

**THE INJECTION OF
METHADONE SYRUP
IN SYDNEY, AUSTRALIA**

Shane Darke, Joanne Ross
&
Wayne Hall

National Drug and Alcohol Research Centre

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EXECUTIVE SUMMARY

A sample of 312 heroin users was interviewed regarding the injection of methadone syrup. Methadone syrup injecting was widespread, with 52% of the sample having injected methadone syrup, 29% in the preceding six months. Males and females were equally likely to report having ever injected methadone syrup, and to have done so in the six months preceding interview. Among current methadone injectors, frequent methadone injecting was common, with 40% reporting weekly or more frequent injecting in the preceding six months.

Methadone injecting was more common in western Sydney, both in lifetime prevalence (58% v 45%) and within the preceding six months (36% v 21%). Frequent injecting was also more common in the western suburbs. Recent methadone injecting was more common among respondents currently enrolled in methadone maintenance (34% v 23%). Both area of residence and treatment status were independent predictors of current methadone injecting.

The two most common sources for obtaining methadone for injection were friends/partners or respondents' own prescribed take-away doses. Illicit methadone was considered easy to obtain by 87% of respondents. The average price of methadone was 50c per milligram in the western suburbs and \$1 per milligram in other regions of Sydney.

There were clear harms associated with methadone syrup injecting. Current methadone injectors were in poorer general health than other respondents, and had more symptoms related to injecting. A history of methadone injecting was associated with abscesses and infections in injection sites, and having been diagnosed with a venous thrombosis. Those with a history of methadone injecting were also more likely to have overdosed (70% v 52%), with current injectors being more likely to have overdosed in the preceding six months (26% v 14%). Current methadone injectors also showed higher levels of current psychological distress, were more likely to have recently passed on used injecting equipment and to have recently committed criminal acts.

The results of the present study raise questions about ways in which to reduce the harms associated with methadone syrup injecting. Issues that require attention include: policies on the provision of take-away methadone doses; strategies such as diluting methadone syrup to expand the volume of a methadone dose; and education of methadone maintenance clients on the harmful effects of methadone injecting.

1.0 INTRODUCTION

Orally delivered methadone maintenance has been repeatedly demonstrated to be the most cost effective, efficacious treatment for opioid dependence¹. Enrolment in methadone maintenance had been associated with reduced frequency of injecting, reduced frequency of needle sharing, a reduced risk of HIV infection and a reduced risk of heroin overdose^{1,2}. Methadone maintenance services have expanded rapidly in Australia since 1987, with approximately 17,000 people now enrolled on methadone maintenance³.

A great deal of recent clinical concern has arisen, however, about the injection of methadone syrup. Anecdotal evidence has linked this practice to the western suburbs of Sydney in particular, with needle exchanges in this region reporting an increased demand for 10 ml and 20 ml syringes and vein infusion sets, equipment thought to be employed to inject methadone syrup.

The major health concern raised by the injection of methadone syrup is the development of venous thrombosis. The viscous nature of the syrup makes it difficult to inject and, as such, greatly increases the risk of thrombosis after delivery into the vascular system. It should be noted that the development of thrombosis has also been associated with injection of temazepam capsules, like methadone a viscous liquid^{4,5}.

Direct damage arising from repeated injections with large gauge needles is also of concern, with cases of fistulas having been reported to have arisen from the repeated injection of methadone syrup⁶. Repeated injections may be necessary in order to inject the large volume of methadone syrup and water needed for intoxication.

The use of large sized syringes to inject methadone is also a cause for concern in relation to the spread of blood borne viruses. It has been shown that the risk of passing on blood through needle sharing substantially increases as the size of the syringe increases⁷. These authors estimated that 10 times more blood is transferred when using a 2 ml syringe as opposed to the more common 1 ml syringe. The use of 10 ml and 20 ml syringes for methadone syrup injections clearly would exacerbate this problem if needles were being shared.

Despite these concerns, to the authors' knowledge, no study on the illicit injection of methadone syrup has been conducted to date in Australia. Several studies outside Australia have reported on the use of illicit methadone, but these have not focussed on the injection of methadone syrup⁸⁻¹². Inciardi⁸, in 1977, reported 46% of a large sample of U.S. heroin users had used illicit methadone during the week prior to interview, with 70% of respondents having used illicit methadone in the three months prior to interview. Daily use of methadone was rare, with 5% of respondents reporting daily use in the preceding three months, 40% weekly or more frequent use, and 55% less than weekly use. No data on route of administration was provided. Weppner et al¹²

reported a lifetime prevalence of illicit methadone use of 43% among patients admitted to Lexington hospital for opiate detoxification.

Sapira et al¹⁰ reported in 1968 on 25 methadone dependent males admitted to Lexington hospital. Less than half (36%) of these patients used methadone orally, with 40% using intravenously and a further 24% intramuscularly.

A third (34%) of methadone patients interviewed in Spunt et al¹¹ reported having ever diverted their methadone dose. More recently, Lauzon et al⁹ reported a lifetime prevalence of illicit methadone use of 59% among a sample of Canadian heroin users. In the six months preceding interview, 42% of these respondents reported having used illicit methadone. No data were given on route of administration.

The current study aimed to provide data on the prevalence of methadone syrup injecting among a sample of Sydney heroin users, and the procedures and problems associated with this practice.

1.1 Study Aims

The major aims of the study were as follows:

- 1) To determine the extent of methadone injecting, and the factors associated with it;
- 2) To examine methadone injecting procedures;
- 3) To examine problems associated with the injection of methadone.

2.0 METHOD

2.1 Procedure

All respondents were volunteers who were paid A\$20 for their participation in the study. Recruitment took place from January to October of 1995, by means of advertisements placed in rock magazines, a users group magazine, needle exchanges, methadone maintenance clinics and by word of mouth.

Respondents contacted the researchers, either by telephone or in person, and were screened for eligibility to be interviewed for the study. To be eligible for the study respondents had to either be in treatment for heroin dependence, or have used heroin during the preceding three months, or both. Those respondents who had injected methadone were questioned in detail about their experience in doing so (see below).

Each interview was conducted in a location determined by the subject in an attempt to minimise any hesitation they might have about participating. Consequently, interview sites ranged from pubs, coffee shops, parks, shopping centres, to respondents' homes and the researchers' workplace (National Drug & Alcohol Research Centre). All respondents were guaranteed, both at the time of screening and interview, that any information they provided would be kept strictly confidential and anonymous. All interviews were conducted by one of the research team and took between 45 and 60 minutes to complete.

2.2 Structured Interview

A structured interview was constructed that addressed the following areas: demographic characteristics, drug use history, heroin dependence, health, psychological functioning, heroin overdose, needle risk behaviours, criminal behaviours, the initiation of methadone injecting, methadone injecting procedures and the most recent methadone injection episode. The questionnaire was pilot tested on 10 heroin users, and refinements were made on the basis of this. The areas covered by the interview are outlined in detail below.

2.2.1 Demographic characteristics

The demographic details obtained included: the respondent's gender, age, suburb of residence, level of high school and tertiary education, employment status, current form of drug treatment and prison record.

2.2.2 Drug use history

In order to gain an indication of overall drug use, respondents were asked which drug classes they had ever used, which ones had they ever injected, and which ones had

they injected in the last 6 months. An estimation of how many days they had used each of the drug classes during the 6 months preceding interview was also sought. Further questions were asked about the first drug ever injected and how old they were when they first injected heroin.

2.2.3 Heroin dependence

Current dependence on heroin was measured using the Severity of Dependence Scale (SDS)¹³. This is a 5-item scale, with scores ranging from 0-15. Higher scores are indicative of a higher degree of dependence.

2.2.4 Health

The Health Scale of the Opiate treatment Index (OTI)¹⁴ was used to gain some indication of the respondent's current state of health. This scale is divided into items addressing signs and symptoms in each of the major organ systems, with one section specifically focusing on injection-related health problems. The higher the score obtained, the poorer the overall health of the subject.

Respondents who had injected methadone were also asked about specific health problems related to the injection of methadone, and whether they had consulted medical practitioners about these problems.

2.2.5 Psychological functioning

Psychological adjustment was assessed using the 28 item version of the GHQ¹⁵. This scale gives a global measure of non-psychotic psychopathology and is made up of the following 4 sub-scales: Somatic symptoms, Anxiety, Social dysfunction and Depression. Global scores range from 0-28, with 4/5 being the most commonly used cut-off point in determining the number of 'cases' of psychopathology in a sample.

2.2.6 Heroin overdose

Respondents were asked how many times they had overdosed, how long since they had last overdosed and whether they had ever been administered naloxone.

2.2.7 Needle risk behaviours

The HIV Risk-taking Behaviour Scale (HRBS), a component of the OTI was used in assessing injecting behaviours in the month preceding interview that placed respondents at risk of either contracting or transmitting blood borne viruses.

2.2.8 Criminal behaviours

Using the Criminality Scale of the OTI, a record was taken of any property crimes, drug dealing, fraud and violent crimes committed during the month preceding interview. Higher scores on the Criminality Scale denote greater criminal involvement. As in the OTI, respondents were also asked whether they were currently facing any charges.

2.2.9 Initiation of methadone injecting

Respondents were asked when they had commenced injecting methadone, whether they were in methadone maintenance at the time, their reason for injecting methadone and the source of the methadone used for initial injection. The frequency of injecting of 'street' and personal methadone, the use of physeptone, and the availability and cost of 'street' methadone were also recorded.

2.2.10 Methadone injecting procedures

Respondents were asked about the procedures they employed in injecting methadone syrup. Specifically, the average and maximum amounts of methadone injected, the use of vein infusion sets ("butterfly clips"), and the size of syringes used to inject methadone. "Butterfly clips" are the street name for vein infusion sets. A vein infusion set consists of a needle attached to a length of plastic tube, to which a syringe is attached. They may be occluded between injections to prevent blood loss through the inserted needle, and improve stability for the use of larger sized syringes.

2.2.11 Most recent methadone injection episode

Respondents were asked about the details of their most recent injection of methadone. Specifically, questions included time since last methadone injection, treatment status, amount injected, ratio of water to methadone, source of methadone, size of syringe, number of injections, and the use of infusion sets.

2.3 Analyses

For continuous variables t-tests were employed. Categorical variables were analysed using chi², and corresponding odds ratios (O.R.) and 95% confidence intervals (C.I.) were calculated. Where distributions were highly skewed, medians were reported. Highly skewed continuous data were analysed using the Mann-Whitney U statistic, a non-parametric analogue of the t-test. In order to determine which factors were independently associated with the injection of methadone, multiple logistic regressions were conducted. Backwards elimination of variables was used to select the most appropriate models. In analyses where "current users" of methadone were compared to other respondents, current use was defined as use within the six months preceding interview. All analyses were conducted using SYSTAT¹⁶.

3.0 RESULTS

3.1 *Sample Characteristics*

The sample consisted of 312 respondents, recruited from all areas of Sydney (Table 1). Males constituted 61% of the sample. The mean age of respondents was 28.8 years (SD 6.9, range 16-48), with males being significantly older than females (29.8 yrs v 27.3 yrs, $t_{310}=3.1$, $p<.005$). Approximately half of the respondents were currently enrolled in treatment for opioid dependence (53%). Females were significantly more likely to be currently enrolled in treatment (66% v 46%, O.R. 2.4, 95% C.I. 1.5-3.9). Almost all of those in treatment were currently enrolled in methadone maintenance programmes (166/168). The mean methadone dose was 64.1 mg (SD 31, range 10-150). The median length of time enrolled in current treatment was 24 months (range 1-144). Two thirds (63%) of the sample had previously been enrolled in drug treatment.

The mean years of formal school education was 9.7 (SD 1.5, range 3-12). A fifth (22%) of respondents had completed a trade or technical course, with 5% having completed a university or college course. The majority of respondents (80%) were currently unemployed, with only 4% in full-time employment, and a further 10% in part-time/casual employment.

Nearly half of respondents (44%) had a regular sexual partner who was an injecting drug user (IDU), but significantly more females than males had IDU partners (57% v 36%, O.R. 2.4, 95% C.I. 1.5-3.9).

A large proportion of respondents reported having a prison record (45%), with males significantly more likely than females to report having been imprisoned (55% v 30%, O.R. 2.8, 95% C.I. 1.7-4.5).

Table 1: Demographic characteristics of 312 heroin users

	Males	Females	Persons
	N=190	N=122	N=312
Age in years (Mean)#	29.8	27.3	28.8
Employment: (%)			
Not employed	83	75	80
Full time	6	1	4
Part time/casual	11	9	10
Student	0	3	1
Home duties	0	12	5
School Education (Mean years)	9.6	9.7	9.7
Tertiary Education: (%)			
No tertiary education	75	73	74
Trade/technical	22	21	22
University/college	3	4	4
Trade & college	0	2	1
Currently in treatment (%)#	46	66	53
IDU partner (%)#	36	57	44
Prison record (%)#	55	30	45

Statistically significant difference between males and females

3.2 Drug use history

The mean age of first injection of any drug was 18.2 (SD 3.9, range 10-35). Heroin was the first drug injected by only 53% of the sample, with 41% reporting amphetamine as the first drug injected. The mean age of initiation of heroin use was 18.5 (SD 3.8, range 10-35).

At the time of interview, the mean length of heroin use career was 10.3 years (SD 7.1, range 0-28). Males had significantly longer heroin using careers than females (11.1 v 9.0, $t_{310}=2.6$, $p<.05$).

The majority (73%) of those respondents who were currently in treatment had used heroin in the preceding six months. However, respondents currently in treatment had used heroin on a median of 6 days, compared to 100 days for the non-treatment respondents.

Poly-drug use was common among the sample (Table 2). The median number of drug classes ever used by respondents was 10, a median of 5 having been used in the six months preceding interview. A median of 4 different drug classes had ever been injected, with a median of 2 in the six months preceding interview.

The use of opiates other than heroin was common in the preceding six months (40%). Alcohol (75%) and benzodiazepines (71%), also both central nervous system depressants, were also widely used. Poly drug use was not restricted to central nervous system depressants, with significant proportions of respondents having recently used cannabis (80%), amphetamines (41%), cocaine (26%) and hallucinogens (19%).

Table 2: Drug use history of 312 heroin users

Drug Class	Ever Used %	Ever Injected %	Used lst 6 months %	Injected lst 6 months %	Days Used lst 6 months*
Heroin	100	100	86	85	72
Other Opiates	82	66	40	23	7
Amphetamines	97	90	41	37	4
Cocaine	75	62	26	20	3
Hallucinogens	88	29	19	4	4
Benzodiazepines	94	28	71	13	20
Barbiturates	22	8	1	0	2
Alcohol	99	N/A	75	N/A	14
Cannabis	99	N/A	80	N/A	90
Inhalants	60	N/A	13	N/A	3
Tobacco	98	N/A	94	N/A	180
Poly-drug use (mdn no. drugs)	10	4	5	2	-

* Median number of days used in the last 6 months by those who had used the drug class in that period

3.3 Heroin dependence

The mean score on the SDS was 7.9 (SD 4.5, range 0-15). There was no significant difference in levels of dependence on heroin between males and females (7.7 v 8.2).

3.4 Prevalence of methadone injecting

Table 3 presents the prevalence of methadone syrup injecting among the sample. A half (52%) of the sample reported having ever injected methadone syrup, with 29% having injected methadone syrup in the preceding six months. More specifically,

`street' methadone (methadone purchased illicitly) had been injected by a third of respondents (34%), 18% having done so in the six months preceding interview.

Of those respondents who had ever been enrolled in methadone maintenance, 50% had injected their own prescribed methadone. Almost a third (31%) of respondents currently enrolled in methadone maintenance had injected their prescribed methadone in the preceding six months.

Of those who had injected methadone syrup, 47% had also injected physeptone tablets, a tablet form of methadone hydrochloride.

Table 3: Prevalence of methadone injecting

	Males N=190	Females N=122	Persons N=312
Ever injected methadone syrup (%)	51	53	52
Injected methadone syrup in last 6 months (%)	30	27	29
Ever injected `street' methadone syrup (%)	34	34	34
Injected `street' methadone syrup in last 6 months (%)	18	17	18
Ever injected own prescribed methadone syrup* (%)	53	46	50
Injected own prescribed methadone syrup in last 6 months** (%)	38	25	31

* Percentage of those ever in methadone:

Males n=131, Females=94, Persons n=225

** Percentage of respondents currently enrolled in methadone:

Males n=85, Females n=81, Persons n=166

3.5 Frequency of methadone injecting

A quarter (26%) of those who had injected methadone syrup reported weekly or more frequent methadone injecting over their entire methadone injecting careers. Less than a fifth (17%) reported having injected methadone syrup once only. There were no differences between genders in lifetime frequency of methadone injecting.

The frequency of methadone injecting in the preceding six months among current methadone injectors is presented in Table 4. Forty percent of respondents who had injected methadone in the preceding six months had done so on a weekly or more frequent basis. The same proportion (40%) reported less than monthly use over that period. There were no differences between males and females in the frequency of methadone injecting in the preceding six months.

The median number of days that 'street' methadone had been used in the preceding six months was 4, with 17% of those who had used 'street' methadone using it weekly or more often. Personal prescribed methadone was injected on a median of 18 days in that period, with 50% injecting it weekly or more often.

Table 4: Frequency of methadone injecting among current methadone injectors in preceding six months

Frequency of methadone injecting	Males N=57	Females N=33	Persons N=90
Daily (%)	5	6	6
More than weekly (%)	21	30	24
Weekly (%)	11	9	10
Less than weekly (%)	21	18	20
Less than monthly (%)	42	36	40

When asked how easy it was to obtain illicit methadone syrup, 87% stated that it was either easy or very easy to obtain. Respondents who had injected methadone were asked about the price of illicit methadone syrup. The most common price cited was 50c per milligram (40%), with a further 32% citing \$1 per milligram.

3.6 Characteristics of methadone injectors

3.6.1 Demographics

Table 5 presents the demographic characteristics of those respondents who had ever injected methadone and the remainder of the sample. Methadone injectors were significantly older than other respondents (29.7 yrs v 27.9 yrs, $t_{310}=-2.3$, $p<.05$) and were more likely to have been imprisoned (55% v 34%, OR 2.4, 95% CI 1.5-3.7). There were no other significant demographic differences between methadone injectors and other respondents.

Table 5: Demographic characteristics of respondents who had injected methadone versus those who had not

	Injected methadone N=161	Never injected methadone N=151
Mean age (yrs)#	29.7	27.9
Sex (% males)	60	62
Education (yrs)	9.5	9.8
Unemployed (%)	81	78
Prison record (%)#	55	34
IDU partner (%)	46	42

Statistically significant difference between groups

3.6.2 Area of residence

For the purposes of analysis, and the clinical concerns raised about methadone injecting in western Sydney, respondents' areas of residence were divided into western Sydney (including south western suburbs), and the remainder. There were approximately equal proportions of respondents in the two groups, with 53% of respondents residing in western Sydney, and 47% in other suburbs. There were no significant differences between western Sydney and other respondents in age (29.5 v 28.0) or the proportions in methadone treatment (58% v 48%). There were, however, significantly more males in the western Sydney group (67% v 54%, OR 1.8, 95% CI 1.1-2.8).

Respondents residing in western Sydney were more likely to have ever injected methadone (58% v 45%, OR 1.7, 95% CI 1.1-2.6) and to have injected methadone syrup in the preceding six months (36% v 21%, OR 2.1, 95% CI 1.3-3.5) (Table 6). A significantly larger proportion of western Sydney respondents reported having injected methadone syrup on a weekly or more frequent basis over the preceding six months (14% v 3%, OR 5.3, 95% CI 2.0-14.5).

In order to further explore the differences regional differences in the prevalence of methadone injecting, the injection of both 'street' and personally prescribed methadone were analysed. There were no significant differences between the two groups in the proportion of respondents who had ever injected 'street' methadone, or had injected it in the preceding six months. Among those who had ever been enrolled on methadone maintenance, however, a higher proportion of western Sydney respondents reported having ever injected personally prescribed methadone (56% v 41%, OR 1.8, 95% CI 1.04-3.05). Furthermore, among those currently enrolled in methadone maintenance, a higher proportion of western Sydney respondents had injected personally prescribed methadone in the preceding six months (43% v 16%, OR 4.1, 95% CI 1.9-8.9).

It should be noted that the cost of 'street' methadone was significantly cheaper in the western suburbs, with a reported median price of 50c compared to \$1 in other regions of Sydney (U=3263, p<.001).

Table 6: Area of residence and methadone injecting

	Western Sydney N=147	Other regions N=165
Ever injected methadone syrup (%)#	58	45
Injected methadone syrup in last 6 months (%)#	36	21
Weekly or more frequent methadone injections in last 6 months (%)#	14	3
Ever injected 'street' methadone syrup (%)	38	29
Injected 'street' methadone syrup in last 6 months (%)	20	15
Ever injected own prescribed methadone syrup* (%)#	56	41
Injected own prescribed methadone syrup in last 6 months** (%)#	43	16

Statistically significant difference between groups

* Percentage of those ever enrolled in methadone maintenance:

Western Sydney n=133, Other regions n=92

** Percentage of respondents currently enrolled in methadone maintenance:

Western Sydney n=95, Other regions n=71

3.6.3 Methadone maintenance

A third (34%) of current methadone clients had injected methadone syrup (prescribed and/or illicit) in the six months preceding interview. There was no significant difference in the proportions of male and female clients who had injected methadone in that period (40% v 28%). Current methadone clients who had injected methadone in the preceding six months were on significantly higher methadone doses than other methadone clients (75.0 mg v 58.3 mg, $t_{164}=-3.4$, $p<.005$). There was

no difference in the time enrolled in current methadone treatment between those who had injected and other methadone clients, with both groups having been retained for a median of 24 months.

Of those respondents not currently enrolled in methadone maintenance, 23% had injected methadone syrup in the preceding six months. As was the case for methadone clients, there was no significant difference in the proportions of males and females who had injected methadone in that period (22% v 24%).

Respondents currently enrolled in methadone maintenance were significantly more likely than those not currently in methadone treatment to have injected methadone syrup in the preceding six months (34% v 23%, OR 1.8, 95% CI 1.1-3.0).

3.6.4 Drug use history

There was no significant difference between those who had injected methadone syrup and others in age of first heroin use (18.9 v 18.1). Those respondents who had ever injected methadone had used a significantly higher median number of drug classes (10 v 9, $U=8870$, $p<.001$) and injected significantly more of drug classes (4 v 3, $U=7190$, $p<.001$) than respondents who had not injected methadone. Current methadone injectors had used a higher median number of drug classes in the preceding six months (6 v 5, $U=7025$, $p<.001$) and had also injected more drug classes in that period (2 v 1, $U=5612$, $p<.001$).

3.6.5 Heroin dependence

Current injectors of methadone syrup (those who had injected in the preceding six months) had significantly higher SDS scores than non-injectors (8.7 v 7.6, $t_{310}=-2.1$, $p<.05$), indicating higher levels of current heroin dependence.

3.7 *Initiation of methadone injecting*

Those respondents who had injected methadone syrup were asked details about the first injection episode (Table 7). The mean age of respondents at first methadone injection was 24.5 years (SD 5.5, range 12-42), with females initiating injection at a significantly younger age (23.2 v 25.3, $t_{159}=2.4$, $p<.05$). The mean interval between first injection of heroin and initial methadone injection was 6.3 years (SD 4.8, range 0-24), with females reporting a significantly shorter interval (5.4 yrs v 7.0 yrs, $t_{159}=2.3$, $p<.05$). Only one subject reported having injected methadone prior to injecting heroin.

Forty per cent of methadone injectors reported having been enrolled in methadone maintenance at the time of their first methadone injection.

The major sources of methadone at initial injection were friends/partners (54%) and respondents' own take-away doses (31%). Diversion of a patient's own methadone dose from the dosing room was rare, with 3% reporting this as the source of methadone for the initial injection. Only 9% reported obtaining methadone syrup from a dealer for their initial injection.

The most frequently given reason for initiating methadone injecting was because respondents were in heroin withdrawal (31%) and could not obtain heroin. Closely related to this reason was heroin substitution (18%), where respondents used methadone as a substitute, but were not in withdrawal. Together, these two circumstances of heroin substitution were given by 49% of respondents as the reason for initial injection. Experimentation ("wanting to see what it was like") was given by 29% of respondents, while 22% nominated the fact that others were doing it, and recommended it.

Table 7: Circumstances of initial methadone syrup injection

	Males N=97	Females N=64	Persons N=161
Mean age at initial injection (yrs)#	25.3	23.2	24.5
Mean interval initial heroin and methadone injections (yrs)#	7.0	5.4	6.3
Enrolled in methadone at time (%)	37	45	40
Source of methadone (%):			
Friend/partner	55	55	54
Own take away doses	30	33	31
Own dose (diverted)	1	5	3
Dealer	10	6	9
Other	4	1	3
Reasons for first injecting methadone (%)*:			
In heroin withdrawal			

Heroin substitute	28	36	31
Experimentation	22	13	18
Others were doing it	32	23	29
Other reasons	17	30	22
	12	15	13

Statistically significant difference between males and females

* More than one reason could be given

3.8 Methadone injecting procedures

The median amount injected by those who had injected methadone syrup was 50 mg, there being no difference between males and females (Table 8). Nearly a fifth, however, reported that they used more than 100 mg on an average use day. Respondents were also asked the most methadone syrup that they had ever injected in a day. The median reported maximum was 70 mg, with 40% having injected more than 100 mg in a day. Again, there was no significant gender difference.

Larger sized syringes (10 ml and 20 ml) were the most popular sizes used to inject methadone syrup, with 46% (10 ml) and 44% (20 ml) of methadone injectors having used the larger syringes. However, methadone injecting was not restricted to the larger syringes, with significant proportions of respondents having used 1 ml, 2 ml and 5 ml syringes to inject methadone.

Infusion sets had been used to inject methadone syrup by 57% of respondents. Those respondents who had used infusion sets reported using a median of 50 mg of methadone on an average occasion compared to 30 mg for those who had not used infusion sets to inject methadone (U=1520, p<.001). They had also reported a significantly higher maximum amount ever injected in a day (105 mg v 40 mg, U=1320, p<.001).

The most widely used infusion set was the 25 mg gauge (orange), with nearly half of methadone injectors having used this gauge. The larger 23 gauge (blue) infusion sets had been used by a quarter (27%) of methadone injectors to inject methadone. Few methadone injectors had injected with the 21 gauge (green) infusion sets (3%).

Table 8: Methadone syrup injection procedures

	Males	Females	Persons
	N=97	N=64	N=161
Amount injected per average day (Mdn)	50 mg	43 mg	50 mg
Maximum ever injected in a day (Mdn)	75 mg	68 mg	70 mg
Size of syringes ever used (%)*:			
1 ml	24	22	23
2 ml	19	14	17
5 ml	26	27	26
10 ml	52	38	46
20 ml	46	39	44
Ever used infusion sets (%)	60	53	57
Size of infusion sets ever used (%):			
Orange (25 gauge)	46	50	48
Blue (23 gauge)	31	22	27
Green (21 gauge)	3	3	3

* Does not sum to 100% as subjects may have used more than one size of syringe.

3.9 Most recent methadone injection episode

Details of respondents' most recent methadone injection episode are presented in Table 9. The median time since last injection was 4 months, with 38% of methadone injectors injected the drug in the month preceding interview, and 54% in the preceding six months. The majority (60%) were enrolled in a methadone maintenance program at the time of their most recent methadone injection.

The median amount injected at the most recent injection episode was 50 mg, with 15% of methadone injectors having injected more than 100 mg on that occasion. A median of two injections was used to inject the methadone syrup on that occasion.

The most frequently used syringes on the most recent occasion were 20 ml (37%) and 10 ml (26%) syringes, although over a third (37%) had used smaller sized syringes.

Infusion sets were used by approximately half (48%) of methadone injectors on the most recent injecting occasion. Orange (25 gauge) infusion sets were used by 36% of methadone injectors on the most recent occasion, with 12% using the blue (23 gauge) infusion sets. No respondent reported using the larger 21 gauge green infusion sets. Respondents who had used infusion sets reported having used a higher median amount of methadone (52.5 mg v 30 mg, $U=1731$, $p<.001$) than those who did not use infusion sets, and a higher proportion had used 10 ml or 20 ml syringes (90% v 37%, OR 15.3, 95% CI 6.5-36.1). Nearly a fifth (19%), however, had injected with 10 ml or 20 ml syringes and not used an infusion set.

Respondents were asked about the ratio of methadone syrup to water for their most recent injection. The most common ratio was equal proportions of methadone and water (34%). A quarter (25%) of methadone injectors reported that they had injected undiluted methadone syrup at their most recent injection.

The major sources of methadone for the most recent injection were friends or partners (48%) and respondents own methadone take-away doses (40%). As was the case with the initial injection, diversion of the patient's own dose from the dosing room was rare, with 3% reporting this as the source for their most recent injection. Only 8% of methadone injectors reported that they had obtained methadone from a dealer for their most recent injection.

Table 9: Circumstances of most recent methadone injection

	Males N=97	Females N=64	Persons N=161
Median time since last injection (Mths)	2.5	5.3	4
Enrolled in methadone at time (%)	63	55	60
Median amount injected (Mgs)	50	40	50
Number of injections (Mdn)	1	2	2
Size of syringe used (%):			
1 ml	12	20	16
2 ml	6	11	8
5 ml	10	17	13
10 ml	33	16	26
20 ml	38	36	37
Infusion sets used (%)	51	44	48
Size of infusion sets used (%):			
Orange (25 gauge)	31	41	36
Blue (23 gauge)	19	3	12
Green (21 gauge)	0	0	0
Ratio methadone/water (%):			
100/0	27	22	25
75/25	31	25	29
50/50	33	37	34
25/75	10	16	12
Source of methadone (%):			
Friend/partner	43	55	48
Own take away doses	40	39	40
Own dose (diverted)	2	3	3

Dealer	11	3	8
Other	4	0	1

3.10 *Correlates of methadone injecting*

3.10.1 Health

Current injectors of methadone syrup had significantly higher scores on the OTI health scale (18.0 v 15.5, $t_{310}=-2.4$, $p<.05$) and the injection-related problems sub-scale (1.3 v 0.9, $t_{310}=-3.6$, $p<.001$), indicating poorer current general health and more injection-related health problems than the rest of the sample (Table 10).

Respondents who had ever injected methadone were significantly more likely to report having had abscesses and infections from injecting (23% v 11%, OR 2.4, 95% CI 1.3-4.4), and to have been diagnosed with a thrombosis from injecting (16% v 8%, OR 2.2, 95% CI 1.1-4.6).

Over a half (55%) of respondents stated that they had experienced difficulties specifically related to injecting methadone syrup. The most commonly reported problems were burning/stinging (30%) and collapsed veins (27%).

3.10.2 Heroin overdose

Those respondents who had ever injected methadone were significantly more likely to report having had a heroin overdose (70% v 52%, OR 2.2, 95% CI 1.4-3.5) and to have been administered the opioid antagonist naloxone (NARCAN®) than other respondents (40% v 30%, OR 1.6, 95% CI 1.0-2.6).

Current methadone injectors (those who had injected in the preceding six months) were more likely to have overdosed within the preceding six months (26% v 14%, OR 2.5, 95% CI 1.4-4.6) and to have been administered naloxone in that period (14% v 6%, OR 2.5, 95% CI 1.1-5.6) (Table 10).

Table 10: Correlates of current methadone injecting

	Current methadone injectors N=90	Other respondents N=222
<i>Health</i>		
OTI Health total#	18.0	15.5
OTI Injecting sub-total#	1.3	0.9
<i>Heroin overdose (% in last 6 months)</i>		
Overdosed#	26	14
Naloxone administered#	14	6
<i>Psychological functioning</i>		
GHQ total#	10.2	7.8
"Psychiatric" cases (%)#	67	54
<i>Needle risk (% in last month)</i>		
Borrowed needles	13	10
Lent needles#	28	16
<i>Criminal behaviours (Last month)</i>		
OTI crime total#	2.5	1.3
Any crime (%)#	68	43

Statistically significant difference between groups

3.10.3 Psychological functioning

Current injectors of methadone had significantly higher GHQ total scores than other non-injectors (10.2 v 7.8, $t_{310}=-2.6$, $p<.01$), indicating higher levels of psychological distress (Table 10). A significantly higher proportion of current injectors had scores over the diagnostic cut-off for 'cases' of psychopathology (67% v 54%, OR= 1.7, 95% CI 1.0-2.8).

Current injectors had higher scores on the depression (2.3 v 1.6, $t_{310}=-2.6$, $p<.01$), anxiety (3.1 v 2.4, $t_{310}=-2.5$, $p<.05$) and social dysfunction (2.4 v 1.8, $t_{310}=-2.1$, $p<.05$) sub-scales. There was no significant difference between groups on the somatic symptoms sub-scale.

3.10.4 Needle risk behaviours

There were no significant differences in the proportions of current methadone injectors and other respondents who had borrowed used injecting equipment during the month preceding interview (13% v 10%). However, current methadone injectors were significantly more likely to have lent their used injecting equipment in that period (28% v 16%, OR 2.0, 95% CI 1.1-3.6) (Table 10).

3.10.5 Criminal behaviours

Current methadone injectors had significantly higher OTI crime total scores (2.5 v 1.3, $t_{310}=-4.6$, $p<.001$), indicating higher degrees of criminal involvement (Table 10). Current methadone injectors were more likely to have committed any crime in the preceding month (68% v 43%, OR=2.8, 95% CI 1.7-4.6), to have committed property crimes (50% v 27%, OR=2.7, 95% CI 1.6-4.5), to have committed fraud (21% v 6%, OR=4.3, 95% CI 2.0-9.2) and to have dealt drugs (43% v 28%, OR=1.9, 95% CI 1.2-3.2).

3.11 *Predictors of current methadone injecting*

In order to determine which demographic factors were independently associated with having injected methadone syrup in the preceding six months, multiple logistic regressions were performed. Variables entered into the initial model were age, sex, area of residence, years of school education and current methadone maintenance status.

Table 11 presents the final model. Currently being enrolled in methadone maintenance treatment and residing in the western suburbs were independent predictors of having injected methadone syrup in the preceding six months. After controlling for the effects of other variables in the model, residing in the western suburbs increased the probability of having recently injected methadone syrup by 100%. Similarly, being currently enrolled in methadone treatment increased the odds

of having recently injected methadone syrup by 70%. The regression equation was significant (χ^2 , 2df= 12.5, $p < .005$), and had a good fit (Hosmer-Lemeshow $\chi^2=1.4$, $p < .25$).

Table 11: Multiple logistic regression predicting injection of methadone syrup

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Variable	O.R.	95% C.I.
Area of residence	2.00	1.20-3.34
Methadone maintenance status	1.70	1.02-2.83

Hosmer-Lemeshow $\chi^2=1.4$, $p < .26$ (Note: High p -values indicate better goodness of fit)

4.0 DISCUSSION

4.1 *Major findings of the study*

The major finding of this study was the widespread prevalence of methadone syrup injecting among this sample of Sydney heroin injectors. A half of the sample reported having injected methadone syrup, with 29% having injected methadone in the preceding six months. Methadone injecting was evenly represented between the sexes, with males and females equally likely to report having ever injected methadone syrup, and to have done so in the six months preceding interview. Among current methadone injectors, frequent methadone injecting was common, with 40% reporting weekly or more frequent injecting in the preceding six months.

The second major finding concerned the geographical distribution of methadone injecting. Methadone injecting was more common in western Sydney, both in lifetime prevalence and within the preceding six months. Frequent injecting was also more common in the western suburbs. The relationship between methadone injecting and the western suburbs remained significant, even after the effects of other variables had been taken into account. However, while there was a higher prevalence of methadone injecting in the western suburbs, substantial proportions of methadone injecting was occurring in other regions. Hence, although methadone injecting may be more prevalent in the western suburbs of Sydney, it is not restricted to that region.

4.2 *Data validity and representativeness of sample*

The findings of this study are derived from data based upon self-reported behaviour. Although the questions asked often required respondents to talk about their involvement in various illegal and socially stigmatised activities, efforts were made to ensure that valid data were obtained. Respondents were given strong assurances that any information they divulged would be treated as strictly confidential and anonymous. Other research on illicit drug use has shown that when respondents are given such guarantees the data obtained are reasonably valid and reliable¹⁷⁻¹⁹. In a recent Australian study on primary heroin users for instance, self-reported drug use showed respectable validity when assessed against collateral interviews and urinalysis results¹⁴.

In interpreting the results of the current study, it is appropriate to examine how representative the sample is of heroin users in general. Even though multiple recruitment methods were used in an attempt to access a broad spectrum of heroin users, the fact that the sample was self-selected implies that its characteristics should be borne in mind and care taken when generalising to other samples. At the same time, it is difficult to conceive how it would be known if a sample of heroin users was representative, given that the parameters of the population of heroin users are

unknown. However, it is important to note that the characteristics of the sample are in accordance with those reported by other studies of Australian heroin users^{20,21}.

4.3 Prevalence of methadone injecting

The results of this study indicate that the injection of methadone syrup is widespread among heroin users, both among methadone maintenance clients and heroin users not in treatment. A half of respondents who had been enrolled in methadone maintenance had injected their own prescribed doses. A third of the overall sample had injected illicit 'street' methadone. Nor is this an historical phenomenon. The median time since last injection was 4 months, and 29% of all respondents had injected methadone in the preceding six months. The injection of methadone syrup is clearly a widespread, and current, occurrence.

It is important to note that substantial proportions were injecting methadone syrup frequently. It should be noted that of those who had injected methadone, only 17% did so on only one occasion. Forty per cent of current injectors had done so on a weekly or more frequent basis in the six months preceding interview. While daily methadone injection was rare, a quarter of current injectors injected more than once a week in that period. Thus, methadone injecting would appear to be both common and frequent. The frequency data reported in this study are remarkably similar to those reported by Inciardi⁸, where 45% of respondents injected methadone on a weekly or more frequent basis. These data clearly have implications for the identified harms associated with methadone syrup injecting, discussed below.

Methadone injecting initially occurred on average 6 years after the initiation of heroin injecting, an identical figure to that reported recently in Lauzon et al⁹ among Canadian heroin users. The time lag between heroin and methadone injecting in the current study was significantly shorter for females, where the time lag was 18 months shorter than for males. The main reason given for initiation of methadone injection was being in heroin withdrawal. It is relevant to note that methadone injectors in the current study had significantly higher levels of heroin dependence than other respondents. However, substantial proportions of respondents reported that initial use was due to experimentation, and to the fact that others they knew were doing it.

4.4 Methadone injecting procedures

Methadone injectors were injecting substantial amounts of methadone. The median amount injected on the most recent injection occasion was 50 mg, with a median of two injections required to inject the methadone. Fifteen per cent of injectors reported having injected more than 100 mg on that occasion. In their methadone injecting careers, 40% of injectors had injected more than 100 mg in a day. There were no gender differences in the amount of methadone that respondents were injecting.

As expected, 10 ml and 20 ml syringes were most commonly used to inject methadone syrup. However, all sizes of syringes had been used to inject methadone syrup. Infusion sets had been used by a half of injectors at their most recent injection. Injectors who used infusion sets injected significantly more methadone than other methadone injectors. The most common infusion set used was the 25 gauge set. Substantial numbers of injectors, however, had used the larger 23 gauge infusion sets. While these larger gauge needles would facilitate the injection of a viscous fluid, repeated use of larger gauge needles may result in a greater degree of vascular damage.

At the most recent methadone injection, a quarter of injectors did not dilute the methadone syrup prior to injection. Only 12% diluted the syrup with more water than methadone. The data indicate that injectors are injecting a viscous liquid, rather than a substantially diluted solution of reduced viscosity.

4.5 Methadone maintenance and methadone injecting

The results of this study show a clear link between enrolment in methadone maintenance and the probability of injecting methadone syrup. This link was independent of area of residence and other factors related to injecting methadone. A half of respondents who had ever been enrolled in methadone maintenance had injected their own doses and almost a third of currently enrolled clients had done so in the preceding six months.

Those current methadone clients who had injected methadone syrup (either prescribed or illicit) in the six months prior to interview, were on significantly higher doses than other clients. This finding is consistent with the higher levels of heroin dependence among methadone injectors.

The current data raise questions about policies on the provision of take-away methadone doses. Given the large proportions of methadone clients and others injecting take-away methadone doses, caution appears warranted in the provision of take-away doses. It should be noted that the data for this study was collected prior to a change in NSW Health Department policy governing take-away doses, which restricted the eligibility of clients for take-away doses. The effects of these changes are unknown, and clearly require evaluation.

The current data should *not* be taken as an indication of the failure of methadone maintenance. As noted previously, methadone maintenance is associated with reductions in harms such as HIV and overdose risk. However, it is clear that the delivery system of methadone needs reappraisal.

4.6 Area of residence and methadone injecting

The data from this study confirm the perception of treatment providers that methadone syrup injecting is widespread in the western suburbs of Sydney. Methadone injecting was more common and more frequent in western Sydney than in other regions. As noted above, the relationship between methadone injecting and the western suburbs remained significant, even after the effects of other variables had been taken into account. It is worth noting that illicit methadone syrup was cheaper in the western suburbs, possibly reflecting its greater availability.

However, it cannot be concluded from this study that methadone syrup injecting is a problem restricted to a particular region. Nearly a half (45%) of respondents from other regions had injected methadone, 21% within the preceding six months. The current data indicate that while methadone syrup injecting is more widespread in the western suburbs, it is a problem throughout the Sydney region.

4.7 Sources of methadone for injecting

The two most common sources for obtaining methadone for injection were friends/partners or respondents' own prescribed take-away doses. This was true both for initial methadone injection and the most recent methadone injection. Buying methadone from a dealer was rare, with less than 10% reporting doing so for their last methadone injection. The illicit supply of methadone to those not currently in methadone treatment would thus appear to be an informal black market revolving around friends, rather than one organised by dealers. Illicit methadone was considered easy to obtain. As noted above, the quoted average price of methadone was 50c per milligram in the western suburbs, and \$1 in the other regions of Sydney. The cost for the average amount of methadone used at the last injecting episode (50 mg) would thus vary between \$25 and \$50.

4.8 Harms associated with methadone injecting

There were clear harms associated with methadone syrup injecting. Current methadone injectors were in poorer general health than other respondents, and had more symptoms related to injecting. A history of methadone injecting was associated with abscesses and infections in injection sites, and having been diagnosed with a venous thrombosis. Those with a history of methadone injecting were, in fact, over twice as likely to have experienced a thrombosis. The results of this study indicate that, like the injection of benzodiazepines, the injection of methadone can have serious consequences for vascular health.

There was also a clear relationship between methadone injecting and opioid overdose. Those with a history of methadone injecting were over twice as likely to have overdosed, and one and a half times as likely to have been administered naloxone for an overdose. This relationship is further illustrated by examining

current methadone injectors and recent overdose. Current injectors were more likely to have overdosed in the preceding six months and to have been administered naloxone in that period. Injection of methadone syrup would appear to be a risk factor for overdose, in addition to the concomitant use of alcohol and benzodiazepines that have been reported elsewhere²⁰.

In addition to poorer physical health, current methadone injectors showed higher levels of current psychological distress. These respondents had higher general levels of distress, higher levels of depression and anxiety, and were more likely to meet the criterion for a psychiatric "case" requiring attention than their peers who were not currently injecting methadone.

Interestingly, current methadone injecting was not associated with an increased risk of having borrowed used injecting equipment. However, current methadone injectors were more likely to have passed on their used equipment. On a social level, current methadone injecting was associated with higher prevalence and frequency of recent criminal behaviours.

4.9 Implications

The results of the present study raise questions about ways in which to reduce the harms associated with methadone syrup injecting. Based upon these results, one of the issues that requires attention is policy on the provision of take-away methadone doses. Take-away doses were the largest source of methadone for injecting in the current study.

One possible intervention to reduce the prevalence of methadone injecting may be to expand the volume of take away doses. Currently the ratio of milligrams to millilitres is five to one. A dose of 50 mgs of methadone is thus equivalent to 10 mls of liquid. If this ratio was raised substantially, the practicality of injecting methadone syrup may be reduced, as the volume needed for intoxication may become too large to inject. It is suggested that if volume expansion is adopted that water be used as the diluting agent (rather than orange juice) to reduce the harm associated with the preparation if it was injected, and to make the preparation less appealing to children if stored at home.

Given the high prevalence of methadone syrup injecting, education on the harmful effects of this practice would appear warranted. While education alone cannot be expected to substantially reduce the harms of methadone injecting, a knowledge of the potential harms would provide a basis for behaviour change, as has occurred among injecting drug users in relation to HIV risk-taking. Such education should be aimed at both treatment and non-treatment heroin users. Given the larger proportions of methadone injectors in the western suburbs of Sydney, this region

would appear to be a priority in the provision of information on the potential health effects of methadone injection.

4.10 Conclusions

In summary, the current study indicates that the injection of methadone syrup is a widespread phenomenon throughout the Sydney region, among both heroin users enrolled in methadone treatment and other heroin users. As anecdotal evidence had suggested, the practice was more common in the western suburbs of Sydney. The current study has documented specific harms associated with methadone injecting, that are occurring among Sydney heroin users. It is clear that the prevalence of methadone injecting, and its associated harms, constitute a problem that needs urgent attention from methadone prescribers and policy makers.

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