International Journal of Drug Policy 21 (2010) 208–214

Contents lists available at ScienceDirect

International Journal of Drug Policy

journal homepage: www.elsevier.com/locate/drugpo

Research paper

# Assessing a drop box programme: A spatial analysis of discarded needles

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ARTICLE INFO

*Article history:*
Received 15 May 2009
Received in revised form 22 July 2009
Accepted 29 July 2009

*Keywords:*
Needle and syringe disposal
Injection drug users
Discarded needles
Spatial analysis
Geographic information system (GIS)

ABSTRACT

*Background:* Distributing sterile injection equipment to injection drug users is one of few proven ways of lowering the transmission rate of blood borne viruses. Distribution of equipment has also been linked to increased needle discarding, which is a public health risk for both injectors and their host communities. Drop boxes (anonymous and public-access sharps containers) are a promising and increasingly popular means of reducing unsafe disposal, yet there is little empirical research to support or guide their implementation.

*Methods:* Using a dataset containing the locations of 7274 discarded needles and syringes collected monthly in the non-park open spaces of a 2.5 km$^2$ neighbourhood of Montréal, Canada for a period of five years, we compared levels of discards before and after the installation of 12 drop boxes. We used quasi-Poisson regression to test the effects of drop boxes on monthly counts of collected discards for areas within a walking distance of 25, 50, 100 and 200 m of a drop box. We adjusted for known time-dependent covariates linearly and unknown time-dependent covariates using a smoothing function.

*Results:* We found strong evidence of reduced discarding following the installation of drop boxes; drop boxes were associated with reductions of up to 98% (95% CI: 72–100%) and significant reductions for areas up to 200 m from a drop box. Reductions were inversely proportional to walking distance from drop boxes. No measure of weather or use of needle exchange programmes (NEPs) had a consistent relationship with discard counts.

*Conclusion:* Our research suggests that IDUs changed their needle-disposal behaviour in response to increased safe disposal options. In addition to being relatively low-threshold, economical and rapid, drop boxes appear to be a highly effective intervention to reduce discarded needles.



## Introduction

Unsafely discarded drug injection equipment has been associated with personal and public health risk and with social disapproval. Although the risk of contracting blood borne viruses from non-medical needle-stick accidents is known to be low (Garcia-Algar & Vall, 1997; Libois et al., 2005), needle-sticks provoke considerable adverse psychological effects (O'Leary & Green, 2003).

Research has shown that the presence of discarded needles[1] in public spaces symbolizes social disorder and quickly engenders community resentment (Smith, Riley, Beilenson, Vlahov, & Junge, 1998). Thus discards can jumpstart a downward spiral in areas where services for injection drug users (IDUs) are most needed. Research has pointed to discards as the cause of opposition to needle exchange programmes (NEPs) (Drug Policy Alliance, 2001; Kermode, Harris, & Gospodarevskaya, 2003; Tempalski et al., 2003); closure of NEPs (Broadhead, van Hulst, & Heckathorn, 1999); and refusal by private pharmacies to serve IDUs (Kermode et al., 2003; Wright-De Aguero, Weinstein, Jones, & Miles, 1998). Photo 1 shows examples of graffiti expressing community resentment towards IDUs caused by discards (the printed sign on the left reads: "Smile, you are being watched by a hidden camera").

At the aggregate level, the number of discards is a function of the number of public injections. In turn, the number of public injections is assumed to be a function of the total number of injections, i.e., public injection should vary in concert with the overall level of injection drug use. Where direct measures of drug use are not available, measures of demand for clean needles could be used as a proxy. All else being equal, the number of discards should be positively associated with the number of sterile needles dis-

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[1] We use the term "needle" to refer to both the plastic syringe and its metal needle.

0955-3959/$ – see front matter 
doi:10.1016/j.drugpo.2009.07.003


**Photo 1.** Graffiti showing community resentment provoked by discarded needles.

tributed or not returned. The relationship between public injection and overall use of injection drugs could be modified by identifiable environmental factors, such as weather conditions, as well as more complex factors related to seasonal changes in IDU population and behaviour. Inclement weather, either extremes of temperature or heavy precipitation, is expected to discourage public injection, leading IDUs to find other injection locations, thus decreasing discards.

Drop boxes (DBs) refer to publicly accessible "sharps" containers in which needles can be deposited anonymously at any time of day or night. DB programmes serve to reduce discarded needles by providing IDUs with a disposal option that is anonymous, accessible and relatively convenient. DBs can be implemented as a stand-alone intervention in an area that has a problem with discarded needles, or as a supplementary disposal option for needle exchange programmes (NEPs) to pre-empt or reduce potential discard problems (Golub et al., 2005). Because they are discreet and provide no other services that might attract IDUs or cause them to spend additional time in the area, DBs are more likely tolerated by the communities that host them (Smith et al., 1998) than NEPs, which face opposition at both the local and national levels (Tempalski, Friedman, Keem, Cooper, & Friedman, 2007). IDUs indicate a general willingness to use them (Springer, Sterk, Jones, & Friedman, 1999). From the perspective of public health and city officials, DBs are attractive because they represent a low-cost intervention that requires little maintenance. The goal of a DB programme is to modify the relationship between public injection and needle discarding. By increasing disposal options – making safe disposal more accessible in time and space – those who implement DBs hope to reduce the barriers to safe disposal, thus reducing the number of public injections that result in discards. All else being equal, the number of discards should decrease after the installation of DBs.

Despite their promise and growing popularity, DBs are understudied. Only two assessments of DB programmes are recorded in the literature. The first investigated a pilot initiative in Baltimore, Maryland, which had only four boxes in operation (Riley et al., 1998). In the first 10 months of operation close to 3000 needles were deposited in the boxes, yet discard counts were no lower in areas around boxes than in control areas. The second study investigated the implementation, public acceptance and effects of DBs in Melbourne, Australia (Devaney & Berends, 2008). All of the DBs in question had been installed at indoor locations only; the study did not investigate outdoor boxes.

In this study, we sought to quantify the effect of DBs on discarded needles by comparing rates of discarded needles before and after the installation of drop boxes in Montréal, Canada. The study represents a natural experiment, using data on discarded needles from 2001 to 2006, over a period in which multiple DBs were installed in a single neighbourhood. To investigate the range of effect of drop boxes, we examined changes in rates of discards across a range of distances from individual DBs, while controlling for environmental covariates.

### *Setting and history*

A 2001 estimate placed the Montréal IDU population at between 4300 and 12,500 individuals (Archibald et al., 2001), with cocaine – which is associated with frequent daily injections (Green, Hankins, Palmer, Boivin, & Platt, 2003) – being the drug of choice. After many months of negotiation between IDU-service providers, public health officials, property owners and police, Montréal installed its first two outside DBs in 1997. The programme has been expanding ever since, due in part to a significant change in public attitude towards DBs. By the end of the study period over half of the city's 27 DBs were located in a single neighbourhood, which corresponds roughly to the study area (see Fig. 1).

DBs were placed following two strategies: installing DBs outside NEP facilities, and targeting areas with high levels of discarded needles ("hot spots"). Staff of local service providers identified hot spots of discards, such as specific alleys or parking lots. Property owners were then approached and negotiation ensued. In most cases, permission to place a DB was granted; in some cases permission was denied and owners of "next best" locations were approached.

In the first years of the programme, the existence and location of DBs were communicated to IDUs by word of mouth; police officers and service providers informed IDUs about the programme and where to find individual boxes. By 2002, the Department of Public Health was producing a booklet containing a map of DBs, which was distributed at NEPs and by outreach workers in the field.

Montréal DBs are locked stainless-steel boxes protecting a standard-issue disposable sharps container with a maximum capacity of approximately 450 needles. The boxes are installed on the sides of private buildings or public structures. A drop box can be seen to the immediate left of the "P" in the first line of graffiti in Photo 1.

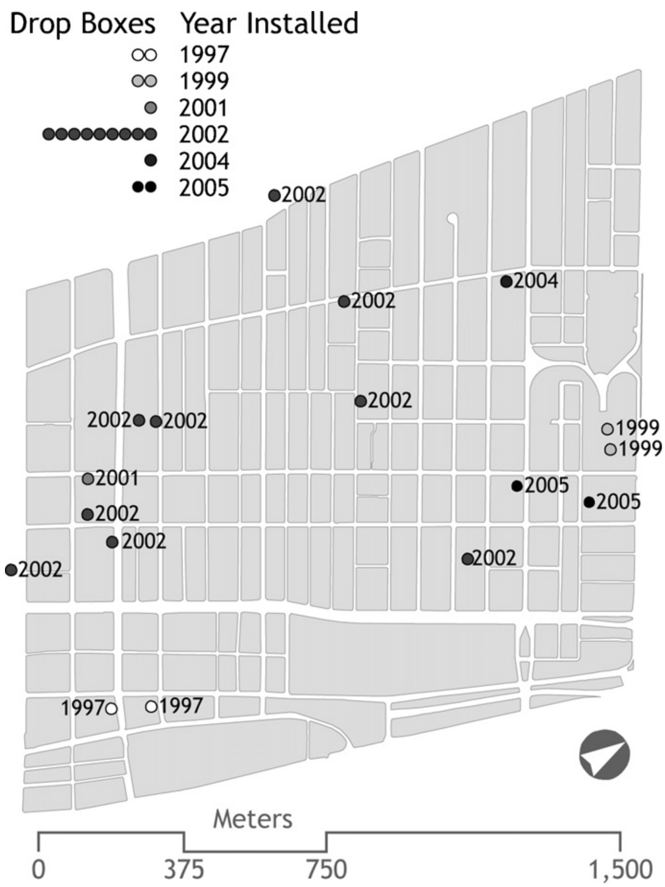


**Fig. 1.** Locations and installation dates of drop boxes.

## Methods

### Measures

#### Needles discarded

We analysed a dataset of discarded needles collected from a 2.5 km$^2$ area in central Montréal. The study area, part of the Sainte-Marie neighbourhood, is centred on the most active injection drug use area of the city (Leclerc, Tremblay, & Morissette, 2007). Sainte-Marie is known to be home to a long-standing population of IDUs, as well as being one of the city's centres for drug sales.

Discarded needles were collected by *Spectre de rue* (hereafter simply Spectre), a not-for-profit community organization primarily serving IDUs. Spectre employed full-time staff to conduct weekly discard "sweeps" and collect discarded needles in all non-park, publicly accessible open spaces within the study area. Each spring the programme manager identified discard hot spots. These areas were visited, on foot, at least once a week; areas outside of the hot spots were visited less frequently, on average once a week. Hot spots were dropped or added in response to observed changes in the spatial distribution of discards. All discards found during sweeps were collected, documented and destroyed. The boundaries of Spectre's needle-sweep programme defined the study area. A complementary programme, named *Tapaj*, periodically hired street youth to clean targeted alleys, vacant lots and other open spaces identified by the sweep programme manager (e.g., to respond to surges of discarding). Additional details on the discard data collection can be found elsewhere (de Montigny, 2008).

Spectre developed its data collection protocol over the 2000 calendar year and finalized it by 2001. Discard data were collected systematically over the study area for the study period (2001–2006). In addition to the cyclical sweeps, Spectre collected discards brought to its attention by other parties. Local service providers forwarded complaints and phone enquiries to Spectre, which responded by sending staff to retrieve and document the discards. Sites at which discarded needles were collected were noted in situ and then plotted on paper maps at monthly intervals. The base maps were highly detailed – showing such features as utility covers, lampposts, bus shelters – which allowed precise positioning of the discard collection sites. Each discard collection site, i.e., point on the map, was given a value (magnitude) equal to the total number of discards collected at that location within the calendar month.

Spectre reduced its collection efforts during winter months, when outdoor activities – including public injection – dropped considerably, and snow cover made collecting discards difficult and dangerous. Due to illness of Spectre staff, discard data for certain months were missing. Over the period of the study, Spectre reported data for 48 months. Discard data were missing for the 2004 calendar year.

#### Needles deposited in drop boxes

Of six independent organizations that were involved in the installation and management of DBs, only one systematically documented the number of needles collected from its DBs. A majority of DBs required infrequent emptying; we estimated that only three to six boxes would have been emptied more than once a year. Information on needles that were discarded in DBs was incomplete and irregular; we could not measure actual DB use (e.g., monthly deposits) for all boxes. Based on the available, incomplete data, a minimum of 15,000 needles found their way into the boxes. We speculated that the actual total was closer to twice that number.

#### Needles distributed and returned

The Montréal Public Health Department provided monthly tallies of sterile needles distributed and used needles returned from the four NEPs operating in or in close proximity to the study area (personal communication; Leclerc et al., 2007). Eleven pharmacies were located in the study area during the study period but were not required to report needle distribution or return data to the Public Health Department. We conducted a telephone survey of the pharmacies to assess the importance of these missing data. Results suggested that the pharmacies were not a significant source of sterile needles for IDUs, nor did the pharmacies receive a significant number of returns from IDUs. We used the monthly tallies from the NEPs as an estimate of the total number of needles distributed in the study area, and subtracted returned needles from distributed needles to obtain an estimate of unreturned needles.

#### Weather

The public archives of Environment Canada provided monthly measurements of total precipitation (mm) and median temperature (°C) in Montréal during the study period (Environment Canada, 2007).

#### Geocoding and creation of buffers

Discard collection sites reported on Spectre paper maps were geocoded using ArcMap, a geographic information system (GIS) (ESRI, 2007). The sweep-programme manager verified the geocoding of all 2001 data; geocoding accuracy was estimated to have a measurement error of no more than 10 m.

In order to examine the influence of distance from DBs on density of discards, we constructed buffers around all DB locations at four distances (25, 50, 100 and 200 m). Walking buffers represented distances as a pedestrian travels. They had the advantage of approximating spatial behaviour and cognition more closely than the more common straight-line buffers. We used GIS to construct polygons based on distance measured outwards from each DB respecting barriers to walking (e.g., fences and buildings). Buffers were allowed to overlap. We calculated the area (in $m^2$) of each walking buffer for all buffer sizes. We then counted the total number of discards falling inside each of the buffers in each month of the study period; the dependent variable was measured as the number of discards collected per buffer month.

### *Exclusions*

Two DBs were located at the periphery of the study area and two DBs were located in parks. No significant part of the sample frame, which included only non-park areas, could be reached within a 25 m walk of these DBs, and we therefore excluded the corresponding 156 buffer months from the data. We also excluded one of a pair of DBs installed very close together (on either end of a building housing an NEP), reasoning that including DBs for which buffers overlapped considerably would inflate the sample size without providing additional information about discards.

Four of the study area's 17 DBs were installed prior to the beginning of the study period and consequently there were no measures of needle discards prior to their installation. Even if the installation of DBs did reduce discarding in surrounding areas, those areas might still have had higher than average levels of discards post-installation. We were concerned that post-installation measures without their pre-installation counterparts would bias the results of the analysis, and we excluded these DBs from the analysis.

Data for September 2005 were excluded from the regression analysis due to atypically high discard counts for that month (see Fig. 3). (This one-time spike was attributed to a needle-dumping incident involving a single point-of-sale; garbage bags were taken from behind a shooting gallery, their needles removed and later discarded *en masse* in neighbouring open spaces.) Data were excluded for the 12 months of 2004, for the 15 winter months of the remaining study years, and for six months in 2005 and 2006 for which no data were reported by Spectre. The sample used for analysis included 38 months.

### *Analysis*

We used quasi-Poisson regression to model the association between the monthly number of discards collected in a buffer and the presence/absence of a DB in that buffer in that month while adjusting for temporal and spatial covariates. The Poisson distribution assumes that the mean and variance of events are identical. Counts of discards did not meet this assumption; their variance was considerably higher than their mean. We used quasi-Poisson models to deal with this overdispersion.

We fitted a separate regression model for each of the four buffer sizes, and we constructed parallel models for the pre-2004 sample and for the full sample. Informants identified 2004 as the beginning of gentrification and increased police activity in the neighbourhood. Moreover only two DBs were installed in the study area in the post-2004 period.

All models included area of buffer to standardize discard counts across different sized buffers for a same distance value. We adjusted for time trends by using a smoothing function for elapsed month of the study period; the smoothing function was a natural cubic spline function with degrees of freedom equal to the number of years in the sample.

### *Software details*

We used *R*, version 2.8.1 for analyses (R Development Core Team, 2008). The tools for regression modelling were available in the *stats* package (R Development Core Team, 2007b) with the function

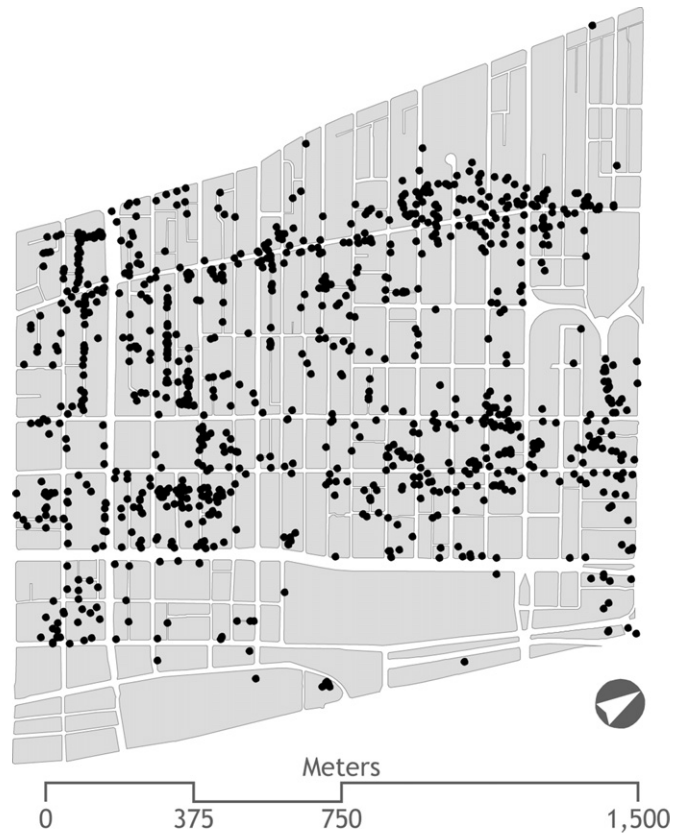


**Fig. 2.** Locations of discarded needles collected from 2001 through 2006, excluding 2004.

named *glm* (Hastie & Pregibon, 1992; R Development Core Team, 2007a). The tool for smoothing was available in the *splines* package (Bates & Venables, 2007) with the function named *ns* (Hastie, 1992).

## Results

### *Sample description*

The discard locations retained for the purposes of our analysis are shown in Fig. 2. The 1545 points represented a total of 7274 individual needles collected over the study period. The spatial distribution of points was neither uniform nor random; discards tended to cluster, forming hot spots that changed location over the course of the study period.

### *Discarded needles*

During the study period Spectre staff collected a monthly mean of 187 discards, with a sizeable standard deviation of 148 discards underlining important month-to-month variation (see Table 1). Average discard counts for buffer months where drop boxes were present were lower than for buffer months where drop boxes were absent for the smaller buffer sizes and higher for larger buffer sizes; in both cases the sample exhibited much variability. Average counts of discards were higher for post-2004 months compared to pre-2004 months, both for the study area and for all buffer sizes.

### *Drop boxes*

The twelve DBs included in the analysis were installed in the first five summers of the study period. Because no DB was removed during the study period the total number of DBs in the study area increased monotonically. Fig. 3 shows the monthly count of

**Table 1**
Mean number of discards per month by buffer size and study period.

| | | Discarded needles in study area | Discarded needles in walking buffers | | | |
|---|---|---|---|---|---|---|
| | | | 25 m | 50 m | 100 m | 200 m |
| | Count | Discards per buffer month—mean [standard deviation] | | | | |
| Drop boxes | | | | | | |
| Absent | 197 buffer months | n/a | 0.8 [4.5] | 1.3 [5.4] | 1.9 [6.3] | 7.5 [14.4] |
| Present | 259 buffer months | n/a | 0.6 [2.7] | 0.6 [2.6] | 2.4 [9.3] | 7.7 [23.4] |
| Total | 456 buffer months | n/a | 0.7 [3.7] | 0.9 [4.1] | 2.2 [8.1] | 7.6 [20.0] |
| | Count | Discards per month—mean [standard deviation] | | | | |
| Period | | | | | | |
| Pre-2004 | 27 months | 139 [80] | 4 [13] | 10 [13] | 18 [26] | 69 [49] |
| Post-2004 | 11 months | 249 [144] | 9 [9] | 12 [12] | 47 [40] | 146 [115] |
| Total | 38 months | 171 [112] | 6 [12] | 10 [16] | 26 [33] | 91 [81] |

DBs in relation to monthly counts of discards. Of the total 456 buffer months, 197 buffer months corresponded to pre-installation, meaning that DBs were absent in approximately 40% of the buffer months.

*NEP distribution and return*

Subject to important seasonal variation, an overall pattern of NEP use emerged: from 2002 onwards both the number of needles distributed and needles returned fell—but the number of needles returned dropped more rapidly. The annual number of unreturned needles increased monotonically during the study period. Return rates dropped from 85% in 2001 to 60% in 2006. When the study period started we could expect roughly 7000 needles a month went unreturned; in 2006 it was closer to 16,000 needles a month.

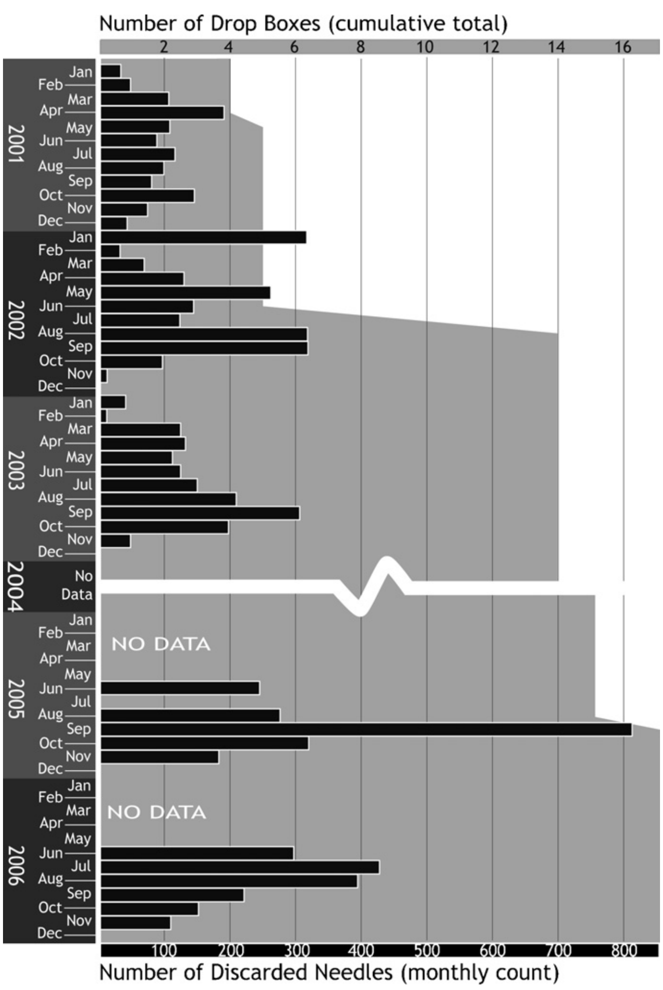


**Fig. 3.** Monthly counts of discards and cumulative count of drop boxes.

*Weather*

Despite removing winter months, considerable variability remained in our measures of weather. The mean monthly temperature was 13 °C with a standard deviation of 8 °C; the total monthly precipitation was 91 mm with a standard deviation of 41 mm.

*Regression analysis*

Table 2 summarizes results for the pre-2004 and the full study period analyses.

In both analyses the presence of a DB was associated with fewer discarded needles for all four buffer sizes. When other variables were held constant, the presence of a DB was associated with a 98% reduction of discards within 25 m; a 92% reduction within 50 m; a 73% reduction within 100 m; and 71% reduction within 200 m. Results were similar though more moderate for the analysis of the full study period sample, which showed a 75% reduction of discards within 25 m; a 83% reduction within 50 m; a 61% reduction within 100 m; and 46% reduction within 200 m.

None of the covariates was associated significantly with discards consistently across buffer sizes for the pre-2004 analysis or the study period analysis. Warmer temperatures were associated with more discards, but the associations were not significant in the pre-2004 analysis and only irregularly significant across the buffer sizes for the study period analysis.

The sign, strength and significance level of the association between discards and NEP needle distribution varied highly across buffer sizes and between pre-2004 and study period analyses. In the pre-2004 analysis, the measure of unreturned needles had a strong positive association with discards around DB locations, which was significant for the 25 m, 50 m and 100 m buffers. The association was weaker, irregular and not significant in the full analysis.

## Discussion

Though a single discard at the wrong time and place is one too many, and nearly 8000 over 39 months would strike many as intolerably high, it should be recognized that the number of discards collected paled in comparison to the magnitude of sterile needles distributed in the study area (0.2% of 3.3 million), or even those unreturned (0.9% of 0.9 million) during the study period.

It should come as little surprise then that our study found strong evidence that the presence of outdoor DBs reduced discards in non-park open space surrounding DBs. Most IDUs in most situations prefer safe disposal to discarding; providing “knowledge and means” for safe disposal reduces discarding, as has been suggested by qualitative research (Neale, 1998; Smith et al., 1998). Indeed

**Table 2**
Quasi-Poisson regression predicting number of discards for four buffer sizes.

| | Walking distance to drop box | | | |
|---|---|---|---|---|
| | 25 m | 50 m | 100 m | 200 m |
| Pre-2004 period (2001–2003) | Relative risk [95% CI] | | | |
| Drop box | | | | |
| Present (ref: absent) | 0.02 [0.00–0.19] | 0.08 [0.03–0.24] | 0.27 [0.13–0.55] | 0.29 [0.18–0.49] |
| Weather | | | | |
| Temperature (additional °C) | 1.18 [1.01–1.39] | 1.06 [0 96–1.17] | 1.03 [0.97–1.10] | 1.00 [0.96–1.04] |
| Precipitation (additional mm) | 0.98 [0.96–1.01] | 0.98 [0.97–1.00] | 0.99 [0.98–1.00] | 0.99 [0.99–1.00] |
| NEP use | | | | |
| Distributed needles (logged) | 0.00 [0.00–0.02] | 0.00 [0.00–0.22] | 0.12 [0.00–4.15] | 2.58 [0.26–>10] |
| Unreturned needles (logged) | >10 [6.27–>10] | >10 [5.97–>10] | 7.38 [1.51–>10] | 2.42 [0.92–6.38] |
| Valid *n* (buffer months) | 216 | 324 | | 324 |
| Study period (2001–2006; no 2004) | Relative risk [95%CI] | | | |
| Drop box | | | | |
| Present (ref: absent) | 0.25 [0.08–0.83] | 0.17 [0.06–0.53] | 0.39 [0.17–0.94] | 0.54 [0.30–0.95] |
| Weather | | | | |
| Temperature (additional °C) | 1.17 [1.03–1.34] | 1.05 [0.96–1.15] | 1.05 [1.01–1.15] | 1.02 [0.98–1.06] |
| Precipitation (additional mm) | 1.01 [0.99–1.03] | 0.99 [0.95–1.00] | 1.00 [0.99–1.01] | 1.00 [1.00–1.01] |
| NEP use | | | | |
| Distributed needles (logged) | 0.01 [0.00–5.23] | 0.05 [0.00–>10] | 0.34 [0.00–>10] | 2.06 [0.13–>10] |
| Unreturned needles (logged) | 1.22 [0.06–>10] | 5.20 [0.37–>10] | 0.74 [0.12–4.45] | 1.34 [0.45–3.99] |
| Valid *n* (buffer months) | 304 | 456 | 456 | 456 |

*Notes*: Models included area of buffer ($m^2$) and natural spline smoothing of elapsed months with degrees of freedom: 3 for pre-2004 and 5 for full period. Sample size varied due to drop boxes being installed near study area's edges and parks. Square brackets show 95% confidence intervals, adjusted for model overdispersion; values truncated at 10.

the rapid expansion of the DB programme in Montréal reflects a critical change in attitude across affected neighbourhoods. Where once the installation of a DB was met with a "not in my backyard" (NIMBY) opposition typical of other services for IDUs (Tempalski et al., 2007), residents and business owners now request DBs to deal with discard problems (Spectre, 2007, personal communication).

What was surprising about our findings was the degree and range of the reductions. Quasi-Poisson regression models showed that DBs were associated with reductions of up to 98% for the 2001–2003 period, and 83% for the entire study period. Considerable reductions (71% for the 2001–2003 period; 46% for the study period) were measured up to 200 m walking distance from DBs. Two hundred metres is equivalent to one to two average city blocks in Montréal, or a 3–4 min walk. IDUs appeared willing to do more than just cross a street or parking lot to use a DB. Yet reductions were inversely proportional to walking distance from the DBs, supporting findings from research on IDUs' use of services, which suggested that convenience was an important predictor of use (Coffin et al., 2007) and use was heaviest closest to a given facility (Bruneau, Daniel, Kestens, Zang, & Genereux, 2008).

Among the variables we were unable to measure was police activity, which has been found to be an important determinant of IDU behaviour, including needle disposal practices (Cooper, Bossak, Tempalski, Des Jarlais, & Friedman, 2009; Small, Kerr, Charette, Schechter, & Spittal, 2006; Wood et al., 2004). In our informal interviews, police officers and street workers asserted that the installation of DBs did not influence police presence; specifically, police denied monitoring DB locations.

The analysis was limited to public-access DBs. No data were available for the multiple indoor DBs installed in the study area by private parties. Informal interviews suggested that such DBs are used relatively little, a finding in line with the North American literature (McNeely, Arnsten, & Gourevitch, 2006).

Also, months for which discard data were unavailable were clustered in the post-2004 period of the study, introducing the possibility that reductions of discards around DBs were only temporary (i.e., the counts went back up in the months for which we have no data). The partial data available for DB deposits (not shown) suggested that this had not been the case; the number of needles deposited in each DB remained relatively constant from 2001 through 2006. Persistent reduction in discards over the full study period – with only two boxes installed in the post-2004 period – suggested that the effects of installing DBs were durable.

Areas of the study neighbourhood identified as hot spots were "swept" more frequently than other areas, which was not an ideal sampling strategy and might have introduced bias into the data—were it not for the targeting of these very hot spots by the DB programme. Sub-areas of the study area that might have suffered from irregular discard collection were not included in the analysis. Spectre staff reported that they did not reduce the frequency of their sweeps of areas serviced by DBs, and the staff was responsible for emptying the DBs, which ensured regular visits. The DB programme's strategy of targeting hot spots, and its effects on our natural experiment, implied that our findings might not hold true for situations where the level of discarding would be relatively low; DBs might be effective only at combating hot spots.

*Policy implications*

DBs are unthreatening (to IDUs and non-drug users alike), relatively inexpensive and flexible harm-reduction interventions. If they work, as the case seems to be for Montréal, public health departments could organize formal, citywide programmes, starting with locations around NEPs; IDU service providers could install DBs on their own property; merchants associations could do likewise on the properties of their members; and pharmacists could use DBs for after-hours disposal.

Findings suggested that DBs reduced discards considerably even at a 200 m walking distance, and probably beyond. Based on these results, installing a DB on each block, second or even third block could reduce discarded needles by up to 80%.

No single harm reduction intervention will eradicate discarded needles completely (Neale, 1998)—as was made clear by the needle-dumping incident in September 2005, which occurred despite well-run neighbouring NEPs and a mature DB programme, and was contained only by the timely actions of the sweep team alerted to the problem by its community contacts. Minimizing the harm caused by discards requires a multipart policy, which includes permanent programmes to encourage return-to-the-source (NEPs and pharmacies), low-threshold programmes to provide anonymous, convenient and around-the-clock disposal (DBs), and rapid-response programmes to deal with needles that routinely "fall through the cracks" and those resulting from exceptional circumstances (needle-sweeps and community outreach).

## Acknowledgements

The author thanks our primary community partners, *Spectre de rue*, without whose hard work and generous help the research would have been impossible. Specific recognition goes to Danny Raymond, who inspired the research, and Robert Beaudry and Jean-Sébastien Mercier-Lamarche to whom he passed the torch. *L'anonyme*, *Cactus Montréal* and the *Direction de la santé publique de Montréal* also contributed substantially to the research. We recognize as well the good work of our research assistants: Torsten Bernhardt, Tessa Greegor, Seunghoon Park and Eric Scharnhorst. This work was supported by the Robert Wood Johnson Foundation Grant 61232.

## Conflict of interest

All authors declare no competing interests, including no financial, personal or other relationships with people or organizations that could inappropriately influence, or be perceived to inappropriately influence, the work.

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