

CONTEXT AND CORRELATES OF NON-FATAL OVERDOSE  
AMONG HEROIN USERS IN SYDNEY

Shane Darke, Joanne Ross, Julia Cohen & Wayne Hall

NDARC Monograph No. 20

**CONTEXT AND CORRELATES OF  
NON-FATAL OVERDOSE AMONG  
HEROIN USERS IN SYDNEY**

Shane Darke, Joanne Ross, Julia Cohen &  
Wayne Hall

National Drug and Alcohol Research Centre

1994

Monograph Number 20

ISBN 0 947 229 40 X



# TABLE OF CONTENTS

<b>ACKNOWLEDGMENTS</b> .....	<b>vi</b>
<b>1.0 INTRODUCTION</b> .....	<b>1</b>
1.1 Study Aims... ..	2
<b>2.0 METHOD</b> ....	<b>3</b>
2.1 Procedure.....	3
2.2 Structured Interview.....	3
2.2.1 Demographic characteristics .....	3
2.2.2 Drug use history.....	4
2.2.3 Heroin dependence... ..	4
2.2.4 Personal experience with overdose. ....	4
2.2.5 Presence at an overdose .....	4
2.2.6 Impediments to help-seeking.....	4
2.2.7 Prevention of overdose .....	5
2.2.8 Beliefs regarding main causes of overdose.....	5
2.2.9 Attitudes towards naloxone.....	5
2.3 Analyses.....	5
<b>3.0 RESULTS</b> .....	<b>6</b>
3.1 Sample Characteristics .....	6
3.2 Drug Use History .....	8
3.3 Heroin Dependence.....	9
3.4 Personal Experience with Overdose.....	9
3.4.1 Prevalence of overdose .....	9
3.4.2 Circumstances surrounding last overdose .....	11
3.4.3 Factors associated with overdose... ..	12
3.5 Presence at an Overdose .....	14
3.5.1 Prevalence .....	14
3.5.2 Circumstances of last overdose at which present. ....	15
3.5.3 Responses to overdose .....	16

3.6	Impediments to Help-Seeking .....	17
3.7	Prevention of Overdose .....	18
3.8	Beliefs About the Primary Cause of Overdoses.....	20
3.9	Attitudes Towards Naloxone.....	20
<b>4.0</b>	<b>DISCUSSION</b> .....	<b>22</b> .....
4.1	Major Findings of the Study.....	22
4.2	Data Validity and Representativeness of Sample.....	22
4.3	Circumstances and Factors Associated with Overdose... ..	23
4.4	Responses to Overdose .....	24
4.5	Attitudes Towards Overdose.....	24
4.6	Implications for Interventions.....	25
4.7	Implications for Future Research .....	26
4.8	Conclusions.. ..	26
<b>5.0</b>	<b>REFERENCES</b> .....	<b>28</b>

## LOCATION OF TABLES

<b>Table 1:</b>	Demographic characteristics of 329 heroin users. ....	7
<b>Table 2:</b>	Drug use history of 329 heroin users.....	9
<b>Table 3:</b>	Prevalence of overdose among 329 heroin users . ....	10
<b>Table 4:</b>	Circumstances of last overdose.....	11
<b>Table 5:</b>	Other drug use at last overdose ....	12
<b>Table 6:</b>	Multiple logistic regression predicting personal experience of overdose.....	13
<b>Table 7:</b>	Presence at an overdose .....	14
<b>Table 8:</b>	Circumstances of last overdose at which present .....	15
<b>Table 9:</b>	First actions taken when last present at an overdose .....	16
<b>Table 10:</b>	Observed symptoms when last present at an overdose .....	17
<b>Table 11:</b>	Main reasons for stopping or delaying seeking help at an overdose .....	18
<b>Table 12:</b>	Strategies for preventing overdose among heroin users .....	19
<b>Table 13:</b>	Beliefs about the primary cause of overdoses.....	20
<b>Table 14:</b>	Attitudes of heroin users towards naloxone.....	21

## ACKNOWLEDGMENTS

This research was funded by the Drug and Alcohol Directorate of New South Wales. The authors would like to thank the following organisations for their assistance in this study: Liverpool Hospital Drug and Alcohol Unit, Canterbury Hospital Drug and Alcohol Unit, Kullaroo Clinic, the Central Coast Needle Exchange, We Help Ourselves and the NSW Users and AIDS Association. In particular, we would like to thank Bruce Flaherty, Dr Deborah Zador, Sandra Sunjic, Professor Ian Webster, Dr Tony Gill, Mario Fantini, Karen Becker, Garth Popple, Dave Burrows and Dr Gabrielle Bammer.

## 1.0 INTRODUCTION

It is well documented that heroin users are at substantially greater risk of premature mortality than their non-heroin using peers. Longitudinal studies generally suggest that approximately 2-3% of heroin users die each year<sup>1-5</sup>. The excess mortality rates among heroin users in these studies have been variously estimated to be between 6 and 20 times those expected among peers of the same age and gender<sup>1,3,6,7</sup>. In Australia, and other countries, the major contributor to the excess mortality among this population has been narcotic overdose<sup>7-9</sup>. In 1990, 457 opioid-related deaths occurred in Australia<sup>10</sup>.

Unlike alcohol and tobacco related deaths, which have declined, the incidence of opioid related deaths in Australia appears to be rising significantly, with death rates due to opioids increasing by 170% between 1981-1990<sup>10</sup>.

The magnitude of the problem of opioid overdoses in Australia is best illustrated by comparison to deaths due to HIV/AIDS among injecting drug users. To date, 170 injecting drug users have died of AIDS in Australia<sup>11</sup>. As noted above, 457 people died of opioid overdose in 1990 alone. Overdose is currently a far greater public health problem among heroin users than is HIV.

Despite the mortality caused by overdose among heroin users, surprisingly little research has been conducted on this topic. Such studies that have been conducted have overwhelmingly been retrospective ones of either coronial records, or of hospital emergency admission records<sup>1,2,8,12-16</sup>. These studies have identified several factors that may be related to opioid overdose deaths. One major factor is the use of alcohol<sup>8,17-20</sup>. Rutenber and Luke<sup>19</sup>, for example, reported that 74% of heroin-related deaths between 1976-1979 in Washington, D.C. had alcohol present at autopsy, with a mean blood ethanol level of 0.09mg/100mls. Walsh<sup>20</sup> found that 48% of opioid deaths in Newcastle, Australia had alcohol present, with a mean blood ethanol level of 0.14mg/100mls. Benzodiazepine use has also been implicated in several studies<sup>14,20</sup>. Other factors include being female<sup>7,13</sup>, not currently being in drug treatment<sup>7,8,21</sup>, being single<sup>8,22</sup>, longer heroin using careers<sup>8,12</sup> and week-end use<sup>18,19,23</sup>.

While such retrospective record studies are useful, they cannot provide information on the prevalence of non-fatal overdose among heroin users, or the actions taken by those present at another's overdose. To the best knowledge of the authors, only three published studies have involved interviews with heroin users about their experiences with overdose<sup>24-26</sup>. Bammer and Sengoz<sup>24</sup> interviewed heroin users in the Australian Capital Territory. The results indicated that overdose is a common experience among heroin users, with a third of the sample reporting an overdose in the preceding twelve months. Apart from the Bammer and Sengoz study, the only other published study on the prevalence of non-fatal overdose is that of Toet & Ven, cited in Grund<sup>25</sup>. This



study was based upon reports of non-fatal overdoses among Rotterdam methadone maintenance clients, registered in the Rotterdam Drugs Information System. The authors reported that, in 1988, 27% of clients had a lifetime prevalence of non-fatal overdose. Again, overdose would appear to be a common experience among heroin users.

Manning et al<sup>26</sup> conducted psychological autopsies following 37 heroin-related deaths and near-deaths among U.S. military personnel based in Germany. The study involved interviews with friends of the victims, those present at the overdose, and the victims themselves in the 13 near-death overdoses. Questions were asked concerning the circumstances leading to overdose and the actions that were taken upon overdose. This was not, however, an epidemiological study concerning the prevalence of such experiences.

The current study was designed to investigate the prevalence of overdose and the circumstances surrounding overdose among a large sample of Sydney heroin users. It also aimed to investigate actions taken at others' overdoses; obstacles to help-seeking; the beliefs of heroin users about overdose and its causes; and their attitudes towards the opioid antagonist naloxone. The motive for the study was to develop interventions to reduce overdose and overdose deaths among injecting drug users (IDU) who continue to use heroin.

## **1.1 Study Aims**

The major aims of the study were as follows:

- 1) To estimate the prevalence and frequency of non-fatal overdose among heroin users.
- 2) To ascertain the circumstances in which heroin overdoses occur.
- 3) To examine the help-seeking behaviours, and obstacles to such behaviours, of heroin users present at other heroin users' overdoses.
- 4) To examine the beliefs of heroin users about overdose.
- 5) To ascertain the attitudes of heroin users to the use of the opioid antagonist naloxone.

## 2.0 METHOD

### 2.1 *Procedure*

Structured face to face interviews were conducted with 329 heroin users. All subjects were volunteers who were paid A\$20 for their participation in the study. Recruitment took place from January to August of 1994, by means of advertisements placed in rock magazines, treatment agencies (methadone maintenance units and drug free), needle exchanges and by word of mouth. In order to obtain heroin users at different stages in their careers, purposive sampling was employed to obtain approximately equal representations of users in and out of treatment for opiate dependence.

Subjects contacted the researchers by telephone or in person, and were screened for suitability for the study. To be eligible subjects must have either not been in treatment for opiate dependence and have used heroin in the preceding three months, or been currently enrolled in a methadone maintenance program. Each interview was conducted in a location determined by the subject in an attempt to allay any hesitations they might have about participating in the study. Consequently, interview sites ranged from methadone units, pubs, coffee shops, parks, shopping centres, to peoples' homes and the researchers' workplace (National Drug & Alcohol Research Centre). Subjects 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.

### 2.2 *Structured Interview*

A structured interview was devised that examined demographics, drug use history, heroin dependence, personal experience with overdose, presence at other peoples' overdoses, impediments to help-seeking, prevention of overdose, beliefs and attitudes regarding overdose and attitudes towards naloxone. The interview was constructed after three focus groups of heroin users were conducted to gain information on how to structure the questionnaire. The questionnaire was pilot tested on 21 heroin users during December 1993, and refinements were made on the basis of this. The areas covered by the interview are outlined in more detail below.

#### 2.2.1 Demographic characteristics

The demographic details obtained included: the subject'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 some indication of overall drug use, subjects 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 their main drug of choice, how old they were when they first injected heroin and their HIV-risk-taking behaviour (using the HIV Risk-taking Behaviour Scale<sup>27</sup>).

### **2.2.3 Heroin dependence**

Current dependence on heroin was measured using the Severity of Dependence Scale (SDS)<sup>28</sup>. 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 Personal experience with overdose**

Subjects were asked how many times they had overdosed, and whether they had ever been administered naloxone. For the purposes of the study, overdose was defined as any of the following symptoms occurring in conjunction with heroin use: difficulty breathing, turning blue, lost consciousness and was unable to be roused, collapsing. It was emphasised that overdose did not mean being "on the nod", i.e. acute intoxication with heroin resulting in drifting in and out of consciousness, but without the above signs and symptoms.

The circumstances surrounding the *most recent* time that they had overdosed were explored in detail, including questions on other drug use, whether they were alone at the time and whether they were in treatment for opiate dependence at the time. The most recent overdose experience was focused on in order to maximise recall.

### **2.2.5 Presence at an overdose**

This section asked how many times subjects had ever been present at another person's overdose. The circumstances, the actions taken on the most recent overdose occasion, and how the subject determined that the person had overdosed were also ascertained.

### **2.2.6 Impediments to help-seeking**

Items asked whether subjects have experienced impediments to help-seeking at an overdose, and invited them to identify the major impediments to seeking help.

### **2.2.7 Prevention of overdose**

Subjects were asked if they used strategies to avoid overdose. Those that did were asked to nominate their strategies.

### **2.2.8 Beliefs regarding main causes of overdose**

Subjects were asked to nominate what they perceived to be the major cause of overdose among heroin users.

### **2.2.9 Attitudes towards naloxone**

This section consisted of items regarding familiarity with the opioid antagonist naloxone (*Narcan*®), the illicit use of naloxone, and their attitudes to making the drug available to heroin users to treat overdoses.

## **2.3 *Analyses***

For continuous variables t-tests were employed. Categorical variables were analysed using  $\chi^2$ , 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 personal experience of overdose, multiple logistic regressions were conducted. Backwards elimination of variables was used to select the most appropriate models. All analyses were conducted using SYSTAT<sup>29</sup>.

## 3.0 RESULTS

### 3.1 *Sample Characteristics*

The sample consisted of 329 subjects, recruited from all areas of Sydney (Table 1). Males constituted 65% of the sample. The mean age of subjects was 30.2 years (range 17-50, SD 6.7), with males being significantly older than females (31.2 v 28.3,  $t_{326}=4.0$ ,  $p<.001$ ). Approximately half of the subjects were currently enrolled in treatment for opioid dependence (51%). Females were significantly more likely to be currently enrolled in treatment (60% v 46%, O.R. 1.77, 95% C.I. 1.12-2.80). The majority of those in treatment were currently enrolled in methadone maintenance programmes (150/168). The median length of time enrolled in current treatment was 15 months. Two thirds (66%) of the sample had previously been enrolled in drug treatment.

The mean years of formal school education was 10.0 (range 4-12, SD 1.6). Nearly a quarter (23%) of subjects had completed a trade or technical course, with 11% having completed a university course. The majority of subjects (72%) were currently unemployed, with only 10% in full-time employment, and a further 13% in part-time/casual employment.

Half of subjects (51%) had a regular sexual partner who was an injecting drug user (IDU), but significantly more females than males had IDU partners (73% v 39%, O.R. 4.29, 95% C.I. 2.62-7.04).

A large proportion of subjects reported having a prison record (40%), with males significantly more likely than females to report having been imprisoned (47% v 28%, O.R. 2.32, 95% C.I. 1.43-3.78).

**Table 1: Demographic characteristics of 329 heroin users**

	<b>Males</b>	<b>Females</b>	<b>Persons</b>
<b>N</b>	213	116	329
Age in years (Mean)	31.2	28.6	30.2*
Employment: (%)			
Not employed	73	71	72
Full time	12	6	10
Part time/casual	13	11	13
Student	1	2	1
Home duties	1	10	4
School Education (mean years)	10.0	9.7	10.0
Tertiary Education: (%)			
No tertiary education	75	61	66
Trade/technical	16	27	23
University/college	9	12	11
Trade & college	-	1	1
Currently in treatment (%)	46	60	51*
IDU partner (%)	39	73	51*
Prison record (%)	47	28	40*

\* Statistically significant difference between males and females

### 3.2 *Drug use history*

The mean age of first heroin use was 19.3 (range 13-39, SD 4.5), with the mean age of regular heroin use being 20.9 years (range 13-39, SD 4.8). At the time of interview, the mean length of heroin use career was 10.9 years. Males had significantly longer heroin using careers than females (11.7 v 9.4,  $t_{325}=2.9$ ,  $p<.01$ ).

The majority (83%) of those subjects who were currently in treatment had used heroin in the preceding six months. However, subjects currently in treatment had used heroin on a median of 30 days, compared to 90 days for the non-treatment subjects.

Polydrug use was common among the sample (Table 2). The median number of drug classes ever used by subjects was 10, a median of 6 having been used in the six months preceding interview. A median of 4 drug different classes had ever been injected, with a median 2 in the six months preceding interview.

The use of opiates other than heroin was common in the preceding six months (42%). Alcohol (78%) and benzodiazepines (64%) were also widely used. Poly drug use was not restricted to central nervous system depressants, with significant proportions of subjects having recently used amphetamines (42%), cocaine (24%) and hallucinogens (22%).

**Table 2: Drug use history of 329 heroin users**

Drug Class	Ever Used %	Ever Injected %	Used lst 6 months %	Injected lst 6 months %	Days Used lst 6 months*
Heroin	100	99	92	91	72
Other Opiates	76	58	42	29	10
Amphetamines	95	87	42	38	5
Cocaine	81	69	24	21	3
Hallucinogens	90	25	22	2	2
Benzodiazepines	90	32	64	9	20
Barbiturates	31	14	1	1	2
Alcohol	98	N/A	78	N/A	48
Cannabis	99	N/A	84	N/A	85
Inhalants	68	N/A	13	N/A	4
Tobacco	98	N/A	94	N/A	180
Poly-drug use (mdn # drugs)	10	4	6	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 7.4. Females had significantly higher scores than males, indicating higher levels of dependence on heroin (8.2 v 7.0,  $t_{327}=2.6$ ,  $p<.01$ ).

### 3.4 Personal experience with overdose

#### 3.4.1 Prevalence of overdose

As can be seen from Table 3, overdose is a common experience among heroin users. Two thirds (68%) of the sample reported having experienced an overdose, with no difference in prevalence between males (68%) and females (69%). In the



course of their heroin using careers, subjects reported a median of three overdoses, again with no differences between males and females. The prevalence of overdose increased with the length of heroin using career: 0-5 years (54%), 6-10 years (68%), more than 10 years (78%).

Over a quarter (29%) of subjects reported having overdosed in the preceding twelve months, with a median of 24 months since their last overdose. The median length of time since the last overdose was significantly longer for those subjects who were currently enrolled in treatment compared to non-treatment subjects (32 months v 12 months,  $U=4803$ ,  $p<.005$ )

The opioid antagonist naloxone had been administered to 38% of subjects at some stage in their heroin using careers, with 12% reporting having been administered naloxone in the twelve months preceding interview.

The median length of time between the initiation of heroin use and first overdose was 30 months. Less than a quarter (22%) of initial overdoses occurred within the first twelve months of heroin use.

**Table 3: Prevalence of overdose among 329 heroin users**

	<b>Males</b>	<b>Females</b>	<b>Persons</b>
Ever overdosed (%)	68	69	68
Number of overdoses (median)	3	2.5	3
Ever been administered naloxone (%)	39	35	38
Overdosed in last year (%)	25	30	29
Naloxone in last year (%)	11	14	12
Time until first overdose (median months)	36	24	30
Time since last overdose (median months)	24	18	24

### 3.4.2 Circumstances surrounding last overdose

The overwhelming majority (85%) of those who had overdosed reported that their last overdose occurred when they were *not* in drug treatment (Table 4). Approximately half (51%) reported having been administered naloxone on this occasion.

Over two thirds (69%) reported that the heroin injection that resulted in their last overdose was the first of the day. Most overdoses (80%) were reported as having occurred in the afternoon or night. There was no indication that there was an over-representation of week-end overdoses, with 29% of last overdoses occurring on week-ends, which is the expected proportion if overdoses are equally likely to occur on weekdays and weekends.

Two thirds (66%) of last overdoses occurred in a home environment, most commonly at the person's own house (37%) with only 10% of subjects reporting that they had last overdosed on the street. Only a minority (15%) were alone at the time of their last overdose. A significant minority (13%) reported that they last overdosed after recently having been released from prison. Only three subjects (1%) reported that their last overdose had been deliberate.

**Table 4: Circumstances of last overdose**

Circumstance	% Yes
In treatment	15
Alone at time	15
Naloxone administered	51
First heroin injection of day	69
Time of day: Morning	20
Afternoon	39
Night	41
Day of week*: Weekday	61
Weekend/Public holiday	29
Recently released from prison	13
Where overdose occurred: Home	37
Friends place	29
Other	34
Deliberate overdose	1

\* Excluding 14% who could not recall

The use of drugs other than heroin at the time of the last overdose was extremely common (Table 5). Nearly three quarters (72%) reported having consumed a drug other than heroin at the time of their last overdose. Males and females were equally likely to have done so (72% v 71%). The most commonly used drugs were the central nervous system depressants alcohol (35%), benzodiazepines (26%) and opiates other than heroin (16%). Nearly two thirds (62%) of subjects reported having used at least one of these three depressants in addition to heroin at their last overdose, with 13% having used two or more of these depressants. The overwhelming majority (83%) of those who had used other drugs at the time of their last overdose reported that they had used the drugs *prior* to using heroin.

**Table 5: Other drug use at last overdose**

<b>Drug Class</b>	<b>Males %</b>	<b>Females %</b>	<b>Persons %</b>
Alcohol	38	30	35
Benzodiazepines	24	30	26
Other Opiates	14	20	16
Cannabis	19	11	16
Amphetamines	5	1	4
Barbiturates	1	0	1
Cocaine	2	0	1
Hallucinogens	1	1	1
Inhalants	0	0	0

### **3.4.3 Factors associated with overdose**

In order to ascertain the factors associated with having experienced an overdose, those subjects who had experienced overdoses were compared with the remainder of the sample. Those subjects who reported having overdosed had longer heroin using careers (11.7yrs v 9.0yrs,  $t_{325}=3.7, p<.001$ ) and were more likely to have been in treatment for drug dependence (73% v 52%, O.R. 2.48, 95% C.I. 1.45-4.24). As was noted above, males and females were equally likely

to report having experienced an overdose.

Comparisons were also made on current drug use patterns. Those who had overdosed had significantly higher SDS scores (7.9 v 6.3,  $t_{327}=3.3$ ,  $p<.001$ ), indicating higher levels of heroin dependence. There were no significant differences in the frequency of heroin use, benzodiazepine use, extent of polydrug use or alcohol use in the preceding six months. It should be noted, however, that the difference in the mean frequency of alcohol use between groups approached significance (54.1 days v 40.2 days,  $p<.06$ ).

In order to determine which factors were independently associated with having overdosed, multiple logistic regressions were performed. The first logistic regression examined the relationship between demographic variables and overdose. Age, sex, ever having been in drug treatment and length of heroin using career were entered into the model. Ever having been in drug treatment and length of heroin using career were significantly related to having overdosed.

The second model examined the relationship between current drug use patterns and overdose. Frequency of heroin use, frequency of other opiate use, frequency of alcohol use, frequency of benzodiazepine use, SDS scores and whether the person employed prevention strategies were entered into the model. Benzodiazepine and alcohol use were entered into the model as they have been implicated in fatal overdose<sup>17-20</sup>. Frequency of alcohol use and SDS scores were significantly related to having overdosed.

Those variables that were significant from the two regressions were entered into the final model (Table 6). Length of heroin using career, SDS scores and frequency of alcohol use were significantly related to having overdosed. The regression equation was significant ( $\chi^2$ , 3df= 26.7,  $p<.001$ ), and had a good fit, Hosmer-Lemeshow  $\chi^2=5.0$ ,  $p<.42$ .

**Table 6: Multiple logistic regression predicting personal experience of overdose**

Variable	O.R.	95% C.I.
Length of heroin using career (years)	1.06	1.02-1.10
SDS score	1.12	1.05-1.18
Frequency of alcohol use (days in last 6 months)	1.01	1.00-1.01

Hosmer-Lemeshow  $\chi^2=5.0$ ,  $p<.42$  (Note: High  $p$ -values indicate better goodness of fit)

The results indicate that, after controlling for the effects of other variables in the model, each year of heroin use increased the odds of having overdosed by 6%. Similarly, each additional point on the SDS (indicating higher levels of heroin dependence) increased the probability of having overdosed by 12%, and each extra day alcohol was consumed in the preceding six months increased the odds of having overdosed by 1%.

### 3.5 Presence at an overdose

#### 3.5.1 Prevalence

The overwhelming majority of subjects (86%) reported having been present at another person's overdose, with a half having witnessed an overdose in the past twelve months (Table 7).

Those subjects who had been present at an overdose reported that this had happened a median of six times. The median length of time since last present at an overdose was 10 months.

**Table 7: Presence at an overdose**

	<b>Males</b>	<b>Females</b>	<b>Persons</b>
Ever present (%)	87	85	86
Times present (median)	6	6	6
Present at overdose in last year (%)	45	59	50
Time since last present at an overdose (median months)	12	8	10

### 3.5.2 Circumstances of last overdose at which present

Subjects were asked about the circumstances of the last overdose at which they were present (Table 8). The most common response as to the identity of the person who had overdosed was a friend (64%), with only a minority nominating a regular sexual partner (12%). In approximately a third (30%) of cases the subject was the only person present apart from the person who had overdosed.

An ambulance was called in just over half of the incidents (56%), with a median of four minutes reported between noticing the person had overdosed, and calling the ambulance. Females called an ambulance sooner than males (2 mins v 5 mins,  $U=2023$ ,  $P<.01$ ). It should be noted that a larger proportion of females reported calling an ambulance on the last overdose occasion, although this narrowly missed out on significance ( $p<.07$ ).

Over three quarters of subjects (80%) reported that they were intoxicated at the time of the last overdose they witnessed. Males were significantly more likely than females to report being intoxicated at the last overdose occasion (O.R. 2.03, 95% C.I. 1.12-3.68).

The person who had overdosed was reported to have died in 5% of the incidents.

**Table 8: Circumstances of last overdose at which present**

	<b>Males</b> %	<b>Females</b> %	<b>Persons</b> %
Identity of person:			
Friend	67	60	64
Partner	14	19	12
Other	19	21	24
Called an ambulance	52	63	56
Intoxicated at time	84	72	80*
Only person present	32	27	30
Person died	5	4	5

--	--	--	--

### 3.5.3 Responses to overdose

Subjects were asked to nominate the first action that they took the last time that they were present at an overdose (Table 9).

**Table 9: First actions taken when last present at an overdose**

Action	%
Mouth to mouth/Heart massage	29
Rang ambulance	17
Caused pain	13
Walked them around	13
Put in shower	5
Shook person	4
Placed in recovery position	3
Left/Did nothing	1
Injected with salt	1
Injected with speed	1
Got help from others	1
Take to hospital	1
Other	11

As can be seen, in only 17% of cases did the person initially call an ambulance. The most common response was to attempt to revive the person using mechanical techniques such as mouth to mouth and heart massage, or by inflicting pain (13%) and walking the person around (13%).



Those subjects who had been present at an overdose were asked how they knew the person had overdosed, and was not merely "on the nod". The symptoms described, listed below in Table 10, are all symptoms of acute narcosis. Changes in the person's colour, indicating anoxia, was the most frequently cited symptom (71%). Difficulties in the person's breathing (36%) and an inability to rouse them (34%) were the next most common responses.

**Table 10: Observed symptoms when last present at an overdose**

Symptom	%
Colour (turning blue)	71
Breathing	36
Unable to rouse	34
Collapsed	31
Eyes rolled	13
Limp	10
No movement	10

*Note: Percentages sum to more than 100 as multiple responses were permitted*

### **3.6 Impediments to help-seeking**

Those subjects who had been present at an overdose were asked whether anything had stopped or delayed them seeking help for a person who had overdosed. Nearly half (44%) reported that something had done so, with a fifth (19%) reporting that this had happened the last time that they were present at an overdose. Subjects were then asked the *main* reason for having stopped or delayed seeking help (Table 11).

**Table 11: Main reasons for stopping or delaying seeking help at an overdose**

Reason	%
Fear of police involvement	54
Other IDU stopped	6
Worried about person's reaction	5
Loss of confidentiality (neighbours, etc, will know we are IDU)	4
No phone/No money for phone	2
Attitudes of medical staff	2
Other	24

Fear of police involvement was overwhelmingly the main reason for stopping or delaying seeking help (54%). The next most common reason was that other IDU had stopped the person from seeking help, but this was given by only 6% of subjects.

### ***3.7 Prevention of overdose***

Subjects were asked whether they employed any strategies to prevent overdose. Over three quarters (80%) reported that they did employ such strategies. It should be noted that those subjects who did not employ prevention strategies were more likely to have overdosed (79% v 66%, O.R. 1.97, 95% C.I. 1.04-3.75). Strategies employed by current heroin users are listed in Table 12.

**Table 12: Strategies for preventing overdose among heroin users**

Strategy	%
Have taste of new heroin (split dose)	41
Always go to same dealer	13
Don't use too much heroin	10
Use same amount each time	8
Ask other users how strong	7
Ask dealer how strong	6
Let others shoot up first	6
Don't use alone	6
Don't mix with alcohol	5
Don't mix with other drugs	3
Inject slowly to gauge effect	3
Use small amounts	1
Other	10

*Note: Percentages sum to more than 100 as multiple responses were permitted*

The most common strategy employed by current heroin users was to split their usual dose when they acquired new heroin (41%). The next most common strategy employed was to always go to the same dealer, in the belief that the purity of the heroin stayed relatively constant at any one dealer and/or the dealer would tell them if the heroin was stronger than usual. The small numbers of subjects who reported that they had a strategy of not mixing heroin with alcohol (6%) or benzodiazepines (5%) should be noted, given the widespread use of these drugs (see above).

### 3.8 Beliefs about the primary cause of overdoses

Subjects were asked to nominate what they considered to be the *main* cause of overdoses among heroin users (Table 13).

**Table 13: Beliefs about the primary cause of overdoses**

Reason	%
Use more heroin than usual	31
Heroin stronger than usual	23
Other drugs	18
Alcohol	9
Don't test strength of heroin	5
Low tolerance (e.g. been in prison)	4
Recreational or inexperienced users	3
Deliberate	2
Impurities	2
Other	4

The most common responses were that overdose is caused by people using more than usual (31%) and by variations in the purity of heroin (23%). While 18% of subjects nominated other drug use as a major cause of overdose, only 9% nominated alcohol.

### 3.9 Attitudes towards naloxone

The overwhelming majority of subjects (90%) claimed to know what the opioid antagonist naloxone (NARCAN®) was. Only 5 of these subjects were incorrect in nominating what naloxone was or did.

Naloxone was reported to have been obtained illegally by 9% of subjects, with 5% reporting having injected someone with the drug.

Those subjects who knew what naloxone was were asked about their views about providing the drug to heroin users in order to reduce overdose deaths (Table 14). The overwhelming majority of these subjects (90%) were in favour of doing so. The main reason in favour was that it could be administered faster than waiting for an ambulance (58%).

When asked whether they would keep vials of naloxone at home if it was available to heroin users, 81% replied that they would. Importantly, only 5% thought that the provision of naloxone would result in their using more heroin than previously. Three quarters (75%) of the subjects stated that they would be willing to pay for naloxone.

In terms of the possibility of naloxone as an intervention to prevent overdose deaths, 83% of subjects stated that they would have used the drug at the last overdose at which they were present if it had been available.

**Table 14: Attitudes of heroin users towards naloxone**

N=291	% Yes
Good idea if made available to heroin users	90
Would keep some at home if available	81
Would use more heroin if available	5
Would have used naloxone at last overdose present at if available*	83
Willing to pay for naloxone	75

\* *Subjects who had been present at an overdose only*



## 4.0 DISCUSSION

### 4.1 *Major findings of the study*

The major finding of the current study was the high prevalence of reported non-fatal overdose among heroin users. Two thirds of the sample reported having overdosed, with a median of three overdoses in their heroin using careers. Overdose was evenly represented between the sexes, with males and females equally likely to report having had an overdose. Over a quarter of the sample (29%) reported having overdosed in the preceding twelve months. More than a third of subjects (38%) reported having been administered naloxone in the course of their heroin using careers. The results of this study are consistent with those of the recent study by Bammer and Sengoz<sup>24</sup>, conducted in the Australian Capital Territory.

The second major finding concerned the high percentage of subjects (86%) who had been present when another heroin user had overdosed, with a median of six such occasions being reported. Half of subjects had been present at such an occasion in the preceding twelve months. Clearly there is widespread exposure to overdose crisis situations, emphasising the possibility of intervening to prevent overdose deaths. However, only 17% reported that calling an ambulance was the first intervention that they employed on the last such occasion.

Overall, these two figures indicate that personal and vicarious experience of overdose is pervasive throughout the heroin using population.

### 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 subjects to talk about their involvement in various illegal and socially stigmatised activities, efforts were made to ensure that valid data were obtained. Subjects 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 subjects are given such guarantees the data obtained are reasonably valid and reliable<sup>30-32</sup>. 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 results<sup>33</sup>.

It should also be noted that subjects appeared quite clear of the definition of overdose, particularly in distinguishing overdose from acute intoxication. The symptoms reported by subjects as alerting them that an overdose had occurred in another person were all recognised symptoms of acute narcosis.

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 heroin users, both in Australia and other countries<sup>34-36</sup>.

### *4.3 Circumstances and factors associated with overdose*

Overdose does not appear to be related to initial, inexperienced heroin use. Subjects reported a median of 30 months before initial overdose, with only 22% of initial overdose occurring within the first twelve months of heroin use. Overdose seems to occur later in the heroin using career, probably as drug involvement increases. The fact that higher levels of dependence were associated with an increased risk of overdose supports this view. Length of heroin using career was also a significant predictor of having ever overdosed, with the probability of overdosing increasing by 6% per year of heroin use. This is again consistent with the view that overdose is primarily a problem experienced by older, more dependent users. If it is assumed that there is a small probability of overdosing with any one heroin injection, then the longer the drug is used, the greater the probability that an overdose, fatal or non-fatal, will occur.

The day of the week on which subjects last overdosed is consistent with the picture of regular, dependent heroin use being related to overdose. Unlike previous studies of fatal overdose<sup>18,19,23</sup>, there was no over-representation of week-end/public holiday overdoses.

The role of polydrug use in overdose has been commented on in studies of fatal overdoses<sup>14,18-20</sup>. The current data are consistent in implicating polydrug use in overdose, particularly alcohol and benzodiazepine use. Two thirds of most recent overdoses involved the presence of another central nervous system depressant. Overall, overdoses involving heroin use alone are in the minority. Alcohol appears to be especially implicated, with the frequency of current alcohol consumption being a significant predictor of having had an overdose. In the majority of overdoses that involved polydrug use, the other drugs were taken prior to heroin, a finding consistent with Manning et al<sup>26</sup>. The role of polydrug use in heroin overdoses may reflect a pharmacological interaction or the additive respiratory effects of depressant polydrug use. Alternatively, intoxication with other drugs may affect the judgement of users in such things as the amount of heroin that they use. In any case, the current study indicates



that polydrug use, particularly of other depressants, is associated with the majority of most recent heroin overdoses.

Drug treatment appears to have a protective effect. The overwhelming majority of last overdoses (85%) occurred when the subject was not in a current drug treatment. The length of time since the last overdose was also significantly longer for those subjects currently enrolled in a drug treatment than for subjects who were not currently in treatment. Opioid dependence treatment is known to be associated with lower HIV risk-taking behaviour<sup>37</sup>. The current data indicate that it is also a prophylactic against non-fatal overdose. These data accord well with those of Gronbladh et al<sup>38</sup>, who reported that subjects not in opioid treatment were seven times more likely to die over an eight year follow-up than those retained in methadone treatment, with overdose being the most common cause of death. The results are also consistent with those of Caplehorn et al<sup>21</sup> and Davoli et al<sup>8</sup>, both of which found not being enrolled in treatment to be related to overdose deaths.

Overdoses typically occurred in a home environment, with two thirds of most recent overdose occurring either in the person's own house or a friend's house. Other people were present at this occasion in 85% of cases. The public image of heroin users overdosing alone in the street is not supported by this study.

It should be noted that a substantial minority (13%) of those who had overdosed reported that their most recent overdose had occurred soon after release from prison. This may indicate a poor understanding of the dynamics of drug tolerance, with subjects using at the levels that they used prior to their incarceration. It may also reflect binge drug and alcohol use after release from prison.

#### **4.4 Responses to overdose**

Although the overwhelming majority of subjects (86%) reported that they had witnessed an overdose, an ambulance was called on the last occasion in only a half of cases. Overall, only 17% of subjects reported that the first thing that they did at the last overdose was call an ambulance. Other means of resuscitation, such as mouth to mouth or causing pain to the person, were tried first. Nearly a half of subjects who had witnessed an overdose reported that they had on at least one occasion delayed or not called an ambulance due to perceived obstacles. The low prevalence of calling an ambulance as a first action at an overdose is related to a fear of police involvement. Other factors were relatively rare. The fear of police involvement following an overdose is not entirely an unrealistic one, as users are sometimes charged with manslaughter for administration of the drug to the person who overdosed. Clearly this issue needs attention, both from the perspective of emergency services and heroin users themselves.

#### **4.5 Attitudes towards overdose**

Despite the high prevalence of polydrug use, particularly alcohol and benzodiazepines, on the most recent overdose occasion, heroin users attributed overdose to using more heroin than usual, or to the heroin being stronger than usual. In only 9% of cases was alcohol regarded as a main cause of overdose, yet alcohol consumption was an independent predictor of having overdosed. This is reflected in the strategies employed to avoid overdose. While 41% of current users reported splitting their dose when using new heroin, only 5% stated that they employed a strategy of not using alcohol with heroin, with 3% not using heroin with other drugs. Given the prevalence of polydrug use in this population, the risk of polydrug overdoses is not understood.

#### **4.6 Implications for interventions**

The current study has several major implications for interventions to reduce the frequency of overdose among heroin users.

Education directed at heroin users to prevent overdose would appear justified by the results of this study. Something akin to the Speedwise/Speedsafe campaign directed at amphetamine users, launched in New South Wales in 1993, may be appropriate. One major area that needs to be addressed in such a campaign is the use of other drugs with heroin, particularly central nervous system depressants such as alcohol. Heroin users should be informed of the dangers of the concurrent use of other depressants. The typical pattern of heroin use after intoxication with other depressants should be targeted. Other preventative measures that could be addressed in interventions could include not using heroin when alone and elementary information about changes in drug tolerance after periods of enforced (e.g. prison), or therapeutic abstinence (e.g. therapeutic communities). Given the substantial minority of subjects who had last overdosed shortly after leaving prison, the provision of such information at pre-release would be appropriate.

Heroin users appear reluctant to call ambulances, with only a minority (17%) reporting this as their first action at an overdose. This is particularly true of males, who took significantly longer than females to do so. Interventions to address the fears preventing users from calling an ambulance need to be considered and implemented. Users, particularly males, need to be encouraged to call an ambulance immediately that they recognise the signs of acute narcosis in a user.

Finally, the possibility of the provision of naloxone to heroin users deserves serious consideration. The current sample were overwhelmingly in favour (90%) of providing naloxone, with 81% stating that they would keep naloxone

in their home. Given that most recent overdoses reported by subjects occurred in a home environment, the possibility for life-saving intervention using naloxone exists. One of the major advantages of making naloxone available would be to remove the perceived problems involved for heroin users in ringing an ambulance. If naloxone had been available, 83% of those who had witnessed an overdose would have used it the last time that they were present at an overdose. This indicates a willingness to use the drug that may reduce fatalities. Provision of naloxone would be unlikely to result in an increase in heroin use among users, with only 5% stating that they would use more heroin if naloxone was available. It should be noted that those in favour of the provision of naloxone typically stated that they would like information on its use to also be provided.

Naloxone has no abuse potential, and there is no risk of death from its use. A trial and evaluation of the provision of naloxone would appear to be well warranted. One means of doing this would be to conduct a trial in one State jurisdiction, and assess the impact of the provision of the drug over a period of a year, as indicated by ambulance records, and interviews with heroin users.

#### ***4.7 Implications for future research***

The major research that would appear necessary in the field of heroin overdose are evaluations of interventions to reduce overdose. The prevalence of overdose, both fatal and non-fatal, indicates that there is an urgent need to develop and evaluate such interventions.

The actions taken by heroin users when present at an overdose need further consideration. Many users report using mouth to mouth, and other resuscitation techniques. What users are actually doing, and how effectively, needs to be documented.

The actions taken by heroin users to avoid overdose also warrant research attention. While users report a range of strategies, some of which would appear ineffective, it is not clear how frequently they use these strategies. A further question relates to how the experience of overdose itself affects the use of preventative strategies, e.g. do users adopt safer patterns of use after an overdose?

#### ***4.8 Conclusions***

Experience with overdose, both personal and vicarious, is ubiquitous among heroin users. Those who report having overdosed are typically older, more dependent heroin users who drink more frequently than other heroin users. The study is consistent with earlier studies in pointing to the role of other drugs in

overdose, with the majority of most recent overdoses involving other drug use. Given the prevalence of polydrug use in this population, interventions to reduce the frequency of the use of heroin with other drugs may result in a reduction in heroin overdoses, both fatal and non-fatal.

Despite the wide exposure to overdose among subjects, there appeared to be significant barriers to help-seeking in crisis situations. A large proportion of subjects reported a fear of police involvement as a significant factor in delaying help-seeking, preferring to employ other, less effective interventions. It is clear from this study that the help-seeking of heroin users needs urgent attention.

The current study confirms overdose as the most prominent public health issue among heroin users. On the basis of these data, it is hoped that interventions to reduce the frequency of overdose among this group can be constructed, both in terms of user education, and the provision of the opioid antagonist naloxone to this group.

## 5.0 REFERENCES

1. ENGTSROM, A., ADAMSSON, C.M., ALLEBECK, P. & RYDBERG, W. (1991) Mortality in patients with substance abuse: a follow-up in Stockholm County, 1973-1984. *International Journal of the Addictions*, 26, pp. 91-106.
2. HAARSTRUP, S. & JEPSON, P.W. (1988) Eleven year follow-up of 300 young opioid addicts. *Acta Psychiatrica Scandinavia*, 77, pp. 22-26.
3. GHODSE, H., STAPLETON, J., EDWARDS, G., BEWLEY, T. & AL-SAMARRI, M. (1986) A comparison of drug-related problems in London accident and emergency departments, 1975-1982. *British Journal of Psychiatry*, 148, pp. 658-662.
4. SEGEST, E., MYGIND, O. & BAY, H. (1990) The influence of prolonged stable methadone maintenance treatment on mortality and employment: an eight year follow-up. *International Journal of the Addictions*, 25, pp. 53-63.
5. TUNVING, K. Fatal outcome in drug addiction, *Acta Psychiatrica Scandinavia*, 77, pp. 551-566.
6. DUKES, P.D., ROBINSON, G.M. & ROBINSON, B.J. (1992) Mortality of intravenous drug users: attenders of the Wellington Drug Clinic, 1972-1989. *Drug and Alcohol Review*, 11, pp. 197-201.
7. PERUCCI, C.A., DAVOLI, M., RAPITI, E., ABENI, D.D. & FORSTIERI, F. (1991) Mortality of intravenous drug users in Rome: A cohort study. *American Journal of Public Health*, 81, pp. 1307-1310.
8. DAVOLI, M., PERUCCI, C.A., FORASTIERE, F., DOYLE, P., RAPITI, E., ZACCARELLI, M. & ABENTI, D.D. (1993) Risk factors for overdose mortality: a case control study within a cohort of intravenous drug users. *International Journal of Epidemiology*, 22, pp. 273-277.
9. RISSER, D. & SCHNEIDER, B. (1994) Drug-related deaths between 1985 and 1992 examined at the Institute of Forensic Medicine in Vienna, Austria. *Addiction*, 89, pp. 851-857.
10. COMMONWEALTH DEPARTMENT OF HEALTH, HOUSING AND COMMUNITY SERVICES. *Statistics on Drug Abuse in Australia*, 1992.
11. KALDOR, J. (ed.) (1994) *Cumulative analysis of AIDS cases in Australia* (Sydney, National Centre in AIDS Epidemiology and Clinical Research).
12. ESKILD, A., MAGNUS, P., SAMUELSON, S.O., SOHOLBERG, C. &

- KITTELSEN, P. (1993) Differences in mortality rates and causes of death between HIV positive and HIV negative intravenous drug users. *International Journal of Epidemiology*, 22, pp. 315-320.
13. FRISCHER, M. BLOOR, M., GOLDBERG, D., CLARK, J., GREEN, S. & MCKEGANY, N. (1993) Mortality among injecting drug users: A critical reappraisal. *Journal of Epidemiology and Community Health*, 47, pp. 59-63.
  14. FUGELSADT, A. (1994) Heroin deaths in Stockholm, 1986-1991. *Paper presented to the Fifth International Conference on the Reduction of Drug Related Harm*, Toronto, 1994.
  15. HARLOW, K.C. (1990) Patterns of rates of mortality from narcotics and cocaine overdose in Texas, 1976-1987. *Public Health Reports*, 195, pp. 455-462.
  16. GARRIOT, J.C. & STURNER, W.Q. (1973) Morphine concentrations and survival periods in acute heroin fatalities. *New England Journal of Medicine*, 289, pp. 1276-1278.
  17. JOE, G.W., LEHMAN, W. & SIMPSON, D.D. (1982) Addict death rates during a four-years posttreatment follow-up. *American Journal of Public Health*, 72, pp. 703-709.
  18. MANNING, F.J. & INGRAHAM, L.H. (1983) Drug "overdoses" among U.S. soldiers in Europe, 1978-1979. I. Demographics and toxicology. *International Journal of the Addictions*, 18, 89-98.
  19. RUTTENBER, A.J. & LUKE, J.L. (1984) Heroin-related deaths: new epidemiologic insights. *Science*, 226, pp. 14-20.
  20. WALSH, R.A. (1991) Opioid drug accidental deaths in the Newcastle area of New South Wales, 1970-1987. *Drug and Alcohol Review*, 10, pp. 79-83.
  21. CAPLEHORN, J.R.M., DALTON, M.S.Y.M., CLUFF, M.C. & PETRENAS, A.M. (1994) Retention in methadone maintenance and heroin addicts' risk of death. *Addiction*, 89, pp. 203-207.
  22. REILLY, D.K., RAY, J.E., DAY, R.O., WODAK, A., O'CONNOR, D. & THOMPSON, J. (1987) Classification of overdose/self-poisoning presentations to an accident and emergency department. *International Journal of the Addictions*, 22, pp. 941-955
  23. SWENSON, G. (1988). Opioid deaths in Western Australia: 1974-1984. *Australian Drug and Alcohol Review*, 7, pp. 118-185.

24. BAMMER, G. & SENGOZ, A. (1994) How would the controlled availability of heroin affect the illicit market in the Australian Capital Territory? An examination of the structure of the illicit heroin market and methods to measure changes in price, purity, availability, including heroin-related overdoses. *National Centre for Epidemiology and Public Health Working Paper No. 10.*
25. GRUND J-P. C. (1993) *Drug use as a Social Ritual. Functionality, Symbolism and Determinants of Self-regulation* (Rotterdam, University of Rotterdam).
26. MANNING, F.J., INGRAHAM, L.H., DEROUIN, E.M., VAUGHN, M.S., KUKURA, F.C. & ST MICHEL, G.R. (1983) Drug "overdoses" among U.S. soldiers in Europe, 1978-1979. II. Psychological autopsies following deaths and near-deaths. *International Journal of the Addictions, 18*, 153-156.
27. DARKE, S., HALL, W., HEATHER, N., WARD, J. & WODAK, A. (1991) The reliability and validity of a scale to measure HIV risk-taking among intravenous drug users. *AIDS, 5*, pp. 181-185.
28. GOSSOP, M., GRIFFITHS, P., POWIS, B. & STRANG, J. (1992) Severity of dependence and route of administration of heroin, cocaine and amphetamines, *British Journal of Addiction, 87*, pp. 1527-1536.
29. WILKINSON, L. (1990) *SYSTAT: The System for Statistics* (Evanston IL, SYSTAT Inc.).
30. BALE, R.N., VAN STONE, W.W., ENGELSING, T.M.J., ZARCONE, V.P. & KULDAU, J.M. (1981). The validity of self-reported heroin use. *International Journal of Addictions, 16*, 1387-1398.
31. BALL, J.C. (1967). The reliability and validity of interview data obtained from 59 narcotic drug addicts. *American Journal of Sociology, 72*, 650-654.
32. MAGURA, S., GOLDSMITH, D., CASRIEL, C., GOLDSTEIN, P.J & LIPTON, D.S. (1987). The validity of methadone clients' self-reported drug use. *International Journal of Addictions, 22*, 727-749.
33. DARKE, S., HALL, W., HEATHER, N., WODAK, A. & WARD, J. (1992) Development and validation of a multi-dimensional instrument for assessing outcome of treatment among opioid users: The Opiate Treatment Index, *British Journal of Addiction, 87*, 593-602.
34. CAPLEHORN, J.R.M. & SAUNDERS, J.B. (1993) Factors associated with heroin users' AIDS risk-taking behaviours, *Australian Journal of Public Health, 17*, 13-17.

35. HALL, W., BELL, J. & CARLESS, J. (1993) Crime and drug use among applicants for methadone maintenance, *Drug and Alcohol Dependence*, 31, 123-129.
36. GRIFFITHS, P., GOSSOP, M., POWIS, B. & STRANG, J. (1994) Transitions in patterns of heroin administration: a study of heroin chasers and heroin injectors. *Addiction*, 89, 301-309.
37. WARD, J., MATTICK, R. & HALL, W. (1992) *Key Issues in Methadone Maintenance Treatment* (Sydney, University of New South Wales Press).
38. GRONBLADH, L., OHLAND, L.S. & GUNNE, L.M. (1990) Mortality in heroin addiction: impact of methadone treatment, *Acta Psychiatrica Scandinavia*, 82, pp. 223-227.