Injections and Infections: Understanding Syringe Service Program Utilization in a Rural State

Kinna Thakarar (kthakarar@mmc.org)
Tufts University School of Medicine https://orcid.org/0000-0003-4689-0240
Nitysari Sankar
University of New England
Kimberly Murray
Maine Medical Center Research Institute
Frances Lee Lucas
Maine Medical Center Research Institute
Deb Burris
Maine Medical Center Research Institute
Robert Smith
Maine Medical Center Research Institute

Research

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Abstract

Background: Increasing rates of injection drug use (IDU) associated-infections suggest significant syringe service program (SSP) underutilization. Our study objective was to assess patient knowledge, attitudes, and practices of safe injection techniques and to determine predictors of SSP utilization in a rural state.

Patients and Methods: This was a fifteen-month cross-sectional study of participants hospitalized with IDU-associated infections in Maine. Data were collected through Audio Computer-Assisted Self-Interview survey and medical record review. Descriptive analyses were performed to characterize injection knowledge, attitudes and practices. The primary outcome was SSP utilization, and the main independent variable was self-reported distance to SSP. Logistic regression analyses were performed to identify factors associated SSP utilization, controlling for gender, homelessness, history of overdose, having primary care physician and distance to SSP.

Results: Of the 101 study participants, 65 participants (64%) reported past 3 month SSP utilization, though only 33% used SSPs frequently. Many participants (57%) lived more than 10 miles from an SSP. Participants who lived less than 10 miles of an SSP were more likely to use an SSP (adjusted odds ratio 5.39; 95% CI 1.9-15.7).

Conclusions Our study highlights unsafe injection practices and lack of frequent SSP utilization among people admitted with IDU-associated infections in a rural state. Especially given increasing stimulant use, these results also highlight the need for SSP access even among individuals prescribed medication for opioid use disorder. Particularly in rural areas where patients may live more than 10 miles from an SSP, expansion of harm reduction services, including mobile units, should be a priority.

Introduction

The increasing prevalence of substance use disorders in the United States has highlighted the need to examine approaches to reduce injection drug use (IDU)-associated infections (Rudd, Aleshire, Zibbell, & Gladden, 2016). Unsafe injection practices among people who inject drugs (PWID) have led to rising rates of HIV, viral hepatitis, and serious bacterial and fungal infections, such as infective endocarditis (Gordon & Lowy, 2005; Ronan & Herzig, 2016; Wurcel et al., 2016). Harm reduction services, specifically syringe services programs (SSPs), have been shown to effectively counsel clients about safe injection techniques, reduce the transmission of infections like HIV, deliver overdose prevention/education, administer vaccinations, and also facilitate referrals for medication for opioid use disorder (MOUD) (Des Jarlais, Feelemyer, Modi, Abdul-Quader, & Hagan, 2013; Fernandes et al., 2017; Patel et al., 2018) .

Nationally, outbreaks of HIV and viral hepatitis, such as those in Scott County, Indiana, and the rise of other serious complications such as infective endocarditis, have raised concern about access to preventive and treatment services for PWID in rural areas (Canary et al., 2017; Kishore, Hayden, & Rich, 2019; Nenninger, Carwile, Ahrens, Armstrong, & Thakarar, 2020; Zibbell et al., 2015). Additionally, some factors such as higher drug supply, close social networks, and economic hardship may play role in the

increasing incidence of IDU-associated infections in rural areas.(Keyes, Cerda, Brady, Havens, & Galea, 2014). In Maine, a predominantly rural state, the incidence of viral hepatitis and IDU-associated infective endocarditis have increased over recent years, (Bosse, 2016) (Prevention, 2017) (Thakarar K, 2019), leading to concerns that PWID underutilize SSP services and that SSPs may be less accessible to rural residents. A recent study showed that a majority of young people with acute hepatitis C in Maine lived ≥ 10 miles from an SSP (Canary et al., 2017). The fact that IDU-associated infections have been reported at hospitals both near and far from SSPs suggests that geographic dispersion however may not be the only factor influencing utilization and that other barriers need to be identified. Thus, the goal of our study was to provide a more detailed understanding of factors that influence SSP utilization in Maine and also help inform future interventions to improve access to SSP services, particularly in rural states. Our hypothesis was that distance from SSP would be a significant predictor of SSP utilization, and that other social determinants of health, such as homelessness, insurance and employment status, would play a role as well. Our study objectives were to 1) examine knowledge, attitudes, and practices around safe injection techniques and 2) determine factors predicting utilization of SSPs.

Methods

Study Design

This is a cross-sectional study of participants hospitalized with IDU-associated infections at four hospitals in Maine in counties deemed high risk for HIV/hepatitis outbreaks (Van Handel et al., 2016). A convenience sample of n=101 participants was prospectively recruited from January 1, 2019 through March 18, 2020. Study enrollment was halted due the COVID-19 pandemic.

Inclusion and exclusion criteria

Criteria for study enrollment included: 1) inpatient infectious disease consultation for a primary diagnosis of an IDU-associated infection such as infective endocarditis, skin/soft tissue infection, osteomyelitis, HIV or viral hepatitis, or whose chart has been reviewed by the ID antibiotic stewardship team and found to have an IDU-associated infection; 2) age 18-65; 3) EHR-reported or self-reported injection drug use and/or recent stigmata (e.g., injection sites on physical exam); 4) English speaking; and 5) ability to provide informed consent. Exclusion criteria included intubation, suicidal/homicidal ideation, or if the individual showed signs of psychotic symptoms. Data were collected through Audio Computer-Assisted Self-Interview (ACASI) ("ACASI: Audio Computer-Assisted Self-Interview Software,") survey and medical record review.

Measurements

Outcome

The primary outcome was SSP utilization which was defined as 1) having reported using an SSP in the past 3 months or 2) responding to the question about most common ways the participant got to an SSP

in the past 3 months.

Variables

The main independent variable was driving distance to closest SSP. Driving distance from the closest SSP to the participant's address was calculated in miles with an online map tool. If the participant was experiencing homelessness or if the participant's address was not available in electronic health record (EHR), driving distance was calculated between the closest SSP and the self-reported place/zip code centroid where the participant most frequently lived or slept in the past 90 days.

Some variables were collected through self-report. Self-report demographic and health variables included gender, history of incarceration, willingness to take pre-exposure prophylaxis for HIV/discussed pre-exposure prophylaxis with provider, condomless sex, and homelessness. Self-report variables regarding substance use included overdose history and injectable and non-injectable drug(s) of choice. Severity of opioid use disorder was measured using the Short-inventory of Problems-Modified for Drug Use (SIP-DU) (Alterman, Cacciola, Ivey, Habing, & Lynch, 2009). The Bacterial Skin Index Risk Score (BIRSI) score, which includes questions about alcohol pad and sterile water use, handwashing, rotating injection sites, injecting subcutaneously or in the muscle ("skin/muscle popping"), and clean needle use, was used as a continuous score to measure risk of skin and soft tissue infections (Phillips & Stein, 2010). Syringe disposal variables (i.e. disposal of needle/syringes in SSPs, public places, etc.) were also collected through self-report. Unhealthy alcohol use was categorized using the AUDIT-C score (Saunders, Aasland, Babor, de la Fuente, & Grant, 1993). Naloxone uptake was defined by self-report use of naloxone on another person, or having naloxone used on themselves. Self-report variables around SSP utilization included barriers to access, reasons for re-use of needles/syringes and other drug injection equipment.

Additional variables such as having a primary care provider (PCP), prior infectious complications, history of sexually transmitted disease and viral hepatitis were collected by a combination of self-report and EHR data. Hepatitis C (HCV) exposure was defined as positive if the participant self-reported history of HCV, HCV found in EHR, HCV antibody positive and no HCV RNA available. HCV infection was defined as HCV RNA detectable or self-reported history of HCV treatment. Hepatitis B (HBV) infection was defined as self-reported chronic HBV, HBV listed in EHR, or positive HBV DNA. HIV infection was defined as self-reported HIV infection, positive HIV antigen/antibody or HIV noted in EHR. Vaccinations for Hepatitis A, HBV, HCV, and Tdap were collected via self-report and EHR. Rurality was categorized as either rural (small or isolated rural) or urban (large rural or metropolitan) using the Rural-urban commuting area (RUCA) codes (Agriculture, 2019). Other variables were collected through EHR review exclusively. Such variables included insurance status, infectious disease diagnosis, Charlson co-morbidity index (Charlson, Pompei, Ales, & MacKenzie, 1987), prescribed MOUD prior to admission. MOUD prior to admission was defined as buprenorphine, buprenorphine/naloxone, naltrexone, or methadone on the pre-admission medication list.

Statistical analyses

Descriptive analyses were performed to characterize injection knowledge, attitudes and practices. The primary outcome was past 3-month SSP utilization, and the main independent variable was driving distance to closest SSP. Data were compared between subgroups using t tests for continuous data; chi square tests or Fisher's exact tests were used as appropriate for categorical data. Logistic regression analyses were performed to identify factors associated with SSP utilization. Potential covariates were chosen a priori based on clinical knowledge and literature review. Bivariate unadjusted odds analyses were performed testing the following variables: gender, insurance, employment status, homelessness, overdose history, PCP, insurance, condomless sex, driving distance, MOUD, trouble accessing SSP, HIV, HBV, HCV, SIP-DU and BIRSI scores**.** Gender, homelessness, history of overdose, having primary care physician and distance to SSP were included in the final multivariable regression model based on statistical significance of $p<0.05$ in the bivariate, unadjusted odds analyses. SAS Enterprise Guide version 7.1 was used for the analysis.

Results

Descriptive analysis

There were 101 study participants enrolled in the study, of whom n = 65 (64%) reported SSP utilization (Table 1). Fifty-seven percent (n = 57) of participants had a driving distance of $\geq$ 10 miles to the closest SSP. Few participants used clean needles (10%), works (cookers/filters) (5%), sterile water (31%), rotated their injection site (5%), performed handwashing (7%), or used alcohol pads (8%) each time they injected. Ninety-four percent of participants reported licking their needle and or re-injecting their needle (24%).

Table 1
Demographics and Health Characteristics among the Study Population, stratified by Syringe Service Program use

	Overall n = 101	SSP use [a] n = 65	No SSP use n = 36
Demographics			
Female [b]	56 (55%)	41 (63%)	15 (42%)
Median age (SD)	35 (7)	34 (8)	26 (6)
Caucasian	96 (95%)	61 (94%)	35 (97%)
Insurance[c]			
Medicaid	60 (61%)	39 (61%)	21 (60%)
Medicare	6 (6%)	6 (9%)	0
Dual Medicare/Medicaid	3 (3%)		
Commercial	5 (5%)	2 (3%)	3 (9%)
Uninsured	25 (25%)	14 (22%)	11 (31%)
Primary care provider	68 (67%)	48 (74%)	20 (56%)
History of incarceration [c]	90 (89%)	61 (94%)	29 (81%)
Experiencing homelessness	46 (46%)	36 (55%)	10 (28%)
Small/Isolated rural	18 (18%)	5 (7.7%)	13 (36%)
> 10 miles from SSP	57 (56%)	28 (43%)	29 (81%)
Health characteristics			
Person with HIV	1 (1%)	1 (1.5%)	0 (0)
Hepatitis C infection	46 (46%)	31 (48%)	15 (42%)
Hepatitis B infection	8 (8%)	6 (9%)	2 (6%)
Hepatitis C exposure	73 (72%)	50 (77%)	23 (64%)
Condomless sex	76 (75%)	46 (71%)	30 (83%)
Pregnant	3 (3.0%)	2 (3.1%)	1 (2.8%)
History of infectious complications			
Endocarditis	52 (51%)	36 (55%)	16 (44%)

[a] SSP = syringe service program; [b] n = 1 female to male transgender participant identified as male; thus, was categorized as male; [c] missing n = 3

	Overall n = 101	SSP use [a] n = 65	No SSP use n = 36
Skin/soft tissue infection	31 (31%)	21 (32%)	10 (28%)
Other septic emboli	26 (26%)	19 (29%)	7 (19%)
Bacteremia/sepsis	18 (56%)	12 (48%)	6 (86%)
Septic joint	11 (11%)	7 (11%)	4 (11%)
Epidural abscess	14 (14%)	5 (8%)	9 (25%)
Osteomyelitis/Diskitis	26 (26%)	13 (20%)	13 (36%)
History of STD	27 (27%)	21 (32%)	6 (17%)
Any mental health condition	91 (90%)	62 (95%)	29 (81%)
Charlson comorbidity index (0, 1+)	24 (24%)	14 (22%)	10 (28%)

[a] SSP = syringe service program; [b] n = 1 female to male transgender participant identified as male; thus, was categorized as male; [c] missing n = 3

Differences in demographics in participants with SSP utilization versus no SSP utilization include female gender (63% versus 42%, $p = 0.06$), homelessness (55% versus 28%, $p = 0.014$), driving distance ≥ 10 miles (43% versus 81%, $p < 0.001$), and rurality (8% versus 36%, $p < 0.001$). There were no significant differences in SSP utilization by race, sexual preference, or insurance status.

In terms of health differences, participants with a mental health condition were more like to report SSP utilization compared to those who did not use SSPs (95% versus 81%, $p = 0.03$). History of overdose was more common among participants who reported SSP utilization (65% versus 33%, $p = 0.005$), and there were significant differences in injection drugs of choice (notably methamphetamine 14% versus 6%, heroin 49% versus 21%, buprenorphine 5% versus 15%, $p = 0.03$) compared to participants who did not use SSPs (Table 2). Certain infectious complications, such as epidural abscesses (8% versus 25%, $p = 0.03$) were less common among participants with SSP utilization. Although not statistically significant, naloxone uptake (55% versus 33%, $p = 0.06$), MOUD treatment prior to hospitalization (71% versus 58%, $p = 0.3$), hepatitis A vaccination completion (61% versus 54%, $p = 0.7$), hepatitis B vaccination (57% versus 44%, $p = 0.3$), and Tdap vaccination (51% versus 29%, $p = 0.13$), were higher among participants who reported SSP utilization. There were no statistically significant differences in HCV exposure, chronic HCV infection, HIV infection, pre-exposure prophylaxis awareness, skin and soft tissue infection risk (BIRSI-7 score), drug use severity (SIP-DU), or unhealthy alcohol use (AUDIT-C) between the two groups.

Table 2
Substance use characteristics and Syringe acquisition/disposal in Study Participants, stratified by Syringe Service Program use

	Overall Study Population n = 101 (%)	SSP use [a] n = 65 (%)	No SSP use n = 36 (%)
Substance use characteristics			
Drug use severity (mean SIP-DU [b] (standard deviation))	33 (12)	33 (12)	32
Unhealthy alcohol use (positive AUDIT-C score) [c]	31 (31%)	17 (26%)	14 (39%)
Skin infection risk (median BIRSI-7 score [d])	3.77	3.75	3.81
Injection drugs of choice			
Heroin	39 (40%)	32 (49%)	7 (21%)
Fentanyl	14 (14%)	7 (11%)	7 (21%)
Cocaine	11 (11%)	7 (11%)	4 (12%)
Amphetamine	11 (11%)	9 (14%)	2 (6%)
Buprenorphine	8 (8%)	3 (5%)	5 (15%)
Speedball (cocaine + heroin)	9 (9%)	5 (8%)	4 (12%)
Other	6 (6%)	2 (3%)	4 (12%)
History of overdose	54 (53%)	42 (65%)	12 (33%)
MOUD [e] before admission	67 (66%)	46 (71%)	21 (58%)
Naloxone uptake	48 (48%)	36 (55%)	12 (33%)
Injected alone 30 days prior to hospitalization	89 (91%)	60(92%)	29 (88%)
Syringe acquisition and disposal			
Always used new needle	10 (9.9%)	8 (12%)	2 (5.6%)

[a] SSP = syringe service program ; [b] SIP-DU = Short-inventory of Problems-Modified for Drug Use; [c] AUDIT-C = Alcohol Use Disorders Identification Test [d]Bacterial Skin Index Risk Score; [e] Medication for opioid use disorder; [f] n = 1 other

	Overall Study Population n = 101 (%)	SSP use [a] n = 65 (%)	No SSP use n = 36 (%)
Always used clean works	5 (5.0%)	3 (4.6%)	2 (5.6%)
Where needles acquired [f]			
SSP	39 (39%)	38 (59%)	1 (3%)
Pharmacy	51 (51%)	23 (35%)	28 (80%)
Peer exchange	9 (9%)	3 (4.6%)	6 (17%)
Interest in mobile harm reduction unit	97 (97%)	65 (100%)	32 (91%)
Interest in supervised injection facility	93 (93%)	62 (95%)	31 (89%)

[a] SSP = syringe service program ; [b] SIP-DU = Short-inventory of Problems-Modified for Drug Use; [c] AUDIT-C = Alcohol Use Disorders Identification Test [d]Bacterial Skin Index Risk Score; [e] Medication for opioid use disorder; [f] n = 1 other

There were several differences in syringe acquisition and disposal between the two groups. People who reported SSP utilization were more likely to report past-3 month clean “works” (i.e. cookers and filters; (31% versus 11%, p = 0.04), clean needles (52% versus 23%, p = 0.05) “most of the time” or “all of the time.” They were also more likely neutral/interested in mobile syringe service program units (100% versus 91%, p = 0.04) or supervised injection facilities (95% versus 89%, p = 0.2). There were no statistically significant differences in syringe disposal in public places (45% versus 37%, p = 0.6), or re-use of needles (82% versus 78%, p = 0.8). Participants who did not use SSPs were more likely to acquire their needle/syringes from pharmacies (80% versus 35%, p < 0.001).

Of those n = 65 participants who used an SSP, 33% used an SSP frequently (few times per week), whereas others used it sometimes (20%) or hardly ever (27%). Many (57%) reported using one because its free services or because of privacy (32%). Fifty-four percent of participants reported trouble accessing an SSP, largely due to distance (28%), lack of car (19%), or stigma (14%).

Multivariable analysis

Participants who lived ≤ 10 miles from an SSP were more likely to use an SSP (OR 5.4, 95% CI 1.9–15.7), controlling for female gender, homelessness, history of overdose, and having a PCP (Table 3). Notably, participants with history of overdose (OR 3.1, 95% CI 1.2–8.3) and with a PCP (3.1, 95% CI 1.1–8.7) were also more likely to use an SSP.

Table 3
Unadjusted and Adjusted Analyses of Predictors of Syringe Service Program Use

Variable	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Female (ref [a] =male)	2.0 (0.9–4.6)	1.4 (0.5–3.6)
Homelessness (ref = housed)	3.2 (1.3–7.8)	2.5 (0.9-7.0)
History of overdose (ref = none) [b]	3.7 (1.5–8.6)	3.0 (1.1–8.1)
Primary care physician (ref = none) [b]	2.3 (1.0-5.3)	3.1 (1.1–8.7)
Driving distance ≤ 10 miles (ref = > 10 miles) [b]	5.5 (2.1–14.3)	5.4 (1.9–15.7)

[a] ref = reference group [b] denotes statistical significance; $p < 0.05$ considered statistically significant

Discussion

In this study of hospitalized individuals with IDU-associated infections, unsafe injection practices were common and living ≤ 10 miles from an SSP was associated with SSP utilization. The high rate of unsafe injection practices in our convenience sample is likely due, in part, to a selection bias implicit in our study population. Prior studies have documented the health benefits of access to SSPs, particularly when combined with access to MOUD treatment (Des Jarlais et al., 2013; Platt et al., 2017). Given the unsafe injection practices in this study population and geographic distribution of PWID in rural Maine, expansion of SSPs, including mobile units, could improve SSP utilization (Strike & Miskovic, 2018) and potentially prevent IDU-associated infections (Fernandes et al., 2017). Thus far, behavioral interventions that include harm reduction counseling in the hospital have not yet been shown to reduce future hospitalizations (Stein et al., 2020), leading to an emphasis on community strategies for harm reduction, such as access to SSPs. At the time of this study, there were only 6 SSPs in Maine, though in the setting of increasing overdoses and costly IDU-associated infections, additional SSPs opened upon study completion. It is noteworthy that rural addresses can lead to barriers to access to SSPs due to both distance and to lack of public transportation. Our study results are consistent with prior research where geographic disparities in SSP access were noted, particularly among young people with acute HCV (Canary et al., 2017). Modeling studies have shown that scaling up prevention (SSPs) and treatment efforts (MOUD) could decrease the burden of IDU-associated infections like HCV (Fraser et al., 2019; Platt et al., 2017). In our study, 66% of the participants were being treated with MOUD, yet still developed IDU-associated infections. Given rising stimulant use (Kariisa, Scholl, Wilson, Seth, & Hoots, 2019) and lack FDA-approved pharmacotherapy for stimulant use disorder, our findings highlight the importance of preventive services like SSPs. While a multipronged approach including Medicaid expansion, increasing MOUD treatment capacity, housing security, and access to pre-exposure prophylaxis for HIV, is certainly needed for infection prevention

(Schranz, Barrett, Hurt, Malvestutto, & Miller, 2018), increased access to SSPs is especially needed given the disproportionate burden of IDU-associated infections in rural areas.

While SSPs help reduce infection transmission, they also play a large role in naloxone distribution and overdose reversals (Rowe et al., 2015). Our results also showed that participants with a history of overdose were more likely to use SSPs. Notably, 90% of our study population reported injecting alone in the 30 days prior to hospitalization, and 72% of the participants supported supervised injection facilities, which are safe places where people can inject pre-owned drugs. While increasing accessibility to SSPs is needed, particularly to people who may not perceive overdose risk, consideration of supervised injection facilities is also important given the overdose and infection risks in our study population. Supervised injection facilities have not yet been adopted in the United States at the time of this study, but have been shown to reduce adverse outcomes, such as overdoses, elsewhere (Kilmer et al., 2018).

This study had some limitations. Nearly 20% of the study population came from small/isolated rural areas, and there was only one participant with HIV; our results may not be generalizable to more urban regions or regions with a higher prevalence of HIV. While reflective of our state's demographics, a majority of our study population was white. Black, Indigenous, people of color may experience additional barriers to SSP utilization that were not captured by this study. Our study was also a convenience sample of hospitalized people with IDU-associated infections, whose knowledge, attitudes and practices around safe injection techniques may not represent non-hospitalized people who use SSPs.

Conclusions

In our study of people hospitalized with IDU-associated infections in a rural state, unsafe injection practices were common. Especially given increasing stimulant use, these results also highlight the need to improve SSP access even among individuals prescribed medication for opioid use disorder. Living ≤ 10 miles from an SSP was associated with SSP utilization. Expansion of SSPs into rural areas, including mobile units, could increase SSP utilization and potentially reduce morbidity and mortality.

Declarations

Ethics approval and consent to participate.

The Maine Medical Center Institutional Review Board approved this study. Informed consent was obtained from study participants.

Consent for publication.

Not applicable.

Availability of data and material.

De-identified data can be made available upon request to corresponding author.

Competing interests.

The authors declare they have no competing interests.

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Authors' Contributions.

Conceived and designed the study: KT, FL, DB, RS. Analyzed the data: KM. Wrote the manuscript: KT, NS, FL, DB, RS.

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