Published in final edited form as:

Am J Drug Alcohol Abuse. 2010 March ; 36(2): 92–97. doi:10.3109/00952991003592311.

Risk practices associated with bacterial infections among injection drug users in Denver, CO

Kristina T. Phillips¹ and Michael D. Stein²

¹University of Northern Colorado, Greeley, CO

²Warren Alpert Medical School of Brown University/Butler Hospital, Providence, RI

Abstract

Background—There has been limited research on bacterial infections (e.g., skin and soft tissue abscesses, endocarditis) among injection drug users (IDUs), despite these infections often resulting in serious morbidity and costly medical care. Although high-risk practices that contribute to bacterial infections are not entirely clear, certain injection practices have been found to increase risk in past studies.

Objectives—To examine rates of bacterial infections among IDUs in Denver, CO and high-risk practices that predict skin infections.

Methods—Structured interviews were conducted with 51 active heroin, cocaine and methamphetamine IDUs (over 18 years).

Results—Among all participants, 55% reported a lifetime history of at least one skin infection and 29% reported having an infection in the last year. Those with a skin infection in the last year were significantly more likely to inject intramuscularly (OR = 1.57) and to report greater heroin injection frequency (OR = 1.08) compared to IDUs with no history of skin infections. Heroin and speedball injectors reported a higher number of past abscesses compared to methamphetamine and cocaine injectors.

Conclusion—Intervention strategies to reduce bacterial infections should focus on high-risk injection practices.

Scientific Significance—Learning about rates of bacterial infections and high-risk practices associated with these infections can benefit researchers developing risk reduction interventions for IDUs.

Keywords

injection drug use; bacterial infections; abscess; HIV; hepatitis C; black tar heroin

INTRODUCTION

Injection drug use (IDU) is a worldwide public health concern. IDUs are at increased risk for developing viral disease (e.g., HIV, HCV; 1), bacterial infections (e.g., skin abscesses, endocarditis; 2; 3; 4), and overdose fatalities (5). Although research on bacterial infections among IDUs is more limited, several studies in San Francisco and in the U.K. have found that 21–32% of active IDUs report a current skin infection and almost 70% report a lifetime history of past infection (6; 7). Phillips, Anderson, and Stein (8) found lower rates (around 10%) of bacterial infections in a sample of HCV-negative IDUs, suggesting that rates of bacterial infections may vary by location and sample.

Bacterial infections associated with drug injection include skin infections (abscesses, cellulitis), endocarditis, osteomyelitis, sepsis/bacteremia, tetanus, wound botulism, and pneumonia (9). Skin infections are generally painful, and while some IDUs attempt to self-treat, others present to the emergency department for care (10). Injection equipment may carry bacteria (11), but other factors likely contribute to infection. An injector's skin, overall hygiene, and use of contaminated water sources have been linked to bacterial infections among IDUs (12). The prevalence of skin infections appears to increase as the frequency of injecting subcutaneously increases (6; 13). Frequent injection among IDUs who do not always clean their skin has also been associated with skin infections (14). Injecting black tar heroin subcutaneously or intramuscularly may heighten the risk of wound botulism (15).

The primary goal of the current study was to collect pilot data for a skin and needle hygiene intervention to prevent bacterial infections that is currently being developed for IDUs. To better inform the intervention, we assessed rates of skin and other bacterial infections and high-risk injection practices that might be associated with skin infections in Denver, CO by examining a comprehensive set of high-risk injection practices. Because past studies have focused predominantly on IDUs on the east or west coast, we hoped to inform the literature about injectors in the central United States. We hypothesized that high-risk injection practices such as lack of skin and hand washing, frequent injection, and subcutaneous or intramuscular injection would predict skin infections contracted within the last year. We also hypothesized that black tar heroin and speedball (heroin/cocaine mix) injectors would report a greater number of past skin infections compared to methamphetamine and cocaine injectors.

METHOD

Participants and Procedure

Drug injectors were recruited between November 2007 – August 2008. Out of 68 participants screened, 51 were eligible to participate and were interviewed at a drop-in center near downtown Denver. Participants were recruited through the drop-in center, a local research/clinical drug treatment center, and by advertisement in a free local newspaper. Participants had to be at least 18 years old, deny psychotic symptoms, and report drug injection in the last month.

After consent, participants completed a structured interview lasting approximately 60 minutes in a private room. Participants were provided with a \$20 reimbursement. The University of Northern Colorado Institutional Review Board approved the materials and recruitment procedures.

Instruments and Measures

The interview included questions about demographics, drug use and injection history, and history of bacterial infections. Adapting language from Binswanger et al. (6), participants were asked “Have you ever had an abscess or other skin infection (such as an ulcer or cellulitis) at a place where you injected drugs – that is any pain, swelling, redness, hardness under your skin, heat, pus, or oozing anywhere you inject?” Participants who endorsed past skin infections were asked to provide information about the location of an infection, the approximate month and year when an infection occurred, history of health service utilization and self-treatment. Participants were asked to report the number of times they had a skin infection ever in the past using ranges that included: one time, 2 – 3 times, 4 – 6 times, 7 – 9 times, or more than 10 times. Participants with a current skin infection (i.e., abscess, ulcer, or cellulitis) from injection were asked to show the infection to the interviewer.

We asked participants how often they engaged in a wide range of injection practices in the last six months that are believed to be predictive of bacterial infections, including hygienic practices (e.g., not cleaning one’s skin or washing hands before injecting), subcutaneous and intramuscular injection, frequency of injection and injection equipment use, cleaning injection equipment, using sterile water, and booting.

Data Analysis

We report descriptive statistics (means, standard deviations, percentages) to summarize sample demographic, drug use and bacterial infections. Variables significantly associated with skin infections in univariate analyses were included in a multivariate logistic regression model.

RESULTS

Background Characteristics and Drug Use

Participants averaged 39.2 ($SD = 9.7$) years of age, 17 (33%) were female, and most were Caucasian (88%). The majority of participants reported being homeless or living in transient housing such as a shelter or motel within the last three months (57%). Other background characteristics can be found in Table 1.

Most participants were not in drug treatment and reported heroin, methamphetamine, or speedball (heroin/cocaine) as their primary drug of choice. Over 80% of all participants demonstrated track marks at their usual injection site. Of 32 participants who reported injecting heroin alone in the last month, 24 described using black tar heroin as the type of heroin typically used. All other drug use characteristics can be found in Table 2.

Rates of Infectious Disease and Bacterial Infections

Rates for infectious diseases and bacterial infections can be found in Table 3. Although only one participant self-reported HIV-positive status, over half of participants reported HCV-positive status (57%). Over half of participants (55%, $n = 28$) reported ever having a bacterial skin infection from injecting drugs. Participants reported having an average of 4 – 6 skin infections ($M = 3.07$ corresponds to 4 – 6 skin infections, $SD = 1.54$) in their lifetime. Out of participants reporting a history of skin infections, 15 IDUs (29% of total sample) reported a current abscess ($n = 6$) or an abscess in the last year ($n = 9$). Out of the six participants who reported a current abscess, three had received medical treatment for the abscess, two planned to seek treatment, and one did not plan to seek treatment.

The remaining nine IDUs who reported a skin infection within the last year (but not currently) received medical treatment for the abscess. Twenty-two participants who had ever had an abscess reported trying to self-treat; most had lanced and drained an abscess ($n = 12$), but others also described using gauze to drain the abscess, applying a warm compress or heat to the abscess, trying to squeeze or pop the abscess, and taking street-bought antibiotics.

High-Risk Injection Practices for Bacterial Infections

Participants reported that, on average, they clean their skin at the injection site and wash their hands only “about half of the time” prior to injecting. Most participants reported using alcohol pads to clean their injection site (53%). Others described using soap and water, tap water alone, bottled rubbing alcohol/hydrogen peroxide, or an alcohol-based/antibiotic hand cleanser, such as Purell®. Participants reported that they used new, sterile needles to inject “most of the time.” On average, participants described “sometimes” to “never” bleach cleaning needles before reusing them and using sterile, disinfected, or bottled water to mix and inject their drug.

Predictors of Skin Infections

We used a two-step model to determine variables to include in a multivariate logistic regression model assessing the relationship between past year skin infections and demographic and high-risk practices. In the first step, univariate logistic regression analyses were used to determine the unadjusted association between past year history of infections (skin infection in the last year vs. no skin infection in the last year) and demographics (i.e., age, homeless vs. not homeless status, and Caucasian vs. non-Caucasian race), injection frequency, subcutaneous or intramuscular injection, use of a used needle when injecting, use of bleach to clean a used needle, infrequent hand washing prior to injecting, infrequent skin cleaning prior to injecting, booting, and days of heroin or speedball injection in the last month. Results (Table 4) indicated that a number of high-risk practices were associated with last year skin infections.

In the second step, only variables (i.e., hand washing, intramuscular injection, and days of heroin injection in last month) that were controlled for family-wise error with a Bonferroni correction ($p = .05/13 = < .004$) were included in the final multivariate model. Those with a skin infection were more likely to inject intramuscularly (OR = 1.57, 95% CI .90–2.69, $p = .$

09) and reported greater days of heroin injection in the last month (OR = 1.08, 95% CI 1.01–1.16, $p = .02$) compared to IDUs with no history of skin infections in the last year.

Drug of Choice Differences in Number of Skin Infections

Injectors with a past history of skin infections who reported heroin or speedball as their drug of choice self-reported a higher number of past skin infections ($M = 3.6$, corresponding to 4 – 6 skin infections, $SD = 1.57$) compared to methamphetamine and cocaine users ($M = 1.9$, corresponding to 1 – 2 skin infections, $SD = .69$), $t(24) = 2.77$, $p = .01$. Four participants were excluded from these analyses due to reporting meth/heroin or marijuana solely as their preferred drugs of choice. Examination of the mean number of skin infections for each drug independently indicated that injectors of speedball reported the highest number of skin infections ($M = 4.75$, corresponding to over 7 infections ever in the past).

DISCUSSION

As far as we are aware, this is the first study conducted on risks for bacterial infections among IDUs in the central United States. Our data suggest that IDUs who engage in certain injection-related practices are more likely to experience bacterial infections. Lifetime rates of skin infections, the most common bacterial infection among IDUs, was over 50%. In the last year, almost 30% of participants reported experiencing a skin infection. These rates are consistent with rates found in other studies. For example, Binswanger et al. (6) found that 32% of 169 IDUs in San Francisco had a current skin infection and 68% reported a past skin infection. Similar to our participants, San Francisco IDUs also inject black tar heroin (16), which may contribute to increased rates of bacterial infections where this type of heroin is available. Our data did suggest that heroin and speedball injectors (predominantly using black tar heroin) had a higher number of past skin infections compared to methamphetamine and cocaine users. Interestingly, in our prior work on the east coast (8), we found lower rates (around 10%) of bacterial infections in a sample of HCV-negative IDUs. Similarly, when examining data collected by Vlahov et al. (14), only 11% of 1057 active IDUs in Baltimore reported a history of at least one subcutaneous abscess in the last six months.

IDUs in this study reported engaging in injection practices that place them at risk for bacterial infections. Participants reported that they often fail to clean their skin at the injection site and wash their hands “about half of the time” prior to injecting. Previous studies have shown that IDUs who inject more frequently are less likely to practice skin cleaning (17). This may be due to the time demands of frequent injections or fatalism about benefits of skin cleaning. IDUs often inject in unhygienic environments where no sink is available, such as shooting galleries or on the street. IDUs also described only “sometimes” using sterile, disinfected, or bottled water to inject their drug and only “sometimes” rotating their injection site, a practice that would also improve vein health.

Best injection practices for infection control in medical settings have been established (18) and emphasize the importance of first cleaning soiled skin (i.e., washing with soap and water) and washing or disinfecting hands prior to preparing injection materials. Use of an alcohol-based hand rub is indicated as an effective method to reduce transmission of pathogenic microorganisms to patients and healthcare personnel (19). Because of prolonged

needle insertion time due to sclerosed veins and booting (drawing blood back and forth into the syringe multiple times), skin cleaning prior to injection may be particularly important. Commercial products that may be more effective in killing bacteria, such as chlorhexidine, are costly and not easily accessible to IDUs, whereas alcohol is readily available and therefore more practical.

While diverse injection practices were associated with skin infections in our study, only intramuscular injection and greater days of heroin injection in the last month were found to be independently associated with having a skin infection in the last year. Of note, participants who injected intramuscularly were one and a half times more likely to have an infection compared to those who did not report a skin infection in the last year.

Our results overlap with findings from other studies on bacterial infections among IDUs. Murphy et al. (13) found that using a dirty needle, failing to clean one's skin, and injecting speedball were the strongest preventable risk factors for skin infections. Binswanger et al. (6) found that IDUs who injected subcutaneously or intramuscularly were almost five times more likely to have a skin infection compared to those who injected intravenously only. It is also important to consider that the drugs themselves, particularly opioids, can have a deleterious effect on immune functioning, which may further sensitize IDUs to bacterial infections (20). The current study provides further evidence of high-risk injection practices that IDUs should be educated about in order to reduce their risk of infection.

In addition to skin infections, IDUs in our study also reported a high rate of HCV infection (57%) and described past diagnoses of other bacterial infections. Although 12% of participants reported a history of endocarditis and 10% reported sepsis, other bacterial infections were not commonly reported. Recent research suggests that rates of endocarditis among IDUs in the U.S. are increasing (21).

There are a number of limitations to the current study. First, our findings were based primarily on self-report. Second, our sample size was small. Nonetheless, there are a number of clinical implications. First, there is a need to educate IDUs specifically about bacterial infections, including information on how to prevent them and when to seek treatment. Although education will be a component of any intervention, it is necessary to teach behavioral skills, such as proper skin, hand and needle cleaning, and to provide IDUs with risk reduction supplies (e.g., alcohol, alcohol-based hand cleansers, sterile water and needles) or inform them where they can purchase such supplies.

Increasing access to risk reduction services will likely decrease rates of bacterial infections. There are data that demonstrates that greater utilization of needle exchange, for example, is associated with decreased abscess rates (22). Because of the overlap between viral and bacterial infection risk practices, it is possible to integrate HIV/HCV prevention and bacterial infection prevention services for IDUs to reduce medical complications and expensive healthcare utilization. Data from this study will be used to assist in the development of an integrated program for IDUs at risk for such infections.

Acknowledgments

This study was supported by an internal grant through the University of Northern Colorado. Dr. Stein is supported by NIDA Mid-Career Research Award DA 000512. The authors wish to thank the staff and clients of the drop-in center for their assistance and participation with this project.

REFERENCES

1. Schoener EP, Hopper JA, Pierre JD. Injection drug use in North America. *Infect Dis Clin North Am.* 2002; 16:535–551. [PubMed: 12371114]
2. Ebricht JR, Pieper B. Skin and soft tissue infections in injection drug users. *Infect Dis Clin North Am.* 2002; 16:697–712. [PubMed: 12371123]
3. Kak V, Chandrasekar PH. Bone and joint infections in injection drug users. *Infect Dis Clin North Am.* 2002; 16:681–695. [PubMed: 12371122]
4. Haverkos HW, Lange WR. Serious infections other than human immunodeficiency virus among intravenous drug users. *J Infect Dis.* 1990; 161:894–902. [PubMed: 2182730]
5. Pollini RA, McCall L, Mehta S, Vlahov D, Strathdee SA. Non-fatal overdose and subsequent drug treatment among injection drug users. *Drug Alcohol Depend.* 2006; 83:147–156. [PubMed: 16364568]
6. Binswanger IA, Kral AH, Blumenthal RN, Rybold DJ, Edlin BR. High prevalence of abscesses and cellulitis among community-recruited injection drug users in San Francisco. *Clin Infect Dis.* 2000; 30:579–581. [PubMed: 10722447]
7. Morrison A, Elliott L, Gruer L. Injecting-related harm and treatment-seeking behaviour among injecting drug users. *Addiction.* 1997; 92:1349–1352. [PubMed: 9489051]
8. Phillips KT, Anderson BJ, Stein MD. Predictors of bacterial infections among HCV-negative injection drug users in Rhode Island. *Am J Drug Alcohol Abuse.* 2008; 34:203–210. [PubMed: 18293237]
9. Stein MD. Medical consequences of substance abuse. *Addict Disord.* 1999; 22:351–370.
10. Kerr T, Wood E, Grafstein E, Ishida T, Shannon K, Lai C, Montaner J, Tyndall MW. High rates of primary care and emergency department use among injection drug users in Vancouver. *J Public Health.* 2005; 27:62–66.
11. Gordon RJ, Lowy FD. Bacterial infections in drug users. *N Engl J Med.* 2005; 353:1945–1954. [PubMed: 16267325]
12. Tuazon CU, Hill R, Sheagren JN. Microbiologic study of street heroin and injection paraphernalia. *J Infect Dis.* 1974; 129:327–329. [PubMed: 4361247]
13. Murphy EL, DeVita D, Liu H, Vittinghoff E, Leung P, Ciccarone DH, Edlin BR. Risk factors for skin and soft-tissue abscesses among injection drug users: A case-control study. *Clin Infect Dis.* 2001; 33:35–40. [PubMed: 11389492]
14. Vlahov D, Sullivan M, Astemborski J, Nelson KE. Bacterial infections and skin cleaning prior to injection among intravenous drug users. *Public Health Rep.* 1992; 107:595–598. [PubMed: 1410243]
15. Passaro DJ, Werner SB, McGee J, MacKenzie WR, Vugia DJ. Wound botulism associated with black tar heroin among injecting drug users. *JAMA.* 1998; 279:859–863. [PubMed: 9516001]
16. Ciccarone D, Bourgois P. Explaining the geographical variation of HIV among injection drug users in the United States. *Subst Use Misuse.* 2003; 38:2049–2063. [PubMed: 14677781]
17. Varga LM, Chitwood DD, Fernandez I. Research note: Factors associated with skin cleaning prior to injection among drug users. *J Drug Issues.* 2006 Fall;:1015–1030.
18. Hutin Y, Hauri A, Chiarello L, Catlin M, Stilwel B, Ghebrehiwet T, et al. Best infection control practices for intradermal, subcutaneous, and intramuscular needle injections. *Bull World Health Organ.* 2003; 81:491–500. [PubMed: 12973641]
19. Boyce JM, Pittet D. Guideline for Hand Hygiene in Health-care Settings: Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. *Infect Control Hosp Epidemiol.* 2002; 23:S3–S40. [PubMed: 12515399]

20. Risdahl, JM.; Peterson, PK.; Molitor, TW. Opiates, Infection and Immunity. In: Friedman, H.; Klein, TW.; Specter, S., editors. *Drugs of Abuse, Immunity, and Infection*. Boca Raton: CRC Press; 1996. p. 1-42.
21. Cooper HLF, Brady JE, Ciccarone D, Tempalski B, Gostnell K, Friedman SR. Nationwide increase in the number of hospitalizations for illicit injection drug use–related infective endocarditis. *Clin Infect Dis*. 2007; 45:1200–1203. [PubMed: 17918083]
22. Tomolillo CM, Crothers LJ, Aberson CL. The damage done: A study of injection drug use, injection related abscesses and needle exchange regulation. *Subst Use Misuse*. 2007; 42:1603–1611. [PubMed: 17918030]

Table 1Participant background characteristics ($n=51$)

Variable	n	%
Gender		
Male	34	66.7
Female	17	33.3
Race/Ethnicity		
Caucasian	45	88.2
Hispanic/Latino	4	7.8
Asian/Pacific Islander	1	2.0
Native American/Alaskan Native	1	2.0
Sexual Orientation		
Heterosexual	46	90.2
Bisexual	3	5.9
Lesbian Females	2	3.9
Homosexual Males	0	0
Highest Level of Education		
Less than high school	12	23.5
High school degree or GED	24	47.1
Some college	14	27.4
University degree or higher	1	2.0
Employment		
Full-time	2	3.9
Part-time	9	17.6
Unemployed or on disability	40	78.4

Table 2Drug use characteristics ($n=51$ unless noted otherwise)

Variable	n	%	Mean (SD)	Median
Primary Drug of Choice				
Heroin	21	41.2		
Methamphetamine	15	29.4		
Speedball	6	11.8		
Marijuana	5	9.8		
Cocaine	4	7.8		
Injection of heroin (alone) in last month	32	62.7		
Injection of cocaine (alone) in last month	25	49.0		
Injection of speedball in last month	17	33.3		
Injection of methamphetamine (alone) in last month	19	37.3		
Type of heroin used among all heroin users ($n = 32$)				
Black tar	24	75.0		
Light brown powder	4	12.5		
White powder	1	3.1		
Other	1	3.1		
Missing	2	6.5		
Years of injection			17.9 (11.4)	17.0
Days since last injection at screening (range = 1 – 30)			4.4 (6.2)	1.0
Days of injection/week			4.5 (2.6)	5.0
# of injections/day			3.7 (2.0)	4.0
Primary injection site				
Cubital fossa of arm	25	49		
Hand	8	16		
Upper arm	6	12		
Forearm or lower arm	6	12		
Leg	2	4		
Groin	2	4		
Shoulder	1	2		
Neck	1	2		

* Diagnoses sum to over 100% due to a number of participants having more than one diagnosis

Table 3Rates of viral and bacterial infections* ($n=51$)

Variable	n	%
HIV+	1	2.0
HCV+	29	57.0
Abscess ever in past	28	54.9
Total number of past abscesses among those reporting abscesses ($n=28$)		
One time	4	14.2
Two to three times	10	35.7
Four to six times	3	10.7
Seven to nine times	2	7.1
10 times or more	9	32.1
Abscess currently (at interview)	6	11.8
Abscess within past year (not currently)	9	17.6
Locations of current abscesses**		
Upper arms	4	
Genital/groin	1	
Lower legs	1	
Hand	1	
Report of other bacterial infections ever in past		
Endocarditis	6	11.8
Blood poisoning/sepsis	5	9.8
Necrotizing fasciitis/gangrene	2	3.9
Wound botulism	2	3.9
Septic arthritis	1	2.0
Tetanus	1	2.0
Osteomyelitis	0	0.0

* All infections based on self-report; Current abscesses confirmed by interviewer

** One participant had two current abscesses

Table 4Predictors of abscesses in univariate logistic regression models ($n=51$)

Variable	OR	95% CI
Age	.98	.92–1.04
Race	.36	.06–2.05
Homeless	1.22	.35–4.27
Heroin Injection Days Past Month (0–30)	1.11 *	1.04–1.18
Speedball Injection Days Past Month (0–30)	1.06 **	1.00–1.12
Booting	.71	.46–1.09
Skin cleaning	1.39 ***	.94–2.05
Hand washing	2.07 *	1.27–3.38
Subcutaneous injection	1.86 **	1.00–3.43
Intramuscular injection	2.11 *	1.33–3.35
Use of used needle when injecting	1.89 **	1.07–3.34
Bleach cleaning a used needle	1.12	.79–1.60
Frequency of injection	13.98 **	1.75–111.73

*
p < .004,**
p < .05;***
p < .10