DRUG POLICY MODELLING PROGRAM

MONOGRAPH 14

WORKING ESTIMATES OF THE SOCIAL COSTS PER GRAM AND PER USER FOR CANNABIS, COCAINE, OPIATES AND AMPHETAMINES

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ERRATUM

Moore, T. (2007). Monograph No. 14: Working estimates of the social costs per gram and per user for cannabis, cocaine, opiates and amphetamines. *DPMP Monograph Series*. Sydney: National Drug and Alcohol Research Centre.

In the original monograph, there is a calculation error in the way the weights for cannabis from Clements and Daryal (1999) were converted from ounces to grams and kilograms, resulting in the weights being overstated by a factor of 10. The main estimate for the amount of cannabis changes from 2,815,008 kilograms to 281,501 kilograms, and the main estimate for the social cost per kilogram of cannabis changes from $1,106 per kilogram to $11,064 per kilogram. There are a number of other changes, as specified below. The social costs per user are unchanged.

p.3
In the table, the Cannabis column should read: "$3,115; 281,501; $11,064; $11".
In the paragraph below the table: "for cannabis the 95% confidence intervals around the social cost per annum per pure gram were between $4.47 and $19.86;...".

p.23
In Table 6, the bottom value of the first column should read: "281,501(g)".

p.24
The last sentence should read "On this basis, it is estimated that 281,501 kilograms of marijuana is consumed in Australia."

p.26
In the second sentence of the bottom paragraph, "more than 10,000 times" should read "more than 1,000 times".

p.27
In Table 9, the first row should read "Total costs - all drug users ($m)". Also, the Cannabis column should read: "$3,115; 281,501; $11,064; $11".

p.29
In Table 10 in the last subsection "Amount consumed (pure except cannabis)", the Cannabis column should read "281,501; 173,316; 406,603; 698,639".

p.30
In Table 11 in the second subsection "Per Weight estimates", the Cannabis column should read "$11,064; $4,471; $9,894; $19,859; $11.06; $4.47; $9.89; $19.86".

p.50
In Table A3.3, the top row should read: 93,834; 281,501; 844,503.

These changes have been incorporated into the electronic version of the monograph.

THE DRUG MODELLING POLICY PROGRAM

This monograph forms part of the Drug Policy Modelling Program (DPMP) Monograph Series.

Drugs are a major social problem and are inextricably linked to the major socio-economic issues of our time. Our current drug policies are inadequate and governments are not getting the best returns on their investment. There are a number of reasons why: there is a lack of evidence upon which to base policies; the evidence that does exist is not necessarily analysed and used in policy decision-making; we do not have adequate approaches or models to help policy-makers make good decisions about dealing with drug problems; and drug policy is a highly complicated and politicised arena.

The aim of the Drug Policy Modelling Program (DPMP) is to create valuable new drug policy insights, ideas and interventions that will allow Australia to respond with alacrity and success to illicit drug use. DPMP addresses drug policy using a comprehensive approach, that includes consideration of law enforcement, prevention, treatment and harm reduction. The dynamic interaction between policy options is an essential component in understanding best investment in drug policy.

DPMP conducts rigorous research that provides independent, balanced, non-partisan policy analysis. The areas of work include: developing the evidence-base for policy; developing, implementing and evaluating dynamic policy-relevant models of drug issues; and studying policy-making processes in Australia.

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01. What is Australia's "drug budget"? The policy mix of illicit drug-related government spending in Australia
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13. Scoping the potential uses of systems thinking in developing policy on illicit drugs

14. Working estimates of the social costs per gram and per user for cannabis, cocaine, opiates and amphetamines
15. Priority areas in illicit drug policy: Perspectives of policy makers

DPMP strives to generate new policies, new ways of making policy and new policy activity and evaluation. Ultimately our program of work aims to generate effective new illicit drug policy in Australia. I hope this Monograph contributes to Australian drug policy and that you find it informative and useful.

Alison Ritter
Director, DPMP

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The Drug Use Monitoring in Australia (DUMA) data used in this report were made available by the Australian Institute of Criminology and the DUMA steering committees in New South Wales, Queensland, South Australia and Western Australia. The DUMA program is funded under the Australian Government's National Illicit Drug Strategy, and the South Australian Attorney-General's Department funds one of the South Australian sites. These data were originally collected by data collection agencies at each of the sites around Australia, with the assistance of police services, for the Australian Institute of Criminology. Neither the collectors, police services nor the AIC bear any responsibility for the analyses or interpretations presented herein.

The Australian Bureau of Statistics mortality data used was held by the Drug Statistics and Epidemiology Program at the Turning Point Alcohol and Drug Centre. Access was obtained after ethical approval was sought and granted from the Human Research Ethics Committee at the Victorian Department of Human Services.

TABLE OF CONTENTS

Summary **1**
Introduction **5**
Conceptual and methodological issues **6**
Social costs related to illicit drugs 6
The incidence and prevalence of illicit drugs 7
Drug categories 7
Prevalence and consumption estimates 7
Dependence 8
Consistency of cost and other information 8
Use of the results 8
Health effects **9**
Data and methods 9
Results 12
Crime effects **13**
Data and methods 13
Results 15
Road accidents **17**
Welfare and labour market effects **18**
Prevalence estimates **19**
Opiate/heroin users 19
Amphetamine users 20
Cannabis users 21
Cocaine users 21
Consumption-based market estimates **22**
Heroin consumption 22
Amphetamine consumption 23
Cocaine consumption 24
Cannabis consumption 24
Results **25**
Social costs per drug user 25
Social costs per amount consumed 26
Sensitivity analysis 27

Conclusion and discussion **31**
References **33**
Appendix 1: Health-related calculations **37**
Appendix 2: Calculation of crime costs **40**
Appendix 3: Sensitivity analysis **46**

LIST OF TABLES

Table 1: Health categories in Mathers et al. (1999) and how assigned to illicit drug types 11
Table 2: Drug-attributable disability adjusted life years (DALY), converted to annual cost, by illicit drug type 12
Table 3: Drug-attributable crime calculated as annual social cost ($million), by illicit drug type...16
Table 4: Annual road accident cost attribution between dependent and non-dependent users.....17
Table 5: Illicit drug prevalence estimates, by level of dependence and illicit drug type.....19
Table 6: Estimates of the annual quantity consumed in pure terms (except cannabis), by illicit drug type.....23
Table 7: Total social costs per year ($million), by illicit drug type 25
Table 8: Annual social costs per drug user, by level of dependence and illicit drug type.....26
Table 9: Annual social costs per pure kilogram and pure gram, by illicit drug type.....27
Table 10: Sensitivity analysis, 95% confidence intervals: Costs, prevalence, market size.....28
Table 11: Sensitivity analysis, 95% confidence intervals: Per user and weight estimates 30

Table A1.1: Years lost as a result of a disability (YLD), by illicit drug type 37
Table A1.2: Drug-attributable potential years of life lost (YLL), by illicit drug type 38
Table A1.3: Cost attribution between dependent and non-dependent users, $million.....39
Table A2.1: DUMA income-generating offences, by dependence and attribution 40
Table A2.2: Fractions of income-generating crimes attributed to illicit drug use.....41
Table A2.3: Cost of income-generating crime attributed to illicit drug use ($million).....42
Table A2.4: Other DUMA offences, by dependence and attribution 43
Table A2.5: Fractions of other crimes attributed to illicit drug use.....44
Table A2.6: Cost of other crimes attributed to illicit drug use ($million) 45
Table A3.1: Sensitivity analysis for health, crime, road accident and labour costs.....46
Table A3.2: Sensitivity analysis for numbers of drug users.....48
Table A3.3: Sensitivity analysis for the market-sizing estimates.....50

SUMMARY

Purpose of the work

This work represents a first step in estimating the different social costs associated with different illicit drugs. More specifically, the report sets out in detail the annual costs in Australia (circa 2004) associated with opiates, amphetamines, cocaine, and other illicit drugs separately across two major classes of social costs: health and crime. The cost estimates are further broken down between dependent users and non-dependent users. These are then combined with prevalence and consumption to generate estimates of the:

1. social costs per drug user by drug type; and
2. social costs per kilogram (or gram) for each drug type.

The work is important because, by generating estimates such as these, we can begin to evaluate different policy responses in terms of cost savings to the community. Being able to specify the social costs per gram and per user for the main classes of illicit drugs means that we can then evaluate policy responses – such as the potential cost savings of reducing the supply of a specific drug by X kilograms; or the cost savings of decreasing the number of dependent drug users by Y.

Social costs associated with health and crime by different drug types

Firstly, Moore estimated the total health and crime costs per annum, associated with dependent and non-dependent use of cannabis, cocaine, opiates and amphetamine.

For health (disability adjusted life years), the costs are distributed such:

	Cannabis	Cocaine	Opiates	Amphet.
Dependent users ($million) p.a.	$ 1,195	$ 113	$ 2,386	$ 274
Non-dependent users ($million) p.a.	$ 0.067	$ 24.7	$ 137	$ 67.5

As can be seen, in relation to health costs, dependent opiate users bear the largest costs ($2,386 million p.a.), followed by dependent cannabis users. Non-dependent users' health costs are negligible relative to the dependent users.

For crime costs, the costs are distributed such:

	Cannabis	Cocaine	Opiates	Amphet.
Dependent users ($million) p.a.	$ 1,601	$ 135	$ 1,714	$ 2,795
Non-dependent users ($million) p.a.	$ 319	$ 26.7	$ 29.6	$ 244

In the case of social costs attributable to crime, dependent amphetamine users generate the largest cost burden to our community ($2,795 million), with cannabis and opiates at roughly equal crime costs per annum. Again, the non-dependent user annual costs are significantly less than for dependent users. Indeed dependent drug users account for more than 80% of the total identifiable social costs (health and crime).

The social costs of road accidents are also reported herein. The next step in the work was to use these cost calculations, and combine them with both prevalence estimates and consumption estimates in order to estimate:

1. social cost per drug user (by drug type); and
2. social cost per kilogram (or gram) for each drug type.

Estimates of social cost per drug user

To evaluate policy responses it is helpful to have some estimate of the annual social cost of opiate, amphetamine, cocaine and cannabis users. Thus, if an intervention claimed to reduce the number of users by 10%, the potential cost savings could be calculated using the figures below.

The results per drug user are summarised here. At a simplistic level, the total costs (health, crime, road accidents) for cannabis ($3,115m per annum) can be divided by the total number of users (approximately 1.9 million users), which results in a social cost per cannabis user of $1,631 per annum. The results for the four drug classes using this summary approach are:

	Cannabis	Cocaine	Opiates	Amphet.
Total costs – all drug users ($million)	$ 3,115	$ 299	$ 4,574	$ 3,731
Number of users	1,910,075	176,346	149,299	568,757
Social cost per user ($)	$ 1,631	$ 1,699	$ 30,633	$ 6,560

However, this does not acknowledge the significant social cost differences between dependent and non-dependent drug users. Therefore a more detailed picture can be gained by separating dependent from non-dependent users. These results are presented in the table below. As can be seen, dependent opiate users annual social cost per user is $105,342 compared to an annual social cost per non-dependent opiate user of $1,965.

Annual social cost (health, crime and road accidents) per user by drug type, dependent and non-dependent users

	Cannabis	Cocaine	Opiates	Amphet.
Dependent drug users				
Costs – dependence ($million)	$ 2,796	$ 248	$ 4,361	$ 3,272
Number of users	247,500	13,892	41,401	73,257
Social cost per dep. user	$ 11,296	$ 17,852	$ 105,342	$ 44,665
Non-dependent drug users				
Costs – non-dependence ($million)	$ 319	$ 51	$ 212	$ 459
Number of users	1,662,575	162,454	107,898	495,500
Social cost per non-dep. user	$ 192	$ 314	$ 1,965	$ 926

Sensitivity analyses (95% confidence intervals) revealed that the plausible range for the estimates for dependent users of cannabis was between $6,998 and $17,437 social cost per annum; for cocaine between $12,107 and $24,548 social cost per annum; for opiates between $55,330 and $115,222; and for amphetamines between $18,258 and $48,757. (The report details the sensitivity analysis for the non-dependent users).

Estimates of social cost per kilogram of drug

An alternate way of estimating the effect of policy responses is to consider a social cost per kilogram of drug, which is a metric that may be more useful for supply reduction interventions. The table below provides the results (the distinction between dependent and non-dependent users is not relevant here as the calculations are driven purely by quantity consumed).

Annual social costs per pure kilogram and pure gram, by illicit drug type

	Cannabis	Cocaine	Opiates	Amphet.
Total costs – all drug users ($million)	$ 3,115	$ 299	$ 4,574	$ 3,731
Amount consumed per year (kg)	281,501	830	335	575
Social cost per kilogram	$ 11,064	$ 360,241	$ 13,653,731	$ 6,488,695
Social cost per gram	$ 11	$ 360	$ 13,653	$ 6,488

Again, it is important to consider the plausible range for these figures of social cost per annum per pure gram (kilogram figures are in the report): for cannabis the 95% confidence intervals around the social cost per annum per pure gram were between $4.47 and $19.86; for cocaine between $147.00 and $540.00; for opiates between $4,100 and $14,891; and for amphetamines between $1,710 and $6,983.

Caveats and important considerations

There are several significant and important caveats. First, the analysis depends on the assumption that social costs can be linked to particular types of drugs, and a decrease in how much that drug is used will decrease social costs. While this is a reasonable assumption for small changes in use, it would certainly not hold for large changes.

Second, it is important to understand that all social costs are allocated to illicit drugs as if their consumption has been constant over time. This has clearly not been the case, but there is not enough information to allocate current social costs between current and past use. Interpretations related to drugs whose use is known to have varied a lot recently – especially heroin and amphetamine – require an added degree of caution.

Third, there are significant gaps in our knowledge about the relationships between drug use and social costs. Even in countries where they have access to longitudinal datasets of the type that make such relationships easier to understand, the findings are conflicting and uncertain. In every estimate made herein, there are assumptions and caveats (the simplest example is the wide variation in estimates of prevalence of different types of drug use). Sensitivity analyses are provided in the report and should be used together with the main results.

Future directions

This work represents a first attempt to specify social costs (health, crime and road accidents) by four main classes of illicit drugs distinguishing between dependent and non-dependent users. As a first endeavour, we expect that there will be substantial refinement required. We would encourage researchers and policymakers to use the information here, with appropriate caveats, in order to assess its usefulness to advancing illicit drug policy in Australia. We would also encourage critical review and would be pleased to receive feedback.

Alison Ritter,
Director, Drug Policy Modelling Program

INTRODUCTION

Illicit drug use is an area of major policy concern in Australia. It has been estimated that approximately $1.3 billion is spent on drug policies by Australian governments, with more again spent on dealing with the consequences of illicit drug use. The majority is spent on enforcing drug laws, while significant amounts are spent on preventing drug use and treating drug users (Moore, 2005).

Despite the extent of the resources committed to minimising drug use and its harmful effects, there is little information available for setting policy priorities both within and across programs. Cost-of-illness studies, the major sources of information on the economic effects of illicit drug use, provide little policy guidance (Moore & Caulkins, 2006). The only major requirement made of them is that they supply an estimate of what a nation would save if there were no illicit drug use. Collins and Lapsley (2002), in the most recent Australian study, do not attribute social costs to particular illicit drug types and provide little insight into the causal relationships between drug use and social costs.

The Australian Federal Police (AFP) has developed a set of measures that provide more assistance in policy development and priority setting than the cost-of-illness studies. They have attempted to assess the impact of their activities on societal wellbeing by assessing the "social cost per kilogram" of four major categories of illicit drugs: opiates, cannabis, amphetamines and cocaine (and sometimes other drugs).

The first estimate considered illicit drugs seized by the AFP during a two-year period during 1999 and 2001, and used the street value of heroin, cocaine and amphetamines as a proxy for their social costs (McFadden, Mwesigye & Williamson, 2002). A second estimate, which included estimates for marijuana, was made for the 2002-03 financial year by McFadden (2006). This estimate was based on social cost figures taken primarily from Collins and Lapsley (2002).

Reuter (1999) once described a cost-of-illness study as "an exercise in hubris", given that the information required to properly estimate the social costs caused by illicit drug use exceeds the information available to researchers. It should be noted that the exercises undertaken previously by the AFP, now updated and extended here, are more ambitious than cost-of-illness studies. In this report, there is an effort to lessen the "hubris" required by being explicit about assumptions and conducting sensitivity analyses, but users of such estimates should be aware of how inexact the estimates may be. On the other hand, critics should understand that, for government agencies having to make decisions about where to deploy their resources and having to meet outcome reporting requirements, such an approach has at least the potential to get agencies to focus their attention on the drugs and drug users generating the greatest harm.

The report is set out as follows. Conceptual and methodological issues are discussed in the next section. The social costs generated by illicit drug use are estimated in the next four sections: health effects (third section), crime effects (fourth section), road accidents (fifth section) and labour market outcomes (sixth section). The prevalence of particular types of illicit drug use is made in the seventh section and an estimate of the amount of drugs consumed in the eighth section. In the ninth section, the preceding estimates are combined to calculate per user and per gram estimates. These are discussed in the final section.

CONCEPTUAL AND METHODOLOGICAL ISSUES

In broad terms, the exercise is conceptually straightforward: estimate the social costs caused by illicit drug use and then identify who generates those social costs and how much of a particular drug has been consumed in the process. However, the simplifications required to do this means conceptual and methodological issues are important for understanding the results presented later in the report.

Social costs related to illicit drugs

An issue of primary importance is to determine what should be regarded as social costs. Earlier versions of the AFP's Drug Harm Index relied on cost-of-illness studies' estimates of the social costs of substance abuse. Such studies have been conducted for more than 20 years, purportedly exactly on this topic. However, simply transferring these estimates, such as those contained in Collins and Lapsley's (2002) Australian study, is inappropriate for several reasons.

First, cost-of-illness studies compare the current situation to one where there is no illicit drug use. Costs that are essentially fixed, which are not relevant for this exercise, are combined with those that are variable.[1] Second, cost-of-illness studies generally do not value effects where the available information is deemed inadequate, and adopt lower estimates whenever there is some uncertainty. Third, a focus on tangible costs means important intangible costs are not included (Moore & Caulkins, 2006).

The approach adopted here was to use Collins and Lapsley (2002) as a starting point for the identification of social costs. A determination was then made about whether the costs would vary on the basis of small changes in the number of drug users or the amount of drug use. A decision was made to ignore the costs of policies specifically directed at addressing illicit drug problems (these policies are most commonly thought of as comprising: drug law enforcement; specialist drug treatment; school and community programs that seek to preventing the uptake of drug use; and programs reducing the harmful effects of illicit drug use). The amount spent on some policies, such as public health campaigns, would not change with one less drug user. However, it is also not clear that the number of arrests or amount spent on drug treatment will diminish if one drug user was to be no longer in need of assistance or attention.[2]

One significant cost included by Collins and Lapsley and in the previous Drug Harm Indices was omitted. Collins and Lapsley (2002) considered any illicit drug consumption as "abuse", as society has decided to proscribe their consumption, and counted all expenditure on illicit drugs as a social cost. On the other hand, Harwood, Fountain and Livermore (1998), the last major cost-of-illness study into substance abuse in the United States, confine their analysis to costs relating to abuse and dependence (psychiatrically defined) and do not count expenditure as a social cost. The inclusion of this kind of private expenditure in public policy analysis seems unwarranted, and is not included here.

For costs that were included (costs related to crime, health effects, road accidents and the labour market), the best estimate was sought. This included intangible costs, as they reflect what

[1] Ideally, marginal costs should be estimated directly. In practice, it is rarely possible.
[2] This would only be the case if treatment places currently meet demand, or if police are arresting all of the people they possibly can. For those that are interested or want to include such costs, many of the costs for these policies in Australia are estimated in Moore (2005).

someone would do to avoid the pain or suffering they might bear as a result of drug use. Fortunately, in the health and crime areas there are estimates of the social costs that are superior to Collins and Lapsley's (2002) estimates. However, this is a difficult exercise; it is still not certain, for example, that the intangible costs relating to drug dependence itself are appropriately taken into account.

The incidence and prevalence of illicit drugs

It is important to understand a simplification in this report: all social costs are allocated to illicit drugs as if their consumption has been constant over time. This has clearly not been the case, but there is not currently enough information to allocate current social costs between, say, the current levels of heroin use and the higher levels of use that occurred in the late 1990s. On a per kilogram basis, this simplification means actual social costs may be either under-estimated (if consumption is increasing) or over-estimated (if consumption is decreasing). In this estimate, this issue is most relevant for the social costs of opiates, which are likely to be overstated as consumption has recently decreased, and amphetamines, which are likely to be understated as consumption has recently increased.

Drug categories

Throughout the report, drug types are separated into opiates (heroin), amphetamines, cocaine, cannabis (marijuana) and other drugs (which includes ecstasy, illegal benzodiazepines, inhalants and steroids). Data are drawn from a large number of sources, whose categories are not defined in exactly in the same way. This is most pertinent for amphetamines (including methamphetamine but generally not ecstasy and related drugs) and opiates (which includes illicit methadone, buprenorphine and morphine wherever possible).

Many people use more than one drug (Breen et al., 2004; McKetin et al., 2005). This is dealt with by assuming the relationships between drug types and their effects are independent. That is, there are no interaction effects between combinations of drugs, such as cocaine and amphetamines or opiates and amphetamines. This means the effects can be decomposed in this analysis. It also means that assessing the social costs of someone who used more than one drug involves summing social costs of the individual drug categories.

Prevalence and consumption estimates

Previous estimates of prevalence and consumption have relied on the National Drug Strategy Household Survey conducted by the Australian Institute for Health and Welfare (AIHW). In this report, household survey results are combined with other epidemiological information to adjust for the likelihood that household surveys understate the number of dependent drug users.

Most illicit drugs can be consumed in a variety of different ways (e.g. orally, by injection, smoking, inhaling, snorting). However, prevalence studies do not normally provide details of route of administration when they record how often particular drugs are used. In the market estimations, one route of administration is chosen for estimation purposes.

It is important to understand the market estimates developed here are consumption-based estimates. They will be different from estimates of the amount of an illicit drug that is imported into Australia or produced, as such estimates would have to include quantities that are seized by police or lost.

Dependence

The division between users is made on the basis of drug dependence. Dependence is a concept used in an explicit way in the crime-related data and in the epidemiological studies used to estimate the prevalence of drug use. All of these studies follow DSM-IV criteria for dependence, although there are differences in how it is applied in data collection instruments. Where dependence was not explicitly used, indirect methods have to be applied to separate dependent drug users from other drug users.

Consistency of cost and other information

Many different data sources are drawn upon in the development of the estimates. The most recent information is used; data are generally from the last two or three years. It is important that the monetary values are set to a common year; they are updated to 2005 prices using the Australian Bureau of Statistics (ABS) chain price index (ABS, 2006a).

There are also broader issues of consistency. One issue is the consistency of drug categories. For example, some datasets record the use or effects of heroin, while others record the use or effects of opiates, which includes other substances such as methadone and buprenorphine. Similarly, some datasets use methamphetamine as a drug category, while others use the broader category of amphetamine. Care is taken to match categories as much as possible, yet inconsistencies do remain.

Another issue is in the calculation of costs. Costing individual effects of drug use are large exercises in themselves, and there is a reliance on existing reports. The authors of these reports adopt broadly similar methodologies, but this is another area where there are likely to be inconsistencies.

Use of the results

The attributions are made as carefully as possible. However, there are significant gaps in our knowledge about the relationships between drug use and social costs. Even in countries where they have access to longitudinal datasets of the type that make such relationships easier to understand, the findings are conflicting and uncertain. Sensitivity analysis is conducted and should be used together with the main results.

It should also be remembered that average values are used. Studies consistently find that the distribution of the social costs of drug use is highly skewed within populations of drug users, with the majority of costs generated by a small number of people. The dependence/non-dependence division was introduced to address this, but only partially does so.

HEALTH EFFECTS

This section estimates the health costs associated with illicit drug use, by drug type (cannabis, cocaine, opiates, amphetamines, other) for dependent and non-dependent users.

Ridolfo and Stevenson (2001) indirectly quantified the causal relationship between illicit drug use and health in Australia, updating previous studies by English et al. (1995). They identified 26 conditions as completely or partially caused by illicit drug use and estimated the proportions of deaths and hospital separations considered attributable to illicit drug use.

Collins and Lapsley (2002) used this information to estimate the health-related social costs of illicit drug use. They measured expenditure on hospital services, medical services, nursing homes, pharmaceuticals and ambulance attendances, adjusted for the savings in these areas due to premature deaths, and estimated that the social costs amounted to $60 million in 1998-99.

This is a narrow conception of health-related social costs, limited largely to tangible costs borne by government. Mathers, Vos and Stevenson (1999) estimated the burden of 176 disease and injury categories in 1996 in Australia in terms of disability adjusted life years (DALYs). A DALY is equivalent to the loss of one year of life free of disability and disease, combining time lost as a result of both premature mortality (potential years of life lost) and years of "healthy" life lost by virtue of being in states other than good health (years lost as a result of disability). (Comparisons between health conditions and also good health are based on surveys and expert judgements.)

Using English et al.'s (1995) fractions for drug-attributable morbidity and mortality, Mathers et al. (1999) estimated that 45,124 DALYs were lost as a result illicit drug use, with 22,031 potential years of life lost from premature mortality and 23,093 lost as a result of disability. The potential years of life lost were re-estimated for 2004 (the most recent available year) using ABS mortality data. The original estimate of the years lost to disability was updated and allocated to particular types of drugs on the basis of information on the number of hospital separations in Australia for particular conditions in 1996-97 (1996 being the reference year used by Mathers et al, 1999) and 2003-04 (the most recent available year). Costs identified by Collins and Lapsley (2002) are not included; they are subsumed into the broader valuation contained in this willingness to pay approach.

DALYs need to be monetised. Abelson (2003) estimated that an appropriate value of a DALY for public policy was $108,000 (in 2002 prices). This is based on studies of individuals' marginal willingness to pay to avoid unforeseen death, which is generally justified because it measures the relative value placed on goods and can lead to potentially Pareto-efficient outcomes. The same average willingness to pay value is applied to all DALYs. This is considered equitable as those willing to pay the most may differ from those considered most in need (Abelson, 2003). Updating the 2002 figure to 2005 on the basis of the GDP chain price index resulted in a DALY being valued at $120,000 (ABS, 2006a).

Data and methods

The overall estimate of the health-related social costs of illicit drugs consisted of two separate estimates: 1) the years lost due to a disability; and 2) the potential years lost due to premature mortality. These strategies required different data and methods.

Years lost due to a disability

Updating years lost to a disability required matching drug-attributable health conditions from three sources: Mathers et al. (1999) estimate of the burden of disease; Ridolfo and Stevenson's (2001) assessment of drug-attributable health conditions; and the AIHW's (2006) hospital morbidity database (classified by principal diagnosis). The major complications in doing this were:

1. Mathers et al. (1999) and Ridolfo and Stevenson (2001) had used the 9th edition of the International Classification of Disease classification system (ICD-9), whereas conditions are currently classified using ICD-10;
2. Mathers et al. (1999) estimate was based on English et al.'s (1995) drug attributable conditions, which has subsequently been updated by Ridolfo and Stevenson (2001);
3. Mathers et al (1999) health conditions classifications did not match up with some of the classifications used by English et al. (1995) and Ridolfo and Stevenson (2001); and
4. Some conditions were not classified to a particular type of drug.

The first one was relatively easy to remedy. Collins and Lapsley (2002) provide, as an appendix, the ICD-10 classifications for all of the drug-attributable conditions covered by Ridolfo and Stevenson (2001) and the matching ICD-9 codes. The second issue, the need to take account of changes between English et al. (1995) and Ridolfo and Stevenson (2001) was addressed by applying the earlier fractions to the number of hospital separations in 1996/97, and later fractions to separations in 2003/04.

The third issue, the mismatch in classifications between studies, had to be dealt with on a condition-specific basis. The other studies had to be made to match the classifications of Mathers et al. (1999); it was not possible to decompose their categories given the large number of individual calculations that went into the overall DALY calculations. Table 1 shows which categories the various health conditions were assigned to. Three conditions – *Antepartum haemorrhage*, *Maternal drug dependence* and *Newborn drug toxicity* – were not included in any of Mathers et al.'s (1999) categories. The *Low birthweight* DALYs were extrapolated to these conditions on the basis of the number of hospital separations. Table 1 also contains information on how DALYs were assigned to drug types where the health condition was related to more than one type of drug.

Potential years of life lost due to premature mortality

The Australian Bureau of Statistics annually produces unit record data on deaths in Australia. This includes individuals' age at death and the primary cause of death, which is classified according to the ICD-10 codes. The ICD-10 codes identified by Collins and Lapsley (2002) and the allocations outlined in Table 1 were used to identify which deaths should be allocated to particular type of illicit drug.

For each death, the age at death was deducted from 81.5 years for males and 85.7 years for females. These were the expected lengths of life used by Mathers et al. (1999). Future years are discounted relative to current years. A discount rate of 3 per cent per annum was used, which was the social discount rate used by Mathers et al. (1999) and Abelson (2003).

Table 1: Health categories in Mathers et al. (1999) and how assigned to illicit drug types

Categories	Health conditions	How assigned to drug types?
Heroin dependence & harmful use	Opiate dependence Opiate abuse	Only one drug type in category
Cannabis dependence & harmful use	Cannabis dependence Cannabis abuse	Only one drug type in category
Other drug dependence & harmful use	Amphetamine dependence Amphetamine abuse Cocaine dependence Cocaine abuse Hallucinogen dependence Hallucinogen abuse Drug psychoses	Hospital separations [hospital separations for drug psychoses are recorded for major drug types in ICD-10]
Benzodiazepine dependence and harmful use	None	It was not assigned
Poisoning	Poisoning by psychostimulants Opiate poisoning Poisoning by hallucinogens	Hospital separations
Suicide and self-inflicted injuries	Suicide	Assigned to opiates, as done in Ridolfo & Stevenson (2001)
Low birth weight	Low birth weight	Assigned to opiates and cocaine on the basis of hospital separations and attributable fractions
Hepatitis C Hepatitis B HIV/AIDS Inflammatory heart disease	Hepatitis non A, and B Hepatitis B AIS Infective endocarditis	Conditions were assigned to drug types on the basis of injecting drug use. Responses to the "drug last injected" question in the 2005 Needle and Syringe Program Survey were used (NCHECR, 2005)
Omitted conditions	Antepartum haemorrhage Maternal drug dependence Newborn drug toxicity	It was not obvious that these conditions had been included in the other conditions. The DALYS for *Low birth weight* were extrapolated on the basis on hospital separations. The separations for *Antepartum haemorrhage* attributable to opiates and cocaine were directly available, so were used to assign the DALYs for that condition. The other conditions were assigned on the basis of the separations for drug dependence for each drug type

Sources: Mathers et al. (1999); Ridolfo & Stevenson (2001); Collins & Lapsley (2002); AIHW (2006).

Results

The detailed calculations for the estimated years lost as a result of a disability and potential years of life lost for individual conditions are provided in Appendix 1. The overall results are shown in Table 2. The disability adjusted life years were monetised by multiplying each year by approximately $120,000. The social costs of opiates were estimated to be approximately $2.5 billion per annum, cannabis $1.2 billion per annum, amphetamines $340 million per annum, cocaine $138 million per annum and other illicit drugs $49 million per annum.

The DALYs had to be monetised and allocated to dependent and non-dependent users. However, there is no information in the health datasets to attribute morbidity and mortality to dependent or non-dependent drug use. While some health conditions are related to chronic drug use, poisoning and blood-borne viruses could potentially be conditions that affect occasional users.

Therefore, the relationships between drug use and these conditions were assumed to be a function of frequency of drug use: costs were allocated to dependent and non-dependent users on that basis. All remaining health-related costs were allocated to dependent users.

Table 2: Drug-attributable disability adjusted life years (DALY), converted to annual cost, by illicit drug type

	Cannabis	Cocaine	Opiates	Amphet.	Other illicit drugs
Yrs lost as a result of disability	9,835	791	12,470	1,552	177
Potential years of life lost	130	357	8,569	1,293	235
Disability adjusted life years (a)	9,965	1,148	21,040	2,845	412
Cost ($million) (b)	$ 1,195	$ 138	$ 2,523	$ 341	$ 49
Dependent users ($ million)	$ 1,195	$ 113	$ 2,386	$ 274	
Non-dependent users ($million)	$ 0.067	$ 24.7	$ 137	$ 67.5	

Notes:

(a) Equals: YLD + YLL

(b) Equals: DALYs *$119,937 (2005 equivalent of $108,000 in 2002 prices)

Components may not sum to total due to rounding

See Appendix 1 for detailed calculations

CRIME EFFECTS

This section reports on the estimated crime costs associated with different drug types for dependent and non-dependent users.

There is clearly an association between illicit drugs and criminal activity. For example, in Australia approximately 70% of arrestees have used illicit drugs within the past month, and nearly all arrestees have used illicit drugs in their lifetime (Schulte, Mouzos & Makkai, 2005). However, it is difficult to determine whether drug use causes crime, crime causes drug use, or both drug use and crime are caused by other factors (MacCoun, Kilmer & Reuter, 2003).

Goldstein (1985) identified three ways in which drugs can be causally related to crime: 1) via the psychopharmacological effects of the drugs on the drug user (e.g., through intoxication); 2) to finance drug purchases ("economic compulsive crime"); and 3) in the operation of drug markets and drug distribution ("systemic crime").

In Australia, arrestees interviewed in the Drug Use Monitoring in Australia (DUMA) project are asked about their drug-taking and criminal behaviour. For several years, detainees in seven police stations across four jurisdictions (NSW, Queensland, South Australia and Western Australia) have been asked about their drug use and criminal activity, and asked to provide urine to check self-reported drug use (Schulte et al., 2005). They are also asked to assess the extent to which drug use caused their crimes.

DUMA self-reported criminal activity was used by Collins and Lapsley (2002) to attribute a proportion of the social costs of crime to drug use. They applied these fractions to the costs of policing, criminal courts, prisons, customs, national law enforcement agencies, reduction in the value of stolen property, foregone productivity of criminals, and healthcare and mortality resulting from violent crimes. They estimated nearly $3 billion in crime costs could be attributed to illicit drugs, and a further $1.2 billion jointly attributed to illicit drugs and alcohol.

The approach adopted here is broadly similar to that of Collins and Lapsley (2002). A question DUMA respondents are asked is: "What proportion of your crime was related to drug use (except alcohol)?"

When respondents wholly or partially attribute their criminal activity to drug use, this attribution is allocated to particular drug types and then valued in monetary terms. Self-reported drug use was used; comparisons of self-report with urine drug screens have shown general concordance (McGregor & Makkai, 2003). It should be noted that the focus on DUMA and drug use means systemic crime is omitted, as it is related to drug supply rather than drug use.

Data and methods

The Australian Institute of Criminology provided access to unit record data of the Drug Use Monitoring in Australia (DUMA) project. In 2005, there were 3,786 individuals from whom information was collected. There were 250 records where necessary data were missing. The remaining 3,536 individuals had a total of 9,010 criminal charges, classified using the Australian Bureau of Statistics' Australian Standard Offence Classification (ASOC).

The ASOC categories were grouped into broader offence categories, which were then allocated to one of three groups. The first were crimes that clearly generate social costs, such as property and violent crimes. The second were crimes which relate to crimes that generate social costs but do not directly create social costs themselves, such as parole violations, driving offences and weapons charges (and illicit drug offences). In the third group were offences thought to create only negligible social costs, such as offensive behaviour. The first group were the only offences valued for this exercise; they matched all crime categories included in Mayhew's (2003) estimate of the social costs of crime (except illicit drug offences).

The following approach to calculate proportions of offences to particular types of drugs was used:

- To the question about how many offences were drug-related, responses were quantified as follows: "All of them" was considered 100%; "Most of them" was considered 75%; "About half of them" was considered 50%; "Some of them" was considered 25%; and "None of them" was considered 0%; and
- The frequency with which the different types of illicit drugs had been consumed over the month before arrest (i.e. the number of days used in the past month) was used to allocate the crime to particular types of drugs.

There are several assumptions involved in this approach. First, that self-reported attribution is accurate (It has been argued that self-reported causal effects may overstate the actual size of the effect; Best et al., 2001; McGregor & Makkai, 2003). Second, that the quantification of the attribution matches the attribution respondents had in mind. It has been difficult to ensure that DUMA respondents understand the question correctly, and there have been several efforts to improve the accuracy of responses over time. Third, that each individual's drug using and criminal behaviour is consistent over the past 12 months: respondents are asked to make their attribution about crimes over the past 12 months; past month drug consumption was used to make allocations between different types of drugs; and the crime(s) being considered are the ones for which the individual has just been apprehended. Fourth, it is assumed that DUMA detainees are representative of those committing crimes in Australia (for both reported and unreported crimes).

In a number of cases, respondents attributed part or all of their criminal behaviour to illicit drug use but had consumed no illicit drugs over the past month. This is possible, as some arrests are as a result of an arrest warrant, where the offence may have occurred more than 30 days prior to arrest. Despite this, in these cases the attribution was removed. While this was a pragmatic decision, as it was impossible to follow the selected attribution strategy, it also addresses some of the concerns about respondents overstating the role of drugs in their criminal activity, as doubts about attributions are likely to be greatest in such cases (and arrest warrants comprised a minor component of overall arrests).

The method of allocating the attributed portion of a crime to particular drugs was different depending on whether or not the crime was judged to be primarily economic compulsive in nature (i.e. whether the crime was committed to obtain income). For crimes judged to be economic-compulsive, such as theft and fraud, attribution should be based on an offender's expenditure on particular types of drugs. However, there was no information on the amount spent or the number of times a drug had been used in DUMA or in any other dataset that could be considered to cover the same population.

The attribution was assigned to drugs consumed on the basis of days used in the past month. The only adjustment made was that days of use of marijuana were given a weighting of one half, as it is significantly cheaper that the other common illicit drugs (ACC, 2005). For example, if a respondent used marijuana on ten days, amphetamines on ten days and opiates on five days, then the total weighted days is 20 (as marijuana has only five "weighted days") and 25% of the costs of that crime is allocated to marijuana, 50% to amphetamines and 25% to opiates.

For crimes that were not primarily economic compulsive, it was arguable that all drugs should be given equal weight. Cannabis, a drug used within the past month by 56% of DUMA detainees in 2005, has been shown to inhibit aggressive behavior and thus may not be a significant contributor to violent crime (White & Gorman, 2000). Pacula and Kilmer (2003) analysed Arrestee Drug Abuse Monitoring data (the United States equivalent to DUMA) and found a causal relationship between marijuana and income-producing crime but not violent crime. In line with that finding, the approach adopted here was to exclude cannabis from the attribution of violent crime. All other drugs were given equal weight in the self-reported drugs-crime attribution, based on the number of days used in the past month. This may understate or overstate the role of some other drugs, but there is a dearth of studies that could be used to determine how such allocations should be made more precisely.

Crime cost estimates were taken primarily from Mayhew (2003), an Australian Institute of Criminology study that estimated the total costs of crime in Australia. The breadth of the study and the steps undertaken to adjust for measurement issues – particularly the underreporting of crime – make it the best available resource for such information. The frequencies of crimes were updated using Australia Bureau of Statistics data. The costs, which were assumed to be in 2002 prices, were updated using the same chain price index figures used in the previous section (ABS, 2006a).

The analysis of the costs was done separately for DUMA respondents classified as drug dependent and non-dependent respondents. DUMA includes six questions about drug dependence. These questions reflect DSM-IV criteria, and a respondent is classified as dependent if they meet three or more of these criteria (Schulte et al., 2005).

Results

The detailed calculations for crime costs are provided in Appendix 2. The calculations are made for crimes considered to be primarily income generating and then for other crimes that generate social costs. The totals for these two broad categories by drug types and the overall crime costs are shown in Table 3.

The total social cost of drug-attributable crimes is estimated to be nearly $7.5 billion per annum. Offenders classified as drug dependent are estimated to generate $6.8 billion in crime costs, more than 90% of the annual total crime costs. The annual crime costs generated by amphetamine use were estimated to be approximately $3 billion, cannabis $1.9 billion, opiates $1.7 billion, cocaine $160 million and other illicit drugs approximately $600 million.

Table 3: Drug-attributable crime calculated as annual social cost ($million), by illicit drug type

	Cannabis	Cocaine	Opiates	Amphet.	Other illicits (a)
Income-generating offences					
Dependent users	$ 1,601	$ 105	$ 1,551	$ 2,203	$ 325
Non-dependent users	$ 319	$ 26.1	$ 28.4	$ 204	$ 55.6
Total cost	$ 1,919	$ 131	$ 1,579	$ 2,407	$ 380
Other offences					
Dependent users	$ 0	$ 30.2	$ 163	$ 592	$ 196
Non-dependent users	$ 0	$ 0.63	$ 1.16	$ 39.8	$ 12.7
Total cost	$ 0	$ 30.8	$ 164	$ 632	$ 209
Total crime costs					
Dependent users	$ 1,601	$ 135	$ 1,714	$ 2,795	$ 521
Non-dependent users	$ 319	$ 26.7	$ 29.6	$ 244	$ 68.3
Total cost	$ 1,919	$ 162	$ 1,743	$ 3,039	$ 589

Notes:

(a) Other illicit drugs include: hallucinogens/LSD; benzodiazepines; ecstasy; and non-prescribed methadone

See Appendix 2 for detailed calculations

Components may not sum to total due to rounding

ROAD ACCIDENTS

Collins and Lapsley (2002) estimated that the cost of drug-attributable road accidents was $532 million in 1998-99. This was based on Ridolfo and Stevenson's (2001) attributable fractions, which estimated that 0.008 of road accidents could be attributed to the use of amphetamines and 0.007 could be attributed to the use of opiates.[3] No causal relationship was reported for cannabis, cocaine or other illicit drugs.

This broadly accords with international research. Movig et al. (2004) tested drivers for drug use in The Netherlands and compared the results to accident information. They found no effect of cannabis, and effects for amphetamines, cocaine and opiates that were not statistically significant (significant effects were found for alcohol and benzodiazepines). The prevalence and profile of cocaine use in Australia is different to many other countries, and may explain the lack of an association.

Collins and Lapsley's (2002) estimate was updated on the basis of ABS (2006a) and split between amphetamines and opiates on the basis of the relative weighting in Ridolfo and Stevenson (2001). The total social cost was estimated to be $651 million, with $351 million attributed to amphetamines and $307 million to opiates.

There is no obvious basis for distinguishing between road accident costs created by those who are drug dependent and those who are not. Like some of the health conditions, the relationship between drug use and road accidents was assumed to be a function of frequency of use. Costs were allocated between dependent and non-dependent users on that basis, using estimates reported in the later results section. The results are shown in Table 4.

Table 4: Annual road accident cost attribution between dependent and non-dependent users

	Opiates	Amphetamines
Costs of road accidents ($million)	$ 307	$ 351
Proportion of doses – dependent (a)	85%	58%
Road accident costs – dependent ($million)	$ 261	$ 203
Proportion of doses – non-dependent (a)	15%	42%
Road accident costs – non-dependent ($million)	$ 45.6	$ 148

Notes:
(a) Taken from the estimates reported in Results section
Sources: Collins & Lapsley (2002); ABS (2006a)

[3] Road accidents effects were not estimated by English et al. (1995) and therefore not included in Mathers et al. (1999): there is no overlap between these costs and the health costs in the earlier section.

WELFARE AND LABOUR MARKET EFFECTS

Drug use can have an effect on the labour market outcomes of drug users, in terms of reduced productivity, lower wages, higher unemployment and greater reliance on welfare. Collins and Lapsley (2002) used information from the Federal Department of Family and Community Services (FACS) to estimate these costs. FACS identified a group of people receiving unemployment benefits who were exempt from activity test requirements because of an identified alcohol or other drug dependency. Collins and Lapsley (2002) also used information about the proportions of people accessing the Supported Accommodation Assistance Program for whom substance abuse was the main reason for doing so.

In these estimates, the causal relationships are assumed rather than established. Studies have differed as to whether illicit drug use affects labour market outcomes. DeSimone (2002) found marijuana use reduces employment probabilities for men in the United States, Kaestner (1994) found negative wage effects of cannabis (for men and women) and cocaine (for men only) in the United States, and Van Ours (2005) found frequent cannabis use (but not cocaine use or infrequent cannabis use) has a negative wage effect in the Netherlands. Other studies are inconclusive (e.g. MacDonald & Pudney, 2001) or find, perhaps surprisingly, a positive relationship between illicit drug use and wages or employment (e.g. Kaestner, 1991; Gill & Michaels, 1992).

In the main estimate, no labour-related costs are included. In the sensitivity analysis, the upper estimate is based on negative relationships between drug use and employment outcomes for dependent drug users, and valued in terms of the average wage.

PREVALENCE ESTIMATES

Estimating the prevalence of illicit drug use is difficult. The most common method is to extrapolate household survey results. That is certainly possible in Australia: the National Drug Strategy Household Survey (NDSHS) has been conducted by the Australian Institute of Health and Welfare (AIHW) periodically since 1985.

However illicit drug use, which is more common amongst people in marginalised populations, is likely to be underestimated on this basis (Hall et al., 2000; Dietze, Hickman & Kimber, 2005). There are some Australian epidemiological studies that use alternative methods to estimate the prevalence of frequent or problematic use; these provide additional sources of information.

In these epidemiological studies, distinctions are generally made between two types of drug users: 1) "frequent" users (alternatively labelled "regular", "problematic" or "dependent" users); and 2) "infrequent" users (alternatively labelled "occasional", "recreational" or "nondependent" users). The "frequent" and related labels tend to refer to daily, or near-daily, drug users (Hall et al., 2000). Some studies include more than one of these classifications; for example, McKetin et al. (2005) estimates the number of dependent and regular amphetamine users. (Whenever this occurs, estimates of the number of "dependent" drug users will be used.) "Infrequent" users are characterised as people who generally use no more than one or two days a week, primarily in social settings.

The approach taken is as follows. Wherever available, studies using indirect estimation techniques are used to estimate the number of dependent drug users. Judgements are then made about the proportion of dependent drug users likely to overlap with the National Drug Strategy Household Survey estimates, and the remainder of the NDSHS-based figures are used to estimate the number of non-dependent users. All of the results are summarised in Table 5.

Table 5: Illicit drug prevalence estimates, by level of dependence and illicit drug type

	Cannabis	Cocaine	Opiates	Amphet.
Dependent drug users	247,500	13,892	41,401	73,257
Non-dependent drug users	1,662,575	162,454	107,898	495,500
All illicit drug users	1,910,075	176,346	149,299	568,757

Opiate/heroin users

Dependent heroin users

Recent epidemiological estimates of the number of heroin users in New South Wales and Victoria were combined and extrapolated to develop an estimate of the number of frequent heroin users in Australia. Dietze, Hickman and Kimber (2005) estimated the prevalence of problematic heroin use in Melbourne in 2003/04, while Degenhardt, et al. (2004) estimated the number of regular heroin users in New South Wales in 2002. Combining estimates from different years was not expected to lead to too much additional variation, as there were only small changes to other heroin usage indicators between 2002 and 2003 (Breen et al., 2004).

These estimates were averaged and extrapolated to other Australian jurisdictions on the basis of the number of fatal overdoses in each jurisdiction in 2003 (Degenhardt, Roxburgh & Black,

2004). That yielded an estimate of the number of regular heroin users in Australia in 2003 of 41,400 (for more details, see Moore et al., 2005).

Other heroin users

Weatherburn and Lind (1995) applied simple ratios of the number of recreational to regular heroin users to estimate that there were between 72,000 and 450,000 recreational users, while Hall et al. (2000) used Hepatitis C epidemiological studies to estimate that there were between 148,000 and 222,000 non-regular heroin users in Australia. Estimates from the NDSHS are much smaller, with AIHW (2005) estimating that 56,300 of Australian had used heroin within the past 12 months.

Here, the dependent users estimates were used in combination with household survey figures to develop a range of estimates for the number of occasional heroin users. AIHW (2005) provides estimates of the number of Australians who had used heroin in the week (11,000), month (15,000) and year (56,300). A conservative approach would be to assume that all those who had used heroin in the past week were dependent users. Non-dependent users identified by the NDSHS is therefore 45,300 (56,300 – 11,000). Keeping the assumption that weekly users were dependent, but using an alternative assumption that the NDSHS misses as many non-dependent users as dependent users (i.e. that it identifies 11,000 of 41,400), the estimate becomes 170,000. The midpoint of the low and high estimates is 108,000. This is used as the main estimate.

Amphetamine users

Dependent amphetamine users

Many regular methamphetamine users, like heroin users, belong to marginal populations and are unlikely to be commonly represented in household surveys. McKetin et al. (2005) estimated the number of regular and dependent methamphetamine users via an indirect prevalence estimation technique, using treatment, hospital and arrest data. Estimates were based on a survey of 310 regular methamphetamine users recruited from across Sydney between December 2003 and July 2004.

They estimated that the number of dependent methamphetamine users in Australia – with dependence assessed as a score of four or greater on the Severity of Dependence Scale – was approximately 73,000. This was the median estimate of the five estimates they developed (three based on hospital admissions, one on treatment, and one on arrests).

Other amphetamine users

Amphetamine and methamphetamine use in Australia is more prevalent than heroin, and therefore likely to be better estimated by household surveys. For example, 97,000 people had used amphetamines or methamphetamines (it is combined in the survey) in past week in the 2004 NDSHS, which accorded much more closely with the indirect dependence estimate than did the heroin figure.

AIHW (2005) estimated that the number of Australians who had used amphetamines over the past year was 532,000. It was estimated that only half of the dependent users had been identified in the NDSHS, so 532,000 less the half of the number of dependent users (i.e. 36,500) results in an estimate of 495,500 non-dependent amphetamine users.

Cannabis users

Dependent cannabis users

Teesson et al. (2002) used a survey of general population to estimate that 1.5% of the general population was dependent on cannabis. Applying this proportion to the Australian population of those aged above 14 years old (as estimated in AIHW, 2005) results in an estimate of 247,000 dependent cannabis users in Australia.

Other cannabis users

The AIHW (2005) estimated that the number of Australians who had used cannabis over the past year was 1,848,200. Cannabis is more prevalent than other illicit drugs, so it is estimated that only one-quarter of dependent cannabis users (i.e. 61,000) would not have been identified in the NDSHS. Therefore it is estimated there is 1,662,000 non-dependent cannabis users in Australia. (Using the household survey to estimate the number of dependent users and then assuming some of them are missed in the survey is problematic, but unavoidable.)

Cocaine users

Dependent cocaine users

There is little information on the number of cocaine users in Australia. Shearer et al. (2005) researched several aspects of cocaine supply, but they did not specifically consider the question of the number of users (they used the NDSHS figures for a market estimation). Some of characteristics from Shearer et al. (2005) are combined with NDSHS figures to develop an estimate.

The 2004 NDSHS estimates were that 24,700 Australians had used cocaine in the past week and 53,000 had used it in the past month. Shearer et al. (2005) found that 36% of their face-to-face sample was dependent on cocaine. The 36% figure was applied to the users of the past week and month to get estimates of 8,800 and 19,000. The midpoint of these was used: it was estimated there were 14,000 dependent cocaine users in Australia.

Other cocaine users

The AIHW (2005) estimated that the number of Australians who had used cocaine over the past year was 169,400. It was assumed that only half of the dependent users had been identified in the NDSHS, so removing the other half (i.e. 7,000) results in an estimated 162,200 non-dependent cocaine users. (Again, using the household survey to estimate the number of dependent users and then assuming some of them are missed in the survey is problematic, but unavoidable.)

CONSUMPTION-BASED MARKET ESTIMATES

Consumption-based estimates are made for opiates, amphetamines, cocaine and cannabis. In surveys of drug users, respondents are generally not asked about the weights of illicit drugs they consume. Instead, they are normally asked about the number of days or times they use particular drugs over a recent period, such as a week or a month. To develop a consumption-based estimate, this information needs to be combined with information on the amount consumed on each occasion, the average purity of the drug and the number of users. The parameters and estimates are shown in Table 6. This approach is obviously an information-intensive approach, and the use of several uncertain parameters leads to some significant uncertainties. These figures should be used together with the lower and upper estimates.

Heroin consumption

Frequency of heroin use – dependent users. Weatherburn and Lind (1995) estimated that regular users inject 2-3 times per day and used an average of 17.5 times per week in their estimate. This was adopted by Hall et al. (2000), and subsequently by Degenhardt et al. (2004a). Dietze et al. (2003) collected a convenience sample of 1001 regular injecting drug users recruited from sites in Melbourne, Sydney and South Australia. Respondents had used an average of 11.2 times over the past week and 49.2 times over the past month, with a standard deviation in both cases greater than the average. Dietze et al. (2003), the more recent estimate, is adopted for the main estimate (i.e. 11 injections per week).

Frequency of heroin use – non-dependent users. Weatherburn and Lind (1995) estimated that infrequent heroin users tended to use primarily on weekends, at an average frequency of once per week or once per fortnight. This was adopted by Hall et al. (2000), and subsequently by Degenhardt et al. (2004). It is therefore estimated that nondependent users injected heroin at an average rate of 0.75 injections per week (i.e. the midpoint of once per fortnight and once per week).

Amount of impure heroin used per injection. Heroin "caps" are typically used in a single injection (Darke, Topp, Kaye & Hall, 2002; Breen et al., 2004). However, there is little agreement on the weight of a cap of heroin: for example, Maher and Dixon (1999: 490) describes caps as "small units weighing between 0.02 and 0.03 grams", while the Australian Crime Commission uses a weight range of between 0.1 and 0.3 of a gram of impure heroin for a "cap" (e.g. ACC, 2005). Moore et al. (2005) considers these figures and information on the weight of heroin seized in Victoria to estimate a dose at 0.05 gram, with a range of between 0.03 and 0.12 grams.

Purity of heroin used. Purity information is taken from Victorian data, which is seemingly representative of Australian purity levels. In 2003, the average purity was 24% (Moore et al., 2005).

Amount of pure heroin consumed. These elements can be used to estimate the amount of pure heroin consumed by dependent heroin users in Australian each year. The best estimate is that approximately 340 kilograms of pure heroin is annually consumed in Australia.

Table 6: Estimates of the annual quantity consumed in pure terms (except cannabis), by illicit drug type

	Cannabis(a)	Cocaine	Opiates	Amphet.
Estimated number of annual doses				
Dependent drug users	247,500	13,892	41,401	73,257
Weekly use– dependent	(b)	(b)	11	7
Non-dependent drug users	1,662,575	162,454	107,898	495,500
Weekly use – non-dependent	(b)	(b)	0.75	0.75
Weekly use-all users	(b)	3.29	(b)	(b)
Total times used weekly (c)	(b)	580,178	536,335	884,424
Total times used annually (d)	(b)	30,169,258	27,889,410	45,990,048
Other parameters				
Amount per dose (grams)	(b)	0.05	0.05	0.05
Average purity (%)	(e)	55%	24%	25%
Total pure amount (kilograms) (f)	281,501 (g)	830	335	575

Notes:

(a) The cannabis estimate is based on Clements and Daryal (1999), and is therefore not constructed from the prevalence and dose parameters
(b) Not required for the calculation for that illicit drug type
(c) For amphetamines and opiates, this equals: (Dependent drug users)*(Weekly use – dependent) + (Non-dependent drug users)* (Weekly use – nondependent). For cocaine, this equals: [(Dependent drug users) + (Non-dependent drug users)] * (Weekly use – all users).
(d) This equals the previous row times 52
(e) No purity measurement was available for cannabis
(f) Equals: (Total times used annually) * (Amount per dose) * Average purity / 1000 [to convert grams to kilograms]
(g) This is an impure estimate

Amphetamine consumption

Frequency of amphetamine use – dependent users. McKetin et al. (2005) reports that 82% of their respondents had used methamphetamine weekly or more often. AIHW (2005) reported that 95,000 had consumed amphetamines weekly or more often. In the absence of further information, dependent users were assumed to use amphetamines daily.

Frequency of amphetamine use – non-dependent users. Weatherburn and Lind's (1995) assumption for heroin users of occasional use of between once per week or once per fortnight was applied to nondependent amphetamine users. It was in general accord with the frequencies observed in the NDSHS (AIHW, 2005).

Amount of impure amphetamine used per injection. "Caps" are also used to estimate amphetamine consumption (it also comes in other forms). As a result, the same average dose of 0.05 gram applied to heroin is also used here.

Purity of amphetamine used. Purity information is taken from the Australian Crime Commission (2006). Across Australia, the purity of amphetamine police seizures smaller than 2 grams was approximately 25%.

Amount of pure amphetamine consumed. Together, these elements can be used to estimate the amount of pure amphetamines consumed in Australia each year. The best estimate is that approximately 574 kilograms of pure amphetamines is consumed annually.

Cocaine consumption

Frequency of cocaine use. Shearer et al. (2005) asked survey questions that enabled the calculation of a "Q score", which is an estimate of the average number of times per day a drug is consumed. The results were that their Sydney respondents consumed cocaine 0.72 times per day and Melbourne respondents consumed cocaine 0.21 times per day. These were averages for both dependent and non-dependent cocaine users. While the Melbourne estimate is perhaps more representative of other Australian locations, Sydney has more cocaine users (Shearer et al., 2005). Therefore a simple average of these values (0.47 times per day) is applied to the estimated number of cocaine users.

Amount of impure cocaine used per injection. "Caps" are also typically used in cocaine injections, and are used by Shearer et al. (2005) in their market sizing calculations. While they use 0.1 gram, it is likely that caps of cocaine are similar to those of heroin. Therefore a dose of cocaine is estimated to be 0.05 gram, with a range of between 0.03 and 0.12 grams.

Purity of cocaine used. According the Australian Crime Commission (2006), the median purity of cocaine less than 2 grams was 53.8% in Melbourne and 58% in Sydney. On this basis, a purity level of 55% for cocaine was adopted.

Amount of pure cocaine consumed. These elements result in an estimate for the amount of pure cocaine of 788 kilograms.

Cannabis consumption

Clements and Daryal (1999) estimated the amount of marijuana consumed in Australia between 1988 and 1995. This estimate is updated, based on the number of marijuana users recorded in the 2004 NDSHS and the 1995 NDSHS numbers used by Clements and Daryal (1999). On this basis, it is estimated that approximately 281,501 kilograms of marijuana is consumed in Australia.

RESULTS

All of the estimated social costs (health, crime and road accidents) are presented in Table 7. The annual social costs of drug use in Australia are estimated to total approximately $12 billion in these calculations. Crime costs represent the majority of all costs. Dependent opiate ($4.4 billion), amphetamines ($3.3 billion) and cannabis ($2.8 billion) users account for more than 80% of all social costs.

Table 7: Total social costs per year ($million), by illicit drug type

	Cann.	Cocaine	Opiates	Amphet.	Other	All drugs
Health effects						
Dependence-related	$ 1,195	$ 113	$ 2,386	$ 274	n.a.	$ 3,968(a)
Non-dependence related	$ 0.067	$ 24.7	$ 137	$ 67.5	n.a.	$ 229(a)
All use	$ 1,195	$ 138	$ 2,523	$ 341	$ 49.4	$ 4,247
Crime costs						
Dependence-related	$ 1,601	$ 135	$ 1,714	$ 2,795	$ 521	$ 6,765
Non-dependence related	$ 319	$ 27	$ 30	$ 244	$ 68.3	$ 687
All use	$ 1,919	$ 162	$ 1,743	$ 3,039	$ 589	$ 7,453
Road accident costs						
Dependence-related	$ 0	$ 0	$ 261	$ 203	$ 0	$ 464
Non-dependence related	$ 0	$ 0	$ 45.6	$ 148	$ 0	$ 193
All use	$ 0	$ 0	$ 307	$ 351	$ 0	$ 658
Total costs						
Dependence-related	$ 2796	$ 248	$ 4361	$ 3,272	$ 52(a)	$ 11,198(a)
Non-dependence related	$ 319	$ 51	$ 212	$ 459	$ 68(a)	$ 1,110(a)
All use	$ 3,115	$ 300	$ 4,574	$ 3,731	$ 638	$ 12,357

Notes:

(a) These totals omit the health costs associated with the *Other drugs* category, as those costs are not disaggregated by dependence

n.a. = Not available

Components may not sum to total due to rounding

Social costs per drug user

The prevalence estimates are combined with the above cost estimates to estimate the social costs per drug user for amphetamines, cannabis, cocaine and opiates (see Table 8). In all four drug categories, the estimated social cost per dependent user is much higher than the social cost per non-dependent user. The estimated cost per dependent opiate user is estimated to be over $100,000, more than the social costs of $45,000 per dependent amphetamine user, $18,000 per dependent cocaine user and $11,000 per dependent cannabis user. Non-dependent drug users

generate much lower costs, with the non-dependent opiate use of $2,000 being the highest of these estimates. At the other end, cannabis is estimated to have average annual costs per non-dependent user of $192.00.

It should be remembered that it is not possible to specifically consider people who use or are dependent on more than one type of illicit drug. In the way the analysis has been conducted, the average costs for such individuals can be estimated by adding up the social costs of the various drug types they use or are dependent on. For example, it is estimated that, on average, a non-dependent user of both cannabis and amphetamines generates social costs of approximately $1,100 per annum. The average social costs generated by some polydrug users could be substantially more than any one estimate in Table 8.

Table 8: Annual social costs per drug user, by level of dependence and illicit drug type

	Cannabis	Cocaine	Opiates	Amphet.
Dependent drug users				
Costs – dependence ($million)	$ 2,796	$ 248	$ 4,361	$ 3,272
Number of users	247,500	13,892	41,401	73,257
Social cost per dep. user ($)	$ 11,296	$ 17,872	$ 105,342	$ 44,661
Non-dependent drug users				
Costs – non-dependence ($million)	$ 319	$ 51	$ 212	$ 459
Number of users	1,662,575	162,454	107,898	495,500
Social cost per non-dep. user ($)	$ 192	$ 316	$ 1,967	$ 927
All drug users				
Total costs- all drug users ($million)	$ 3,115	$ 300	$ 4,574	$ 3,731
Number of users	1,910,075	176,346	149,299	568,757
Social cost per all user ($)	$ 1,631	$ 1,699	$ 30,633	$ 6,560

Social costs per amount consumed

The average social costs of amphetamines, cannabis, cocaine and opiates by weight consumed are shown in Table 9. The average social costs per kilogram and gram are shown, as cannabis tends to be used and seized by police in larger quantities than the other drug categories. The results are for pure forms of the drug, except cannabis (as the THC content is not easily and consistently analysed by researchers or authorities in Australia). This means that, for example, the weight of retail-level transactions of amphetamines and opiates need to be approximately divided by four to get the drugs in a similar form to that shown in this table.

There are significant differences in social costs by weight, with the illicit drugs that generate the largest social costs generally being consumed in the smallest quantities. The best estimates put the social costs for a kilogram of heroin at nearly $14 million, more than 1,000 times the estimated social costs for a kilogram of cannabis (approximately $1,000 per kilogram). The amphetamine estimate is also large, with social costs of $6.5 million per kilogram of pure amphetamine consumed.

Table 9: Annual social costs per pure kilogram and pure gram, by illicit drug type

	Cannabis	Cocaine	Opiates	Amphet.
Total costs – all drug users($)	$ 3,115	$ 300	$ 4,574	$ 3,731
Amount consumed per year (kg)	281,501	830	335	575
Social cost per kilogram	$ 11,064	$ 361,189	$ 13,665,679	$ 6,490,430
Social cost per gram	$ 11	$ 361	$ 13,666	$ 6,490

Sensitivity analysis

It is important to consider plausible ranges for these estimates, as the parameters used to calculate these are subject to significant uncertainty. For each parameter, "low" and "high" values are developed using additional information or, where there was a lack of alternative information, adjustments to the main estimate that would cover the range of likely values. The details of the values are provided in Appendix 3.

The empirical distributions of the ranges of each parameter (i.e. individual cost categories and prevalence and market-sizing parameters) are generated as independent triangle distributions of random variables, with the main estimate as the modal value. (The distributions of the total values, which are the sums of the dependent and non-dependent values, are the sum of the dependent and non-dependent random variables.) The mean, 5% and 95% percentiles of the distributions from 1,000 trials done in the @RISK computer program are shown in Table 10. The mean is included as many of the distributions are skewed due to both many main estimates not lying at the midpoint of the range and the effect of combining various distributions.

These distributions were then used in Monte Carlo simulations to estimate the distributions of the social cost per user and social cost per weight estimates.[4] The mean, 5% and 95% percentiles of the distributions from 1,000 trials in the @RISK computer program are shown for these outputs in Table 11.

The upper estimates are generally two to three times the lower estimates. The exceptions are the per weight estimates, where the ranges are wider and the upper estimates can be four times greater than the lower estimates. There is some overlap between the social costs per user estimates for cannabis and cocaine, and between the per weight estimates for amphetamines and opiates. This second overlap, together with the structural issues associated with combining current social costs with the current levels of drug use at a time when the use of both opiates and amphetamines is changing, makes it impossible to infer much about the relative harms of this drug, particularly on a per weight basis. The ordering of the other results is generally robust to parametric sensitivity analysis.

[4] This involves generating a sampling distribution of results by re-running calculations with parameters generated randomly within the range of plausible values.

Table 10: Sensitivity analysis, 95% confidence intervals: Costs, prevalence, market size

	Cannabis	Cocaine	Opiates	Amphet.
Costs				
Social costs – dependent drug user				
Main estimate ($million)	$ 2,796	$ 248	$ 4,361	$ 3,272
Distribution				
Lower estimate (5% level) ($million)	$ 2,162	$ 184	$ 3,377	$ 1,829
Average of distribution (50% level) ($million)	$ 3,121	$ 241	$ 4,151	$ 2,942
Upper estimate (95% level) ($million)	$ 4,137	$ 290	$ 4,821	$ 3,823
Social costs – non-dependent drug users				
Main estimate ($million)	$ 319	$ 51	$ 212	$ 459
Distribution				
Lower estimate (5% level) ($million)	$ 140	$ 36	$ 167	$ 279
Average of distribution (50% level) ($million)	$ 260	$ 46	$ 207	$ 415
Upper estimate (95% level) ($million)	$ 351	$ 56	$ 249	$ 543
Social costs – all drug users				
Main estimate ($million)	$ 3,115	$ 300	$ 4,574	$ 3,731
Distribution				
Lower estimate (5% level) ($million)	$ 2,408	$ 229	$ 3,584	$ 2,211
Average of distribution (50% level) ($million)	$ 3,381	$ 287	$ 4,357	$ 3,356
Upper estimate (95% level) ($million)	$ 4,409	$ 338	$ 5,042	$ 4,235
Prevalence of drug use				
Number of dependent drug users				
Main estimate	247,500	13,892	41,401	73,257
Distribution				
Lower estimate (5% level)	203,288	10,432	38,010	67,538
Average of distribution (50% level)	280,497	13,892	52,026	94,445
Upper estimate (95% level)	374,173	17,349	71,157	131,562
Number of nondependent drug users				
Main estimate	1,662,575	162,454	107,898	495,500
Distribution				
Lower estimate (5% level)	1,564,286	139,134	65,040	418,681
Average of distribution (50% level)	1,662,570	162,454	107,897	508,728
Upper estimate (95% level)	1,760,568	185,689	150,524	605,395

Amount consumed (pure except cannabis)	Cannabis	Cocaine	Opiates	Amphet.
Main estimate (kilograms)	281,501	830	335	575
Distribution				
Lower estimate (5% level) (kilograms)	173,316	532	290	505
Average of distribution (50% level) (kilogram)	406,603	1,097	596	1,010
Upper estimate (95% level) (kilograms)	698,639	1,850	1,053	1,726

See Appendix 3 for parameter values

Table 11: Sensitivity analysis, 95% confidence intervals: Per user and weight estimates

	Cannabis	Cocaine	Opiates	Amphet.
Per Person estimates				
Social cost per dependent drug user				
Main estimate	$ 11,296	$ 17,872	$ 105,342	$44,661
Distribution				
Lower estimate (5% level)	$ 6,998	$ 12,107	$55,330	$18,258
Average of distribution (50% level)	$ 11,536	$ 17,757	$ 82,832	$32,479
Upper estimate (95% level)	$ 17,437	$ 24,548	$ 115,222	$48,757
Social Cost per non-dependent drug user				
Main estimate	$ 192	$ 316	$ 1,967	$927
Distribution				
Lower estimate (5% level)	$ 84	$ 216	$ 1,288	$534
Average of distribution (50% level)	$ 157	$ 288	$ 2,040	$824
Upper estimate (95% level)	$ 212	$ 363	$ 3,253	$1,122
Per Weight estimates				
Social cost per kilogram				
Main estimate	$ 11,064	$ 361,189	$ 13,665,679	$ 6,490,430
Distribution				
Lower estimate (5% level)	$ 4,471	$ 147,166	$ 4,099,933	$ 1,710,056
Average of distribution (50% level)	$ 9,894	$ 303,142	$ 8,503,515	$ 3,816,916
Upper estimate (95% level)	$ 19,859	$ 539,811	$ 14,890,850	$ 6,983,485
Social cost per gram				
Main estimate	$ 11.06	$ 361	$ 13,666	$ 6,490
Distribution				
Lower estimate (5% level)	$ 4.47	$ 147	$ 4,100	$ 1,710
Average of distribution (50% level)	$ 9.89	$ 303	$ 8,504	$ 3,817
Upper estimate (95 level)	$ 19.86	$ 540	$ 14,891	$ 6,983

See Appendix 3 for parameter values

CONCLUSION AND DISCUSSION

This exercise adds further detail to our understanding of the contribution of particular types of illicit drugs and drug users in creating "drug problems" in Australia. Previous social cost estimates have rarely allocated the costs to particular types of illicit drugs, and the ones that do have not distinguished between dependent and non-dependent users nor conducted sensitivity analysis of the results.

Given the variations here to the approaches previously adopted by Collins and Lapsley (2002) and McFadden (2006), it is hard to know in advance what magnitude of social costs should be expected. It turned out, while fewer categories of social costs are included in this report, the overall costs are higher: $12.5 billion is more than 70% higher than Collins and Lapsley's 1998/99 estimate in real terms.

In relative terms, the social costs allocated to the various types of drugs are perhaps as expected: opiates account for the largest proportion of costs, while amphetamines and cannabis also account for sizeable proportions. When separate estimates take account of the number and type of users, however, the estimates are quite illuminating. Given the wide ranges of plausible values in most cases, not too much should be made of all of the differences. However, there are two results that are both interesting and fairly robust: 1) in all cases, the costs generated by dependent users are far higher than those generated by non-dependent users; and 2) the social costs of cocaine are relatively low on a per user basis.

With the first of these findings, it is the magnitude of the effects that are noteworthy. In the main estimate, a dependent user generates between 50 and 100 times the average social costs than a non-dependent user. Under any plausible characterisation, dependent users are generating the vast majority of social costs. It is a strong indication of the value of targeted programs.

The second of these findings – the relatively low social costs generated by cocaine users – may highlight the limitations of an excessive focus on individual drug types. While cocaine has traditionally been the drug of greatest concern in the United States, heroin has generally been of greatest concern in Australia. While cocaine is not being used as much as amphetamines and opiates by those caught offending or those presenting with health problems, it seems as though the characteristics of the users can be as important as the type of the drug. The recent decrease in the availability of heroin and the increase in amphetamine use in Australia demonstrates that substitution effects are an important element of understanding social costs. Drug-specific estimates of the type made here are likely to be most helpful when combined with dynamic modelling, rather than being considered in isolation.

Other insights result from the measurement and valuation requirements of this sort of exercise. First, the wide ranges suggest that sensitivity analyses are important and should be consistently done in these sorts of exercises. Unfortunately, none of the source documents included any sensitivity analysis; it would have been far better for the original analysts to select appropriate lower and upper limits.

Second, the structural issue of combining current prevalence of use with the current effects of drug use is particularly problematic when the use of particular drugs has been changing rapidly. The apparent reduction in the use of opiates and increase in the use of amphetamines in recent

years makes it difficult to draw definitive conclusions from the estimates of the social costs of these two drugs.

Third, such an exercise highlights the difficulty of combining existing epidemiological research into the numbers and type of drug users. The indirect prevalence estimates are generally done for one type of drug user. When it comes to understanding the interaction and overlap of different types of drug use, these provide little information on which to do this. With polydrug use quite common, more epidemiological studies estimating the prevalence of all different types of drug use would produce greater consistency.

The large crime cost estimates and the difficulty in determining the size of the attribution indicate it is an area deserving of further research. This is also true of the links between drug use and labour and welfare costs.

This exercise is a further step in the attempt to properly understand, in economic terms, the relationship between illicit drugs and the social costs borne by the Australian community. There are more issues to be dealt with, but it is hoped this additional information will aid government agencies in developing policies that minimise the amount of drug-related harm in Australia.

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APPENDIX 1: HEALTH-RELATED CALCULATIONS

The disability adjusted life years (DALY) estimate has two components: years lost as a result of a disability (YLD) and potential years of life lost (YLL).

The YLD calculations for specific conditions are shown in Table A1.1. The estimates made by Mathers et al. (1999) are updated on the assumption that hospital separations are correlated with years lost as a result of a disability. The hospital separations included are those where the particular condition was judged to be the principal cause of the separation. The 1996-97 separations were classified according to ICD-9 codes, while the 2003-04 separations were classified using the ICD-10 codes. These were matched using Appendix B in Collins and Lapsley (2002).

Table A1.1: Years lost as a result of a disability (YLD), by illicit drug type (a)

Condition	1996 YLDs	Hospital separations 96-97	Hospital separations 03-04	New YLDs (b)	Drug categories Cann	Coca	Opiate	Amph	Other
Abuse, dependence, poisoning conditions									
Opiate dependence	14,005	4,246	3,608	11,901	0	0	11,901	0	0
Cannabis dependence	4,416	652	1,342	9,089	9,089	0	0	0	0
Other drug dependence	1,319	3,685	6,018	2,154	609	60	74	1,372	38
Poisoning	33	2,616	2,070	26	1	0	22	0	2
Transmissible conditions									
Hepatitis C	151	800	58	11	0	0	7	4	0
Hepatitis B	9	146	174	11	0	0	6	4	0
HIV/AIDS	61	5	8	90	0	1	55	33	1
Inflammatory heart disease	6	117	158	9	0	0	5	3	0
Birth-related and maternal conditions									
Low birth weight	90	300	913	273	0	151	122	0	0
Antepartum haemorrhage	(c)	296	678	586	0	443	144	0	0
Maternal drug dependence & Newborn drug toxicity (d)	(c)	845	782	676	135	135	135	135	135
Total	23,093	13,708	15,809	24,826	9,835	791	12,470	1,552	177

Notes:

(a) Components may not sum to total due to rounding.

(b) Equals: (1996 YLDs) * (Separations 03-04) / (Separations 96-97).

(c) Mathers et al. (1999) did not estimate DALYs for Antepartum haemorrhage, Maternal drug dependence and Newborn drug toxicity. It was assumed that these conditions had the same relationship between DALYs and hospital bed days as Low birth weight. Maternal drug dependence and Newborn drug toxicity were estimated together.

(d) There was no obvious basis for allocating these health conditions to specific drug types. They can be caused by illicit drugs in all categories, so were allocated equally to all five categories.

Sources: Mathers et al. (1999); Ridolfo & Stevenson (2001); Collins & Lapsley (2002); AIHW (2006); and author's calculations.

The potential years of life lost were estimated directly using individual mortality data collected by the Australian Bureau of Statistics. The estimate was made for 2004, which is the most recent year for which such data were available. The results are presented in Table A1.3.

Table A1.2: Drug-attributable potential years of life lost (YLL), by illicit drug type (a)

Condition	Total YLL (b)	Fraction attributed to drugs (c)	Drug-related YLL (d)	Drug categories				
				Cann	Coca	Opiate	Amph	Other
Abuse, poisoning conditions								
Opiates	7,192	1	7,192			7,192		
Cannabis	130	1	130	130				
Cocaine	190	1	190		190			
Amphetamine	512	1	512				512	
Hallucinogens	179	1	179					179
Inhalants	26	1	26					26
Transmissible conditions								
AIDS	2,247	0.013	29		0	18	11	0
Endocarditis	465	0.14	65		1	39	24	1
Hep B	1,764	0.29	512		6	309	190	7
Hep non A B	3,576	0.42	1,502		16	908	556	21
Birth-related and maternal conditions								
Antepartum haemorrhage	1,129	0.037;0.012	55		42	14		
Low birth weight	3,951	0.026;0.021	186		103	83		
Other								
Suicide	73	0.09	7			7		
Total	21,946		11,096	130	357	8,569	1,293	235

Notes:

(a) Components may not sum to total due to rounding.

(b) Difference between expected age of death and actual age of death, discounted at 3% per annum.

(c) For Antepartum haemorrhage and Low birth weight, the first fraction relates to cocaine and the second fraction relates to opiates.

(d) Equals: (YLL) * (Fraction attributed to drugs).

Sources: ABS Mortality file; Ridolfo & Stevenson (2001); Collins & Lapsley (2002); and author's calculations.

The DALYs had to be monetised and allocated to dependent and non-dependent users. However, there is no information in the health datasets to attribute morbidity and mortality to dependent or non-dependent drug use. While some health conditions are related to chronic drug use, poisoning and blood-borne viruses could potentially be conditions that affect occasional users.

Therefore, the relationships between drug use and these conditions were assumed to be a function of frequency of drug use: costs were allocated to dependent and non-dependent users on that basis. All remaining health-related costs were allocated to dependent users. Table A1.3 shows the allocation for health-related costs.

Table A1.3: Cost attribution between dependent and non-dependent users, $million

	Cannabis	Cocaine	Opiates	Amph
Health conditions related to frequency of use (a)				
Disability adjusted life years	1	215	7,692	1,337
Cost ($million)	$ 0.1	$ 26	$ 923	$ 160
Other health conditions (b)				
Disability adjusted life years	9,963	934	13,347	1,508
Cost ($million)	$ 1,195	$ 112	$ 1,601	$ 181
Attribution of frequency-related conditions				
Proportion of doses – dependent users (c)	55%	4%	85%	58%
Proportion of doses – non-dependent users (c)	45%	96%	15%	42%
Health costs – dependent users				
Frequency component ($million)	$ 0	$ 1	$ 786	$ 93
Other costs ($million)	$ 1,195	$ 112	$ 1,601	$ 181
Total ($million)	$ 1,195	$ 113	$ 2,386	$ 274
Health costs – non-dependent users ($million)	$ 0	$ 25	$ 137	$ 68

Notes:

(a) Considered to be drug poisoning, Hepatitis B, Hepatitis C, HIV/AIDS and infective endocartitis/ inflammatory heart disease.

(b) All other health conditions.

(c) Taken from the estimates developed in the results section.

Source: Abelson (2003); ABS (2006a) and previous calculations.

APPENDIX 2: CALCULATION OF CRIME COSTS

The calculations are made separately for crimes considered to be primarily income-generating and then for violent or other crimes that generate social costs. None of the 11 homicide offences were attributed to illicit drug use, so no homicide-related costs were allocated to illicit drug use. All of Mayhew's (2003) other categories were given some attribution in this approach.

Income generating crime

The offences considered to be primarily income generating were: burglary, fraud, robbery, shop theft, vehicle-related theft (theft from and of vehicles) and other theft (including theft from persons). Table A2.1 shows the number of these offences committed by a person classified as dependent on illicit drugs, the number committed by other persons and, within each of these categories, the number who partly or wholly attributed their offending to illicit drug use. As would be expected, dependent users more frequently attribute their offending to illicit drug use.

Table A2.1: DUMA income-generating offences, by dependence and attribution

Category	Total offences	Offences by dependent drug users		Other offences	
		Attributed to drugs	Not attributed to drugs	Attributed to drugs	Not attributed to drugs
Burglary	388	199	60	39	90
Fraud	488	161	56	26	245
Robbery (injured)	229	92	42	10	85
Robbery (non-injured)	13	7	10	0	3
Shop theft	683	337	131	59	156
Theft – vehicles	231	107	32	22	70
Theft – other	70	33	23	5	9

Source: Australian Institute of Criminology, DUMA Collection, [computer file].

As explained in Section 3, attributions were removed where no illicit drug use had occurred in the previous 30 days. This led to the removal of: 12 attributions for *Burglary*; 15 for *Fraud*; 4 for *Robbery resulting in injuries to the victim*; 9 for *Shop theft*; and 9 for *Theft – vehicles*.

Fractions of offending attributed to drug use

Table A2.2 contains the proportion of all offences attributed to drug use, and the individual fractions for cannabis, cocaine, opiates, amphetamines and other drugs. These allocations are based on number of days each type of drug had been used over the past 30 days, with cannabis receiving half of the weighting of the other drug categories.

The overall fractions are high: more than 40% for *Burglary*, *Shop theft*, *Theft – other*, and *Robbery where the victim was not injured*. The higher fractions for offences by dependent drug users suggest that income-generating crime is often undertaken to finance frequent purchases of drugs.

Table A2.2: Fractions of income-generating crimes attributed to illicit drug use

	Proportion of all offences	Allocation to drugs				
		Cannabis	Cocaine	Opiates	Amphet	Other
Burglary						
Dependent	44.33%	14.20%	1.14%	12.72%	13.80%	2.47%
Non-dependent	6.31%	3.34%	0.43%	0.28%	1.87%	0.40%
Total	50.64%	17.54%	1.56%	13.01%	15.67%	2.87%
Fraud						
Dependent	23.62%	6.53%	0.38%	6.00%	9.47%	1.24%
Non-dependent	1.90%	0.56%	0.27%	0.39%	0.40%	0.28%
Total	25.51%	7.09%	0.64%	6.40%	9.87%	1.52%
Robbery – where the victim was injured						
Dependent	29.37%	8.83%	0.91%	6.47%	9.47%	3.68%
Non-dependent	1.31%	0.45%	0.61%	0.04%	0.11%	0.10%
Total	30.68%	9.28%	1.52%	6.51%	9.58%	3.78%
Robbery – not resulting in injury to the victim						
Dependent	40.38%	10.29%	0.00%	0.00%	30.09%	0.00%
Non-dependent	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Total	40.38%	10.29%	0.00%	0.00%	30.09%	0.00%
Shop theft						
Dependent	40.85%	8.76%	0.78%	16.73%	11.29%	3.29%
Non-dependent	4.83%	2.19%	0.03%	0.46%	1.45%	0.70%
Total	45.68%	10.95%	0.81%	17.19%	12.74%	3.99%
Theft – personal						
Dependent	37.33%	9.88%	0.00%	8.14%	18.11%	1.20%
Non-dependent	4.78%	2.72%	0.00%	0.00%	1.82%	0.24%
Total	42.11%	20.64%	4.19%	0.50%	4.71%	9.72%
Theft – vehicles						
Dependent	20.64%	4.19%	0.50%	4.71%	9.72%	1.53%
Non-dependent	1.59%	0.33%	0.00%	0.09%	0.72%	0.45%
Total	22.24%	4.52%	0.50%	4.80%	10.44%	1.98%

Note: The first column is the sum of the other five columns.
Source: Australian Institute of Criminology, DUMA Collection, [computer file].

Social costs

These fractions in Table A2.2 are monetised using Mayhew's (2003) valuations, updated to 2005 using Australian chain price index figures (ABS, 2006a). In her report, the frequencies of recorded crime in 2001 are scaled up based on the estimated level of underreporting. ABS (2005), the most recent report on recorded crime in Australia, was used to update the estimates. The estimated costs for dependent drug use that results from these calculations are shown in Table A2.3.

The total social cost of income-generating crime is estimated to be approximately $6.4 billion, with $2.4 billion allocated to amphetamine use and large amounts attributed to cannabis ($1.9 billion) and opiates ($1.6 billion).

Table A2.3: Cost of income-generating crime attributed to illicit drug use ($million)

		Allocation to drugs				
	All offences	**Cannabis**	**Cocaine**	**Opiates**	**Amphet**	**Other**
Burglary						
Dependent	1225	392	31.4	352	381	68.2
Non-dependent	350	185	23.7	15.7	104	22.1
Total	1575	578	55.1	367	485	90.3
Fraud						
Dependent	3468	959	55.6	882	1390.0	182
Non-dependent	0	0	0	0	0	0
Total	3468	959	55.6	882	1390.0	182
Robbery – where the victim was injured						
Dependent	62.4	18.8	1.94	13.8	20.1	7.82
Non-dependent	3.93	1.35	1.84	0.12	0.33	0.30
Total	66.4	20.1	3.77	13.9	20.5	8.12
Robbery – not resulting in injury to the victim						
Dependent	16.3	4.15	0	0	12.1	0
Non-dependent	0.0	0	0	0	0	0
Total	16.3	4.15	0	0	12.1	0
Shop theft						
Dependent	416	89.2	7.96	170.5	115.0	33.5
Non-dependent	107	48.6	0.59	10.2	32.2	15.5
Total	523	137.8	8.56	180.7	147.2	49.0
Theft – personal						
Dependent	258	68.4	0	56.3	125	8.29
Non-dependent	132	75.4	0	0	50.5	6.53
Total	391	144	0	56.3	176	14.8
Theft – vehicle						
Dependent	338	68.6	8.13	77.1	159	25.1
Non-dependent	39.5	8.23	0	2.33	17.8	11.2
Total	378	76.8	8.13	79.4	177	36.3
All offences						
Dependent	5784	1601	105	1551	2203	325
Non-dependent	633	319	26.1	28.4	204	55.6
Total	6417	1919	131	1579	2407	380

Source: Australian Institute of Criminology, DUMA Collection, [computer file]; Mayhew (2003); ABS recorded crime; ABS (2006a).

Other offences

The other offences that lead social costs but which are not primarily motivated by income reasons are offences are arson, assault and sexual assault. Mayhew (2003) distinguishes between assaults requiring hospitalisation, assaults resulting in an injury but not requiring hospitalisation, and other assaults. The Australian Standard Offence Classification codes as recorded in DUMA (i.e. at the three digit level) only enables a distinction to be made between assaults requiring hospitalisation and other assaults, so it is assumed that the attributions are the same across the other two categories.

Table A2.4 contains information on the number of respondents, the number who were classified as dependent or non-dependent, and the number who partly or wholly attributed their offending to illicit drug use for these offences. Arson is the only offence category where numbers are small.

Table A2.4: Other DUMA offences, by dependence and attribution

Category	Total offences	Offences by dependent drug users		Other offences	
		Attributed to drugs	Not attributed to drugs	Attributed to drugs	Not attributed to drugs
Arson	13	5	2	0	6
Assault (hospital)	265	49	61	11	144
Assault (other)	358	84	103	12	175
Criminal damage	233	67	51	12	103
Sexual ass. (injured)	141	17	17	6	101
Sexual ass. (non-inj.)	224	5	28	8	183

Source: Australian Institute of Criminology, DUMA Collection, [computer file].

Attributions were removed where no illicit drug use had occurred in the previous 30 days. This led to the removal of: 2 attributions for *Arson*; 10 for *Assault resulting in hospitalisation*; 33 for *Assault (other)*; 23 for *Criminal damage*; 11 for *Sexual assault where the victim was injured;* and 3 for *Sexual assault not resulting in injury*.

Fractions

Table A2.5 contains the proportion of other offences attributed to drug use, and the individual fractions for cannabis, cocaine, opiates, amphetamines and other drugs. These allocations are based on number of days each type of drug had been used over the past 30 days.

Table A2.5: Fractions of other crimes attributed to illicit drug use

	Proportion of all offences	Allocation to drugs				
		Cannabis	Cocaine	Opiates	Amphet	Other
Arson						
Dependent	23.08%	0.00%	0.00%	0.00%	15.38%	7.69%
Non-dependent	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Total	23.08%	0.00%	0.00%	0.00%	15.38%	7.69%
Assaults resulting in hospitalisation						
Dependent	11.04%	0.00%	0.71%	2.10%	6.37%	1.86%
Non-dependent	1.42%	0.00%	0.04%	0.00%	1.06%	0.32%
Total	12.45%	0.00%	0.75%	2.10%	7.43%	2.17%
Assaults (other)						
Dependent	10.89%	0.00%	0.08%	1.99%	7.33%	1.49%
Non-dependent	0.77%	0.00%	0.00%	0.07%	0.42%	0.28%
Total	11.66%	0.00%	0.08%	2.06%	7.75%	1.77%
Criminal damage						
Dependent	16.52%	0.00%	0.38%	2.85%	9.68%	3.61%
Non-dependent	0.64%	0.00%	0.00%	0.01%	0.53%	0.11%
Total	17.17%	0.00%	0.38%	2.86%	10.21%	3.72%
Sexual assaults resulting in injury						
Dependent	2.66%	0.00%	0.00%	0.00%	2.08%	0.58%
Non-dependent	0.35%	0.00%	0.00%	0.00%	0.00%	0.35%
Total	3.01%	0.00%	0.00%	0.00%	2.08%	0.93%
Sexual assaults (others)						
Dependent	1.00%	0.00%	0.00%	0.00%	0.86%	0.14%
Non-dependent	0.11%	0.00%	0.00%	0.00%	0.00%	0.11%
Total	1.12%	0.00%	0.00%	0.00%	0.86%	0.25%

Note: The first column is the sum of the other five columns.
Source: Australian Institute of Criminology, DUMA Collection, [computer file].

Social costs

These fractions in Table A2.5 are monetised using Mayhew's (2003) valuations, updated to 2005 using Australian chain price index figures (ABS, 2006a). In her report, the frequencies of recorded crime in 2001 are scaled up based on the estimated level of underreporting. ABS (2005), the most recent report on recorded crime in Australia, was used to update the estimates.

The results are presented in Table A2.6. The majority of the costs are attributed to amphetamines ($630 million of $1,035 million), while significant amounts are also attributed to opiates and other drugs.

Table A2.6: Cost of other crimes attributed to illicit drug use ($million)

		Allocation to drugs				
	All offences	**Cannabis**	**Cocaine**	**Opiates**	**Amphet**	**Other**
Arson						
Dependent	64.3	0	0	0	42.8	21.4
Non-dependent	0	0	0	0	0	0
Total	64.3	0	0	0	42.8	21.4
Assaults resulting in hospitalisation						
Dependent	277	0	17.9	52.8	160	46.6
Non-dependent	25.2	0	0.63	0	18.9	5.64
Total	302	0	18.5	52.8	179	52.2
Assaults resulting in injury but not hospitalisation						
Dependent	75.7	0	0.57	13.8	50.9	10.4
Non-dependent	4.88	0	0	0.44	2.66	1.78
Total	80.6	0	0.57	14.3	53.6	12.2
Assaults (other)						
Dependent	67.7	0	0.51	12.3	45.5	9.28
Non-dependent	4.36	0	0	0.40	2.38	1.59
Total	72.0	0	0.51	12.7	47.9	10.9
Criminal damage						
Dependent	485	0	11.2	83.8	284	106
Non-dependent	19.4	0	0	0.32	15.8	3.23
Total	505	0	11.2	84.1	300	109
Sexual assaults resulting in injury						
Dependent	9.85	0	0	0	7.71	2.14
Non-dependent	0.42	0	0	0	0	0.42
Total	10.3	0	0	0	7.71	2.56
Sexual assaults (others)						
Dependent	1.10	0	0	0	0.95	0.15
Non-dependent	0.02	0	0	0	0	0.02
Total	1.13	0	0	0	0.95	0.18
All offences						
Dependent	981	0	30.2	163	592	196
Non-dependent	54.3	0	0.63	1.16	39.8	12.7
Total	1,035	0	30.8	164	632	209

Source: Australian Institute of Criminology, DUMA Collection, [computer file]; Mayhew (2003); ABS recorded crime; ABS chain price index.

APPENDIX 3: SENSITIVITY ANALYSIS

The plausible range of values for the parameters are shown and discussed below.

Table A3.1: Sensitivity analysis for health, crime, road accident and labour costs

	Estimate			
Cost Category	**Low**	**Main**	**High**	**Comments**
Health costs	**($mill)**	**($mill)**	**($mill)**	
Cannabis				Neither Mathers et al. (1999) nor Ridolfo & Stevenson (2001) report error bounds. Mathers et al. (1999) show the YLD calculations for dementia, and estimates the relative standard errors to be 12%. YLL estimates are likely to be more precise (Mathers et al., 1999). As drug attributions would have been more difficult and the monetization creates an additional level of uncertainty, the bounds were set at 25% below and above the main estimate for all health cost categories.
Dependent drug use	896	1195	1494	
Non-dependent drug use	0.050	0.067	0.084	
All cannabis use	896	1195	1494	
Cocaine				
Dependent drug use	85	113	141	
Non-dependent drug use	18.5	24.7	30.8	
All cocaine use	103	138	172	
Opiates				
Dependent drug use	1790	2386	2983	
Non-dependent drug use	103	137	171	
All opiate use	1893	2523	3154	
Amphetamines				
Dependent drug use	205	274	342	
Non-dependent drug use	50.6	67.5	84.4	
All amphetamine use	256	341	427	
Crime costs	**($mill)**	**($mill)**	**($mill)**	
Cannabis				There are a number of sources of uncertainty: how accurate self-attribution is, uncertainty around that attribution, and in the way the costs have been valued. Moore (2005) used an arbitrarily low estimate of one-quarter of the main estimate for government spending on crime-related costs. That is used here. The upper estimate is not likely to be so different from the main estimate. For approximately 10% (131 of 1,373) of the offences partially or wholly attributed to drug use, the attribution was removed as no drug use had occurred in the previous 30 days. There was also some uncertainty around the costing. To take account of these, the main estimates were increased by 20% to create the upper estimates.
Dependent drug use	400	1,601	1921	
Non-dependent drug use	80	319	382	
All cannabis use	480	1,919	2303	
Cocaine				
Dependent drug use	34	135	162	
Non-dependent drug use	7	27	32	
All cocaine use	40	162	194	
Opiates				
Dependent drug use	428	1,714	2056	
Non-dependent drug use	7	30	35	
All opiate use	436	1,743	2092	
Amphetamines				
Dependent drug use	699	2,795	3354	
Non-dependent drug use	61	244	293	
All amphetamine use	760	3,039	3647	

	Estimate			
Cost Category	**Low**	**Main**	**High**	**Comments**
Road accident costs	**($mill)**	**($mill)**	**($mill)**	
Opiates				Ridolfo & Stevenson (2001) provide no bounds on their estimates. As Movig et al. (2004) had found the effects of the use of opiates and amphetamines to not be statistically significant, in the absence of further Australian information a responsible lower bound is zero. There was no clear rationale for calculating the upper bound; a sufficiently high figure was considered to be double the main estimate.
Dependent drug use	0	261	523	
Non-dependent drug use	0	45.6	91.2	
All opiate use	0	307	614	
Amphetamines				
Dependent drug use	0	203	406	
Non-dependent drug use	0	148	295	
All amphetamine use	0	351	702	
Labour costs	**($mill)**	**($mill)**	**($mill)**	
Cannabis				In the main and lower bound estimate, labour costs are assumed to be zero. Mixed research findings make it difficult to select an upper bound. The use of some illicit drugs has sometimes been found to reduce employment probabilities of heavy users by as much as 15% to 17% (De Simone, 2002). The upper bound was calculated by multiplying the number of dependent drug users by 15% and by $50,000 (an approximation of the average wage in Australian in 2005; ABS 2006b).
Dependent drug use	0	0	1,856	
Non-dependent drug use	0	0	0	
All cannabis use	0	0	1,856	
Cocaine				
Dependent drug use	0	0	52.5	
Non-dependent drug use	0	0	0	
All cocaine use	0	0	52.5	
Opiates				
Dependent drug use	0	0	311	
Non-dependent drug use	0	0	0	
All opiate use	0	0	311	
Amphetamines				
Dependent drug use	0	0	548	
Non-dependent drug use	0	0	0	
All amphetamine use	0	0	548	

Table A3.2: Sensitivity analysis for numbers of drug users

	Estimate			
Drug Type	**Low**	**Main**	**High**	**Comments**
Cannabis	*No. of users*	*No. of Users*	*No. of users*	
Dependent drug use	173,250	247,500	420,750	Teesson et al. (2002) estimated 0.7% of the population had a cannabis disorder related to abuse rather than dependence. This was used as the lower estimate; this and the main estimate were combined to create the upper estimate.
Non-dependent drug use	1,518,921	1,662,575	1,806,229	AIHW (2005) contains standard errors for the prevalence estimates. The lower bound was based on the 95% confidence interval and an assumption that all dependent users were in the household sampling. The upper bound was based on the 95% confidence interval and the assumption that half of the dependent users were included in the household sampling (remembering that the higher prevalence of marijuana means the NDSHS provides better estimates).
Cocaine	*No. of users*	*No. of users*	*No. of users*	
Dependent drug use	8,832	13,892	18,952	Shearer et al. (2005) calculated that 36% of their sample was dependent on cocaine. The lower and upper estimates were calculated by multiplying this by the numbers in the NDSHS for those who had used cocaine in the past week and the past month (AIHW, 2005).
Non-dependent drug use	128,404	162,454	196,504	AIHW (2005) contains standard errors for the prevalence estimates. The lower bound was based on the 95% confidence interval and an assumption that all dependent users were in the household sampling. The upper bound was based on the 95% confidence interval and the assumption that none of the dependent users were included in the household sampling.

	Estimate			
Drug Type	**Low**	**Main**	**High**	**Comments**
Opiates	*No. of users*	*No. of users*	*No. of users*	
Dependent drug use	33,827	41,401	80,847	As the main estimates for the numbers of dependent and non-dependent heroin users were the midpoints of plausible ranges, the lower and upper bounds were the low and high ends of those plausible ranges.
Non-dependent drug use	45,300	107,898	170,497	
Amphetamines	*No. of users*	*No. of users*	*No. of users*	
Dependent drug use	59,774	73,257	150,302	McKetin et al. (2005) developed five multipliers of the number of dependent amphetamine users. The lowest estimate was used as the lower estimate. The upper estimate used the largest New South Wales arrest multiplier (there was an anomaly in the Australian arrest multiplier).
Non-dependent drug use	378,887	495,500	651,807	AIHW (2005) contains standard errors for the prevalence estimates. The lower bound was based on the 95% confidence interval and an assumption that all dependent users were in the household sampling. The upper bound was based on the 95% confidence interval and the assumption that none of the dependent users were included in the household sampling.

Table A3.3: Sensitivity analysis for the market-sizing estimates

	Estimate			
Drug Type	**Low**	**Main**	**High**	**Comments**
Cannabis				
Kg Consumed	93,834	281,501	844,503	Clement and Daryal (1999) do not estimate error bounds. They do discuss two earlier estimates of expenditure on cannabis in Australia where the larger estimate was 215% of the smaller one. Given this range and the large ranges for the other drug types, a large range was chosen. The lower estimate was one-third of the main estimate, while the upper range was three times the main estimate.
Cocaine				
Frequency of use (injections per day)	1.47	3.29	5.04	This range is based on the Q-scores (converted to weekly frequencies) in Shearer et al. (2005). The low estimate is the Q-score for Melbourne respondents. The high estimate is the Q-score for Sydney respondents.
Amount per injection	0.03	0.05	0.12	The ranges developed for heroin by using Victoria Police seizure data is also used as the range for cocaine.
Purity	50%	55%	60%	The purity averages are reasonably consistent across states and therefore can be regarded as reasonably accurate. Slightly lower and higher purities were used as the bounds.
Opiates				
Freq of dependent use (weekly)	7	11	17.5	The lower estimate is based on daily use. The Weatherburn & Lind (1995) estimate was used as the upper estimate.
Freq of non-dependent use (weekly)	0.5	0.75	1	The low estimate is based on fortnightly use, and the high estimate is based on weekly use.
Amount per injection	0.03	0.05	0.12	The ranges developed for heroin by using Victoria Police seizure data is used as the range for cocaine.
Purity	20%	24%	30%	The purity averages are reasonably consistent across states and therefore can be regarded as reasonably accurate. Slightly lower and higher purities were used as the bounds.

	Estimate			
Drug Type	**Low**	**Main**	**High**	**Comments**
Amphetamines				
Freq of use - dependent	3.5	7	14	The low estimate was based on using every second day. The high estimate was based on twice daily use.
Freq of use - non-dependent	0.5	0.75	1	The low estimate is based on fortnightly use, and the high estimate is based on weekly use.
Amount per injection	0.03	0.05	0.12	The ranges developed for heroin by using Victoria Police seizure data is used as the range for cocaine.
Purity	20%	25%	30%	The purity averages are reasonably consistent across states and therefore can be regarded as reasonably accurate. Slightly lower and higher purities were used as the bounds.