | 210 | 26 |
| reddit ad | social media ad | YA | 11 | 62 | 20 | 2 |
| Snapchat ad | social media ad | youth/YA | 5 | 57 | 31 | 6 |
| Twitter ad | social media ad | general | 7 | 17 | 6 | 1 |
| UIC announce | electronic post | youth/YA | 64 | 16 | 7 | < 1 |
| Craigslist | electronic post | general | 70 | 88 | 32 | < 1 |
| reddit post | social media post | YA | 35 | 88 | 29 | 1 |
| Tumblr post | social media post | YA | 7 | 4 | 1 | < 1 |
| Bluelight post | social media post | general | 10 | 4 | 1 | < 1 |
| Flyer | non-electronic | general | 14 | 1 | 1 | < 1 |
| Flyer | non-electronic | youth/YA | - | 0 | 0 |  |
| Direct link share | |  |  | 7 | 5 |  |
| *Total* |  |  |  | *1011* | *606* |  |
| aDuration for social media ads is the duration of the campaign; otherwise duration is the time from first posting to last response received. | | | | | | |

responses with 91-98% completion as usable responses (n = 606). (Responses that were 91% complete answered all but the last two questions, asking how they learned about the survey, and for interview-eligible respondents, if they were interested in receiving information about a research study). Instagram produced the fastest rate of responding at 26 valid and complete surveys per day, followed by Facebook at 10 per day. Table 2 shows the proportion of screening responses that resulted in eligible survey respondents and completed surveys for each method. Responses originating from an Instagram ad were most likely to result in a completed survey, followed by a shared link and Facebook ads.

**Table 2. Survey eligibility and completion rates by recruitment method**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **All** | **Eligiblea** | | **Complete (>90%)** | | |
| **Source** | **N** | **N** | **Pct of all** | **N** | **Pct of eligible** | **Pct of all** |
|  |  |  |  |  |  |  |
| Facebook ad | 430 | 376 | 87% | 263 | 70% | 61% |
| Instagram ad | 237 | 226 | 95% | 210 | 93% | 89% |
| Reddit ad (paid) | 62 | 28 | 45% | 20 | 71% | 32% |
| Snapchat ad | 57 | 44 | 77% | 31 | 70% | 54% |
| Twitter ad | 17 | 10 | 59% | 6 | 60% | 35% |
| Reddit post (free) | 88 | 38 | 43% | 29 | 76% | 33% |
| Tumblr post | 4 | 4 | 100% | 1 | 25% | 25% |
| Bluelight post | 4 | 2 | 50% | 1 | 50% | 25% |
| Craigslist | 88 | 37 | 42% | 32 | 86% | 36% |
| UIC announce | 16 | 10 | 63% | 7 | 70% | 44% |
| Flyer | 1 | 1 | - | 1 | - | - |
| Direct link share | 7 | 7 | 100% | 5 | 71% | 71% |
| *Total* | *1011* | *783* |  | *606* |  |  |
| a Met age and zip code eligibility criteria | | | | | | |

Paid advertising metrics, including the results of the Facebook split test, are shown in Tables 3 and 4. The result rate is the percentage of impressions that produced a result (click/swipe-through). Standard cost metrics include cost per 1,000 impressions, and cost per result. In the Facebook split test, the drugs image produced a superior result rate compared with the drug icons and laptop cat images (Chi2 = 29.05, p = 0.0001), at less than half the cost per result ($0.19 vs. $0.40). On Snapchat, the laptop cat image performed better than the alternative images (drug images/icons were not allowed). Facebook/Instagram produced the best result rate

**Table 3. Paid advertising impressions and cost**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Method** | **Image** | **Duration** | **Total spent** | **Impressions** | **CPMa** |
| Reddit: r/chicago | drug icons | 11 days | $ 72.20 | 52512 | $ 1.37 |
| Reddit: r/drugs | drug icons | 11 days | $ 0.91 | 2500 | $ 0.36 |
| Snapchat | laptop cat | 2.5 days | $ 12.86 | 40633 | $ 2.78 |
|  | alt 1 (brain) | 1.5 days | $ 83.71 | 39123 | $ 2.14 |
|  | alt 2 (eggs) | 1.5 days | $ 76.25 | 39480 | $ 1.93 |
| Twitter | drugs image | 7 days | $200.00 | 29141 | $ 6.86 |
| Facebook: split test | laptop cat | 2 days | $ 21.75 | 2450 | $ 8.88 |
|  | drugs image | 2 days | $ 22.39 | 2581 | $ 8.67 |
|  | drug icons | 2 days | $ 21.18 | 2233 | $ 9.48 |
| Facebook: all placements | drugs image | 6 days | $141.47 | 15839 | $ 8.93 |
| Facebook: no Instagram | drugs image | 18 days | $288.45 | 53888 | $ 5.35 |
| aCost per 1,000 impressions | | | | | |

**Table 4. Paid advertising result rate and cost per result**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Method** | **Image** | **Results** | **Result Ratea** | **CPRb** |
| Reddit: r/chicago | drug icons | 146 | 0.28% | $ 0.49 |
| Reddit: r/drugs | drug icons | 27 | 1.08% | $ 0.03 |
| Snapchat | laptop cat | 312 | 0.77% | $ 0.36 |
|  | alt 1 (brain) | 153 | 0.39% | $ 0.55 |
|  | alt 2 (eggs) | 155 | 0.39% | $ 0.49 |
| Twitter | drugs image | 100 | 0.34% | $ 2.00 |
| Facebook: split test | laptop cat | 62 | 2.53% | $ 0.35 |
|  | drugs image | 119 | 4.61% | $ 0.19 |
|  | drug icons | 46 | 2.06% | $ 0.46 |
| Facebook: all placements | drugs image | 938 | 5.92% | $ 0.15 |
| Facebook: no Instagram | drugs image | 898 | 1.67% | $ 0.32 |
| aPercent of impressions (views) that produced a result (click) | | | | |
| bCost per result | | | | |

and second lowest cost per result. Reddit r/drugs was least expensive, but generated a smaller number of impressions and only 27 results over 11 days. Twitter was the most expensive at $2.00 per result.

When we look at sources that produced interview-eligible respondents (n=38 current opioid users), Instagram ads performed less well than other sources (Table 5). Craigslist and reddit posts were more likely to find these respondents. Snapchat also performed slightly better than Facebook/Instagram on the percentage measures, however it was significantly more expensive. Twitter by far had the highest cost per screening, and did not produce any interview-eligible respondents.

For comparisons on sample characteristics across sources, we collapsed low frequency sources (Twitter, Bluelight, UIC Announce, Tumblr, and flyer) into one category of “other”. Demographic characteristics of the sample of survey completers by recruitment method are shown in Table 6. Age varied significantly across sources (F = 8.63, *P* < 0.001); on average, Instagram respondents were significantly younger than Facebook respondents (B = -0.93, *P* = 0.001) and Craigslist respondents were significantly older (B = 2.0, *P* = 0.001). Craigslist respondents also were also more likely to be female (relative risk ratio (RRR) = 4.48, *P* < 0.001), “other” race/ethnicity (RRR = 6.54, *P* < 0.001), and have higher education (OR = 3.96, *P* = 0.012). Instagram respondents were also more likely to be of “other” race/ethnicity (RRR = 2.85, *P* = 0.001) compared to Facebook, and were less likely to have higher education (OR = 0.66, *P* = 0.027).

**Table 5. Sources and cost of subjects screened eligible for telephone interview**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Screening complete** | | **Interview eligible** | | |
| **Source** | ***N*** | **Cost per screening** | ***N*** | **Pct of complete** | **Cost per subject** |
|  |  |  |  |  |  |
| Facebook ad | 263 | $ 1.10 | 16 | 6% | $18.03 |
| Instagram ad | 210 | $ 0.98 | 8 | 4% | $24.41 |
| Snapchat ad | 31 | $ 8.80 | 3 | 10% | $90.94 |
| Twitter ad | 6 | $33.33 | 0 | - | - |
| reddit post | 29 | - | 4 | 14% | - |
| Craigslist | 32 | - | 4 | 13% | - |
| Tumblr post | 1 | - | 1 | - | - |
| Bluelight post | 1 | - | 1 | - | - |
| Link share | 5 | - | 1 | 20% | - |
| *Total* |  |  | *38* |  |  |

**Table 6. Demographic characteristics of survey completers by recruitment source (N=606)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Facebook** | **Instagram** | **Snapchat** | **reddit** | **Craigslist** | **Othera** | **Total** |
| **Age (mean)** | 21.2 | 20.2 | 20.8 | 21.7 | 23.2 | 22.9 | 21.0 |
| **Gender** |  |  |  |  |  |  |  |
| % male | 65.8 | 55.2 | 54.8 | 79.6 | 31.3 | 66.7 | 60.9 |
| % female | 32.3 | 43.3 | 45.2 | 16.3 | 68.8 | 33.3 | 37.5 |
| % other | 1.9 | 1.4 | 0 | 4.1 | 0 | 0 | 1.7 |
| **Race/ethnicity** |  |  |  |  |  |  |  |
| % white | 69.7 | 62.9 | 54.8 | 69.4 | 43.8 | 52.4 | 64.5 |
| % Hispanic | 19.4 | 16.7 | 32.3 | 18.4 | 18.8 | 23.8 | 19.1 |
| % Black | 4.2 | 2.9 | 3.2 | 0 | 9.4 | 4.8 | 3.6 |
| % Otherb | 6.8 | 17.6 | 9.7 | 12.2 | 28.1 | 19.1 | 12.7 |
| **Education** |  |  |  |  |  |  |  |
| % high school or less | 36.1 | 46.2 | 32.3 | 32.7 | 12.5 | 38.1 | 38.0 |
| % some higher ed. | 45.6 | 33.3 | 38.7 | 30.6 | 50.0 | 28.6 | 39.4 |
| % college degree | 18.3 | 20.5 | 29.0 | 36.7 | 37.5 | 33.3 | 22.6 |
| **N** | 263 | 210 | 31 | 49 | 32 | 21 | 606 |
| aOther includes Twitter (6), Bluelight (1), UIC Announce (7), Tumblr (1), flyer (1), and direct link share (5). | | | | | | | |
| bAsian (30), mixed (29), or other/unknown (9) | | | | | | | |

## ***Survey results***

Survey completers (n=606) were 61% male, and 65% non-Hispanic white, with a mean age of 21 (Table 6). Six percent of respondents (n = 34) reported misuse of prescription pain relievers in the past 30 days, and 1% (n = 6) reported recent heroin use. Of the 38 respondents who were eligible for the telephone interview, 26 (68%) indicated that they were interested in learning more about the research study, and 24 provided contact information.

## ***Telephone interview results***

Of 24 subjects with contact information sent to the UIC Survey Research Laboratory over the course of approximately 10 weeks, 17 interviews were completed (71%). The average number of contact attempts for completed interviews was 3.3, and for non-completes was 9.4. One respondent replied by e-mail to say that she was hearing impaired, and could not participate over the phone, so she was given the survey link and completed online. One contacted respondent refused the interview. Of the 17 participants who were interviewed, 14 (82%) confirmed recent opioid use: 4 (24%) reported heroin use in the past 3 months, and 12 (71%) reported misuse of a prescription opioid, including oxycodone/Percocet, hydrocodone/Vicodin, and tramadol. Three respondents did not report any opioid use but did report misuse of other prescription drugs, including stimulants, sedatives, and tranquilizers. Of the 17 completed interviews, 9 came from Facebook, 2 from Instagram, 3 from Craigslist, 2 from Snapchat, and one from a direct link share.

## **Discussion**

Over a period of 3 months, our survey received over 1,000 responses, with 606 completed surveys. In the end, we interviewed 17 people who were identified as current opioid users on the survey, and confirmed current opioid use of 14 respondents (2.3% of survey completers). Most of these respondents were misusing prescription opioids, however we did recruit a few who reported recent heroin use. These respondents could potentially be recruited as seeds for respondent-driven sampling to recruit other young people who use heroin or other illicit opioids. This approach might help to reach more people at an early stage of opioid use.

Of the recruitment strategies examined, Facebook/Instagram advertising appears to be a useful online resource for identifying and recruiting suburban opioid users for research, with a cost of about $20 per subject. Our experience suggests that Instagram ads may be less effective than Facebook ads even though they reach a larger audience, and it may be wise for the investigator to control the distribution rather than allowing Facebook Ads to do this automatically. Craigslist and reddit are slower and require staff time to continually re-post, but may be worthwhile to include as part of a multi-pronged strategy. The other approaches examined were less useful for the recruitment of young adult opioid users residing in suburban areas surrounding Chicago.

While these social media and other electronic recruitment strategies demonstrated considerable promise, they nonetheless come with trade-offs that need to be considered. Most importantly, these approaches are only able to identify convenience samples of the population of interest and thus feature all of the known limitations of non-probability sampling. They are successful, however, in locating useful samples of very narrowly defined populations that random probability methods cannot possibly be expected to locate without time- and cost-prohibitive effort. In recent years, the increased availability of these recruitment tools has provided new opportunities for the study of rare populations that have been traditionally difficult to locate and communicate with.

Another concern with social media and electronic recruitment strategies is that it risks systematic exclusion of persons less connected to the internet and/or who utilize it less frequently. This would introduce a serious bias if internet use is associated with dependent variables of interest, e.g., opioid misuse. Given the ubiquity of internet use and access at the close of the second decade of the 21st Century (e.g., the Pew Research Center reported that 81% of Americans go online on a daily basis as of early 2019) (Perrin & Kumar, 2019), there is reason to believe that any selection effects associated with internet access and/or use are trending towards being minimal at this period in time. While internet-based recruitment is not likely to reach highly marginalized subgroups such as homeless people, it may be particularly useful for reaching young people early in their substance use trajectory.

Potential respondent decisions to accept a survey invitation in some cases may have been influenced by exposure to our recruitment ads posted across multiple platforms (Guillory et al., 2018). Some platforms also likely exposed potential respondents to ads on multiple occasions. Consequently, it seems that the order in which our various recruitment efforts were fielded may also have influenced participation (Davies & Kotter, 2018). There is unfortunately no way to determine these potential effects within the current study.

An important advantage of using online survey platforms for recruiting respondents to participate in studies with sensitive topics such as substance misuse is that they may provide respondents with a degree of confidentiality that traditional interviewer-assisted methods do not afford, leading to potentially increased willingness to participate and improved data quality through reduced social desirability bias. These may come at the cost, however, of increased risk that some respondents, motivated by offers of cash incentives to participate, attempt to complete the survey on multiple occasions (Guillory et al., 2018; Perrin & Kumar, 2019; Quach et al., 2013). In our study, no duplicates were found in the e-mail addresses that respondents submitted to participate in the random drawing for Amazon gift cards. It should be noted that there are unfortunately few options for monitoring and addressing this potential problem that do not involve increased risks to respondents of being identified directly or indirectly (Borodovsky, Marsch, & Budney, 2018).

Evidence from several earlier recruitment studies additionally suggests that social media recruitment may be associated with poor data quality (Guillory et al., 2018; Ibarra, Agas, Lee, Pan, & Buttenheim, 2018; Quach et al., 2013). Of interest in this regard is the finding that the one prior study that has examined prescription opioid medication misuse using respondents recruited from social media ads on Facebook has documented the quality and validity of such data (Lord et al., 2011). In addition, there is some evidence that data quality varies across electronic and social media recruitment methods (Ibarra et al., 2018), and that the effectiveness of these tools for recruitment may also vary across study populations (Sapp, Vogel, Telfair, & Reagan, 2019).

Finally, it is important to note that internet and social media platforms and their functionality continually evolve in response to market demands, often unexpectedly and in ways that could make study replication difficult. These resources nonetheless are increasingly providing opportunities to quickly and efficiently communicate with rare populations that have not been previously available to investigators. Between 2004-2015, for example, more than 100 published studies reported psychosocial, health or medical research that involved subject recruitment using Facebook alone (Thornton et al., 2016). The immediate challenge for researchers now is to learn how to optimize the strengths and minimize the limitations of these new recruitment tools.

## ***Acknowledgements***

MM conceived the study, designed the protocol, conducted the online survey, was responsible for data analysis, and drafted the manuscript. TJ participated in study design, implemented the telephone interview protocol, and contributed to writing of the manuscript. BB participated in the study design and writing of the manuscript.

## ***Conflicts of Interest***

None declared.

## ***Abbreviations***

IDU: injection drug use

PO: prescription opioid

PWID: people who inject drugs

## ***References***

Al-Tayyib, A. A., Rice, E., Rhoades, H., & Riggs, P. (2014). Association between prescription drug misuse and injection among runaway and homeless youth. *Drug and Alcohol Dependence, 134*, 406-409. doi:10.1016/j.drugalcdep.2013.10.027

Armstrong, G. L. (2007). Injection drug users in the United States, 1979-2002: An aging population. *Archives of Internal Medicine, 167*(2), 166-173. doi:10.1001/archinte.167.2.166

Bell, D. C., Erbaugh, E. B., Serrano, T., Dayton-Shotts, C. A., & Montoya, I. D. (2017). A comparison of network sampling designs for a hidden population of drug users: Random walk vs. respondent-driven sampling. *Social Science Research, 62*, 350-361. doi:10.1016/j.ssresearch.2016.08.016

Biernacki, P. (1986). *Pathways from Heroin Addiction: Recovery Without Treatment*. Philadelphia, PA: Temple University Press.

Boodram, B., Mackesy-Amiti, M. E., & Latkin, C. (2015). The role of social networks and geography on risky injection behaviors of young persons who inject drugs. *Drug and Alcohol Dependence, 154*, 229-235. doi:10.1016/j.drugalcdep.2015.06.042

Borodovsky, J. T., Marsch, L. A., & Budney, A. J. (2018). Studying cannabis use behaviors with Facebook and web surveys: Methods and insights. *JMIR Public Health and Surveillance, 4*(2), e48. doi:10.2196/publichealth.9408

Broz, D., & Ouellet, L. J. (2008). Racial and ethnic changes in heroin injection in the United States: Implications for the HIV/AIDS epidemic. *Drug and Alcohol Dependence, 94*(1-3), 221-233. doi:10.1016/j.drugalcdep.2007.11.020

Broz, D., Pham, H., Spiller, M., Wejnert, C., Le, B., Neaigus, A., & Paz-Bailey, G. (2014). Prevalence of HIV infection and risk behaviors among younger and older injecting drug users in the United States, 2009. *AIDS and Behavior, 18*(3 Supp), 284-296. doi:10.1007/s10461-013-0660-4

Burnhams, N. H., Laubscher, R., Howell, S., Shaw, M., Erasmus, J., & Townsend, L. (2016). Using respondent-driven sampling (RDS) to recruit illegal poly-substance users in Cape Town, South Africa: implications and future directions. *Substance Abuse Treatment, Prevention, and Policy, 11*(1), 31. doi:10.1186/s13011-016-0074-1

Casler, K., Bickel, L., & Hackett, E. (2013). Separate but equal? A comparison of participants and data gathered via Amazon’s MTurk, social media, and face-to-face behavioral testing. *Computers in Human Behavior, 29*(6), 2156-2160. doi:10.1016/j.chb.2013.05.009

Center for Behavioral Health Statistics and Quality. (2015). *Behavioral health trends in the United States: Results from the 2014 National Survey on Drug Use and Health* (HHS Publication No. SMA 15-4927, NSDUH Series H-50). Retrieved from Rockville, MD: <http://www.samhsa.gov/data>

Centers for Disease Control and Prevention. (2001). Trends in injection drug use among persons entering addiction treatment --- New Jersey, 1992--1999. *Morbidity and Mortality Weekly Report, 50*(19), 378-381. Retrieved from <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5019a2.htm>

Centers for Disease Control and Prevention. (2011). Vital signs: Overdoses of prescription opioid pain relievers - United States, 1999-2008. *Morbidity and Mortality Weekly Report, 60*, 1487-1492.

Chatterjee, S., Tempalski, B., Pouget, E. R., Cooper, H. L., Cleland, C. M., & Friedman, S. R. (2011). Changes in the prevalence of injection drug use among adolescents and young adults in large U.S. metropolitan areas. *AIDS and Behavior, 15*(7), 1570-1578. doi:10.1007/s10461-011-9992-0

Choi, I., Milne, D. N., Glozier, N., Peters, D., Harvey, S. B., & Calvo, R. A. (2017). Using different Facebook advertisements to recruit men for an online mental health study: Engagement and selection bias. *Internet Interventions, 8*, 27-34. doi:10.1016/j.invent.2017.02.002

Compton, W. M., Jones, C. M., & Baldwin, G. T. (2016). Relationship between nonmedical prescription-opioid use and heroin use. *New England Journal of Medicine, 374*(2), 154-163. doi:10.1056/NEJMra1508490

Davies, B., & Kotter, M. (2018). Lessons from recruitment to an internet-based survey for degenerative cervical myelopathy: Comparison of free and fee-based methods. *JMIR Research Protocols, 7*(2), e18. doi:10.2196/resprot.6567

Duncan, D. F., White, J. B., & Nicholson, T. (2003). Using internet-based surveys to reach hidden populations: Case of nonabusive illicit drug users. *American Journal of Health Behavior, 27*(3), 208-218. doi:10.5993/AJHB.27.3.2

Fenner, Y., Garland, M. S., Moore, E. E., Jayasinghe, Y., Fletcher, A., Tabrizi, N. S., . . . Wark, D. J. (2012). Web-based recruiting for health research using a social networking site: An exploratory study. *Journal of Medical Internet Research, 14*(1), e20. doi:10.2196/jmir.1978

Garfein, R. S., Swartzendruber, A., Ouellet, L. J., Kapadia, F., Hudson, S. M., Thiede, H., . . . Latka, M. H. (2007). Methods to recruit and retain a cohort of young-adult injection drug users for the Third Collaborative Injection Drug Users Study/Drug Users Intervention Trial (CIDUS III/DUIT). *Drug and Alcohol Dependence, 91*(Supplement 1), S4-S17. doi:10.1016/j.drugalcdep.2007.05.007

Grau, L. E., Dasgupta, N., Harvey, A. P., Irwin, K., Givens, A., Kinzly, M. L., & Heimer, R. (2007). Illicit use of opioids: Is OxyContin® a “gateway drug”? *American Journal on Addictions, 16*(3), 166-173. doi:10.1080/10550490701375293

Guillory, J., Wiant, K. F., Farrelly, M., Fiacco, L., Alam, I., Hoffman, L., . . . Alexander, T. N. (2018). Recruiting hard-to-reach populations for survey research: Using Facebook and Instagram advertisements and in-person intercept in LGBT bars and nightclubs to recruit LGBT young adults. *Journal of Medical Internet Research, 20*(6), e197. doi:10.2196/jmir.9461

Heckathorn, D. D. (1997). Respondent-driven sampling: A new approach to the study of hidden populations. *Social Problems, 44*(2), 174-199. doi:10.2307/3096941

Heckathorn, D. D., Semaan, S., Broadhead, R. S., & Hughes, J. J. (2002). Extensions of respondent-driven sampling: A new approach to the study of injection drug users aged 18-25. *AIDS and Behavior, 6*(1), 55-67. doi:10.1023/A:1014528612685

Hendricks, S., Düking, P., & Mellalieu, S. D. (2016). Twitter strategies for web-based surveying: Descriptive analysis from the International Concussion Study. *JMIR Research Protocols, 5*(3), e179. doi:10.2196/resprot.4542

Ibarra, J. L., Agas, J. M., Lee, M., Pan, J. L., & Buttenheim, A. M. (2018). Comparison of online survey recruitment platforms for hard-to-reach pregnant smoking populations: Feasibility study. *JMIR Research Protocols, 7*(4), e101. doi:10.2196/resprot.8071

Iguchi, M. Y., Ober, A. J., Berry, S. H., Fain, T., Heckathorn, D. D., Gorbach, P. M., . . . Zule, W. A. (2009). Simultaneous recruitment of drug users and men who have sex with men in the United States and Russia using respondent-driven sampling: Sampling methods and implications. *Journal of Urban Health, 86*(S1), 5-31. doi:10.1007/s11524-009-9365-4

Johnston, L., O'Malley, P. M., Bachman, J. G., & Schulenberg, J. E. (2010). *Monitoring the Future: National Results on Adolescent Drug Use. Overview of Key Findings, 2009*. Retrieved from

Jones, C. M. (2013). Heroin use and heroin use risk behaviors among nonmedical users of prescription opioid pain relievers - United States, 2002-2004 and 2008-2010. *Drug and Alcohol Dependence, 132*(1-2), 95-100. doi:10.1016/j.drugalcdep.2013.01.007

Jones, C. M., Logan, J., Gladden, R. M., & Bohm, M. K. (2015). Vital signs: Demographic and substance use trends among heroin users — United States, 2002–2013. *MMWR Morbidity & Mortality Weekly Report, 64*(26), 719-725. Retrieved from <http://www.cdc.gov/mmwr/pdf/wk/mm64e0707.pdf>

Kaplan, C. D., Korf, D., & Sterk, C. (1987). Temporal and social contexts of heroin-using populations: An illustration of the snowball sampling technique. *The Journal of Nervous and Mental Disease, 175*(9). doi:10.1097/00005053-198709000-00009

Kayrouz, R., Dear, B. F., Karin, E., & Titov, N. (2016). Facebook as an effective recruitment strategy for mental health research of hard to reach populations. *Internet Interventions, 4*, 1-10. doi:10.1016/j.invent.2016.01.001

Khosla, N., Juon, H. S., Kirk, G. D., Astemborski, J., & Mehta, S. H. (2011). Correlates of non-medical prescription drug use among a cohort of injection drug users in Baltimore City. *Addictive Behaviors, 36*(12), 1282-1287. doi:10.1016/j.addbeh.2011.07.046

Kuehn, B. M. (2014). Driven by prescription drug abuse, heroin use increases among suburban and rural whites. *JAMA, 312*(2), 118-119. doi:10.1001/jama.2014.7404

Lankenau, S. E., Teti, M., Silva, K., Bloom, J. J., Harocopos, A., & Treese, M. (2012a). Initiation into prescription opioid misuse amongst young injection drug users. *International Journal of Drug Policy, 23*(1), 37-44. doi:10.1016/j.drugpo.2011.05.014

Lankenau, S. E., Teti, M., Silva, K., Bloom, J. J., Harocopos, A., & Treese, M. (2012b). Patterns of prescription drug misuse among young injection drug users. *Journal of Urban Health, 89*(6), 1004-1016. doi:10.1007/s11524-012-9691-9

Leach, L. S., Butterworth, P., Poyser, C., Batterham, P. J., & Farrer, L. M. (2017). Online recruitment: Feasibility, cost, and representativeness in a study of postpartum women. *Journal of Medical Internet Research, 19*(3), e61. doi:10.2196/jmir.5745

Lord, S., Brevard, J., & Budman, S. (2011). Connecting to young adults: An online social network survey of beliefs and attitudes associated with prescription opioid misuse among college students. *Substance Use and Misuse, 46*(1), 66-76. doi:10.3109/10826084.2011.521371

Mackesy-Amiti, M. E., Donenberg, G. R., & Ouellet, L. J. (2012). Prevalence of psychiatric disorders among young injection drug users. *Drug and Alcohol Dependence, 124*(1-2), 70-78. doi:10.1016/j.drugalcdep.2011.12.012

Mackesy-Amiti, M. E., Donenberg, G. R., & Ouellet, L. J. (2015). Prescription opioid misuse and mental health among young injection drug users. *American Journal of Drug and Alcohol Abuse, 41*(1), 100-106. doi:10.3109/00952990.2014.940424

Mars, S. G., Bourgois, P., Karandinos, G., Montero, F., & Ciccarone, D. (2014). “Every ‘never’ I ever said came true”: Transitions from opioid pills to heroin injecting. *International Journal of Drug Policy, 25*(2), 257-266. doi:10.1016/j.drugpo.2013.10.004

Martinez, A. N., D’Amico, E. J., Kral, A. H., & Bluthenthal, R. N. (2012). Nonmedical prescription drug use among injection drug users. *Journal of Drug Issues, 42*(3), 216-225. doi:10.1177/0022042612456015

Massachusetts Department of Public Health. CDC joins Department of Public Health in investigating HIV cluster among people who inject drugs [Press release]. Retrieved from <https://www.mass.gov/news/cdc-joins-department-of-public-health-in-investigating-hiv-cluster-among-people-who-inject>

Mathers, B. M., Degenhardt, L., Phillips, B., Wiessing, L., Hickman, M., & Strathdee, S. A. (2008). Global epidemiology of injecting drug use and HIV among people who inject drugs: a systematic review. *Lancet, 372*. doi:10.1016/s0140-6736(08)61311-2

Motoki, Y., Miyagi, E., Taguri, M., Asai-Sato, M., Enomoto, T., Wark, J. D., & Garland, S. M. (2017). Comparison of different recruitment methods for sexual and reproductive health research: Social media–based versus conventional methods. *Journal of Medical Internet Research, 19*(3), e73. doi:10.2196/jmir.7048

Muhib, F. B., Lin, L. S., Stueve, A., Miller, R. L., Ford, W. L., Johnson, W. D., & Smith, P. J. (2001). A venue-based method for sampling hard-to-reach populations. *Public Health Reports, 116*(1\_suppl), 216-222. doi:10.1093/phr/116.S1.216

National Institute on Drug Abuse, & Community Epidemiology Work Group. (2011). *Epidemiologic Trends in Drug Abuse, Volume I*. Retrieved from Bethesda, MD: <https://archives.drugabuse.gov/trends-statistics/community-epidemiology-workgroup-cewg-reports>

Neaigus, A., Gyarmathy, V. A., Miller, M., Frajzyngier, V. M., Friedman, S. R., & Des Jarlais, D. C. (2006). Transitions to injecting drug use among noninjecting heroin users: Social network influence and individual susceptibility. *JAIDS Journal of Acquired Immune Deficiency Syndromes, 41*(4), 493-503. doi:10.1097/01.qai.0000186391.49205.3b

Newcombe, R., O'Hare, P., Matthews, A., & Buning, E. (1992). The reduction of drug related harm: a conceptual framework for theory, practice and research. In P. A. O'Hare (Ed.), *The Reduction of Drug-Related Harm* (pp. 1-14). London: Routledge.

Nunan, D., & Knox, S. (2011). Can search engine advertising help access rare samples? *International Journal of Market Research, 53*(4), 523-540. doi:10.2501/IJMR-53-4-523-540

Peavy, K. M., Banta-Green, C. J., Kingston, S., Hanrahan, M., Merrill, J. O., & Coffin, P. O. (2012). “Hooked on” prescription-type opiates prior to using heroin: Results from a survey of syringe exchange clients. *Journal of Psychoactive Drugs, 44*(3), 259-265. doi:10.1080/02791072.2012.704591

Perrin, A., & Kumar, M. (2019). About three-in-ten U.S. adults say they are ‘almost constantly’ online. *FactTank*. Retrieved from <https://pewrsr.ch/2Y5pwdX>

Peterson, J. A., Reisinger, H. S., Schwartz, R. P., Mitchell, S. G., Kelly, S. M., Brown, B. S., & Agar, M. H. (2008). Targeted sampling in drug abuse research: A review and case study. *Field Methods, 20*(2), 155-170. doi:10.1177/1525822X08314988

Pollini, R., Banta-Green, C., Cuevas-Mota, J., Metzner, M., Teshale, E., & Garfein, R. (2011). Problematic use of prescription-type opioids prior to heroin use among young heroin injectors. *Substance Abuse and Rehabilitation, 2*(1), 173-180. doi:10.2147/SARS24800

Prussing, C., Bornschlegel, K., & Balter, S. (2014). Hepatitis C surveillance among youth and young adults in New York City, 2009–2013. *Journal of Urban Health*, 1-13. doi:10.1007/s11524-014-9920-5

Quach, S., Pereira, J. A., Russell, M. L., Wormsbecker, A. E., Ramsay, H., Crowe, L., . . . Kwong, J. (2013). The good, bad, and ugly of online recruitment of parents for health-related focus groups: Lessons learned. *Journal of Medical Internet Research, 15*(11), e250. doi:10.2196/jmir.2829

Ramo, E. D., & Prochaska, J. J. (2012). Broad reach and targeted recruitment using Facebook for an online survey of young adult substance use. *Journal of Medical Internet Research, 14*(1), e28. doi:10.2196/jmir.1878

Rudd, R. A., Seth, P., David, F., & Scholl, L. (2016). Increases in drug and opioid-involved overdose deaths—United States, 2010–2015. *MMWR Morbidity and Mortality Weekly Report, 65*, 1445–1452. doi:10.15585/mmwr.mm655051e1

Rudolph, A. E., Crawford, N. D., Latkin, C., Heimer, R., Benjamin, E. O., Jones, K. C., & Fuller, C. M. (2011). Subpopulations of illicit drug users reached by targeted street outreach and respondent-driven sampling strategies: Implications for research and public health practice. *Annals of Epidemiology, 21*(4), 280-289. doi:10.1016/j.annepidem.2010.11.007

Sapp, J. L. C., Vogel, R. L., Telfair, J., & Reagan, J. K. (2019). Evaluating web-based platforms and traditional methods for recruiting tattoo artists: Descriptive survey research study. *JMIR Dermatology, 2*(1), e14151. doi:10.2196/14151

Semaan, S. (2010). Time-space sampling and respondent-driven sampling with hard-to-reach populations. *Methodological Innovations Online, 5*(2), 60-75. doi:10.4256/mio.2010.0019

Semaan, S., Lauby, J., & Liebman, J. (2002). Street and network sampling in evaluation studies of HIV risk-reduction interventions. *AIDS Reviews, 4*(4), 213-223.

Seth, P., Scholl, L., Rudd, R. A., & Sarah, B. (2018). Overdose deaths involving opioids, cocaine, and psychostimulants - United States, 2015-2016. *MMWR Morbidity and Mortality Weekly Report, 67*, 349-358. doi:10.15585/mmwr.mm6712a1

Strathdee, S. A., & Beyrer, C. (2015). Threading the needle — how to stop the HIV outbreak in rural Indiana. *New England Journal of Medicine, 373*(5), 397-399. doi:10.1056/NEJMp1507252

Substance Abuse and Mental Health Services Administration. (2009). *The NSDUH Report: Trends in Nonmedical Use of Prescription Pain Relievers: 2002 to 2007*. Retrieved from Rockville, MD:

Substance Abuse and Mental Health Services Administration. (2010). *Results from the 2009 National Survey on Drug Use and Health: Volume I. Summary of National Findings* (HHS Publication No. SMA 10-4586). Retrieved from Rockville, MD: <http://oas.samhsa.gov/>

Tempalski, B., Pouget, E. R., Cleland, C. M., Brady, J. E., Cooper, H. L. F., Hall, H. I., . . . Friedman, S. R. (2013). Trends in the population prevalence of people who inject drugs in US metropolitan areas 1992–2007. *PLoS ONE, 8*(6), e64789. doi:10.1371/journal.pone.0064789

Thompson, S. K., & Collins, L. M. (2002). Adaptive sampling in research on risk-related behaviors. *Drug and Alcohol Dependence, 68*, 57-67. doi:10.1016/S0376-8716(02)00215-6

Thornton, L., Batterham, P. J., Fassnacht, D. B., Kay-Lambkin, F., Calear, A. L., & Hunt, S. (2016). Recruiting for health, medical or psychosocial research using Facebook: Systematic review. *Internet Interventions, 4*, 72-81. doi:10.1016/j.invent.2016.02.001

Thorpe, L. E., Bailey, S. L., Huo, D., Monterroso, E. R., & Ouellet, L. J. (2001). Injection-related risk behaviors in young urban and suburban injection drug users in Chicago (1997-1999). *Journal of Acquired Immune Deficiency Syndromes, 27*(1), 71-78. doi:10.1097/00126334-200105010-00012

Wozney, L., Turner, K., Rose-Davis, B., & McGrath, P. J. (2019). Facebook ads to the rescue? Recruiting a hard to reach population into an Internet-based behavioral health intervention trial. *Internet Interventions, 17*, 100246. doi:10.1016/j.invent.2019.100246

Young, A. M., Rudolph, A. E., & Havens, J. R. (2018). Network-based research on rural opioid use: An overview of methods and lessons learned. *Current HIV/AIDS Reports, 15*(2), 113-119. doi:10.1007/s11904-018-0391-2

Zibbell, J. E., Asher, A. K., Patel, R. C., Kupronis, B., Iqbal, K., Ward, J. W., & Holtzman, D. (2018). Increases in acute hepatitis C virus infection related to a growing opioid epidemic and associated injection drug use, United States, 2004 to 2014. *American Journal of Public Health, 108*(2), 175-181. doi:10.2105/ajph.2017.304132

Zibbell, J. E., Iqbal, K., Patel, R. C., Suryaprasad, A., Sanders, K. J., Moore-Moravian, L., . . . Holtzman, D. (2015). Increases in hepatitis C virus infection related to injection drug use among persons aged </=30 years - Kentucky, Tennessee, Virginia, and West Virginia, 2006-2012. *MMWR. Morbidity and Mortality Weekly Report, 64*(17), 453-458. Retrieved from <https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6417a2.htm>