TOXICOLOGICAL FINDINGS AND CIRCUMSTANCES OF HEROIN-RELATED DEATHS IN SOUTH WESTERN SYDNEY, 1995

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EXECUTIVE SUMMARY

The coronial files of all 1995 heroin-related deaths in the South Western Sydney (SWS) region were inspected for toxicological results, demographic characteristics and circumstances of death. These data were compared with SWS heroin-related deaths from 1992. There were 44 deaths attributed to heroin overdose in the region during 1995, an increase of 120% compared with the 20 cases that occurred in 1992. The mean age of cases was 31.7 years, and 96% were male. Cases were significantly older than in 1992, and more likely to be male. The route of heroin administration was by injection in all cases in both years.

Over a half (59%) of fatalities occurred in the suburb of Cabramatta, compared to 15% of cases in 1992. Seventy one percent of fatalities occurred in a public place, including 92% of cases who died in Cabramatta. The proportion of fatalities that occurred in public settings has increased markedly since 1992, when 35% of fatalities occurred in public places. The proportion of cases in which no interventions occurred prior to rose from 60% in 1992 to 80% in 1995.

The median blood morphine concentration among fatalities in 1995 was 0.35 mg/L (range 0.08-3.20 mg/L), more than twice the corresponding figure of 0.16 mg/L in 1992. The majority of deaths (69%) involved drugs in addition to heroin, a similar pattern to 1992 fatalities (79%). Alcohol was the most frequently detected drug other than morphine, present in 52% of cases at a median concentration of 0.10 g/100ml (range 0.01-0.33 g/100ml). The median blood morphine concentration in cases positive for alcohol was significantly lower than in cases without alcohol (0.26 v 0.55mg/L). There was also a significant negative correlation between blood alcohol and blood morphine concentrations (r_s=-0.41).

A large increase has occurred since 1992 in the number of heroin-related deaths in SWS, and higher concentrations of morphine are being detected. Cabramatta has clearly emerged as a focal point of these fatalities. The patterns of these fatalities also appears to be changing, with more deaths occurring in public settings, and fewer interventions occurring prior to death. Heroin-related fatalities in SWS represent a growing, and changing problem. Interventions designed to prevent heroin-related fatalities in SWS must take into account of the changing patterns of heroin-related fatalities in SWS.

1.0 INTRODUCTION

Deaths attributed to overdose remain the single largest contributor to the excess mortality associated with heroin use, even in countries with a high HIV seroprevalence (Eskild et al, 1993; Frischer et al, 1993; Joe & Simpson, 1987; Oppenheimer et al, 1994; Perucci et al, 1991). Recent research has also indicated that the incidence of non-fatal overdose is high (Bammer & Sengoz, 1994; Darke et al, 1996a; Gossop et al, 1996). The results of this widespread exposure to overdose, and to other causes of mortality, are reflected in an estimated excess mortality rate among heroin users 13 times that of peers of the same age and gender (English et al, 1995).

Despite the magnitude of the problem of heroin overdose, little Australian research has been conducted into the problem. In a recent study, Zador et al (1996) analysed the data from coronial files of all 1992 New South Wales heroin-related deaths. This study found that cases of heroin-related deaths were overwhelmingly male, occurred in a dependent non-treatment population of users, and typically occurred in the home. Of major importance, the study also found that only a minority of cases had only morphine (the metabolite of heroin) detected at autopsy. Nearly half (45%) were positive for alcohol at autopsy, and in 27% of cases benzodiazepines were detected.

The South Western Sydney (SWS) region has, in recent years, become of major concern to drug and alcohol service providers, police and policy makers. The region covers an area of over 6000 km^2 and has a population of approximately 650,000. The major reason for mounting concern has been the emergence of the suburb of Cabramatta as a major distribution point for cheap, high purity heroin (Maher, 1996; O'Brien et al, 1996). A recent study reported a mean purity of 59% for street seizures of heroin in the SWS region, with purity ranging up to 80% (Weatherburn & Lind, 1995). The price of a "cap" of heroin (a small amount wrapped in foil and stored in a water balloon) has fallen from $50 to approximately $30 (O'Brien et al, 1996). There is evidence from both heroin users and local key informants that many heroin users are travelling from outside the SWS area to purchase heroin in Cabramatta, which now appears to rival Kings Cross as a distribution point (Maher, 1996; O'Brien et al, 1996).

The current study aimed to examine the toxicological findings of heroin-related fatalities that occurred in the SWS region during 1995, and the demographic characteristics and circumstances of these cases. In order to ascertain whether any noticeable trends have emerged among heroin-related fatalities in the SWS region, the study also re-analysed data on SWS fatalities that occurred during 1992, derived from the data reported by Zador et al (1996).

1.1 *Study Aims*

The aims of the current study were:

1. To determine the toxicological findings at autopsy of all cases of heroin-related deaths in the SWS region between 1 January 1995 and 31 December 1995;

2. To describe the demographic characteristics of heroin-related deaths in SWS in 1995;

3. To describe the circumstances of heroin-related deaths in SWS in 1995.

4. To compare the above variables with heroin-related deaths that occurred in SWS during 1992, and ascertain trends over time.

2.0 METHOD

2.1 *Procedure*

All cases positive for blood morphine that occurred during 1995 in SWS were identified by the Government Analytical Laboratories. The SWS region was defined as that covered by the South West Sydney Area Health Service.

Permission was obtained from the Department of Courts Administration to inspect each case's coronial file. Each file was inspected by a member of the research team to ascertain whether the fatality was the result of a heroin overdose, or due to other causes. Overdose fatalities were determined by autopsy conclusions, circumstances of death (e.g. presence of injecting equipment), police investigations. Cases due to other causes were excluded from the study.

All heroin-related fatalities that occurred during 1992 in the SWS region were also identified from the data reported by Zador et al (1996).

Fifty seven cases were identified where morphine was detected at autopsy. In 11 cases were identified where the person was not a heroin user, and cause of death was not due to heroin administration. Two cases were identified as suicides who were known heroin users, but who employed means other than heroin for suicide (gunshot, carbon monoxide). These 13 cases were excluded from the study, leaving a total of 44 fatalities attributed to heroin overdose in SWS during 1995.

Inspection of the data from Zador et al (1996) revealed 20 heroin-related deaths in SWS during 1992.

2.2 *Data Collection Form*

Information on the demographic characteristics, drug use history, circumstances of death, and toxicological findings of heroin-related deaths was retrieved from cases' coronial files. Documents contained in the files of particular relevance were police reports, ambulance officers' statements, other witnesses' statements, autopsy reports, and results of toxicological analysis. The standardised data collection form used by Zador et al (1996) was employed to record the relevant data. The data collection form is outlined in more detail below.

2.2.1 *Demographic characteristics*

Demographic data obtained included age, sex, marital status, employment status, country of birth, and suburb or town of residence.

2.2.2 *History of drug use*

Information was sought on cases' history of known drug use, and extent of heroin dependence. History of known use of heroin, benzodiazepines, amphetamines and heavy alcohol use was obtained from family members' and friends' statements to police. Information was also sought on cases' history of treatment for heroin dependence.

An attempt was made to categorise cases' extent of dependence on heroin into three groups: dependent, recreational, and novice. A classification of "dependent" was not restricted to criteria of physiological dependence (tolerance and withdrawal symptoms) alone, as it was not possible on the basis of information contained in the coronial files to establish the frequency and intensity of a case's heroin use. Rather a study subject was defined as "dependent" if the coronial file provided evidence of participation in the heroin lifestyle or heroin sub-culture (which may include physiological dependence). The following criteria were considered suggestive of the centrality of heroin use in the deceased's life: known history of heroin use, partner or friends known to be heroin users, history of heroin overdose or treatment for dependence (e.g. rehabilitation or methadone treatment) and criminal record. A "novice" was considered to be a person whose death was due to first time use of heroin.

2.2.3 *Circumstances of death*

Information was obtained on the day and month of death, suburb of death, type of location of death (e.g. home, street, public toilet), time of death, the presence of other persons at the time of death, and intervention sought or administered (if any).

Intervention was considered to be administered if it was received by the subject while still alive. For example, intervention administered by ambulance officers

or following admission to hospital was not included as "intervention" if the subject was clinically dead (absent respirations or pulse, fixed and dilated pupils) at the time of arrival of the ambulance, or at the time of presentation to hospital.

2.2.4 *Toxicological analyses*

Information on results of toxicological analysis was obtained from reports of laboratory analyses performed by the Division of Analytical Laboratories (NSW Department of Health) on blood and other tissue specimens taken at autopsy. These reports were contained in the coronial files. As it was not possible to be certain whether the presence of two or more benzodiazepine drugs (e.g. diazepam and oxazepam) detected at autopsy represented the administration of two drugs or the original drug and its metabolite, all individually detected benzodiazepines were grouped into the single drug class "benzodiazepines".

2.3 *Statistical analysis*

T-tests were used for continuous data. Where distributions were highly skewed, medians were reported, and were analysed using the Mann-Whitney U statistic. For categorical variables, Odds Ratios (OR) and 95% Confidence Intervals (95% CI) were reported.

A Spearman rank order correlation was conducted to ascertain whether elapsed time between death and autopsy was related to blood morphine concentrations. In cases where there was a range of time in which death could have occurred, the mid-point was chosen for these analyses. Spearman correlations were also calculated to determine the relationship between blood morphine and alcohol concentrations.

All analyses were conducted using SYSTAT (Wilkinson, 1990).

3.0 RESULTS

3.1 *Demographic characteristics*

The mean age of the 44 cases was 31.7 yrs (SD 7.2, range 18-45) (Table 1). The overwhelming majority of cases (92%) were male, with only 4 female cases. Two thirds (68%) were single at the time of death. The majority were unemployed at the time of death (55%), and 81% were Australian-born.

The number of fatalities had increased by 120% compared with 1992, in which there were 20 heroin-related fatalities. The mean age of 1995 cases was significantly older than in 1992 (31.7 v 27.6, t_{62}=2.2, $p<.05$). There were significantly higher proportion of male fatalities in 1995 compared to 1992 (96% v 75%, OR 7.0, 95% CI 1.2-40.0), and significantly more cases were employed in 1995 (41% v 10%, OR 6.5, 95% CI 1.3-35.5). In respect to other demographic characteristics, the cases from the two years were similar.

Table 1: Demographic characteristics of heroin-related fatalities in SWS, 1995 and 1992.

Variable	1995	1992
Number of cases	44	20
Mean age (yrs)	31.7	27.6
Sex (%):		
Males	96	75
Females	4	25
Martial status (%):		
Single	68	50
Defacto/married	32	50
Employment status (%):		
Unemployed	59	90
Employed	41	10
Unknown	2	0
Country of birth (%):		
Australia	80	90
Vietnam	6	0
Argentina	2	0
Nicaragua	2	0
Uruguay	2	0
Indonesia	2	0
Turkey	2	0
Lebanon	0	5
Unknown	2	5

3.2 *History of drug use*

Three quarters of cases were known heroin users, based on statements by friends and relatives in coronial files (Table 2). Nearly a half (47%) were known to be heavy alcohol users. The majority of cases (79%) were classified as dependent heroin users, and 21% were classified as recreational users. No cases were enrolled in methadone maintenance at the time of death. Two cases (4%) had been released from prison in the month preceding death, both of whom died on the day of their release from prison. In all 44 cases, the route of final heroin administration was by injection, as can be seen from Table 2, these patterns were similar to those of 1992 cases.

Table 2: Known drug use, dependence status, and treatment status

Variable	**1995 % (N=44)**	**1992 % (N=20)**
History of known drug use		
Heroin use	77	90
Heavy alcohol use	50	30
Benzodiazepine use	7	20
Amphetamine use	27	10
Dependence status		
Dependent	82	75
Recreational	18	25
Novice	0	0
Route of final heroin administration		
Injection	100	100
Smoking	0	0
Methadone Treatment		
In methadone at time of death	0	5
Prison		
Recently released from prison	5	5

3.3 *Circumstances of death*

3.3.1 Location of death

Fifty nine percent of fatalities in 1995 occurred in the suburb of Cabramatta. The suburb of residence at the time of death was outside of the SWS region in 52% of cases. Of the 26 fatalities that occurred in Cabramatta, 15 were from outside the SWS region, and only 2 cases were residents of Cabramatta.

In 1992, 15% (3/20) of fatalities occurred in Cabramatta. The proportion of cases that occurred in Cabramatta during 1995 was significantly greater than in 1992 (59% v 15%, OR 8.2, 95% CI 2.1-32.1). A third (35%) of cases in 1992 were from outside the SWS region. The increase in the proportion of cases from outside the SWS region in 1992 and 1995 was not significant.

The frequency of types of physical location in which death occurred are presented in Table 3. A half (50%) of cases died in a street setting (e.g. car parks, vacant lots, cars), 9% in a public toilet, and a further 6% died in a railway station. A minority died in their own homes (18%) or in the home of a friend or family (9%). Overall, 71% of fatalities occurred in a public setting. Of the 26 cases who died in Cabramatta, only 2 (8%) died in a home environment. Sixteen cases (62%) died in the street, 4 (15%) in a public toilet, 2 (8%) in hotels and one (4%) on a railway station.

The pattern of physical location of death was substantially different in 1992. In that year, 60% of SWS deaths occurred the person's own home, and a further 10% in the home of a friend or family. Only a quarter of deaths occurred in a street environment, compared to a half of 1995 fatalities. Thus, 35% of fatalities occurred in a public setting. The larger proportion of cases that died in a public place in 1995 was significant (71% v 35%, OR 4.4, 95% CI 1.4-13.6).

Table 3: Physical location of death

Location of death	1995 % (N=44)	1992 % (N=20)
Street	50	25
Own home	18	60
Home of friend or family	9	10
Public toilet	9	0
Railway station	7	5
Hotel/club	5	0
Hospital	2	0

3.3.2 Time of death

The majority of the cases in which the time of death could be estimated died between midday and midnight (76%) (Table 4). The most common time of death was in the afternoon (44%), as was also the case in 1992. Only two cases died in the period between 6AM and midday.

Table 4: Time of death

Time of death	1995* % (N=38)	1992# % (N=19)
Midnight to 6 AM	18	32
6 AM to midday	5	11
Midday to 6 PM	44	37
6PM to midnight	32	21

* *In 6 cases time of death was not able to be ascertained within these intervals*
 # In 1 case time of death was not able to be ascertained within these intervals

3.3.3 Interventions

The presence of other persons at some time during the interval of time from the administration of heroin to the death of the subject was noted in 34% of cases (Table 5). This is likely to be an underestimate, as others may have left the scene prior to the discovery of the body. In 18% of cases the person died segregated from others, and in 48% of cases the person was alone.

While dying alone was most common in 1995, dying segregated from others was the most common situation in 1992. This may reflect the higher proportions of fatalities that occurred in home environments in 1992.

Table 5: Presence of other persons at time of death

Presence	1995 % (N=44)	1992 % (N=20)
Died in presence of others	34	15
Died alone	48	40
Died segregated from others	18	45

The frequency of interventions used to resuscitate subjects are shown in Table 6. In 80% of cases no intervention occurred prior to death. In only 16% of cases was an ambulance called prior to death. Of the 15 cases where others were present at the time of death, no intervention occurred in 7 cases, an ambulance having been called in 6 cases.

The proportion of cases in which no intervention occurred was significantly higher in 1995 than in 1992 (80% v 60%, OR 6.5, 95% CI 2.3-18.1), a possible reflection of the higher proportion of fatalities that occurred in street settings in that year.

Table 6: Frequency of interventions used for resuscitation of cases

Intervention	1995 % (N=44)	1992 % (N=20)
None	80	60
Ambulance	16	20
Friend's CPR*	2	20
Saline injection	2	0

* CPR = cardio-pulmonary resuscitation

3.4 *Toxicological findings*

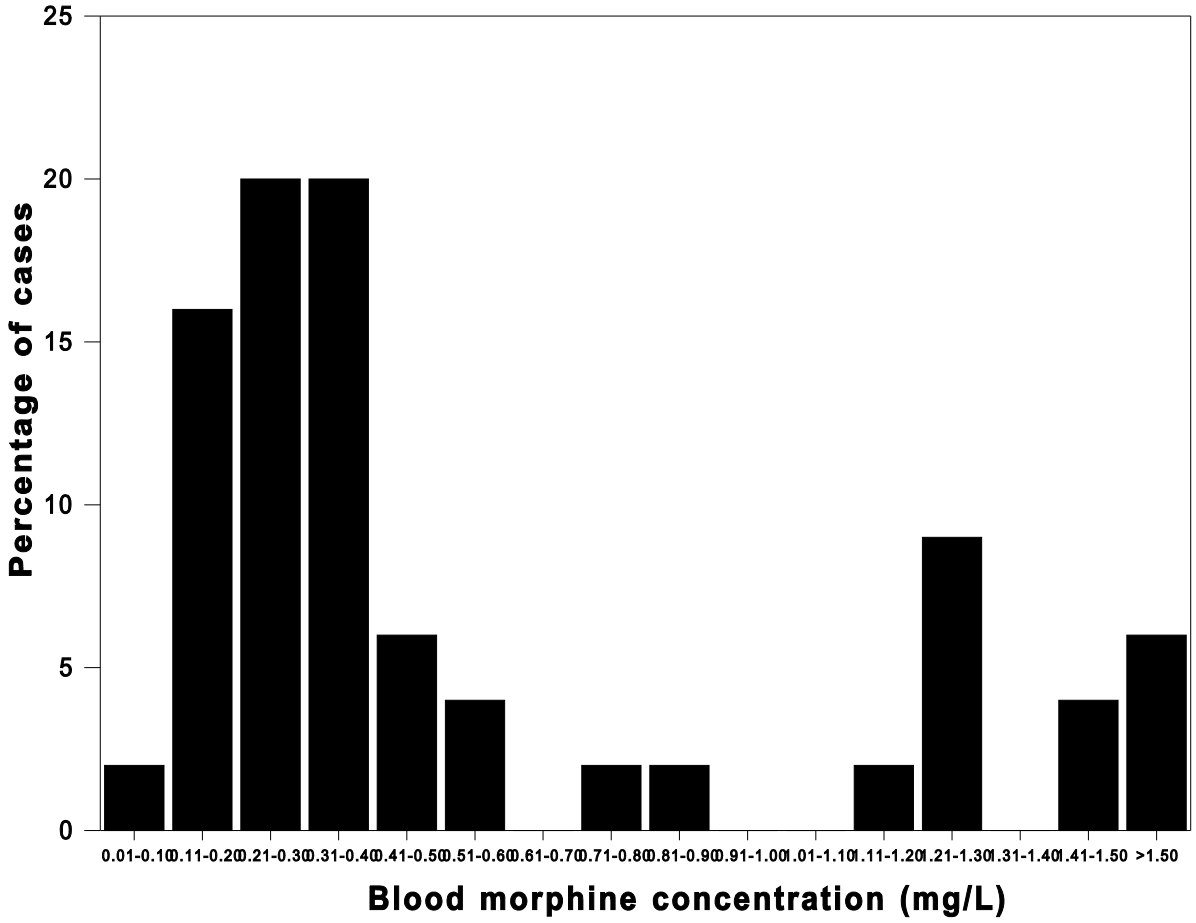
3.4.1 Blood morphine concentration

Two cases were excluded from the toxicological analyses for 1995. One case had been admitted to an intensive care unit for maintenance on a life support system for three days, and one case was in an advanced state of decomposition that precluded blood analyses. This left a total of 42 cases in which toxicological analyses were conducted.

The distribution of blood morphine concentration is presented in Figure 1. The median blood morphine concentration was 0.35 mg/L (range 0.08-3.20 mg/L). There was no correlation between the estimated elapsed time between death and autopsy, and blood morphine concentrations in fatal overdose cases (r_s=-0.03).

Toxicology results were available for 19 of the 20 case that occurred in 1992. The median blood morphine concentration in among 1992 fatalities was 0.16 mg/L (range 0.03-1.30 mg/L). The median blood morphine concentration was significantly higher in 1995 than in 1992 (0.35 mg/L v 0.16 mg/L, U=590 p<.01).

Figure 1: Distribution of blood morphine concentration among fatalities in 1995



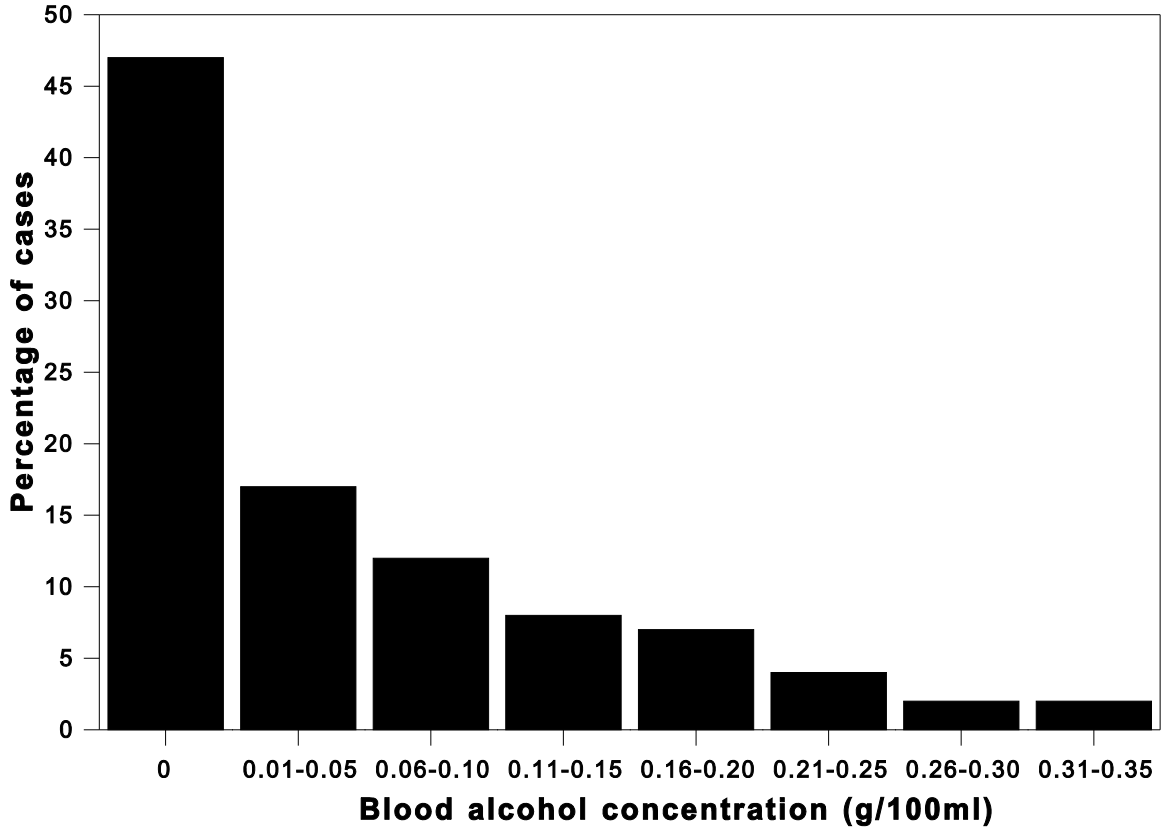
In 31% of cases morphine was the sole drug detected at autopsy. The corresponding figure for 1992 was 21%. This difference was not significant.

3.4.2 Blood alcohol concentration

Alcohol was detected in 52% of cases (Figure 2). The median blood alcohol concentration among those case in which alcohol was detected was 0.11g/100ml (range 0.01-0.33).

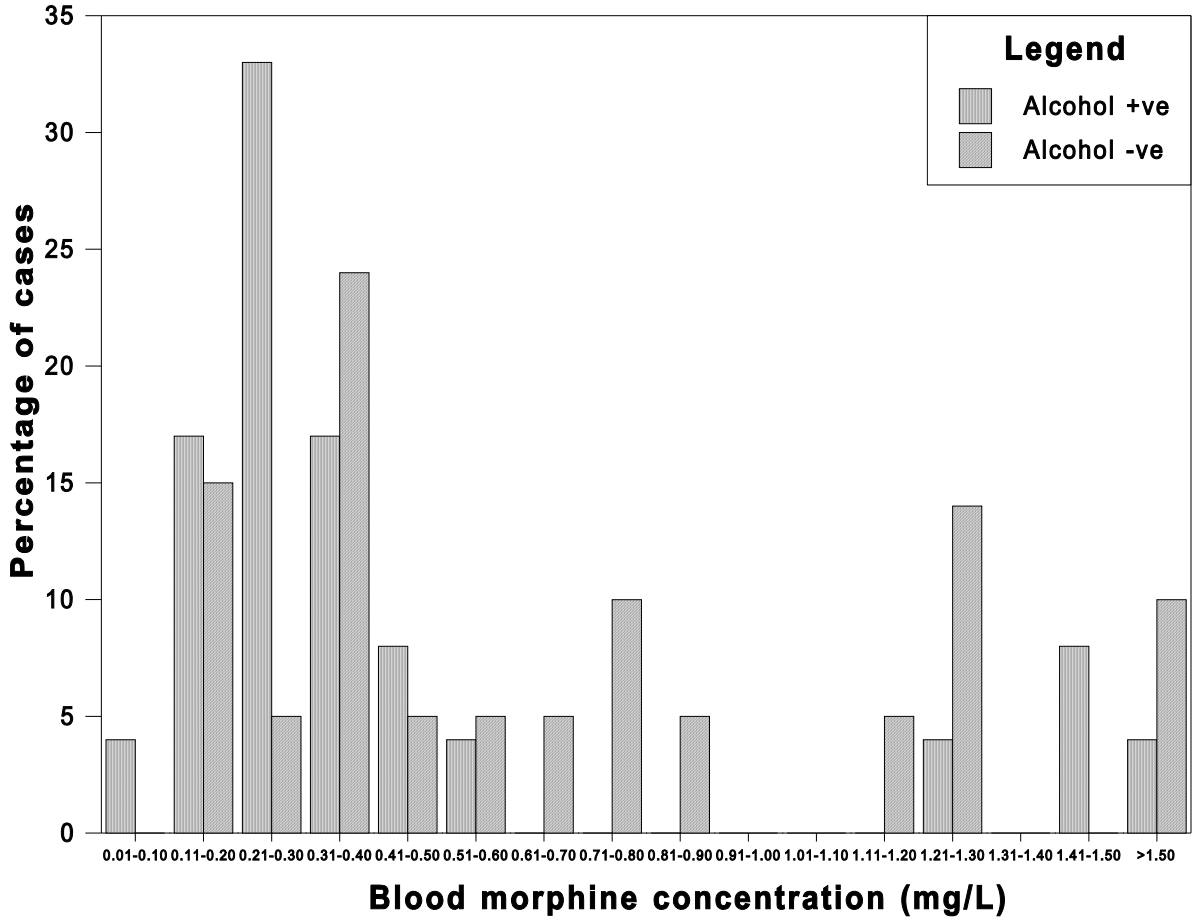
The results for alcohol in 1992 were similar to those of 1995. The proportion of cases in which alcohol was detected in 1992 was 47%, with a median blood alcohol concentration among those cases in which alcohol was detected of 0.13 g/100ml (range 0.08-0.27 g/100ml).

Figure 2: Distribution of blood alcohol concentration among fatalities in 1995



The median blood morphine concentration in the group of subjects positive for presence of alcohol was significantly lower than in other cases (0.26 v 0.55mg/L, U=327.5, $p<.05$). There was also a significant negative correlation between blood alcohol and blood morphine concentrations ($r_s=-0.41$, $p<.001$). The distributions of blood morphine concentrations by presence or absence of alcohol are presented in Figure 3.

Figure 3: Distributions of blood morphine concentrations by presence or absence of alcohol among fatalities in 1995



3.4.3 Benzodiazepines

Benzodiazepines were detected in 22% of cases. In 12% of cases both alcohol and benzodiazepines were detected at autopsy. There was no significant difference in the median blood morphine concentration of cases in which benzodiazepines were detected and those in which they were not (0.32mg/L v 0.38 mg/L). Benzodiazepines were detected in 32% of cases in 1992, which was not significantly different from 1995.

3.4.4 Other drugs

Small proportions of cases had other drugs detected at autopsy (Table 7). The most frequently detected were antidepressants (10% of cases). Methadone was detected in only one case. This case was not enrolled in methadone maintenance at the time of death. Barbiturates were not detected in any case. There were no significant differences in the prevalence of other drugs in 1992 and 1995.

Table 7: Prevalence of other drugs detected at autopsy

Drug	**1995 % (N=42)**	**1992 % (N=19)**
Antidepressants	10	5
Cocaine	5	0
Antipsychotics	2	0
Methadone	2	16
Amphetamines	2	5
Barbiturates	0	0

3.5 *Pathologists' conclusions*

The pathologists' conclusions attributing cause of death are presented in Table 8. In 77% of cases the cause of death was attributed to "acute narcotism", and the remaining deaths were attributed to various forms of multiple drug toxicity. It should be noted that in 15 of the 36 cases in which death was attributed to acute narcotism, alcohol was also detected. Similarly, in 8 of these 36 cases, benzodiazepines were detected. The pattern of pathology conclusions of 1992 fatalities was almost identical to those of 1995.

Table 8: Pathologists' conclusions regarding cause of death

Cause of death	**1995 % (N=44)**	**1992 % (N=20)**
Acute narcotism	80	80
Morphine and alcohol toxicity	14	15
Multiple drug toxicity	4	5
Morphine and cocaine toxicity	2	0

4.0 DISCUSSION

4.1 *Major findings of the study*

Several major findings emerged from this study. First, there was a 120% increase in the number of heroin-related fatalities in 1995 compared with those that occurred in 1992. A second finding concerned the emergence of Cabramatta as the focus of fatalities in the SWS region. Over a half (59%) of heroin-related fatalities from the entire SWS region occurred in the suburb of Cabramatta. The circumstance of deaths appears to be changing, with significantly more deaths occurring in public settings and intervention prior to death occurring in fewer cases.

Finally, toxicology analyses indicated that the median blood morphine concentration was significantly higher among 1995 SWS fatalities compared with 1992 cases. Nevertheless, polydrug use in the toxicology of heroin-related fatalities continued to be the norm, with 69% of cases having drugs other than morphine detected at autopsy.

4.2 *Demographic characteristics*

The 120% increase in the number of fatalities that occurred in SWS is cause for concern. In the absence of statewide data on heroin-related deaths, it is unclear at the present time whether this magnitude of increase has been reflected statewide, or whether SWS has undergone a disproportionate increase in fatalities.

The mean age of heroin-related fatalities in SWS during 1995 was 31.7 years. Given that heroin use typically commences in the late teens, these cases would be likely to have been using heroin for over a decade. Fatalities in SWS would appear to be, on the whole, older heroin users. In fact, the mean age of fatalities was significantly older in 1995 than the 27.6 years of fatalities that occurred in 1992. Despite the emergence of a new generation of younger heroin users (O'Brien et al, 1996), it was still older, dependent users who constitute a majority of fatalities in the SWS region.

The overwhelming majority (92%) of fatalities were male. The proportion of males among 1995 fatalities was a significant increase from the 75% reported in 1992. Males typically constitute around two thirds of recruited samples of heroin users in local and overseas studies (e.g. Ball & Ross, 1991; Griffiths et al, 1994; O'Brien et al, 1996). Males were clearly over-represented in SWS fatalities, even after the preponderance of males in the heroin using population is taken into account.

The relatively high proportion of cases (41%) who were employed at the time of death was surprising. The equivalent figure for 1992 was 10%. There did not appear to have been an increase in the proportion of recreational heroin users in 1995 compared to 1992, which might be expected if more case were employed.

It is important to note that none of the fatalities that occurred in SWS in 1995 were enrolled in methadone maintenance at the time of death. Only one case was enrolled in methadone maintenance in 1992. These data are similar to the statewide data reported from NSW fatalities for 1992, where only 2% of cases were enrolled in treatment at the time of death (Zador et al, 1996). This is consistent with other evidence that methadone maintenance substantially reduce the relative risk of `overdose' (Caplehorn et al, 1994; Fugelstad et al, 1995).

The two cases (5%) who had recently been released from prison are worthy of attention, the identical proportion to 1992. While not a large proportion of total cases, recently released prisoners may be at an increased risk of overdose due to reduced heroin tolerance.

4.3 *Circumstances of death*

Over a half of fatalities in 1995 occurred in the suburb of Cabramatta. This represents a significant increase from the 15% of fatalities that occurred in Cabramatta in 1992. Cabramatta now represents the focus of heroin-related fatalities in the SWS region. These data confirm other evidence for the emergence of Cabramatta as a major heroin distribution point (Maher, 1996; Waetherburn & Lind, 1995).

Seventy one percent of fatalities occurred in a public setting, most commonly a street environment. Of the deaths that occurred in Cabramatta, 92% occurred in a public place. These figures contrast with the SWS data from 1992, in which the majority of deaths occurred in a home environment. The emergence of Cabramatta as a distribution point would appear to be changing the locations of fatalities. Many heroin users who travel to SWS (and Cabramatta in particular) to obtain heroin appear to be using the heroin soon after purchase. As they do not live locally, their injection, and possible overdose, is likely to occur in a street environment. It should be noted that street injecting has been related to a higher risk of non-fatal overdose (Klee & Morris, 1995). This trend may, in part, be responsible for the increased number of heroin-related fatalities in SWS.

Nearly a half of cases died with no-one else present. Of the 26 cases who died alone, 14 died in Cabramatta and all these died in the a street. It is clear from these data that a high risk behaviour of purchasing heroin and using in a street environment, often with no-one else present in settings such as carparks, has emerged.

In 80% of cases no intervention occurred prior to the death of the person. An ambulance was called prior to death in only 16% of cases. Even in the 15 cases where others were present, no intervention occurred in 7 cases. Of concern is the fact that the proportion of cases in which no intervention occurred prior to death was significantly higher in 1995 than in 1992. This may reflect the increase in the number of street deaths, and the corresponding reduction in the proportion of deaths in a home environment. It should be noted that recent research has indicated that heroin users present at an overdose are reluctant to call ambulances, primarily for fear of police involvement (Darke et al, 1996b). As the 1995 data indicate, even when the opportunity for intervention exists, it is not always exercised.

The fact that the route of final heroin administration was by injection in all cases in both 1995 and 1992 is of potential clinical significance. The smoking of heroin has gained in popularity in the SWS region in recent years, a behaviour previously rarely reported (Maher, 1996; O'Brien et al, 1996). It has been suggested that smoking may be a less dangerous route of administration because the drug effect is achieved by repeated small doses rather than a single injection (Grund, 1993). The data from SWS are consistent with this assertion.

4.4 *Toxicological findings*

The median blood morphine concentration among SWS heroin-related fatalities in 1995 was more than twice the corresponding figure for 1992. This increase in blood morphine concentration may reflect the increase in heroin purity that has occurred in this period, particularly in the SWS region. The increase in blood morphine concentration is unlikely to be due to an increased frequency of injecting of heroin. Recent data from SWS indicate that heroin injection patterns have not changed significantly over time (O'Brien et al, 1996). The increase would also not appear to be due to interactions with alcohol, as the proportions of cases in which alcohol was detected in both years was almost identical. It should be noted that there was no correlation between estimated elapsed time between death and autopsy, and blood morphine concentrations.

While there had been an increase in the blood morphine concentration, the majority of heroin-related fatalities in the SWS region in 1995, and in 1992, involved other drugs in addition to morphine. The most commonly detected drug other than morphine in both these years was alcohol, found in approximately a half of cases. There was a significant negative correlation between blood morphine concentrations and blood alcohol concentrations, with higher alcohol concentrations being associated with lower morphine concentrations. In fact, the median blood morphine concentrations of cases in which alcohol was detected was a half that of cases in which alcohol was not present (0.26mg/L v 0.55mg/L). These results are consistent with those reported both in Australia (Zador et al,

1996) and the United States (Ruttenber, 1984; Ruttenber et al, 1990). Alcohol continues to play a major role in SWS heroin-related deaths.

4.5 *Conclusions*

A large increase has occurred since 1992 in the number of heroin-related deaths in SWS, and higher concentrations of morphine are being detected. Cabramatta has clearly emerged as a focal point of these fatalities. The patterns of these fatalities also appears to be changing, with more deaths occurring in public settings, and fewer interventions occurring prior to death. Heroin-related fatalities in SWS represent a growing, and changing problem. The extent to which these trends are specific to SWS, or reflect trends statewide, is unclear.

Interventions to encourage heroin users to call ambulances at overdoses appear necessary in light of the data. The dangerous, and apparently increasingly common, practice of street injecting also clearly requires attention. Finally, messages about the dangers of the concomitant use of heroin with drugs such as alcohol need reinforcing. Interventions designed to prevent heroin-related fatalities in SWS must take into account of the changing patterns of heroin-related fatalities in SWS.

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