

# The impact of a supervised injecting facility on ambulance call-outs in Sydney, Australia

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## ABSTRACT

**Aims** Supervised injecting facilities (SIFs) are effective in reducing the harms associated with injecting drug use among their clientele, but do SIFs ease the burden on ambulance services of attending to overdoses in the community? This study addresses this question, which is yet to be answered, in the growing body of international evidence supporting SIFs efficacy. **Design** Ecological study of patterns in ambulance attendances at opioid-related overdoses, before and after the opening of a SIF in Sydney, Australia. **Setting** A SIF opened as a pilot in Sydney's 'red light' district with the aim of accommodating a high throughput of injecting drug users (IDUs) for supervised injecting episodes, recovery and the management of overdoses. **Measurements** A total of 20 409 ambulance attendances at opioid-related overdoses before and after the opening of the Sydney SIF. Average monthly ambulance attendances at suspected opioid-related overdoses, before (36 months) and after (60 months) the opening of the Sydney Medically Supervised Injecting Centre (MSIC), in the vicinity of the centre and in the rest of New South Wales (NSW). **Results** The burden on ambulance services of attending to opioid-related overdoses declined significantly in the vicinity of the Sydney SIF after it opened, compared to the rest of NSW. This effect was greatest during operating hours and in the immediate MSIC area, suggesting that SIFs may be most effective in reducing the impact of opioid-related overdose in their immediate vicinity. **Conclusions** By providing environments in which IDUs receive supervised injection and overdose management and education SIF can reduce the demand for ambulance services, thereby freeing them to attend other medical emergencies within the community.

**Keywords** Ambulance attendance, drug consumption rooms, injecting drug use, MSIC, opioid-related overdose, overdose management, supervised injecting facilities.

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## INTRODUCTION

Supervised injecting facilities (SIFs) enable injecting drug users (IDUs) to inject pre-obtained illicit drugs under supervision in a hygienic environment [1] and have been shown to be highly effective interventions in reducing the harms associated with injecting drug use [2]. Evidence to date indicates that SIFs are associated with reduced needle and syringe sharing, overdoses and public injecting [3–5]; reduced numbers of publicly discarded syringes and high levels of community support [6–9]; increased uptake of drug detoxification and addiction treatment [10]; and have not led to relapse among former drug users [11] or an increase in drug-related crime [12,13]. Most recently, Milloy *et al.* [14] investigated overdose mortality associated with SIF operation and esti-

ated that between two and 12 deaths per year may have been averted by the operation of the SIF in Vancouver, Canada.

Supervised injecting facilities (SIFs) are effective in reducing the harms associated with injecting drug use among their clientele, but do these facilities ease the burden on ambulance services of attending to opioid-related overdoses in the community? This question has yet to be answered by the growing body of international evidence supporting the efficacy of SIFs.

In May 2001, the Sydney Medically Supervised Injecting Centre (MSIC) opened on a pilot basis in the Australian state of New South Wales (NSW), where approximately half the nation's dependent opioid users reside [15,16]. One of the key public health arguments for the establishment of the service was the potential to

reduce morbidity and mortality related to drug overdose [17] through the timely and effective treatment of overdoses. It was also anticipated that SIFs may reduce the incidence of overdose by addressing risk factors among IDUs [18].

The Sydney MSIC is located the city's 'red light' district of Kings Cross, which is the historic centre of Sydney's street-based drug market [19], and which until the late 1990s had the highest prevalence and concentration of heroin overdose cases in Australia. In the first 6 years of operation 9778 IDUs utilized the service, which supervised approximately 200 injections per day and treated a total of 2106 on-site drug-overdose incidents [20]. The majority of these events were heroin- or other opioid-related ( $n = 1960$ ), with a rate of seven per 1000 visits where heroin or another opioid was injected [20]. Opioid-related overdoses are diagnosed by nursing staff according to standard medical definitions [21]. Staff are trained specifically in the use of the Glasgow Coma Scale [21] to assess level of consciousness objectively and the use of oximeters to assess oxygen saturation.

Unlike most other SIFs [22], nurses employed at the MSIC are also accredited to administer naloxone (Narcan<sup>®</sup>) intramuscularly to reverse the central nervous system depressant effects of heroin and other opioids in overdose situations. The MSIC's original overdose protocol was the same as that used by the NSW Ambulance Service, i.e. initial administration of 2 mg naloxone, followed by expired air resuscitation (EAR) using 100% oxygen. However, this was modified subsequently to reflect the SIF's opportunity for earlier intervention (overdose cases being diagnosed earlier and therefore treated prior to progressing in severity, compared to when these occur in unsupervised community situations) using a lower dose of naloxone (0.8 mg) administered only if clients remain unresponsive after 5 minutes of EAR. As a result, only 18% of all overdose cases required the administration of naloxone and <1% were transported by ambulance to a local hospital for further observation during the study period.

Data on ambulance attendances at suspected opioid-related overdoses are used as a valid approach to tracking change in non-fatal opioid-related overdose prevalence to which an ambulance is called [23–30], and a valuable resource for describing the characteristics associated with non-fatal heroin/opioid-related overdoses [25,27].

The current study aimed to compare patterns in ambulance attendances at suspected opioid-related overdoses using routinely collected data from the NSW State Ambulance Service. Attendances during both operating and non-operating hours were considered, however, and it was assumed that the main potential impact of the SIF would be during operating hours. It should be noted that the opening of the Sydney MSIC coincided with the peak

period of a nation-wide reduction in the availability of heroin that prompted shifts in patterns of drug use and a decline in heroin use [31]. Therefore, the rest of NSW has been included as a control in this study to address this potential confounder and to allow the potential effect of the MSIC to be considered, above and beyond the effect of the reduction in heroin availability during this period. We hypothesized that there would be a decrease in ambulance attendances at suspected opioid-related overdoses in the vicinity of the MSIC following its establishment.

## METHODS

This study involves an ecological analysis to compare, over time, the distribution in suspected opioid-related overdoses attended by an ambulance in the vicinity of the Sydney MSIC compared to the rest of NSW. This analysis was based on the assumption that if the Sydney MSIC was able to reduce opioid-related overdoses in the community, it would do so to a greater degree in the more immediate proximity of the centre. The study does not attempt to compare attendees to non-attendees of the Sydney MSIC.

### Data collection

The original data come from hand-written case reports completed by ambulance officers on all patients treated from May 1998 to May 2006. These data are entered routinely into the NSW Ambulance Service Patient Report Data Collection. De-identified data for the 8-year study period were provided electronically to the authors, via the NSW Health Department.

A suspected opioid-related overdose was defined as one where the patient was administered the opioid antagonist naloxone in accordance with ambulance protocols. The data are based on attendances at incidents rather than individuals and therefore the same individual may have accounted for several ambulance calls. Cases in which naloxone was not used for an opioid-related overdose were not included, nor were cases where the attending officers were not authorized to administer naloxone or where naloxone was declined by the patient. NSW Ambulance Service protocols for naloxone use are consistent for the whole of NSW and, as such, our analysis assumes no difference in application of these protocols in the locations considered.

Ambulance booking time was used to identify attendances during MSIC operating hours (9.30 a.m.–10 p.m. weekdays and 11 a.m.–7.30 p.m. at weekends). The 'MSIC vicinity' was defined as the area captured by two local postal codes of 3.6 km<sup>2</sup>. Postal code A covers a 2.1 km<sup>2</sup> and defined here as the 'immediate MSIC area' and is the area where the Kings Cross open drug scene

was most concentrated. Postal code B covers an area of 1.5 km<sup>2</sup> and is defined here as the 'neighbouring MSIC area'. Ambulance attendances outside either the immediate or the neighbouring MSIC areas were defined as occurring in the 'rest of NSW'.

**Analysis**

The average number of monthly ambulance attendances at opioid-related overdoses was calculated based on postal code. We then calculated the incidence rate of overdoses in the two time-periods—the 36 months prior to and the 60 months following the opening of the MSIC. It was hypothesized that the effect of the MSIC would be confined to the MSIC vicinity and a stepped approach to the analysis was used. First, separate incidence rates were calculated for two locations—MSIC vicinity and for the rest of NSW. To determine whether the relationship between ambulance attendance and period differed by geographic location, an interaction term was created for geographic location and period. The effect of the interaction term on ambulance call-out was tested using Poisson regression and the analysis is based on a comparison of the ratio of the before and after rates between the two areas. Secondly, we examined the effect of being located within the MSIC vicinity via a test for interaction between time period and location—defined as immediate MSIC and neighbouring MSIC areas, also using Poisson regression.

Further, the effect of being located in the immediate MSIC, compared to the rest of NSW, plus the neighbouring MSIC area, was tested for an interaction between time-period and location, also using Poisson regression.

$\chi^2$  tests are presented and *P*-values of <0.05 were considered statistically significant. In this analysis it was assumed that any major influencing factors on opioid-related overdose, such as the heroin shortage in Australia [23], would be similar in all locations.

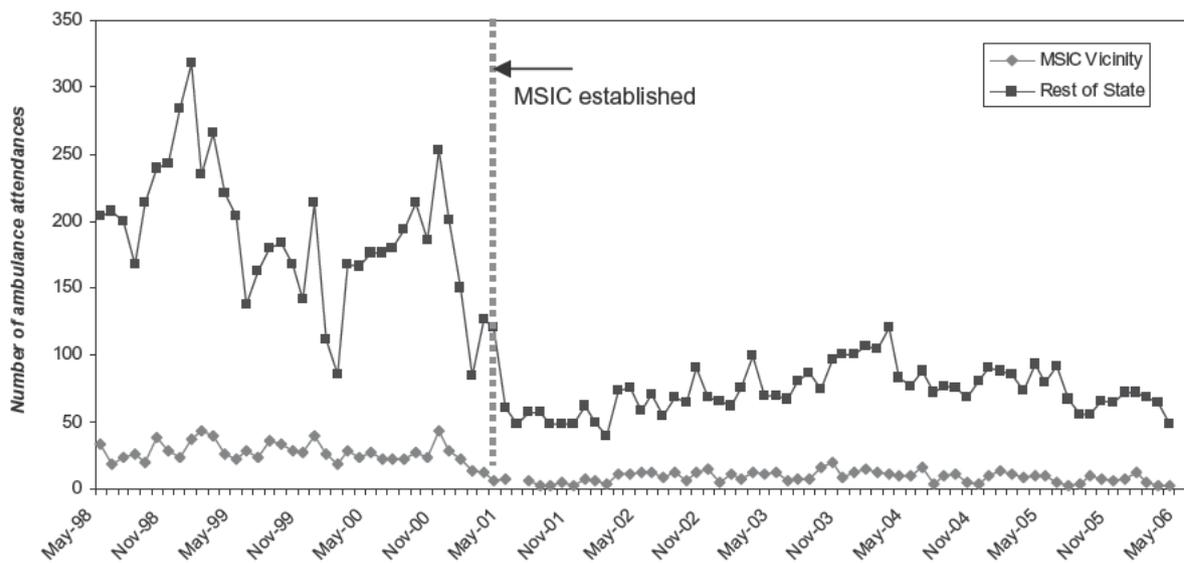
The study was conducted as part of the Phase 2 Evaluation of the Sydney MSIC and approved by the University of NSW Human Research Ethics Committee (HREC # 05182). All analyses were conducted using STATA version 8.2 (STATA Corporation, College Station, TX, USA).

**RESULTS**

**Ambulance attendance to opioid-related overdoses**

During the 36 months prior to, and the 60 months following, the opening of the Sydney MSIC there were 20 409 ambulance attendances at opioid-related overdoses in NSW. Sixty-two per cent (*n* = 12 646) occurred during the operating hours of the Sydney MSIC, and of these 12% (*n* = 1485) were in the MSIC vicinity. Ambulance attendances decreased in both the MSIC vicinity and the rest of NSW following the opening of the facility and during its operating hours (Fig. 1).

Following the opening of the Sydney MSIC, within operating hours there was a 68% decrease in the average monthly number of ambulance attendances in the MSIC vicinity (Table 1). This decline was greater than that observed in the rest of NSW (61%), and the difference in the decrease between the two locations was statistically significant ( $\chi^2$  = 9.62, *P*-value = 0.002).

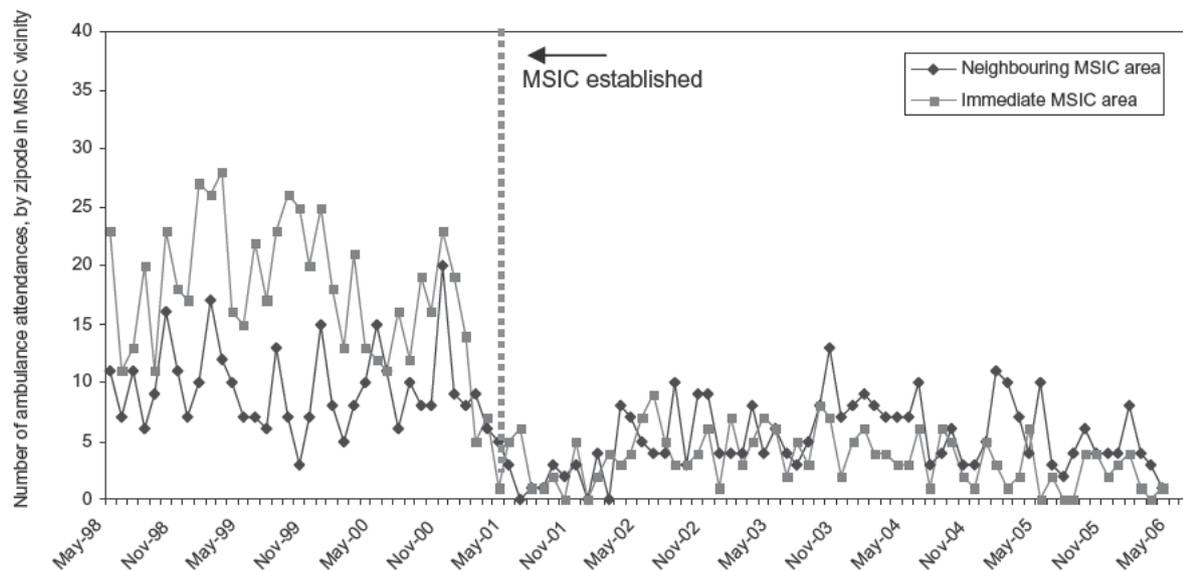


**Figure 1** Ambulance attendances at opioid-related overdoses, within MSIC opening hours: May 1998–April 2006. MSIC: Medically Supervised Injecting Centre

**Table 1** Ambulance attendances at opioid-related overdoses by location, within operating hours: May 1998–2006.

Geographic location	Ambulance attendances within MSIC hours Total (monthly average)		Ratio of change Post-MSIC/pre-MSIC (95% CI)	P-value	Interaction—geographic location and period
	Pre-MSIC: May 1998–April 2001	Post-MSIC: May 2001–April 2006			
MSIC vicinity	964 (27)	521 (9)	0.32 (0.29–0.36)	<0.001	
Rest of NSW	6779 (188)	4382 (73)	0.39 (0.37–0.40)	<0.001	$\chi^2_{(1)} = 9.62$ ; P-value = 0.002
Immediate MSIC area	626 (17)	210 (4)	0.20 (0.17–0.24)	<0.001	
Neighbouring MSIC area	338 (9)	311 (5)	0.55 (0.47–0.64)	<0.001	$\chi^2_{(1)} = 81.23$ ; P-value < 0.001
Immediate MSIC area	626 (17)	210 (4)	0.20 (0.17–0.24)	<0.001	
Rest of NSW + neighbouring MSIC area	7117 (197)	4693 (78)	0.40 (0.38–0.41)	<0.001	$\chi^2_{(1)} = 68.04$ ; P-value < 0.001

MSIC: Medically Supervised Injecting Centre; NSW: New South Wales; CI: confidence interval.



**Figure 2** Ambulance attendances at opioid-related overdoses in immediate and neighbouring Medically Supervised Injecting Centre (MSIC) areas, within opening hours: May 1998–April 2006

In order to explore further results within operating hours, patterns of attendance in the immediate and neighbouring MSIC areas were compared (Fig. 2 and Table 1). While a significant decline in the number of attendances was observed in both areas, the magnitude of this decrease was greatest in the immediate MSIC area (80% versus 45%). The difference in the decreases between the two areas was statistically significant ( $\chi^2_{(1)} = 81.23$ ; P-value < 0.001), indicating a greater decline in the immediate MSIC area compared to the broader neighbouring area.

Following the establishment of the MSIC, within operating hours there was an 80% decrease in the average

monthly number of ambulance attendances in the immediate MSIC area. This decrease was greater than that observed in the rest of NSW (60%) and the difference in the decrease between the two locations was statistically significant ( $\chi^2_{(1)} = 68.04$ ; P-value < 0.001).

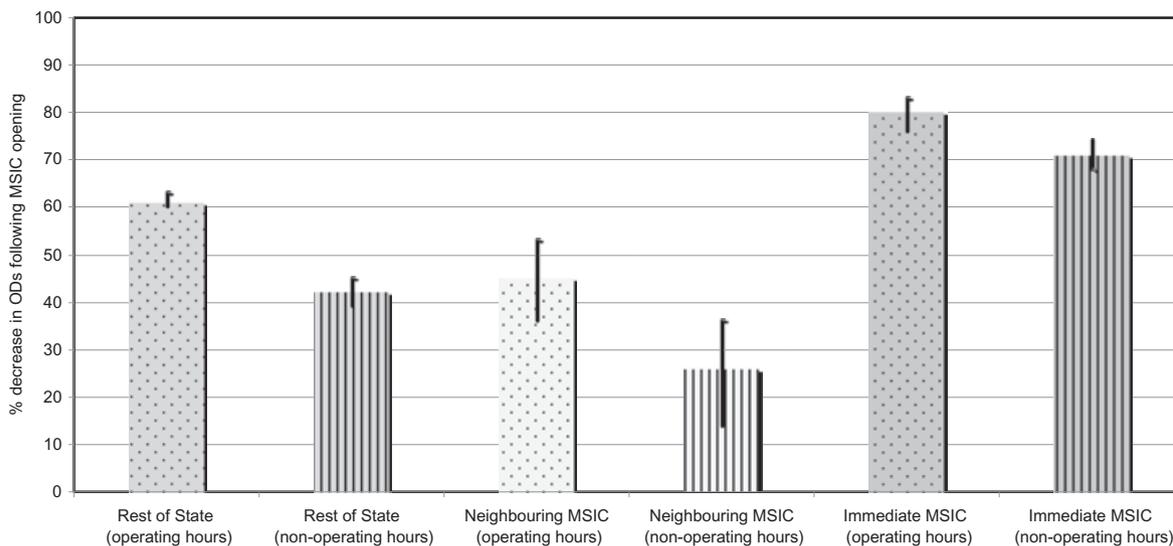
Patterns of ambulance attendance within operating hours versus non-operating hours in the three locations were also examined—immediate MSIC, neighbouring MSIC and rest of NSW. In all three locations, the decline in overdoses was significantly greatest within the operating hours of the MSIC (Table 2).

The greatest decline in ambulance call attendances was in operating hours in the immediate MSIC area, a

**Table 2** Ambulance attendances at opioid-related overdoses by location and operating hours: May 1998–2006.

Geographic location	Ambulance attendances Average per month			P-value	Interaction—geographic location and period
	Pre-MSIC: May 1998 –April 2001	Post MSIC: May 2001– April 2006	Ratio of change Post-MSIC/pre-MSIC (95% CI)		
	Immediate MSIC area (inside o/h <sup>a</sup> )	626 (17)	210 (4)		
Immediate MSIC area (outside o/h)	922 (26)	440 (7)	0.29 (0.26–0.32)	<0.001	$\chi^2_{(1)} = 12.79$ ; P-value < 0.001
Neighbouring MSIC area (inside o/h)	338 (9)	311 (5)	0.55 (0.47–0.64)	<0.001	
Neighbouring MSIC area (outside o/h)	311 (9)	383 (6)	0.74 (0.64–0.86)	<0.001	$\chi^2_{(1)} = 7.08$ ; P-value = 0.001
Rest of NSW (inside o/h)	6779 (188)	4382 (73)	0.39 (0.37–0.40)	<0.001	
Rest of NSW (outside o/h)	2901 (81)	2806 (46)	0.58 (0.55–0.61)	<0.001	$\chi^2_{(1)} = 150.85$ ; P-value < 0.001

MSIC: Medically Supervised Injecting Centre; o/h: operating hours; NSW: New South Wales; CI: confidence interval. <sup>a</sup>MSIC operating hours.



**Figure 3** Percentage decrease in ambulance attendances at opioid-related overdoses by geographic location and MSIC operating hours: May 1998–2006. MSIC: Medically Supervised Injecting Centre; OD: overdose

decline of 80% (range 76–83%) versus 45% (range 36–53%) in the neighbouring area and 61% (60–63%) in the rest of NSW.

Figure 3 illustrates the percentage decrease in both operating and non-operating hours in average monthly ambulance attendances in the 36 months prior to the MSIC opening and the 60 months following for all three geographic locations. The greatest decline in ambulance call attendances was in operating hours in the immediate area of the service, a decline of 80% (range 76–83%) versus 45% (range 36–53%) in the neighbouring area and 61% (60–63%) in the rest of NSW.

## DISCUSSION

There was a greater decline in opioid-related overdoses attended by ambulances in the vicinity of the Sydney MSIC after it commenced operation, compared to the rest of NSW. This effect was significantly greater during the operating hours of the service and was greatest in the immediate area of MSIC compared to the neighbouring area. Results suggest that the Sydney MSIC provided an environment where IDUs who experience opioid-related overdose received early intervention and effective care, thereby obviating the need to utilize ambulance services.

This, in turn, may have freed ambulance and other emergency services to attend other medical emergencies within the community, with associated cost benefits to the health system [32,33]. It should be noted, however, that this may not be the case for SIFs that do not administer naloxone in overdose situations and/or those with overdose protocols that require that ambulance services be called out for additional back-up support.

The greater impact in the immediate MSIC area compared to the neighbouring area, and the neighbouring and rest of NSW area combined, suggests that SIFs may be most effective in preventing overdose-related morbidity and mortality in areas of concentrated drug use, which has implications for where SIFs are best located. Other ecological information that could provide explanation for the substantially smaller decline in the neighbouring area was not collected; however, alternative explanations for the greater difference observed within the immediate MSIC area include a potential shift in the demographics of the injecting population. However, the rapidity of the decline in the immediate area suggests that the service had a direct effect on reducing the need for ambulance services for opioid-related overdoses in this location.

In assessing the impact of a health facility such as a SIF, the ecological study design generally presents the only feasible methodological option. The particular challenge in interpretation of an ecological study is determining whether the factor of interest (in this case the SIF) was the only intervention that differentiated the study area from the comparison area, with the potential to affect the outcome of interest (ambulance attendance for overdose). The main factors influencing opioid-related overdose during the period of the study were the availability of heroin in Australia [23], treatment availability and uptake and changes in policing practices that might contribute to reluctance to call an ambulance. We had no evidence that these factors changed over time in a manner that differed between the immediate vicinity of the SIF and the other areas of New South Wales. In particular, the immediate and neighbouring areas were served by the same heroin market with comparable levels and modes of policing areas during this time. The NSW Ambulance Service's overdose protocols also remained geographically uniform and no other overdose prevention programmes were initiated in the area during this period. Other statistical approaches, for example analysis of ambulance call-outs by exact distance from the MSIC, may provide a more refined measure of proximity to the MSIC, but do not eliminate the fundamental problem of ecological analysis.

While a decline was also found in ambulance attendances outside operating hours in all three locations, the magnitude of this decline was significantly greater in operating hours in the immediate MSIC area. As more

than 1700 overdose cases were treated on-site at the MSIC during this same period, this effect is likely to have been due to the relocation of overdose cases, which would have otherwise occurred in the immediate vicinity of the MSIC. IDUs may have also been likely to inject at the MSIC (versus elsewhere) when they assessed their risk to be high, e.g. post-detoxification or incarceration when opioid tolerance is lower than usual. Given the threefold greater likelihood of overdose when injecting in public (versus private situations) [34], shifts in drug injecting environments may also account for the reduction in overdose incidents in the immediate vicinity of the MSIC. It is also possible that the observed decline during non-operating hours was due to MSIC clients adjusting the timing of their opioid injecting to enable their accommodation at the MSIC during operating hours, thereby reducing the number of injections, and associated overdoses, when the service was closed.

While the impact of treating opioid-related overdoses promptly and effectively on-site at SIFs is primarily to reduce the morbidity and mortality that would otherwise accrue had they occurred in an unsupervised environment, it has also been anticipated that SIFs may have a preventative impact resulting from IDUs' increased awareness of risk factors [18]. It is possible that the impact of routine counselling following every overdose event at the MSIC and at the next subsequent presentation, as well as regular educational campaigns focused upon overdose risk reduction conducted at the MSIC, translated to reductions in overdose risk behaviour and, in turn, reductions in the incidence of overdose in other settings and at other times.

One of the strengths of our study is the large number of cases in the data set. The method of identifying ambulance attendances at opioid-related overdose by naloxone administration is unlikely to reflect accurately the real number of overdoses occurring in any given area due to under-reporting of opioid overdose cases. It is also possible that a small number of unconscious patients who had not actually overdosed from opioid use but who received naloxone as a diagnostic test may have been included inappropriately in the data set and a number of actual heroin/opioid overdose cases may have been excluded where naloxone was not indicated, was declined or was not able to be administered. The large number of cases provides confidence in the trends reported here. When considering changes in opioid-related overdoses there are also methodological limitations related to potential confounding introduced by the reduction in the heroin supply in Australia in 2001. These limitations have been addressed by the inclusion of controls (neighbouring area and the rest of NSW) in the analyses.

Results indicate that by providing an environment where overdose risk reduction education was provided,

where IDUs injected under supervision and where they were treated promptly for overdose using clinical protocols which included naloxone administration when indicated, the Sydney MSIC reduced the demand for ambulance services, freeing them to attend other medical emergencies within the community. Our findings also suggest that SIFs may be most effective in reducing this demand in areas of high-risk, concentrated drug use. These findings contribute to a growing body of international evidence demonstrating the benefits associated with SIFs and indicate the value of including routinely collected external data, such as emergency services data, in the evaluation of these facilities.

#### Declarations of interest

None.

#### Acknowledgements

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