



Changes in Reported Injection Behaviors Following the Public Health Response to an HIV Outbreak Among People Who Inject Drugs: Indiana, 2016

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Abstract

A syringe services program (SSP) was established following the Indiana HIV outbreak among persons who inject drugs (PWID) in Scott County. Among Indiana-based PWID, we examined injection behaviors associated with HIV status, SSP use after its establishment, and changes in injection behaviors after the outbreak response. During 2016, we interviewed 200 PWID and assessed injection behaviors before the response by HIV status. We reported injection behaviors prior to the response and used Fisher's exact Chi square tests ($P < 0.05$) to assess differences by HIV status. Next, among persons who injected both before (July–December 2014) and after (past 30 days) the response, we (1) reported the proportion of persons who used the SSP to obtain sterile syringes, and assessed differences in SSP use by HIV status using Fisher's exact Chi square tests; and (2) compared distributive and receptive sharing of injection equipment and disposal of syringes before and after the outbreak response, and assessed statistical differences using McNemar's test. We also compared injection behaviors before and after the response by HIV status. Injecting extended release oxymorphone (Opana® ER); receptive sharing of syringes and cookers; and distributive sharing of cookers, filters, or water before the response were associated with HIV infection. SSP use was high (86%), particularly among HIV-positive compared with HIV-negative persons (98% vs. 84%). Injection equipment sharing decreased and safe disposal of used syringes increased after the response, especially among HIV-positive persons. Injection equipment sharing contributed to the outbreak. High SSP use following the response, particularly among HIV-positive persons, contributed to decreased high-risk injection practices.

Keywords HIV · Persons who inject drugs · Outbreak · Syringe services program

Introduction

During early 2015, the Indiana State Department of Health began investigating a large outbreak of HIV infection among people who inject drugs (PWID) in Scott County, Indiana. By the end of 2015, 181 persons received a diagnosis of HIV infection in this community of 14,799 persons, where only 5 HIV infections were previously identified during 2004–2013. In response to the outbreak, the state of Indiana declared a public health emergency during March 2015 and organized a large multi-agency response to expand HIV and hepatitis C (HCV) testing and partner services, and provide treatment for HIV and substance use [1–3].

This outbreak occurred amid an epidemic of opioid overdose in the United States (U.S.), which has led to a 30% increase in emergency department visits for opioid-related

Disclaimer The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention.

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overdoses during 2016–2017 [4], as well as increased rates of opioid-related overdose deaths over time [5, 6]. The first wave of the epidemic, beginning in the 1990s, was driven largely by prescription opioid overdoses [7]. Persons in the U.S. consume more prescription opioids than in any other country [8], with greater use reported in less urban areas, particularly in Appalachian states [9, 10], and prescription opioid misuse often precedes injection of illicit opioids, such as heroin [11]. In addition, although prescription opioids are most commonly ingested, manipulation of prescription opioids to snort or inject them has increased [12]. Though HIV infections attributed to injection drug use (IDU) in the U.S. decreased from 2011 through 2016 [13], the increasing trend of IDU could alter this trajectory [14, 15]. When paired with sharing of injection equipment and condomless sex, IDU is associated with an increased risk of hepatitis B (HBV), HCV, and HIV [16–20].

A major component of the large-scale emergency response to the HIV outbreak in Indiana included the establishment of the state's first legally authorized SSP in April 2015 [2]. Syringe services programs (SSPs) increase access to sterile syringes and other injection equipment, provide safe disposal of used injection equipment, and offer a forum for harm reduction education and services, including HIV risk reduction counseling, HIV testing, and referrals for HIV and HCV medical care, and substance use treatment [21]. SSPs have been proven to be an effective, cost-saving HIV prevention strategy, as they can provide comprehensive prevention services and have been associated with a substantial reduction of risk of HIV among PWID [22–25]. However, SSP coverage in the US is low, including in areas where risk of HIV infection due to injection drug use is increasing [26, 27].

The Scott County SSP served as a hub for provision of a variety of HIV prevention services and was the backbone of the public health response. The SSP provided services at a fixed location inside a Scott County Health Department facility that operates 5 days a week, as well as through a mobile van that provides services to clients in the county 1 day a week. The Scott County SSP provided anonymous, needs-based services, including a 7-day supply of sterile injection equipment based on the number of syringes returned and reported injection frequency, wound care kits, and a medical waste container for disposal of syringes to PWID who reported living in Scott County, Indiana. Harm reduction education, including safer injection practices, naloxone administration to reverse overdose, and HIV prevention, as well as HIV and HCV testing and naloxone distribution, were provided on-site at the SSP and via the mobile unit.

Treatment for substance use disorder and primary care clinical services were also co-located at the facility. HIV and HCV testing, medical treatment for persons with HIV

and HCV, and pre-exposure prophylaxis (PrEP), an HIV prevention method for HIV-negative persons [28], were offered both at the clinic and by a local primary care provider through a linkage to care services coordinator [29, 30]. The SSP was a major component of the public health response and a means for service provision during the response. Thus, use of the SSP also served as a proxy for being reached by the overall public health response and increased awareness of HIV and the outbreak in Scott County, Indiana. However, the effect of the large-scale public health response on injection behaviors has never been previously evaluated.

Thus, we conducted a quantitative study among HIV-positive and HIV-negative PWID in Scott County to examine: (1) associations between injection behaviors before the outbreak response and self-reported HIV status, (2) use of the SSP (a major component of the public health response) after its establishment, and (3) changes in injection behaviors after the public health response to the HIV outbreak.

Methods

Population

During January–February 2016, we recruited PWID through respondent-driven sampling (RDS), a peer-referral sampling method that can be used to reach hidden populations such as PWID [31]. Through discussions with the SSP and the local primary care provider, a select number of initial recruits ('seeds') with diverse demographic characteristics known to belong to a large network of PWID were asked to participate. If eligible, 'seeds' were asked to refer up to five peers within their network for participation in the study. Upon participation, these peers were also provided recruitment coupons to distribute to their peers, and the cycle continued for multiple waves of recruitment. Our target sample size was 200 PWID.

Persons who received a recruitment coupon were asked to come to one of the local study sites within Scott County. The two site locations included a local church and a local doctor's office centrally located within Scott County. Those eligible for participation included residents of Scott County who were aged 18 years or older, were able to complete the interview in English, had reported injecting drugs in the previous 12 months, and consented to participate in the study. Based on previously published methods for IDU assessment, history of IDU was confirmed by either viewing track marks or other physical signs of injection, or by asking participants to provide a brief explanation of their injection drug practices to ensure they matched with local practices [32]. All eligible, consenting participants completed a 30–45 min interviewer-administered, standardized questionnaire. Interviews were conducted by trained staff in a private space at the study site to protect confidentiality. We collected

information about self-reported HIV status at the time of the interview. For those who did not know their HIV status, HIV testing was offered by the Indiana State Department of Health. We collected information on demographic characteristics, such as age, gender, race/ethnicity, educational attainment, sources of household income, housing stability, and incarceration during 2014 and 2015 (years during the peak of HIV transmission). We also collected data on injection behaviors, including age at first injection, type of drugs injected, frequency of IDU, multiple injections per injection episode (defined as injecting more than one time in a single setting), and source and disposal of syringes. We assessed periods of IDU and injection equipment sharing practices prior to any public health response activities related to the HIV outbreak (July–December 2014) and following the public health response (30 days prior to the interview, or about 8 months after the large-scale response). These time periods were chosen specifically so we could examine changes in injection behaviors several months following the large-scale emergency response. We asked respondents about sharing syringes, cookers, water, and filters through both distributive sharing, defined as passing used injection equipment to others to use, and receptive sharing, defined as using injection equipment after others have used it. We also asked about backloading, a method to divide drugs, in which a syringe is used to draw up prepared drug solution and dispense a portion of the solution to one or more persons by squirting it into their syringe. Finally, we asked participants about their use of the SSP to obtain sterile syringes during the previous 30 days.

Questions on demographic characteristics, injection behaviors, and HIV testing and status were adapted based on the National HIV Behavioral Surveillance study questionnaire. A qualitative study previously conducted among PWID in Scott County following the outbreak also informed study questions. The questionnaire was pilot-tested among a small sample of PWID in Scott County to ensure that we were capturing the information we needed and questions were well-understood. All participants received \$20 for participating. Participants received an additional \$5 incentive for each person they successfully recruited into the study through peer referral, for up to five recruits. The Indiana University Institutional Review Board approved the study protocol.

Analytic Methods

We described characteristics of PWID in Scott County, including demographic information, age at first injection, number of days since last injection event, and self-reported HIV status. We reported injection behaviors prior to the public health response and used Fisher's exact Chi square tests to assess differences in injection behaviors by HIV status.

Next, we restricted the analysis to persons who reported injecting both before and after the public health response. We reported the proportion of persons who used the SSP to obtain sterile syringes, and assessed differences in SSP use by HIV status using Fisher's exact Chi square tests. We compared distributive and receptive sharing of injection equipment and disposal of syringes by time period, and assessed statistical differences using McNemar's test. We also present injection behaviors before and after the public health response by HIV status, but did not use statistical testing to identify differences in behaviors within each HIV status group by time period due to limitations in sample size. All analyses were conducted using SAS 9.4 (Cary, NC).

Results

In total, 214 persons were screened for eligibility, of whom 200 (93%) were eligible, provided consent, and participated. Of 200 PWID included in this analysis, most were male (58%) and non-Hispanic white (92%). A majority reported ever being homeless (63%) or being incarcerated during 2014–2015 (66%) (Table 1). About a fifth of participants were employed in a part-time or full-time position and nearly a third reported owning or renting their residence. A majority of persons (60%) lived with at least one other person who injected drugs. Nearly half of those interviewed began injecting drugs before 25 years of age and 38% reported last injecting the day of the interview. Fifty-nine persons (30%) reported being HIV-positive, 124 (62%) reported being HIV-negative, and 17 (9%) reported unknown HIV status. Overall, 133 (67%) persons reported injecting prior to the public health response, of whom 124 (93%) reported injecting both before and after the public health response (not shown in tables).

Prior to Public Health Response

Among 133 persons who reported injecting before the public health response to the outbreak (July–December 2014), 87% reported injecting Opana Extended Release (ER)[®] with INTAC (Table 2). Other commonly injected drugs during this time period included Opana Immediate Release (IR)[®] (34%), methamphetamine (59%), heroin (28%), and other prescription opioid pain relievers, including Oxycotin[®], Dilaudid[®], morphine, Percocet[®], or Demerol[®] (35%). Of those who reported using either Opana IR or ER, 78% also injected at least one other drug (not shown in tables). Commonly reported injection venues included personal residences (80%), homes where drugs were purchased (59%), other homes where drugs were not purchased (73%), outside (41%), or in a car (70%). Most people reported injecting in houses

Table 1 Characteristics of a sample of persons who inject drugs—Scott County, Indiana, 2016 (n = 200)

	N ^a	% ^b
Overall	200	100
Age in years, median (interquartile range)	35	(28, 43)
18–25	26	13
25–34	69	35
35–44	62	31
≥ 45	43	22
Gender		
Male	115	58
Female	85	43
Race/ethnicity ^c		
Non-Hispanic white	184	92
Hispanic/Latino	3	2
Multi-racial	9	5
Other	4	2
Highest level of educational attainment		
Less than high school	82	41
High school or equivalent	77	39
At least some college	39	20
Current sources of income (categories not mutually exclusive)		
Employed in a part time or full-time position	41	21
Public aid or benefits (food stamps, disability), retirement/unemployment benefits	64	32
Spouse, boyfriend/girlfriend, borrowing money from friends/family	116	58
Selling drugs, exchanging sex for money, stealing	52	26
Other	38	19
Housing in past 30 days		
Owned or rented residence	61	31
Residence of family, friend, or partner	118	61
Prison/jail, shelter, living in a car, street/outside, abandoned house	16	8
History of ever being homeless		
Yes	126	63
No	74	37
Incarceration during 2014–2015		
Yes	132	66
No	67	34
Lives with at least one resident who injects drugs (among persons who resided with at least one other person)		
Yes	114	60
No	75	40
Age in years at first injection, median (IQR)	25	(20, 34)
< 25	91	46
25–34	63	32
35–44	30	15
≥ 45	16	8
Number of days before last injection event		
0 days	75	38
1–7 days	94	48
> 7 days	28	14
Self-reported HIV status		
HIV-positive	59	30
HIV-negative	124	62
HIV-unknown	17	9

^aNumbers may not add to total due to missing data

^bWhole percentages may not add up to 100 due to rounding

^cRacial/ethnic categories are mutually exclusive. Hispanics/Latinos can be of any race

Table 2 Injection behaviors reported by persons who injected drugs prior to outbreak detection (July–December 2014), overall and by self-reported HIV status—Scott County, Indiana, 2016 (n = 133)

	Overall		HIV-positive		HIV-negative		p
	n	%	n	%	n	%	
Overall	133	100	52	39	70	53	
Types of drugs injected prior to outbreak detection (not mutually exclusive categories)							
Opana ER® with INTAC	114	87	50	98	55	80	0.0020
Opana IR®	42	34	22	46	15	23	0.0145
Methamphetamine	77	59	32	64	41	59	0.5747
Heroin	36	28	11	22	22	33	0.2192
Other opioid pain relievers (Oxycontin®, Dilaudid®, morphine, Percocet®, Demerol®)	45	35	16	33	25	37	0.6975
Frequency of injection of Opana ER® with INTAC							
< 1 time per day	11	10	2	4	7	13	
≥ 1 time per day	103	90	48	96	48	87	0.1651
Injection in different locations (not mutually exclusive categories)							
Home	107	80	40	77	59	84	0.0264
House where drugs purchased	78	59	35	67	39	56	0.0012
House (not where drugs purchased)	97	73	39	75	51	73	0.0043
Outside	54	41	26	50	24	34	0.0007
Car	93	70	37	71	51	73	0.0173
Other place	30	23	10	19	17	24	0.6562
History of injecting in houses where other people inject							
Yes	98	74	45	87	48	69	0.0331
No	35	26	7	13	22	31	
Injected after someone had backloaded drug into syringe							
Yes	75	56	38	73	33	47	0.0053
No	58	44	14	27	37	53	
Multiple injections per injection episode ^a							
Yes	115	87	48	92	56	81	0.1129
No	17	13	4	8	13	19	
Source of syringe (not mutually exclusive categories)							
Bought syringes from pharmacy or store	73	55	31	60	36	51	0.0030
Received new, sterile syringes for free from someone	75	56	30	58	42	60	0.0769
Received used syringes for free from someone	49	37	26	50	20	29	0.0001
Bought new, sterile syringes from syringe/drug dealer	71	53	28	54	36	51	0.0200
Bought used syringes from syringe/drug dealer	15	11	8	15	5	7	0.0290
Found used syringe somewhere	11	8	6	12	4	6	0.0786
Disposal of syringe (not mutually exclusive categories)							
Trash	101	76	40	77	52	74	0.0042
Kept it to re-use it	85	64	37	71	42	60	0.0004
Gave or sold it to someone else	25	19	9	17	15	21	0.6403
Used medical waste disposal container	23	17	5	10	16	23	0.4659
Sharing of injection equipment							
Number of times injecting with the same syringe							
1 time	18	14	3	6	11	17	0.0926
> 1 time	109	86	47	94	55	83	
Any distributive/receptive syringe sharing							
Yes	98	74	47	90	45	65	0.0007
No	34	26	5	10	24	35	

Table 2 (continued)

	Overall		HIV-positive		HIV-negative		p
	n	%	n	%	n	%	
Distributive syringe sharing							0.1330
Yes	78	60	36	69	37	55	
No	52	40	16	31	30	45	
Receptive syringe sharing							<0.0001
Yes	82	62	44	85	33	47	
No	51	38	8	15	37	53	
Receptive sharing of cooker							0.0036
Yes	85	64	42	81	38	54	
No	48	36	10	19	32	46	
Distributive sharing of cooker, filter, or water							0.0030
Yes	96	72	46	88	45	64	
No	37	28	6	12	25	36	

Persons with unknown HIV status excluded from stratified analysis. Overall category includes persons who reported unknown HIV status

Numbers may not add to total due to missing data. Whole percentages may not add up to 100 due to rounding

^aDefined by injecting more than one time in a single setting

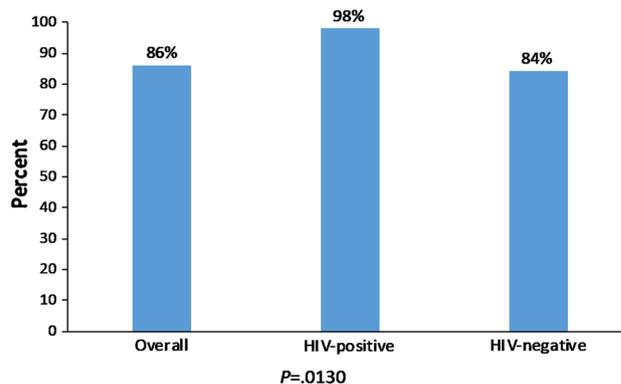
where other people injected (74%). A majority of persons reported injecting drugs that were backloaded from another syringe into their syringe (56%) and multiple injections per injection episode (87%), defined as injecting more than once in a single setting. Almost 40% of PWID reported multiple sources of syringes, such as sterile syringes from a pharmacy or store and new or used syringes from a dealer (not shown in tables), and only 17% reported using a medical waste container to dispose of used syringes. Disposal of used syringes in the trash was commonly reported (76%). Eighty-six percent of PWID reported injecting more than once with the same syringe (mean: 7.5 times, SD: 11.9 times). A majority of persons reported distributive syringe sharing (60%), receptive syringe sharing (62%), receptive sharing of a cooker (64%), and distributive sharing of cookers, filters, or water for injection (72%).

Among persons who reported injecting prior to the public health response, 39% reported being HIV-positive and 53% reported being HIV-negative. Persons who reported being HIV-positive were more likely than persons who reported being HIV-negative to report having injected Opana ER® (98% vs. 80%) and Opana IR® (46% vs. 23%), injecting drugs after they were backloaded into their syringe (73% vs. 47%), and injecting in homes where other people injected (87% vs. 69%). Persons who reported being HIV-positive were also much more likely to report distributive or receptive syringe sharing (90% vs. 65%), receptive sharing of a cooker (81% vs. 54%), and distributive sharing of cookers, filters, and water for injection (88% vs. 64%), compared with persons who were HIV-negative. Keeping used syringes to

re-use them was also more commonly reported among HIV-positive persons compared with HIV-negative persons (71% vs. 60%).

After the Public Health Response

Among 124 persons who injected before and after the public health response, a majority (86%) of persons reported using the SSP for sterile syringes in the 30 days prior to interview (Fig. 1). HIV-positive persons reported greater usage of the SSP for sterile syringes, compared with HIV-negative persons (98% vs. 84%). Compared with before the public health



*Sample was limited to PWID who reported injecting drugs before and after the public health response. Overall category includes persons who reported unknown HIV status. Use of SSPs was reported for the 30 days prior to interview.

Fig. 1 Past 30-day use of syringe services program among persons who inject drugs, overall and by self-reported HIV status—Scott County, Indiana, 2016 (n = 124)

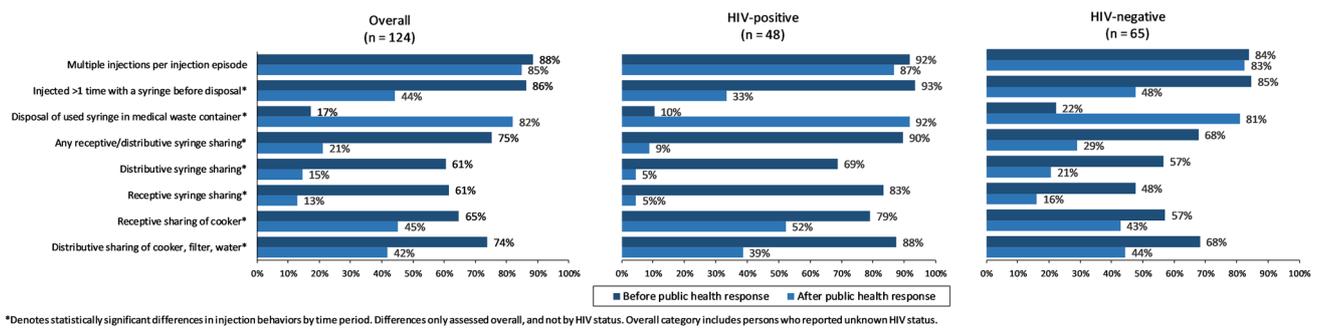


Fig. 2 Changes in injection behaviors after the public health response to the HIV outbreak among persons who inject drugs—Scott County, Indiana, 2016 (n = 124)

response, the proportion of persons who shared injection equipment decreased significantly after the public health response (Fig. 2). For example, distributive or receptive syringe sharing decreased from 75% to 21%, receptive sharing of cookers decreased from 65% to 45%, and distributive sharing of cookers, filters, and water for injection decreased from 74% to 42%. Differences were more pronounced among persons who reported being HIV-positive compared with those who reported being HIV-negative. Disposal of used syringes in a designated medical waste container increased significantly overall, from 17% to 82%; this increase was also more substantial among HIV-positive persons (10% to 92%) compared with HIV-negative persons (22% to 81%).

Discussion

This is the first study to examine the effect of a public health response to a large HIV outbreak, for which the establishment of an SSP served as a large component, on injection behaviors. We documented substantial decreases in unsafe injection practices associated with HIV transmission among PWID following the public health response. Reductions in unsafe injection practices were more pronounced among HIV-positive persons, suggesting that outbreak response efforts contributed considerably to reducing ongoing HIV transmission in this community. Over 80% of participants used the state's first legally operating SSP in this community, established as a part of the public health response. The SSP served as part of a comprehensive, integrated prevention strategy to provide harm reduction education and services to reduce injection behaviors associated with rapid transmission of HIV in this community and provide access and linkage to life-saving health and social services. These results demonstrate the considerable potential for minimizing HIV transmission risk in communities at high risk for infection through IDU [27].

The HIV outbreak in Scott County, Indiana resulted from the intersection of opioid use and IDU. A majority of

PWID in Scott County primarily injected the prescription opioid, Opana ER® with INTAC, an extended-release form of oxymorphone. Unlike other commonly injected drugs such as heroin or methamphetamine, dissolving Opana ER® required a larger amount of water than could fit into the preferred 1 mL syringe. This excess drug solution resulted in multiple injections per each injection episode. Further, the short half-life (4 h) of the drug when injected led to the need for multiple injections per day. In addition, the high cost of a single pill resulted in drug sharing and injection in groups. These practices were commonly reported in this study and an earlier qualitative study among persons identified as part of this outbreak [33]. These patterns in injection practices resulted in sharing of syringes, cookers, water, and filters, and backloading of drugs into others' syringes, amplifying risk of HIV infection [16, 17]. These practices are also consistent with other studies that observed greater risk of HCV infection among persons who injected prescription opioids [34], as their frequency of injection was higher and they were more likely to share injection equipment than persons who injected other drugs. Communities at risk for HIV and HCV transmission through IDU may benefit from the use of SSPs in their comprehensive prevention strategy, as well as engaging in primary prevention efforts to improve opioid prescribing practices through clinical guideline implementation [35].

The high frequency of injection equipment sharing before the outbreak response indicated a strong need for education about the risks of unsafe injection practices and access to sterile injection equipment. Prior to the outbreak, there were no legal SSPs operating in Indiana. As a part of the state's emergency response efforts, an SSP was established in Scott County. Legislation permitting SSPs in other counties was subsequently passed. Since then, other counties in Indiana have authorized SSPs [36]. Once established, the Scott County SSP was able to provide sterile syringes and injection equipment and harm reduction education to PWID in the community. In addition, SSP staff integrated other prevention services, including free naloxone distribution, HIV and HCV testing,

and referrals for HIV/HCV and substance use treatment, eventually co-locating treatment services with the SSP [2].

Although there was a significant decrease in distributive and receptive syringe sharing overall, we demonstrated that changes in sharing of other injection equipment, such as cookers, filters, and water, after the public health response, were not as substantial. In addition, there was not a significant decrease in multiple injections per injection episode after the outbreak response. We hypothesize that common practices related to splitting and injecting an Opana ER® pill may have perpetuated sharing of syringes and other injection equipment in the context of multiple injections per injection episode and back-loading into others' syringes to divide and share drugs [29, 33]. Further, as the SSP did not distribute other injection equipment typically used by persons injecting Opana ER®, such as sterile large volume cookers that were needed to prepare the drug (including cookers made from soda cans to accommodate large volume solution), persons continued using and reusing injection equipment which may have contributed to ongoing risk of HIV and serious bacterial infections. Tailoring distribution of injection equipment and education about safer injection practices according to local practices is key to continuing to decrease risk of HIV, hepatitis, and serious bacterial infections among PWID [37, 38]. In addition, monitoring any changes in local drug use practices over time may also be important. For instance, Opana ER® was voluntarily withdrawn from the market in mid-2017 [39]. As such, drug practices in Scott County could change over time if other opioids are introduced in the community, including fentanyl, which has been a cause of increased overdose deaths in the U.S. [6].

Although a majority of participants reported disposing of syringes in the trash prior to the outbreak, there were anecdotal reports of the use of soda bottles and coffee cans as a safer option for disposal. Use of medical waste containers for disposal of used syringes also increased significantly after the outbreak response, largely driven by dissemination of appropriate waste containers by the SSP and educating PWID to bring used injection equipment to the SSP for safe disposal. Safe disposal of injection equipment resulted in a reported decrease of used syringes found on the street, thus decreasing the risk of needle-stick injuries [29, 40].

After the public health response, use of the SSP and decreases in unsafe injection practices, such as receptive and distributive sharing of injection equipment, were particularly evident among HIV-positive persons. These findings suggest that the SSP played a key role in providing appropriate harm reduction education and sterile injection equipment for persons with HIV, and thus, likely decreased HIV transmission risk in the Scott County PWID community. Other studies have also shown that persons with HIV, including those attending SSPs, report lower levels of injection equipment sharing [32, 41].

SSPs have previously been shown to be an effective and cost-saving HIV prevention intervention by decreasing unsafe

injection practices and reducing HIV transmission [24, 25], and the findings from this study support existing literature. SSPs are also an important conduit for referring PWID to substance use treatment and other health and social services. When the SSP was initially established, referrals for inpatient substance use treatment were provided on-site. Medication-assisted treatment (MAT), which has been shown to be an effective treatment for opioid use disorder, is an effective way to decrease HIV transmission through reduced need for drug injection [42–44]. However, there may be barriers to prescribing MAT [45, 46]; in addition, support from local medical providers and other community stakeholders is needed to improve access to affordable options for MAT. MAT is now offered in some settings to a limited number of patients, including at the Scott County SSP. However, given that many of the more than 230 persons now living with HIV in Scott County are still injecting drugs, continued community support for, and expanded access to, affordable MAT is critical [47]. Other opportunities to expand access to MAT in jail settings, at HIV treatment clinics, emergency departments, and in the primary care setting have been successfully employed in other settings and should be considered in Scott County.

There were some limitations to this analysis. First, all data were self-reported, including HIV status, and may be subject to information bias. Given the high HIV testing rates and awareness in this community as a result of the HIV outbreak response, we believe that misclassification of HIV status should be minimal. However, misclassification of HIV status due to unknown serostatus would likely not affect injection behaviors. We only asked about current residence in Scott County at the time of the interview and did not verify that participants lived in the area during the entire analysis period. However, there was limited migration in and out of Scott County during and after the outbreak due to limited access to transportation and high poverty rates [1, 3]. This is supported by molecular analyses demonstrating that the outbreak was geographically contained to Scott County [2]. Although unlikely in this community, it is possible that there are factors other than those related to the public health response that could have affected injection behaviors. Finally, data may not be representative of all PWID living in Scott County, although robust RDS sampling allowed study staff to obtain a large sample of persons with respect to the estimated PWID population, which included many persons who may have been difficult to recruit through other means [31].

Conclusions

Following the largest HIV outbreak in a rural setting in the U.S. to date, these data demonstrated that incorporating an SSP as part of a comprehensive HIV prevention strategy

decreased HIV/HCV risk through changes in injection practices among PWID. Recent SSP use was reported by the vast majority of participants in our study, suggesting a demand for these services and a desire to reduce risk behaviors [29]. Ongoing HIV prevention education and harm reduction services are needed in Scott County to further reduce the transmission of HIV and other bloodborne infections, and to link PWID to life-saving health and social services. Other communities at risk for HIV/HCV transmission through IDU would benefit by incorporating the use of SSPs in their comprehensive prevention strategy.

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