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Estimating the number of current regular heroin users in NSW and Australia 1997-2002

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EXECUTIVE SUMMARY

Problems related to heroin use, such as dependence, blood borne virus transmission, premature death from overdose and crime, negatively affect the community in ways that are disproportionate to the relatively small proportion of Australian adults who are dependent on heroin. An important question to ask (and answer) is therefore: how many people use heroin? Such an exercise was undertaken in 2000, when Hall and colleagues estimated the population prevalence of opioid dependence using 1997/1998 data.

In recent years, however, we have seen significant changes in the heroin market in Australia. Early in 2001, anecdotal reports were received of a sharp reduction in the availability of heroin. These reports were initially confirmed by research in convenience samples (Day et al., 2003; Weatherburn, Jones, Freeman, & Makkai, 2001), and later confirmed in the monitoring systems that had documented the increasing heroin availability during the previous five years (Darke, Topp, Kaye, & Hall, 2002; Topp et al., 2002). A common issue for consideration has been the extent to which changes in the availability of heroin may have impacted upon the number of persons using the drug. This report seeks to examine which methods for estimating the number of heroin users are most appropriate to use when the numbers of heroin users may be rapidly changing in response to marked changes in availability of their drug of choice.

Achieving this aim is not simple. Making estimates of a hidden population, such as heroin users, is difficult for a range of reasons in the best of circumstances. Added to these difficulties are complications introduced by marked changes in drug supply.

Given the illegal and stigmatised nature of heroin use, it is not a simple task to estimate the number of dependent heroin users in Australia. There are no widely accepted "gold standard" methods for estimating the size of this "hidden population". The favoured strategy is to apply a variety of different estimation methods of varying validity to different data sources, looking for convergence in the estimates. We carried out an evaluation of data sources used to produce estimates of the number of heroin users, and of methods that might be able to measure the size of this population during relatively short periods (i.e. annually).

Aims

The aims of the current study were to:

1. Make annual estimates of the number of current regular heroin users in Australia and NSW, between 1997 and 2002;
2. Calculate population rates; and
3. Estimate the size of this population according to age and gender.

The evaluation of methods used is contained in Degenhardt et al (2004).

Results

Estimates were generated from secondary analyses of existing databases. We made estimates of the number of *current regular heroin users*. The number of opioid dependent persons in total is likely to include the number of persons maintained upon opioid pharmacotherapy as well as our estimates of the number of regular heroin users. The data sources that were used in the current study included:

1. national data on the number of opioid induced deaths per year compiled by the Australian Bureau of Statistics;
2. data on ambulance attendances at suspected drug overdoses provided by the NSW ambulance service;
3. the NSW Health Department's heroin pharmacotherapy client database provided by the Pharmaceutical Services Branch (PSB);
4. data on arrests for drug offences provided by the NSW Police Service.

Clear increases in the scale of harms related to heroin use were documented in the latter half of the 1990s, with sharp reductions from 2001. These changes were relatively consistent across the data sources examined, with the exception of the *total* number of persons in opioid pharmacotherapy, which has steadily increased over time as new heroin dependent persons have entered treatment, and others have remained stabilised on it.

There has been a significant drop in the estimated number of current, regular heroin users in NSW (Table A). This drop was sustained in 2002. Detailed estimates of the number in NSW and in Australia, as well as stratification by age and gender, are provided in the companion report (Degenhardt et al., 2004).

Table A: Median estimates and range of the number of current regular heroin users in NSW, 1997-2002

	1997	1998	1999	2000	2001	2002
Median	**35,300**	**48,000**	**48,200**	**43,900**	**22,100**	**19,900**
Lower limit of range	*25,500*	*42,900*	*41,800*	*35,600*	*16,600*	*17,800*
Upper limit of range	*39,200*	*52,400*	*61,100*	*52,300*	*36,500*	*41,900*
Number in pharmacotherapy	11,304	11,987	12,400	13,363	14,381	14,790

Table B shows estimated rates (per 1000 persons) of current, regular heroin use in Australia. Clearly, there was an estimated decrease in the extent of current regular heroin use across all age and gender categories. The decreases appeared to be a little more marked for younger persons.

Table B: Estimated number of regular heroin users per 1000 persons in Australia by age and gender, 1997-2002

	1997	1998	1999	2000	2001	2002
Age						
15-24	9.6	12.1	12.7	11.3	5.2	4.2
25-34	11.0	15.9	15.3	14.0	7.0	6.3
35-44	6.5	8.8	8.7	7.6	4.1	3.9
45-54	1.7	2.1	2.1	2.4	1.2	1.5
Gender						
Males	10.8	14.9	14.7	13.3	6.2	5.9
Females	4.0	5.0	5.0	4.5	2.7	2.1
Total	**7.4**	**10.0**	**9.9**	**8.9**	**4.4**	**4.0**

These estimates do not necessarily imply a similar reduction in the number of *opioid dependent* people. There has been an increasing number of persons in pharmacotherapy in NSW; in 2002, almost 15 000 persons were in pharmacotherapy for opioid dependence (Table A).

Discussion

The changes we estimate to have occurred were driven by reductions in heroin supply. They were *not* driven by changes in demand for heroin – injecting drug users and key informants from drug monitoring systems and studies conducted since the heroin shortage have both confirmed that users wanted heroin but were finding it difficult to obtain (Breen et al., 2003; Day et al., 2003). It seems reasonable to assume that when the availability of heroin increases again, the number of persons engaging in regular heroin use is likely to increase. Thus, although the heroin shortage has reduced the harms related to heroin use, we should not expect these lower levels of harm to be maintained if or when supply returns *and* heroin use increases.

Despite the difficulties in estimating numbers of users following an abrupt onset of a heroin shortage, the multiple methods used suggested that there has been a reduction in regular heroin use in the community. Some of these users probably moved to using other drugs, but if they did, it did not appear to be to a degree that fully offset the reduction in the number of regular heroin users. It remains to be seen how many of the heroin users who have entered opioid maintenance and other treatment return to heroin use if or when heroin supply improves again.

1. INTRODUCTION

Heroin (diacetylmorphine) is produced from the opium poppy, *Papaver somniferum*. Opiates such as morphine, opium and codeine are all natural derivatives of the opium poppy, whereas methadone and pethidine are synthetically produced opioids.

The use of opiate drugs has a long history in Australia (McCoy, 1980). Concern about the use of heroin began to rise in the 1980s, following an apparent increase in heroin related harms such as overdose deaths. Political concerns about the visibility of heroin use and property crime committed by dependent heroin users led to a Special Premiers' Conference that launched a National Campaign Against Drug Abuse (NCADA), with additional Federal funding for drug programs. Despite increased funding for treatment and harm reduction, the heroin market in Australia – and its related harms - increased. The increase began in the early 1990s, but was particularly marked in the mid 1990s, when national illicit drug monitoring systems were established (Fry & Topp, 2002; Shand, Topp, Darke, Makkai, & Griffiths, 2003).

Data from these monitoring systems indicated that during the mid to late 1990s, heroin was the drug injected most often in Australia (MacDonald, Robotin, & Topp, 2001). In six jurisdictions drug market participants reported that heroin was consistently available (Darke, Hall, & Topp, 2000); the purity of heroin was relatively high; and the price of heroin either remained stable or decreased every year.

Early in 2001, anecdotal reports began to be received of a sharp reduction in the availability of heroin across Australia. These reports were initially confirmed by research in convenience samples (Day et al., 2003; Weatherburn et al., 2001), and later confirmed in the monitoring systems that had documented the increasing heroin availability during the previous five years (Darke et al., 2002; Topp et al., 2002). Greater detail on the causes, course and consequences of the reduction in heroin supply will be provided in 2004, with the publication of a report from an 18 month study of the issues by researchers from in NSW, Victoria and South Australia (Degenhardt & Day, 2004; Degenhardt, Day, & Hall, 2004; Dietze et al., 2004; Harrison, Christie, Longo, Pointer, & Ali, 2004). It was clearly documented that the frequency of heroin use declined during

2001 even among regular heroin users who had previously reported that heroin was readily available (Topp, Day, & Degenhardt, 2003). Thus, the period 1997 to 2002, the period of interest for this report, was characterised by a period of increasing heroin availability in 1997-2000, followed by a sharp and sustained reduction in availability from 2001.

This report seeks to examine trends in the number of heroin users over the last 6 years and how the population of heroin users may have changed (or otherwise) in response to the heroin shortage. Work was conducted elsewhere to examine which methods might be best able to capture any immediate, short-term changes in the size of a drug using population (Degenhardt, Rendle, Hall, Gilmour, & Law, 2004). The current report aims to provide estimates of the estimated number of regular heroin users in NSW and Australia, along with breakdowns by age and gender.

As will be outlined below, making estimates of a hidden population, such as heroin users, is difficult in the best of circumstances. Added to these difficulties are complications introduced by marked changes in drug supply. We will briefly discuss some of the issues before presenting the results of the work. Detailed discussion of different estimation methods and their strengths and limitations is provided in the other work (Degenhardt, Rendle et al., 2004).

1.1. Populations of heroin users

Before attempting to make estimates of the number of heroin users, it is necessary to ask the following question: "Which "population" of heroin users do we want to estimate the size of?"

Estimates of the size of such populations have been made previously in both Australia and overseas. In most cases, such estimates have been made during a period where it has appeared that the market conditions have either been relatively stable, or changing in a consistent manner.

The estimates produced have variously defined the population of concern as: "opioid dependent users" or "heroin dependent users" (Hall, Ross, Lynskey, Law, & Degenhardt, 2000a; Law, Lynskey, Ross, & Hall, 2001; National Drug Abuse Data System, 1988; Sandland, 1984, 1986), "problem drug users" (European Monitoring Centre for Drugs and Drug Addiction, 1999), or "injecting drug users" (Duque-Portugal, Martin, & Taylor, 1994; Hser, 1993). In a steady state, the difference between a regular or problematic heroin user, and an opioid dependent person, may be of little import.

Such definitional issues may seem semantic. However, in the context of the rapid decline of heroin availability, it seems important to examine this critically. This is because it may not be the case that all heroin users change their patterns of heroin use in the same way if heroin becomes less available, more expensive and less pure.

1.1.1. Dependent heroin users

Heroin dependence can be defined as the loss of control over heroin use, as indicated by continuing to use heroin in the face of problems that the user knows or believes are caused by its use, including legal difficulties, interpersonal problems and health problems (American Psychiatric Association, 1994). It has been defined as a recurring disorder. Dependent heroin users in Australia typically inject heroin daily or near daily (Bell et al., 1995).

Epidemiological research indicates that substantial numbers of heroin dependent persons do not come to the attention of drug treatment services or the legal system. (Anthony, Warner, & Kessler, 1994; Eisenhandler & Drucker, 1993). Some of these dependent users discontinue their heroin use without professional assistance (Biernacki, 1986; Johnson, 1978). However, dependent heroin users who seek treatment and who come to the attention of the legal system may continue to use heroin for decades (Goldstein & Herrera, 1995; Hser, Hoffman, Grella, & Anglin, 2001; Vaillant, 1988; Vaillant, 1973). Among these chronic users, periods of daily heroin use are interrupted by detoxification, drug treatment and incarceration for drug-related offences. That is, at any point in time, some dependent heroin users may not be using heroin on a daily basis.

1.1.2. Regular heroin users

Research that aims to make indirect estimates of the number of heroin users often uses data such as arrests for heroin possession or use, heroin overdose figures, and numbers in treatment for heroin as markers of current "regular", "dependent" or "problematic" heroin use (see section 1.2). In the context of stable or slowly changing market conditions, it may be reasonable to assume that the population of dependent heroin users is broadly similar to the population of regular heroin users; that is, many or most heroin dependent heroin users will also be regular heroin users (since regular or recurrent heroin use is one feature of dependence).

It is less clear what we might expect when there is an interruption to heroin supply in a community. Will *all* dependent heroin users continue to use heroin on a regular basis? Will they switch to using other drug types? Will they cease heroin use? Further, if some users cease heroin use, would it be a temporary or permanent change in use patterns? In the current report, we attempt to estimate the number of regular heroin users across time, and discuss the findings in the light of other evidence on drug use patterns in NSW.

Indicators that reflect *current, active heroin use* may be better able to demonstrate changes over time, especially if it is hypothesised that the number of persons *currently* using the drug may have decreased. Such changes may be relevant to policymakers who are addressing issues related to acute harms related to current use, rather than latent dependence. Indicators that are good reflections (almost by definition) of current use are a) fatal overdoses; b) non-fatal heroin overdoses; c) arrests for heroin offences; and d) *registrations* for heroin treatment (such as opioid pharmacotherapy).

1.1.3. Occasional or "recreational" heroin users

The obstacles to making estimates of the number of regular or dependent heroin use are considerable, but those surrounding accurate estimates of the number of occasional or recreational heroin users are even more difficult to make. Because their heroin use is not frequent, these persons are unlikely to come into contact with treatment or law enforcement agencies.

It is therefore necessary to make some assumptions about the ratio of regular to occasional heroin users. This can be done to some extent through examining previous research involving heroin users who did and did not use heroin on a "regular" basis. Heroin use in this population of users would be expected to be most responsive to the heroin shortage. Previous estimates indicate that these users account for a small proportion (between 5-15%) of all heroin consumed (Hall, Ross, Lynskey, Law, & Degenhardt, 2000b), and probably even less during a heroin shortage.

1.2. Methods of estimating the number of heroin users

There are substantial technical difficulties in estimating the number of heroin users in Australia or in any other population. In most developed societies, heroin use is illegal and a stigmatised activity that is practiced in private by consenting adults who prefer others not to know about their behaviour. For this reason and a range of others, survey data are *not* good methods to examine the prevalence of heroin use (Degenhardt, Rendle et al., 2004).

There are no well tested and widely accepted "gold standard" methods for producing credible estimates of the number of people who make up the "hidden population" of heroin users (Hartnoll, 1997). The preferred strategy is to look for convergence in estimates produced by a variety of different methods of estimation (European Monitoring Centre for Drugs and Drug Addiction, 1997, 1999). In view of the difficulties associated with direct estimates such as surveys (refer Degenhardt et al (2004)) this study will concentrate on indirect estimates of regular heroin users, as currently there are not any reliable direct estimation methods that can be applied to Australia.

Further, unlike previous estimates of the number of heroin users in Australia (Hall, 1995; Hall et al., 2000b; Heather & Tebbutt, 1989; National Drug Abuse Data System, 1988) where the rate of change of the number of heroin users was relatively small, the current estimate is being made for a period in which there was an uncharacteristically large and sustained decrease in the level of various indicators of heroin use following the external shock of the heroin shortage (see Figure 13, (Degenhardt, Rendle et al., 2004) for further details). The rapid changes in the number of heroin users means that some methods of

estimating the number of users may be less reliable than they would have been in periods of less rapid change, because many of these methods assume a steady state or a constant change in the population size over the period for which an estimate is to be provided.

1.2.1. Indirect estimates: Multiplier methods

A simple way to estimate the number of regular heroin users in the population is to multiply the number of known heroin users in some accessible population (e.g. persons who have died from an opioid overdose) by a factor that reflects the probability a regular heroin user will be a member of that subpopulation (e.g. the proportion of heroin users who overdose in a given year) (Frischer, 1998);(Kraus et al., 2003). The multiplier method is easy to understand and requires very little data. Further, it begins with a count of the number of persons who one can be reasonably confident are regular heroin users (e.g. persons dying from opioid overdoses) (Hall et al., 2000b).

The method nonetheless has its limitations (Frischer, 1998). First, multiplier methods presuppose that we know the probability that a regular heroin user will be in the sample. This may be estimated from a) information collected on a subsection of the population of heroin users (e.g. a cohort of heroin users) (Frischer, 1998); or b) the implied probability calculated from other estimates of the total number of heroin users (Hall, 1995). Second, the probability may not remain constant over time, and may not be the same in different countries or regions (Frischer, 1998; Hall et al., 2000a). Third, the multiplier method assumes that the number of heroin users in the sample is known (e.g. the number of persons dying from opioid overdoses), and is therefore dependent upon the accuracy of recording and identification practices, which themselves may change over time (Frischer, Hickman , Kraus, Mariani, & Wiessing, 2001; Kraus et al., 2003).

Despite these limitations, multiplier estimates based on mortality (Frischer, 1998; Hartnoll, 1997; Hartnoll, Lewis, Mitcheson, & Bryer, 1997) and treatment data (Hall et al., 2000b) have often produced estimates that have been consistent with estimates produced by other methods, such as, capture-recapture methods. They also have the advantage that they produce methods that reflect the immediacy of the data on which they are based and so are able to reflect rapid changes in the number of heroin users.

In this study, multiplier estimates derived from different sources (fatal opioid overdoses, non fatal opioid overdoses, pharmacotherapy registrations and heroin arrests) form the primary estimates of regular heroin use.

1.2.2. Indirect estimates: Capture-recapture methods

The capture-recapture method for estimating a population size was developed in population biology where it has been used to estimate the numbers of fish and other animals in wild populations. Capture-recapture methods have been used to estimate the number of problem drug users, both using two different data sources that capture problem drug users (Duque-Portugal et al., 1994; Kehoe, Hall, & Mant, 1992) and repeated samples from the same source ((Hall et al., 2000b; Sandland, 1984, 1986); Refer to (Degenhardt, Rendle et al., 2004) for further details).

In view of the rapid changes in the number of regular heroin users that occurred in the period 1997-2002 (see results), estimates of regular heroin users derived from the capture-recapture method have not been included in the primary analysis, but have been used to confirm the reasonableness of the primary estimate. (Refer to Degenhardt et al (2004) for more a more detailed explanation of the method and its limitations).

1.2.3. Indirect estimates: Back projection methods

The back-projection method (De Angelis, Gilks, & Day, 1998; Law et al., 2001) has been applied to two indicators of regular heroin use, the number of fatal opioid overdoses and the new entrants to pharmacotherapy treatment, to derive past and current estimates of heroin use that are consistent with each other and broadly consistent with estimates derived from other sources (Hall et al., 2000a; Law et al., 2001). Although the back projection method can detect increasing and decreasing trends over a 2-3 year period (Law et al., 2001), it is less able to reflect rapid changes over shorter time periods ((Law et al., 2001) In view of the rapid changes in the number of regular heroin users that occurred in the period 1997-2002 (see results), estimates of regular heroin users derived from the back projection method have not been included in the primary analysis, but have been used to confirm the reasonableness of the primary estimate (refer Degenhardt et al (2004) and Law et al (2001) for a more detailed discussion of the limitations of back projection estimates).

1.3. Aims

The aims of the current study were to:

1. Make annual estimates of the number of current regular heroin users in Australia and NSW, between 1997 and 2002;
2. Calculate population rates; and
3. Estimate the size of this population according to age and gender.

We discussed above some of the definitional issues that need to be remembered in any study of this nature. We are making estimates of the number of current, regular heroin users. In a time of relative stability or slow change in heroin supply, the current, regular heroin using population is probably roughly equivalent to the population of dependent heroin users. It is not as clear how these populations might compare when *active* heroin use may change for a period (if dependent heroin users returned to heroin use after that time). To make these indirect estimates, we have used data sources that have been used previously in such estimation exercises: opioid induced deaths; non-fatal heroin overdoses; arrests for heroin offences; and registrations for opioid pharmacotherapy.

2. METHOD

The data sources that were used in the current study included:

1. National data on the number of opioid induced deaths per year compiled by the Australian Bureau of Statistics;
2. Data on ambulance attendances at suspected drug overdoses provided by NSW Health;
3. The NSW Health Department's heroin pharmacotherapy client database provided, from the Pharmaceutical Services Branch (PSB), NSW Health; and
4. Data on arrests for drug offences provided by the NSW Police Service (arrest data).

Population estimates were obtained from the ABS estimates of the resident population in the mid point of each calendar year.

The above data sources were examined for trends in numbers, gender and age distribution. The study focussed on data pertaining to individuals aged 15-54 years. The age range was selected on the basis of previous analyses of illicit drug mortality (English et al., 1995) and trends in opioid overdose deaths in Australia (Degenhardt & Barker, 2003), which suggest that most heroin use and opioid overdose deaths occur among adults within these age groups. The use of a focussed age range also eliminated other (opioid) drug related incidents associated with the elderly.

Using the above data sources, a number of annual estimates of the number of regular heroin users (aged 15-54) in NSW were made for each of the 6 years, in the period 1997 to 2002. The specific methods used are set out below. For each year, the different annual estimates were combined to produce a median estimate and range of estimates. Australian and jurisdictional estimates were made using the NSW estimates as described below.

2.1. Opioid induced deaths

Data were obtained from the Australian Bureau of Statistics (ABS) for each Australian state on gender and age at death for fatal ICD-10 classified opioid induced deaths (including heroin, opium, methadone and codeine) among Australian adults aged 15-54 years, between 1964 and 2002 inclusive (see Degenhardt et al (2004) for further details of the ABS data and classifications included). The switch from ICD-9 to the ICD-10 classification system for causes of death in 1997 led to a 12% increase in the estimated number of opioid overdose deaths compared estimates generated under the ICD-9 system (Barker & Degenhardt, 2003). This increase was included in the rise in opioid overdose deaths for 1997, and would not have affected changes in estimates across this study period.

2.1.1. Estimates produced

Multiplier estimate

In this study, we have used a multiplier of 112.5, which is the average of the two multipliers of 100 and 125 previously adopted by Hall et al (2000) to estimate the number of regular heroin users from the number of fatal opioid overdoses (See Degenhardt at al (2004)).

Confirmatory back projection estimates

The annual number of opioid overdose deaths in Australia for individuals aged 15-54 for the period 1964 and 2002 was used to estimate the number of regular heroin users in Australia by the back-projection method (Hall et al., 2000b; Sandland, 1986). The Australian, rather than NSW figures were used because the number of NSW fatal overdoses was small, particularly in the early years. Estimates for NSW were derived by multiplying the national estimates by the average proportion of fatal overdoses that occurred in NSW between 1997 and 2002 (further details in Degenhardt et al (2004).

2.1.2. Limitations

In this study, some of the concerns about the limitations of multiplier estimates were lessened. The multiplier used in this study was the midpoint of multipliers that were recently validated by the Hall et al, (2000) study, as being appropriate to apply to the number of fatal opioid overdoses to estimate regular NSW and Australian heroin users, as they produced estimates of regular heroin users that were consistent with estimates derived using other data and sources. Nevertheless there have been changes in classification of opioid related deaths, and in the purity and availability of heroin during the study period, which could lead to changes in the multiplier. The limitations of the back projection estimates are set out in Degenhardt et al (2004).

2.2. Ambulance calls to suspected heroin overdoses

The Ambulance Service of NSW provided data on cases where an ambulance attended a person with whom the poisonings protocol was used and naloxone administered ("naloxone ambulance call outs"). Information on the date of each ambulance attendance was obtained for the period from the 1st January 1996 to the 30th December 2002 (refer Degenhardt et al (2004) for further details).

2.2.1. Estimates produced

The ambulance data was used in conjunction with a multiplier of 10.1 derived from the (Hall et al., 2000b) estimate of regular heroin users (see Degenhardt et al (2004)), to provide a multiplier estimate of the number of regular heroin users in NSW.

2.2.2. Limitations

The drug overdose protocol for ambulance call outs includes all drug overdoses and does not distinguish between the different drugs used by the patient. Naloxone may be administered to other patients who have not responded to other treatment. Limiting records to the proportion represented by the 15-54 age group goes some way to reducing the number of individuals who may have had naloxone administered for non-opioid drugs. Nevertheless the ambulance call out records for the age group 15-54 may include cases where naloxone was administered for non-opioid drugs.

The proportion of IDU administered naloxone may vary throughout NSW as identification of drug overdose and the need for treatment is based on the ambulance officers' assessment of the patient at the time of treatment/ transport and whether the ambulance officers are authorised to administer naloxone.

These different parameters contribute to the relationship between the total number of ambulance call outs at which naloxone was administered and the number of regular heroin users. The multiplier was based on the relationship between the 1997/98 figures and the estimated number of heroin users. If the above parameters are substantially different to their 1997/98 level, this could affect the accuracy of using the 1997/98 derived multiplier.

2.3. Heroin arrests

Data were obtained from the NSW police service on all heroin-related arrests in NSW for the period 1995 to 2002. These offences included: possession of drug/plant, use or administration of a drug, possession of a drug utensil, other drug offence, supply of drug/plant, and importing a drug/plant. Each record in the database represents a new offence and an individual may be charged with several offences from one incident. Similarly, several people may be charged for the same incident. All records were de-identified by the police department, but each arrestee had a number that uniquely identified him or her which enabled the number of different charges per individual across the eight-year period to be determined. The variables used were: type of offence (as set out above), date of offence, and age and gender of the offender (refer Degenhardt et al (2004) for further details).

2.3.1. Estimates produced

Multiplier estimate

The arrest data was used in conjunction with a multiplier 20.8 derived from the Hall et al (2000) estimate of regular heroin users (see Degenhardt et al (2004)), to provide a multiplier estimate of the number of regular heroin users in NSW.

Confirmatory capture-recapture estimates

A capture-recapture estimate of the number of regular heroin users using annual capture periods for arrests. The data on arrests for heroin related offences during the years 1996-2002 was used to form 4 four-year blocks of data, starting 1996-1999 and finishing 1999-2002, that were used in a capture – recapture analysis. The estimate derived from each data block was assigned to the second year (the "midpoint") of analysis. Further details of the capture-recapture analysis are provided in Degenhardt et al (2004).

2.3.2. Limitations

The number (and type) of offences that an individual is charged with may reflect policing objectives at the time, in that the police may target particular offences in the short term, as part of their strategies to achieve longer-term goals. For this reason the number of offences may partly reflect changes in policing strategies.

2.4. Opioid pharmacotherapy

We were given access to a subset of the Pharmacotherapy (methadone and buprenorphine) Patient Management Database maintained by the Pharmaceutical Services Branch (PSB) of the New South Wales Health Department (PSB database) for the period 1987 to June 2003. The PSB database is used by the NSW Health Department to monitor dispensing of pharmacotherapy (methadone and buprenorphine) in New South Wales. The data it contains are derived from forms that are completed: when a medical practitioner applies for an authority to prescribe pharmacotherapy to a client, when a course of pharmacotherapy maintenance is terminated, or when a client is transferred to another program.

Records were de-identified by the PSB to maintain client confidentiality, however, individuals were uniquely identified by an arbitrary number assigned by the PSB. The variables used were: date of birth, sex, leaving code (to identify those that did not commence treatment) and the date of treatment entry/exit and number of treatment to identify first time users. All valid records included age and sex data.

The numbers of individuals receiving pharmacotherapy as at 30th June by state for the years 1997 to 2002, and for Australia for the years 1987 to 1996 were also obtained from the Commonwealth Department of Health and Ageing. These figures are based on data supplied by individual states. Thus the estimates of individuals receiving pharmacotherapy in NSW are based on data from the Pharmacotherapy (methadone and buprenorphine) Patient Management Database described above.

2.4.1. Estimates produced

Multiplier estimates

The number of individuals registered for PMT as at June 30, has previously been used as the basis for a multiplier estimate of the number of regular heroin users (Hall et al., 2000b). However, contrary to other indicators of the number of regular heroin users, which suggest that the number of heroin users was higher in 2000 compared to 2001 and 2002 (see results), the number of individuals in PMT in NSW as at June 30 has continued to increase. The continued increase in total PMT registrations is likely to reflect the inclusion of individuals who enter and continue with methadone treatment programs but may not be longer current, regular heroin users. In the current case, the appropriate multiplier to apply to total PMT registrations is likely to change (decline) each year. In the absence of a continuing cohort study of heroin users, this makes it difficult to obtain estimates of the multiplier; however, data from the NSW IDRS are consistent with this, with a higher proportion of those reporting regular heroin use also reporting being in methadone treatment (Roxburgh, Breen & Degenhardt, 2004). It is unclear what the appropriate multiplier might be, however, in the absence of data from less sentinel heroin users than those in the IDRS.

The number of PMT *registrations* (both new and re-registrations) is probably a better reflection of regular heroin users in any given year (see results) and has been used as the basis for a multiplier estimate of regular heroin users. In the absence of reliable and appropriate multipliers, the PMT annual registration data was used in conjunction with a multiplier of 7.6 derived from the Hall et al (2000) estimate of dependent heroin users (see Degenhardt et al, (2004)), to provide a multiplier estimate of the number of regular heroin users in NSW.

Confirmatory capture-recapture and back projection estimates

PMT data was used as the basis for a capture-recapture estimate of the number of regular heroin users. The data on individuals entering PMT programs during the years 1997-2002 was used to form 4 four year blocks of data, starting 1996-1999 and finishing 1999-2002. The estimate derived from each data block was assigned to the second year (the "midpoint") of the four year analysis. Further details of the capture-recapture analysis are provided in (Degenhardt, Rendle et al., 2004).

The number of new entrants to PMT in NSW for each year during 1970 to 2002 was used to estimate the number of regular users in NSW and Australia using the back-projection method (Hall et al., 2000b; Sandland, 1986). The number of new entrants to PMT for the period 1970 to 2002 was used to estimate the number of people who became regular users in any year. The method used estimates of the rate at which people progress from regular heroin use to entering PMT. Further details of the back projection analysis are provided in (Degenhardt, Rendle et al., 2004).

2.4.2. Limitations

The number of PMT registrations may at times be partly determined by the funds allocated to PMT, both at an overall state level and at a more local level rather than the demand. In that in some years not all users who would like to undertake pharmacotherapy may have easy access to treatment. Thus the increase in PMT registrations may at times reflect increases in funding rather than changes to the numbers of underlying users.

2.5. Estimates

2.5.1. NSW estimates

The estimate of regular heroin users aged 15-54 in NSW for each of the years 1997-2002 was calculated as the median of the multiplier estimates of regular heroin users aged 15-54 derived as described above. See Degenhardt et al. (2004) for greater detail if required.

2.5.2. Australian estimates

There were three potential sources of Australia wide state data that could have been used to make national estimates of regular heroin users: fatal opioid overdoses, opioid arrests, and pharmacotherapy numbers. We evaluated all three data sources and decided to use opioid overdoses, since they were least affected by operational or funding differences across jurisdictions (see Appendix C for further detail).

2.5.3. Demographic breakdowns

The issues associated with estimating the demographic splits of estimated numbers of regular heroin users are similar to those for making the estimates themselves. There is no a priori reason to favour one of the data sources used in this report over the others as being more demographically representative than the others. Accordingly all four sources have been used to derive a median estimate of age and gender breakdowns of NSW and Australian regular heroin users.

The NSW and Australian estimates of regular heroin users aged 15-54 were allocated into four 10 year age groups as follows. The percentage age split across the four ten year age groups (15-24, 25-34, 35-44, and 45-54) was calculated for each data source (fatal opioid overdose, heroin arrests, naloxone ambulance call outs, and the number of PMT registrations) for each of the years 1997-2002. The median percentage of the total records from each data source was calculated for each 10 year age group by year, so as to provide a median distribution profile across the four age groups for each year. Where necessary, the median percentages adjusted pro rata so that they summed to 100%. The median distribution profile was then applied to the annual NSW and Australian estimates

of regular heroin users to provide an estimate of the number of regular heroin users in each of the four age groups for each year.

The gender split of the NSW and Australian estimates of regular heroin users was calculated in a similar manner to the age split described above. The percentage of males in the group of individuals aged 15-54 was calculated for each of the four data sources for each year and from these the median male percentage was calculated for each year. The median male percentage was applied to the NSW and Australian estimates of regular heroin users for each year to estimate the number of male regular heroin users aged 15-54 for each year in NSW and Australia. The estimate of the number of female regular heroin users was calculated as the difference.

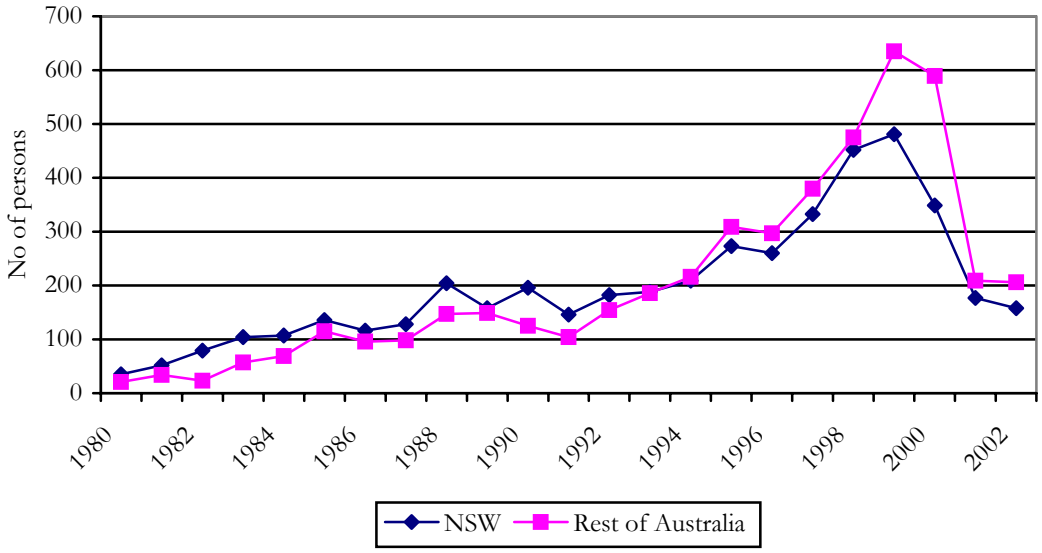
3. RESULTS

3.1. Trends observed

3.1.1. Opioid induced deaths

The number of deaths attributed to opioids among Australian adults aged 15-54 years increased from 56 in 1980 to a peak of 1116 in 1999 (Figure 1). After this point, there was a decline in opioid deaths to 364 in 2002. A similar pattern occurred in NSW, with deaths increasing from 35 to 1980 to a peak of 481 in 1999, declining 158 in 2002. The rate (per million adults aged 15-54) increased 15 fold for Australia and 11 fold for NSW in the period 1980 to 1999. By 2002, the rate had dropped to 32% of the 1999 value for both Australia and NSW (see Appendix A, Figure A.1).

Figure 1: Number of opioid overdose deaths among persons aged 15-54 years, 1980-2002



The trends in opioid induced death rates per million of population were similar for NSW and the rest of Australia. Throughout the period 1980 to 2002, the rate of NSW opioid overdose deaths per million population consistently exceeded those for the rest of Australia and was an average of 57% above the overall Australian rate. In 2001, the year of largest decline in the period 1980-2002, the number of fatal opioid overdoses dropped by 49% in NSW and 65% in the rest of Australia (see also Table B.7 in Appendix B).

In NSW over the period 1980 to 2002, the average age of opioid overdose death for persons aged 15-54 has tended to increase, trending towards the average age of the NSW total population in the 15-54 year age bracket, and in 2002, exceeding it (see Figure 14). Over this period, the 25-34 age group has accounted for the highest proportion of deaths. However, the proportions represented by the older age groups (35-44 and, to a lesser extent, 45-54) steadily increased over this time (see Appendix A). The increasing number of opioid deaths among those aged 35-44 and 45-54 years suggests that there may have been an increase in the number of persons in this age group who were using opioid drugs.

The proportion of opioid induced deaths occurring among males remained relatively constant, with approximately 80% of deaths occurring among males.

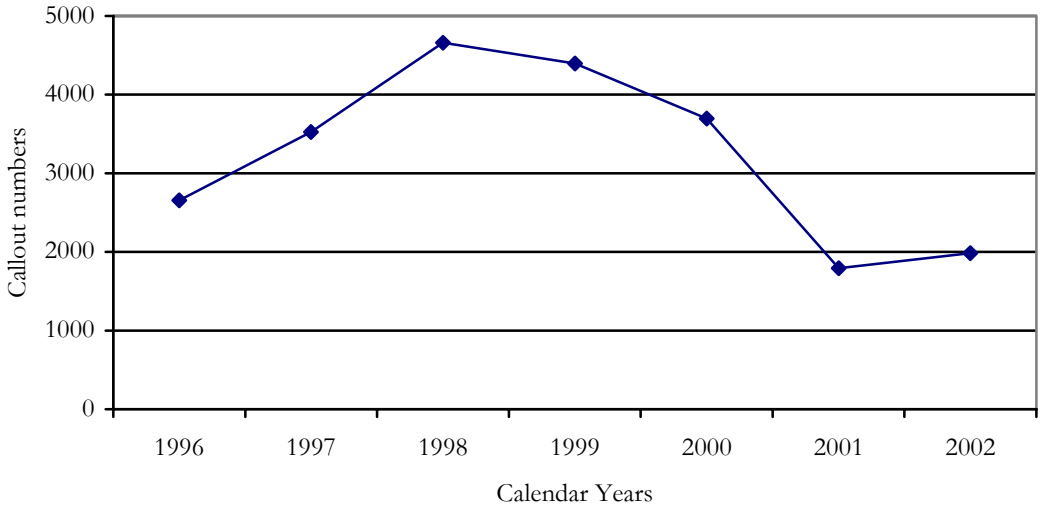
3.1.2. NSW ambulance callouts to suspected heroin overdoses

The number of ambulance callouts to suspected heroin overdoses increased from 2,654 in 1996 to a peak of 4,568 in 1998, declining to 1,793 in 2001 (Figure 3). They remained around this lower level in 2002 (n = 1,983). The number of callouts in 2002 was 25% below the 1997 level and 55% below the peak 1998 level.

Over the period 1996 to 2002, the annual average age of persons receiving ambulance call outs in the age range 15-54 remained between 30-32 years, which was slightly below the NSW average population age in the range 15-54 years (see Figure 7). Throughout the period, the 25-34 year age group consistently had the highest number of call outs and the 45-54 the lowest rate. The percentage of ambulance call outs represented by the different age groups remained reasonably constant.

Throughout the period 1997-2002, males comprised around 69% of ambulance call outs among those aged 15-54 years. In the youngest age group (15-24 years) and the oldest age group (45-54 years) the proportion of males was lower (see Appendix A for further details).

Figure 2: Number of ambulance callouts to suspected heroin overdoses, NSW 1996-2002



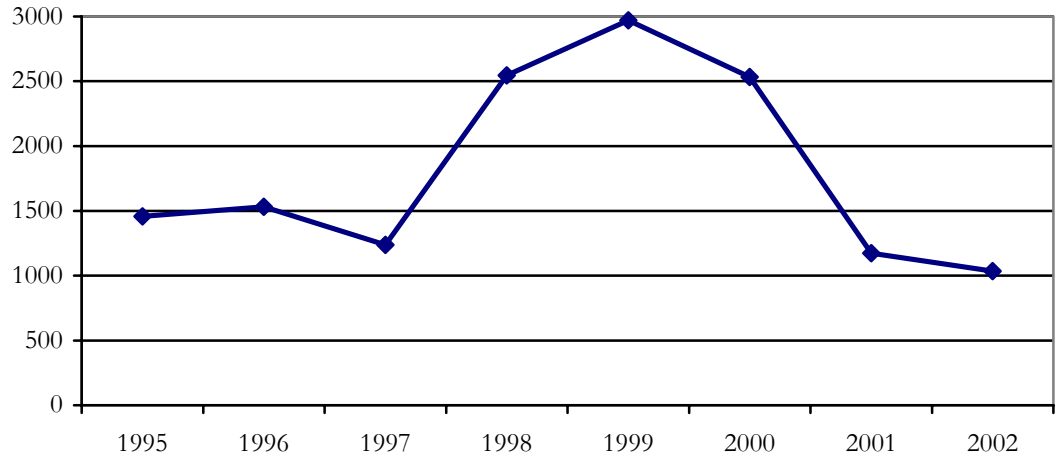
3.1.3. Heroin arrests

Heroin arrests increased sharply between 1997 and 1999, peaking at 4,359 offences per year in 1999, with a decline thereafter (Figure 3). The 2002 level of offences at 1,525 was the lowest level of offences in the 8- year period.

Compared across ten-year age groups, the 15-24 age group represented the highest and the 25-34 age group the second highest percentage of individuals arrested at least once during the period 1995 to 2001 (see Appendix A). In 2002, the 25-34 age group became the group with the highest proportion of individuals arrested, with a decline in the percentage of individuals represented by the 15-24 age group. The percentages represented by the 35-44 and 45-54 age groups both showed a slight increase from 1998, and represented 20% and 6% respectively in 2002.

Across age groups, males comprised around 80% of individuals who were arrested at least once in the year (Appendix A). Throughout the period 1995-2002, there was slightly greater male representation in the 25-34 age group compared to the 15-24 age group.

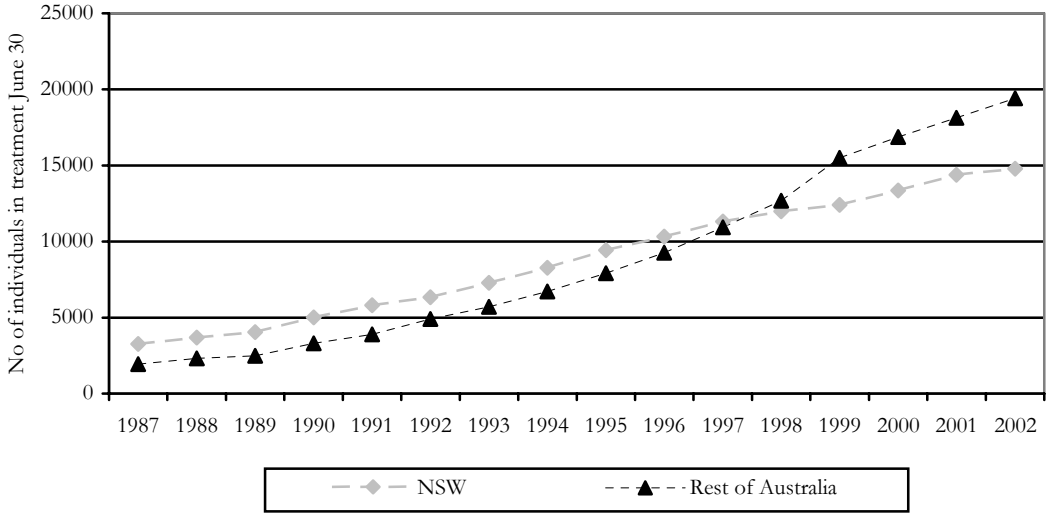
Figure 3: Number of individuals arrested for heroin offences, 1995-2002



3.1.4. Opioid pharmacotherapy

Across the period 1986 to 2002, the number of individuals receiving methadone treatment has steadily increased at both the Australian and NSW levels (Figure 4). As at June 30th 2002, there were 34,210 and 14,790 individuals receiving pharmacotherapy in Australia and NSW respectively. In 1987, NSW accounted for 63% of Australian pharmacotherapy clients; this proportion steadily decreased to 44% in 1999, and has remained around this figure since.

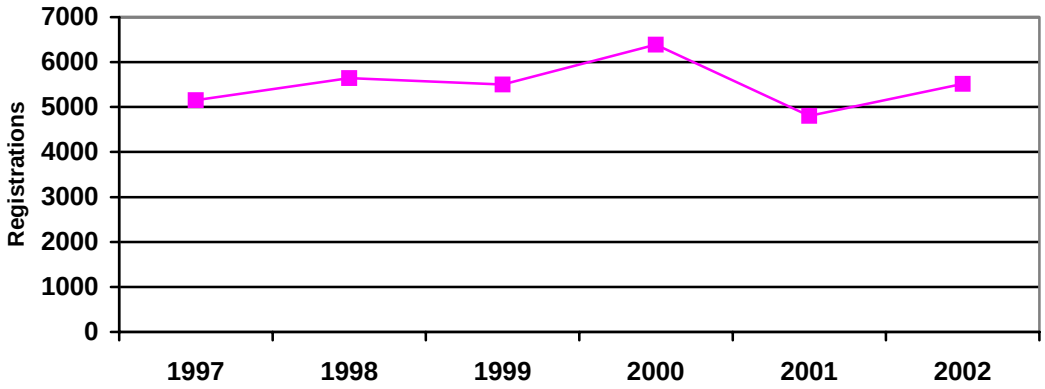
Figure 4: Number of opioid pharmacotherapy clients in NSW and Australia on 30th June, 1987-2002



* Buprenorphine was introduced in 2001

While Figure 4 shows the total number of persons *receiving* opioid pharmacotherapy, Figure 5 shows the number of persons who *registered* for pharmacotherapy each year in NSW. As would be expected, the number registering for this treatment (Figure 5) was smaller each year than the total who received it (Figure 4), since many persons have been receiving pharmacotherapy for some time.

Figure 5: Number of individuals registering for pharmacotherapy by year, NSW



Over the period 1997 to 2002, over 99% of all individuals receiving *and* registering for PMT were aged 15-54 years. The age distribution of individuals registering for PMT was relatively constant, with the 25-34 age group representing just under half (43-44%) of all individuals registering for PMT (see Appendix A). There was a slight trend for the percentage of registrations represented by the two younger age groups (15-24 and 25-34) to decrease and the percentage of registrations represented by the two older age groups (35-44 and 45-54) to increase. This slight trend for an increasing percentage of older participants might reflect the ageing of individuals who are reregistering for PMT (see Appendix A, Figure A.7).

Over the period 1997 to 2002, males consistently represented around two thirds (63-64%) of individuals receiving PMT. There was also a general trend for males to represent and increasing proportion of the individuals receiving PMT with decreasing age groups (see Appendix A, Figure A.8). In 2002, males represented 72% of individuals in the 45-54 age group but only 53% of individuals in the 15-24 age group.

3.1.5. Trends across data sources

Opioid, ambulance and arrest data followed the same broad pattern over the period of concern, particularly during the decline phase. The number of individuals registering for pharmacotherapy, in contrast, showed a less marked decline (Figure 6).

Figure 6: Numbers of overdoses, arrests and persons registering for treatment relative to 1999 levels

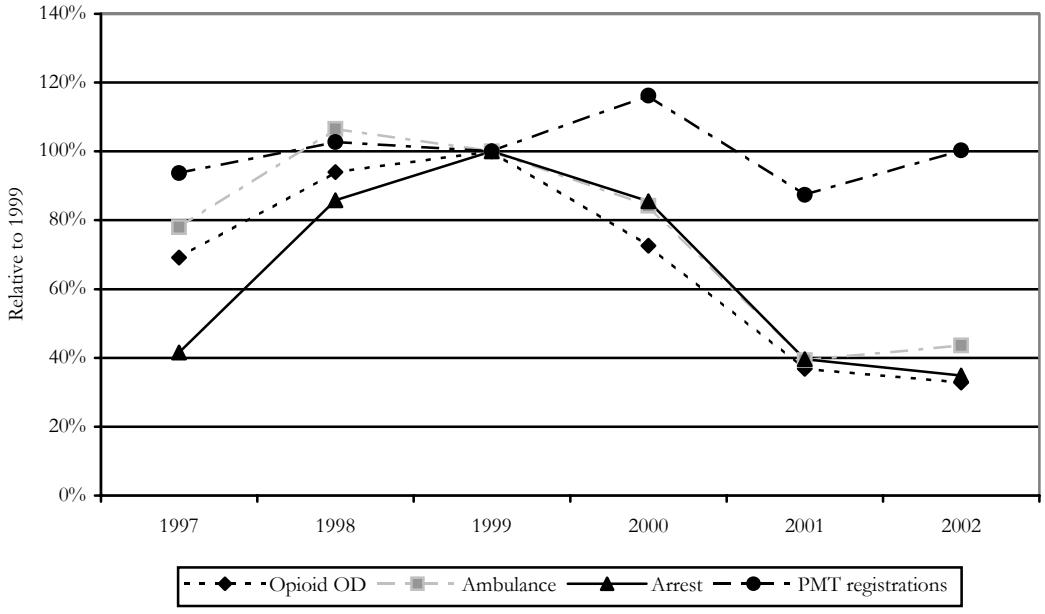


Figure 7 shows that persons arrested for heroin offences were, on average, the youngest group. Over the six years, however, all data sources showed a trend towards increasing average ages.

Figure 7: Average age of individuals in each data source compared with the average age of the NSW population among those aged 15-54 years, 1997-2002

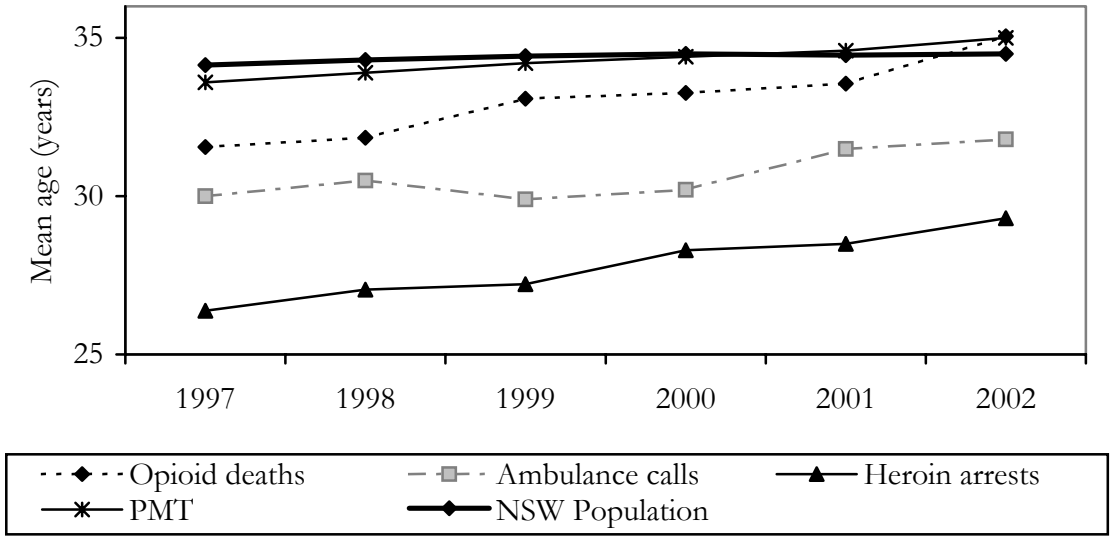


Figure 8 shows that males were most highly represented among persons who were arrested for heroin offences, and among those dying from opioids. All data sources had higher proportions of males than the NSW average.

Figure 8: Percentage of males in datasets, NSW 1997-2002

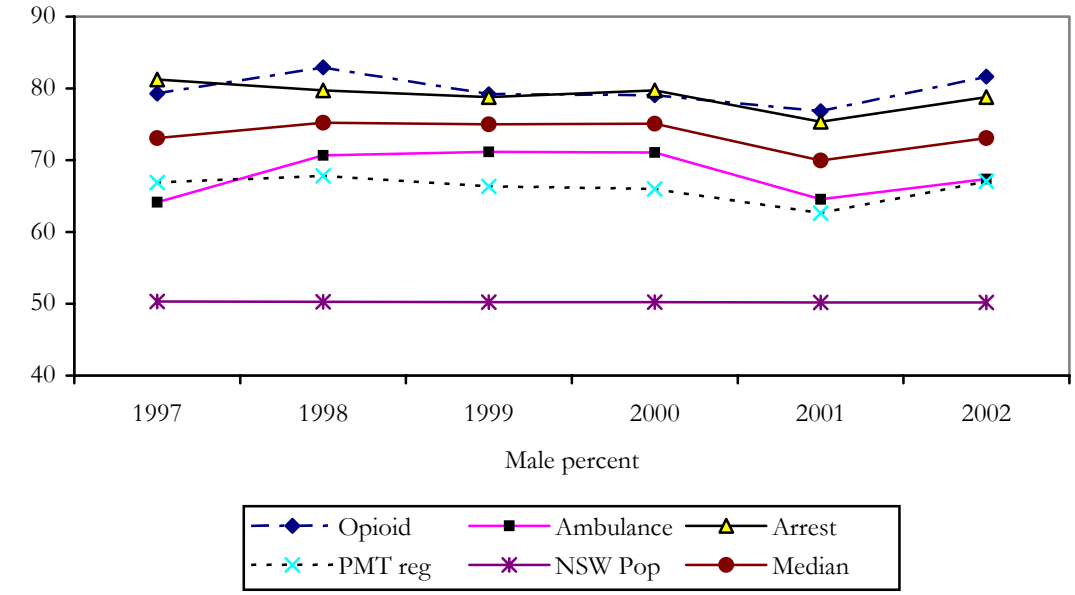


Table A.2 in Appendix A sets out the average age and gender split of the four data sources.

3.2. Estimates produced

Figure 9 sets out the multiplier estimates of NSW regular heroin users derived from different sources, together with the median of the estimates (see also Appendix B and Degenhardt and colleagues, 2004). These show an increase from 1997 until 2001, when there was a sizeable decrease in the estimated number of active, regular heroin users in NSW. The median estimate in 2002 suggested that this lower number was maintained through 2002 also.

Figure 9: Multiplier estimates of regular heroin users in NSW, 1997 to 2002

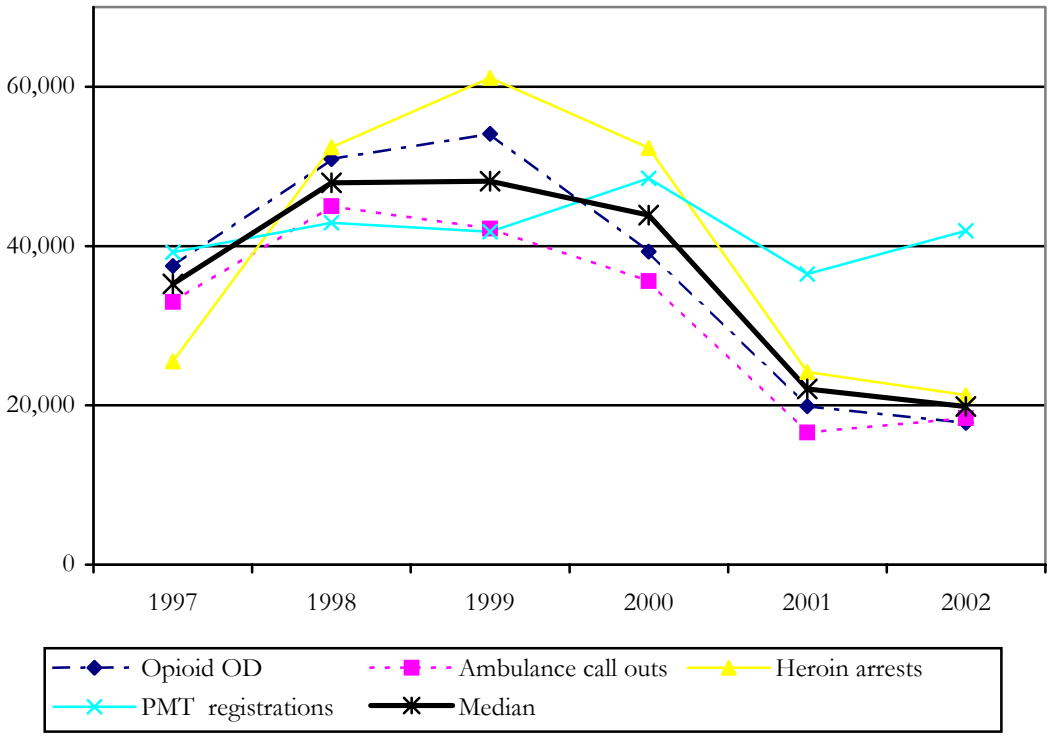


Table 1 shows the estimated median number of current, regular heroin users by age and gender. These breakdowns were derived from all data sources used, to ensure maximum validity of the breakdowns used (see Methods section for further detail).

Table 1: Median estimates of the number of current regular heroin users in NSW by age and gender, 1997-2002

	1997	1998	1999	2000	2001	2002
Age						
15-24	11,300	14,200	15,000	13,500	6,300	5,100
25-34	14,000	20,200	19,500	17,900	9,000	7,900
35-44	8,200	11,300	11,300	9,800	5,300	5,100
45-54	1,800	2,300	2,400	2,700	1,400	1,800
Gender						
Males	25,800	36,100	36,100	33,000	15,500	14,500
Females	9,500	11,900	12,100	10,900	6,600	5,400
Total [1]	**35,300**	**48,000**	**48,200**	**43,900**	**22,100**	**19,900**
Lower range	25,500	42,900	41,800	35,600	16,600	17,800
Upper range	39,200	52,400	61,100	52,300	36,500	41,900

1. Note that components have been rounded to the closest 100 and hence may not sum to the total.
2. These estimates derived from the median multiplier estimate.

Table 2: Estimated number of current regular heroin users per 1000 persons in NSW by age and gender, 1997-2002

	1997	1998	1999	2000	2001	2002
Age						
15-24	12.9	16.4	17.4	15.6	7.2	5.7
25-34	14.5	20.9	20.2	18.4	9.2	8.1
35-44	8.5	11.5	11.4	9.8	5.3	5.1
45-54	2.2	2.8	2.8	3.1	1.6	2.0
Gender						
Males	14.2	19.7	19.6	17.7	8.2	7.7
Females	5.3	6.6	6.6	5.9	3.5	2.9
Total	**9.8**	**13.2**	**13.1**	**11.8**	**5.9**	**5.3**

Table 3: Median estimates of current regular heroin users in Australia by age and gender, 1997 to 2002

	1997	1998	1999	2000	2001	2002
Age						
15-24	25,600	32,200	34,000	30,500	14,300	11,500
25-34	31,600	45,700	44,200	40,500	20,300	18,000
35-44	18,600	25,600	25,500	22,300	12,100	11,600
45-54	4,000	5,200	5,300	6,100	3,300	4,000
Gender						
Males	58,400	81,800	81,800	74,600	35,000	33,000
Females	21,500	26,900	27,300	24,800	15,000	12,100
Total	**79,900**	**108,700**	**109,100**	**99,400**	**50,000**	**45,100**

Table 4: Estimated number of regular heroin users per 1000 persons in Australia by age and gender, 1997-2002

	1997	1998	1999	2000	2001	2002
Age						
15-24	9.6	12.1	12.7	11.3	5.2	4.2
25-34	11.0	15.9	15.3	14.0	7.0	6.3
35-44	6.5	8.8	8.7	7.6	4.1	3.9
45-54	1.7	2.1	2.1	2.4	1.2	1.5
Gender						
Males	10.8	14.9	14.7	13.3	6.2	5.9
Females	4.0	5.0	5.0	4.5	2.7	2.1
Total	**7.4**	**10.0**	**9.9**	**8.9**	**4.4**	**4.0**

Table 5 shows the estimates of the number of regular heroin users by jurisdiction. As noted in the methods section, we have made these estimates based upon the NSW estimate and from the data on opioid induced deaths. It is recommended that other

jurisdictions replicate this research with individual estimates from a number of local data sources.

Table 5: Estimated number of regular heroin users by jurisdiction, 1997-2002

	1997	1998	1999	2000	2001	2002
NSW	35,300	48,000	48,200	43,900	22,100	19,900
Victoria	22,300	30,300	30,400	27,700	13,900	12,600
Queensland	7,800	10,600	10,600	9,700	4,900	4,400
South Australia	4,600	6,300	6,300	5,700	2,900	2,600
Western Australia	6,900	9,400	9,400	8,600	4,300	3,900
Tasmania	1,000	1,300	1,300	1,200	600	500
NT	700	1,000	1,000	900	500	400
ACT	1,300	1,800	1,800	1,700	800	800
Australia[1]	**79,900**	**108,700**	**109,100**	**99,400**	**50,000**	**45,100**

1. State totals have been rounded and so may not sum to the Australian total

Table 6: Estimated number of regular heroin users per 1000 persons aged 15-54 by jurisdiction, 1997-2002

	1997	1998	1999	2000	2001	2002
NSW	9.8	13.2	13.1	11.8	5.9	5.3
Victoria	8.4	11.3	11.2	10.1	5.0	4.5
Queensland	3.9	5.3	5.2	4.7	2.3	2.1
South Australia	5.5	7.5	7.4	6.7	3.4	3.1
Western Australia	6.5	8.7	8.6	7.8	3.8	3.5
Tasmania	3.8	4.9	5.0	4.6	2.3	1.9
NT	5.8	8.2	8.0	7.2	4.0	3.2
ACT	6.6	9.2	9.1	8.6	4.0	4.0
Australia	**7.4**	**10.0**	**10.0**	**9.0**	**4.5**	**4.0**

4. DISCUSSION

The present study has made estimates of the number of regular heroin users when there was a known reduction in the supply of heroin to the drug market. Good evidence suggests that heroin use and harms in the community decreased. Across all of the data examined in this study, marked and sustained decreases occurred in the extent of heroin related harms in the community. The estimates produced by the study suggested that the number of regular heroin users decreased following the reduction in heroin supply, and that this decrease was maintained in 2002.

In the following section, we consider some questions that may be asked of the current findings. These questions largely focus on the following issues: Are the estimates realistic? How could they have been confounded?

4.1. Fewer regular heroin users or less "regular heroin use"?

We need to remember that all of the data used in the current study involves *markers* of heroin use – overdose, arrest, or treatment. One criticism of the current study may be that heroin users reduced the frequency of their heroin use (without ceasing use) such that the probability of being "marked" may have decreased for each user, with no change to the number of regular heroin users per se. In the IDRS, the median days of heroin use among NSW IDU decreased from daily (in 2000) to 158 out of 180 days (in 2001) in the past 6 months (Roxburgh, Degenhardt, & Breen, in press; Topp et al., 2003); the reductions were even more apparent in Victoria, where the median days of use decreased from 176 to 65 days (Jenkinson, Fry, & Miller, 2003). This might have meant, for example, that the likelihood of overdosing decreased (due to fewer occasions of heroin use); or that users were buying heroin less often and therefore were less likely to be caught with heroin on their person.

However, this possibility is not consistent with the pattern of ADIS calls of concern about heroin use: the decrease was just as marked for this source of data as it was for overdose and heroin arrests. Presumably, people would still be concerned about heroin use on 158 out of 180 days, as they would be by daily use.

Furthermore, data from the 2002 IDRS suggested that heroin use among IDU sampled for the study returned to the frequency observed prior to the heroin shortage (Roxburgh, Degenhardt et al., in press; Roxburgh, Degenhardt, Breen, & Barker, 2003). In other words, even though a decrease in frequency *was* noted in 2001 among this group, *it was not sustained in the following year*. Hence, a reduction in frequency of heroin use (and therefore a reduced likelihood of being noted in the data sources used in this study) cannot explain the maintenance of low levels in 2002.

From a conceptual level, too, it would seem that if heroin users reduced their likelihood of being "marked" in these datasets, then some persons they did not meet "criteria" for being marked in such datasets. It must be remembered that the current estimates refer to the number of regular heroin users, that is, people who inject heroin often enough to put themselves at risk of overdosing, being arrested, or needing to enter treatment. If people reduced their risk of overdosing, being arrested or entering treatment, then they were less likely to meet the criteria for inclusion in these datasets. In other words, the estimated decrease in the number of regular heroin users reflected an actual decrease in regular heroin use by people who probably met criteria for opioid dependence in the period before the heroin shortage when heroin was more readily available.

It should be noted that the number of opioid dependent persons may not have changed in such a clear manner. As will be discussed below, continued increases have occurred in the number of persons enrolled in opioid pharmacotherapy. Such persons are heroin dependent persons still receiving treatment. It seems reasonable to conclude that if we were to hazard estimates of the number of *opioid dependent* persons in total, then we would need to add the estimated number of current, regular heroin users to the number receiving opioid replacement therapy.

4.2. Does a reduction in the number of heroin users imply a reduction in overall drug use?

These reductions in heroin use do not imply, however, that all drug use had decreased. There is good evidence that many heroin users used other drugs (both licit and illicit) when heroin became less available.

In NSW, heroin users particularly seemed to substitute cocaine for heroin, although this change did not appear to be sustained, with evidence of reduced cocaine supply in 2002 (Roxburgh, Degenhardt et al., in press). In NSW, there was an increase in the number of younger users seeking treatment for psychostimulants (cocaine and methamphetamine), although the number of people seeking this form of treatment was probably not equivalent to the decrease in the number of people seeking treatment for heroin (Roxburgh, Breen, & Degenhardt, in press; Roxburgh et al., 2003). In Western Australia, Victoria and South Australia, clear increases were observed in methamphetamine use among IDU (Breen et al., 2003).

There was also evidence that some more entrenched heroin users may have increased the injection of benzodiazepines in some Australian jurisdictions such as Victoria and Tasmania (Breen et al., 2003). Furthermore, there was evidence that some substituted other opioids for heroin, such as illicit methadone and morphine, particularly in Tasmania and the Northern Territory. In short, among persons who continued to inject drugs (the population from which IDRS samples are drawn), there was good evidence that IDU used other drugs when heroin became less available (Breen et al., 2003).

Data on how many injecting heroin users may have *ceased injecting* as a route of administration of any drug is much more limited. Suggestive evidence of a decrease in the extent of injecting drug use in the community may be drawn from data on needles and syringes (NSP) distributed; declines in NSP distribution occurred in both NSW and Victoria (Day, Degenhardt, Gilmour, & Hall, in press). Furthermore, since the reduction in heroin supply there has been a decrease in the number of hepatitis C notifications among younger persons in NSW. This would not have been expected if users had merely reduced the number of injections: it has been estimated that the number of injections would have to reduce by a fairly large margin if hepatitis C were to be reduced at the population level. Hepatitis C in Australia is driven by injecting drug use (Dore, Law, MacDonald, & Kaldor, 2003) and heroin injection in particular (MacDonald et al., 2000), so an unexpected reduction in hepatitis C notifications (compared to models of the epidemic (Law et al., 2003)) is consistent with a decrease in the number of injectors (Day et al., in press).

4.3. What does this mean for heroin treatment services?

As we have stated previously, the estimates produced in this study are derived from indirect indicators that are likely to reflect *current regular heroin use*. These numbers will therefore fail to include persons who are receiving treatment for heroin dependence (such as persons in opioid pharmacotherapy) *and no longer use heroin*.

What was clearly shown in this study is that the total number of persons in opioid pharmacotherapy has continued to increase. This number comprises persons maintained on this treatment modality for some time, as well as those who have recently entered treatment. One of the interesting findings of this study was that the total number of persons enrolled in opioid replacement therapy continued to increase during the year after the onset of the heroin shortage. This suggests that the pool of *opioid dependent* persons may not have changed in the same way or to the same extent as the pool of *current regular heroin users*. It also suggests that the need for places in opioid pharmacotherapy has not decreased.

Making any estimates of the extent to which treatment need is being met is fraught with problems. If we conclude that the estimated number of current, regular heroin users has decreased, then it follows that the proportion of the total pool of heroin dependent people in treatment may have increased following the heroin shortage (since total pharmacotherapy numbers have continued to increase). Nevertheless, the fact remains that if we assume that the number of regular heroin users is somewhat distinct from the number who remain in opioid pharmacotherapy, then in 2002, up to an additional 20,000 persons may also have been eligible for pharmacotherapy. In summary, there are more persons who may be eligible for treatment than who are currently receiving such treatment. There appears to be no need to reduce the places available for the treatment of heroin dependence in NSW.

4.4. Will these changes be sustained?

The changes we estimate to have occurred were driven by reductions in heroin supply. They were *not* driven by changes in demand for heroin – injecting drug users and key

informants from drug monitoring systems and studies conducted since the heroin shortage have both confirmed that users wanted heroin but were finding it difficult to obtain (Breen et al., 2003; Day et al., 2003).

It seems reasonable to assume that if or when the availability of heroin increases again, the number of persons engaging in regular heroin use is likely to increase. Thus, although the heroin shortage has reduced the harms related to heroin use, we should not expect these lower levels of harm to be maintained when supply returns *and* heroin use increases.

4.5. Conclusions

In the late 1990s, the number of regular heroin users in NSW was around 30,000-40,000, reflecting concentration in specific geographic areas around drug markets where they have a disproportionate influence on services, crime and public amenity. Despite the difficulties in estimating numbers of users following an abrupt onset of a heroin shortage, the multiple methods used suggested that there has been a reduction in the number of regular heroin users in the community. Some of these users probably moved to using other drugs, but if they did, it did not appear to be to a degree that fully offset the reduction in numbers of regular heroin users. It remains to be seen how many of the heroin users who have entered opioid maintenance and other treatment return to heroin use if or when heroin supply increases.

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APPENDIX A: FURTHER TRENDS IN INDICATOR DATA

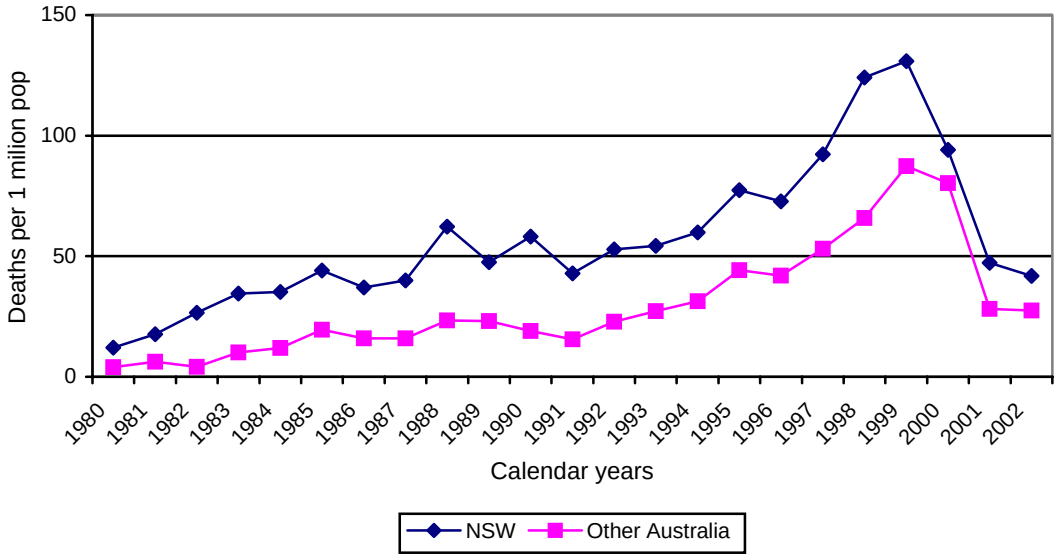


Figure A.1: Rate of opioid overdose deaths per million persons aged 15-54 years in NSW and the rest of Australia, 1980-2002

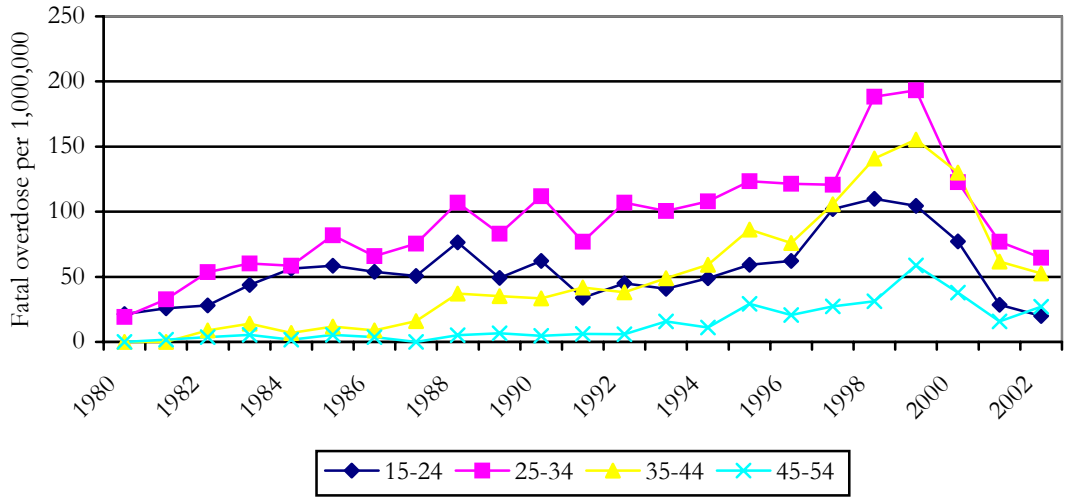


Figure A.2: Rate of accidental deaths due to opioids per million population among those aged 15-54 years, NSW 1980-2002

Table A.1: Percentage of heroin arrests with valid age and sex data

	Percentage of valid demographic data for arrests in the specified year							
	1995	1996	1997	1998	1999	2000	2001	2002
Age	79.1	76.3	75.5	72.2	76.2	75.8	66.9	67.4
Sex	97.9	99.2	98.5	99.0	96.0	95.5	70.8	66.2

Table A.2: Comparison of average demographic characteristics of different data sources for the period 1997-2002

Data source	Average male proportion %	Average age	Percent change in average age 1997-2002
Fatal opioid overdoses	80	33	11
Ambulance call outs	68	31	6
Heroin Arrests	79	28	11
PMT registrations	66	34	4
PMT first time entrants	66	27	2

Figure A.3: Percentage of NSW opioid overdose deaths occurring in 10 year age groups, 1980-2002

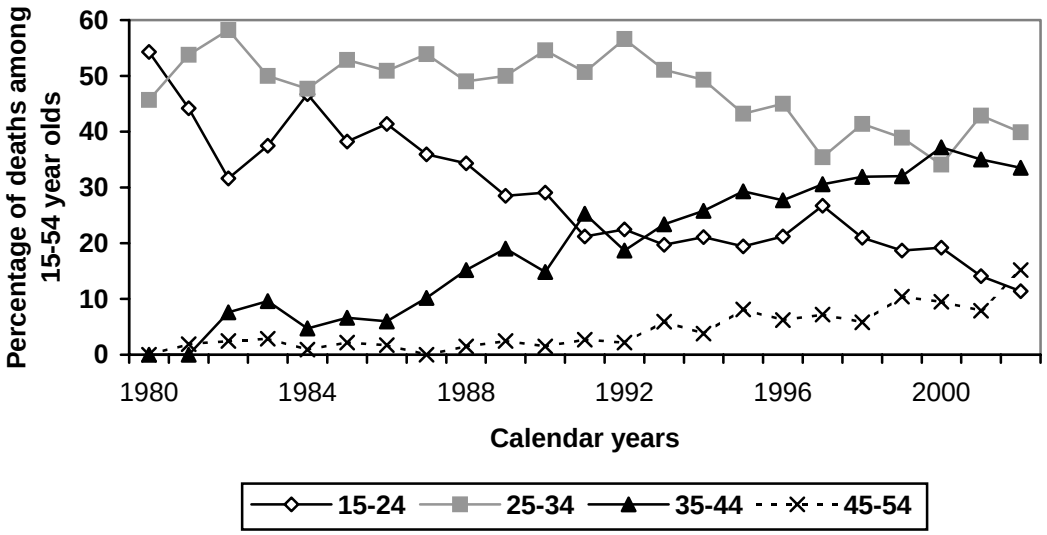
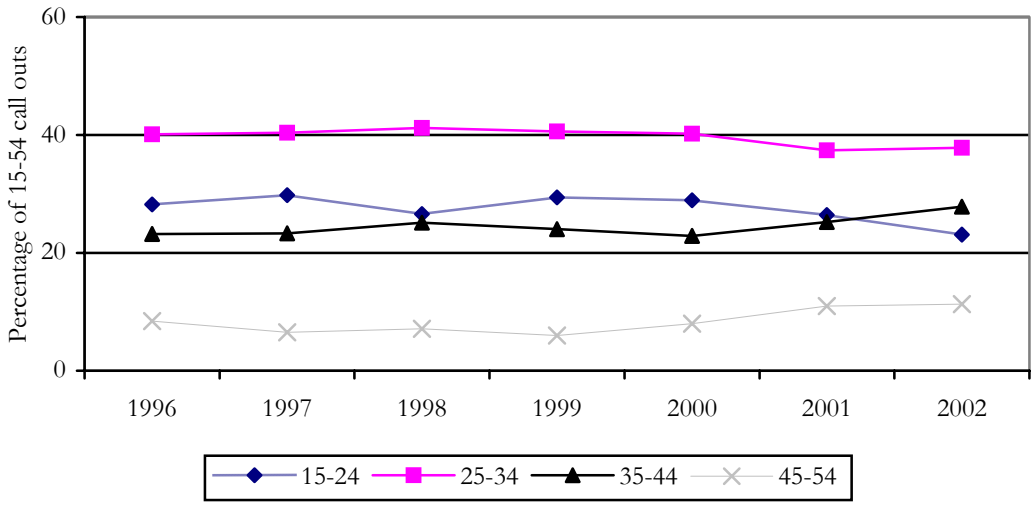


Figure A.4: Percentage of ambulance call outs* by age group among those aged 15-54, NSW 1996-2002



*Based on call outs for which age data is available

Figure A.5: Percentage of ambulance call outs to males by ten-year age groups, NSW 1996-2002

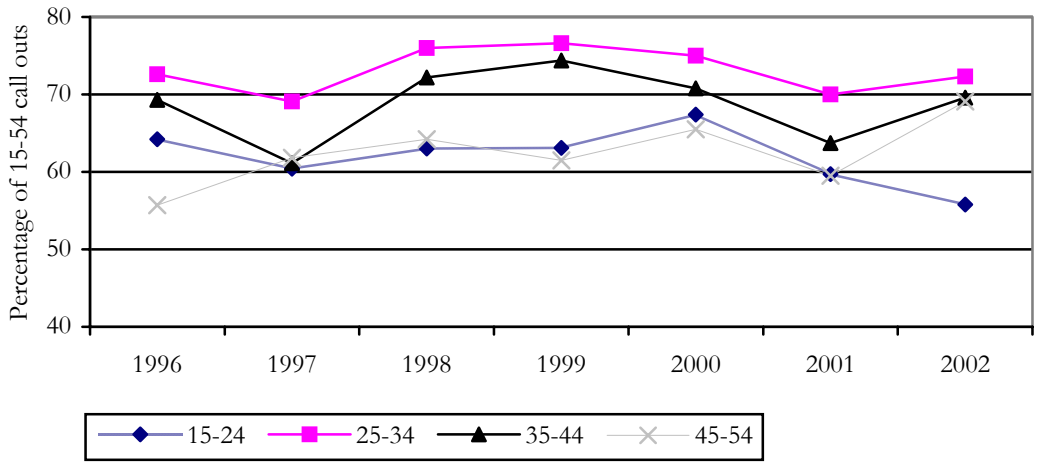
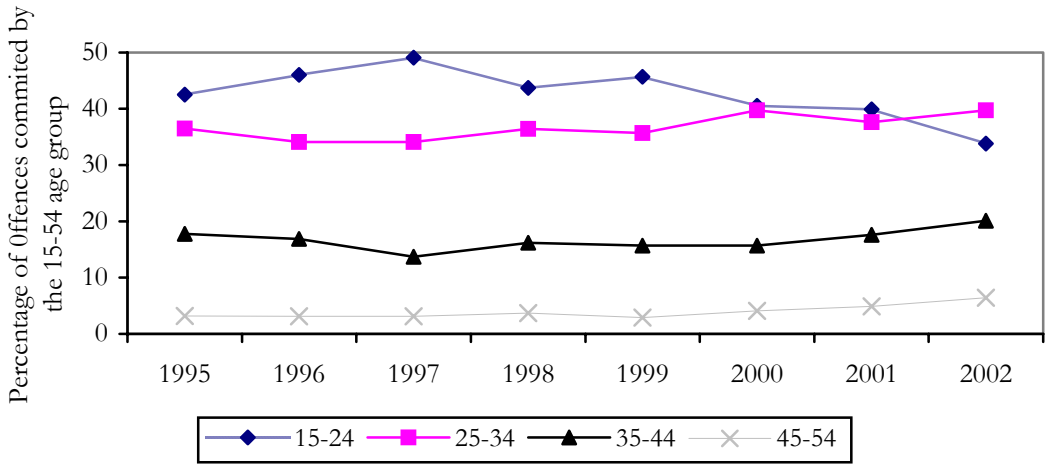
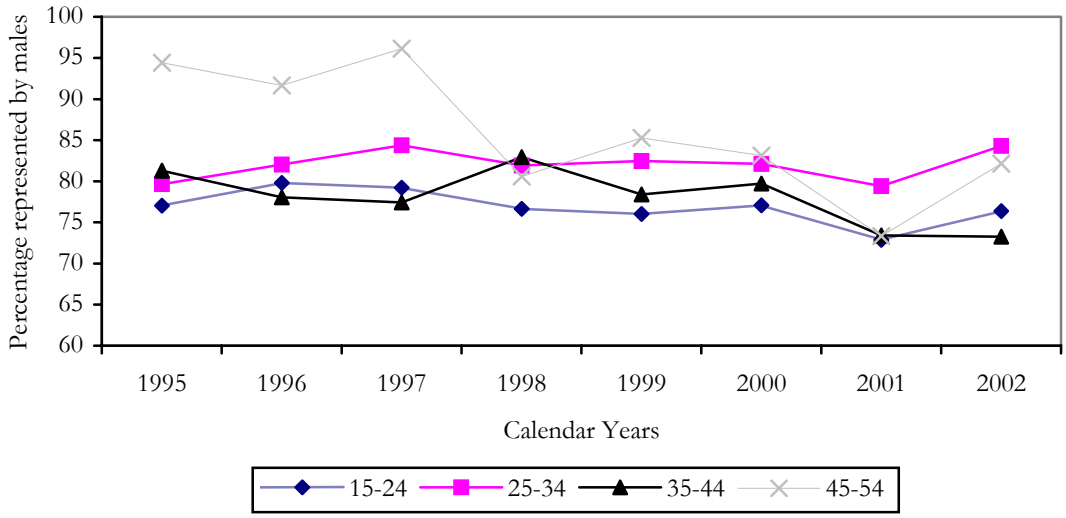


Figure A.6: Individuals arrested at least once in the calendar year* by age group, NSW 1995-2002



* For which valid age data is available

Figure A.7: Percentage of individuals arrested at least once in a year that were males by ten-year age groups*



* For which valid age and sex data is available

Figure A.8: Percentage of individuals in NSW aged 15-54 registering for PMT represented by 10 year age groups, by year 1997-2002

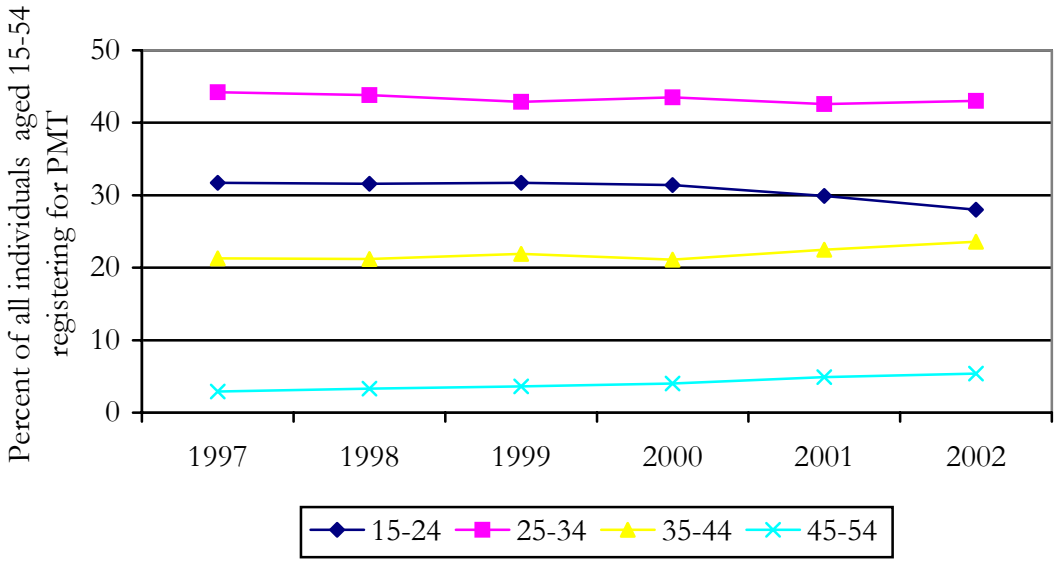
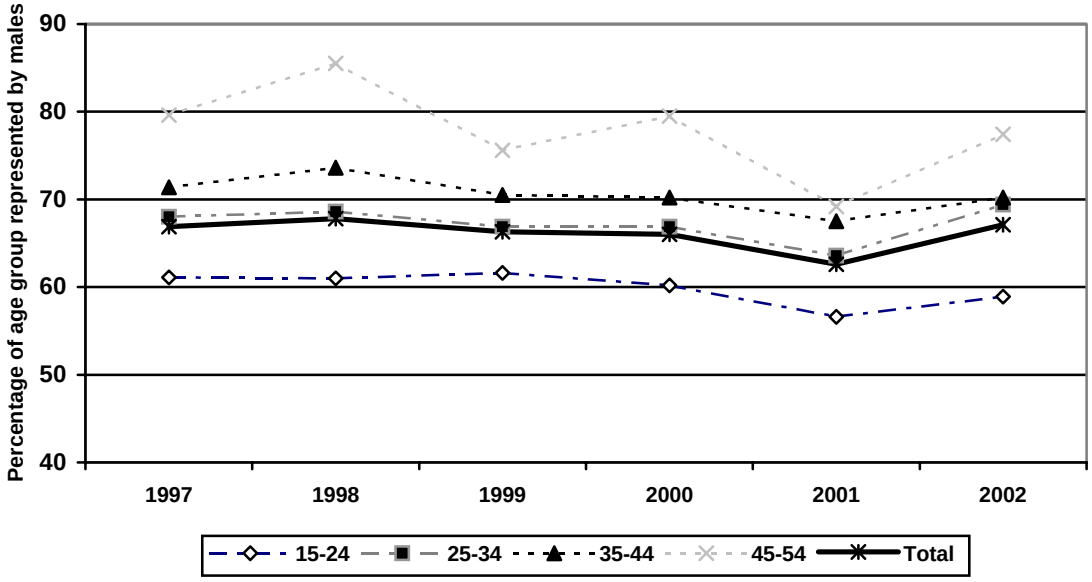


Figure A.9: Percentage of individuals registering for PMT who were male by age group, 1997-2002



APPENDIX B: ESTIMATES

Table B.1: Derivation of the estimated number of regular heroin users in NSW based on fatal opioid overdoses for individuals aged 15-54

	Multiplier	1997	1998	1999	2000	2001	2002
No of fatal opioid overdoses		333	452	481	349	177	158
Estimated number	112.5	37,500	50,900	54,100	39,300	19,900	17,800

Table B.2: Estimated number of regular heroin users by year from the number of naloxone ambulance call outs for the period 1997-2002

	1997	1998	1999	2000	2001	2002
No. call outs	3,525	4,658	4,396	3,694	1,793	1,983
% 15-54 yrs	92.6	95.7	95.1	95.3	91.6	91.9
No. 15-54	3,264	4,456	4,182	3,522	1,642	1,822
Multiplier	10.10	10.10	10.10	10.10	10.10	10.10
Estimated number of regular heroin users	33,000	45,000	42,200	35,600	16,600	18,400

Table B.3: Estimated number of regular heroin users by year from the number of arrested for heroin offences for the period 1997-2002

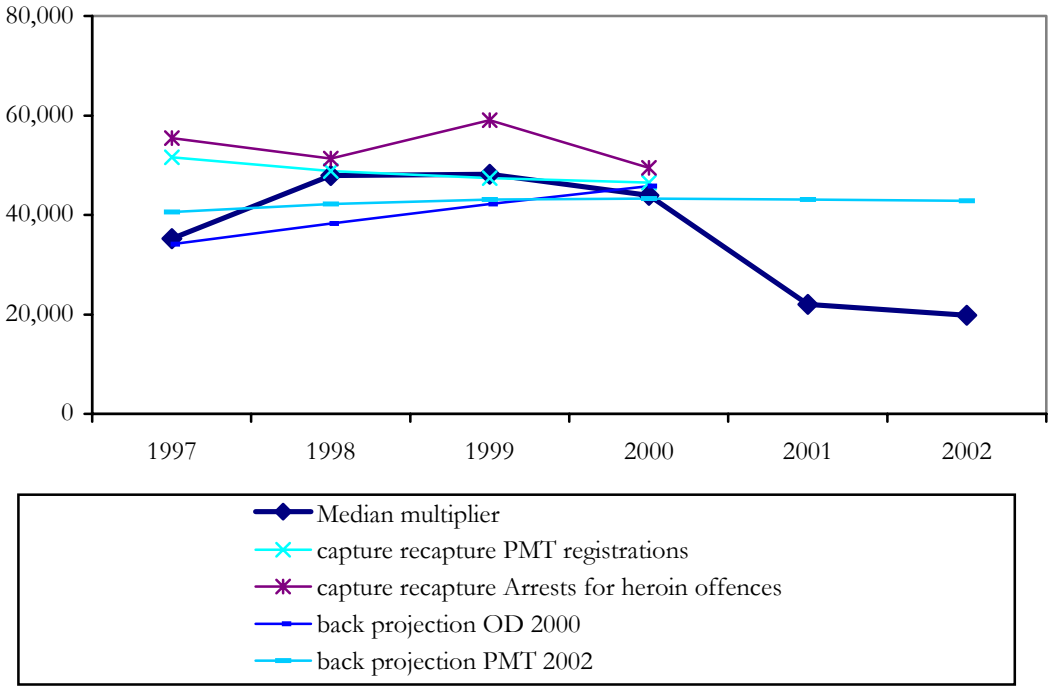
	1997	1998	1999	2000	2001	2002
No of heroin arrests	1,237	2,546	2,970	2,532	1,174	1,036
Percentage aged 15-54	98.9	99.0	99.0	99.3	99.1	99.0
No arrested 15-54	1,224	2,521	2,940	2,514	1,164	1,026
Multiplier	20.8	20.8	20.8	20.8	20.8	20.8
Estimated regular heroin users	25,500	52,400	61,100	52,300	24,200	21,300

Table B.4: Derivation of the estimated number of regular heroin users in NSW based of pharmacotherapy registrations made for individuals aged 15-54

	1997	1998	1999	2000	2001	2002
Number registering for PMT[1]	5,152	5,647	5,498	6,386	4,803	5,514
Multiplier	7.6	7.6	7.6	7.6	7.6	7.6
Number of regular heroin users	39,200	42,900	41,800	48,500	36,500	41,900

1. Registrations taken from figures supplied by NSW Department of Health.

Figure B.1: Comparison of median estimate of regular heroin users with confirmatory estimates of regular heroin users using other methods



Refer Degenhardt et al (2004) for details of derivation of capture-recapture and back projection estimates

Table B.5: Median age distribution across data sources across by ten-year age groups, ages 15-54

	1997	1998	1999	2000	2001	2002
15-24						
Median	30.7	29.1	30.5	30.1	28.2	25.6
Range	26.7-49.1	21.0-43.7	18.7-45.7	19.2-40.5	14.1-39.9	11.4-33.8
25-34						
Median	37.9	41.3	39.7	40.0	40.1	39.8
Range	34.1-44.2	36.4-43.8	35.7-42.9	34.1-43.5	37.4-42.9	37.8-43.0
35-44						
Median	22.3	23.2	22.9	22.0	23.9	25.7
Range	13.7-30.6	16.2-31.9	15.7-32.0	15.7-37.2	17.6-35.0	20.1-33.5
45-54						
Median	4.8	4.7	4.8	6.1	6.4	8.9
Range	2.9-7.2	3.3-7.1	2.9-10.4	4.0-9.5	4.9-11.0	5.4-15.2

The median percentages (prorated so that they sum to 100%) have been applied to the estimated number of heroin users in Australia to calculate the estimated age distribution of regular heroin users in Australia. The data sources included were ambulance callouts; heroin related arrests; opioid pharmacotherapy; and opioid induced deaths.

APPENDIX C: COMPARISON OF NATIONAL DATASETS

The ABS fatal opioid overdose data for each state is based on clearly defined criteria (ICD-10 definitions), which are applied uniformly by the ABS across the states. Jurisdictional differences may be introduced if coroners differ in the information they record on death certificates. This indicator is likely to reflect regular heroin use in that it is a direct outcome of heroin use.

Data on the number of individuals receiving PMT as at 30th June by state for the years 1997 to 2002 were obtained from the Australian Government Department of Health and Ageing. These figures are provided by the individual states to the Commonwealth. As discussed above, unlike other indicators of heroin use, the number of PMT registrations has consistently increased throughout the period 1997-2002, probably reflecting the fact that some individuals registering in a given year remain on the program, and possibly reflecting increased funding for this form of heroin treatment over time. Thus, the level of state PMT registrants may reflect the time that the program has been operating and previous levels of funding for the program, not simply the current level of regular heroin use. As NSW was the first state to offer PMT, the level of NSW PMT registrations may be disproportionately higher than those states that started PMT programs later (particularly jurisdictions such as the Northern Territory).

The annual Australian Illicit Drug Reports provide information about the number of heroin and other opioid related offences for which individuals were arrested by state and gender. The information varies in its quality, as it is provided by the individual states who have different reporting systems (Australian Crime Commission, 2003). Further, the number of arrests in each state depends on state policing and charging policies. The relative state figures were somewhat different to those provided by the other two methods (see Appendix A Figure A.6). In 2000, Victoria represented 53.4% and NSW 32.1% of offences (based on averaging 1999/00 and 2000/01) whereas Victoria accounted for 34.4% and NSW 37.2% of fatal opioid overdoses.

Because of the limitations of Australia wide PMT and arrest data, data on opioid induced deaths has been used to estimate the number of regular heroin users in Australia and states other than NSW from the estimate of NSW regular heroin users. As the number of

fatal opioid overdoses is small and hence subject to sample variation, especially for the smaller states, the Australian and state estimates have been calculated averaging the proportion of fatal overdoses across all (six) years. In view of the very small numbers of fatal opioid overdoses in the smaller states the estimates are likely to be subject to considerable error, and it may be more appropriate for the smaller states to estimate the numbers of heroin users in their state using a number of local data sources.

Comparison of data

The state breakdown of the three national data sets (fatal opioid overdoses, PMT registrations and arrests for heroin and opioid offences for the year 2000 (the year prior to the heroin shortage) is compared in Figure B.4.

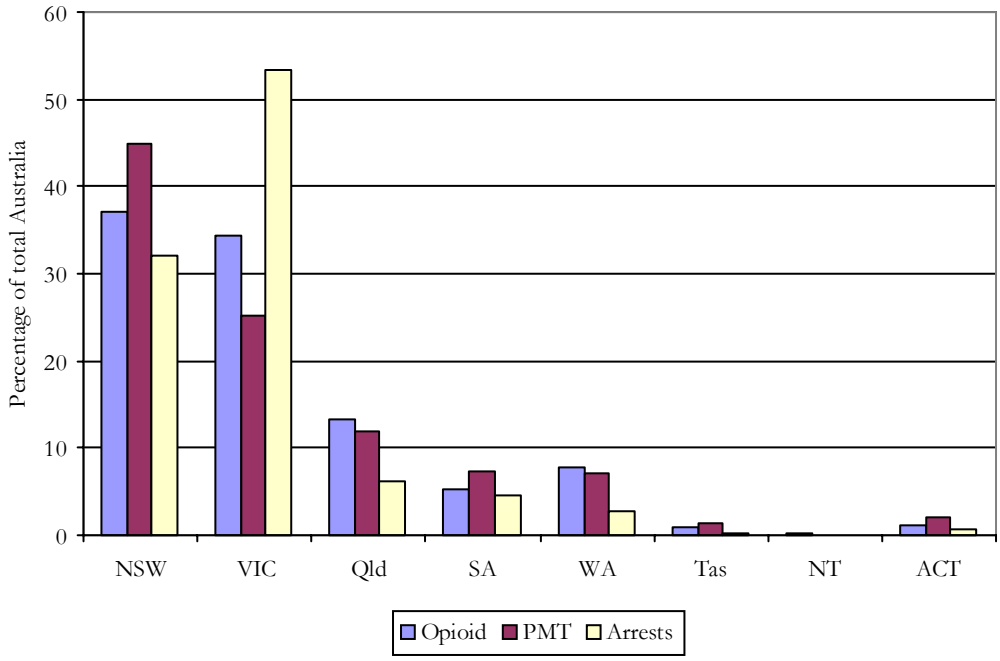


Figure C.1: Jurisdictional distribution of national data sources, 2000

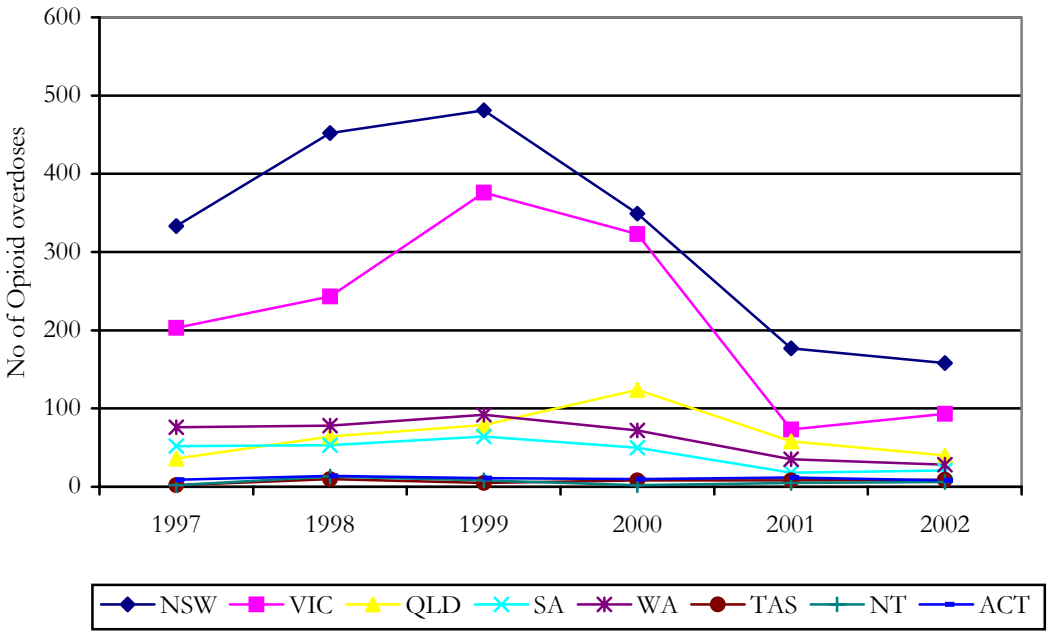


Figure C.2: Opioid overdoses by state, 1997 -2002

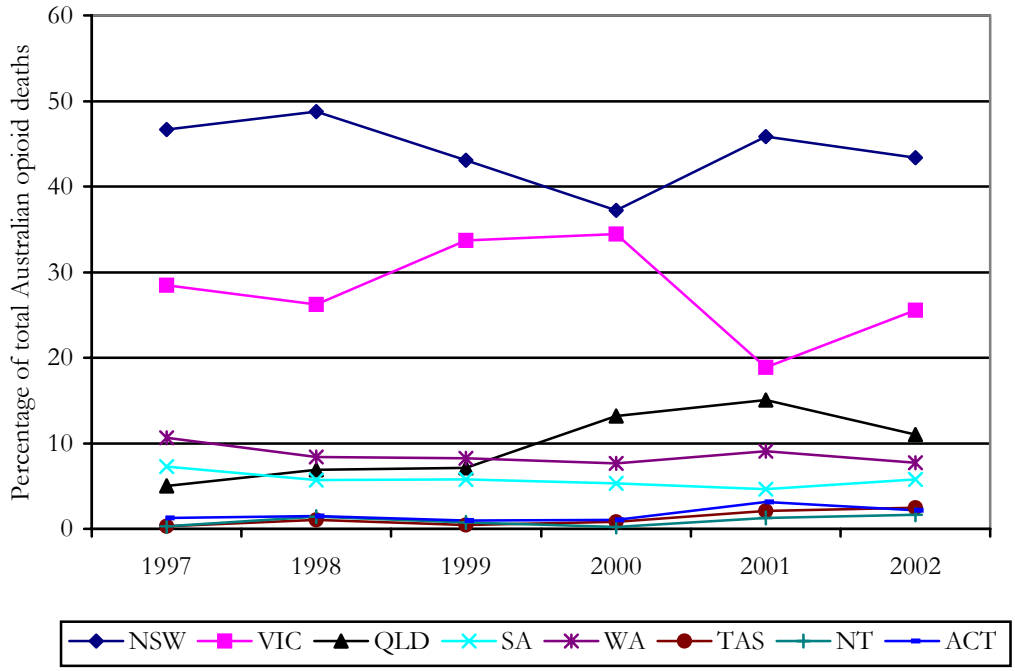


Figure C.3: State percentages of total Australian fatal opioid overdoses by year, 1997-2002

Table C.1: Proportional distribution of opioid overdoses by jurisdiction, 1997-2002

	1997	1998	1999	2000	2001	2002	Average
New South Wales	46.7	48.8	43.1	37.2	45.9	43.4	44.2
Victoria	28.5	26.2	33.7	34.4	18.9	25.5	27.9
Queensland	5.0	6.9	7.1	13.2	15.0	11.0	9.7
South Australia	7.3	5.7	5.7	5.3	4.7	5.8	5.8
Western Australia	10.7	8.4	8.2	7.7	9.1	7.7	8.6
Tasmania	0.3	1.1	0.4	0.9	2.1	2.5	1.2
Northern Territory	0.3	1.4	0.7	0.2	1.3	1.6	0.9
Australian Capital Territory	1.3	1.5	1.0	1.1	3.1	2.2	1.7
Other Territories	0.0	0.0	0.0	0.0	0.0	0.3	0.0
Australia	100	100	100	100	100	100	100

Table C.2: Number of individuals in PMT as at 30 June by jurisdiction, 1997-2002

	1997	1998	1999	2000	2001	2002
NSW	11365	12107	12500	13594	15069	15471
Victoria	4464	5334	6700	7647	7743	7700
Queensland	2754	3011	3341	3588	3745	3896
South Australia	1760	1839	1985	2198	2522	2417
WA	1242	1654	2449	2140	2307	3602
Tasmania	267	306	370	423	464	513
NT			2	32	25	21
ACT	387	406	559	615	641	590
Australia	22239	24657	27906	30237	32516	34210

Table C.3: Proportional distribution of PMT clients by jurisdiction at June 30, 1997-2002

	1997	1998	1999	2000	2001	2002
NSW	51.1	49.1	44.8	45.0	46.3	45.2
Vic	20.1	21.6	24.0	25.3	23.8	22.5
Qld	12.4	12.2	12.0	11.9	11.5	11.4
SA	7.9	7.5	7.1	7.3	7.8	7.1
WA	5.6	6.7	8.8	7.1	7.1	10.5
Tas	1.2	1.2	1.3	1.4	1.4	1.5
NT	0.0	0.0	0.0	0.1	0.1	0.1
ACT	1.7	1.6	2.0	2.0	2.0	1.7
Australia	100.0	100.0	100.0	100.0	100.0	100.0

Table C.4: State arrests for heroin offences, 1997 to 2001[1]

	1997	1998	1999	2000	2001
NSW	2963	4063	4221	2333	442
VIC	4470	6849	7053	3880	904
Qld	424	598	705	454	132
SA	232	266	418	330	83
WA	548	469	320	195	32
Tas	22	21	17	22	17
NT	19	5	8	9	1
ACT	77	85	75	44	10
Aust	8753	12354	12816	7265	1620

1. Data is provided in financial years, and has been expressed in calendar years by averaging the figures for the two financial years containing 6 months of the calendar year.

Table C.5: Proportional distribution of arrests for heroin offences by jurisdiction, 1997 to 2001[1]

	1997	1998	1999	2000	2001
NSW	33.8	32.9	32.9	32.1	27.3
VIC	51.1	55.4	55.0	53.4	55.8
Qld	4.8	4.8	5.5	6.2	8.1
SA	2.6	2.2	3.3	4.5	5.1
WA	6.3	3.8	2.5	2.7	1.9
Tas	0.3	0.2	0.1	0.3	1.0
NT	0.2	0.0	0.1	0.1	0.1
ACT	0.9	0.7	0.6	0.6	0.6
Aust	100.0	100.0	100.0	100.0	100.0

1. Data is provided in financial years, and has been expressed in calendar years by averaging the figures for the two financial years containing 6 months of the calendar year.