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Impact of the heroin shortage:
Additional research

Monograph Series No. 19

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Abbreviations

ARIMA	AutoRegressive, Integrated, Moving Average
BBVI	Blood-borne virus infections
BOCSAR	Bureau of Crime Statistics and Research
CNS	Central nervous system
COPS	Computerised Operational Policing System
DAL	Division of Analytical Laboratories
ED	Emergency departments
HIV	Human Immunodeficiency Virus
HREC	Human Research Ethics Committee
ICD	International Classification of Disease
ICPMR	Institute of Clinical Pathology and Medical Research
IDRS	Illicit Drug Reporting System
IDU	Injecting drug users
KI	Key informants
LAC	Local Area Command
NDARC	National Drug and Alcohol Research Centre
NSMHWB	National Survey of Mental Health and Well-Being
NSP	Needle and syringe program
NSW	New South Wales
SD	Standard deviation
STI	Sexually Transmitted Infections
TSA	Time series analysis

Executive Summary

Background

In early 2001, Australia experienced a sudden and dramatic decrease in heroin availability, concomitant with increases in price and decreases in purity. This phenomenon, known as the 'heroin shortage', was assessed in a comprehensive body of research examining the causes, course and consequence of the shortage (Degenhardt et al. 2004). As a result of those findings a number of additional questions were raised, and some findings required further and more detailed analysis, which are addressed in the current report.

Aims

The aims of the research presented herein were to: (1) assess what impact, if any, the heroin shortage had on initiation to heroin use; (2) examine whether the associated increase in cocaine use led to (a) an increase in violent crime and (b) an increase in sex work; (3) provide a more detailed and analytical analysis of fatal and non-fatal drug overdose; and (4) provide a closer examination of the impact of law enforcement operations on harm reduction in the context of the heroin shortage.

Methods

Data collected as part of the larger heroin shortage study was assessed in greater detail. These data included secondary analysis of extant databases including injecting drug users (IDU) interview data from the Illicit Drug Reporting System (IDRS); data on fatal and non-fatal overdoses was collected from hospital emergency departments (ED), the NSW ambulance service, and laboratories examining suspected drug-related deaths; and monthly NSW Police incident data on arrests for cocaine possession/use, robbery offences, homicides, and assaults was obtained from the Bureau of Crime Statistics and Research. Time series analysis (TSA) was conducted on data where possible.

Semi-structured interviews were also conducted with a variety of representatives from law enforcement and health agencies and also heroin users in and out of treatment. Interviews were audio taped and transcribed verbatim and examined for major themes.

Results and conclusions

Initiation

The proportion of IDU interviewed in the IDRS who were aged 24 years or less decreased from 46 percent in 1996 to 12 percent in 2004, with a marked drop in 2001, the year of the change in the heroin market. Of those who reported first injecting between 1993 and 2000, similar proportions reported heroin and amphetamine as the first drug injected; after 2000, methamphetamine was the most commonly reported drug first injected. Estimates suggested that between 2,745 and 10,560 young persons did not begin heroin use in 2001 as a result of reduced heroin supply. If around one in four of these young users would have progressed to regular or dependent heroin use, then there has been a reduction of between 700 and 2,500 dependent heroin users and a substantial reduction in future heroin-related morbidity and mortality in Australia.

Reduced heroin availability probably resulted in a reduction in the number of new heroin injectors in Australia. However, as initiation to heroin use has decreased, there have been concomitant increases in initiation to injecting with amphetamines. Effort needs to be made to reduce the harms associated with methamphetamine injection, and to ensure that such IDU do not switch to heroin use should heroin supply return in the future.

The relationship between cocaine use and violent crime

There was a significant increase in cocaine use and cocaine possession offences in the months immediately following the reduction in heroin supply. There was also a significant increase in incidents of robbery where weapons were involved. There were no increases in offences involving firearms, homicides or reported assaults. Conclusion: the increased use of cocaine among injecting drug users following the heroin shortage led to increases in violent crime. Other states and territories that also experienced a heroin shortage but did not show any increases in cocaine use did not report any increase in violent crimes. The violent crimes committed did not involve guns, most likely because of stringent gun laws, in contrast to the experience of American cities that have experienced high rates of cocaine use and violent crime.

The relationship between cocaine use and sex work

A clear increase in cocaine use among IDU was accompanied by increased police incidents of cocaine possession/use offences, and increased prostitution offences. Key informants (KI) reported increased numbers of IDU engaging in street-based sex work, along with increased visibility of such workers, and decreases in their health and exacerbation of risky behaviour that were primarily linked by KI to the increases in cocaine use among this group. Apparent later reductions in cocaine availability led to decreased cocaine use and possession offences, along with reductions in prostitution offences, back to levels seen prior to the increase in such use.

Injecting cocaine use was linked to increased visibility and frequency of street-based sex work among a marginalised group of injecting drug users. A reduction in cocaine availability was probably responsible for the subsequent decline in such incidents, and – given that cocaine supply may well return in future – further work is required to develop effective strategies to reduce cocaine-related risks among this group.

Detailed analysis of the impact of the heroin shortage on overdose

Both fatal and non-fatal heroin overdoses decreased significantly when heroin supply reduced; the reductions were greater among younger age groups than they were among older age groups. Despite some evidence of increased cocaine, methamphetamine and benzodiazepine use following the reduction in heroin supply, no clear increases were observed in non-fatal overdoses on these drugs recorded at hospital ED. Examination of data on drug-related deaths suggested that deaths related to heroin use were the predominant driver of drug-related deaths in NSW, and that, when heroin supply reduced, those deaths that occurred were more likely to involve a wider combination of drugs.

Reducing heroin supply reduced deaths related to heroin, and did not result in a concomitant increase to the same degree in deaths related to other drugs. Younger persons appear to have been more affected by the reduction in supply, suggesting that supply reduction does not affect all users in the same way.

Law enforcement, harm reduction and the heroin shortage

Australia's drug policy of 'harm minimisation' encompasses the principles of supply reduction, demand reduction and harm reduction. The role of law enforcement with regard to harm minimisation has nonetheless been contentious because of evidence that heavy policing of drug markets can increase harms to drug users. Some drug policy analysts have argued that harm reduction can be divided into micro (individual level) and macro (or population) level harm. The impact of the heroin shortage on macro and micro level harms was examined using indicators of drug use and harms, interviews with KI from law enforcement and health sectors, and a sample of heroin users. The results show that, despite an increase in harms at the micro (or individual) level, there was an aggregate decrease in harms at the population level. The heroin shortage also facilitated local level policing, as resources previously used for heroin market policing were redistributed to other drug markets and criminal activity. These changes suggest that, in a policy context in which there were good demand and harm reduction initiatives in place, law enforcement could be effective in reducing macro level harm.

Chapter one: Changes in the initiation of heroin use after a reduction in heroin supply

Carolyn Day, Louisa Degenhardt and Wayne Hall

Background

Recent decades have seen apparent increased rates of heroin use and a decline in the age of its initiation among successive cohorts of people born in Australia and the USA (Johnson & Gerstein 1998; Lynskey & Hall 1998; Degenhardt et al. 2000; Hall et al. 1999a). Such patterns are cause for concern because younger age of heroin initiation has been associated with greater risks of polydrug use, unintentional overdose, mental health problems and criminal behaviour, independent of the number of years of heroin use (Lynskey & Hall 1998; Mills et al. 2004).

Heroin 'epidemics'

In the 1960s, de Alarcón (1969) mapped the 'spread of heroin use' in a British community using a contagious disease model, arguing that heroin use 'spreads' as one user initiates another. The concept of the 'spread' of heroin use or heroin epidemics was further explored in the United States where a number of heroin epidemics were mapped in the 1970s (e.g. Hughes et al. 1972; Hughes & Crawford 1972; Dupont & Greene 1973).

According to the 'epidemic' theory, young people who are heroin naïve are introduced to heroin use by friends and peers who are recent initiates, and who therefore have little or no experience of the negative consequences of its use. Such initiation most often occurs when the drug is relatively available to young people (Hughes & Rieche 1995). Crofts et al. (1996) found support for this hypothesis in a study of young recently initiated injecting drug users (IDU) in Australia. The majority had instigated the first injecting episode, but they were assisted or injected by friends who were only a little more experienced than them. These results have been supported by more recent research (Doherty et al. 2000; Roy et al. 2002; Day et al. 2005). A recent survey of heroin users in Sydney also found that a third of the sample reported having taught others to inject (Day et al. 2005).

There has been limited empirical research on the role played by drug markets in heroin initiation. Consistent with theories of heroin use epidemics, if the drug is inexpensive and freely available, then there will be an increase in initiation to heroin use. Conversely, one may expect that a reduction in heroin supply may reduce rates of initiation of heroin injecting.

Australian heroin markets

During the mid-to late-1990s in Australia, heroin availability and purity rapidly increased while street price dramatically decreased (Darke et al. 2002). In New South Wales (NSW), for example, between 1996 and 2000 the street price of heroin halved and the price of a gram of heroin decreased from $400 to $220. Heroin purity at the 'street' level increased from 25% to around 60%, and heroin was the drug most often reported by IDU as the drug that they primarily injected (Topp et al. 2002b; MacDonald et al. 2001; Darke et al. 2002). During this period, there was also evidence of a decreasing age of initiation to heroin use which suggested an increased rate of initiation into injecting heroin use among younger Australians (Lynskey & Hall 1998; Hall et al. 1999a; Degenhardt et al. 2000).

In early 2001, the Australian heroin market underwent dramatic changes (Day 2004a; Degenhardt et al. 2005d). There were reports of a dramatic decline in the availability of heroin in Sydney, NSW, from IDU, law enforcement personnel working in key drug markets across the city, and from those working in treatment agencies targeting heroin users (Day et al. 2003b). These reports were later confirmed across the country by the 2001 Illicit Drug Reporting System (IDRS), Australia's strategic early warning system (Topp et al. 2002b), and examined in the United Nations' *Global Illicit Drug Trends* report (United Nations Office for Drug Control and Crime Prevention 2002).

In NSW, street purity fell from 60% to around 25-30%, availability decreased significantly, and the price of a 'cap' of heroin doubled from $25 to $50 (Day 2004b). The reduction in availability was most severe from January to April 2001, but the heroin market still does not appear to have returned to the levels of supply seen in the late 1990s, with a persistence of lower purity and higher prices (Day 2004b). This change in market conditions occurred in a context of continued demand for the drug (Day et al. 2003b; Day et al. 2003a; Weatherburn et al. 2003).

The consequences of this 'heroin shortage' have been well documented (Degenhardt et al. 2005d). In NSW, they included: reductions in injecting drug use (Day et al. 2004) and drug use patterns (Topp et al. 2003; Roxburgh et al. 2004; Degenhardt et al. in press-b); a reduction in heroin-related arrests and shifts in drug distribution methods and street markets (Degenhardt et al. 2005c); significant reductions in heroin overdoses (Degenhardt et al. 2005b); and changes in drug treatment entry (Degenhardt et al. 2005a).

An analysis of age trends in these changes has also been completed (Degenhardt et al. in press-a). Using interrupted time series analysis across a number of different indicators of heroin-related harm, a significant age effect was found, whereby the reduction in heroin-related harms was greater for those aged 15-24 years than it was for older age groups (Degenhardt et al. in press-a). For example, there was a 49% reduction in the number of heroin possession/use offences among those aged 15-24 years, compared to declines of 31-40% among older age groups. Declines in heroin-related deaths were also greatest among 15-24 year olds (a 65% reduction versus 39% and 44% in older age groups) (Degenhardt et al. in press-a).

Although these age effects suggest that the extent of heroin use *among* 'heroin users' decreased, it does not necessarily indicate that 'initiation' of heroin use has changed. It could be the case, for example, that the reductions seen in heroin-related harm reflect reductions in frequency of heroin use among existing users rather than a decrease in the initiation of new heroin users in this age group.

The theory of 'heroin epidemics' would predict, however, that a decrease in use among young users would also reduce initiation of new users because there are fewer opportunities for existing users to initiate new users. Accordingly, it was of interest to examine evidence on whether initiation to injecting heroin use declined after the reduction in the supply of the drug (and in its use among young persons). If this occurred, we also wanted to estimate the number of persons who may 'not' have begun to use heroin during the period of reduced heroin supply.

This paper aims to examine these issues as follows. First, an analysis of data collected from regular IDU – on drugs first injected over the period 1996-2004 – are examined for evidence that the initiation of heroin use changed after the onset of the heroin shortage; and second, using estimates of the number of injecting heroin users derived from previous research (Degenhardt et al. 2004c), the number of young people who may not have commenced using the drug are estimated.

Method

Data on initiation of drug use from IDU

Data on changes in the age of first injection and first drug injected was derived from the IDRS. The IDRS is Australia's strategic early warning system which monitors the price, purity, availability and patterns of use of illicit drugs (Hando et al. 1998). The IDRS annually collects comparable and detailed information from a sentinel population of IDU in each capital city regarding their history and patterns of drug use. It has been conducted in NSW each June since 1996 and in every state and territory since 2000. The method of recruitment has remained consistent across years and jurisdictions.

The methods for the IDRS have been reported elsewhere (Hando et al. 1998; Darke et al. 2002). Briefly, sentinel groups of IDU were recruited through needle and syringe programs (NSP), treatment facilities, advertisements in street press and via peer referral. To participate, IDU must be regular injectors (at least once a month), be resident in the state's capital city for the year preceding interview, and not have experienced substantial periods of incarceration during the preceding twelve months. Recruitment of such convenience samples is consistent with best practice in drug market monitoring (United Nations Office for Drug Control & Crime Prevention 1999; Griffiths et al. 2000).

A survey examining the demographic characteristics and drug use, patterns of drug use and illicit drug market conditions (price, purity and availability) is administered by trained interviewers. All participants are asked 'How old were you when you first injected any drug?' and 'What drug did you first inject?'. All participants are volunteers and reimbursed between $20 and $30 on completion of the interview. Full details of the demographic and methodological characteristics of each sample can be found elsewhere (O'Brien et al. 1996; Hando & Darke 1998; McKetin et al. 1999; McKetin et al. 2000; Topp et al. 2001; Topp et al. 2002b; Breen et al. 2003; Breen et al. 2004; Stafford et al. 2005).

Estimates of reduction in the number of persons initiating heroin use

Estimates of the number of dependent heroin users in Australia have been made for the period 1997 through 2002 using a combination of multiplier estimates derived from multiple indicators of heroin use, such as arrests for heroin offences, fatal and non-fatal overdoses, and new treatment entries (Degenhardt et al. 2004c). Changes in the number of initiates to heroin use were calculated based on these estimates. Changes to the heroin market were documented at the beginning of 2001, so it was assumed that, had the heroin market remained stable during 2001, the number of dependent heroin users would have also remained stable; the potential reduction in number of new heroin initiates was only estimated for 2001.

The available data suggests that the majority of initiation to heroin use in Australia occurs between the ages of 15 and 24. Sydney heroin users reported a mean age of first heroin use at 19 years (Swift et al. 1999; Darke et al. 1999; Day et al. 2005). The annual rate of initiation to heroin use was assumed to be 10% of the total cohort who used the drug (i.e. the incidence rate in this age period is 10% of the prevalence).

Estimates of the reduction in heroin use initiation were calculated based on parameters derived from interrupted time series analysis of indicators of heroin-related harms (Degenhardt et al. in press-a), plus an estimate that the period of reduced heroin supply 'stopped' all initiation. The four estimates made were:

1.	That the period of reduced heroin supply led to a 100% reduction in initiation;

2. That there was a 65% reduction in initiation – based upon the reduction observed in opioid overdose deaths among those aged 15-24 years old (parameters derived from time series analysis of opioid overdose numbers; Degenhardt et al. in press-a);

3. That there was a 40% reduction in initiation – based upon reduction observed in heroin arrests among those aged 15-24 years old (parameters derived from time series analysis of police incidents of heroin possession or use; Degenhardt et al. in press-a); and

4. That there was a 26% reduction based upon reduction observed in treatment numbers among those aged 15-24 years old (parameters derived from time series analysis of entrants to opioid pharmacotherapy; Degenhardt et al. in press-a).

Recreational heroin users

A multiplier of 2.5 recreational heroin users to regular users was applied to the median estimates of regular heroin users in NSW. This was derived from two independent estimates, one derived from previous work examining the ratio of regular to occasional users (Weatherburn & Lind 1997); and the ratio of past year heroin use to opioid dependence derived from The Australian National Survey of Mental Health and Well-Being (NSMHWB) (Hall et al. 1999b).

Results

Trends noted among IDU

The proportion of injectors interviewed in the IDRS who were aged 24 years or less decreased from 46 percent in 1996 to 12 percent in 2004 (Figure 1.1). Conversely, the proportion of injectors aged 35 or over has increased since 1996 (Figure 1.1). Of notable interest is the fact that the proportion of younger IDU who were interviewed dropped quite markedly in 2001, the year in which the heroin market underwent significant changes.

Figure 1.1: Age composition of IDU samples, 1996-2004
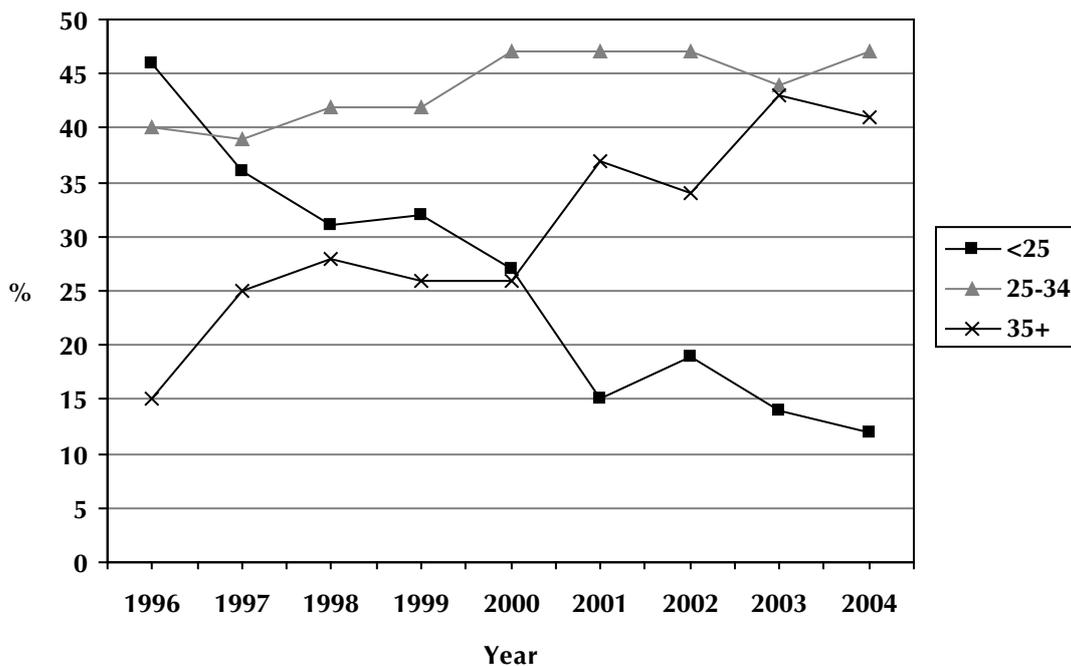
Source: NSW, IDRS interviews 1996-2004.

Figure 1.2 shows the first drug injected (heroin or amphetamine) by IDRS participants by year of first injection. Of those who reported first injecting between 1993 and 2000, similar proportions reported heroin and amphetamine as the first drug injected (Figure 1.2). However, for those who reported first injection after 2000, the proportion reporting heroin as the first drug injected decreased and that for amphetamines increased (Figure 1.2).

Figure 1.2: First drug injected by year of initiation to injecting drug use, 1967-2003
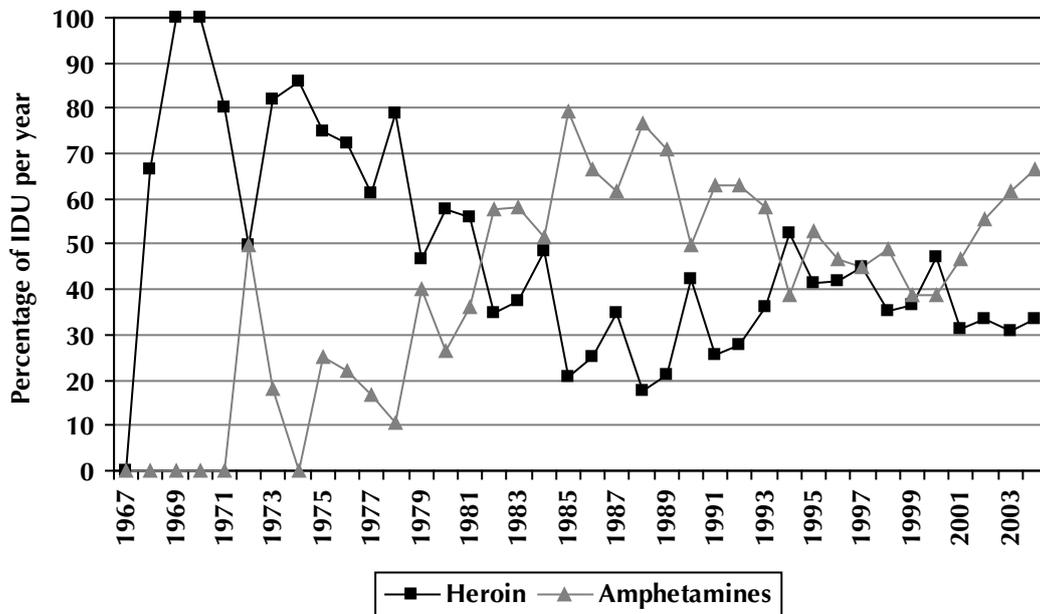
Source: NSW IDRS interviews 2004.

Table 1.1 shows the estimated number of persons who did not begin heroin use in 2001. In 2001 there were an estimated 2,666,746 young people aged 15-24 years in Australia. The estimated rate per 1,000 of initiation to heroin use in 2001 was 3.96. Assuming a 100% reduction in heroin initiation, there was an estimated 10,560 young people who did not commence heroin use. Based on the reduction in opioid overdose of 65%, there were 6,864 fewer young people starting heroin injection in 2001. These figures are reduced to 4,224 and 2,745 for reductions of 40% and 25% respectively, based on observed reductions in the number of heroin-related arrests and treatment numbers for 2001. Figures for NSW are also shown in Table 1.1.

Table 1.1: Estimates of the number of persons who did not start heroin use in 2001.

	NSW			Australia		
	Regular	Occasional	Total	Regular	Occasional	Total
Year 2000 rates of use per 1,000 persons for 15-24 years	15.6	39	44.6	11.3	28.3	39.6
Estimated standard rate per 1,000 of initiation to heroin use in 2001[1]	1.56	3.90	4.46	1.13	2.83	3.96
Number in at-risk population in 2001		884,752			2,666,746	
Estimated number who did not initiate heroin use in 2001						
No initiation[2]	1,380	3,451	4,831	3,013	7,547	10,560
65% reduction in initiation[3]	897	2,243	3,140	1,958	4,906	6,864
40% reduction in initiation[4]	552	1,380	1,932	1,205	3,019	4,224
26% reduction in initiation[5]	359	897	1,256	783	1,962	2,745

1. Assuming that 10% of the cohort will begin heroin use in a given year.
2. Based upon assumption of complete stop in initiation among 15-24 years.
3. Based upon reduction observed in opioid overdose deaths among 15-24 years.
4. Based upon reduction observed in heroin arrests among 15-24 years.
5. Based upon reduction observed in treatment numbers among 15-24 years.

Discussion

This study found an increase from 1996 to 2004 in the age of IDU recruited as part of a routine drug monitoring system across Australia. It is important to remember that these samples were requited in the same manner and from the same locations across years. The reduction in the proportion of younger users accelerated after the reduction in heroin supply in 2001. This finding is consistent with previous evidence that the heroin shortage reduced the number of younger persons injecting heroin (Day et al. 2004; Degenhardt et al. in press-a; Day et al. in press).

The drugs first injected changed considerably after the heroin shortage. Heroin no longer ranked as the most common drug for the initiation of injection drug use; after 2001, methamphetamine became the most commonly injected drug 'among those who initiated any injecting drug use'. This appears to be a return to patterns seen prior to the mid-1990s when amphetamine was the drug reported to be most commonly first injected (Crofts et al. 1996; Darke et al. 1999).

This finding reflects trends among persons who have continued to inject drugs. Following the predictions of epidemic theory, it is new users who initiate their peers into use early in their injecting careers. A range of estimates of the number of persons who may not have started heroin use during 2001 suggested that between 2,745 and 10,560 young persons did not begin heroin use in 2001 as a result of reduced heroin supply. If we assume that around one in four of these young users would have progressed to regular or dependent heroin use (Anthony et al. 1994), then there has been a reduction of between 700 and 2,500 dependent heroin users and a substantial reduction in future heroin-related morbidity and mortality in Australia.

These findings are consistent with other Australian research studies on the impact of the heroin shortage. These include studies showing: a decrease in the number of dependent heroin users, particularly among those aged 15-24 years (Degenhardt et al. 2004c); decreases in needle and syringe distribution though registered programs in NSW (Day et al. 2004); and decreases in the proportion of NSP attendees and new injectors from 1999-2003 (Thein et al. 2004). These findings are also supported by reports from KI working in the field reporting fewer young heroin users presenting to services (Degenhardt et al. 2004a); and documented reductions in heroin use and increases in psychostimulant use among those young people who did enter drug treatment (Degenhardt et al. 2002; Degenhardt et al. in press-a).

The trend observed in the initiation of methamphetamine injection is consistent with other indicators suggesting that there has been a growing methamphetamine market across Australia in recent years, which seems to have developed independently of the heroin market (Topp et al. 2002a). The reported increases in the use and availability of crystalline methamphetamine in particular continue to raise issues for health and law enforcement professionals. It is anticipated that the problems associated with the use of methamphetamine (e.g. amphetamine psychosis, amphetamine dependence, paranoia, cardiovascular complications such as strokes and arrhythmias) develop more quickly in response to the use of the potent crystal form (Methamphetamine Interagency Task Force 2000; Farrell et al. 2002; Matsumoto et al. 2002; Degenhardt & Topp 2003). Changes in patterns of drug use such as these therefore have important implications for drug treatment and other health services.

Limitations

The study has a number of limitations. Firstly, it was necessary to rely on extant indicators of new heroin use, rather than observe the actual rate of heroin use uptake among a susceptible cohort of young people. Secondly, the data may represent a higher rate of *drop out* of young people from the heroin market, rather than a reduction in new initiation. It is also possible that some part of these apparent reductions in heroin use were the result of the natural decline in heroin use that

follows an epidemic, as the harms of heroin use (e.g. overdose deaths) become apparent to current users (some of whom desist) and to non-users who decide not to initiate. However, the available evidence suggests that these market changes occurred in the context of continued demand for heroin (Day et al. 2003b; Weatherburn et al. 2003; Degenhardt et al. 2004b), and that in the face of declining heroin availability there was an increase in the injecting use of other drugs such as methamphetamine (Degenhardt & Day 2004; Degenhardt et al. 2005e).

Conclusions

This research has found that reduced heroin availability probably resulted in a reduction in the number of new heroin injectors in Australia. However, as initiation to heroin use has decreased, there have been concomitant increases in initiation to injecting with amphetamines. Although harms related to heroin use and injecting may decrease, these may have been offset to some extent by increasing methamphetamine-related harms among new injectors. Since the transition from amphetamine injecting to heroin injection is common (Darke et al. 1999), many of these new initiates to injecting drug use may turn to heroin if supply increases. If this happens, the estimated reductions in new heroin injectors may fail to have a longer-term impact on rates of heroin dependence and heroin-related harm in Australia. Nevertheless, these estimates suggest that in the short to medium-term the Australian heroin shortage reduced initiation to heroin use and its resultant harms.

References

Anthony, J. C., Warner, L. & Kessler, R. (1994) Comparative epidemiology of dependence on tobacco, alcohol, controlled substances, and inhalants: Basic findings from the National Comorbidity Survey, *Experimental and Clinical Psychopharmacology*, 2, 244-268.

Breen, C., Degenhardt, L., Roxburgh, A., Bruno, R., Duquemin, A., Fetherston, J., Fischer, J., Jenkinson, R., Kinner, S., Longo, M. & Rushforth, C. (2003) *Australian Drug Trends 2002: Findings of the Illicit Drug Reporting System (IDRS),* NDARC Monograph No. 50, National Drug and Alcohol Research Centre, University of New South Wales, Sydney.

Breen, C., Degenhardt, L., Roxburgh, A., Bruno, R., Fetherston, J., Jenkinson, R., Kinner, S., Moon, C., Proudfoot, P., Ward, J., & Weekley, J. (2004) *Australian Drug Trends 2003: Findings of the Illicit Drug Reporting System (IDRS),* NDARC Monograph No. 51, National Drug and Alcohol Research Centre, University of New South Wales, Sydney.

Crofts, N., Louies, R., Rosenthal, D. & Jolley, D. (1996) The first hit: circumstances surrounding initiation into injecting, *Addiction*, 91, 1,187-1,196.

Darke, S., Kaye, S. & Ross, J. (1999) Transitions between the injection of heroin and amphetamines, *Addiction*, 94, 1,795-803.

Darke, S., Topp, L., Kaye, S. & Hall, W. (2002) Heroin use in New South Wales, Australia, 1996-2000: 5 year monitoring of trends in price, purity, availability and use from the Illicit Drug Reporting System (IDRS), *Addiction*, 97, 179-186.

Day, C. (2004a) Documenting the heroin shortage, in *The Cause, Course and Consequence of the Heroin Shortage in Australia*, (Eds. Degenhardt, L., Day, C. & Hall, W.) National Drug Law Enforcement Research Fund, pp. 39-47.

Day, C. (2004b) Documenting the heroin shortage in New South Wales, in *The Course and Consequence of the Heroin Shortage in New South Wales*, (Eds. Degenhardt, L. & Day, C.) National Drug Law Enforcement Research Fund, pp. 11-17.

Day, C., Degenhardt, L., Gilmour, S. & Hall, W. (2004) Effects of supply reduction upon injecting drug use, *British Medical Journal,* 329, 428-429.

Day, C., Degenhardt, L., Hall, W., Conroy, E. & Gilmour, S. (in press) Changes in blood-borne virus notifications and injecting-related harms following reduced heroin supply in New South Wales, Australia, *BMC Public Health*.

Day, C., Gibson, A., Collins, L., Degenhardt, L. & Dietze, P. (2003a) *Research methodologies used to obtain retrospective self-reports of the impact of changes in heroin supply on regular users,* NDARC Technical Report No. 173, National Drug and Alcohol Research Centre, University of New South Wales, Sydney.

Day, C., Topp, L., Rouen, D., Darke, S., Hall, W. & Dolan, K. (2003b) Decreased heroin availability in Sydney in early 2001, *Addiction,* 98, 93-95.

Day, C., Ross, J., Dietze, P. & Dolan, K. (2005) Initiation to heroin injecting among heroin users in Sydney, Australia, *Harm Reduction Journal BMC,* 2:2.

de Alarcón, R. (1969) The spread of heroin abuse in a community, *Bulletin on Narcotics,* 21, 17-22.

Degenhardt, L., Conroy, E., Day, C., Gilmour, S. & Hall, W. (2005a) The impact of the Australian heroin shortage on demand for and compliance with treatment for drug dependence, *Drug and Alcohol Dependence,* 79, 129-135.

Degenhardt, L., Conroy, E. & Gilmour, S. (2004a) Changes in the health effects of drug use, in *The Course and Consequence of the Heroin Shortage in New South Wales*, (Eds. Degenhardt, L. & Day, C.) National Drug Law Enforcement Research Fund, pp. 51-65.

Degenhardt, L., Conroy, E. & Gilmour, S. (2005b) The effect of a reduction in heroin supply upon population trends in fatal and non-fatal drug overdoses, *Medical Journal of Australia,* 182, 20-23.

Degenhardt, L., Conroy, E., Gilmour, S. & Collins, L. (2005c) The effect of a reduction in heroin supply in Australia upon drug distribution and acquisitive crime, *British Journal of Criminology,* 45, 2-24.

Degenhardt, L. & Day, C. (2004) Changes in patterns of drug use, in *The Course and Consequence of the Heroin Shortage in New South Wales*, (Eds. Degenhardt, L. & Day, C.) National Drug Law Enforcement Research Fund, pp. 19-30.

Degenhardt, L., Day, C., Collins, L. & Gibson, A. (2004b) Changes in injecting drug use, in *The Course and Consequence of the Heroin Shortage in New South Wales*, (Eds. Degenhardt, L. & Day, C.) National Drug Law Enforcement Research Fund, pp. 31-43.

Degenhardt, L., Day, C., Conroy, E., Gilmour, S. & Hall, W. (in press-a) Age differentials in the impacts of reduced heroin: Effects of a 'heroin shortage' in NSW, Australia, *Drug and Alcohol Dependence*.

Degenhardt, L., Day, C., Dietze, P., Pointer, S., Conroy, E., Collins, L. & Hall, W. (2005d) The consequences of the heroin shortage in three Australian States, *Addiction,* 100, 908-920.

Degenhardt, L., Day, C. & Gilmour, S. (in press-b) Changes in community level drug use associated with a reduction in heroin supply, *International Journal of Drug Policy*.

Degenhardt, L., Gascoigne, M. & Howard, J. (2002) Examining the changes in drug use patterns of young people in drug treatment during a period of reduced heroin availability, *Youth Studies Australia,* 21, 11-16.

Degenhardt, L., Lynskey, M. T. & Hall, W. (2000) Cohort trends in the age of initiation of drug use in Australia, *Australian and New Zealand Journal of Public Health,* 24, 421-426.

Degenhardt, L., Rendle, V., Hall, W., Gilmour, S. & Law, M. (2004c) *Estimating the size of a heroin using population after a marked reduction in heroin supply,* NDARC Technical Report No. 198, National Drug and Alcohol Research Centre, University of New South Wales, Sydney.

Degenhardt, L., Reuter, P., Collins, L. & Hall, W. (2005e) Evaluating explanations of the Australian 'heroin shortage', *Addiction,* 100, 459-469.

Degenhardt, L. & Topp, L. (2003) 'Crystal meth' use among polydrug users in Sydney's dance party subculture: Characteristics, use patterns and associated harms, *International Journal of Drug Policy,* 14, 17-24.

Doherty, M. C., Garfein, R. S., Monterroso, E., Latkin, C. & Vlahov, D. (2000) Gender differences in the initiation of injection drug use among young adults, *Journal of Urban Health,* 77, 396-414.

Dupont, R. L. & Greene, M. H. (1973) The dynamics of a heroin addiction epidemic, *Science,* 181, 716-722.

Farrell, M., Marsden, J., Ali, R. & Ling, W. (2002) Methamphetamine: drug use and psychoses becomes a major public health issue in the Asia Pacific region, *Addiction,* 97, 771-772.

Griffiths, P., Vingoe, L., Hunt, N., Mounteney, J. & Hartnoll, R. (2000) Drug information systems, early warning and new trends: Can drug monitoring systems become more sensitive to emerging trends in drug consumption?, *Substance Use and Misuse,* 35, 811-844.

Hall, W., Degenhardt, L. & Lynskey, M. T. (1999a) Cohort trends in overdose mortality in Australia 1964-1996: A window on post-war trends in heroin use, *Medical Journal of Australia,* 171, 34-37.

Hall, W., Teesson, M., Lynskey, M. & Degenhardt, L. (1999b) The 12-month prevalence of substance use and ICD-10 substance use disorders in Australian adults: Findings from the National Survey of Mental Health and Well-Being, *Addiction,* 94, 1,541-1,550.

Hando, J. & Darke, S. (1998) *NSW Drug Trends 1997. Findings from the Illicit Drug Reporting System (IDRS),* NDARC Technical Report No. 56, National Drug and Alcohol Research Centre, University of New South Wales, Sydney.

Hando, J., Darke, S., O'Brien, S., Maher, L. & Hall, W. (1998) The development of an early warning system to detect trends in illicit drug use in Australia: The Illicit Drug Reporting System, *Addiction Research,* 6, 97-113.

Hughes, P. H., Barker, N. W., Crawford, G. A. & Jaffe, J. H. (1972) The natural history of a heroin epidemic, *American Journal of Public Health,* 62, 995-1,001.

Hughes, P. H. & Crawford, G. A. (1972) A contagious disease model for researching and intervening in heroin epidemics, *Archives of General Psychiatry,* 27, 149-155.

Hughes, P. H. & Rieche, O. (1995) Heroin epidemics revisited, *Epidemiologic Reviews,* 17, 66-73.

Johnson, R. A. & Gerstein, D. R. (1998) Initiation of use of alcohol, cigarettes, marijuana, cocaine and other substances in US birth cohorts since 1919, *American Journal of Public Health,* 88, 27-33.

Lynskey, M. & Hall, W. (1998) Cohort trends in age of initiation to heroin use, *Drug and Alcohol Review,* 17, 289-297.

MacDonald, M., Robotin, M. & Topp, L. (2001) *Drug use trends among injecting drug users (IDU): Findings from the Australian Needle and Syringe Program (NSP) Survey, 1995-2000,* National Drug and Alcohol Research Centre, University of New South Wales, Sydney.

Matsumoto, T., Kamijo, A., Miyakawa, T., Endo, K., Yabana, T., Kishimoto, H., Okudaira, K., Iseki, E., Sakai, T. & Kosaka, K. (2002) Methamphetamine in Japan: The consequences of methamphetamine abuse as a function of route of administration, *Addiction,* 97, 809-817.

McKetin, R., Darke, S. & Godycka-Cwirko, K. (1999) *NSW Drug Trends 1998: Findings from the Illicit Drug Reporting System (IDRS),* NDARC Technical Report No. 72, National Drug and Alcohol Research Centre, University of New South Wales, Sydney.

McKetin, R., Darke, S. & Kaye, S. (2000) *NSW Drug Trends 1999: Findings from the Illicit Drug Reporting System (IDRS),* NDARC Technical Report No. 86, National Drug and Alcohol Research Centre, University of New South Wales, Sydney.

Methamphetamine Interagency Task Force (2000) *Methamphetamine Interagency Task Force: Final Report*, National Institute of Justice, United States.

Mills, K., Teesson, M., Darke, S., Ross, J. & Lynskey, M. (2004) Young people with heroin dependence: Findings from the Australian Treatment Outcome Study (ATOS), *Journal of Substance Abuse Treatment,* 27, 67-73.

O'Brien, S., Darke, S. & Hando, J. (1996) *Drug Trends: Findings from the Illicit Drug Reporting System (IDRS),* NDARC Technical Report No. 38, National Drug and Alcohol Research Centre, University of New South Wales, Sydney.

Roxburgh, A., Degenhardt, L. & Breen, C. (2004) Changes in patterns of drug use among injecting drug users following a reduction in the availability of heroin in New South Wales, Australia, *Drug and Alcohol Review,* 23, 287-294.

Roy, E., Haley, N., Leclerc, P., Cedras, L. & Boivin, J. F. (2002) Drug injection among street youth: The first time, *Addiction,* 97, 1,003-1,009.

Stafford, J., Degenhardt, L., Black, E., Bruno, R., Buckingham, K., Fetherston, J., Jenkinson, R., Kinner, S., Moon, C. & Weekley, J. (2005) *Australian Drug Trends 2004: Findings from the Illicit Drug Reporting System (IDRS),* NDARC Monograph No. 55, National Drug and Alcohol Research Centre, University of New South Wales, Sydney.

Swift, W., Maher, L. & Sunjic, S. (1999) Transitions between routes of heroin administration: A study of Caucasian and Indochinese heroin users in south-west Sydney, Australia, *Addiction,* 94, 71-82.

Thein, H. H., Zhou, J., Wodak, A. D., Dolan, K. A., van Beek, I., Cunningham, P. H., Kaldor, J. M., Maher, L., Dore, G. J., MacDonald, M. & on behalf of the Collaboration of Australian Needle and Syringe Programs (2004), Hepatitis C prevalence and risk behaviours among young injecting drug users in Australia, 4th Australian Conference on Hepatitis C. Canberra, 31 August – 2 September.

Topp, L., Darke, S., Bruno, R., Fry, C., Hargreaves, K., Humeniuk, R., McAllister, R., O'Reilly, B. & Williams, P. (2001) *Australian Drug Trends 2000: Findings from the Illicit Drug Reporting System (IDRS),* NDARC Monograph No. 47, National Drug and Alcohol Research Centre, University of New South Wales, Sydney.

Topp, L., Day, C. & Degenhardt, L. (2003) Changes in patterns of drug injection concurrent with a sustained reduction in the availability of heroin in Australia, *Drug and Alcohol Dependence,* 70, 275-286.

Topp, L., Degenhardt, L., Kaye, S. & Darke, S. (2002a) The emergence of potent forms of methamphetamine in Sydney, Australia: A case study of the IDRS as a strategic early warning system, *Drug and Alcohol Review,* 21, 341-348.

Topp, L., Kaye, S., Bruno, R., Longo, M., Williams, P., O'Reilly, B., Fry, C., Rose, G. & Darke, S. (2002b) *Australian Drug Trends 2001: Findings from the Illicit Drug Reporting System (IDRS),* NDARC Monograph No. 48, National Drug and Alcohol Research Centre, University of New South Wales, Sydney.

United Nations Office for Drug Control & Crime Prevention (1999) *Drug Abuse Rapid Situation Assessment and Responses*, United Nations, Vienna.

United Nations Office for Drug Control and Crime Prevention (2002) *Global Illicit Drug Trends 2002*, United Nations, New York.

Weatherburn, D., Jones, C., Freeman, K. & Makkai, T. (2003) Supply control and harm reduction: Lessons from the Australian heroin 'drought', *Addiction,* 98, 83-91.

Weatherburn, D. & Lind, B. (1997) *Drug law enforcement policy and its impact on the heroin market*, NSW Bureau of Crime Statistics and Research, Sydney.

Chapter two: Was an increase in cocaine use among injecting drug users (IDU) in New South Wales, Australia, accompanied by an increase in violent crime?

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Background

In the United States in the mid and late-1980s, there was a cocaine epidemic fuelled by the use of 'crack' cocaine (Golub & Johnson 1994; Agar 2003; Golub & Johnson 1997; Bowling 1999). At the same time, increases were noted in violent crime (Blumstein et al. 2000). New York experienced a particularly notable increase in the extent of violent crime in the city (Johnson et al. 2000; Bowling 1999; McBride & Swartz 1990). These violent crimes often involved firearms and led to an increased homicide rate (Blumstein et al. 2000).

Goldstein (1985) proposed a tripartite model to explain why crime may be related to drug use. First, the psychopharmacology of the drug may increase the users' likelihood of acting in a violent manner. Second, violent crimes may be committed by users to finance expensive drug habits. Third, crime may be related to the distribution and sale of drugs, particularly with respect to distributors' need to protect market share. Previous analyses of the US crack cocaine epidemic suggested that all three of these factors may have been involved in the crack cocaine epidemic, and in the escalation of violent crime in the US (McBride & Swartz 1990; Blumstein et al. 2000; Bowling, 1999; Johnson et al. 2000). Suggestive evidence has been collected that the increase in crime may have been related to: the relative youth of drug market participants (Blumstein et al. 2000); the profitability of crack cocaine distribution and hence disputes over market share and distribution points (Johnson et al. 2000); and some contribution from the pharmacological effects of sustained crack cocaine use among low level user-dealers (McBride & Swartz 1990). The relatively easy availability of firearms at that time has been argued to be a large contributor to the increases in homicide observed in the US during the period (Blumstein et al. 2000).

In contrast to the US, Australia has had relatively little notable cocaine use among problematic drug users (Darke et al. 2002; Hall & Hando 1993; Hando et al. 1997). In the later part of the 20th century, harms related to cocaine use have historically been low across the country (Degenhardt & Barker 2003; Breen et al. 2004). This may be related to; the high cost and relatively low availability of the drug in street-based drug markets (Darke et al. 2002; Breen et al. 2004); low rates of cocaine injecting or crack smoking among regular IDU (Darke et al. 2002; Breen et al. 2004); and the purported concentration of use (because of its high costs) among smaller, advantaged social groups or commercial sex workers (who may have greater disposable income) (Homel et al. 1990; Hall et al. 1991; Mooseburger et al. 1990).

In New South Wales (NSW) in the late 1990s, heroin was the drug most frequently reported by regular IDU as their drug of injection and choice. In early 2001, there were reports of a dramatic decline in the availability of heroin in Sydney, NSW (Day et al. 2003; Weatherburn et al. 2003). This was confirmed by the 2001 Illicit Drug Use Reporting System (IDRS), Australia's strategic early warning system. The IDRS observed an overall reduction in the availability and street level purity of heroin, and an increase in heroin price for all major heroin markets that began in early 2001 and was sustained for much of that year (Topp et al. 2002; Day 2004).

Following this reduction in heroin supply, regular IDU reported less frequent heroin use, and more frequent cocaine use (Topp et al. 2003; Roxburgh et al. 2004). The availability of cocaine had also increased (Roxburgh et al. 2004). An examination of changes in drug distribution in NSW suggested that those involved in street level and mid-level heroin distribution began distributing cocaine when heroin became less available (Degenhardt et al. 2005).

This sudden reduction in heroin use and increase in cocaine use provided a unique opportunity to conduct a natural experiment into the relationship between cocaine use and violent crime. We examined if changes in the nature or extent of violent crime in NSW following evidence of increased availability and use of cocaine were similar to those observed in New York. Specifically, this paper aimed to do the following:

1. Examine changes in cocaine use in NSW from 2001 (see also Topp et al. 2003; Roxburgh et al. 2004);

2. Examine potential changes in rates of violent crime at this time (see Degenhardt et al. 2005);

3. Examine the extent to which these changes in cocaine use and crime were related.

Method

Data used in the study

Data used in this study have been described elsewhere (see Degenhardt et al; Degenhardt & Day 2004b).

Semi-structured interviews with heroin users

Heroin users were recruited via advertisements placed in opioid pharmacotherapy clinics. They had to have (a) recent experience of the drug market and (b) to have commenced pharmacotherapy either between August and December 2000 (pre-shortage) or between February and April 2001 (during shortage). Fifty-three users were interviewed in total, approximately half entering treatment in each time period. Users were surveyed on a range of issues including their involvement in and experience of drug markets prior to and during the heroin shortage (Day et al. 2004).

Semi-structured interviews with key informants (KI)

Selection of KI was based on one or more of the following:

• the extent of their contact with the illicit drug market;

• their level of knowledge of the illicit drug market and illicit drug users;

• the focus of their position (e.g. direct/indirect, operational/policy); and

• the length of time the key informant had held the position, particularly their ability to comment on changes over time, pre-to-post heroin shortage.

A total of 49 KI were recruited for this study, including 5 from NSW State organisations. The remainder were recruited in the Sydney drug markets of Kings Cross (n=16), Cabramatta (n=14) and Redfern (n=15). The roles of these KI were as follows: Drug health (n=25), community health (n=3), community welfare (n=5), emergency health (n=1), indigenous health (n=2), mental health (n=2), prenatal health (n=4), primary health care (n=2) and youth services (n=5).

Law enforcement

The NSW Police Service comprises three levels of command: State, Region and Local Area Command (LAC). Key informants were selected across all three levels and across the four LAC responsible for policing the three Sydney open-air drug markets, two region commands in which these LAC were located, and a range of squads within the State Command (including squads focused on organised crime groups and drug crime).

A total of 22 law enforcement key informants were interviewed for this study, 20 of whom were sworn officers. Seven were state level personnel, 2 regional personnel and 13 LAC personnel. Seven interviewees held the position of Commander of their squad, 7 were managers of their unit, and 8 held general duty or operational positions (the latter includes 2 civilians – an analyst and a pharmacist).

Health

Health and/or welfare sector professionals were recruited as KI from organisations involved in supporting drug users in Sydney, NSW. These KI were recruited for their knowledge of drug users based in one of the three largest Sydney illicit drug markets in the regions of Kings Cross, Cabramatta and Redfern (Gibson et al. 2003). KI from State Government bureaucracies and organisations were also recruited to provide statewide observations. KI were drawn from a range of positions within their respective organisations, from management to front line positions.

NSW Police incident data

NSW Police record all police activity in a centralised database known as the Computerised Operational Policing System (COPS). This information can be analysed at the level of 'event' or 'incident'. An event is a record created in COPS whenever police attend a criminal or non-criminal activity. An event includes the incidents that comprise it (what happened, where, who was involved) and the actions taken by police in response to the event. This information is not reliant on a charge having been laid (but offender details on gender and age may not be provided if the offender is not arrested). Information from this 'real time' dataset is downloaded at regular intervals for analysis by the NSW Bureau of Crime Statistics and Research (BOCSAR). The following incident types were used in the current study: cocaine possession/use, robbery with a firearm, robbery with a weapon (not a firearm), robbery without a weapon, homicide, assault, and weapons offences.

Time series analysis

The indicator data series were analysed using an AutoRegressive, Integrated, Moving Average (ARIMA) model time series. The heroin shortage was represented in these models in the following three ways as: (1) a permanent effect (step); (2) a brief effect (pulse); or (3) a change in slope. Analyses dated the onset of the heroin shortage from January 2001, in accordance with the findings of other research on the course of the event (Day 2004). Intervention models were fitted using SAS v. 8.2. Intervention ARIMA models can require estimation of many parameters, and some of the data series lacked clearly definable responses at the point of the heroin shortage (e.g. Figure 2.4). In order to avoid large probability of type I error, analysis of data series which showed no evidence of a response to the heroin shortage on visual inspection were analysed by examination of cross-correlation functions only. If the cross-correlation functions for these series showed no clear evidence of an effect due to the shortage no further modelling was conducted on these series, and the conclusion of no noticeable effect due to the heroin shortage was drawn.

Results

Trends in cocaine use

Clear increases were observed in the use of cocaine among regular injecting drug users in 2001 (Figure 2.1). This was true whether IDU were asked about their use of cocaine in the previous day, the number of days used in the past 6 months, or whether it was the last drug they had injected. This increase did not persist, however, with the proportion reporting cocaine use decreasing in 2002 and further in 2003 (Figure 2.1).

Figure 2.1: Proportion of IDU reporting cocaine use in the past six months, daily use, and use on the day preceding interview, 1996-2003
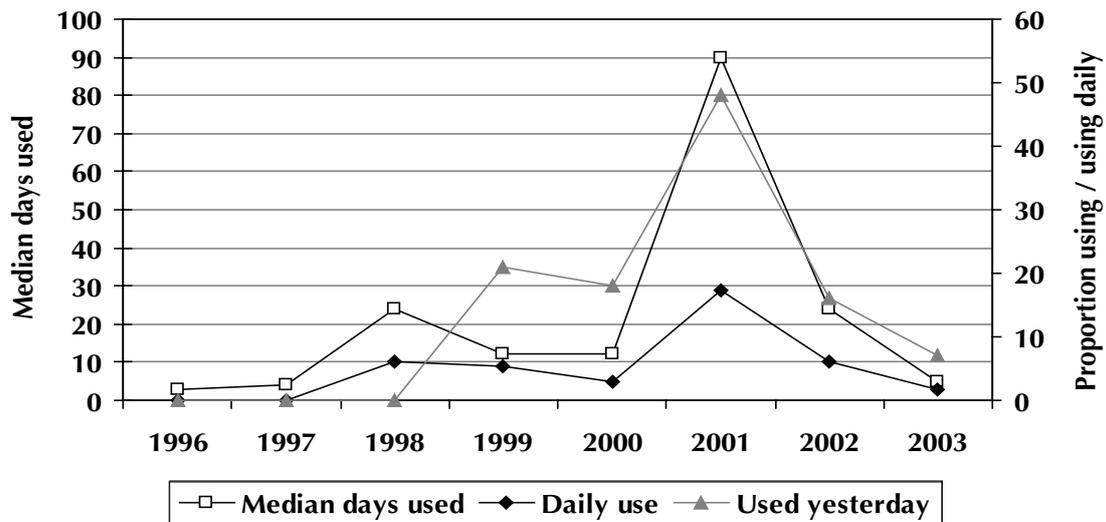
Source: IDRS, IDU interviews.

Figure 2.2 shows the number of incidents recorded for cocaine possession/use in NSW. This peaked at 64 in March 2001 and remained high throughout the year but declined in 2002. The modelled series (Figure 2.2) showed that, while police incidents for cocaine possession or use were at a steady level prior to the reduction in heroin supply, they increased significantly over the six months following the reduced heroin supply before returning to the levels seen prior to the heroin shortage. The maximum increase of 207% occurred 2 months after the shortage began (March 2001).

Figure 2.2: Incidents of cocaine possession/use in NSW, 1997-2002
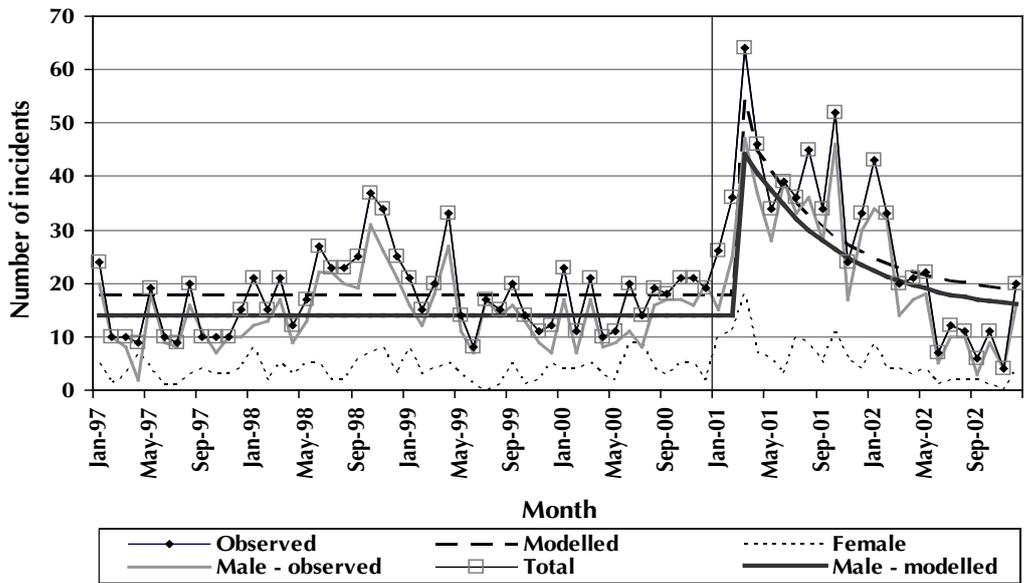
Source: NSW Bureau of Crime Statistics & Research.

Trends in robbery offences

Figure 2.3 shows the number of robbery offences in NSW for the period January 1997 to December 2002. The onset of the reduction in heroin supply was associated with a 33% (p<0.0001) increase in the incidence of 'robbery without a weapon'. The trend seen in incidents of 'robbery with a weapon other than a firearm' followed a similar pattern. In contrast, there was no apparent effect of the heroin shortage upon the series 'robbery with a firearm'.

Figure 2.3: Incidents of robbery offences in NSW, 1997-2002
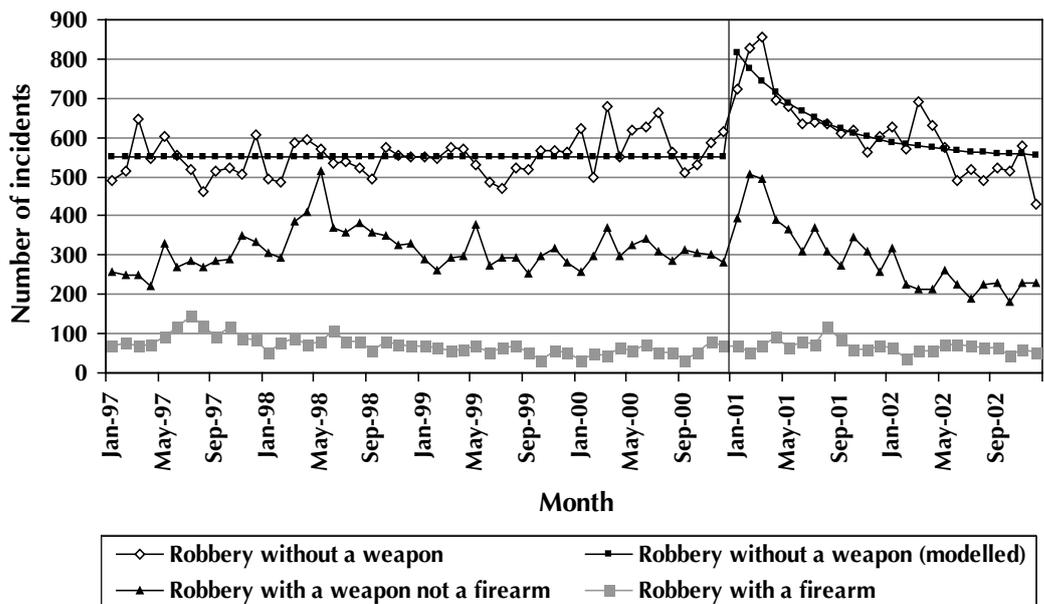
Source: NSW Bureau of Crime Statistics & Research.

Results of the time series analysis were consistent with the qualitative information collected in KI interviews. An increase in the incidence of robberies was the single most commonly reported change in criminal activity. KI consistently attributed it to a combination of the behavioural effects of cocaine and the need to increase criminal activity to fund the higher cost of using cocaine.

> 'So, more likely to commit crime or for violence to be included in the crime, and that seems to be likely given that people would be more desperate and presumably also, you know, if they are using cocaine in association with their crimes, more reckless and more aggressive, abusive, volatile.' (Health/Welfare KI).

KI reports described thefts 'gone wrong' in which excessive force and crude weapons were opportunistically used. Some drug users also reported attempting ill-planned armed robberies and being caught in the act by police.

KI reported that the type of crime engaged in by individual users during the heroin shortage was 'out of character', and that users were less careful in the commission of crime. Overall, the tone of the offences changed: KI and users in all markets reported that drug-related crime became more desperate, violent and impulsive. KI reported that users stepped up their involvement in crime, moving from non-violent acquisitive crime (i.e. theft) to violent acquisitive crime (i.e. robbery).

The behavioural effects of cocaine meant that the execution of a theft often became more violent than intended or than was typical for that offender.

> 'The whole nature of the offences changed. There was no change in so far as people were still doing property offences, stealing – it's all the same. But people weren't getting enough money so they'd turn to violent offences. But not just that, because of the amount of cocaine they were using, it was just making them angry.' (Law enforcement KI).

Trends in homicide and assault

Figures 2.4 and 2.5 show the incidence of homicide and assault offences between 1997 and 2002. There did not appear to be a change in either time series around the time when cocaine use increased. Apart from the general increase in violence commonly reported by KI, there were no reports of any changes in the incidence of homicides and assaults.

Figure 2.4: Incidents of homicide in NSW, 1997-2002
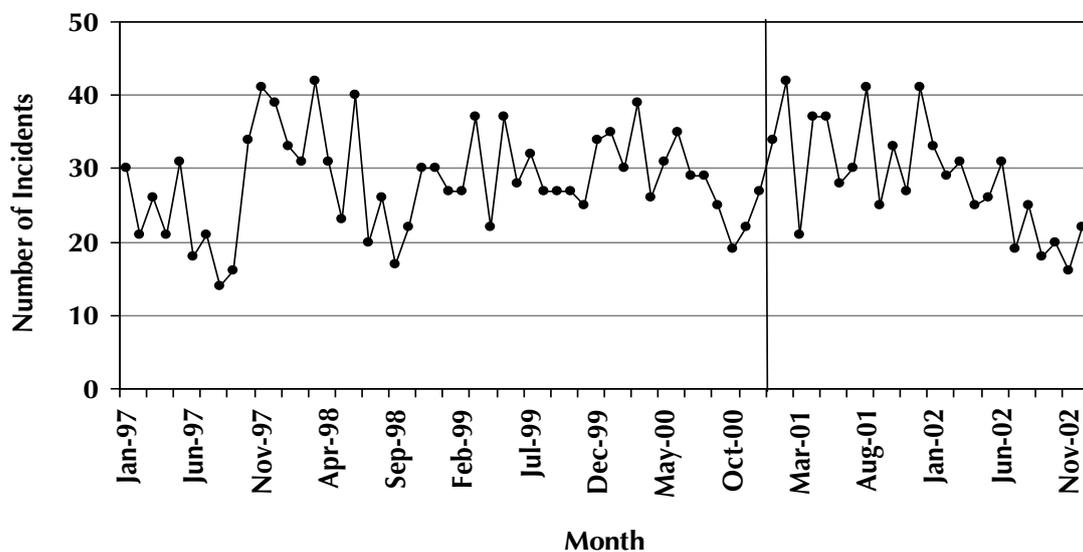
Source: NSW Bureau of Crime Statistics and Research.

Figure 2.5: Incidents of assault in NSW, 1997-2002
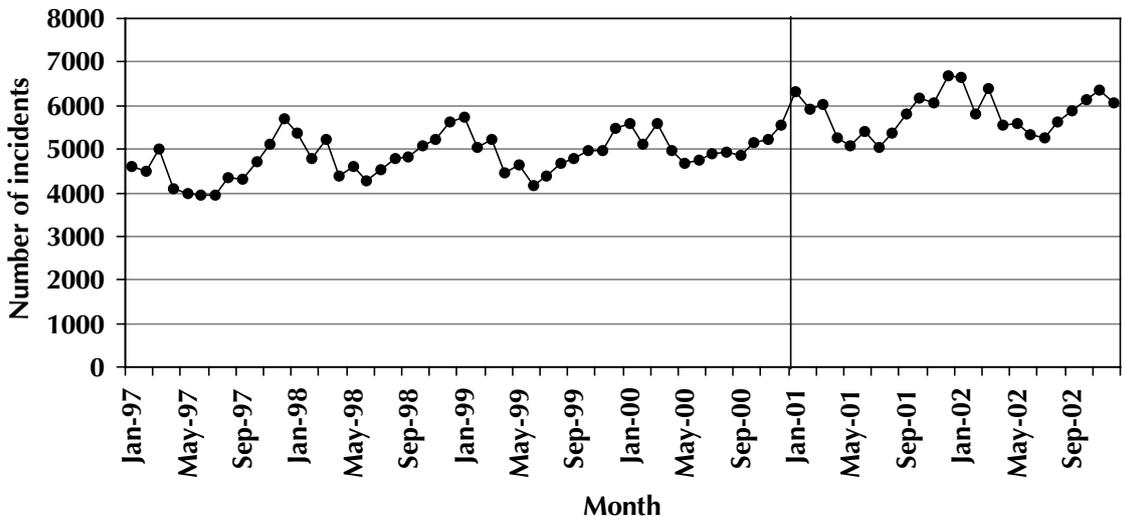
Source: NSW Bureau of Crime Statistics and Research.

Trends in weapons offences

Figure 2.6 shows the number of weapons offences in NSW. This offence category includes charges relating to the illegal possession, sale and discharge of firearms, and offences relating to explosive/ dangerous articles or threats. There was no change in the incidence of weapons offences at the time of the shortage (Jan-Apr 2001), either at a state or local level. It should be noted that the sharp increase in the series at the beginning of 1999 reflects a change in the legislation that gave NSW Police the power to conduct knife searches.

Figure 2.6: Incidents of weapons offences in NSW, 1997-2002
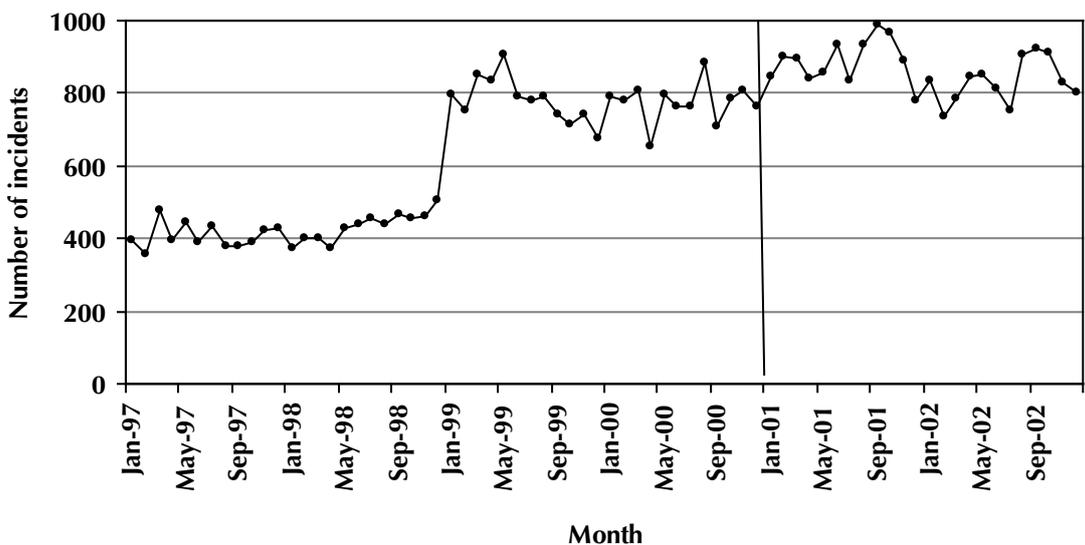
Source: NSW Bureau of Crime Statistics and Research.

Note: A change in legislation was associated with the increase observed in 1999.

KI typically mentioned the increased use of weapons in acquisitive crimes. Some thought that organised crime groups were involved in the distribution of firearms as part of their criminal repertoire, but these activities were not linked to either the reduction in heroin supply or the increase in cocaine availability and use.

Discussion

This study has found a clear increase in the rate of violent crime concurrent with an increase in cocaine use. As has been shown elsewhere, there were marked increases in the use of cocaine among regular injecting drug users in major drug markets in Sydney (Degenhardt & Day 2004a; Roxburgh et al. 2004). There was also evidence from NSW Police records that this increase was observed at a state level for cocaine possession/use offences (Degenhardt et al. 2005). These findings were supported by data on the number of calls of concern to NSW telephone help lines about cocaine, and increased reports of cocaine as the last drug injected by NSP attendees (Degenhardt et al. in press). The consistency of these changes suggests that there was a definite shift in drug use patterns in the IDU community from heroin to cocaine injecting.

These increases in cocaine use were accompanied by increased rates of violent crime. Consistent with the model proposed by Goldstein (1985), interviews with KI of all types suggested that increases in violent acquisitive crime was related to both the psychopharmacological effects of heavy cocaine use, and also to the increased financial costs of users' drug use. KI reports were also obtained of violent crime occurring among those involved in cocaine distribution, but these could not be evaluated using police data.

Comparable research in other Australian states revealed little, if any, change in cocaine use among similar populations of IDU (Dietze et al. 2004; Harrison et al. 2004). Furthermore, there was no significant increase in violent crime in these states. The absence of any increase provides further support for the argument that the increase in cocaine use among this disadvantaged group in NSW was causally related to the change in violent crime in that state. An increase in the rate of non-violent acquisitive crime in NSW (Degenhardt et al. 2005) provided further evidence to support the notion that part of the increase in violent acquisitive crimes may have been related to the increased costs of drug users' habits following increases in the price of heroin (the previously dominant drug) and the relatively higher cost of the cocaine that some switched to using after the onset of the heroin shortage.

Perhaps the most interesting difference between the experiences in Sydney and New York with increasing cocaine use was the lack of any increase in the number of gun-related incidents in Sydney, compared to a dramatic increase in such incidents that occurred in New York. There was an increase in the number of incidents of robberies involving weapons, but these did not involve guns. In New York, by contrast, many crimes involved guns and the homicide rate involving firearms increased markedly.

In New York and Sydney, organised crime groups have access to, and are involved in, the sale of illicit firearms. However, firearms are 'not' available legally for personal use in Australia, whereas they were relatively easily available in the United States at the height of the crack cocaine epidemic (Blumstein et al. 2000). It seems possible that this availability leads to two sources of firearms in the US: licit sources, and illicit sources, whereby illicit sources may comprise the diversion of legally registered firearms as well as the large scale distribution of illegal firearms. In Australia, however, there are no legal sources of handguns. This suggests that maintaining such stringent controls upon firearms may have assisted in maintaining a low rate of firearm offences (Kaplan & Geling 1998), *even in the face of increased cocaine use among criminally involved IDU that increased the risk of violent incidents*.

Limitations

This paper is subject to the flaws that beset all natural experiments, in that it is not possible to guarantee that the intervention being studied was the only event that affected cocaine use and/or violent crime in the time period. However, similar research on rates of crime conducted in the same time period in both Victoria and South Australia provided a control series. These two states were geographically isolated from NSW and both experienced a heroin drought, but neither experienced any increase in cocaine use among IDU. Although it might be possible that some other event interfered in NSW drug markets at the same time as the heroin shortage, such possibilities were examined in a process of extensive cross-checking through KI, consultation with stakeholders and analysis of other data sources in the wider project from which this study is drawn. No plausible alternative explanations remained (Degenhardt et al. 2004; Degenhardt & Day 2004b).

The increase in availability and use of cocaine was relatively short-lived. And so was the increase in violent crime. This adds to the case for it being a causal factor in the increased rate of violent offences. It is unknown what the consequences would have been if the increased cocaine supply and use had persisted for a much longer period of time.

This natural experiment provided a unique opportunity to identify the effects of a sudden increase in cocaine use in a major Australian drug market, and to investigate previous findings regarding the role of cocaine use in violent criminal activity. Given the extensive attempts to eliminate other causes of the increase in violent crime, and the existence of a partial control group, it seems reasonable to conclude that a transient increase in cocaine use among IDU in NSW produced a transient increase in violent crime.

Conclusions

Increases in cocaine use in NSW were accompanied by increases in violent crime as were observed in New York in the 1980s. However, these violent crimes did 'not' involve the use of firearms, providing some support for the value of stringent gun control laws in reducing access to guns by criminals (Kaplan & Geling 1998).

References

Agar, M. (2003) The story of crack: Towards a theory of illicit drug trends, *Addiction Research and Theory*, 11, 3-29.

Blumstein, A., Rivara, F. & Rosenfeld, R. (2000) The rise and decline of homicide – and why, *Annual Reviews of Public Health*, 21, 505-541.

Bowling, B. (1999) The rise and fall of New York murder: Zero tolerance or crack's decline?, *British Journal of Criminology*, 39, 531-554.

Breen, C., Degenhardt, L., Roxburgh, A., Bruno, R., Duquemin, A., Fetherston, J., Fischer, J., Jenkinson, R., Kinner, S., Longo, M. & Rushforth, C. (2004) *Australian Drug Trends 2003: Findings from the Illicit Drug Reporting System (IDRS),* NDARC Monograph No. 51, National Drug and Alcohol Research Centre, University of New South Wales, Sydney.

Darke, S., Kaye, S. & Topp, L. (2002) Cocaine use in New South Wales, Australia, 1996-2000: 5 year monitoring of trends in price, purity, availability and use from the Illicit Drug Reporting System, *Drug and Alcohol Dependence*, 67, 81-88.

Day, C. (2004) Documenting the heroin shortage in New South Wales, in *The Course and Consequence of the Heroin Shortage in New South Wales*, (Eds. Degenhardt, L. & Day, C.) National Drug Law Enforcement Research Fund, pp. 11-17.

Day, C., Gibson, A., Collins, L., Degenhardt, L. & Dietze, P. (2004) *Research methodologies used to obtain retrospective self-reports of the impact of changes in heroin supply on regular users in and out of treatment*, NDARC Technical Report No. 176, National Drug and Alcohol Research Centre, University of New South Wales, Sydney.

Day, C., Topp, L., Rouen, D., Darke, S., Hall, W. & Dolan, K. (2003) Decreased heroin availability in Sydney in early 2001, *Addiction*, 98, 93-95.

Degenhardt, L. & Barker, B. (2003) *Investigating trends in cocaine and methamphetamine mentions in accidental drug-induced deaths in Australia 1997-2002*, National Drug and Alcohol Research Centre, University of New South Wales, Sydney.

Degenhardt, L., Conroy, E., Gilmour, S. & Collins, L. (2005) The effect of a reduction in heroin supply in Australia upon drug distribution and acquisitive crime, *British Journal of Criminology*, 45, 2-24.

Degenhardt, L. & Day, C. (Eds.) (2004a) Changes in patterns of drug use, in *The course and consequences of the heroin shortage in New South Wales*, National Drug Law Enforcement Research Fund.

Degenhardt, L. & Day, C. (Eds.) (2004b) *The course and consequences of the heroin shortage in New South Wales*, National Drug Law Enforcement Research Fund.

Degenhardt, L., Day, C. & Gilmour, S. (in press) Changes in community level drug use associated with a reduction in heroin supply, *International Journal of Drug Policy*.

Degenhardt, L., Day, C. & Hall, W. (Eds.) (2004) *The causes, course and consequences of the heroin shortage in New South Wales, South Australia and Victoria*, National Drug Law Enforcement Research Fund.

Dietze, P., Miller, P., Clemens, S., Matthews, S., Gilmour, S. & Collins, L. (2004) *The course and consequences of the heroin shortage in Victoria*, National Drug Law Enforcement Research Fund.

Gibson, A., Degenhardt, L., Topp, L., Day, C., Hall, W., Dietze, P. & McKetin, R. (2003) *Global and Australian heroin markets*, NDARC Technical Report No. 167, National Drug and Alcohol Research Centre, University of New South Wales, Sydney.

Goldstein, P. (1985) The drugs/violence nexus: A tripartite conceptual framework, *Journal of Drug Issues*, 14, 493-506.

Golub, A. & Johnson, B. (1994) A recent decline in cocaine use among youthful arrestees in Manhatten, 1987 through 1993, *American Journal of Public Health*, 84, 1,250-1,254.

Golub, A. & Johnson, B. (1997) *Crack's Decline: Some Surprises Across US Cities,* US Department of Justice, Washington, DC.

Hall, W., Carless, J., Homel, P., Flaherty, B. & Reilly, C. (1991) The characteristics of cocaine users among young adults in Sydney, *Medical Journal of Australia*, 155, 11-14.

Hall, W. & Hando, J. (1993) Patterns of illicit psychostimulant use in Australia, in *Psychostimulant Use in Australia*, (Eds. Burrows, D., Flaherty, B. A. and MacAvoy, M.) Australian Government Publishing Service, Canberra.

Hando, J., Flaherty, B. & Rutter, S. (1997) An Australian profile on the use of cocaine, *Addiction*, 92, 173-182.

Harrison, A., Christie, P., Longo, M., Pointer, S. & Ali, R. (2004) *The course and consequences of the heroin shortage in South Australia*, National Drug Law Enforcement Research Fund.

Homel, P., Flaherty, B., Reilly, C., Hall, W. & Carless, J. (1990) The drug market position of cocaine among young adults in Sydney, *British Journal of Addiction*, 85, 891-897.

Johnson, B., Golub, A. & Dunlap, E. (2000) The rise and decline of hard drugs, drug markets, and violence in inner-city New York in, *The crime drop in America*, (Eds. Blumstein, A. & Wallman, J.) Cambridge University Press, New York, pp. 164-206.

Kaplan, M. & Geling, O. (1998) Firearm suicides and homicides in the United States: Regional variations and patterns of gun ownership, *Social Science and Medicine*, 46, 1,227-1,233.

McBride, D. C. & Swartz, J. A. (1990) Drugs and violence in the age of crack cocaine, in Weisheit, R.A. (Ed.) (1990) *Drugs, crime and the criminal justice system*, Academy of Criminal Justice Sciences monograph series, pp. 141-169.

Mooseburger, R., Plant, A. & Pierce, J. (1990) The drug use behaviour of cocaine users, *Drug and Alcohol Review*, 9, 251-258.

Roxburgh, A., Degenhardt, L. & Breen, C. (2004) Changes in patterns of drug use among injecting drug users following a reduction in the availability of heroin in New South Wales, Australia, *Drug and Alcohol Review*, 23, 287-294.

Topp, L., Day, C. & Degenhardt, L. (2003) Changes in patterns of drug injection concurrent with a sustained reduction in the availability of heroin in Australia, *Drug and Alcohol Dependence*, 70, 275-286.

Topp, L., Kaye, S., Bruno, R., Longo, M., Williams, P., O'Reilly, B., Fry, C., Rose, G. & Darke, S. (2002) *Australian Drug Trends 2001: Findings from the Illicit Drug Reporting System (IDRS)*, NDARC Monograph No. 48, National Drug and Alcohol Research Centre, University of New South Wales, Sydney.

Weatherburn, D., Jones, C., Freeman, K. & Makkai, T. (2003) Supply control and harm reduction: Lessons from the Australian heroin 'drought', *Addiction*, 98, 83-91.

Chapter three: Examining links between injecting cocaine use and street-based sex work in NSW, Australia

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Background

Increasing interest has been observed in recent years in the study of sex workers as a marginalised group at increased risk for a range of poorer mental and physical health outcomes (Vanwesenbeeck 2001). Previous research has documented the risks of blood-borne virus infections (BBVI) transmission and sexually transmitted infections (STI) among sex workers due to unprotected sex with clients (Gossop et al. 1995) and the potential risks posed to the broader community via BBVI transmission through clients to the general population (Tuan et al. 2004). Illicit drug use, including cocaine and heroin use, have previously been documented as common among street-based sex workers (e.g. Leggett 2001; Roxburgh et al. 2005; Minichiello et al. 2003; Tuan et al. 2004; Gossop et al. 1995; Inciardi & Surratt 2001). The use of such drugs has been related to increased risk behaviours, including riskier sexual encounters (Minichiello et al. 2003) and risk of BBVI transmission due to injecting drug use and needle sharing (Gossop et al. 1995).

The sex work industry

New South Wales (NSW), Australia, has a good tradition of measures designed to reduce harms and risks related to the public health posed by sex work. Legalisation exists in the form of brothels that operate under permits, and sex workers may operate from their own homes after obtaining permits from local councils, and along public thoroughfares as long as they are not within close proximity of churches or schools (Perkins 1991). Relatively good outreach efforts have targeted sex workers in NSW, with a strong focus on the reduction of sexual and other risk behaviours among this group. Harm reduction and treatment measures for street-based sex workers engaging in injecting drug use have been developed and largely targeted towards heroin use (and injection), particularly outside the inner-city area.

Despite links between crack cocaine use and sex work in the UK and US (Gossop et al. 1995; Green et al. 2000; Inciardi & Surratt 2001), less work has investigated in detail the potential relationships between injecting cocaine use and sex work in Australia. This is disappointing because cocaine use has been associated with significant BBVI risk and sex risk behaviours among injecting drug users (Tyndall et al. 2003; Hudgins et al. 1995).

Drug markets in Australia

Heroin has traditionally been the most commonly injected drug among sentinel groups of regular IDU in Sydney, NSW (Roxburgh et al. 2004a; MacDonald et al. 2003). In early 2001, however, there were reports of a dramatic decline in the availability of heroin in Sydney, NSW (Weatherburn et al. 2003; Day et al. 2003) which were confirmed by the 2001 Illicit Drug Reporting System (IDRS), Australia's strategic early warning system. The IDRS observed an overall reduction in the availability and street level purity of heroin, and an increase in heroin price for all major heroin markets, that began in early 2001 and was sustained for much of that year (Day 2004a; Topp et al. 2002). The reduction in availability – the so-called 'heroin shortage' (United Nations Office for Drug Control and Crime Prevention 2002) – was greatest from January to April 2001, was sustained for the better part of that year, and the NSW heroin market does not appear to have returned to levels seen prior to the reduction in heroin supply (Degenhardt et al. 2005; Day 2004b).

Following the reduction in heroin supply, regular IDU reported less frequent heroin use, and more frequent cocaine use (Roxburgh et al. 2004b; Topp et al. 2003). The availability of cocaine also increased (Roxburgh et al. 2004b), and an examination of changes in drug distribution in NSW suggested that those involved in street-level and mid-level heroin distribution began distributing cocaine when heroin became less available (Degenhardt et al. 2005).

The reduction in heroin supply was also associated with a sharp, short-term spike in robberies in NSW, followed by a longer-term decline (Degenhardt et al. 2005; Weatherburn et al. 2003). A similar, though more attenuated spike in the incidence of home burglary was also noted (Weatherburn et al. 2003). It was hypothesised that the increase in crime was related to increased cocaine use, as it was more expensive and often more frequently used by IDU.

Aims

Given the increase in acquisitive crime, and the previously documented association between cocaine and street-based sex work in other countries, this study took advantage of a unique opportunity to conduct a natural experiment into the relationship between cocaine use and street-based sex work. It was particularly of interest to examine the changes that occurred in a state where harm reduction measures had been well established within the current injection drug market, which had historically been dominated by heroin. Specifically, this paper aimed to do the following:

1. Examine changes in cocaine use in NSW from 2001 (see also Degenhardt & Day 2004a; Degenhardt et al. 2005; Roxburgh et al. 2004b);

2. Examine potential changes in rates of prostitution at this time;

3. Examine the extent to which these changes in cocaine use and illegal prostitution were related.

Method

Two broad approaches were adopted to address these questions. The first was an analysis of police data on arrests for use/possession of cocaine and prostitution. We assume in this analysis that arrests for cocaine use/possession and prostitution are, over the relatively short timeframe covered by this study, a reasonable proxy for involvement in these two classes of offence. This assumption was examined by assessing whether specific operations were targeted towards either drug users or street-based sex workers during the study period (no such operations were reported by any key informants interviewed). The second involved a series of semi-structured interviews with IDU and other key informants in the Sydney heroin market (such as police officers and health workers). These interviews assessed a number of issues related to the heroin shortage, and included discussion of trends in drug use among injecting drug users and illicit activities such as street-based sex work.

Structured interviews with regular IDU

As part of the IDRS, approximately 150 IDU have been surveyed annually in Sydney, NSW since 1996. To be eligible to participate in the survey, IDU needed to have been injecting at least monthly during the six months preceding the interview, and to have been a resident for at least 12 months in the capital city in which they were interviewed. Participants have typically been recruited through multiple methods, including treatment agencies, needle and syringe programs (NSP) and peer referral. The study methodology has remained consistent over time. Further details on the IDRS IDU interview methodology can be found in Breen et al. (2004). Each year, IDU were asked about their use of a range of drugs including cocaine.

Semi-structured interviews with heroin users

Heroin users were recruited via advertisements placed in opioid pharmacotherapy clinics. They had to have recent experience of the drug market and to have commenced pharmacotherapy between August and December 2000 (pre-shortage) or between February and April 2001 (during shortage). Fifty-three users were interviewed in total, approximately half in each time-group. Users were surveyed on a range of issues including their involvement and experience of drug markets prior to and during the heroin shortage (Day et al. 2004).

Semi-structured interviews with key informants

Selection of KI from all three sectors was based on one or more of the following:

- the extent of their contact with the illicit drug market;
- their level of knowledge of the illicit drug market and illicit drug users;
- the focus of their position (e.g. direct/indirect, operational/policy); and
- the length of time the key informant had held the position, particularly their ability to comment on changes over time, pre-to-post heroin shortage.

All interviews were conducted by trained researchers using a semi-structured interview schedule. The interviews explored respondents' tasks at the time of the shortage; effect of the shortage on IDU drug use; IDU treatment seeking behaviour; psychosocial and general health of drug users; effects on communities and drug users; and the effect of the shortage on community and health service provision.

All interviews were tape recorded unless otherwise requested by the interviewee, and transcribed. A thematic analysis of the transcripts was performed, presenting verbatim quotes for illustration. This analysis was performed with the aid of Microsoft Excel. All KI gave their informed consent to participate.

Law enforcement

The NSW Police Service comprises three levels of command of relevance to this study: State, Region and Local Area Command (LAC). Key informants were selected across all three levels and across the four LAC responsible for policing the three Sydney open-air drug markets, two region commands in which these LAC were located, and a range of squads within the State Command (including squads focused on organised crime groups and drug crime). A total of 29 law enforcement KI were interviewed for this study, 20 of whom were sworn officers. Table 3.1 provides further detail on the numbers of KI recruited for each drug market and police command level.

Table 3.1: Law enforcement sector key informants.

| FOCUS | TOTAL | DRUG MARKET | | | | | | ROLE | | | |
		RF	KX	CAB	NSW	AUS	INT	UPR MNGT	MID MNGT	OPS	RCH
Crime management	5	-	2	2	1	-	-	1	3	1	-
Drug crime	7	1	2	1	1	1	2	3	2	2	1
Drug policy	2	-	-	-	-	2	-	-	-	2	-
General policing	5	3	-	2	-	-	-	3	-	2	-
Intelligence	5	-	1	-	2	2	-	-	-	5	-
Organised crime	3	-	1	-	2	-	-	3	-	-	-
Serious crime	1	-	-	1	-	-	-	-	1	-	-
TOTAL	29	4	6	6	6	5	2	10	6	12	1

KEY:	RF	Redfern	UPR MNGT	Upper Management (no client contact)
	KX	Kings Cross	MID MNGT	Middle Management (some client contact)
	CAB	Cabramatta	OPS	Operations
	NSW	New South Wales	CLIN	Clinical (see Table 3.2)
	AUS	Australia	RCH	Research
	INT	International		

Health

Health sector KI were recruited from organisations involved in the support of drug users across the three Sydney illicit drug markets of Kings Cross, Cabramatta and Redfern (Gibson et al. 2003). KI from State Government bureaucracies and organisations were also recruited to provide statewide observations. KI were drawn from a range of positions within their respective organisations, from middle and upper management to front line positions. A total of 49 health sector KI were recruited for this study, including five from NSW State organisations. Table 3.2 provides further detail on the number of KI recruited for each drug market and health discipline.

Table 3.2: Health sector key informants.

FOCUS	TOTAL	DRUG MARKET				ROLE		
		RF	KX	CAB	NSW	UPR MNGT	MID MNGT	CLIN
Aboriginal health	2	2	-	-	-	-	1	1
Community health	3	-	-	2	1	2	-	1
Community welfare	5	1	1	-	3	1	3	1
Drug health	25	7	10	7	1	6	13	6
Emergency health	1	-	1	-	-	-	1	-
Mental health	2	1	1	-	-	-	1	1
Pre-natal health	4	2	1	1	-	-	-	4
Primary health care	2	1	-	1	-	-	-	2
Youth	5	1	2	2	-	-	2	3
TOTAL	49	15	16	14	5	9	21	19

Note: For Key see Table 3.1.

Policy/Advocacy

An additional three KI were recruited for their experience and expertise in drug policy and advocacy.

NSW Police incident data

NSW Police record all police activity in a centralised database known as the Computerised Operational Policing System (COPS). This information can be analysed at the level of either 'event' or 'incident', and is not reliant on a charge having been laid (an event is a record created in COPS whenever police attend a criminal or non-criminal activity. An event includes the incidents that comprise it (what happened, where, who was involved and the actions taken by police in response to the event).

Two incident types were used in the current study: cocaine possession/use, and prostitution. Incidents of possession/use were unlikely to be influenced by the outcome of proactive investigations and, in turn, unlikely to be influenced by changes in police activity and resources; but, rather, a reflection of trends in use (and detection) of illicit drugs (in this case, cocaine).

It is not an offence in NSW to offer sex in return for money. The offence of 'prostitution' occurs when a person solicits for sex in close proximity to certain designated locations, such as a school or hospital. There are several key areas in Sydney where such illicit prostitution occurs, which are largely in close proximity to the major Sydney street drug markets.

The indicator data series were analysed using an ARIMA model time series. Intervention models were fitted using SAS v. 8.2. If the number of events per month in a sub-population of the series was too small to analyse statistically, that sub-population was described qualitatively.

Ethics approval

This project was approved by the University of New South Wales Human Research Ethics Committee (HREC), the South East Sydney Area Health Service HREC, the South West Sydney Area Health Service HREC, the Central Sydney Area Health Service HREC and the Aboriginal Health and Medical Research Ethics Committee. All participants gave written consent to being interviewed and to the use of their information in the generation of project reports, journal articles and conference proceedings relating to the project, providing they were unable to be identified.

Results

Trends in cocaine use

Clear increases were observed in the use of cocaine among injecting drug users in 2001 (Figure 3.1). This was noted whether IDU were asked about their use in the previous day, the number of days used in the past 6 months, or whether it was the last drug they had injected.

Figure 3.1: Proportion of IDU reporting cocaine use in the past six months, daily use, and use on the day preceding interview, 1996-2003
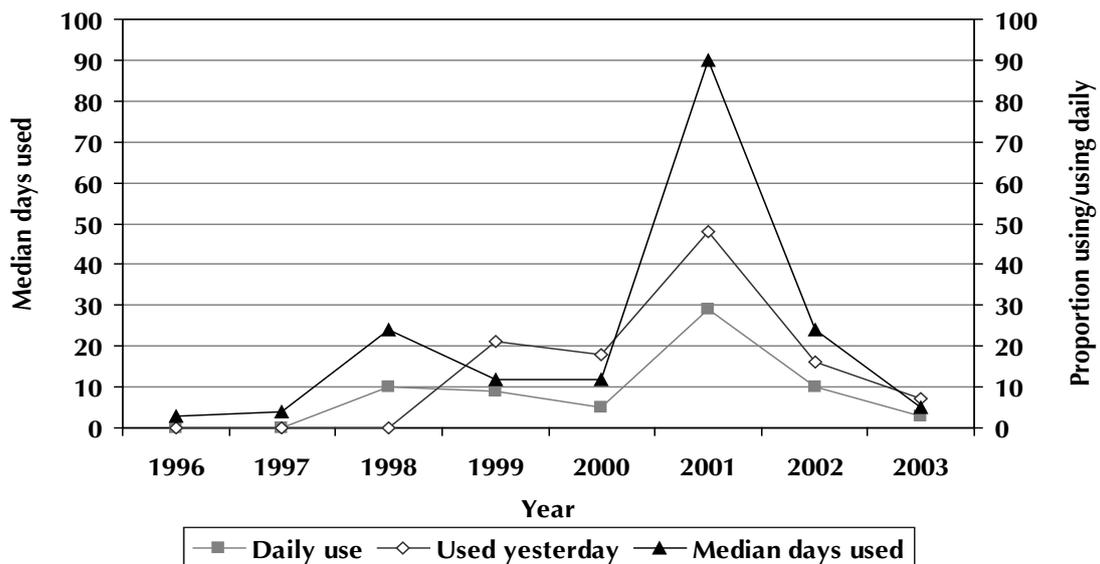
Source: NSW DRS IDU interviews.

Figure 3.2 shows the number of incidents recorded for cocaine possession/use in NSW. This peaked at 64 in March 2001 and remained high throughout the year but declined in 2002. The modelled series (Figure 3.2) showed that, while police incidents for cocaine possession or use were at a steady level prior to the reduction in heroin supply, they increased significantly over the six months following the reduced heroin supply before later returning to lower levels than were seen prior to the heroin shortage. The maximum mean increase on pre-shortage levels was 269%, occurring 2 months after the shortage. This peak decayed to a long-term level that was 73% lower than the numbers seen prior to the onset of the heroin shortage.

Figure 3.2: Incidents of cocaine possession/use in NSW, 1997-2004
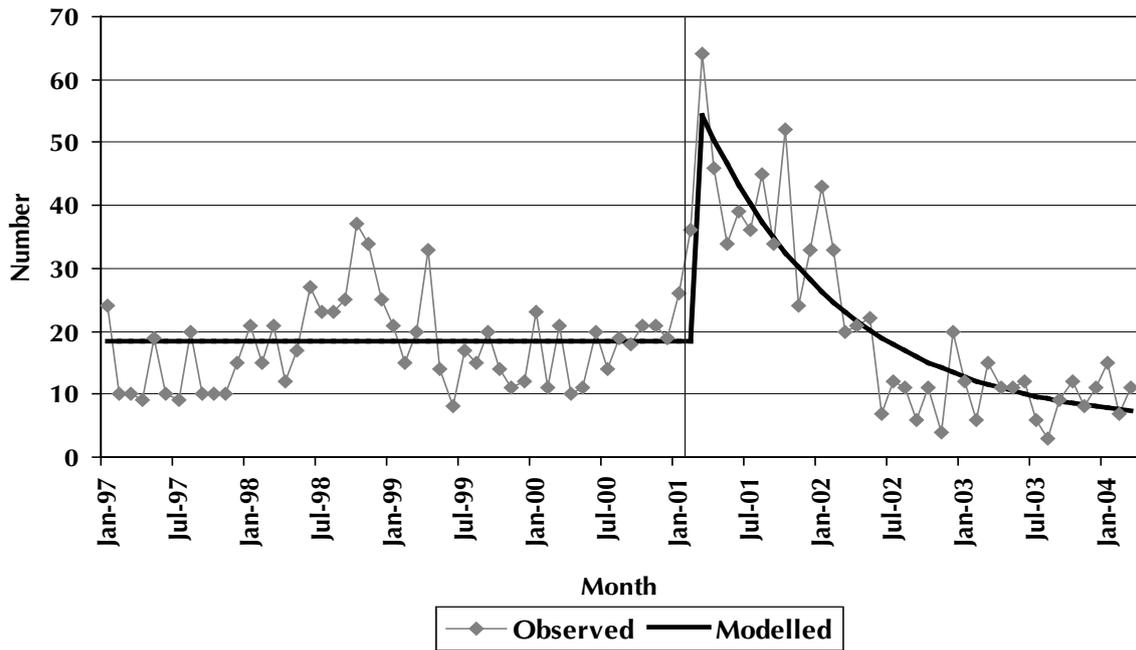
Source: NSW Bureau of Crime Statistics & Research.

Data on possession/use offences by gender (not shown) indicated similar patterns for males and females, but the small number of cases in 2003/2004 precluded statistical analysis, and the data was described qualitatively only. The duration of the increase in recorded incidents was marked for males, with only an apparently short spike of one month for females.

Trends in illicit sex work

There was a rapid increase in the incidence of prostitution offences (from a mean of 31.4 offences per month to a peak of 116.7, p<0.0001), which occurred across NSW one month after the onset of the shortage. This represented a brief 272% increase in the number of offences. The number of prostitution offences returned slowly to pre-shortage levels over the next 15 months. Figure 3.3 shows both the observed and modelled series for this offence category. The brief peak which occurred in January 2003 is probably representative of a brief police campaign occurring in connection with the New Year, and had no impact on the magnitude and significance of parameter estimates for the model presented here, even when modelled in statistical analyses as a separate event.

Figure 3.3: Incidents of prostitution offences in NSW, 1997-2004
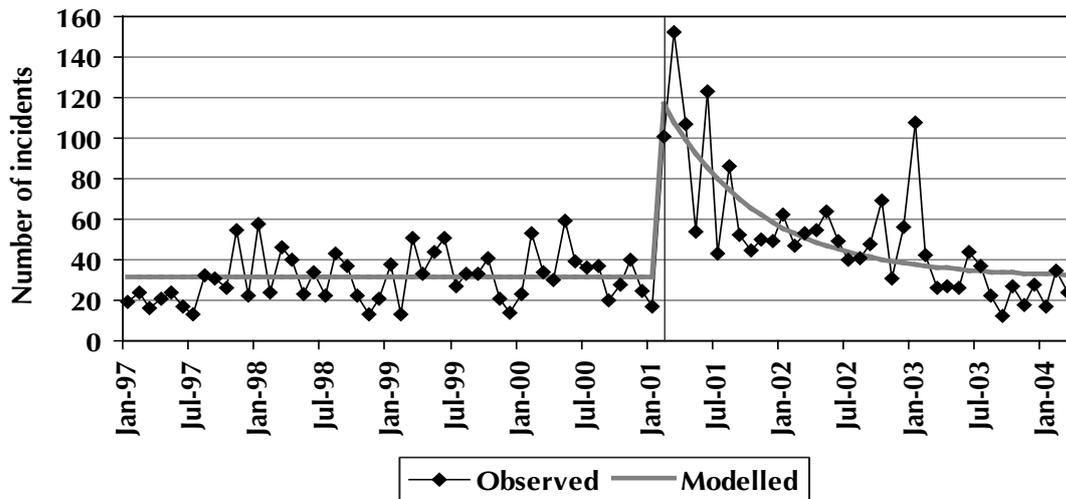
Source: NSW Bureau of Crime Statistics & Research.

There were reports from both KI and IDU that some women felt they had been forced into sex work as a way to meet the increasing financial demands associated with cocaine use. In Cabramatta, where prostitution had not previously been an issue, this increase was thought by one law enforcement KI to be due to an increase in the number of sex workers coming in from outside the Cabramatta area, because the sex workers believed that Cabramatta would be the first market to be supplied with heroin when the supply of heroin returned.

KI also noted that women were working longer hours as a consequence of the behavioural effects of cocaine and, in doing so, became more visible to police. Reduced condom use was also reported and therefore increased risk of sexually transmitted infections (STI) and Human Immunodeficiency Virus (HIV) to both the workers and their clients. This was particularly evident in the Kings Cross drug market, and with the younger sex workers.

> *'Services up there were really worried about some very young workers who were into sex work and were using heroin and then went straight over to coke, and they were very concerned at their level of use, and the fact that they were working so much and so therefore were at greater risk in terms of the numbers of clients they were seeing each day, and access to condoms, given that they were working around the clock virtually'.*
> (NSW, Health, Community Welfare, Upper Management).

Similar patterns were observed among male and transgender sex workers in the same areas. An outreach worker reported that the increased use of cocaine among this group resulted in longer worker hours (and therefore more visibility), increased violence between the workers, and also greater risk to clients.

> *'Those who went from heroin to coke [cocaine] or speed [methamphetamine powder] have really shaken up their old lifestyle or lost it completely'.*
> [Q: What would they have lost?]
>
> *'Their house … [Their] looks. Their ability to put on a face of make up and not have it look absolutely shocking'.*

The increase in sex work was also related to greater levels of violence among sex workers because of a perceived desire to work longer hours.

> 'I think there's also been an increased amount of violence between sex workers, because they're more hungry for work. They need to be standing on that particular spot twenty four hours a day'.

> 'Their focus became more desperate. They're focused on getting the money off the client. So that means they're more likely to roll him or give a poor or short service. So a level of professionalism dropped'. (NSW, Health, Community Welfare, Middle Management).

KI working in outreach programs for sex workers reported that they felt it necessary to respond to the changes in drug use among their client base. In particular, they reported needing to develop new educational material, and adapt to the changing needs of their clients due to the disruption that cocaine use appeared to be causing among this group. For example, there was a greater perception that services were more 'crisis-driven', and that sex workers' lives were 'falling apart' due to their escalating cocaine use.

> 'I think that we saw a lot more demand for welfare-related or drug-and alcohol-related services and referrals … We had referral around emergency accommodation, emergency assistance, financial assistance and detox'.

Discussion

This study found an increase in the number of arrests for cocaine possession and use in the period immediately following the reduced heroin supply, which was consistent with other reliable evidence that a marked increase in cocaine use occurred among regular injecting drug users following the heroin shortage (Roxburgh et al. 2004b; Topp et al. 2003). Concurrent with these changes were increased incidents of prostitution offences. Interviews with IDU and KI who had had frequent, direct contact with sex workers indicated that the increase in prostitution offences stemmed from increased sex worker visibility (due to longer working hours) and increased discord among sex workers (due to increased competition for business). It was consistently reported that sex workers were working longer hours, aided, in part, by their cocaine use, but also necessitated, in part, by the greater cost of cocaine use compared to heroin use.

Although sex work is more commonly reported by female IDU than male IDU (Roxburgh et al. 2005), KI reported the observed changes in cocaine use and sex work practices for all sex workers (female, male and transgender), suggesting that risk was not confined to one group of sex workers nor to a group of clients with specific gender preferences.

KI reported that clients in contact with outreach services became more chaotic and took more risks, which they attributed to cocaine use; this is consistent with previous research examining risk behaviours among injecting cocaine users (Tyndall et al. 2003; Hudgins et al. 1995). The need for outreach services to adapt to the changing drug market was apparent.

Limitations

This paper is subject to the flaws that beset all natural experiments, in that it is not possible to guarantee that the intervention being studied was the only event that affected cocaine use and/ or sex work in the time period. However, similar research on rates of crime conducted in the same time period in both Victoria and South Australia provided a control series. These two states were geographically isolated from NSW and both experienced a heroin shortage but neither

experienced any increase in cocaine use or street-based sex work among IDU (Dietze et al. 2004; Harrison et al. 2004). Although it might be possible that some other event interfered in NSW drug markets at the same time as the heroin shortage, such possibilities were examined in a process of extensive cross-checking through KI, consultation with stakeholders, and analysis of other data sources in the wider project from which this study is drawn (Degenhardt & Day 2004b; Degenhardt et al. 2004). No plausible alternative explanations remained (Degenhardt et al. 2004; Degenhardt & Day 2004b).

The increase in cocaine use was not a sustained one; nor was the increase in sex work offences sustained. This was most likely due to apparent decreases in cocaine availability in 2002 (and an increase in heroin use among regular IDU) (Roxburgh et al. 2004b). However, there is no reason to believe that such a reduction in cocaine supply to IDU will persist. When cocaine use increases among injecting drug users, so too does the extent of street-based sex work among this marginalised group, in part due to the relatively higher cost of the drug and relatively shorter half-life of its effects, and in part due to its psychostimulant nature. One thing remains relatively clear, however: the surge in prostitution was almost entirely a consequence of the temporary increases in cocaine consumption among IDU.

Clear reports were obtained in this study of increased sex risk behaviours among this group when cocaine use increased (longer working hours, unprotected sex and reductions in condom use in order to increase income), increasing the potential for transmission of BBVI and STI (as has been found previously) (Tyndall et al. 2003; Hudgins et al. 1995). This has significant public health consequences, which need to be weighed against the public health benefits of reduced availability of heroin (van Beek et al. 2001). Health services need to be adaptive to respond to such potential changes in drug use among this particularly at-risk group should cocaine use return.

Conclusions

Increased cocaine use was associated with increased street-based sex work by some IDU, increased visibility of these sex workers, and an apparent decline in the health and social stability of these workers. Positive effects of a sudden reduction in heroin use need to be balanced against a sudden increase in other behaviours that may have poor health consequences for IDU. Rapid changes in drug markets lead to rapid changes in the public health burden of injecting drug use, which need to be considered by health and law enforcement agencies alike. Given the increased risks among IDU during this period, and the apparent lack of appropriate harm reduction strategies to target such behaviours, it would be of use to develop such interventions in anticipation of future returns to such risky behaviour.

References

Breen, C., Degenhardt, L., Roxburgh, A., Bruno, R., Duquemin, A., Fetherston, J., Fischer, J., Jenkinson, R., Kinner, S., Longo, M. & Rushforth, C. (2004) *Australian Drug Trends 2003: Findings from the Illicit Drug Reporting System (IDRS),* NDARC Monograph No. 51, National Drug and Alcohol Research Centre, University of New South Wales, Sydney.

Day, C. (2004a) Documenting the heroin shortage, in *The Cause, Course and Consequence of the Heroin Shortage in Australia*, (Eds. Degenhardt, L., Day, C. & Hall, W.) National Drug Law Enforcement Research Fund, pp. 39-47.

Day, C. (2004b) Documenting the heroin shortage in New South Wales, in *The Course and Consequence of the Heroin Shortage in New South Wales*, (Eds. Degenhardt, L. & Day, C.) National Drug Law Enforcement Research Fund, pp. 11-17.

Day, C., Gibson, A., Collins, L., Degenhardt, L. & Dietze, P. (2004) *Research methodologies used to obtain retrospective self-reports of the impact of changes in heroin supply on regular users in and out of treatment,* NDARC Technical Report No. 176, National Drug and Alcohol Research Centre, University of New South Wales, Sydney.

Day, C., Topp, L., Rouen, D., Darke, S., Hall, W. & Dolan, K. (2003) Decreased heroin availability in Sydney in early 2001, *Addiction,* 98, 93-95.

Degenhardt, L., Conroy, E., Gilmour, S. & Collins, L. (2005) The effect of a reduction in heroin supply in Australia upon drug distribution and acquisitive crime, *British Journal of Criminology,* 45, 2-24.

Degenhardt, L. & Day, C. (2004a) Changes in patterns of drug use, in *The course and consequences of the heroin shortage in New South Wales*, (Eds. Degenhardt, L. & Day, C.) National Drug Law Enforcement Research Fund.

Degenhardt, L. & Day, C. (Eds.) (2004b) *The course and consequences of the heroin shortage in New South Wales,* National Drug Law Enforcement Research Fund.

Degenhardt, L., Day, C. & Hall, W. (Eds.) (2004) *The causes, course and consequences of the heroin shortage in New South Wales, South Australia and Victoria,* National Drug Law Enforcement Research Fund.

Dietze, P., Miller, P., Clemens, S., Matthews, S., Gilmour, S. & Collins, L. (2004) *The course and consequences of the heroin shortage in Victoria,* National Drug Law Enforcement Research Fund.

Gibson, A., Degenhardt, L., Topp, L., Day, C., Hall, W., Dietze, P. & McKetin, R. (2003) *Global and Australian heroin markets,* NDARC Technical Report No. 167, National Drug and Alcohol Research Centre, University of New South Wales, Sydney.

Gossop, M., Powis, B., Griffiths, P. & Strang, J. (1995) Female prostitutes in South London: Use of heroin, cocaine and alcohol and their relationship to health risk behaviours, *AIDS Care,* 7, 253-260.

Green, A., Day, S. & Ward, H. (2000) Crack cocaine and prostitution in London in the 1990s, *Sociology of Health and Illness,* 22, 27-39.

Harrison, A., Christie, P., Longo, M., Pointer, S. & Ali, R. (2004) *The course and consequences of the heroin shortage in South Australia,* National Drug Law Enforcement Research Fund.

Hudgins, R., McCusker, J. & Stoddard, A. (1995) Cocaine use and risky injection and sexual behaviours, *Drug and Alcohol Dependence,* 37, 7-14.

Inciardi, J. A. & Surratt, H. L. (2001) Drug use, street crime, and sex-trading among cocaine-dependent women: Implications for public health and criminal justice policy, *Journal of Psychoactive Drugs,* 33, 379-89.

Leggett, T. (2001) Drugs, sex work, and HIV in three South African cities, *Society in Transition,* 32, 101-109.

MacDonald, M., Zhou, J. & Breen, C. (2003) *Drug use trends among injecting drug users (IDU): Findings from the Australian Needle and Syringe Program (NSP) Survey, 1995-2002,* National Centre in HIV Epidemiology and Clinical Research, University of New South Wales, Sydney.

Minichiello, V., Marino, R., Khan, M. & Browne, J. (2003) Alcohol and drug use in Australian male sex workers: Its relationship to the safety outcome of the sex encounter, *AIDS Care,* 15, 549-561.

Perkins, R. (1991) *Working girls: prostitutes, their life and social control*, Canberra.

Roxburgh, A., Breen, C. & Degenhardt, L. (2004a) *New South Wales Drug Trends 2003: Findings from the Illicit Drug Reporting System (IDRS),* NDARC Technical Report Number 174, National Drug and Alcohol Research Centre, University of New South Wales, Sydney.

Roxburgh, A., Degenhardt, L. & Breen, C. (2004b) Changes in patterns of drug use among injecting drug users following a reduction in the availability of heroin in New South Wales, Australia, *Drug and Alcohol Review,* 23, 287-294.

Roxburgh, A., Degenhardt, L. & Breen, C. (2005) Drug use and risk behaviours among injecting drug users: A comparison between sex workers and non-sex workers, *Harm Reduction Journal*, 2:7 (6 June 2005).

Topp, L., Day, C. & Degenhardt, L. (2003) Changes in patterns of drug injection concurrent with a sustained reduction in the availability of heroin in Australia, *Drug and Alcohol Dependence,* 70, 275-286.

Topp, L., Kaye, S., Bruno, R., Longo, M., Williams, P., O'Reilly, B., Fry, C., Rose, G. & Darke, S. (2002) *Australian Drug Trends 2001: Findings from the Illicit Drug Reporting System (IDRS),* NDARC Monograph No. 48, National Drug and Alcohol Research Centre, University of New South Wales, Sydney.

Tuan, N. A., Hien, N. T., Chi, P. K., Giang, L. T., Thang, B. D., Long, H. T., Saidel, T. & Roger, M. (2004) Intravenous Drug Use Among Street-Based Sex workers: A High-Risk Behaviour for HIV Transmission, *Sexually Transmitted Diseases,* 31, 15-19.

Tyndall, M. W., Currie, S., Spittal, P., Li, K., Wood, E., O'Shaughnessy, M. V. & Schechter, M. T. (2003) Intensive injection cocaine use as the primary risk factor in the Vancouver HIV-1 epidemic, *AIDS,* 17, 887-893.

United Nations Office for Drug Control and Crime Prevention (2002) *Global Illicit Drug Trends 2002,* United Nations, New York.

van Beek, I., Dwyer, R. & Malcolm, A. (2001) Cocaine: The sharp end of drug-related harm!, *Drug and Alcohol Review,* 20, 333-342.

Vanwesenbeeck, I. (2001) Another Decade of Social Scientific Work on Sex Work: A Review of Research 1990-2000, *Annual Review of Sex Research,* 12, 242-289.

Weatherburn, D., Jones, C., Freeman, K. & Makkai, T. (2003) Supply control and harm reduction: Lessons from the Australian heroin 'drought', *Addiction,* 98, 83-91.

Chapter four: The effect of a reduction in heroin supply upon population trends in fatal and non-fatal drug overdoses

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Background

The harm that heroin use causes its users and the community is disproportionate to the relatively low prevalence of its use in most developed countries (Hall et al. 1999b), and one of the commonly mentioned harms is that of non-fatal and fatal heroin overdose (Darke & Zador 1996; Degenhardt et al. 2001; Hall et al. 1999a; Warner-Smith et al. 2001; Darke et al. 1996; Darke et al. 2000). Considerable work has been completed examining the epidemiology and trends in heroin-related overdose deaths around the world (Lepere et al. 2001; Davidson et al. 2003; Coffin et al. 2003; Sergeev et al. 2003; Clark & Bates 2003; Dietze et al. 2003; Landen et al. 2003; Oliver & Keen 2003; Quaglio et al. 2001; Preti et al. 2002). Research has suggested that many heroin-related deaths are polydrug deaths (Darke 2003; Coffin et al. 2003; Oliver & Keen 2003; Darke & Zador 1996; Darke et al. 2000; Grass et al. 2003), and it may be that the combinations involved in drug-related deaths change over time (Coffin et al. 2003).

During the 1990s, there was an apparent increase in the scale of Australian heroin markets: in New South Wales (NSW) between 1993 and 1999 the price per gram of heroin reached an historic low, heroin purity at 'street' level reached 60%, and heroin was the drug most commonly injected by injecting drug users (IDU) (Topp et al. 2002b; MacDonald et al. 2001; Darke et al. 2002b). In the late 1990s, there were substantial rises in the number of persons in treatment for heroin dependence, heroin-related overdose deaths, heroin arrests, and hepatitis C infections (Hall et al. 1999a; Hall et al. 2000; Law et al. 2003). Heroin overdose deaths became an issue of great public concern around the country. In response to these concerns, new harm reduction initiatives were implemented in the late 1990s: in NSW, information about reducing the risk of overdose was distributed, and NSW Police introduced policies that stipulated police would not attend ambulance attendances at overdoses, to reduce the fear of police apprehension among illicit drug users. In NSW, the health services such as ambulance and emergency department attendances are publicly funded. Despite these harm reduction efforts, overdoses continued to increase.

In early 2001, there were reports of a dramatic decline in the availability of heroin in Sydney, NSW (Weatherburn et al. 2003; Day et al. 2003). This was confirmed by the 2001 Illicit Drug Use Reporting System (IDRS) – Australia's strategic early warning system – which found an overall reduction in the availability and street level purity of heroin, and an increase in heroin price for all major heroin markets (Weatherburn et al. 2003; Topp et al. 2002a; Day 2003). The reduction in availability was most severe from January to April 2001 (Day 2004). Regular IDU reported less frequent heroin use, and increases in cocaine, methamphetamine and possibly benzodiazepine use were reported (Topp et al. 2003; Degenhardt et al. in press; Roxburgh et al. 2004). The use of cocaine, in particular, among Australian IDU has historically been relatively infrequent and uncommon; street level purity of cocaine is probably low and there is little or no use of 'crack' cocaine in the country (Darke et al. 2002a; Breen et al. 2003).

It was, therefore, of interest to examine whether there were potential changes in fatal and non-fatal heroin overdoses that coincided with the reduction in availability of heroin. Furthermore, it was of interest to examine whether there were changes in the number of overdoses on other drugs, given the evidence suggesting shifts to other drug use may have occurred as a result of the change in heroin supply. Finally, it was of interest to examine the drug combinations detected at death.

The aims of this paper were therefore to examine the effect of the reduction in heroin supply on:

1. The number of non-fatal and fatal heroin overdoses;

2. The number of cocaine, methamphetamine and benzodiazepine overdoses;

3. The drug combinations involved in drug-related deaths.

Methods

Data used in the study

Data on suspected drug-related deaths

The NSW Division of Analytical Laboratories (DAL) conducts pathology tests upon all cases in which post-mortem examinations are conducted. All suspected drug-related deaths have post-mortems and toxicology analyses performed. The place of death, age and gender of the subjects are recorded. The DAL data – included in these analyses – include all cases in which the deceased was identified by either police or pathologists as an illicit drug user or 'known drug taker'. For the purposes of these analyses, deaths where a drug was detected were defined as deaths related to that drug.

The following drug categories were used when examining drugs detected at death: heroin, methamphetamine, alcohol, cocaine, benzodiazepines, antidepressants, methadone, and other opioids (e.g. fentanyl, pethidine, oxycodone).

When examining drug combinations at death, the following groupings were used: (a) heroin only (excluding deaths where other opioids, benzodiazepines, alcohol, cocaine, methamphetamine were detected); (b) heroin and benzodiazepines (excluding deaths where other opioids, methadone, alcohol, cocaine or methamphetamine where detected); (c) heroin and cocaine or methamphetamine (excluding deaths where benzodiazepines, methadone or alcohol were detected); (d) heroin and alcohol (excluding deaths where other opioids, benzodiazepines, methadone, cocaine, or methamphetamine were detected); (e) heroin, benzodiazepines and alcohol (excluding deaths where other opioids, methadone, cocaine, or methamphetamine were detected); (f) heroin and central nervous system (CNS) depressants not elsewhere classified (excluding deaths in the a, b, d, e categories, and deaths where cocaine or methamphetamine were detected); (g) methadone only, or with benzodiazepines (excluding deaths where heroin, other opioids, alcohol, cocaine, or methamphetamine were detected); (h) heroin with other drug combinations (excluding any deaths that were included in the above categories); and (i) other drug combinations without heroin (excluding all above categories).

NSW Ambulance Service data on callouts to suspected heroin overdoses

These data are based on cases where ambulance officers have used the Ambulance Service protocol for drug overdose/poisoning <u>and</u> where naloxone was administered. Cases where naloxone was not used for persons are not included. The drug overdose/poisoning protocol includes 'all' drug overdoses and does not distinguish between the drugs used by the patient, and naloxone may be administered to unconscious patients who have not responded to other treatment. The data are based on 'attendances at incidents' rather than 'persons', which means that the same person may have accounted for several ambulance callouts. It must be noted that this data does not allow an examination of the outcome of the ambulance attendance. Some persons may subsequently have died despite receiving assistance from the ambulance officers. Nonetheless, if we assume that these sources of error remain relatively constant over time and area, these data provide potentially useful information on trends in non-fatal overdose.

Emergency department (ED) data on drug overdoses

Diagnostic information on persons presenting to the emergency departments (ED) of NSW hospitals is coded using the International Classification of Diseases, 9th Revision (ICD-9). This information is recorded at the time of presentation to the ED. The following ICD-9 code groups were used to examine overdose upon different drug types: (a) heroin: 965, 965.01, E850.0; (b) methamphetamine: 969.7, E854.2; (c) cocaine: 968.5; and (d) benzodiazepines: 969.4.

Data analysis

The data series were analysed using an ARIMA model time series with intervention terms (Degenhardt & Day 2004). Analyses revealed that the intervention model time series was not appropriate for some series that showed different behaviour in different time periods. Natural spline smoothers with serially-dependent residuals were fitted to these data series, testing the impact of the heroin shortage as a step or a pulse term. Although the coefficients of the spline smoother could not be interpreted meaningfully, the intervention terms were linear and could be interpreted as in a standard linear model. Several models were tested with different numbers and types of basis points, and standard methods of model selection (generalised cross-validation, significance of terms, and low prediction variance) used to select the best-fitting model. Model fitting for these types of smoothers is described in Venables and Ripley (2002). Linear models were fitted using S-Plus (computer program), Version 6.1.

Results

Non-fatal overdose

Heroin

Non-fatal heroin overdoses were assessed in two ways: through callouts by the NSW Ambulance Service to suspected heroin overdoses, and through emergency department (ED) data on presentations for heroin overdoses.

Overdoses related to heroin decreased substantially, whether measured by callouts to ambulances or ED admissions. Figure 4.1 shows the observed and modelled number of ambulance callouts to suspected heroin overdoses between 1995 and 2003. After adjusting for serial dependence there was a 40 percent decrease (p=0.009) following the reduction in heroin supply, which decayed further over time to a final stable mean of 111.6 callouts per month (from an initial mean of 302.7 callouts per month). This represented an overall decrease of 63 percent (p=0.02). Decay terms were represented by significant first-order denominator terms in transfer functions for the pulse and step terms of the ARIMA model (p<0.0001 and p=0.0002 respectively).

Figure 4.1: Ambulance callouts to suspected heroin overdoses, 1995-2003
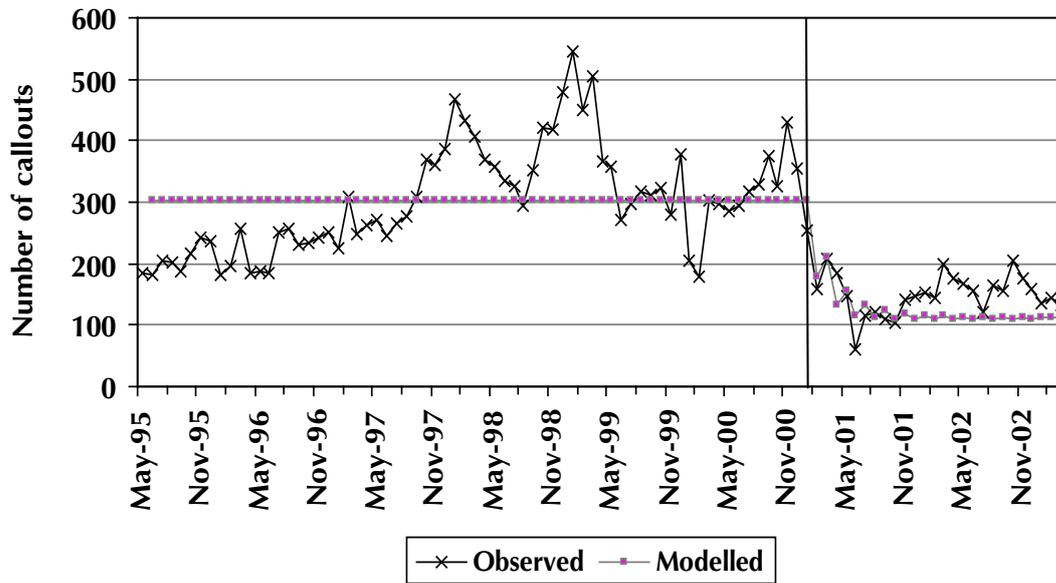
Across NSW, the number of ED presentations for heroin overdose decreased from a pre-shortage mean of 102.8 to 61.7 post-shortage (Figure 4.2). This represented a 40 percent decrease in the mean number of overdose presentations per month (p<0.0001).

It was difficult to determine statistically any effect of the shortage on heroin overdose presentations to ED among certain age or gender groups. The data suggested a larger decrease for males and for the younger age groups, but the high variability in the time series for gender and age precluded analysis by TSA.

Figure 4.2: Heroin overdose presentations to NSW emergency departments, 1997-2003
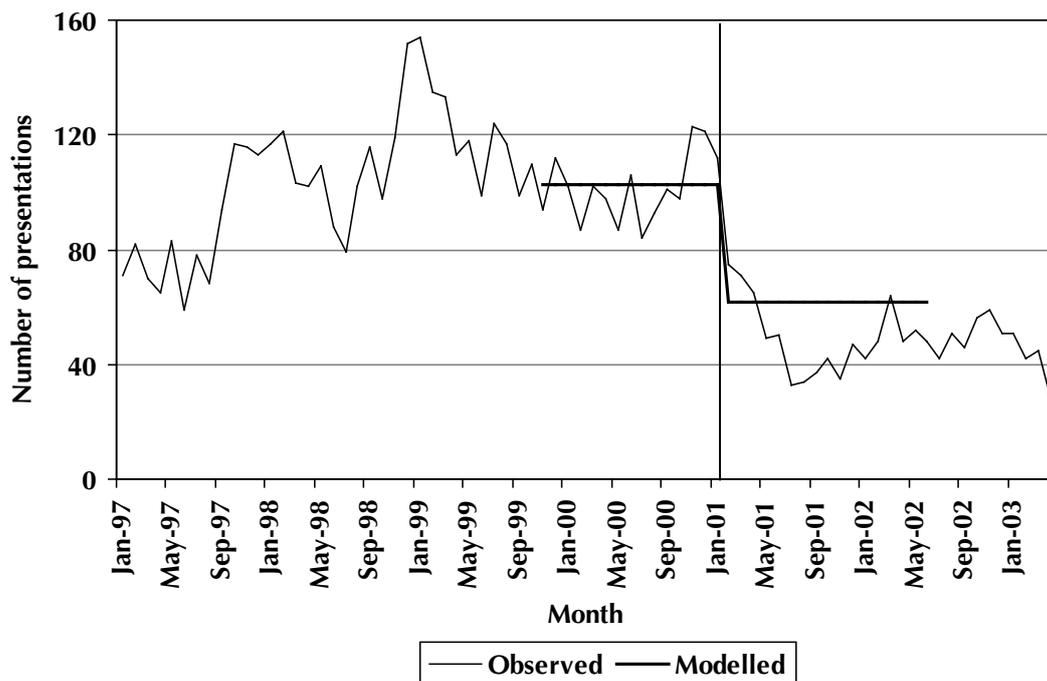
Methamphetamine

In contrast to the strong effect observed for heroin overdoses, there was no significant change in methamphetamine overdoses associated with the reduction in heroin supply (Figure 4.3). This did not differ between gender or age groups.

Cocaine

There was an apparent increase in cocaine overdose presentations to emergency departments across NSW at the time of the shortage (Figure 4.3). This increase was apparent for both males and females, and for all age groups except the older age group of 45 years and over. Due to the very small numbers, however, statistical analyses were not possible.

Benzodiazepines

Examination of the number of benzodiazepine overdose presentations to emergency departments in NSW using time series analysis revealed no significant trends related to the shortage (Figure 4.3). There were also no apparent changes according to age, gender or geographic groupings.

Figure 4.3: Other drug overdose presentations to NSW emergency departments, 1997-2003
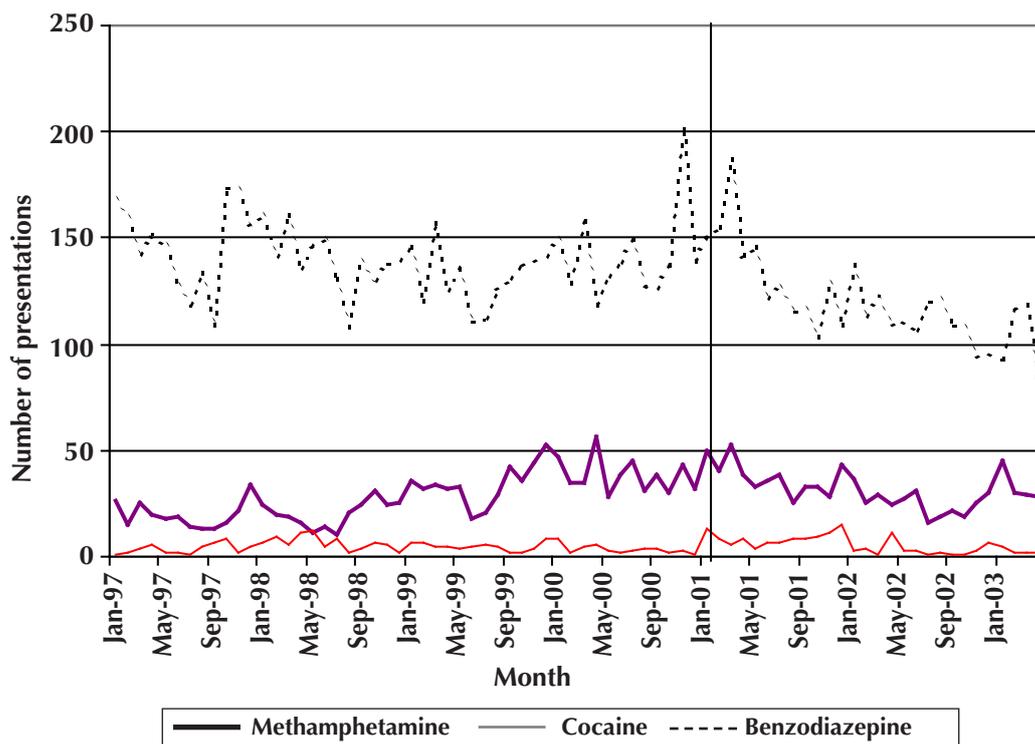
Fatal overdose

Data on suspected drug-related deaths from DAL/Institute of Clinical Pathology and Medical Research (ICPMR) were collected between January 1995 and June 2003. Figure 4.4 shows a 43 percent decrease (p<0.0001) in the number of drug-related deaths associated with the reduced supply of heroin.

Figure 4.4: Number of suspected drug-related deaths in NSW, 1995-2003
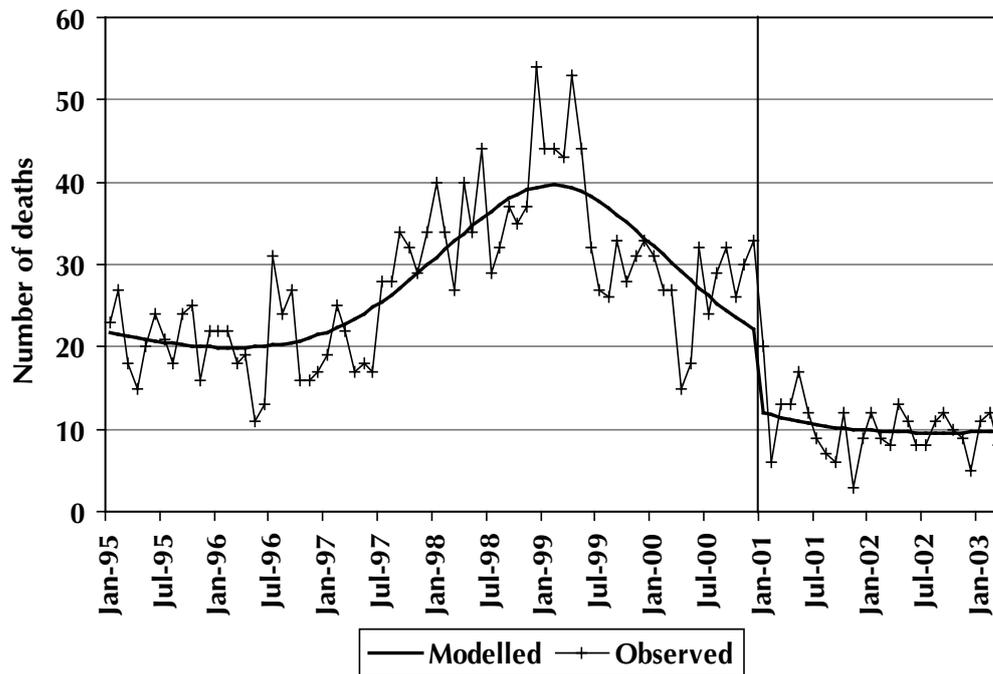
Changes in the number of deaths where heroin was involved accounted for most of the steep drop in the total number of drug-related deaths (Figure 4.5). Following the reduction in heroin supply, there was a decrease in the number of deaths where heroin was detected and a corresponding decrease in the *total* number of drug-related deaths in NSW. Drug-related deaths involving alcohol and benzodiazepines changed along with the shifts in the number of heroin-related deaths (Figure 4.5). In contrast, deaths involving cocaine, methadone, methamphetamine, and antidepressants remained stable.

Figure 4.5: Number of suspected drug-related deaths where particular drugs were detected post-mortem, 1995-2003
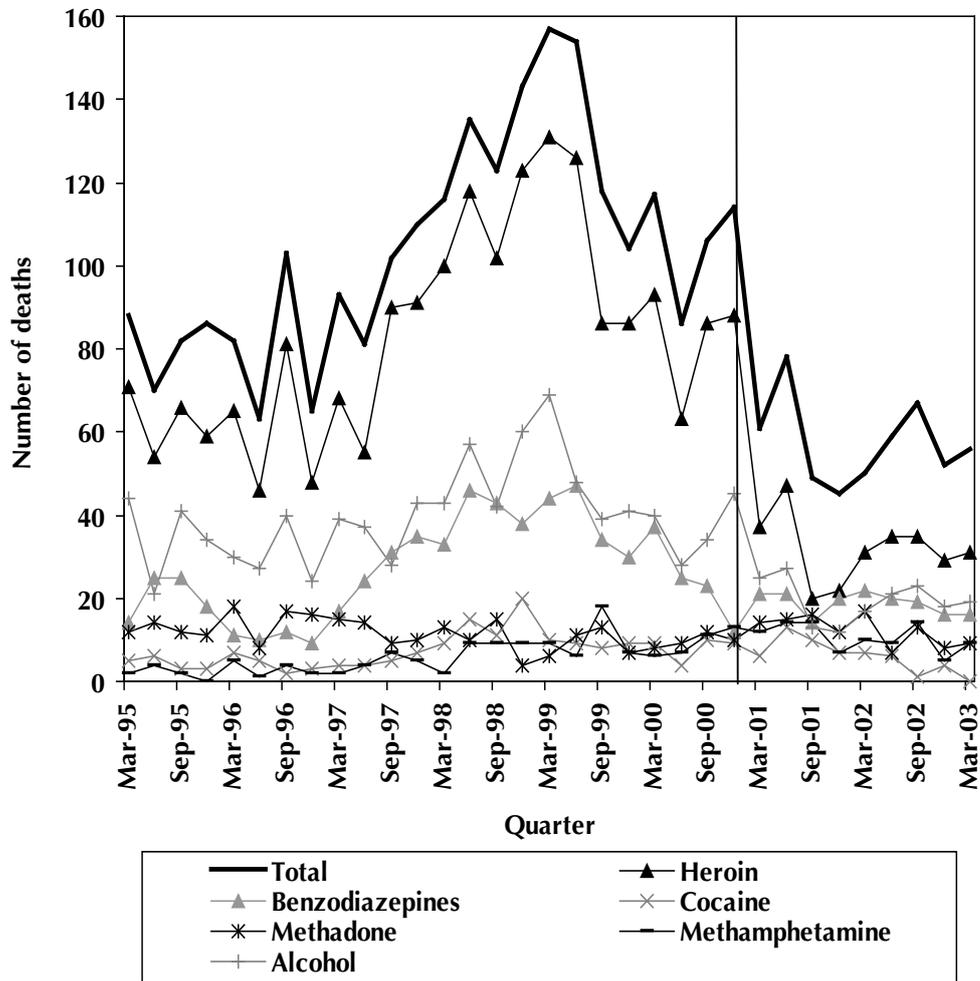
The decreases were of a similar magnitude for males and females. The number of deaths among males decreased from around 25 per month immediately prior to the heroin shortage, to around 10 after the onset of the shortage, while the number of deaths among females decreased from around five to seven per month, to around two per month. These lower levels appear to have been maintained since that time. There were marked age differences, however, in the trends in heroin-related deaths (Figure 4.6). There was a 65 percent decrease in heroin-related deaths among 15-24 year olds (p<0.0001), a 39 percent decrease in those aged 25-34 (p=0.01) and a 42 percent decrease in those aged 35-44 (p=0.008).

The step associated with the heroin shortage was not statistically significant (Table 4.1); in the presence of the interaction terms, this step term can be interpreted as the effect of the heroin shortage on overdose deaths among those aged over 45 (a non-significant effect). Since this term is non-significant, the interaction terms for step and age group can then be interpreted as the change in number of deaths in the other age groups due to the heroin shortage. There was no significant decrease in heroin-related deaths among persons aged over 45 (Table 4.1).

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Figure 4.6: Number of heroin-related deaths among those aged 15 years and over, NSW 1995-2003
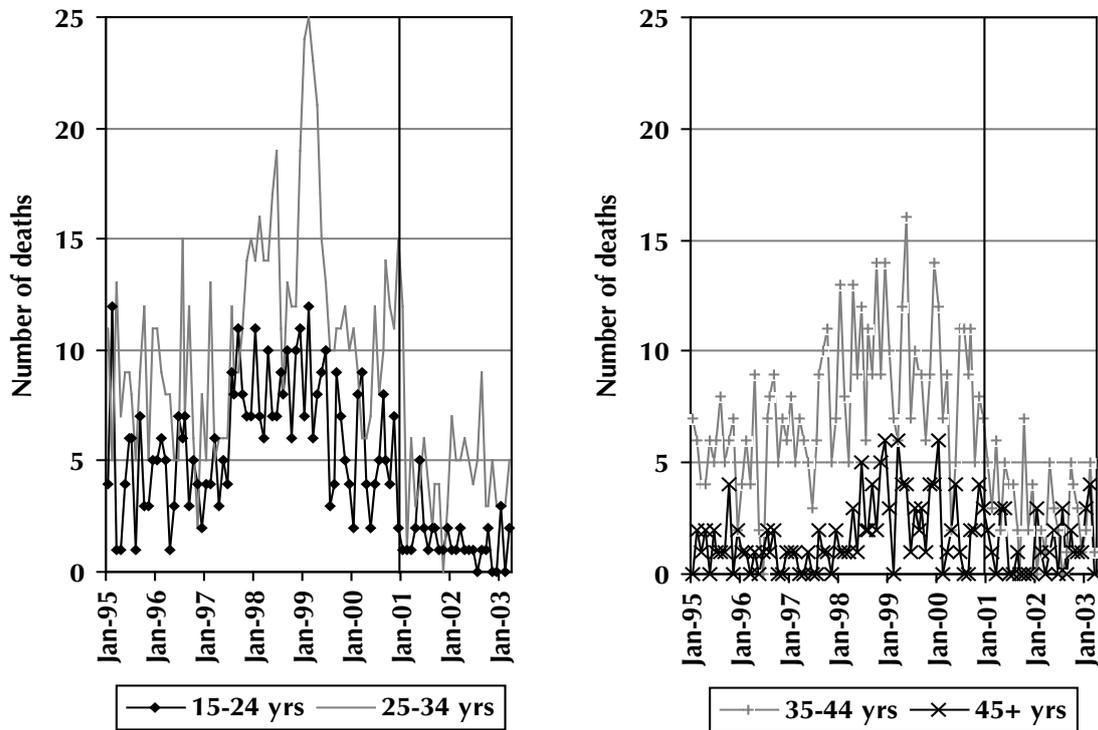
Table 4.1: Parameter estimates for time series analysis (TSA) of suspected drug-related deaths.

Parameter	Estimate	T statistic	P value
Intercept	0.35	2.88	0.002
Spline1	1.07	10.16	<0.0001
Spline2	-0.28	-2.07	0.02
Spline3	-0.55	-1.93	0.03
Spline4	-0.10	-0.44	0.3
Step	0.06	0.24	0.41
Age			
15 – 24 years	1.21	12.01	<0.0001
25 – 34 years	1.81	19.05	<0.0001
35 – 44 years	1.46	14.86	<0.0001
45+ years	Ref	Ref	<0.0001
Interaction (step * age)			
15 – 24 years	-1.06	-4.07	<0.0001
25 – 34 years	-0.49	-2.24	0.01
35 - 44 years	-0.55	-2.40	0.008

Figure 4.7 shows the drug combinations detected among persons suspected of dying from drug-related causes (presented as six monthly intervals). The proportion of drug-related deaths in which heroin was detected decreased markedly after the reduction in heroin supply, from approximately 90 percent of deaths to 70-75 percent of deaths. The proportion of drug-related deaths in which only heroin was detected also decreased, from around 25% to 10% of deaths. The proportion of deaths involving heroin with alcohol and/or benzodiazepines also appeared to decrease (Figure 4.7-legend key: Heroin-alcohol-benzo).

In contrast, the proportion of drug-related deaths where heroin was detected along with the full range of depressant drugs (methadone, alcohol, benzodiazepines, or other opioids) increased (Figure 4.7-legend key: Heroin-depressants), from around 10 percent of all drug-related deaths in December 2000 to 25 percent in December 2001. Furthermore, the proportion of heroin-related deaths involving methadone with or without benzodiazepines (Figure 4.7-legend key: Heroin-methadone-benzo) also increased. Finally, the proportion of deaths where heroin was not detected, but a range of other drugs was detected, may also have increased somewhat following the reduction in heroin supply (Figure 4.7-legend key: Other drugs-no heroin).

Figure 4.7: Proportion of drug-related deaths involving different drug combinations at death, NSW, 1995-2002
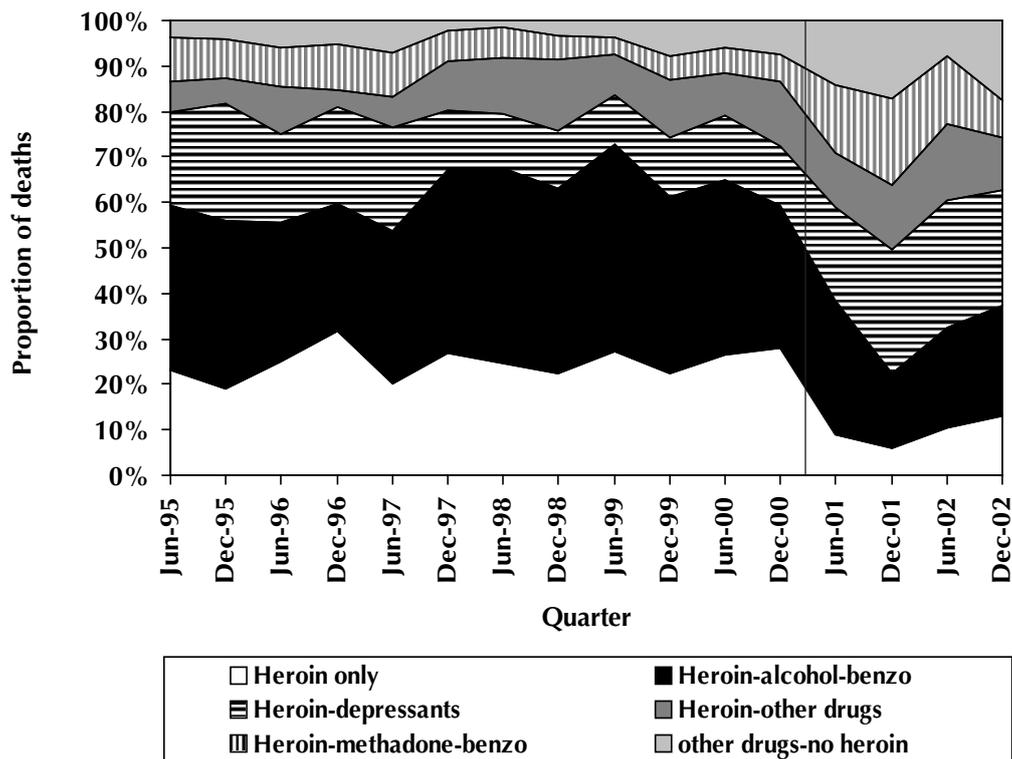
Discussion

There was a large and persistent decrease in the number of non-fatal heroin overdoses in early 2001. There was also a significant and sustained decrease in the number of deaths where heroin was detected. Decreases in heroin overdoses were of a similar magnitude for males and females, but there were bigger decreases among younger age groups and no detectable change among

those aged 45 years and older. This suggests that a reduction in heroin availability had a bigger impact upon younger than older heroin users' likelihood of overdose. This age effect suggested that older users remained in the market, whereas younger users may have ceased or reduced their use of heroin.

There was no detectable change in ED admissions for cocaine, methamphetamine or benzodiazepine overdose, despite evidence that the use of these drugs increased among some injecting drug users. This suggests a few possibilities: (a) users did not experience overdoses related to the use of these drugs; (b) that they did not seek the assistance of ED personnel when they did overdose, perhaps because the symptoms were less obvious; and (c) ED personnel may not have recognised the overdose as such. Given the presence of harm reduction initiatives to encourage users to call ambulances, and continued free access to emergency health services in NSW, there were no other factors identified that could have affected the number of calls about overdoses.

This study also suggested that, following a reduction in heroin supply (and street level purity), there was a decrease in the proportion of suspected drug-related deaths where heroin was the only drug detected. Concomitantly, there was an increase in the proportion of suspected drug-related deaths where heroin was detected with a range of other depressant drugs, and a small increase in the proportion of deaths where no heroin was detected. Overall, however, the total number of suspected drug-related deaths decreased following the reduction in heroin supply. This provided some support for the possibility that, although heroin appears to be the drug that drives the number of drug-related deaths in NSW, among those deaths that did occur following a reduction in heroin supply there seemed to be evidence of drug substitution and a greater range of drug types used by the deceased persons.

The predominance of heroin in drug-related deaths seen in NSW is not the case in all countries: the United States, for example, has had a considerable problem with cocaine-related deaths and morbidity (Coffin et al. 2003; Office of Applied Studies Substance Abuse and Mental Health Services Administration 2002). The contrast between these two countries may lie in the relatively limited availability of cocaine in Australia (Darke et al. 2002a), compared to much greater availability and use of both cocaine and 'crack' cocaine in the US (Substance Abuse and Mental Health Services Administration 2002; Galai et al. 2003).

Conclusions

A reduction in the availability of heroin in NSW, Australia, led to significant decreases in non-fatal and fatal heroin overdoses. Total suspected overdose deaths also decreased, suggesting that heroin may have been driving the total number of suspected drug-related deaths; and that when heroin supply decreased, the use of other drugs did not lead to comparable increases in deaths related to other drugs. The decreases were larger among younger users, suggesting that supply reduction affected younger users to a greater extent that it did older users. Given the relatively limited supply of cocaine in Australia, it is unclear how such heroin supply reduction may have affected users in countries where cocaine was in ready supply.

References

Breen, C., Degenhardt, L., Roxburgh, A., Bruno, R., Duquemin, A., Fetherston, J., Fischer, J., Jenkinson, R., Kinner, S., Longo, M. & Rushforth, C. (2003) *Australian Drug Trends 2002: Findings from the Illicit Drug Reporting System (IDRS),* NDARC Monograph No. 50, National Drug and Alcohol Research Centre, University of New South Wales, Sydney.

Clark, M. J. & Bates, A. C. (2003) Non-fatal heroin overdoses in Queensland, Australia: An analysis of ambulance data, *Journal of Urban Health*, 80, 238-47.

Coffin, P. O., Galea, S., Ahern, J., Leon, A. C., Vlahov, D. & Tardiff, K. (2003) Opiates, cocaine and alcohol combinations in accidental drug overdose deaths in New York City, 1990-98, *Addiction*, 98, 739-47.

Darke, S. (2003) Polydrug use and overdose: Overthrowing old myths, [comment], *Addiction*, 98, 711.

Darke, S., Kaye, S. & Topp, L. (2002a) Cocaine use in New South Wales, Australia, 1996-2000: 5 year monitoring of trends in price, purity, availability and use from the Illicit Drug Reporting System, *Drug and Alcohol Dependence*, 67, 81-88.

Darke, S., Ross, J. & Hall, W. (1996) Overdose among heroin users in Sydney, Australia: I. Prevalence and correlates of non-fatal overdose, *Addiction*, 91, 405-411.

Darke, S., Ross, J., Zador, D. & Sunjic, S. (2000) Heroin-related deaths in New South Wales, Australia 1992-1996, *Drug and Alcohol Dependence*, 60, 141-150.

Darke, S., Topp, L., Kaye, S. & Hall, W. (2002b) Heroin use in New South Wales, Australia, 1996-2000: 5 year monitoring of trends in price, purity, availability and use from the Illicit Drug Reporting System, *Addiction*, 97, 179-186.

Darke, S. & Zador, D. (1996) Fatal heroin 'overdose': A review, *Addiction*, 91, 1,765-1,772.

Davidson, P. J., McLean, R. L., Kral, A. H., Gleghorn, A. A., Edlin, B. R. & Moss, A. R. (2003) Fatal heroin-related overdose in San Francisco, 1997-2000: A case for targeted intervention, *Journal of Urban Health*, 80, 261-73.

Day, C. (2004) Documenting the heroin shortage in New South Wales, in *The Course and Consequence of the Heroin Shortage in New South Wales*, (Eds. Degenhardt, L. & Day, C.) National Drug Law Enforcement Research Fund, pp. 11-17.

Day, C., Topp, L., Rouen, D., Darke, S., Hall, W. & Dolan, K. (2003) Changes in heroin availability in Sydney, Australia in early 2001, *Addiction*, 98, 93-95.

Degenhardt, L. & Day, C. (Eds.) (2004) *The Course and Consequences of the Heroin Shortage in New South Wales*, National Drug Law Enforcement Research Fund.

Degenhardt, L., Day, C. & Gilmour, S. (in press) Changes in community level drug use associated with a reduction in heroin supply, *International Journal of Drug Policy*.

Degenhardt, L., Hall, W. & Adelstein, B. A. (2001) Ambulance calls to suspected drug overdoses: New South Wales patterns July 1997 to June 1999, *Australian and New Zealand Journal of Public Health*, 25, 447-450.

Dietze, P., Jolley, D. & Cvetkovski, S. (2003) Patterns and characteristics of ambulance attendance at heroin overdose at a local-area level in Melbourne, Australia: Implications for service provision, *Journal of Urban Health*, 80, 248-60.

Galai, N., Safaeian, M., Vlahov, D., Bolotin, A. & Celentano, D. (2003) Longitudinal patterns of drug injection in the ALIVE study cohort, 1988-2000: Description and determinants, *American Journal of Epidemiology*, 158, 695-704.

Grass, H., Behnsen, S., Kimont, H. G., Staak, M. & Kaferstein, H. (2003) Methadone and its role in drug-related fatalities in Cologne 1989-2000, *Forensic Science International*, 132, 195-200.

Hall, W., Degenhardt, L. & Lynskey, M. (1999a) Opioid overdose mortality in Australia: 1964-1997: Birth-cohort trends, *Medical Journal of Australia*, 171, 34-37.

Hall, W., Lynskey, M. & Degenhardt, L. (1999b) *Heroin use in Australia: Its impact on public health and public order,* NDARC Monograph No. 42, National Drug and Alcohol Research Centre, University of New South Wales, Sydney.

Hall, W., Ross, J., Lynskey, M., Law, M. & Degenhardt, L. (2000) How many dependent heroin users are there in Australia?, *Medical Journal of Australia*, 173, 528-531.

Landen, M. G., Castle, S., Nolte, K. B., Gonzales, M., Escobedo, L. G., Chatterjee, B. F., Johnson, K. & Sewell, C. M. (2003) Methodological issues in the surveillance of poisoning, illicit drug overdose, and heroin overdose deaths in New Mexico, *American Journal of Epidemiology*, 157, 273-8.

Law, M., Dore, G., Bath, N., Thompson, S., Crofts, N., Dolan, K., Giles, W., Gow, P., Kaldor, J., Loveday, S., Powell, E., Spencer, J. & Wodak, A. (2003) Modelling hepatitis C virus incidence, prevalence and long-term sequelae in Australia, 2001, *International Journal of Epidemiology*, 32, 717-724.

Lepere, B., Gourarier, L., Sanchez, M., Adda, C., Peyret, E., Nordmann, F., Ben Soussen, P., Gisselbrecht, M. & Lowenstein, W. (2001) [Reduction in the number of lethal heroin overdoses in France since 1994. Focus on substitution treatments], *Annales de Medecine Interne*, 152, IS5-12.

MacDonald, M., Robotin, M. & Topp, L. (2001) *Drug use trends among injecting drug users (IDU): Findings from the Australian Needle and Syringe Program (NSP) Survey, 1995-2000*. National Drug and Alcohol Research Centre, University of New South Wales, Sydney.

Office of Applied Studies Substance Abuse and Mental Health Services Administration (2002) *The DAWN Report: Major drugs of abuse in ED visits, 2001 update,* October 2002, SAMHSA, Rockville, MD.

Oliver, P. & Keen, J. (2003) Concomitant drugs of misuse and drug using behaviours associated with fatal opiate-related poisonings in Sheffield, UK, 1997-2000, *Addiction*, 98, 191-7.

Preti, A., Miotto, P. & De Coppi, M. (2002) Deaths by unintentional illicit drug overdose in Italy, 1984-2000, *Drug & Alcohol Dependence*, 66, 275-82.

Quaglio, G., Talamini, G., Lechi, A., Venturini, L., Lugoboni, F., Mezzelani, P. & Gruppo Intersert di Collaborazione, S. (2001) Study of 2708 heroin-related deaths in north-eastern Italy 1985-98 to establish the main causes of death, *Addiction*, 96, 1,127-37.

Roxburgh, A., Degenhardt, L., Breen, C. & Barker, B. (2004) Changes in patterns of drug use among injecting drug users following a reduction in the availability of heroin in New South Wales, Australia, *Drug and Alcohol Review*, 23, 287-294.

Sergeev, B., Karpets, A., Sarang, A. & Tikhonov, M. (2003) Prevalence and circumstances of opiate overdose among injection drug users in the Russian Federation, *Journal of Urban Health*, 80, 212-9.

Substance Abuse and Mental Health Services Administration (2002) *Results from the 2001 National Household Survey on Drug Abuse: Volume I. Summary of National Findings,* SAMHSA, US Department of Health and Human Services, Rockville, MD.

Topp, L., Day, C. & Degenhardt, L. (2003) Changes in patterns of drug injection concurrent with a sustained reduction in the availability of heroin in Australia, *Drug and Alcohol Dependence*, 70, 275-286.

Topp, L., Kaye, S., Bruno, R., Longo, M., Williams, P., O'Reilly, B., Fry, C., Rose, G. & Darke, S. (2002a) *Australian Drug Trends 2001: Findings from the Illicit Drug Reporting System (IDRS),* NDARC Monograph No. 48, National Drug and Alcohol Research Centre, University of New South Wales, Sydney.

Topp, L., Kaye, S., Bruno, R., Longo, M., Williams, P., O'Reilly, B., Fry, C., Rose, G. & Darke, S. (2002b) *Australian Drug Trends 2001: Findings from the Illicit Drug Reporting System (IDRS),* NDARC Monograph No. 48, National Drug and Alcohol Research Centre, University of New South Wales, Sydney.

Venables, W. & Ripley, R. (2002) *Modern applied statistics with* S, Springer-Verlag, New York.

Warner-Smith, M., Darke, S., Lynskey, M. & Hall, W. (2001) Heroin overdose: Causes and consequences, *Addiction*, 96, 1,113-1,125.

Weatherburn, D., Jones, C., Freeman, K. & Makkai, T. (2003) Supply control and harm reduction: Lessons from the Australian heroin 'drought', *Addiction*, 98, 83-91.

Chapter five: Law enforcement operations, harm reduction and the Australian heroin shortage

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Background

The role of law enforcement in Australia's harm minimisation drug policy has been contentious because a number of studies have reported negative consequences of heavy policing on drug users (Maher & Dixon 1999; Maher & Dixon 2001; Aitken et al. 2002), including displacement of drug markets (Wood et al. 2003), with little or no effect upon drug use (Wood et al. 2004). Some authors have argued that law enforcement approaches are inconsistent with the goals of harm reduction (Maher & Dixon 1999; Maher & Dixon 2001).

Others, however, have argued that law enforcement is not necessarily at odds with harm reduction. According to Caulkins (2002) for example, if the goal is to reduce overall harm to both drug users and to the community at large, then it is important to consider not only the effects of law enforcement (and other interventions) upon those who use illicit drugs (micro harms), but also to consider the harm caused to the community as a whole (macro harms). Caulkins (2002) proposed that, in some instances, a focus upon harms at the user level (micro level), although clearly important, might fail to capture harms caused to others in the community at large.

Macro and micro harms might change in different ways as a result of law enforcement interventions. For example, efforts by police to disrupt a street level drug market might mean that users who continue to obtain drugs find it more difficult to do so; they need to travel to other locations or pay more for their drugs (necessitating greater income generation); and they might also take greater risks in the process which lead to potential health and legal harms as a result. Such consequences have previously been well-documented in studies of law enforcement efforts in street-based drug markets in Sydney, Australia (Maher 2002; Maher & Dixon 2001; Maher & Dixon 1999).

It is also important to consider the possibility that, in some cases, law enforcement may deter some people from drug use (or at least reduce the extent of use). A reduction in the extent of drug use could mean that, although more harm is experienced by those who continue to use (increased micro harm), the overall harm decreases because fewer persons are using (decreased macro harm). The Australian heroin shortage presented an opportunity to examine this possibility.

The heroin shortage

In early 2001, anecdotal reports emerged from heroin users, local police and those working in drug treatment services of a dramatic decline in the availability of heroin in Sydney and Melbourne. These reports were subsequently confirmed by timely surveys of heroin users (Day et al. 2003b; Weatherburn et al. 2001; Miller et al. 2001). The 2001 Illicit Drug Reporting System (IDRS) – Australia's strategic early warning system for monitoring trends in illicit drug markets – subsequently found that there had been a reduction in the availability and purity of heroin and an increase in heroin price in all major Australian heroin markets (Topp et al. 2002). The reduction in availability was most severe from January to April 2001 and, although the market has stabilised since then, heroin availability has not returned to pre-shortage levels. The heroin market in Australia appears to have been reduced in size (Day 2004). This phenomenon is referred

to as the 'heroin shortage'. This abrupt and sustained reduction in heroin supply, coupled with sophisticated monitoring of key parameters of the drug market, drug use, and its harms, provided a unique situation in which to examine the impact of change in supply upon drug use and harms (Degenhardt et al. 2004c; Degenhardt & Day 2004; Dietze et al. 2004; Harrison et al. 2004).

New South Wales (NSW) contains the largest heroin market in the country; it is thought that heroin largely enters Australia through the state's capital city, Sydney (Australian Crime Commission, 2003), and it has been estimated that approximately half of dependent opioid users in Australia live in NSW (Hall et al. 2000). The heaviest patterns of heroin use were historically documented among regular injecting drug users (IDU) in NSW (Topp et al. 2001), which also had the highest rates of overdose in the country (Lynskey & Hall 1998; Degenhardt 2001).

Macro harm reduction in Australia

Australia has had a 'harm minimisation' drug policy since the mid-1980s. This approach has incorporated supply reduction, demand reduction and harm reduction strategies. This policy has, since the introduction of the National Campaign Against Drug Abuse in 1985, endeavoured to minimise the harmful effects of drugs on Australian society. In 1998, the National Drug Strategy was revised and a tougher approach was adopted. The three essential components of the strategy remained, but greater emphasis was placed on supply reduction, and demand reduction by way of increased public education and awareness campaigns (Fitzgerald & Sewards 2002). Australia's harm minimisation approach to drugs therefore remains consistent with macro harm reduction as it aims to reduce harm to the community by reducing harm to drug users and more generally to reduce drug use, but the precise meaning of the policy and its various iterations has remained ambiguous (Wellbourne-Wood 1999). The policy has enabled continued public funding to harm-reduction initiatives such as needle and syringe programs, methadone maintenance programs and, in the state of NSW, a medically supervised injecting centre (though this only receives state funding and is not supported at the federal level).

In this paper the impact of the heroin shortage on macro and micro level harms was examined, and the impact of the heroin shortage on local policing and the subsequent impact on drug-related harms is discussed. The paper draws on the findings of a comprehensive body of research into the consequences of the heroin shortage in NSW (Degenhardt & Day 2004).

Methods

A range of different data sources were collected (for a discussion of strengths and limitations see Degenhardt et al. 2002; Day & Degenhardt 2004). The results of analyses of trend data on major indirect indicators of heroin use reported elsewhere are presented (Topp et al. 2003; Roxburgh et al. 2004; Day et al. 2004b; Degenhardt et al. 2005a; Degenhardt et al. 2005c; Degenhardt et al. 2005b). These data were supplemented with data derived from interviews with heroin users about their own experiences, and with data obtained from key informants (KI) who had good knowledge of the three largest NSW open-air drug markets or had contact with drug users.

Selection and method of KI interviews have been described elsewhere (Degenhardt et al. 2005c; Gibson et al. 2005). Briefly, KI selection was based on their contact with and knowledge of the illicit drug market /drug users; the focus of their position (e.g. direct/indirect, operational/policy); the length of time in the position; and their ability to comment on changes over time, including pre- and post-heroin shortage.

The NSW Police Service comprised three levels of command of relevance to this study: State, Region and Local Area Command (LAC). KI were selected across all three levels and across the four LACs responsible for policing the three largest Sydney drug markets, two region commands in which these LACs were located and a range of squads within the State Command (including squads focused on organised crime groups and drug crime). A total of 22 law enforcement KI were interviewed for this study, 20 of whom were sworn officers.

Health and/or welfare sector professionals were recruited from organisations involved in supporting drug users in Sydney, NSW. These KI were recruited for their knowledge of drug users based in the three largest Sydney illicit drug markets. KI from State Government bureaucracies and organisations were also recruited to provide statewide observations. KI were drawn from a range of positions within their respective organisations, from management to front line positions. A total of 49 health KI were recruited.

Current and in-treatment heroin users were recruited via advertisements placed in needle and syringe programs (NSP) and opioid pharmacotherapy clinics. They had to have recent experience of the drug market (i.e. participated in the market within the preceding six months) and to have commenced pharmacotherapy between August and December 2000 (pre-shortage) or between February and April 2001 (during shortage). Fifty-three users were interviewed in total, approximately half in each time-group. Users were surveyed on a range of issues including their involvement and experience of drug markets prior to and during the heroin shortage (Day et al. 2003a; Day et al. 2004a).

Findings

Reduction in macro harm related to the heroin shortage

Following the reduction in heroin supply, there was good evidence to suggest that the scale of harms related to heroin use decreased in NSW. In NSW, there were significant reductions in deaths related to heroin (Degenhardt et al. 2004a), in new entrants to heroin treatment, along with reductions in early drop-out for opioid replacement therapies (Degenhardt et al. 2005a). There were also reductions in police incidents related to heroin possession or use (Degenhardt et al. 2005c). The number of needles and syringes distributed to IDU reduced following the reduction in heroin supply (Day et al. 2004b), and there appears to have been a decline in the number of hepatitis C notifications (Day et al. in press), consistent with a reduction in the number of dependent heroin users (Degenhardt et al. 2004d). Despite evidence of increased use of drugs such as cocaine and benzodiazepines (Topp et al. 2003; Roxburgh et al. 2004), and some increases in treatment episodes for the use of these drugs (Degenhardt et al. 2005a), the increases were not of a magnitude comparable to the reductions in heroin treatment episodes (Degenhardt et al. 2005a), and deaths related to these drugs did not increase (Degenhardt et al. 2005b).

A possible reason for these changes is a reduction in the number of new heroin users/injectors. Prior to the heroin shortage, Australia had experienced a rapidly expanding heroin market, in which the price of heroin had decreased and availability and purity had increased. This expanding market was accompanied by increasing overdose deaths (Hall & Darke 1998; Hall et al. 1999) and some evidence that young people were more willing to use the drug (Maher et al. 1998), conditions consistent with a 'heroin epidemic' (e.g. Dupont & Greene 1973; Hughes & Rieche 1995; Caulkins 2001).

Caulkins and others have contended that illicit drug markets develop in cyclical or epidemic phases and that the application of different drug control strategies may be more effective if undertaken during these phases (Caulkins 2001; Caulkins 2002; Behrens & Caulkins 1999).

According to this hypothesis, law enforcement is most effective during the early stage of the epidemic when adequate pressure can be applied to those in or entering the market to act as a deterrent or demand reduction, rather than at the latter stage when there are more dependent and problematic users. It is not clear what stage of the epidemic Australia was at, but given the previously expanding market, it was most likely the height of an epidemic or the beginning of the decrease from an epidemic peak.

Changes in market size and visibility

Reports from law enforcement suggested that the shortage resulted in reduced market visibility, despite initial reports of short-term community level disruption due to loitering and threats by users attempting to buy drugs and observed spikes in acquisitive crime. There was also increased prostitution in the short-term, which may have been related to the substitution of cocaine for heroin, but this was not sustained (see Chapter 3). Overall, acquisitive crime and prostitution decreased (Degenhardt et al. 2005c), and the heroin shortage appeared to reduce the size of the market and the nature of heroin distribution (Day 2004).

Reduced market visibility was supported by a reduction in the number of needles and syringes distributed (Day et al. 2004b). Whilst such a reduction may have increased harms, and almost certainly did for some users (Maher 2002; Degenhardt et al. 2004b), reduced hepatitis C notifications and unchanged HIV and hepatitis B notifications suggest these harms did not *increase* at the macro level (Day et al. in press).

Increased policing strategies

Reduced heroin market visibility meant that resources usually spent in policing heroin markets and its associated crime could be diverted to other areas, including more effective policing of other illicit markets. The shortage therefore began to have an impact on the resources for additional operations, and enabled police to do more targeted operations, and thereby (potentially) increase their effectiveness. As the reduction in the supply of heroin was sustained, police reported gaining new knowledge of the mechanics of drug supply in their areas.

In one market, this was attributed by police KI to the attrition of the number of heroin dealers, and a switch by others to the sale of cocaine during the heroin shortage. KI reported that a number of smaller quantity heroin dealers left the market, as they could not source heroin to sell and/or were arrested by police. This allowed police to 'get closer' to people who supplied larger quantities of heroin. Police also reported they were able to observe the activities of cocaine suppliers, as undercover-police could make frequent purchases of cocaine due to the continuous use and purchase of the drug by drug users. Previously such operations were constrained due to the necessary policing of the overt heroin market.

Police involved with mid- to upper-levels of drug distribution also reported gaining a greater understanding of drug markets other than heroin. Some of the groups and individuals of interest to police changed their activities from the distribution of heroin to the importation of heroin or distribution and sale of other drugs, such as cocaine and methamphetamine, or to criminal activities such as credit card fraud (Degenhardt et al. 2005c).

There were also reports of a shift during the shortage by drug suppliers to trading in other commodities in addition to drugs (Degenhardt et al. 2005c). As a result, police were able to shift their focus not only to other drugs, but to other criminal activity such as fraud.

Police could not always take advantage of these gains in intelligence and operations. For example, a senior police officer reported that LAC did not have the resources to target the higher level dealers they identified. This apparent failure to take full advantage of opportunities to disrupt heroin distribution was also noted by other law enforcement personnel.

According to these reports, the changes in policing associated with the shortage allowed for more effective policing of a range of harms and also facilitated a shift away from street-level dealers, to the middle and upper-level dealers. Degenhardt et al. (2005c) have also described how these changes have led to changes in trafficking techniques, which are perhaps less effective, such as a move away from large shipments to body packing. Such shifts almost certainly increase micro-level harm, especially for the body packer, but if the result is smaller amounts of heroin entering the country, then it may ultimately result in reduced macro harms.

Changes in micro harms following the heroin shortage

Despite the reduction in macro-level harms and the increased effectiveness of local-level policing as a result of the shortage, there were also clear increases in micro-level harms for some heroin users. Older, more entrenched heroin users experienced increased harms in terms of increased or more violent criminal activity, and mental and physical health problems (Degenhardt et al. in press).

KI across all markets reported that the shortage had both positive and negative effects on drug users' physical health. It was generally agreed that the physical health of those people who entered treatment during the shortage improved concomitantly with their decreasing illicit drug use. For those who remained in the drug market, the general appearance and physical health of users reportedly declined (Day et al. 2003a; Degenhardt et al. 2004b). Some KI attributed this to more acute withdrawal symptoms experienced by many users. A number of KI also reported that the increased cost of heroin during the shortage and the more expensive cost of cocaine meant that users diverted income to drugs that otherwise would have been spent on food. This was also reported by users (Day et al. 2003a).

Also reported were harms specific to the use of cocaine, such as the suppressant effect cocaine has on appetite and 'cocaine bugs' – continual scratching and picking of the skin – which was associated with paranoid and deluded thinking. Both KI and heroin users reported increased numbers of people with injection-related problems associated with cocaine and benzodiazepine injection. Increased benzodiazepine injecting was reported by KI in all areas.

The harms associated with benzodiazepine injecting are well documented, including vascular problems, increased poly drug use, increased risk of overdose and blood-borne virus infection risk behaviours (Ross et al. 1997). The injection of Temazepam® gel capsules has been associated with amputations (Eddey & Westcott 2000; Dupont 1998). Health and law enforcement KI working at the drug market level reported increasing risky injecting following reduced heroin availability and related drug substitution. Most involved sharing or reuse of injecting equipment. It was not clear how frequently this occurred or whether it had increased specifically during the shortage. Police in some areas reported concerns that some IDU were reusing and sharing injecting equipment, particularly cocaine injectors. Many workers were concerned that the reduction in NSP activity reflected increased BBVI risk (due to reuse or sharing of injecting equipment).

NSP and other health workers in all sites reported that the reduction in heroin supply led to changes in the frequency of injecting, which differed over time. An initial 'increase' in injection frequency was reported in all areas at the onset of the heroin shortage, mainly associated with an uptake of cocaine use. Significant increases in police incidents for cocaine possession/use were recorded during this period, consistent with some heroin users shifting to cocaine use after the reduction in heroin supply (Degenhardt et al. 2005c; Degenhardt et al. 2005d).

Some users were reported by KI to have changed their route of administration from smoking to injecting to increase the effect of the lower purity heroin. These reports are supported by independent research, such as that by Maher (2002), who reported changes in the route of administration from non-parenteral routes such as smoking to injecting. A small number of clients in pharmacotherapy also reported that they changed their route of administration of heroin and/or methadone during the heroin shortage.

A number of health care workers suggested that perhaps the level of physical harm for users had not deteriorated, but instead those users with the poorest health became more visible because of the reduction in the size of the drug user market (Day et al. 2003a). After the heroin shortage eased, there was some agreement that there was a reduction in physical health problems. The improvements were thought to have been due to decreases in cocaine use and increases in heroin use among those who had remained injecting. Most KI commented that the psychosocial problems associated with cocaine and amphetamine use dissipated over time, sometimes associated with a return to heroin use and sometimes associated with better management of cocaine and amphetamine use. However, this did not seem to be true for all users, particularly the more marginalised users.

The response of law enforcement to changes in micro harms

General duties police reported that in all drug markets relevant to the study the crimes committed by psychostimulant users were more violent, serious, desperate, and brazen; these crimes took more time to investigate. Furthermore, law enforcement officers reported that people intoxicated with benzodiazepines and cocaine tended to cause more trouble in custody, with higher levels of aggression.

In one area, the custody areas were altered to reduce the potential for prisoners to harm themselves. This included installation of plastic screens and surveillance cameras. Police reported seeking help with the management of this violent behaviour from outside agencies.

An increase in the size and number of specialist drug units in areas in NSW was widely reported. These changes were variously attributed to the movement of drug users and dealers to new locations (market decentralisation) as well as awareness in areas of an actual or apparent increase in the use of other drugs such as methamphetamine, and an increase in the crime associated with these drugs. One State Command officer suggested that the need for Drug Units existed before the shortage but has become more evident to Commanders in its wake.

There were uniform increases in the levels of violence reported by those working in the health and law enforcement sectors, and among IDU, resulting in increased calls for police attendance at treatment services (Gibson et al. 2005; Collins et al. 2004). In some areas, this initially resulted in strained relations between health services and police, but, over time, relations reportedly improved.

Discussion

The heroin shortage led to significant changes in patterns of drug use and related harms across the community. The evidence presented herein shows (1) a decrease in macro harms such as decreased overdose death, overall reductions in crime and a population level reduction in hepatitis C infection, but (2) an increase in micro harms, such as increased violence, altered and problematic patterns of drug use and increased injection risk, among older more entrenched heroin users. The increases in micro-level harms were clearest among the more entrenched and

marginalised heroin users. These were offset by a decrease in macro-level harms. The heroin shortage may therefore be seen as having an overall positive impact at the population level (net benefit) while having a negative impact on individuals who remained in the market.

The heroin shortage was the result of a complex synergy of events, in which increased border-level law enforcement played a significant role (Degenhardt et al. 2005e). Although local policing was unlikely to have played a major role in the causes of the shortage (Degenhardt et al. 2005e), the changes to the drug market brought about by the shortage facilitated local-level operations, primarily by allowing police resources previously used for the control of heroin-related problems to be used for other purposes. This provided an opportunity for police to become more familiar with other drug markets and organised crime activities, although it is not possible to say what impact the increased intelligence and policing had on these areas. Thus, consistent with Caulkins' (2002) hypothesis, law enforcement can play an integral role in macro-level harm reduction in the circumstances that prevailed in the Australian heroin shortage.

These outcomes, however, must be considered in light of Australian drug policy, which comprises strong harm and demand reduction components. The aggregate benefits achieved might not have occurred in the absence of a comprehensive, inclusive drug policy. For example, the concurrent increase in the use of psychostimulant drugs such as cocaine and methamphetamine did not result in increased blood-borne viral infections. Similarly, reduced heroin supply did not adversely affect heroin and other drug dependence treatment efficacy. Moreover, the shortage has demonstrated that there is a group who are adversely affected by successful supply reduction, and efforts to reduce the harm to this vulnerable group 'in addition to' overall (macro) harm should remain a goal of drug policy.

In conclusion, the Australian heroin shortage has demonstrated how effective law enforcement can reduce macro-level harm. However, in order to achieve such a macro reduction in harm, a comprehensive approach to drug policy is needed.

References

Aitken, C., Moore, D., Higgs, P., Kelsall, J. & Kerger, M. (2002) The impact of a police crackdown on a street drug scene: Evidence from the street, *International Journal of Drug Policy,* 13, 193-202.

Australian Crime Commission (2003) *Australian Illicit Drug Report 2001/02,* Australian Crime Commission, Canberra.

Behrens, D. A. & Caulkins, J. P. (1999) A dynamic model of drug initiation: Implications for treatment and drug control, *Mathematical Biosciences,* 159, 1-20.

Caulkins, J. P. (2001) The dynamic character of drug problems, *Bulletin on Narcotics,* LIII, 11-23.

Caulkins, J. P. (2002) Law enforcement's role in a harm reduction regime, *Crime and Justice Bulletin,* no. 64.

Collins, L., Day, C. & Degenhardt, L. (2004) Impact upon law enforcement operations, in *The Course and Consequences of the Heroin Shortage in New South Wales*, (Eds. Degenhardt, L. & Day, C.) National Drug Law Enforcement Research Fund, pp. 111-120.

Day, C. (2004) Documenting the heroin shortage, in *The Cause, Course and Consequence of the Heroin Shortage in Australia*, (Eds. Degenhardt, L., Day, C. & Hall, W.) National Drug Law Enforcement Research Fund, pp. 39-47.

Day, C., Collins, L., Degenhardt, L., Thetford, C. & Maher, L. (2004a) Reliability of heroin users' reports of drug use behaviour using a 24 month timeline-follow-back technique to assess the impact of the Australian heroin shortage, *Addiction Research and Theory,* 12, 433-443.

Day, C. & Degenhardt, L. (2004) Research strengths and limitations, in *The Causes, Course and Consequence of the Heroin Shortage in Australia*, (Eds. Degenhardt, L., Day, C. & Hall, W.) National Drug Law Enforcement Research Fund, pp. 100-104.

Day, C., Degenhardt, L., Gilmour, S. & Hall, W. (2004b) Effects of supply reduction upon injecting drug use, *British Medical Journal,* 329, 428-429.

Day, C., Degenhardt, L., Hall, W., Conroy, E. & Gilmour, S. (in press) Changes in blood-borne virus notifications and injecting-related harms following reduced heroin supply in New South Wales, Australia, *BMC Public Health*.

Day, C., Gibson, A., Collins, L., Degenhardt, L. & Dietze, P. (2003a) *Research methodologies used to obtain retrospective self-reports of the impact of changes in heroin supply on regular users,* NDARC Technical Report No. 173, National Drug and Alcohol Research Centre, University of New South Wales, Sydney.

Day, C., Topp, L., Rouen, D., Darke, S., Hall, W. & Dolan, K. (2003b) Decreased heroin availability in Sydney in early 2001, *Addiction,* 98, 93-95.

Degenhardt, L. (2001) *Opioid overdose deaths in Australia, 2000 edition,* National Drug and Alcohol Research Centre, University of New South Wales, Sydney.

Degenhardt, L., Conroy, E., Day, C., Gilmour, S. & Hall, W. (2005a) The impact of the Australian heroin shortage on demand for and compliance with treatment for drug dependence, *Drug and Alcohol Dependence,* 79, 129-135.

Degenhardt, L., Conroy, E. & Gilmour, S. (2005b) The effect of a reduction in heroin supply upon population trends in fatal and non-fatal drug overdoses, *Medical Journal of Australia,* 182, 20-23.

Degenhardt, L., Conroy, E., Gilmour, S. & Collins, L. (2005c) The effect of a reduction in heroin supply in Australia upon drug distribution and acquisitive crime, *British Journal of Criminology,* 45, 2-24.

Degenhardt, L. & Day, C. (Eds.) (2004) *The Course and Consequence of the Heroin Shortage in New South Wales,* National Drug Law Enforcement Research Fund.

Degenhardt, L., Day, C., Collins, L. & Gibson, A. (2004b) Changes in injecting drug use, in *The Course and Consequence of the Heroin Shortage in New South Wales*, (Eds. Degenhardt, L. & Day, C.) National Drug Law Enforcement Research Fund, pp. 31-43.

Degenhardt, L., Day, C., Conroy, E., Gilmour, S. & Hall, W. (in press) Age differentials in the impacts of reduced heroin: Effects of a "heroin shortage" in NSW, Australia, *Drug and Alcohol Dependence*.

Degenhardt, L., Day, C. & Hall, W. (Eds.) (2004c) *The Causes, Course and Consequence of the Heroin Shortage in Australia,* National Drug Law Enforcement Research Fund.

Degenhardt, L., Day, C., Hall, W., Conroy, E. & Gilmour, S. (2005d) Was an increase in cocaine use in New South Wales, Australia, accompanied by an increase in violent crime?, *BMC Public Health,* 5.

Degenhardt, L., Rendle, V., Hall, W., Gilmour, S. & Law, M. (2004d) *Estimating the size of a heroin using population after a marked reduction in heroin supply,* NDARC Technical Report No. 198, National Drug and Alcohol Research Centre, University of New South Wales, Sydney.

Degenhardt, L., Reuter, P., Collins, L. & Hall, W. (2005e) Evaluating explanations of the Australian 'heroin shortage', *Addiction,* 100, 459-469.

Degenhardt, L., Topp, L. & Day, C. (2002) Issues surrounding the detection of a reduction in drug supply: The case of the heroin shortage in Australia, 2001, *Bulletin on Narcotics,* LIV.

Dietze, P., Miller, P., Clemens, S., Matthews, S., Gilmour, S. & Collins, L. (2004) *The Course and Consequences of the Heroin Shortage in Victoria,* National Drug Law Enforcement Research Fund.

Dupont, R. L. (1998) Abuse of benzodiazepines: The problems and the solutions, *American Journal of Drug and Alcohol Abuse,* 14, 1-69.

Dupont, R. L. & Greene, M. H. (1973) The dynamics of a heroin addiction epidemic, *Science,* 181, 716-722.

Eddey, D. P. & Westcott, M. J. (2000) 'The needle and the damage done': Inter-arterial temazepam, *Emergency Medicine,* 12, 248-252.

Fitzgerald, J. L. & Sewards, T. (2002) *Drug Policy: the Australian approach,* ANCD Research Paper No. 5, Australian National Council on Drugs, Canberra.

Gibson, A., Day, C. & Degenhardt, L. (2005) The impact of illicit drug market changes on health agency operations in Sydney, Australia, *Journal of Substance Abuse Treatment,* 21, 35-40.

Hall, W. & Darke, S. (1998) Trends in opiate overdose mortality in Australia 1979-1995, *Drug and Alcohol Dependence,* 52, 71-77.

Hall, W., Degenhardt, L. & Lynskey, M. T. (1999) Cohort Trends in Overdose Mortality in Australia 1964-1996: A window on post-war trends in heroin use, *Medical Journal of Australia,* 171, 34-37.

Hall, W. D., Ross, J. E., Lynskey, M. T., Law, M. G. & Degenhardt, L. J. (2000) How many dependent heroin users are there in Australia?, *Medical Journal of Australia,* 173, 528-531.

Harrison, A., Christie, P., Longo, M., Pointer, S. & Ali, R. (2004) *The Course and Consequences of the Heroin Shortage in South Australia,* National Drug Law Enforcement Research Fund.

Hughes, P. H. & Rieche, O. (1995) Heroin epidemics revisited, *Epidemiologic Reviews,* 17, 66-73.

Lynskey, M. & Hall, W. (1998) *Jurisdictional trends in opioid overdose deaths, 1988-1996,* NDARC Technical Report No. 54, National Drug and Alcohol Centre, University of New South Wales, Sydney.

Maher, L. (2002) Don't leave us this way: Ethnography and injecting drug use in the age of AIDS, *International Journal of Drug Policy,* 13, 311-325.

Maher, L. & Dixon, D. (1999) Policing and public health: Law enforcement and harm minimization in a street-level drug market, *British Journal of Criminology,* 39, 488-512.

Maher, L. & Dixon, D. (2001) The cost of crackdowns: Policing Cabramatta's heroin market, *Current Issues in Criminal Justice,* 13, 5-22.

Maher, L., Dixon, D., Lynskey, M. & Hall, W. (1998) *Running the Risks: heroin, health and harm in South West Sydney,* NDARC Monograph 38, National Drug and Alcohol Research Centre, University of New South Wales, Sydney.

Miller, P., Fry, C. & Dietze, P. (2001) *A Study of the Impact of the Heroin 'Drought' in Melbourne: Results of the Drug Availability Monitoring Project (DAMP),* Turning Point Alcohol and Drug Centre, Inc., Melbourne.

Ross, J., Darke, S. & Hall, W. (1997) Transitions between routes of benzodiazepine administration among heroin users in Sydney, *Addiction,* 92, 697-705.

Roxburgh, A., Degenhardt, L. & Breen, C. (2004) Changes in patterns of drug use among injecting drug users following a reduction in the availability of heroin in New South Wales, Australia, *Drug and Alcohol Review,* 23, 287-294.

Topp, L., Darke, S., Bruno, R., Fry, C., Hargreaves, K., Humeniuk, R., McAllister, R., O'Reilly, B. & Williams, P. (2001) *Australian Drug Trends 2000: Findings from the Illicit Drug Reporting System (IDRS),* NDARC Monograph No. 47, National Drug and Alcohol Research Centre, University of New South Wales, Sydney.

Topp, L., Day, C. & Degenhardt, L. (2003) Changes in patterns of drug injection concurrent with a sustained reduction in the availability of heroin in Australia, *Drug and Alcohol Dependence,* 70, 275-286.

Topp, L., Kaye, S., Bruno, R., Longo, M., Williams, P., O'Reilly, B., Fry, C., Rose, G. & Darke, S. (2002) *Australian Drug Trends 2001: Findings from the Illicit Drug Reporting System (IDRS),* NDARC Monograph No. 48, National Drug and Alcohol Research Centre, University of New South Wales, Sydney.

Weatherburn, D., Jones, C., Freeman, K. & Makkai, T. (2001) The Australian heroin drought and its implication for drug policy, *Crime and Justice Bulletin,* 59, 1-15.

Wellbourne-Wood, D. (1999) Harm reduction in Australia: Some problems putting policy into practice, *International Journal of Drug Policy,* 10, 403-413.

Wood, E., Spittal, P. M., Small, W., Kerr, T., Li, K., Hogg, R. S., Tyndall, M. W., Montaner, J. S. & Schechter, M. T. (2004) Displacement of Canada's largest public illicit drug market in response to a police crackdown, *Canadian Medical Association Journal,* 170, 1,551-1,556.

Wood, E., Tyndall, M., Spittal, P. M., Li, K., Anis, A. H., Hogg, R. S., Montaner, J. S. G., O'Shaughnessy, M. V. & Schechter, M. T. (2003) Impact of supply-side policies for control of illicit drugs in the face of the AIDS and overdose epidemics: Investigation of a massive heroin seizure, *Canadian Medical Association Journal,* 168, 165-169.