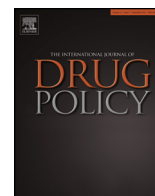




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Research Paper

Changes in public order after the opening of an overdose monitoring facility for people who inject drugs

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ABSTRACT

Background: In the face of an increasingly fatal opioid crisis, Boston Health Care for the Homeless Program (BHCHP) opened the Supportive Place for Observation and Treatment (SPOT), a unique low-threshold harm reduction program for monitoring people who have injected drugs and are at imminent risk of overdose. This study examines the impact of the opening of the SPOT program on measures of injection drug-related public order in the neighborhood surrounding the facility.

Methods: Data was collected at 10 weeks prior and 12 weeks post SPOT implementation on: number of over-sedated individuals in public, publicly discarded syringes, publicly discarded injection-related litter, and instances of active injection drug use or exchange of drugs. Changes were evaluated using Poisson log-linear regression models. Potential confounders such as weather and police presence were measured and controlled for.

Results: The average number of over-sedated individuals observed in public significantly decreased by 28% (4.3 [95% Confidence Interval (CI) 2.7–6.9] v 3.1 [CI 1.4–6.8]) after SPOT opened. The opening of SPOT did not have a significant effect on the other measures of public order. The daily average number of publicly discarded syringes (28.5 [CI 24.5–33.1] v 28.4 [CI 22.0–36.5]), pieces of publicly discarded injection-related litter (376.3 [CI 358.6–394.8] v 375.0 [CI 345.8–406.6]), and observed instances of active use or exchange of drugs (0.2 [CI 0.1–0.9] v 0.1 [CI 0.0–0.1]) were not statistically significantly different after the opening of SPOT.

Conclusions: The opening of SPOT was associated with a significant decrease in observed over-sedated individuals. Other measures of injection-drug related public order did not improve or worsen with the opening of SPOT, however, they have been shown to improve with the implementation of a supervised injection facility.

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Background

The United States is experiencing an opioid overdose epidemic (Rudd, Aleshire, Zibbell, & Gladden, 2016). The national death rate from drug overdoses has increased 137% since 2000, including a 200% increase in the rate of overdose deaths involving opioids (Rudd et al., 2016). In Massachusetts, the opioid-related death rate has increased 350% since 2000, with a sharp rise beginning in 2011 (Health, 2016). In hospitals in the city of Boston, from 2007 to 2012, there was a significant increase in unintentional overdose/poisoning patient encounters for opioids (Commission, 2016).

In Boston, individuals experiencing homelessness have been disproportionately affected by this epidemic of opioid use disorder and overdose deaths (Baggett et al., 2013). One study showed that adults under the age of 45 experiencing homelessness had an overall death rate 16 to 24 times higher than in the Massachusetts general population (Baggett et al., 2013). Another showed that drug-attributable mortality rates in people experiencing homelessness were 8 to 17 times higher than the Massachusetts general population (Baggett et al., 2014). Of the overdose deaths among a cohort of individuals experiencing homelessness, 81% involved opioids and 40% involved multiple drugs (Bauer, Brody, Leon, & Baggett, 2016). It has also been shown that people who lack housing are at a higher risk for using alone (Bauer et al., 2016; McKnight et al., 2007), which is a risk factor for overdose (Jozaghi & Andresen, 2013; Milloy et al., 2010). Public drug use increases risk

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for overdose (Van Beek, Kimber, Dakin, & Gilmour, 2004) and unsafe situations like robbery (Jozaghi & Andresen, 2013) and violence (Fairbairn, Small, Shannon, Wood, & Kerr, 2008).

Boston Health Care for the Homeless Program (BHCHP) implemented a unique harm reduction intervention to better manage overdoses. The Supportive Place for Observation and Treatment (SPOT) opened at BHCHP in April of 2016 (Gaeta, Bock, & Takach, 2016). SPOT is a facility for up to 10 individuals who are intoxicated from the use of opioids and other substances to be medically monitored for signs of an overdose and provide rapid intervention with naloxone and/or supplemental oxygen when an overdose occurs (Gaeta et al., 2016). Consumption of illegal substances is not permitted within the facility. SPOT serves as an alternative to being over-sedated, alone, and at risk after using substances on the street or elsewhere in public. More details of the operations of the program have been described elsewhere (Gaeta et al., 2016). The goals of the program are to reduce the opioid overdose fatality rate in the area, engage high-risk individuals in care and treatment, and address the impact of substance use disorder (SUD) on patients and the neighborhood.

A distinct effect of the opioid crisis in the area is the burden of public use on the surrounding neighborhood. Public injection drug use and its consequences on public order and public health (e.g. publicly discarded syringes) are of great concern. The area in which SPOT was opened is known as an epicenter of public drug activity in Boston. In internal evaluations, the SPOT program has been shown to directly connect patients to health care and addiction treatment services, engage a hard-to-reach and high-risk patient population, and provide a low-threshold overdose prevention intervention. As part of the evaluation of SPOT, the following study assesses the impact of the facility on injection-drug-related public order in the surrounding area.

Methods

Study design to assess public order before and after the opening of SPOT was modeled after the Wood et al. (2004) study in Vancouver, Canada that measured changes in public order following the opening of a SIF. Measures and data collection were modified to fit the intervention.

Data collection involved surveying three predetermined routes that, together, comprised a comprehensive walking course of the publicly accessible area within a 500-m radius of the planned intervention. Each of the three routes was completed at the same time once weekly. Each observation session was performed by four data collectors, with two lead collectors who were present throughout every collection period to promote consistency. Two data collectors from each observation session were members of the Boston Public Health Commission (BPHC) Mobile Sharps Team – specifically trained and tasked to recover publicly discarded syringes. Counts of injection-drug related measures of public order were documented. Data was collected for ten weeks before the opening of the SPOT facility and for twelve weeks after.

Four indicator measures of public order were measured. Instances of observed public use or exchange of drugs, publicly discarded syringes, and publicly discarded injection drug related litter were identified as measures of public drug use, as measured by Wood in 2004. In addition to being counted, syringes were also recovered and safely discarded at each observation session eliminating repeat documentation at successive data collection sessions.

As publicly discarded syringes alone would not provide a clear indication of public drug use, injection drug related litter was chosen as a measure to capture the full picture of injection drug use in the area. Drug related litter included syringe caps, tourniquets, cookers (containers known locally to be used to mix and heat

substances before injection), alcohol swabs, clean cotton (used for filtering substances), and sterilized water containers. Improvised drug use paraphernalia such as soda cans or spoons likely used as cookers were not counted. Consequently, our estimates are likely conservative. Litter was not recovered during data collection. Each observed piece of litter was counted at each data collection session.

The final measure of drug related public order was over-sedated individuals in public. The area in which the study was conducted has a concentration of addiction and homelessness services and fatal and non-fatal overdoses are common. Over-sedated individuals in public, especially those at risk of or experiencing an overdose in public, are the target population for the SPOT facility's services, and represented a measure of direct relevance to the new programming. An over-sedated individual was defined as a person with a decreased level of consciousness. Commonly observed signs of over-sedation in this study were: inability to stand up, keep balance, or keep eyes open, and slumped appearance in public. Additional behaviors that implied impaired judgement were also taken into consideration when applicable, such as crossing a dangerous intersection slowly and without looking, standing and swaying in one place for too long, and difficulty talking or communicating.

Because public drug use may be impacted by police presence (Wood, Spittal et al., 2004) and weather conditions, data was also collected on other potential explanatory variables that included: number of uniformed police patrols observed during data collection sessions, rainfall amounts (in inches) on days of data collection publicly available from the Boston Water and Sewer Commission, (Walsh and Vitale, 2016) the observed presence or absence of snow coverage, and outdoor temperature during observation sessions as reported by the Weather Channel that also incorporated the effects of wind chill and humidity.

Finally, publicly-accessible data from the City of Boston's non-emergency reporting service (BOS:311) was used to compare trends of counts of reported publicly discarded syringes outside the 500-m observation area in the same timeframe. (The purpose of the BOS:311 program is for anyone to report by phone call the presence of a publicly discarded syringe within City limits.)

Data was entered into a Microsoft Access database. Double data entry was used for quality control. Data was managed in Microsoft Excel and analyzed in SAS 9.4.

Analysis

The statistical protocol used in the analysis was modeled after the analysis plan of Wood 2004 to examine the potential relationship between the public order measures and the operation of the SPOT facility. The mean daily numbers of participants who used SPOT and each of the four public order measures were calculated. To test for changes in each of the measures of public order before and after the opening of SPOT, pre- and post- daily averages were compared using the Wilcoxon Rank Sum test for non-normally distributed data. The correlation between SPOT use and each of the public order measures was evaluated using Spearman's correlation coefficient. Poisson log-linear models were fit with the daily count of each of the public order and potential explanatory measures. The independent variables were examined in unadjusted regression models and then adjusted for potential explanatory variables and study period. Parameter estimates from the unadjusted and adjusted regression models were used to calculate the predicted mean daily numbers of each public order measure in the two study time periods. To create a proxy control of the 500-m radius data collection area, publicly available data from the city's public syringe clean-up report service was analyzed. All p values were 2-sided with a significance level of $p < .05$.

Results

The unadjusted mean daily numbers of participants who used SPOT and each of the four public order measures were calculated and are presented in Fig. 1.

The mean number of daily visits in the first week of operation of SPOT was 7. The mean daily visits in SPOT's 12th week of operation was 15, with a peak of 18 mean daily visits at week 10.

When data for the periods before and after the opening of the facility were compared, no statistically significant reductions were found in the unadjusted mean daily numbers of use or exchange of drugs (0.7 [interquartile range (IQR) 0.3–1.0] v. 0.6 [IQR 0.3–0.8]; $p = .920$), publicly discarded syringes (39 [IQR 27.0–50.7] v. 50 [IQR 36.–63.7]; $p = .171$), or over-sedated individuals (5.1 [IQR 3.3–5.7] v. 4.3 [IQR 3.0–5.2]; $p = .672$). There was a statistically significant increase in observed pieces of injection drug related litter (393.9 [IQR 362.0–437.7] v. 454.8 [IQR 426.2–502.0]; $p = .029$).

When testing for correlations between daily counts of SPOT facility usage and daily counts of the four public order measures, there were no statistically significant correlations found with: observed active use or exchange of drugs ($r = 0.02$, $p = .48$), publicly discarded injection-related litter ($r = -0.12$, $p = .71$), publicly observed over-sedated individuals ($r = -0.16$, $p = .62$). The correlation between SPOT facility usage and publicly discarded syringes was borderline significant ($r = 0.53$, $p = .07$).

The independent variables were examined in unadjusted regression models and then adjusted for daily rainfall amount (inches), snow coverage (present vs. absent), outside temperature, number of uniformed police patrols observed, and study period (before vs. after SPOT opening). The beta coefficients from the Poisson regression models were used to calculate the ratio of means for each of the measures and effects. The significant results are reported in Table 1.

Additionally, approaching significance was a 52% decrease in use and exchange of drugs in public after the opening of SPOT (Beta coefficient -0.7391 , ratio of means 48%, $p = .0830$).

The predicted mean daily level of each public order measure in the periods before and after the opening of the SPOT facility was calculated using the parameter estimates from the adjusted regression model (Table 2) (Fig. 2).

As an external measure of the impact of SPOT on public drug use, the publicly available data from the city of Boston's public syringe reporting line, BOS:311 was examined. Weekly averages of syringe count data were evaluated, as some calls constituted multiple syringes, as well as weekly averages of call counts. There were no statistically significant differences before and after the opening of SPOT in calls in the same neighborhood as SPOT (4.0 [standard deviation (SD) 3.1] vs. 3.4 [SD 2.3], $p = .82$), calls in all other Boston neighborhoods (32.0 [SD 7.0] vs. 32.2 [SD 6.3], $p = .82$), syringe counts in the same neighborhood as SPOT (8.7 [SD 9.9] vs.

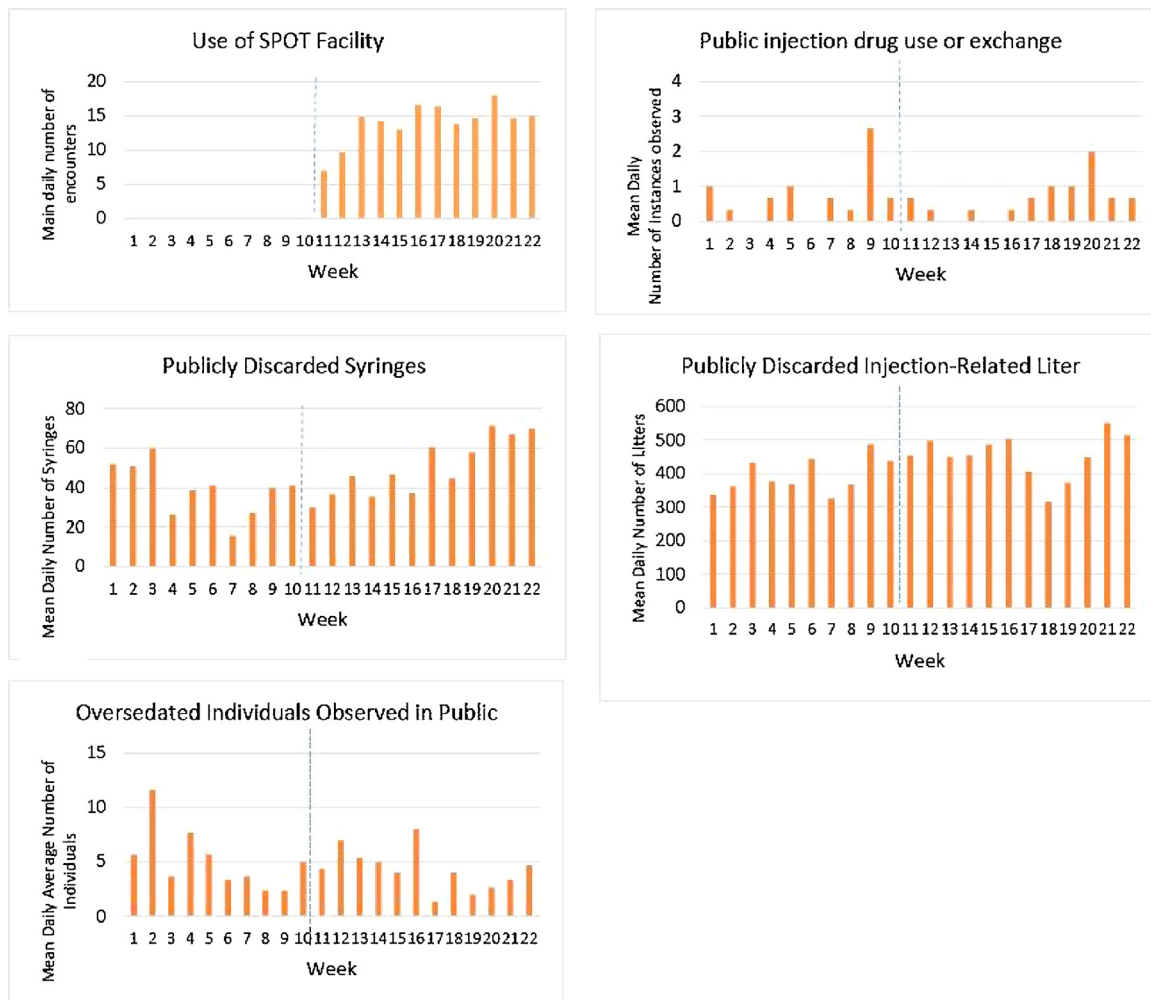


Fig. 1. Unadjusted mean daily numbers of people observed using or exchanging drugs in public, publicly discarded syringes, publicly discarded injection-related litter, and over-sedated individuals in public counted during the 10 weeks before and 12 weeks after the SPOT facility opened. Dotted line represents opening of facility.

Table 1

Poisson log-linear models and ratios of means of public order measures and significantly associated explanatory variables.

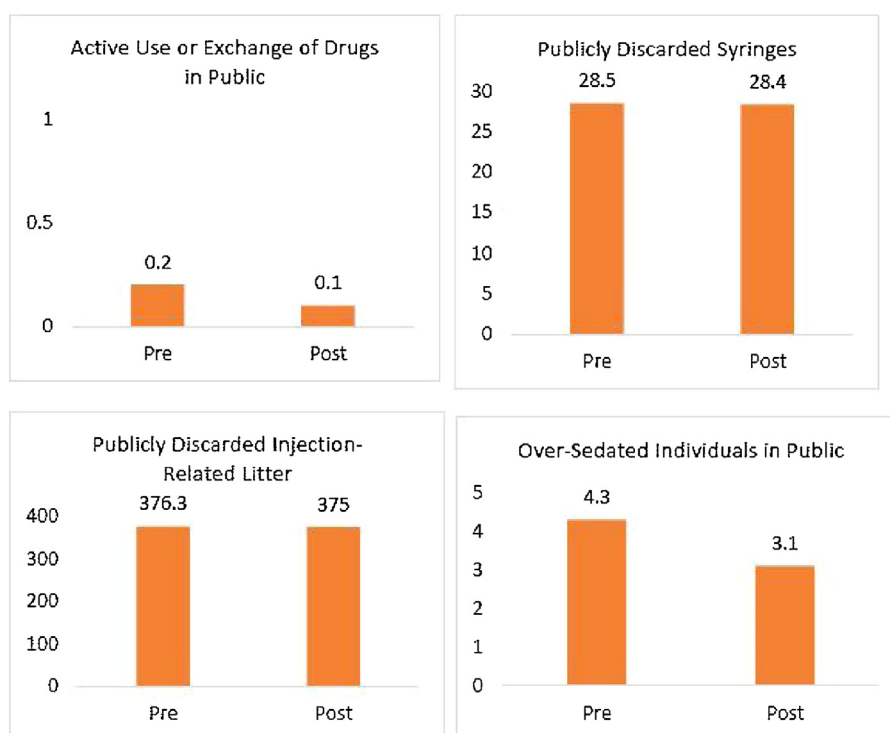
Public Order Measure	Significantly associated factors	Beta coefficient	Ratio of Means	Change in dependent variable	p value
Exchange of drugs observed in public	Outside temperature	0.0246	102%	2% increase	.0415
Publicly discarded injection related litter	Police patrols	0.0407	104%	4% increase	<.0001
	Rainfall	-0.2484	78%	22% decrease	<.0001
	Snow coverage	0.0014	36%	64% decrease	<.0001
Publicly discarded syringes	Outside temperature	-1.0264	100%	<1% increase	.0031
	Police patrols	-0.0303	97%	3% decrease	.0013
	Rainfall	0.5527	174%	74% increase	<.0001
Over-sedated individuals in public	Snow coverage	-1.1930	30%	70% decrease	<.0001
	Outside temperature	0.0089	101%	1% increase	<.0001
	Opening of SPOT	-0.3240	72%	28% decrease	.0449

Table 2

Predicted mean measures of public order measures during the 10 weeks before and 12 weeks after the opening of SPOT*.

	Predicted Daily Mean Number (and 95% Confidence Interval)			
	Before SPOT opened		After SPOT opened	
Active use or exchange of drugs in public	0.2	(0.1–0.9)	0.1	(0.0–1.0)
Publicly discarded injection-related Litter	376.3	(358.6–394.8)	375.0	(345.8–406.6)
Publicly discarded syringes	28.5	(24.5–33.1)	28.4	(22.0–36.5)
Over sedated individuals in public	4.3	(2.7–6.9)	3.1	(1.4–6.8)

*Parameter estimates from the adjusted Poisson log-linear regression models were used to calculate the predicted means.

**Fig. 2.** Adjusted average mean daily counts of four metrics of injection-drug related public order during the 10 weeks before and 12 weeks after the opening of the SPOT facility.

4.5 [SD 2.7], $p = .48$), or syringe counts in all other Boston neighborhoods (64.6 [SD 7.0] vs. 53.0 [SD 16.4], $p = .62$).

Discussion

SPOT was designed to monitor and manage individuals over-sedated from the use of substances. This observational field study showed a statistically significant decrease of 28% of over-sedated individuals in public after the opening of SPOT. The results indicate

that the opening of SPOT did not positively or negatively affect the number of observed instances of individuals using or exchanging drugs in public, the number of publicly discarded syringes, or the amount of publicly discarded injection-drug related litter.

Before the SPOT program opened, there was community concern that the opening of a harm reduction facility would exacerbate the public burden of the opioid crisis including increased public drug use, public syringe disposal, and public disposal of injection drug related litter. The Needle Exchange

Program (NEP) in the center of the study observation area had a syringe uptake rate of 112% (BPHC, Internal Data) during their most recent fiscal year (July 2015–June 2016), which included the study period and indeed, there is evidence that NEPs reduce the burden of publicly discarded syringes in the area surrounding them (Doherty et al., 2000; Tookes et al., 2012). The results of this study show there were no significant increases in those public order measures after the opening of SPOT, particularly when controlling for rainfall, snow coverage, and outdoor temperature. Controlling for these weather-related factors is relevant and appropriate based on the extreme changes in local weather from the beginning of data collection to the end. Average temperature the first week of data collection was two degrees Celsius compared with 33 °C the last week of data collection.

Interestingly, while an increase in number of observed police patrols was significantly associated with a reduction in publicly discarded syringes, the effect was minimal (a 3% decrease). The same measure was associated with a statistically significant increase in injection related litter and had no effect on active use or exchange of drugs in public. These outcomes suggest that additional law enforcement resources in the neighborhood may not be a sufficiently effective intervention to decrease these measures.

This study was modeled after a study that measured changes in public order after the opening of a supervised injection facility (SIF) in Vancouver, Canada (Wood, Small et al., 2004). A SIF is a facility where people who inject drugs can inject previously obtained substances under the supervision of medical staff (Wood, Kerr et al., 2004). Emergency care is provided when necessary including overdose management and lifesaving. SIFs also provide medical services and referrals to substance use disorder treatment (Wood, Kerr et al., 2004). Participants are provided with sterile injecting equipment, injection education, and disposal receptacles (Wood, Kerr et al., 2004). Over 90 SIFs exist worldwide (Semaan et al., 2011), but for legal reasons at the state and federal level, none exist in the United States (Beletsky, Davis, Anderson, & Burris, 2008). The Wood 2004 (Wood, Small et al., 2004) study measured the number of individuals using in public, publicly discarded syringes, and injection-related litter. While our study found no changes in any of those measures after the opening of SPOT, the Wood 2004 study found significant decreases in each of the three measures after the opening of a SIF (Wood, Small et al., 2004).

Community support is necessary for the success of innovative harm reduction programming, and, while support exists for the positive health effects associated with a SIF, there has been found to be concern for risk of increased public disorder. (Kolla et al., 2017) However, SIFs have been shown not only to not negatively affect public disorder, but to reduce public injection and reduce unsafe syringe disposal (Kimber & Dolan, 2007; Potier, Laprevote, Dubois-Arber, Cottencin, & Rolland, 2014; Stoltz et al., 2007; Kinnard, Howe, Kerr, Skjodt Hass, & Marshall, 2014; Petrar et al., 2007; Zurhold, Degkwitz, Verthein, & Haasen, 2003). A study of community perceptions of public order after the opening of a SIF in Sydney Australia found a significant decrease in the proportion of respondents who reported having witness public injection and publicly discarded drug-related litter, (Salmon, Thein, Kimber, Kaldor, & Maher, 2007) and findings suggested decreased community concern for crime and drug users in the area after the SIF opened. Thein, Kimber, Maher, MacDonald, and Kaldor, (2005), DeBeck et al. (2008) found that police in Vancouver, Canada may have helped improve public order by referring to a SIF those more likely to discard used syringes in public spaces. Other harm reduction programming has also shown no effect on neighborhood crime or public disorder (Lasnier, Brochu, Boyd, & Fischer, 2010).

There is also evidence that SIFs reach a similar vulnerable high-risk population as targeted in SPOT (Bravo et al., 2009). Wood

2005 found that those who utilize SIFs are more likely to have reported past public injection, be homeless or unstably housed, and have had a recent non-fatal overdose (Wood et al., 2005). Previous public injection has been found to be independently associated with SIF use (Hadland et al., 2014; Scherbaum, Specka, Bombeck, & Marrziniak, 2009; Kimber et al., 2003). Utilization of an available SIF was found to be associated with less frequent public drug use (Jozaghi & Andresen, 2013; van der Poel, Barendregt, & van de Mheen, 2003; Zurhold et al., 2003). A recent study found that the majority of surveyed injection drug users in Boston would be willing to use a SIF, with previous public drug use being associated with an increase in willingness (Leon, Cardoso, Mackin, Bock, & Gaeta, 2017).

Of additional importance is the rate of overdose intervention within the SPOT facility. Within the study time period, nasal naloxone and/or supplemental oxygen were used to intervene on overdose progression when determined medically necessary from clinical assessment of blood oxygen saturation levels, respiratory rate, blood pressure, and/or heart rate. This occurred in 22 of 457 (4.8%) of encounters (BHCHP internal data). This rate is considerably higher than the initial rate of overdose intervention after the opening of a SIF in Vancouver, Canada which was reported at 1.33 overdoses per 1000 injections (Kerr, Tyndall, Lai, Montaner, & Wood, 2006). Intervention rates at SPOT would increase further if use of substances were permitted and providers could respond to overdoses that occur at the point of injection.

In addition to the effect on measures of public order, SIFs have been shown to significantly reduce overdose mortality (Marshall, Milloy, Wood, Montaner, & Kerr, 2011), reduce risky injection behavior (Petrar et al., 2007), and increase access to substance use disorder treatment (DeBeck et al., 2011; Wood et al., 2006).

The differences in the outcomes of this study and the outcomes of the Wood 2004 (Wood, Kerr et al., 2004) study evaluating the effect of a SIF on the same measures of public order, the existing evidence that SIFs reach a high-risk population that contribute to public disorder, and the studies that have shown SIFs impact on behaviors that influence public order suggest that a SIF may be a more effective model for improving public order than SPOT, and should be considered as part of a broader approach in communities in the United States most affected by the opioid overdose crisis.

Our study has limitations. As this observational study was not controlled, it was subject to observer bias and seasonal fluctuations in drug use and public behavior. A proxy control analysis was conducted in lieu of an actual control area. Recovery of syringes may have also contributed to observer bias. Individuals observed as over-sedated may not have been under the influence of substances from injection drug use. Observation of the measures of public order was susceptible to inter-observer variance. Future studies are needed to evaluate the overall health and community impacts of the facility.

Conflicts of interest

None of the authors have any conflicts of interest to disclose.

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