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Heroin use in Australia: Its impact on public health & public order

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Its Impact on Public Health and Public Order

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Key points

- It is estimated that heroin has been used by 1-2% of the Australian population. In 1997, approximately 0.2-0.7% of the Australian adult population were dependent upon heroin.

- The persons who are most likely to use heroin generally come from a disadvantaged background, have had problems at school and home, and are often impulsive. Affiliations with substance using peers also increase the likelihood of substance use, although the reason for this association is unclear.

- The adverse health consequences of heroin use include: heroin dependence; contraction of infectious diseases through risky injecting practices; and premature mortality from overdose, violence and other causes.

- Interventions are needed to reduce the disproportionately large contribution that heroin overdoses make to the number of drug-related deaths in Australia. These include increasing treatment places for dependent heroin users, peer education about the risks of heroin overdose and improving responses to overdose. The distribution of naloxone to heroin users and the supervised injecting rooms may be worthy of trial.

- Public order is affected by the large number of property and drug-related offenses that are committed by a substantial proportion of persons who are heroin dependent. While both crime and heroin use have common causes, the frequency of criminal acts increases with the frequency of heroin use. This has important implications for law enforcement policies, namely, that reducing heroin use among heroin dependent persons may produce significant reductions in criminal activity.

- The range of treatment options for persons dependent upon heroin include: detoxification and abstinence based therapies, and drug substitution treatments, the most effective and widely used of which is methadone maintenance treatment. There is considerable evidence that drug substitution treatment results in significant reductions in the negative health consequences of dependent heroin use and the adverse effects that it has on public order.

- There is evidence from a range of sources that heroin use is increasing among young Australians. Considerable increases in treatment services, education of heroin users in methods that will reduce the negative health impact of dependent heroin use, and continuation of existing services such as needle and syringe programs, are necessary to reduce heroin overdose deaths, infectious disease, and the adverse impact of dependent heroin use on public health and public order.

Executive Summary

This report describes what research over the past decade has revealed about the impact of heroin use on public health and public order in Australia. It summarises what is known about: the prevalence of heroin use and dependent heroin use in Australia; the major health risks that heroin injection poses to users, their families and the community; and the connection between heroin use and property and drug-related crime. The report argues that effective forms of treatment for heroin dependence exist, which can reduce the adverse impact that heroin use has on the health of heroin users while improving public health and public order.

The Prevalence of Heroin Use in Australia

Historical information suggests that illicit heroin use by young adults has largely developed since the late 1960s in Australia, with a major initiation of heroin use in the period 1982-1985. There are indications of another recent rise in heroin use among young Australian adults. It has been estimated that 1 to 2% of the adult population has used heroin at some time in their lives, with higher rates among adults aged 20 to 29 years. Since heroin users are probably under-represented in household survey samples, and may be reluctant to admit heroin use, these are probably under-estimates.

The Antecedents of Heroin Use

Very few studies have examined the risk factors and life pathways that lead young people to use and become dependent on heroin. There is, however, a large literature on risk factors for early use and abuse of alcohol and cannabis which indicates that young people who are the earliest initiators and heaviest users of alcohol and cannabis are those who are most likely to use heroin. The risk factors can be divided into social and contextual factors, family factors, individual factors, and peer affiliations during adolescence.

The social and contextual factors include law enforcement efforts to reduce the availability of heroin and therefore increase its price, to deter illicit drug use, and promote social values that discourage heroin use. These factors have weak associations with heroin and other illicit drug use but do provide an environment in which other programs are more likely to be effective.

Two aspects of the family environment are associated with increased rates of licit and illicit drug use among children and adolescents. The first concerns the extent to which the child is exposed to a disadvantaged home environment, with parental conflict and poor discipline and supervision. The second is the extent to which the child's parents and siblings use alcohol and other drugs.

Children who perform poorly in school, because of impulsive behaviour or problem behaviour in childhood, and those who are early users of alcohol and other drugs, are most likely to use drugs like

heroin. The nature of the relationship between peer affiliations and adolescent substance use remains controversial, but affiliation with drug using peers is an important risk factor for drug use, which operates independently of individual and family risk factors.

Exposure to these risk factors is highly correlated. Young people who initiate substance use at an early age have often been exposed to multiple social and family disadvantages. They also tend to be impulsive, have performed poorly at school, to come from families with problems and a history of parental substance use, and to affiliate with delinquent peers.

THE HEALTH CONSEQUENCES OF HEROIN USE

Heroin Dependence

Persons who are heroin dependent have impaired control over their use of heroin, indicated by continued use in the face of problems that they know (or believe) to be caused by heroin use. These problems include being arrested or imprisoned, interpersonal and family problems, infectious diseases and drug overdoses. In Australia, heroin users who seek treatment are typically daily heroin injectors.

Direct estimates of the prevalence of heroin dependence come from population surveys. The Australian National Survey of Mental Health and Well-Being estimated that 26 000, or 0.2% of adults, were opioid dependent in the past year. Household surveys probably under-estimate the prevalence of highly stigmatised and illegal forms of behaviour like heroin use.

Indirect estimates of the prevalence of heroin dependence produce higher estimates. These are provided by multiplying the number of dependent heroin users who are identified from a particular source by a factor thought to represent the ratio of known to unknown dependent heroin users. These estimates, and a consensus estimate of experts in the field, suggest that there were approximately 100,000 dependent heroin users in Australia in the late 1990s (0.7% of adults).

Research in the UK and the US indicates that dependent heroin users who seek treatment or come to attention through the legal system, may continue to use heroin for decades. In this population, daily heroin use is punctuated by periods of abstinence, drug treatment and imprisonment. In the year after any episode of drug treatment, the majority of users relapse to heroin use. When periods of voluntary and involuntary abstinence during treatment or imprisonment are included, dependent heroin users use heroin daily for 40% to 60% of their 20-year addiction careers.

Infectious Diseases and Heroin Use

In the USA and parts of Europe, sharing contaminated needles, syringes and other injecting equipment account for 50% of new HIV notifications. In Australia, approximately eight percent of new HIV

diagnoses occur in persons with a history of injecting drug use, of whom just under half are men with a history of male sexual contact. The prevalence of HIV infection among people attending needle and syringe programs (NSPs) in Australia has been estimated at less than three percent. Low HIV infection among Australian injecting drug users may reflect Australia's geographic isolation, and the early introduction of needle and syringe programs that have averted an HIV epidemic among Australian injecting drug users and their sexual contacts.

The prevalence of Hepatitis C virus (HCV) among needle and syringe attenders has been estimated to be between 50 and 60%. In 1997 there were estimated to be at least 197,000 Australians infected with Hepatitis C, with 11,000 new infections occurring each year as a result of injecting drug use. Chronic infection has been estimated to occur in 80% of infections, and 20% of chronic HCV carriers will develop liver cirrhosis within 20 years. Given the larger number of people infected with HCV, and the more protracted complications arising from this infection, the net health and economic costs of HCV transmitted by injecting drug use is likely to considerably higher than those of HIV.

HCV is spread by the shared use of injecting equipment. HCV is a more robust virus than HIV and more easily spread. The base rate of HCV infection among injecting drug users before NSP were introduced was substantially higher than the base rate of HIV infection, ensuring that the risks of HCV infection from any episode of sharing were much higher than those for HIV. Injecting drug users are likely to spend time in prison at some point in their life and most inject drugs while in prison sharing needles with large numbers of other injectors. The rate of HCV transmission in prison is not yet documented, but there are suggestions that it is double that in the community.

Premature Mortality and Heroin Use

Long-term heroin users have a substantially increased risk of premature death from drug overdoses, violence, and alcohol-related causes. Cohort studies of the mortality of heroin users treated before the advent of HIV indicated that they were 13 times more likely to die prematurely than their age peers. Analyses of premature mortality due to illicit drug use in Australia indicated that one of the most frequent causes of death among heroin users is unintentional opioid overdose. In 1997, it accounted for 80% of all illicit drug-related deaths among Australians aged between 15 and 44 years. This represented 60% of the total deaths attributed to alcohol in the same age group and almost double the number of deaths due to motor vehicle accidents involving alcohol in this age group.

Between 1964 and 1997 there was a 55 fold increase in the rate of overdose per million of population aged 15 to 44 years; males comprised 80% of these deaths. The average age at death rose from early 20s to early 30s over this period. Heroin users who initiated use in the late 1970s and early 1980s comprised most deaths over the period 1979 to 1997. The increase was observed in most states and territories and similar trends in fatal overdoses have been observed in Europe.

Among the risk factors for fatal opioid overdose are: a history of heroin dependence; the length of dependence; being male; concurrent use of heroin, alcohol and benzodiazepines; and using heroin alone.

Overdose fatalities could be prevented by: increasing the number of heroin users in methadone and other forms of maintenance treatment; peer education about the risks of polydrug use and using alone; improving bystanders' responses to overdoses by increasing the use of ambulances. Other strategies worthy if trial include: distributing naloxone to dependent heroin users; and supervised injecting rooms in areas with a high prevalence of street injecting.

HEROIN USE AND PUBLIC ORDER

Dependent heroin users who come to attention through drug treatment or the legal system typically engage in high rates of criminal activity. These offences are most often drug dealing and property crimes. Heroin dependent women may be involved in prostitution. At least half of heroin users in treatment were engaged in property offences before they first used heroin.

There are causes common to crime and heroin use. Adolescents who have a history of poor school performance, who begin alcohol and tobacco use early, and who have a criminal history, are more likely to use heroin in their late teens. The frequency of heroin use is also positively correlated with the frequency of criminal activity. Reducing dependent heroin offenders' need for heroin through treatment reduces the amount of criminal activity in which they engage.

Although only a very small proportion of adults ever become dependent on heroin, the frequency with which they engage in crime and the range of their criminal activity has a disproportionate impact on the community. Detailed studies of criminal behaviour and heroin use in New York City indicate that a large proportion of all forms of theft were committed by a minority of dependent heroin users.

A survey of 200 heroin users in South-Western Sydney indicated that many were actively engaged in acquisitive property crime and dealing illicit drugs. Illegally obtained income accounted for 82% of the sample's income in the week before interview. From these data it was estimated that the total costs of heroin-related crime in Australia was between $535 million and $1.6 billion per annum.

TREATMENT AS A PUBLIC HEALTH STRATEGY

Treatment of heroin dependence is of benefit to those who receive it and is cost effective in terms of reduced crime, health costs and mortality.

Detoxification is supervised drug withdrawal with the aim of minimising the severity of withdrawal symptoms. It is not a treatment for heroin dependence but it is one of the interventions most often sought by dependent heroin users. It is a palliative treatment for opioid withdrawal that provides heroin users a respite from drug use, an occasion to reconsider heroin use, provides an opportunity for outreach, and may be a prelude to abstinence-based treatment.

Drug-free treatment approaches include: residential treatment in Therapeutic Communities (TCs);

outpatient drug counselling (DC); and the self-help group Narcotics Anonymous. All these approaches share a commitment to achieving abstinence from all opioid and other illicit drugs; they do not substitute other opioid drugs for heroin; and they all use group and psychological interventions to assist dependent heroin users to achieve abstinence.

Recently, there has been renewed interest in the use of Naltrexone, an opiate antagonist, as an adjunct to drug free treatment. Naltrexone is an opiate antagonist which blocks the opiate receptors so that any opiates that are taken have no effect. Naltrexone maintenance aims to ensure that the client remains opiate-free.

Drug substitution treatment substitutes a long-acting, usually orally administered, opioid drug for the shorter-acting heroin that is typically used by injection. It aims to stabilise the dependent heroin user so that they become more accessible and amenable to rehabilitation. They are among the most popular forms of treatment with heroin users. Methadone Maintenance Treatment (MMT) is the most common form of drug substitution worldwide; it is taken once daily. When given in high or `blockade' doses, it blocks the euphoric effects of injected heroin, providing an opportunity for the individual to improve his or her social functioning by taking advantage of the psychotherapeutic and rehabilitative services that are an integral part of any treatment program.

The Effectiveness of Treatment for Heroin Dependence

If we evaluate the success of treatment for heroin dependence in terms of abstinence during and after treatment, then all treatments have poor results because enduring abstinence is a rare outcome from any form of treatment. It is more realistic to judge the outcome of treatment or heroin dependence by assessing its effects on the frequency of heroin use and crime, and the health and well being of heroin dependent persons. When judged by these criteria, treatment for heroin dependence is a good investment of community resources.

Drug-free treatment: There have been no randomised-controlled trials for TCs or outpatient DC. Most of the evidence on the effectiveness of TC and DC programs comes from observational studies such as the Drug Abuse Reporting Program and the Treatment Outcome Prospective Study in the USA. TCs and DC are more demanding of drug users, and are less successful than MMT in attracting and retaining dependent heroin users in treatment. They nonetheless substantially reduce heroin use and crime in those who remain in treatment for at least three months. There is some evidence that TCs may be more effective if they are used in combination with legal coercion to ensure that heroin users are retained in treatment long enough to benefit from it.

Naltrexone: A central requirement for effective naltrexone maintenance is that naltrexone is taken daily. Research has typically shown poor compliance with naltrexone with 80-90% of individuals on naltrexone maintenance in the absence of outpatient treatment resuming illicit opiate use within 12 months.

Methadone Maintenance Treatment: Six randomised-controlled trials have studied the effectiveness of MMT. All produced positive results, despite small sample sizes (that worked against finding an effect). Other larger observational studies have found that patients in MMT decreased their heroin use and criminal activity while they remained in treatment. MMT also substantially reduces the transmission of HIV via needle sharing and protects patients from HIV infection in locations where HIV has spread rapidly among injecting drug users who have not been in treatment.

LAAM is a synthetic opiate agonist with an action that is similar to morphine, but with a duration of action that extends from 48 to 72 hours, which means that dosing is only necessary three times a week. LAAM's relatively slower onset and longer duration of the action mean that there is less risk of LAAM being diverted for abuse. Further, fewer visits for dosing are needed, making fewer demands on both the patients and on the service provider.

Buprenorphine is a mixed agonist-antagonist that has partial agonist effects similar to those of morphine, while blocking the effects of pure agonists like heroin. When given in high doses, its effects can last for up to 3 days and its antagonist effects substantially reduce the risk of overdose and abuse. Doses of 8mg daily are equivalent to methadone doses of 60mg. Because of its long half-life, buprenorphine may be given every second or third day.

Slow release oral morphine. Slow release morphine may be used treat heroin-dependent patients intolerant of methadone but to date there are no controlled trials demonstrating its efficacy.

Injectible heroin maintenance is one way of attracting more heroin users into treatment by providing them with their preferred drug, heroin, by their preferred route of administration, injection. The feasibility, safety and impact of Heroin Maintenance Treatment (HMT) has been evaluated in a controlled observational trial in a number of sites in Switzerland; three referenda in Switzerland have supported the continuation of HMT to individuals who fail in MMT. The major constraint upon its use is societal concern about providing injectible heroin to dependent heroin users, even under medical supervision. Australian politicians and parents worry about sending the "wrong" message to youth about heroin and other drug use. Even if there was stronger public support for HMT the costs of providing it by comparison with MMT mean that the scale of its provision is likely to be modest.

THE FUTURE

A number of Australian data sources suggest that the prevalence of heroin use has increased in the past several years. Police and Customs report increased amounts and availability of heroin in Australia. There has been a steady decline in the age of people being arrested for heroin-related offences, and a decline in the average age of first heroin use among injecting drug users in Sydney. Overdose mortality data from 1979 to 1995 indicate that more recent birth cohorts have experienced higher rates of opioid overdose mortality than older birth cohorts. An increase in overdose fatalities in Australia has been paralleled by similar increases in the Nordic countries, Spain, Italy, Austria and the United States. Australia is facing a risk of the spread of HIV and HCV by injecting heroin use; a continued increase in the number of opiate related deaths over the next ten years; and the need for a substantial increase in

treatment services for heroin dependence.

1. Introduction

In this report we attempt to describe the impact of heroin use on public health and public order in Australia. A population health perspective has improved our understanding of the adverse health consequences of tobacco and alcohol use in Western societies; it has also helped identify interventions that have reduced some of these harms. The adoption of a similar approach to understanding heroin use may also improve our understanding of the harms that heroin use causes in Australia and suggest interventions to reduce this harm.

A population perspective considers heroin use as a behaviour in which a proportion of the population engages that puts users' health and the health of the broader community at risk. It also disturbs public order. Such a perspective prompts us to ask the following questions: How many people use heroin? What factors influence their decision to use heroin and to persist in using it? What are the major adverse health effects caused by illicit heroin use? How many of those who use heroin experience these adverse health and social consequences? What are the major adverse effects that heroin use has on public order? How can we reduce the adverse effects that heroin use has on users' health, public health and public order?

In this report, we describe data on the prevalence of heroin use and heroin dependence in Australia. We discuss what we know about the characteristics of persons who use and become dependent on heroin. We also review research on the drug use careers of dependent heroin users, a literature that is primarily from the USA and the UK. We then outline the major health risks that injecting heroin use poses to users, their families and the broader community. These include infectious diseases, such as HIV and hepatitis C (HCV), transmitted by needle-sharing and unprotected sexual activity; dependence on heroin as a result of sustained daily use of the drug; and premature death from heroin "overdoses". Dependent heroin users are also at increased risk of being imprisoned for drug and property offences, an outcome that has consequences for their health and well-being, and directly to the cost of the broader community in terms of the effect upon public order. A detailed discussion is then provided of the relationship between heroin use and property crime.

We conclude by reviewing the effectiveness of health interventions that aim to reduce heroin use and improve the health of heroin users, the public health and public order. These include needle and syringe programs, detoxification, methadone maintenance treatment, alternative pharmacotherapies and residential and drug-free counselling. These interventions have substantial economic and social benefits to the community in terms of reduced crime, illicit heroin use and its adverse health consequences. We leave for another occasion the task of assessing the effectiveness of law enforcement and educational efforts to prevent heroin use.

2. The History of Illicit Opioid use in Australia

There are limited historical data on illicit opiate use in Australia. Opium was reportedly smoked by Chinese immigrants in nineteenth century Australia and the first legal restrictions on the importation and use of opium were introduced early in the present century (Manderson, 1993). Opium use outside the Chinese community was rare, however. The use of injected opiates was largely unknown, with the exception of a small number of persons who had become dependent on morphine and pethidine as a result of medical treatment (Manderson, 1993).

Illicit heroin use was first noted in Sydney and Melbourne in the late 1960s (Manderson, 1993). Heroin use was reportedly introduced to Australia by American soldiers on leave from Vietnam where heroin was freely available and commonly smoked (Manderson, 1993; McCoy, 1980; Robins et al, 1975; Robins, 1993). The first major epidemic of illicit heroin use in Australia in the early 1970s prompted the establishment of methadone maintenance treatment programs in 1970 (Mattick and Hall, 1993).

Comment: Reynolds et al incorrect ref??? Instead Reynolds, 1976 – see reference list?? Williams Royal Commission – library book # 239 – few details really – age, gender etc – questionable use.

A further "epidemic" of illicit heroin use occurred in the early and middle 1980s. This prompted the launch of the National Campaign Against Drug Abuse in 1985. Data on age of initiation among heroin users interviewed in 1989 (ANAIDUS, 1991), and samples of heroin users interviewed in NDARC studies, suggest that the major period of initiation was 1982-1985. This period of increased initiation was also reflected in numbers of convictions for possession and sale of heroin, and in rates of imprisonment for drug and property offences (Manderson, 1993). Since 1985 there was a substantial expansion of methadone maintenance treatment for opioid dependence (Mattick and Hall, 1993). In 1987 concern about HIV transmission via shared injection equipment led to the introduction of needle and syringe programs (Feacham, 1995).

Since late 1997, concerns about rising rates of opioid overdose deaths have produced another "heroin crisis". Between 1979 and 1995 there was a six fold increase in fatal opioid overdose among Australians aged 15 to 44 years (Hall & Darke, 1997). Subsequent research showed that the number of deaths attributed to opioid overdose among Australian adults aged 15-44 years increased from 6 in 1964 to 600 in 1997 (Hall, Degenhardt & Lynskey, 1999). The proportion of all deaths attributed to opioid overdose among persons in this age group increased from 0.1% in 1964 to 7.3% in 1997, with the mortality rate per million population increasing from 1.3 in 1964 to 71.5 in 1997 (Hall et al, 1999).

2.1 The Prevalence of Heroin Use in Australia

In household surveys of alcohol and illicit drug use in Australia between 1985 and 1995, 1 to 2% of the adult Australian population report that they have used heroin at some time in their lives (Makkai & McAllister, 1998). In the 1998 National Household Survey, 2.2% of the population over the age of 14 (2.9% of males and 1.5% of females) reported that they had ever used heroin (Australian Institute of Health and Welfare (AIHW), 1999). The prevalence of heroin use was higher among young adults aged 20 to 29 years. In this age group, 6.2% of males and 3.2% of females reported lifetime heroin use

and 2.2% and 0.5% respectively reported that they had used heroin in the past year (AIHW, 1999).

These figures are likely to underestimate heroin use for a number of reasons. First, heroin users are probably under-represented in household survey samples. Their lifestyle makes them less likely to live in conventional households and the distribution of heroin use tends to be concentrated in particular localities, making it likely that household surveys will underestimate use. Second, if heroin users are interviewed, their heroin use may be under-reported because it is an illegal and socially stigmatised behaviour. Nevertheless, allowing for these probable biases, it is still true that a minority of the Australian population has ever used heroin. Even if we assume that surveys underestimate the number of heroin users by half, the proportion of the Australian population that has ever used heroin would still be less than 5%.

3. The Antecedents of Heroin Use

Very few studies have examined the risk factors and life pathways that lead young people to use and become dependent on heroin because the small number of heroin users in the population makes it difficult to study these processes. There is, however, a large literature on risk factors for early alcohol and cannabis use and abuse in adolescence and early adult life. Although these studies have primarily examined heavy alcohol and cannabis users, there is good evidence that young people who are the earliest initiators, and heaviest users, of alcohol and cannabis are those who are most likely to use heroin and cocaine (Kandel, 1993).

These studies have identified a wide range of factors which predict an increased risk of substance use and abuse (for a comprehensive review of these factors see Hawkins, Catalano & Miller, 1992). In general, these factors may be divided into the following broad categories: social and contextual factors, family factors, individual factors, and peer affiliations during adolescence. A brief discussion of research findings in each of these key areas is given below.

3.1. Social and Contextual Factors

A broad range of social and contextual factors predicts early substance use and abuse by adolescents. For example, ready availability of drugs and alcohol is a moderate predictor of rates of tobacco, alcohol and illicit drug use (Dembo, Farrow, Schmeidler & Burgos, 1979; Gorsuch & Butler, 1976; Maddahian, Newcomb & Bentler, 1988). The use of these substances is also likely to be influenced by laws and norms concerning their use. In particular, alcohol consumption has been shown to be affected by the amount of tax placed on alcohol (Levy & Sheflin, 1985). Lowering the minimum legal drinking age has been shown to increase drink-driving while raising the minimum drinking age decreases drink-driving convictions among teenagers (Saffer & Grossman, 1987).

There have been continuing debates about whether the illegality of heroin, cocaine and cannabis use deters young people from using them, and whether law enforcement reduces drug supply, demand, use and drug-related harm. Proponents have pointed to three main benefits of law enforcement efforts. First, they suggest that law enforcement reduces the supply o f heroin and increases its price, and thereby reduces use. There is little evidence, however, that law enforcement is effective in reducing the supply of heroin and other illegal drugs, although it undoubtedly contributes to the high street price of heroin. Hawkins et al (1992) point out that although US federal government spending on interdiction and enforcement of drug laws rose from $US 1.8 billion in 1986 to $US 3.8 billion in 1989, the average street price of cocaine fell from US $100 per gram to US $75 over the same period. Similarly, a recent analysis of the impact of drug seizures on heroin availability and price in Sydney by Weatherburn and Lind (1997) found that law enforcement had no detectable effect on the price or availability of heroin.

Second, advocates of law enforcement point to the deterrent effects of the illegality of heroin use. They suggest that relaxing drug laws would remove barriers to heroin use for many individuals who are currently deterred from using by its illegality (Moffit et al, 1997). Evidence on the deterrent effects of criminal sanctions is mixed. For example, a recent analysis of changes in the prevalence of cannabis use in South Australia after the decriminalisation of the drug in that state suggested that the rates of cannabis use in South Australia did not increase any more than in other states over the same time period (Donnelly et al, 1995). One might plausibly argue, however, that the very low prevalence of heroin use suggests that while legal sanctions may not have deterred many cannabis users, the same is not true for "harder" drugs like heroin (Moffit et al, 1997).

Third, it is more plausible that the illegal status of heroin deters many people from using them because it conveys the message that its use is socially unacceptable. Hawkins et al (1992, p 88), for example, argue that: " the most powerful effect of interdiction and enforcement activities is to communicate general social norms of disapproval for the distribution and use of illegal drugs."

In summary, while increasing existing law enforcement efforts may not increase the price or reduce the availability of heroin, maintenance of the current laws may promote social values and norms which discourage heroin use (Moffit et al, 1997). Moreover, while social and contextual factors may have weak associations with rates of substance use, interventions that target these factors may nonetheless provide an environment in which other programs are more likely to be effective (Fergusson, Horwood & Lynskey, 1998; Kleiman, 1993).

3.2. FAMILY FUNCTIONING AND FAMILY SUBSTANCE USE

The literature on adolescent substance use behaviours has identified an array of family factors that are associated with increased rates of illicit drug use during adolescence. These have included: poor quality of parent-child interaction and parent-child relationships (Cohen et al, 1994; Hundelby & Mercer, 1987; Jessor & Jessor, 1977; Kandel et al, 1978), parental divorce and conflict (Doherty & Needle, 1991; Fergusson, Horwood & Lynskey, 1994; Flewelling & Bauman, 1990; Needle et al, 1990); and parental and sibling substance use (Bailey et al, 1993; Barnes & Welte, 1986; Brook, Brook, Gordon, Cohen & Whiteman, 1990; Charlton & Blair, 1989; Lynskey, Fergusson & Horwood, 1994; Von Knorring, 1991).

In general, this literature suggests that there are two main aspects of the family environment, which are associated with increased rates of licit and illicit drug use among children and adolescents. These are the extent to which the child is exposed to a disadvantaged home environment with parental conflict and poor discipline and supervision, and the extent to which the child's parents and siblings use alcohol and other drugs.

3.3. INDIVIDUAL FACTORS

A number of individual factors during early childhood are associated with increased rates of alcohol and other drug use during adolescence and young adulthood. Two of these are the personality traits of high novelty seeking (Cannon et al, 1993; Cloninger et al, 1988) and sensation seeking (Earleywine & Finn, 1991; Lipkus et al, 1994; Pederson, 1991; Thombs et al, 1994). Early behavioural problems, particularly disruptive and troublesome behaviours during childhood, predict early and regular use of alcohol and other drugs (Lynskey & Fergusson, 1995; Newcomb et al, 1986; Robins, 1978; Shedler & Block, 1990; Windle, 1990). Poor performance on tests of intelligence, poor school performance and low commitment to education all increase the risk of adolescent alcohol and drug use (Bewley & Bland, 1977; Bewley et al, 1974; Chassin et al, 1984). Generally, the earlier that substance use begins, the higher the risk of an adolescent becoming a regular user (Fergusson et al, 1994; Fleming et al, 1982; Kandel et al, 1976; Robins and Pzybeck, 1985; Schukit & Russell, 1983).

These findings may be summarised briefly as follows. Children who perform poorly in school, with impulsive or problem behaviour in childhood, and children who are early inititiators of alcohol and other drug use, are those who are most likely to become heavily involved in alcohol and other drug use. They are, in turn, those who are most likely to use drugs like heroin and cocaine (Kandel, 1993).

3.4. Peer Affiliations During Adolescence

A large number of studies have found that affiliating with delinquent or drug using peers is one of the strongest predictors of adolescent alcohol and other drug use (Barnes & Welte, 1986; Botvin et al, 1992; Brook et al, 1990; Castro et al, 1987; Elliot et al, 1985; Fergusson, Horwood & Lynskey, 1995; Kandel & Andrews, 1987). In her highly influential review of adolescent substance use, Kandel (1980) concluded that:

> "The most consistent and reproducible finding in drug research is the strong relationship between an individual's drug behaviour and the concurrent drug use of his friends either as perceived by the adolescent or as reported by the friends." (p 269).

Although the nature of this strong relationship between peer affiliations and adolescent substance use remains controversial, the weight of the evidence favours the view that peer affiliations during adolescence are an important determinant of alcohol and other drug use, one that operates independently of individual and family risk factors (Hawkins et al, 1992).

3.5. Associations between Risk Factors

An important finding in research on adolescent alcohol and drug use is that exposure to these risk factors is often highly correlated. That is, a young person who initiates substance use at an early age has often been exposed to multiple social and family disadvantages (Newcomb et al, 1986). They also often come from families with problems and a history of parental substance use, are often impulsive and have performed poorly at school. They tend to affiliate with delinquent peers, a fact that is encouraged by ability streaming in schools which places many children with poor school performance and family disadvantages in the same class. Consequently, although these factors individually make small contributions to the use of illicit drugs, a young person who has a number of these risk factors, as they often do, is at high risk both of starting illicit drug use at an early age, and of developing serious problems related to their licit and illicit drug use.

4. The Health Consequences of Heroin Use

The major health risks of heroin use can be considered under the following headings: dependence on the drug; infectious disease contracted from sharing injecting equipment; and premature death from opioid overdose and other causes. Research on the prevalence and risk factors for each of these adverse health consequences is reviewed from both the Australian and international literature below.

4.1 Heroin Dependence

Persons who are heroin dependent have impaired control over their use of heroin, indicated by continuing to use heroin in the face of problems that they know (or believe) to be caused by heroin use. These problems include legal difficulties arising from being arrested for drug or property crimes, imprisonment after conviction for these offences, interpersonal and family problems, and serious health problems such as infectious diseases and life-threatening drug overdoses. In Australia, dependent heroin users who seek treatment are typically heroin injectors (e.g. Bell et al, 1995; Hall et al, 1993).

Most heroin users do not become instantly addicted to heroin. The estimated one in four heroin users who eventually become dependent on heroin (Anthony et al, 1994) typically report a 1 to 2 year period between their first use of heroin and their first period of sustained daily use (a reasonable indicator of dependent use). As is true of other types of drug dependence, the development of heroin dependence, including marked tolerance and withdrawal symptoms, probably requires daily heroin use over several weeks or months. Most heroin users probably gradually drift into this pattern of use rather than setting out with the intention of becoming dependent.

US community surveys of mental disorders, such as the Epidemiological Catchment Area (ECA; Robins and Regier, 1991) and the National Comorbidity Surveys (NCS; Kessler et al, 1994) indicate that approximately a quarter of those who report ever having used heroin meet criteria for heroin dependence. This represents between 0.4% (Anthony et al, 1994) and 0.7% (Anthony & Helzer, 1991) of the US adult population.

Not all dependent heroin users remain dependent. Epidemiological research indicates that there are many more persons who ever become heroin dependent than come to the attention of drug treatment services or the legal system (Anthony et al, 1994; Eisenhandler & Drucker, 1993). Many of these discontinue their heroin use without professional assistance (Biernacki, 1986; Johnson, 1978). It is still nonetheless true that, while many dependent heroin users stop their use in their late 20s and early 30s, a substantial minority remain chronically dependent on heroin for decades. For the sake of brevity, these may be referred to as chronically dependent heroin users.

4.1.1 The Prevalence of Heroin Dependence in Australia

There is only one Australian survey that has estimated the population prevalence of heroin dependence

in the same way as the ECA or the NCS in the USA. The National Survey of Mental Health and Well-Being (NSMHWB), conducted in 1997, estimated that 0.2% of the Australian population met ICD-10 criteria for opioid dependence in the past year (Hall et al, 1998). This was equivalent to 27,000 dependent heroin users in Australia in 1997. Because the sample size was only 10,641 the number of dependent heroin users identified in the NSMHWB was too few to provide either an accurate estimate of population prevalence or to enable detailed analyses to be done on the characteristics of dependent heroin users.

The 1998 National Household survey of drug use (AIHW, 1999) estimated the number of Australian adults who had used heroin in the past year. This was 113,000 persons. If we assume (following Anthony et al, 1994) that approximately one in four of these users were dependent on heroin, then the estimated number of dependent heroin users would be 28,250. The NSMHWB estimate is close to this estimate. Both seem too low because in 1998 there were almost as many heroin users in treatment (see below).

4.1.1.1 Indirect Prevalence Estimates

There are a number of further methods for producing indirect estimates of the number of dependent heroin users in Australia. A brief discussion of these methods, and estimates of the prevalence of heroin dependence based on the application of each method, are provided below. A more detailed report on estimates of dependent heroin users is in preparation.

Multiplication Methods

Multiplication methods estimate the number of dependent heroin users in the population by multiplying the number of heroin dependent individuals who come to the attention of services for their heroin use (e.g., arrested for a heroin offence, died of a heroin overdose, or sought treatment for heroin dependence) by some number that is assumed to reflect the proportion that these cases represent of all dependent heroin users in the population. For example, it has been estimated from longitudinal studies of heroin users that 0.5% to 1% will die in any one year from an opioid overdose. This can be used to estimate the number of dependent heroin users in the Australian population as follows. There were 600 opioid overdose deaths among young adults aged 15 to 44 years in Australia in 1997 (Hall et al, 1999). The estimated number of heroin dependent individuals in the Australian population would therefore be in the range of 60,000 to 120,000.

Multiplication methods are direct, simple to use, and easy to understand but there are several obvious problems with them. First, in the absence of baseline data on the prevalence of heroin dependence, it is difficult to estimate the appropriate "multiplier", i.e. the number by which the known number of heroin users should be multiplied to estimate the total number in the population who have not come to official attention. Second, problems with data collection systems may make it difficult to estimate the number of arrested heroin dependent individuals, the number of opioid overdose deaths and the number of people seeking treatment for heroin dependence. Third, the number of identified heroin dependent people can

also vary for reasons that are not related to the prevalence of heroin use (e.g. decreases or increases in government funding for drug treatment or drug law enforcement). For all these reasons, multiplication estimates need to be critically examined.

Accepting these limitations, the following is an estimate the number of people who are heroin dependent in Australia derived from data on the number of people who are currently receiving methadone maintenance treatment in Australia.

Firstly, the number of clients currently receiving methadone maintenance treatment is 22,500. If the number of individuals receiving any form of treatment for heroin dependence can be estimated by multiplying the number of people in MMT by 1.5 (Hall, 1995), then the estimated number of individuals receiving treatment for heroin dependence in Australia is 33,750. Secondly, if for every individual receiving treatment there are a five to nine who are heroin dependent (Hartnoll et al, 1985), then the estimated total number of heroin dependent people in Australia is between 202,500 and 337,500. However, recent estimates suggest that the treatment multiplier in Australia should be smaller than the 5-9 estimated in London in the early 1980s (Hartnoll, 1985). If a multiplier of 3 or 4 (Hall, 1995) is used, then the number of dependent heroin users in Australia would be between 101,250 and 135,000, closer to the multiplier estimate derived from opioid overdose deaths above (60,000 to 120,000).

Capture-Recapture Estimates

A further approach to estimating the size of the heroin dependent population involves the use of the capture-recapture method. This conceptually simple method was originally developed in animal ecology to estimate the size of hidden animal populations. It involves "capturing" an initial sample, tagging the captured individuals (e.g. by name or other unique identifier in the case of a person) and then releasing them. A second sample is then obtained and the number of "recaptured" individuals is observed in this subsequent sample. The rationale of the method is that the ratio of the original sample size to the total population size is the same as the ratio of the number of recaptured individuals to the size of the second sample (see Appendix A).

The method makes a number of assumptions that may be violated when using it to estimate the size of the heroin dependent population. A strong assumption is that the population is "closed", that is, no new members enter the population and no members leave the population in the time between taking the two (or more) samples. Over the period of a year (which is often used) (e.g. Kehoe et al, 1991), we know that new persons become heroin dependent and others exit from dependence (e.g. by becoming abstinent, dying or going to gaol). Other assumptions are that each member of the population under study is equally likely to be "captured" and that the chance of being included in two such samples is the same for all individuals. There are sensitivity tests and elaborations of the initial method that can be used to examine the extent to which the estimates obtained from this method are sensitive to violations of its underlying assumptions (Hook & Regal, 1995).

Another limitation of the capture-recapture method is that data sources that are often used exclude the infrequent heroin user. This is clear in studies that estimate the size of the heroin using population from the number who are in contact with health services or the criminal justice system, most of whom have experienced health or legal problems as a result of their heroin use. Consequently, capture-recapture methods are most suited to estimating the size of the dependent heroin using population who need treatment or other services.

A final limitation of capture-recapture procedures is that they cannot be used to estimate the number of heroin users in the whole of Australia (Larson & Bammer, 1996). National estimates can only be obtained indirectly, by adding up separate capture-recapture estimates for a number of geographic areas, such as the larger Australian cities. Even the possibility of doing this is limited because only a small number of studies have applied these methods to estimate the number of heroin users within clearly defined geographic areas, and these have been done at widely different times.

Studies using capture-recapture methods have produced estimates of around 10 000 dependent heroin users in NSW in 1984 (Sandland, 1986), increasing to 15 000 persons in 1989 (Duque de Portugal et al, 1993; Kehoe, Hall and Mant, 1992). Further, it has been estimated that between 890 and 1229 dependent persons were in the ACT in Canberra in 1989 (Larson and Bammer, 1996; for more detail, see Appendix A). No such studies have been undertaken since 1992.

Consensus or Delphi Estimates

A consensus estimate of the number of dependent heroin users in Australia was recently made in a study to produce projections of hepatitis C infections in Australia (Hepatitis C Virus Projections Working Group, 1998). A group of nominated experts in the epidemiology of injecting drug use was surveyed as to their best estimates of the number of dependent heroin users, and the key variables that affect the prevalence of injecting drug use, such as rates of recruitment to heroin use, rates of transition from occasional to regular use, and rates of exit from regular injecting drug use. The results of these first estimates were summarised and fed back to the experts who were asked to produce a revised set of estimates. The best estimate of the number of regular injecting drug users from this procedure was 100,000, with a range between 80,000 and 120,000. This estimate included not only heroin injectors but also regular injectors of other drugs, such as, amphetamines and cocaine. Nonetheless, it is within the range of estimates produced by multiplier estimates.

4.1.2 The Drug Use Careers of Dependent Heroin Users

US research indicates that some dependent heroin users who seek treatment, and those who come to attention through the legal system, continue to use heroin for decades (Goldstein & Herrera, 1995; Hser et al, 1993; Vaillant, 1988). In this population, periods of daily heroin use are punctuated by detoxification, drug treatment and incarceration for drug-related offences. The proportion who achieve enduring abstinence from opioid drugs after any treatment encounter is small, although it gradually increases with age (Goldstein & Herrera, 1995; Hser et al, 1993; Vaillant, 1973).

The low rates of abstinence after treatment are not surprising as many of these dependent heroin users enter drug treatment reluctantly, under legal duress and with considerable ambivalence about their drug use (Gerstein & Harwood, 1990). They enter treatment under informal pressure from family and friends, or because of formal legal coercion when they have been charged with a drug or property offence. In these circumstances it is unsurprising that the proportion who complete treatment, and the proportion of these who remain abstinent, are low. In the year after drug treatment, the majority relapse to heroin use.

Over the longer term (20 years or more), the chances of treated dependent heroin users becoming and remaining abstinent are approximately equal to their chances of dying prematurely (approximately a third in each case). The remaining third cycle through prison, drug treatment and periods of active heroin use well into their 40s and 50s (Goldstein & Herrera, 1995; Hser, Anglin & Powers, 1993; Vaillant, 1973). When periods of voluntary and involuntary abstinence during treatment or imprisonment are included, dependent heroin users are daily heroin users for between 40% (Maddux & Desmond, 1981) and 60% (Ball et al, 1983) of their 20 year addiction careers.

4.2 Infectious Diseases and Heroin Use

Infectious disease specialists have drawn attention to a public health perspective on heroin use. They have shifted the focus of concern from crime and heroin dependence to the health consequences for heroin users that may indirectly affect others who do not use heroin, e.g. the sexual partners and children of heroin users. Foremost among the public health threats that heroin use poses have been HIV and hepatitis C (HCV) which may be transmitted by sharing needles, syringes, and other injection paraphernalia such as swabs, spoons, and torniquets.

4.2.1 HIV

In the USA and parts of Europe, sharing syringes has been a major method of HIV transmission. For example, estimates from the US and Europe suggest that in the region of 50% of new HIV notifications are attributable to injecting drug use. By comparison, in Australia the prevalence of HIV among injecting drug users has been considerably lower, with approximately 8% of HIV diagnoses in Australia being notified in persons with a history of injecting drug use, of whom just under half were men who also reported a history of male sexual contact. The prevalence of HIV infection among people attending

needle and syringe programs (NSPs) in Australia has been estimated as below 3% (National Centre in HIV Epidemiology and Clinical Research, 1998). The main reasons for the lower levels of HIV infection among Australian injecting drug users include Australia's geographic isolation, and the early introduction of needle and syringe programs have averted a major HIV epidemic among Australian injecting drug users.

4.2.2 Hepatitis C

While concerns about infectious disease among heroin and other drug injectors originally focussed on HIV, more recently attention has turned to the role of injecting drug use as a risk factor for the hepatitis C virus (HCV). The prevalence of HCV among needle and syringe attendees has been estimated to be between 50 and 60% (National Centre in HIV Epidemiology and Clinical Research, 1998). In 1993 there were estimated to be at least 80,000 Australians infected with Hepatitis C as a result of injecting drug use, with 10,000 new infections occurring each year as a result of injecting drug use (Crofts et al, 1993).

Although less is known about the natural history of Hepatitis C than of HIV (Wodak & Crofts, 1996), chronic infection has been estimated to occur in 75% of infections, and 3-11% of chronic HCV carriers will develop cirrhosis of the liver within 20 years (Hepatitis C Virus Projections Working Group, 1998). Given the larger number of people infected with HCV, and the more protracted complications arising from this infection, Wodak and Crofts (1996) have suggested that the net health and economic costs of HCV transmitted by injecting drug use are likely to be comparable to those of HIV.

HCV is spread by blood contact, for example by sharing injecting equipment. Unfortunately, although needle exchange programs have been successful in limiting the spread of HIV among the drug using population (Hurley et al, 1997), they have been less successful in halting the spread of HCV. Studies have consistently shown much higher rates of HCV than HIV infection among injecting drug users who use needle and syringe programs.

The are a number of reasons why NSP have been less successful in halting the spread of HCV than HIV. Not only is HCV a more robust virus than HIV; it was well established in the drug using population before NSP were introduced. Over 50 % of IDUs were infected with HCV before NSP started, whereas less than two percent of IDUs had HIV at the same time. This would have ensured that the risks of HCV infection from any episode of sharing were much higher than those for HIV. The high prevalence of HCV among injecting drug users warrant increased efforts to limit its spread among injecting drug users (Crofts and Kaldor, 1999).

4.2.3 Transmission of HIV and Hepatitis C in Prisons

Injecting drug users (IDUs) are likely to spend time in prison at some point in their life. European research has found that between 21% and 65% of IDUs have previously been imprisoned (European

Centre for the Epidemiological Monitoring of AIDS, 1994). In New South Wales 50% of IDUs , and slightly smaller proportions in other states, report a history of imprisonment (see Crofts et al., 1996). IDUs also make up a significant proportion of the prison population: studies have found that between one quarter (26%) and two thirds (64%) of prisoners engaged in injecting drug use prior to imprisonment, with higher proportions in NSW than other states (Crofts et al., 1996).

Injecting drug use is also common in prison, with NSW studies estimating that half of inmates inject while imprisoned, national studies estimating that around a third of inmates do so (Crofts et al., 1996; Darke, Kaye & Finlay-Jones, 1998). Since the majority of those who inject during imprisonment report sharing syringes, the likelihood of infectious disease transmission in prison is very high. Furthermore, while studies with community samples have tended to show decreasing rates of needle sharing over the past 10 years, studies of prison populations have not shown any change in the proportion sharing over the same period (Crofts et al., 1996).

A number of factors increase the likelihood that infectious diseases will be transmitted by injecting drug use in prison. First, prisoners tend to come from socially disadvantaged backgrounds, and are so are likely to have poor literacy and limited education (Dolan, Wodak & Penny, 1995), factors that increase the likelihood of risk taking behaviour. Second, the prevalence of HIV in prisons has been estimated as higher than in the general community. This means that the chances of transmission are higher simply because the base rate of infection is greater (Dolan et al., 1995). Third, the dynamics of the prison population also increase the likelihood of transmission: prisons have both a high annual turnover rate (estimated as three times the size of the prison population at any one time), and a high rate of internal transfers between prisons during a prisoners' sentences (Dolan et al., 1995). These characteristics increase the number of people with whom prisoners come into contact, and hence, the chance that infectious diseases will be transmitted.

The very limited range of prevention measures available to prisoners also contributes to the transmission of infectious diseases via injecting drug use among prisoners. New South Wales is the only jurisdiction with a methadone maintenance program for prisoners but the extent of its coverage is less than that in the community. For example, only one quarter of estimated demand is met in prison whereas one third of estimated demand is met in the community (Dolan, Hall & Wodak, 1996). NSW is also the only state with a bleach program (Dolan et al., 1998), while only NSW and Western Australia provide condoms for prisoners (Lowe, 1998). Evaluation of these programs has found that inmates can access bleach and condoms and were using them when engaging in risk behaviours (Dolan et al, 1996).

Tattooing is another behaviour that occurs in prisons which poses a risk of infectious disease transmission. Tattooing has been found to pose a significant risk for transmission of hepatitis C, even after controlling for injecting drug use (Holsen, Harthug & Myrmel, 1993). Tattooing has also been identified as a risk factor for transmission of HIV (Loimer & Werner, 1992). The limited research on tattooing in Australian prisons indicates that it is common: a survey of inmates in NSW prisons found 38% had been tattooed while in prison (Dolan, Shearer, Hall & Wodak, 1996), while 58% of inmates in WA prisons reported having done so (Close, 1990). The sharing of tattooing implements was also

common, with another study of NSW inmates finding that 16% of inmates shared tattoo implements while in prison (Dolan, Wodak & Hall, 1994).

Penetrative sex among male prisoners is a significant risk for transmission of infectious diseases since male-to-male sex has been identified as one of the most common risk factors for HIV infection (Mann, Tarantola & Netter, 1992). Studies of anal sex among male inmates in Australian prisons have produced average prevalence estimates of approximately 10%, with a range of 2-20% (Crofts, Webb-Pullman & Dolan, 1996). Of particular concern is the finding in one study that HIV-infected prisoners were significantly more likely to be sexually active while in prison (Dolan et al., 1995).

Given the high turnover within prison populations, the high prevalence of risk behaviours, and the lack of opportunity for inmates to reduce the risk of such activities (e.g. through needle exchange), drug injecting prisoners are at high risk of transmitting or contracting infectious diseases such as HIV and hepatitis C. This risk of infection will affect those with whom prisoners come into contact once released, as has been shown by an apparent outbreak of HIV in a Bangkok prison (Choopanya, 1989) which spread to half a million Thais within 5 years. Clearly, the health status of the prison population is of great concern not only in and of itself but also because of the risk to the community as a whole.

4.3. PREMATURE MORTALITY

Dependent heroin users have a substantially increased risk of premature death from various causes in addition to infectious diseases spread by sharing contaminated injecting equipment. These include: drug overdoses, violence, and alcohol-related causes in the substantial proportion of heroin users who also have alcohol problems (Goldstein & Herrera, 1995; Hser et al, 1993; Joe & Simpson, 1990; Vaillant, 1973). Mortality studies among cohorts of heroin users treated before the advent of HIV indicated that they were 13 times more likely to die prematurely than their same aged peers (English et al, 1995). More recently, HIV has been added to the causes of premature death among heroin users in the USA and Europe; emerging evidence suggests that this will become a more important cause of premature death among heroin users in Australia in the future, as will liver disease caused by infection with the hepatitis C virus (Crofts et al, 1993).

It is difficult to disentangle the contribution that heroin use makes to premature mortality over and above the risky and hazardous lifestyle that many heroin users lead. Some of the health risks of opioid dependence arise, in part, because heroin use is a criminal offence. These include infectious diseases from needle sharing and the risk of violence and death from criminal involvement in the distribution of heroin.

English and colleagues (1995) developed estimates of the aetiologic fraction of various causes of death due to illicit drug use in their study of drug-related mortality and morbidity in Australia. Applying their methods to Australian mortality data for 1997 indicates that in 1997 illicit drugs were responsible for 751 deaths among Australians aged 15 to 44 years. Opioid overdose (a combination of deaths

attributed to opioid dependence and accidental opiate poisoning) accounted for 80% (600 deaths) of these drug-related deaths. The next most common cause was suicide, which accounted for 129 deaths in 1997. The remaining deaths were attributed to blood-borne viruses (11 deaths) and a variety of other rare causes (11 deaths).

Opioid overdose death is not only the major cause of illicit drug-related deaths; it was responsible for 60% as many deaths as were attributed to alcohol in the same age group. The number of opioid overdose deaths (600) in this age group was almost twice the number of deaths attributed to motor vehicle accidents involving alcohol (345). In 1997, opioid overdose deaths accounted for 27% of all drug-related deaths and for 8% of deaths in this age group that were attributed to alcohol, tobacco and illicit drug use. Given the disproportionately high proportion of drug-related deaths attributed to overdose mortality, a detailed discussion of the prevalence, causes and possible strategies for the prevention of overdose is given below.

4.3.1 Opioid Overdose Mortality in Australia 1964-1997

Hall and Darke (1997) examined trends in the number and rate of opioid overdose using national data collected during the interval from 1979 to 1995. They found that the number of opioid overdose deaths rose from 70 in 1979 to 550 in 1995. There was a corresponding six-fold increase in the rate (per million of the adult population aged 15 to 44) of fatal overdose from 10.7 in 1979 to 67.0 in 1995. The increase in the rate of fatal overdose was more marked among males (from 15.3 in 1979 to 104.6 in 1995) than among females (from 5.9 in 1979 to 27.9 in 1995). The average age at death increased from 24.5 years in 1979 to 30.6 years in 1995. The increase in overdose mortality was greatest among men and women aged 35 to 44 years, and 25 and 34 years. It was lowest among those aged between 15 and 24 years.

In a subsequent report, Lynskey and Hall (1998a) examined jurisdictional differences in opioid overdose deaths for the period from 1988 to 1996. They found that the highest rate of fatal overdose occurred in New South Wales, Victoria had the second highest rate and the standardised mortality rate among the remaining States and Territories fluctuated quite markedly. Despite these differences in rates of mortality, all States showed an increase in the rate of overdose mortality between 1988 and 1996. Further analyses suggested that, while the rate of opioid overdose has increased throughout Australia, the rate of increase has been greater in some of the smaller States and Territories than it has in New South Wales or Victoria.

In 1996 approximately 6.5% of all deaths among people aged 15-24 years were due to opioid overdose and nearly 10% of all deaths among those aged 25-34 were attributed to this cause. During the interval from 1988 to 1996 the proportion of deaths attributed to opioid overdose increased. In 1996 among individuals aged 25-34 years, the proportion of deaths attributed to opioid overdose was approximately half that attributed to suicide. The rate of increase in the proportion of deaths attributed to opioid overdose was higher than the rate of increase in the proportion of deaths attributed to suicide.

Hall, Degenhardt and Lynskey (1999) reported that the number of deaths attributed to opioid overdose among Australian adults aged 15-44 years increased from 6 in 1964 to 600 in 1997. The proportion of all deaths attributed to opioid overdose among persons in this age group increased from 0.1% in 1964 to 7.3% in 1997, while the mortality rate per million population increased from 1.3 in 1964 to 71.5 in 1997. There were marked differences between birth cohorts in the proportion of deaths that were attributed to opioid overdose. Persons born between 1944-49 had a consistently low proportion of deaths attributed to opioid overdose throughout the period 1964-1997, while successive birth cohorts showed progressively higher proportions of deaths due to opioid overdose. The onset of the increase in overdose mortality began at progressively younger ages in each successive cohort.

The recent marked increases in fatal opioid overdose are not peculiar to Australia. There have been similar rises in the rate of fatal opioid overdose in the Nordic countries (Steentoft et al, 1996), Spain (de la Fuente, 1995; Sanchez et al, 1994), Italy (Davoli et al, 1997), Austria (Risser & Schneider, 1994), the United States (Drucker, 1999; United States Department of Health and Human Services, 1997) and England and Wales (Hall, Lynskey, and Degenhardt, 1999; Neeleman & Farrell, 1997).

Given the high rate of fatal opioid overdose and evidence that this rate is increasing, there is an urgent need to consider strategies for the prevention of overdose. A brief discussion of some potential strategies for preventing overdose is given below.

4.3.2 Risk Factors for Fatal Opioid Overdose

Research on the causes of overdose, recently reviewed by Darke and Zador (1996) and Sporer (1999), has dispelled a number of misconceptions. Firstly, it is commonly believed that many overdose deaths occur among young, relatively inexperienced heroin users. However, Hall and Darke (1997) found that the average age of those dying from overdose in 1995 was 30.6 years. Similarly, Zador, Sunjic and Darke (1996), who reviewed the coronial files of all heroin related deaths in New South Wales during 1992, reported that the average age among males dying from opioid overdose was 30.3 years while among females it was 27.2 years. Zador et al (1996) also reported that the majority (80%) of deaths occurred among regular heroin users. Only two of those who died were identified as novice heroin users, and both were classified by the coroner as suicides.

A second misconception is that the major cause of opioid overdose is unexpectedly high potency of heroin. The evidence in favour of this view is, at best, sparse. While there is an association between purity of heroin and rates of fatal overdose (Darke, Hall, Weatherburn, & Lind, 1999), research evidence suggests that many individuals who die of an opioid overdose have levels of blood morphine at autopsy which are below the commonly accepted toxic dose. A number of case-control studies (reviewed by Darke & Zador, 1996) have indicated that the serum blood levels of opioids among victims of overdose are often no higher than the levels of blood opioids among heroin addicts who die from other causes (Monforte, 1977) or among heroin users suffering non-fatal overdoses (Aderjan et al, 1995; Fugelstad, 1994; Gutierrez-Cebollada et al, 1994).

A third misconception is that overdoses are caused by impurities and contaminants in illicit heroin. Similarly, there is little evidence to suggest that this is the case. For example, Zador et al (1996) found no evidence of contaminants in injecting equipment or at autopsy of the 152 heroin-related deaths that they examined. These findings have recently been replicated in a study of heroin-related deaths occurring in New South Wales between 1992 and 1996 (Darke, Ross, Zador and Sunjic, 1999).

Concomitant use of opioids with other CNS depressant drugs is an important factor contributing to opioid overdose deaths (Goldberger et al, 1994; Ruttenber & Luke, 1984; Ruttenber et al, 1990; Walsh, 1991; Zador et al, 1996). Concurrent use of alcohol and the benzodiazepines (Chan et al, 1988; Darke & Zador, 1996; Fugelstad, 1994; Monforte, 1977; Richards et al, 1976; Zador et al, 1996) are especially prominent in opioid overdose fatalities. For example, Zador et al (1996) reported that alcohol was detected in 45% of heroin related deaths. The mean blood alcohol concentrations among these cases was 0.14g/ 100 ml and there was a negative correlation between blood morphine and alcohol concentrations, indicating that those individuals who had been drinking alcohol had lower mean blood morphine levels when they died. The association between polydrug use and risks of overdose appears so strong, in fact, that, in their review of the factors associated with overdose, Darke and Zador (1996) suggested that the term "opioid overdose" be replaced by the term "multiple drug toxicity".

4.3.3 Preventing Opioid Overdose

Given the significant prevalence of fatal opioid overdose, there is a need to develop, implement and evaluate effective strategies to prevent or reduce the occurrence of opioid overdose. There are a number of promising strategies that may be successful in reducing fatal opioid overdose.

1. Increasing Access and Utilisation of Methadone Maintenance and other Treatment. The risk of overdose death is substantially reduced in individuals who are enrolled in methadone maintenance treatment (Caplehorn, Dalton, Cluff & Petrenas, 1994; Gearing & Schweitzer, 1974). For example, Gearing & Schweitzer (1974) who studied mortality among 17,000 patients receiving methadone maintenance reported that the mortality rate among methadone maintenance patients (7.6 per 1,000) was similar to that in the general population (5.6 per 1,000). It was significantly lower than the mortality rate among those who left the methadone maintenance program (28.2 per 1,000) and among opioid users who were not in treatment (82.5 per 1,000). Similarly, an Australian study of 307 heroin users enrolled in a methadone maintenance program in the early 1970's found that they were nearly three times more likely to die when they were not receiving methadone than when enrolled on the methadone program (Caplehorn et al, 1994).

Since older, long term users are at greatest risk of fatal overdose, one strategy for reducing fatalities would be to increase the number of older heroin users who are enrolled in methadone maintenance and other treatment. An increase in the number of people enrolled in methadone maintenance treatment has occurred over the past decade (Hall, 1996). However, more effort may need to be made to enrol older users who have not been attracted to methadone treatment. This may require the trial and evaluation of alternative maintenance pharmacotherapies (Mattick, Oliphant, Ward & Hall, 1998) including levo-

alpha acetyl methadyl (LAAM), buprenorphine and slow release oral morphine (see Section 6 below).

2. Educating Injecting Drug Users about the Dangers of Polydrug Use. A recurrent finding in the literature has been that risks of fatal opioid overdose are heightened by the concurrent use of other CNS depressant drugs, particularly benzodiazepines and alcohol. It is therefore important that heroin users are informed about the risks of combining heroin with alcohol and other depressant drugs. A trial of a peer-based intervention to inform heroin users of these dangers has recently been conducted in South Australia (McGregor et al, 1999).

3. Encouraging Injecting Drug Users not to Inject Alone. Heroin users also need to be discouraged from injecting in the streets or alone, thereby denying themselves assistance in the event of an overdose. An evaluation of peer based education on these issues is currently being conducted in South Australia. Recent proposals to establish safe injecting rooms in locations where street injection is common may also be worth serious consideration as a way of reducing overdose deaths caused by these risky practices.

4. Establishing Safe Injecting Rooms. Safe injecting rooms are places in which injecting drug users are able to inject drugs in a clean environment, with sterile equipment and with medically trained persons on hand in the event of an overdose. They are designed to reduce the risks posed by injecting drug use to long term users and to the public, including deaths from overdoses, and the transmission of HIV, HCV and HBV. They also provide a point of contact with services for injecting drug users who are not in treatment.

There is evidence to suggest that supervised injecting rooms hold benefits for both users and the community. Injecting rooms were opened in 1991 in Frankfurt, Germany, as part of a program of harm minimisation that included needle exchange and methadone maintenance programs. In the following 5 years, the number of lethal overdoses in Frankfurt declined by 80%, compared to a 20% reduction in Germany as a whole, suggesting that the program, of which injecting rooms had formed a part, was effective in significantly reducing overdose deaths (Joint Select Committee into Safe Injecting Rooms, 1998). Supervised injecting rooms have been in place in Switzerland since 1986. In these centres, injecting drug users inject in a sterile environment, with cleaning injecting equipment and under the supervision of health workers. Other services provided in the injecting rooms include counselling and referrals to drug treatment programs, free tea, coffee and soup, and inexpensive fruit and vegetables (Dolan & Wodak, in press). An investigation of safe injecting rooms in Switzerland revealed that there was overwhelming support for safe injecting rooms, and recommendations were made to continue this project (Ronco et al., 1994). A joint select committee was convened in NSW in 1997 to investigate the value and the viability of the establishment of injecting rooms in NSW, with the recommendation that safe injecting rooms should be trialed. No such trial has yet been approved.

5. Encouraging Witnesses of Opioid Overdose to Seek Medical Assistance. An additional priority must be to improve users' responses to overdoses that occur among their peers. A number of studies

have shown that, in the majority of fatal and non-fatal overdoses, other people who are present delay seeking assistance for fear of police involvement (Darke et al, 1996a; 1996b; Zador et al, 1996). For example, Zador et al (1996), who examined the circumstances surrounding 152 fatal overdoses in New South Wales, reported that medical assistance was sought prior to death in only 10% of cases. A further study by Darke et al (1996b), who interviewed a large sample of injecting drug users, revealed that many who had been present at the overdose of a friend reported either delaying or failing to seek medical assistance. By far the most commonly cited reason for delay was fear of police involvement. Current initiatives throughout Australia to limit police attendance at overdoses may go some way to reducing these concerns, thereby encouraging earlier requests for medical assistance.

A further strategy to reduce the overdose toll may be to teach injecting drug users simple but effective resuscitation techniques to revive peers who have overdosed or to keep them alive until help arrives. One possible component of such education may be education in the use of naloxone, which is discussed below.

6. The Distribution of Naloxone. Naloxone is a narcotic antagonist that rapidly reverses the effects of acute narcosis, including respiratory depression, sedation and hypotension. It is routinely used by ambulance and emergency department staff to reverse the effects of opioid overdose. Distributing or selling naloxone over the counter to high risk heroin users has been proposed as one means of reducing the number of fatalities due to opioid overdose (Darke & Hall, 1997; Strang et al, 1996).

There are a number of reasons why the distribution of naloxone may be effective in reducing the rate of fatal opioid overdose. Firstly, there are often witnesses to an overdose who would be in a position to administer naloxone, if it was available. Secondly, research has indicated that immediate death from overdose is rare, meaning that there is often an opportunity for bystanders to intervene. Thirdly, the majority of fatal overdoses occur in the home of a victim or that of another user (Zador et al, 1996) so if heroin users had a supply of naloxone in their own homes, it could be used in the majority of overdose instances.

There are also, however, a number of potential problems with the distribution of naloxone. These include the fact that in Australia naloxone is only available on prescription and can only be administered by a medical practitioner or licensed paramedic. Thus, it would need to be rescheduled for over-the-counter sale or distribution. Naltrexone also has a relatively short half-life by comparison with heroin. This may mean that a person who has overdosed on heroin may recover upon administration of naloxone only to overdose again after the effects of the naloxone have worn off. This problem could be overcome by educating users about the risks of further overdoses and by providing them with multiple doses of naloxone. In summary, as there are both benefits and potential liabilities to the distribution of naloxone, the net benefits of naloxone distribution should be assessed by a carefully planned trial and evaluation.

4.4. HEROIN USE AND PUBLIC ORDER

Dependent heroin users who come to attention through the legal system or drug treatment services typically engage in high rates of criminal activity. These offences are most often drug dealing and property crimes (such as, robbery, break, enter and steal, fraud and shoplifting). Heroin dependent women may be involved in prostitution (Hall et al, 1993; Bell et al, 1992; 1995). For example, Lehman and Simpson (1990) found that 99% of a cohort of 490 American heroin users reported that they had engaged in some form of illegal activity during a 12-year period after treatment, and 60% had spent a year or more in gaol. High rates of convictions have been reported among methadone applicants in Australia: 90% had one or more convictions, 76% for drug offences, and 78% for property offences (Hall et al, 1993).

There is no doubt that heroin use and crime are associated, but there is argument about the reason for the association (e.g. Dobinson, 1989; Chaiken & Chaiken, 1990; Hammersely et al, 1989). The simplest interpretation, and the one most often favoured in public discussion, is that heroin users commit property crimes to finance their heroin use. Sceptics have offered two types of alternative explanations. One is that the causal relationship operates in the opposite direction, that is, that property criminals are more likely to become dependent heroin users. Another explanation is that crime and drug use are not directly related but have common causes, such as, multiple social disadvantage, or a criminal subculture that encourages heroin use and crime in the communities within which heroin users and criminals grow up (Clayton & Tuchfield, 1982; Hammersely et al, 1989; McBride & McCoy, 1982).

Heroin use is not a simple and direct cause of criminal behaviour, if this is taken to imply that dependent heroin users would not have engaged in crime if they had not used heroin. The evidence indicates that at least half of treated heroin users were involved in criminal activity, typically property offences, before they first used heroin (Dobinson & Ward, 1984, 1987; Hall et al, 1993; Kaye, Darke & Finlay-Jones, 1998). This is especially true of male heroin users (Kaye et al., 1998); heroin dependent women are more likely to be recruited to heroin use by a heroin-using male sexual partner, so their criminal activities are more likely to follow their heroin use (Hser et al, 1987; Hall et al, 1993).

There also are common causes of crime and heroin use. Longitudinal studies of drug use and criminal behaviour in the US indicate that common causes are at work in adolescence when drug use and criminal behaviour are first manifested. For example, adolescents who have a history of poor school performance, who begin to use alcohol and tobacco in their early teens, and who have a juvenile criminal history, are those who are most likely to use heroin in their late teens (Elliot, Huzinga & Ageton, 1985; Jessor & Jessor, 1977; Kandel, 1993). Future heroin users begin all types of drug use at an earlier age than their peers, are more likely to become heavily involved in tobacco and alcohol use, and are also more likely to be exposed to illicit drugs at an earlier age. They are also more socially deviant and nonconformist than their peers, and more likely to associate with other socially deviant and delinquent peers. All these personal attributes and life experiences make them more likely to use a highly stigmatised drug like heroin and to engage in crime (Elliot et al, 1985; Jessor & Jessor, 1977).

None of this evidence excludes the reasonable hypothesis that dependent heroin use contributes to the frequency with which heroin users engage in criminal acts. Indeed, there is good evidence that the

frequency of heroin use is positively correlated with the frequency of criminal activity among dependent heroin users. McGlothlin et al (1978) studied the criminal and drug use careers of 590 heroin addicts in California and Ball et al (1983) studied 343 heroin users in Baltimore. Both groups found a much higher rate of self-reported crime when users were using heroin daily than when they were abstinent in the community. McGlothlin et al showed the same difference in the frequency of recorded arrests, indicating that the relationship between self-reported heroin use and crime was not the result of response biases. The differences in reported rates of criminal activity between periods of active heroin use and abstinence were substantial. In Ball et al's study, for example, when users were abstinent there was a 75% drop in the number of days that they engaged in crime. Substantial reductions in criminal activity have also been noted among heroin users engaged in MMT (e.g. Ball & Ross, 1991).

Even so, some remain sceptical about a causal interpretation of the difference in rates of crime during periods of daily heroin use and abstinence. Hammersely et al (1989), for example, argued that there may be a common cause of the fall in rates of crime and heroin use, e.g. active criminals may choose to take a break from both heroin use and crime. This is an unlikely explanation of the findings of McGlothlin et al (1978) since some of the periods of abstinence were produced by compulsory drug treatment and community supervision under the California Civil Addict Program. On the grounds of parsimony, the simplest explanation of these data is that frequency of heroin use is a contributory cause of the frequency of criminal activity (Hall, 1996).

There are additional arguments in favour of the hypothesis that heroin use is a contributory cause of the frequency of criminal offences. This is the explanation that heroin users provide of some of their criminal activities (Johnson et al, 1985). Although such reports may be self-interested and exculpatory, they are consistent with what ethnographers observe about the heroin use and criminal behaviour of heroin users (Johnson et al, 1985; Maher et al, 1998; Preble & Casey, 1969). Such behaviour also makes good social and economic sense. Because heroin is an illegal commodity it can only be obtained at high cost on the blackmarket, necessitating dealing with the criminals who control its distribution. Its high costs also means that one cannot use illicit heroin often enough, and for long enough, to become dependent without having a large income. For young people who are poorly educated and lacking in job skills, as many heroin users are, such an income is most likely to come from drug dealing, property crime or prostitution. Heroin users who refuse to engage in crime accordingly find it more difficult to become dependent on heroin. It is unsurprising then that many of those who become dependent on heroin were involved in crime before they used heroin. Since they typically lack highly marketable job skills, they are more likely to resort to crime to fund the high cost of their heroin use.

4.4.1 Gender Differences in the Heroin-Crime Link

While male and female dependent heroin users are likely to be involved in some form of criminal activity to help support their heroin use, the nature and type of crime in which they are involved differs. Males are more likely to be involved in property crime while females appear more likely to be involved in prostitution. For example, Hser, Anglin & McGlothlin (1987) reported that among a sample of 424 Anglo methadone maintenance clients, 25% of the women but none of the men reported involvement in

prostitution. They also found that females were more involved in forgery while men favoured burglaries and robberies. Hser et al's (1987) estimate of the percentage of female opiate addicts involved in prostitution is a little lower than some other studies with estimates in the range of 40-70% of female addicts involved in prostitution.

The extent to which injecting female drug users are involved in prostitution has implications for the spread of infectious diseases. These individuals engage in two high risk activities for the spread of these diseases: injecting drug use with the potential sharing of needles; and multiple sexual partners with increased probability of unsafe sexual practices. Sexual transmission of these viruses by female drug users involved in prostitution may provide a bridge between the injecting drug using population and the rest of the population.

4.4.2 Conclusions on the Link between Heroin Use and Crime

In concluding that the frequency of heroin use is a contributory cause of the frequency of criminal activity, it is important to be clear about what this type of causal interpretation entails, since some sceptics have been motivated by mistaken assumptions about what it implies. First, it does not mean that heroin users are driven by pharmacological necessity to commit crime. The association between crime and heroin use is historically contingent upon the prohibition of heroin use and the existence of a criminal subculture within which heroin use is common, both of which are relatively recent developments in the US (Ball & Chambers, 1970; Courtwright, 1986), the United Kingdom (Strang & Gossop, 1994) and Australia (Hall et al., 1999). Given this historical contingency, the consequently high cost of heroin, and the willingness of many dependent heroin users to commit criminal offences, it is not surprising that the frequency with which they commit crimes is determined in part by the amount of heroin that is required to meet their needs.

Second, the type of causal interpretation we have proposed *does* imply that reducing the heroin dependent offenders' need for heroin will reduce the amount of criminal activity in which they engage. There is no logical requirement, however, that their criminal acts will be eliminated, as Hammersely et al (1989) have mistakenly claimed. Research reviewed below indicates that reducing the need for heroin by prescribing an alternative maintenance opioid drug does reduce the rate of crime committed by dependent heroin users.

Third, accepting that heroin use sustains and maintains crime among criminal heroin users does not imply that we should necessarily adopt more punitive law enforcement policies towards heroin users (Clayton & Tuchfield, 1982). Some sceptical arguments are motivated by the mistaken assumption that it does. As will be argued below, accepting that dependent heroin use is a contributory cause of crime may be a good reason for expanding treatment services for persons who are opioid dependent.

4.4.3 The Community Impact of Heroin-related Crime

Only a small proportion of adults ever become dependent on heroin, but the frequency with which they engage in crime and the range of their criminal activity has a disproportionate impact on the communities within which they live. Detailed studies of criminal behaviour and heroin use in New York City indicate that the major criminal activity in which heroin users engage is low level drug dealing, either by direct drug selling, or more often by serving as an intermediary between dealers and buyers by "steering, touting and copping" (Johnson et al, 1985). The average heroin user in this study committed an average of 665 crimes related to drug distribution in a year. This financed a substantial part of their heroin use because they were paid in drugs for their labour (Johnson et al, 1985). It also provided them with an incentive to initiate friends and acquaintances into heroin use, thereby encouraging the spread of heroin use among their social networks and the communities in which they live.

Johnson et al (1985) found that property crimes of robbery, burglary, shop-lifting and other forms of theft were less frequently engaged in than drug dealing, but they still provided a substantial part of the cash income used for drug purchases. The frequency with which these offences were committed by a sizeable minority of dependent heroin users produced very large numbers of property crimes. Johnson et al, for example, estimated that 100 daily heroin users in New York City in 1980 committed 20,900 non-drug offences in a year. Each of these 100 users imposed an estimated economic cost of $22,840 per annum on victims of non-drug property crimes, such as householders who were robbed, or the owners of stores from which goods were shoplifted for resale. Apart from the drug users, the principal beneficiaries of this crime were the persons who purchased the stolen goods at substantial discount.

The scale of the property crime committed by dependent heroin users affects not only those whose homes are robbed, but also those whose household insurance premiums are increased to meet the claims of others who have been robbed. It also affects those who have to pay higher prices for goods purchased in stores with high rates of shop-lifting. High rates of property crimes also reduce the quality of community life more generally by increasing fear of crime, by increasing the costs of home security, and by reducing the amenity of community living.

The relationship between heroin use and crime has recently been explored by Maher et al (1998) in a long-term study of income generation among young heroin users in Southwest Sydney. Results of a survey of 202 heroin users indicated that many, although not all, respondents were actively engaged in some form of criminal activity. This was primarily acquisitive property crime (70%) and the sale and distribution of illicit drugs (70%). Illegally obtained or criminal income accounted for 82% of the sample's total income in the week before interview. While these data do not imply that all heroin users commit crime, or that all crime is committed by heroin users, they show, as the authors concluded, that dependent heroin users make a significant contribution to acquisitive property crime in Australia. They estimated that the total costs of heroin-related crime were between $535 million and $1.6 billion Australian dollars.

5. Drug Treatment as a Public Health Strategy

There are a number of treatments and treatment approaches available for people who are heroin dependent or experiencing problems as a result of heroin use. A brief description of the principal treatment modalities (detoxification, drug free treatments, and drug substitution) is given below and the following section (5.2) presents evidence on the efficacy of these treatments. The research indicates that not only are these treatments of benefit to those who receive them; they are also a sensible investment of public funds in that they produce substantial returns in terms of reduced crime, drug use, and mortality (Gerstein, Harwood & Suter, 1994; NTORS, 1997). They therefore should be seen as part of a public policy response to the adverse effects that heroin use in Australia has on public health and public order.

5.1. TYPES OF TREATMENT

5.1.1 DETOXIFICATION

Detoxification is the supervised withdrawal of a drug dependent person from their drug of dependence with the aim of minimising the severity of the withdrawal symptoms that are experienced in the process. Although not a specific treatment for heroin dependence (or indeed for any other form of drug dependence) (Mattick & Hall, 1996), detoxification is one of the interventions most often sought by dependent heroin users (Marsh et al, 1990). From the heroin user's point of view, one of its attractions is that it reduces their opioid tolerance, and hence, the amount of street heroin that they need to achieve the desired pharmacological effect (Marsh et al, 1990). It should be regarded as a palliative treatment for opioid withdrawal that provides heroin users a respite from drug use, and an occasion to reconsider the wisdom of continued heroin use. It also provides an opportunity for outreach and education of heroin users, and although not a treatment in itself, it can be a prelude to abstinence-oriented treatment.

In Australia in recent years entrepreneurs have promoted "Ultra-Rapid Opiate Detoxification" (UROD) as a treatment for heroin dependence that achieves abstinence in up to 65% of patients 12 months after treatment. UROD involves two stages of treatment: rapid detoxification under a general anaesthetic, followed by up to a year's maintenance on the opioid antagonist naltrexone. "Rapid detoxification" is achieved within 24 hours by administering naltrexone under a general anaesthetic to displace heroin from opioid receptors in the brain. This is accomplished under general anaesthesia so that patients do not experience the distressing symptoms of accelerated opioid withdrawal.

The purported benefits of UROD are: the rapid completion of withdrawal by 100% of patients who start the process; immediate commencement of daily doses of naltrexone that blocks craving and prevents the euphoric effects of heroin or other opiate agonists that may be injected, producing high rates of enduring abstinence a year after treatment. There is good evidence that naltrexone accelerates opiate withdrawal. General anaesthesia does prevent patients from experiencing withdrawal symptoms. But there is no evidence from controlled clinical trials that UROD and naltrexone maintenance produce

the high abstinence rates claimed at 12 months (Kleber,1998; Hall and Wodak, 1999).

5.1.2 Drug-free Treatment Approaches

Drug-free treatment approaches include: residential treatment in Therapeutic Communities (TCs); out-patient drug counselling (DC); and self-help groups like Narcotics Anonymous (NA). All these approaches share a commitment to achieving abstinence from all opioid and other illicit drugs; they all eschew the substitution of other opioid drugs for heroin; and they all use group and psychological interventions to assist dependent heroin users to achieve enduring abstinence from all drugs and to learn to address their problems in ways other than by using opioids and other drugs.

TCs typically involve residential programs of 3 to 12 months' duration during which users live and work within a community of other users, ex-users and professional staff. Group processes and individual counselling are used to change self-defeating behaviour and to support abstinence (Mattick and Hall, 1993). Drug-free outpatient counselling is usually provided individually on an out-patient basis by drug counsellors (usually professionals but may include some former drug users). The aim is to address any underlying psychological problems and to assist drug users to become and remain abstinent. These programs often provide vocational rehabilitation and training.

NA runs self-help groups in the community which follow a program modelled on the 12-step program originally developed by Alcoholics Anonymous. The assumption is that addiction is a disease for which there is no cure. Recovery can only occur if the addict remains abstinent from all mind-altering substances. The fellowship aims to assist its members to achieve and maintain abstinence by providing mutual help and support in working through the structured program of the 12 steps (Wells, 1987).

Recently, there has also been renewed interest in the use of Naltrexone, an opiate antagonist, as an adjunct to drug free treatment. Naltrexone has been used as an opiate antagonist for a number of decades: it completely blocks the opiate receptor cells so that any opiates in a person's system will be displaced, meaning that if any opiates are taken, they have no effect. Opiate antagonists have been discussed as possibly extinguishing the conditioned withdrawal response occurring in response to environmental stimuli associated with the use of drugs (e.g. Wikler, 1980). Naltrexone maintenance hence aims to ensure that the client remains opiate-free.

5.1.3 Drug Substitution Treatments

Drug substitution treatment substitutes a longer-acting, usually orally administered, opioid drug for the shorter-acting heroin that is typically used by injection. It aims to stabilise the dependent heroin user so that they become more accessible and amenable to rehabilitation. They are among the most popular forms of treatment with heroin users (Marsh et al, 1990). MMT is the most common form of drug substitution worldwide and it is the only type of opioid substitution treatment that is currently provided in Australia (Mattick & Hall, 1993).

Dole and Nyswander (1965, 1967) introduced orally administered maintenance doses of the synthetic opioid drug methadone as a drug-substitution treatment for opioid dependence. Methadone provided a legal and controlled supply of an opioid drug which only had to be taken once a day because its long duration of action eliminated opiate withdrawal symptoms for 24 to 36 hours. When given in high or `blockade' doses, it blocked the euphoric effects of injected heroin, thereby providing an opportunity for the individual to improve his or her social functioning by taking advantage of the psychotherapeutic and rehabilitative services that were an integral part of the program.

5.2 The Effectiveness of Treatment for Heroin Dependence

Ideally, the effectiveness of all treatments for drug and alcohol dependence would be evaluated by randomised controlled trials in which representative samples of patients are randomly assigned to receive either a specified treatment or some ethically defensible minimum form of treatment (e.g. advice to stop drug use and referral to Narcotics Anonymous). Such studies have only been conducted on MMT, and there are very few of them. Assessments of the effectiveness of treatments for heroin dependence has had to depend upon the consistency of evidence from observational treatment outcome studies in which large groups of persons selecting different types of treatment are followed over time to evaluate its impact on drug use, crime and other outcomes. Statistical methods are used to assess the plausibility of alternative explanations of differences in outcome between different forms of treatment. Among these the leading hypothesis is that the different forms of treatment attracted heroin users who had very different prognoses.

It has also been common to evaluate the success of treatment for heroin dependence in terms of the proportion of heroin users who become abstinent during treatment and remain abstinent thereafter (Hall, 1993). When evaluated by this standard, all interventions for heroin dependence have poor results. Most attempts at heroin detoxification, for example, fail since many users do not complete detoxification, and few of those who do achieve enduring abstinence from opioid drugs (Mattick and Hall, 1996). It is more realistic to judge the outcome of treatment or heroin dependence by comparing the effects of drug treatment on the frequency of heroin use and crime, and the health and well being of heroin dependent persons. When judged by these more realistic criteria, treatment for heroin

dependence is a good investment of community resources (Hall, 1993; Gerstein & Harwood, 1990).

5.2.1 Drug-free Treatment

There is little research evidence on the effectiveness of NA and other self-help approaches, and there have been no randomised-controlled trials for TCs or outpatient DC. Most of the evidence on the effectiveness of TC and DC programs comes from observational studies such as the Drug Abuse Reporting Program (DARP) (Simpson & Sells, 1982) and the Treatment Outcome Prospective Study (TOPS) in the USA (Hubbard et al, 1989). In general, TCs and DC are more demanding of drug users, and hence are less successful than MMT in attracting dependent heroin users into treatment and in retaining them in treatment. They do nonetheless substantially reduce heroin use and crime in the minority of entrants who remain in treatment for long enough to benefit (at least three months) (Gerstein and Harwood, 1990; Hubbard et al, 1989; Mattick and Hall, 1993). There is some evidence that TCs may be more effective if they are used in combination with legal coercion or during imprisonment to ensure that heroin users are retained in treatment long enough to benefit from it (Gerstein and Harwood, 1990).

5.2.2 Naltrexone

A requirement for the effectiveness of naltrexone maintenance is that naltrexone is taken daily: hence, one of the biggest determinants of the effectiveness of naltrexone's efficacy is the client's motivation to remain abstinent (and therefore take naltrexone). Such motivation may not characterise the majority of opiate dependent persons, many of whom enter treatment through coercion (either legal or social). Research has shown that 90% of individuals on naltrexone maintenance resume illicit opiate use within 12 months in the absence of outpatient treatment (Kosten, 1990).

The success of naltrexone maintenance, as for any treatment, depends ultimately upon the outpatient treatment program, the nature of the client group, and the appropriateness of the program to the client group (Stine & Kosten, 1997). Research indicates that the majority of business executives and physicians who are opiate-dependent who are prescribed naltrexone in combination with outpatient treatment and therapy will significantly improve their social and professional functioning and most will remain opiate free (Ling & Wesson, 1984; Roth et al., 1997; Washton et al., 1984). In comparison, a study conducted in a suburban health project clinic with opiate-dependent persons with an average length of 10.5 years of dependence, found that after 90 days, only 17% of clients remained in treatment, despite the fact that they all expressed a desire for abstinence-based treatment (Tennant et al., 1984).

In summary, it appears that naltrexone may be appropriate for less heavily dependent heroin users, who are motivated to cease use, and who have social and employment stability. Trials of naltrexone are in progress across Australia, reflecting a recent increase in public interest for naltrexone maintenance as an additional treatment for opiate dependence. However, no results have yet been published in a peer-reviewed journal, and the client group targeted in such trials has not been made explicit by the

researchers.

5.2.3 Methadone Maintenance Treatment

Six randomised-controlled trials have been conducted on the effectiveness of MMT. All of these trials have involved small numbers of patients (e.g. Dole et al, 1969) who have been followed up for short periods (rarely longer than one year). Nevertheless, all have produced positive results, despite small sample sizes that worked against finding differences. The positive findings of these trials have been corroborated by the results of controlled observational studies in which statistical forms of control have addressed the major alternative explanations of apparent effectiveness which are dealt with by randomisation in controlled trials (Cook & Campbell, 1979). These controlled observational studies have generally shown that patients in MMT decreased their heroin use and criminal activity while they remained in treatment; they relapsed rapidly to heroin use after leaving treatment (Ward et al, 1992a; Hall, Ward and Mattick, 1998).

More recent evidence indicates that MMT also substantially reduces the transmission of HIV via needle-sharing (Ward et al, 1992b). Studies of self-reported rates of injecting and needle-sharing among opioid injectors who were or were not in methadone treatment indicate that MMT markedly reduces the frequency of sharing needles (Ball et al, 1988; Ball and Ross, 1991; Darke et al, 1990). Studies of HIV seroprevalence also show that MMT has protected patients from HIV infection in locations where HIV has spread rapidly among injecting drug users who have not been in treatment (e.g. Abdul-Quader et al, 1987; Des Jarlais et al, 1989; Novick et al, 1990; Schoenbaum et al, 1989).

5.2.4 Other maintenance pharmacotherapies

There are a number of pharmacotherapies available as alternatives to methadone maintenance: levo-alpha-acetylmethadol (LAAM), buprenorphine, slow release oral morphine, and injectible heroin. The characteristics of these are outlined below.

5.2.4.1 Levo-alpha-acetylmethadol (LAAM)

LAAM is a synthetic opiate agonist with an action that is similar to morphine, but which has a much longer half-life than that of other opiates. Its duration of action extends from between 48 to 72 hours which means that dosing is only necessary three times a week.

The safety and efficacy of LAAM is similar to that of methadone. Early studies comparing methadone and LAAM found no significant differences in rates of positive urine screens to opiates, treatment retention, or attendance to the clinic, as well as no differences in self-reported anxiety or opiate use (Jaffe & Senay, 1971; Jaffe et al., 1972). Several large scale studies have also been conducted as part of the process of registering LAAM as an alternative drug treatment approved by the US Food and Drug Administration (FDA). The VA Cooperative study examined the comparative effectiveness of

LAAM and methadone (Ling et al., 1976). It found that the rate of early termination was higher in the LAAM group (80 mg three times a week) than the low dose (50mg daily) or high dose (100mg daily) methadone groups but this appeared to be due to slow induction. For those who stayed in the study, the efficacy of LAAM was similar to high dose methadone, and superior to low dose methadone.

Studies have also assessed the feasibility of moving patients from methadone to LAAM (Ling et al., 1978). A comparison of transfer to LAAM with those continuing in MMT found that more methadone patients dropped out than those who crossed over to LAAM, and more patients opted to continue LAAM than methadone maintenance.

The advantages of LAAM in comparison to methadone lie in the relatively slower onset of the effects, and in the longer duration of the action. This has two consequences: the risks of abuse by patients are reduced as the effects are not felt immediately, which results in a lower risk of LAAM being diverted for abuse by persons not enrolled in LAAM maintenance. Second, it also provides the benefit of fewer visits being required for dosing, making fewer demands on both the patients and on the service provider. This allows greater flexibility to the client and reductions in time taken by clinic staff to prepare doses and keep records.

5.2.4.2 Buprenorphine

Buprenorphine is a mixed agonist-antagonist: it has partial agonist effects similar to those of morphine, but blocks the effects of pure agonists such as heroin or morphine. When given in high doses, the effects of buprenorphine can last for up to 3 days (Rosen et al., 1994). An attractive feature of buprenorphine is the antagonist effect that is seen at higher doses, which has important implications in the risk of overdose and abuse potential (Oliveto & Kosten, 1997). The optimal dosage of buprenorphine is yet to be determined, but research has found that doses of 8mg daily result in similar rates of opiate-free urine screens to methadone doses of 60mg daily (Johnson et al., 1992). Because of the long half-life of buprenorphine, dosing may be made on an alternate or thrice-daily basis, which results in increased flexibility for the client and reduced demands upon the clinic.

5.2.4.3 Slow release oral morphine

Slow release oral morphine is given orally on a 12 hourly or daily basis because its duration of action is shorter than that of methadone. The term "slow-release" refers to the gradual and predictable manner in which morphine is released into the body by the preparation, ensuring that the level of morphine in the blood is more even (Lintzeris & Benporath, 1997). An open study of slow-release morphine in heroin-dependent persons was conducted in Austria (Fischer et al., 1996), with apparent success but no randomised controlled trials have been conducted to date.

Slow release morphine has been used successfully to treat heroin-dependent patients who were intolerant of methadone, with successful results (Fischer et al., 1996; Sherman, 1996). Fewer

symptoms of subjective discomfort (e.g. fluid retention, insomnia, poor concentration) were reported by persons when on morphine compared to their symptoms whilst on methadone. Slow-release may be useful for patients who cannot tolerate the negative side effects of methadone. Recent research has revealed that slow release oral morphine is suitable for pregnant clients, with no apparent complications or health consequences for the child, and no significant differences from methadone maintenance during pregnancy (Fischer et al., 1999).

Because it has a longer period of action than heroin, the abuse potential of slow-release morphine has been estimated to be similar to that of methadone (Ternes & O'Brien, 1990). However, there have been some reports of injuries resulting from the injection of morphine extracted from tablets (Bloor & Smalldridge, 1990) and the tablets can be chewed producing a quicker release of morphine.

5.2.4.4 Injectible heroin maintenance

One way of attracting more heroin users into drug treatment may be to offer injectible heroin maintenance treatment (HMT). Its principal attraction is that it may increase the number of heroin users who are attracted into and retained in treatment by providing them with their preferred drug, heroin, by their preferred route of administration, injection. There are reports of successful clinical experience using this form of maintenance treatment (e.g. Marks, 1987). The opportunity to prescribe injectible heroin has been part of the so-called "British system" since 1926, although it has only rarely been used (Strang and Gossop, 1994). The feasibility, safety and impact of HMT has also been evaluated in a controlled observational trial in a number of sites in Switzerland (Rihs, 1994; Uchtenhagen et al, 1998).

The major constraint upon the use of HMT has been societal concern about providing injectible heroin, even when it is restricted to dependent heroin users who receive it under medical supervision. These concerns take various forms (Bammer, 1995). Some community members have strong moral objections to providing any drug of dependence, whether it be heroin or methadone, to dependent drug users; for them abstinence is the only acceptable treatment aim and outcome. Parents of adolescents worry about sending the "wrong" message to youth about heroin and other drug use. Residents of localities that provide HMT are concerned that there will be a "honey-pot" effect attracting even more heroin users into their communities. Treatment personnel may fear that HMT will create an incentive for heroin users to become heroin dependent, that prescribed heroin will be diverted from dependent to non-dependent heroin users, and that HMT will adversely affect recruitment of dependent heroin users into less attractive forms of drug treatment.

Even if there was stronger public support for HMT the costs of providing it mean that the scale of its provision is likely to be modest. The costs of HMT are of the order of two to three times those of providing MMT (Uchtenhagen et al, 1998). If we assume a rough equivalence between HMT and MMT in their impact on heroin use and crime (Hartnoll et al, 1980), then on the grounds of cost-effectiveness MMT would be preferable to HMT. That is, we would attract more users into drug substitution by using MMT than by HMT, even if the latter was more attractive than the former, because we could treat many more by MMT than by HMT. HMT would have to produce substantially greater

benefits for each participant than MMT to make it competitive.

All considered, there is a case for cautious trial and evaluation of HMT as an option for opioid dependent persons who have failed to respond to other forms of treatment. It may also have benefits for the community if it reduces the criminal activity of a small actively criminal group of dependent users, and if it reduces their risks of contracting or transmitting HIV and other infectious diseases. It will be much more expensive to provide HMT than MMT. Given the cost of its provision, it will not replace existing forms of treatment but it may provide a modest additional way of ameliorating the health and social problems caused by opioid use.

6. The Future

Heroin use and heroin related harm is currently a topic of great political and public concern in Australia. This concern has been motivated, in part, by perceptions that the use of heroin in Australia is increasing and will continue to do so. The evidence indicating a recent increase in heroin use and its potential implications for public health and public order in Australia is briefly discussed here.

Recent analyses of the combined ASHIDU and ANAIDUS data sets show that the age of initiation to heroin use has declined in recent decades. Among individuals born between 1940 and 1949 the average age of initiation was 20.5 years whereas it was 16.5 years among those born between 1970 and 1979 (Lynskey & Hall, 1998b). Other data consistent with both an increasing prevalence of heroin use and a decreasing age of initiation to heroin use includes the following.

1. *Police and Customs report increased amounts and availability of heroin in Australia.* The annual reports on illicit drug use published by the Australian Bureau of Criminal Intelligence in 1996 (Australian Bureau of Criminal Intelligence, 1996) and 1997 (Australian Bureau of Criminal Intelligence, 1997) show a rise in heroin seizures and heroin-related arrests. The most recent edition (Australian Bureau of Criminal Intelligence, 1997) concludes that: the world-wide production of heroin has increased in recent years; there has been an overall increase in the amount of heroin detected at the customs barrier over the past five years and; heroin was widely available in Australia during 1996-1997. The 1997 Illicit Drug Report also notes a steady decline in the age of people being arrested for heroin related offences. The average age of people arrested for heroin possession in the first quarter of 1995 was 28 years but this decreased to just over 25 years by the second quarter of 1997. During the same time the average age of those arrested for supplying heroin fell from 30 to 25 years (Australian Bureau of Criminal Intelligence, 1997).

2. R*esults from the Illicit Drug Reporting System suggest that there has been a decline in the average age of injecting drug users in Sydney* (Hando et al, 1997). This conclusion was also

supported by reports from key informants in the IDRS. Because of the selected nature of the samples included in the IDRS these results are tentative, but they provide support for an increase in the number of users and a decline in the age of initiation.

3. *A decrease in the age at which overdose mortality peaks.* Analyses of data on overdose mortality during the period from 1979 to 1995 have indicated that more recent birth cohorts have experienced higher rates of opioid overdose mortality than older birth cohorts (Hall and Darke, 1997). These data have also shown a decline in the average age at which overdose deaths have increased across birth cohorts. Among those born in 1960-64, the age at which overdose accounted for10% of all deaths was 33 years while it was only 23.5 years among those born in 1970-74. While an increase in opioid overdose could be attributed to factors other than an increase in the number of people using heroin, these results, which mirror the reported decline in the age of initiation to heroin use, support the view that there has been an increase in the numbers of people using heroin.

4. *International evidence of an increase in the prevalence of heroin use and heroin related harm.* There is evidence that the rise in overdose fatalities in Australia has been paralleled by similar increases in the rate of opioid overdose in the Nordic countries (Steentoft et al, 1996), Spain (de la Fuente, 1995; Sanchez et al, 1994), Italy (Davoli et al, 1997), Austria (Risser & Schneider, 1994) and the United States (United States Department of Health and Human Services, 1997a). For example, annual medical examiner data reported as part of the Drug Abuse Warning Network indicates that the number of deaths attributed to heroin/ morphine (but not other opiates) rose from 2,868 in 1992 to 3,976 in 1995. Similarly, further evidence indicates that the United States has recently experienced an increase in the use of heroin (Office of National Drug Control Policy, 1996) and in the number of hospital admissions related to heroin use (United States Department of Health and Human Services, 1997b).

The convergence of evidence indicates that in Australia there has been an increase in heroin use in recent years and a concurrent decline in the average age of initiation to heroin use. The apparent rise in heroin use is paralleled by a general rise in the rates of many psychosocial disorders among youth (Rutter & Smith, 1995). In a comprehensive review of this issue, Rutter and Smith (1995) documented a rise in the prevalence of a number of psychosocial disorders (including substance use and misuse, juvenile offending, depression, suicidal behaviours and eating disorders) over the last fifty years. They concluded their discussion of possible causal explanations of the rise in psychosocial disorders with the assertion that it cannot be attributed to one specific social condition, such as unemployment or media influences. Rather, it reflects the combination of societal changes that have occurred since the end of the Second World War.

In conclusion, the finding that there has been a steady decline in the age of initiation to heroin use in recent years has a number of important public health implications. It suggests that there has been an increase in the willingness of young people to experiment with heroin use, probably as a consequence of its increased availability in recent years. This, coupled with related evidence that there has been an increase in both the amount of heroin being imported into Australia (Australian Bureau of Criminal Intelligence, 1997) and the demand for treatment for opiate dependence (Hall, 1995), suggests that

Australia is faced with an increase in the use of heroin among its youth, similar to that which was experienced in the early and mid-1980s.

If this is the case, the Australia could be facing: an increased risk of the spread of infectious diseases and particularly HIV and HCV by injecting heroin use; the need for a substantial increase in the provision of treatment services for heroin dependence; and a continued increase in the number of opiate related deaths over the next ten years. The challenge facing Australian society is to develop an effective set of strategies that address these issues while ensuring that recruitment to heroin use declines. Since no single strategy will address all these problems, a combination of coordinated strategies in education, treatment and law enforcement is needed.

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APPENDIX A: CAPTURE-RECAPTURE METHODS FOR ESTIMATING THE NUMBER OF HEROIN DEPENDENT INDIVIDUALS

The rationale of the method is that the ratio of the original sample size (m) to the total population size (N) is the same as the ratio of the number of recaptured individuals (r) to the size of the second sample (s).

That is: $m/N = r/s$

The following formula (or derivatives of it) can then estimate the unknown size of the target population (N):

$N = sm/r$

Sandland (1986) applied refined capture-recapture methods to NSW records of arrest for drug offences between 1979 and 1984. He estimated that there was a large increase in the number of dependent heroin users in NSW over this period from less than 3,000 in 1979 to over 10,000 in 1984. Larson and Bammer (1996) used capture-recapture methods to estimate the numbers of heroin dependent individuals in the Australian Capital Territory in 1989. They used information from methadone treatment services, other drug treatment agencies and arrest data. They estimated that there were between 890 and 1229 dependent heroin users in the ACT in 1989.

Kehoe, Hall and Mant (1992) used data from methadone services, a drug advisory service and a HIV testing service in Eastern Sydney to estimate the number of dependent heroin users residing within the Eastern Sydney Area Health Services region in the late 1980s. Their analyses suggested that there were between 1103 and 3449 dependent heroin users in this area, with a best estimate of 3,000 persons. If, as treatment data suggested, this area contained a third of these users in New South Wales, then there were 15,000 dependent heroin users in New South Wales in 1989. Finally, Duque-Portugal, Martin, Taylor and Ross (1994) used data from two surveys of injecting drug users conducted in 1989 and 1990 to estimate the same population in Eastern Sydney. They estimated that there were 3597 injecting opiate users in the Eastern Sydney Area Health Services region in 1989-90.