The costs and consequences of three policy options for reducing heroin dependency

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Abstract

Introduction and Aims. This study compares the costs and consequences of three interventions for reducing heroin dependency: pharmacotherapy maintenance, residential rehabilitation and prison. Design and Methods. Using Australian data, the interventions’ cost–consequence ratio was estimated, taking into consideration reduction in heroin use during the intervention; the length of intervention; and post-intervention effects (as measured by abstinence rates). Sensitivity analyses were conducted, including varying the magnitude and duration of treatment effects, and ascribing positive outcomes only to treatment completers. A hybrid model that combined pharmacotherapy maintenance with a prison term was also considered. Results. If the post-programme abstinence rates are sustained for 2 years, then for an average heroin user the cost of averting a year of heroin use is approximately AUD$5000 for pharmacotherapy maintenance, AUD$11 000 for residential rehabilitation and AUD$52 000 for prison. Varying the parameters does not change the ranking of the programmes. If the completion rate in pharmacotherapy maintenance was raised above 95% (by the threat of prison for non-completers), the combined model of treatment plus prison may become the most cost-effective option. Discussion and Conclusions. Relative performance in terms of costs and consequences is an important consideration in the policy decision-making process, and quantitative data such as those reported herein can provide insights pertinent to evidence-based policy. [Moore TJ, Ritter A, Caulkins JP. The costs and consequences of three policy options for reducing heroin dependency. Drug Alcohol Rev 2007;26:369 – 378]

Key words: cost–consequences, cost-effectiveness, drug policy, heroin dependency, methadone maintenance.

Introduction

There is considerable debate about the relative merits of treatment and law enforcement drug control strategies (e.g. [1 – 5]). Increasingly, emphasis has been placed on evaluating such interventions in terms of their ‘return-on-investment’ on taxpayer dollars. The hope is that, by applying these economic evaluation techniques to the public policy process, resources will be allocated more effectively and there will be better outcomes for society as a whole.

In Australia, there is a strong association between illicit drug use and criminal activity. Approximately 71% of police detainees surveyed in the Drug Use Monitoring in Australia project had used an illicit drug in the last 30 days, and 37% attributed some of their criminal activity to illicit drug use [6]. However, there has been little research directly comparing the cost-effectiveness of different policy options that span treatment and law enforcement.

Research from the United States has demonstrated the cost-effectiveness of the provision of treatment during incarceration, in post-release programmes and in prison diversion programmes [7,8]. Australian research into the cost-effectiveness of drug courts [9] and treatment within prison [10] also suggests that treatment can be cost-effective in criminal justice settings. However, questions remain for Australian policy-makers who are contemplating the use of coerced treatment as an alternative to incarceration, as there has been no such analysis to date.

As a first step toward filling this gap, we consider a stylised choice between three interventions: (1) pharmacotherapy maintenance (either methadone or buprenorphine); (2) residential rehabilitation; and (3) a...
prison term (set at 1 year). By using existing data and conducting extensive sensitivity analyses, important insights are generated and key gaps in knowledge identified.

One outcome measure is used: the reduction of personal heroin use that results from these interventions, measured as the (equivalent) number of years of heroin use that are avoided. It is rare for people to go into drug treatment and never use heroin again. More often, they may have periods of abstinence and/or reduced use then a return to using at or near pretreatment levels. We can compare interventions that differ in terms of these periods. As an example, a programme which led to abstinence for 1 year and then pretreatment use in the second year is regarded as equivalent to a programme that produced a 50% reduction in pretreatment heroin use for 2 years.

Each intervention’s average reduction in heroin use and the associated costs are reported and combined by estimating what it costs to avert 1 year of heroin use (see Table 1). This is conducted for several different scenarios. This approach is a cost–consequences analysis, as disaggregated results as well as ratios of outcomes to costs are provided [11]. The format is one that should be understandable to health care and criminal justice policy-makers, thus avoiding a common failing of health care-related economic evaluations [12].

A major limitation to this approach is that heroin use serves as a proxy for all social costs of concern to policy-makers. Sindelar et al. [13] considered different outcome measures and found the relative attractiveness of different drug treatment programmes varied depending on the measure used. While it would have been preferable to consider a range of outcomes, the paucity of common measures across the interventions considered meant it was not possible to do so.

The stylised policy choice is as follows. For dependent heroin users who have come to the attention of authorities in a form that allows a 1-year prison term, a course of pharmacotherapy maintenance or a stay in residential rehabilitation to be pursued (i.e. the individuals have been arrested), how would each intervention perform in terms of both the amount of heroin reduced and cost of the programme?

Pharmacotherapy maintenance programmes in Australia are normally provided in community settings by general medical practitioners. Clients remain in treatment for varying periods of time, but stays greater than 1 year are not uncommon. Residential rehabilitation programmes in Australia are modelled largely on the Therapeutic Community approach, and average length of stay is around 3 months. It is unlikely that either of the treatment options would be pursued without some further involvement of the criminal justice system, so probation (community corrections) programme costs are included with those options (for the same length of time as the prison term).

As discussed, reductions in heroin use are expressed in use-year equivalents to facilitate comparing interventions that vary in terms of duration of treatment, reduction in use during treatment and effects on heroin use following the programme. The effects of other drug use and deterrence effects are not accommodated. Reductions in heroin use were able to be assessed during a programme, but after an intervention those who do not become abstinent are assumed to return to baseline use.

**Methods**

Parameters related to heroin use during and after the treatments were drawn from the Australian Treatment Outcome Study (ATOS) conducted between 2001 and 2003 across three states of Australia (Victoria, New South Wales and South Australia) [14]. ATOS is a non-randomised prospective treatment outcome study that examined three treatment modalities: pharmacotherapy maintenance, residential rehabilitation and detoxification. There was also a ‘not in treatment’ control group drawn from one state. The total sample
size at baseline was 825, with 657 (80%) re-interviewed at 12 months [14,15].

Raw data from the ATOS national data set were used to calculate parameter values. The majority (65%) of ATOS participants were male, and the average age of the sample was 29.5 years. Participants had used heroin for an average 20.2 days in the past month, and 88% had previously had treatment for heroin dependence (the differences between modalities on these characteristics was not significant). Criminal activity during the month prior to interview was reported by 55% of the sample, most commonly property crime (38%) and drug dealing (27%) [14].

The costs of the resources used in ATOS programmes has been calculated previously by Shanahan et al. [16], who followed the costing principles of Drummond et al. [17] and included costs borne by individuals, governments and health services. Their figures were in 2002 dollars. Prison costs and probation costs calculated in a similar manner were available for 2002/03 [18], meaning all results are reported in 2002 Australian dollars.

Residential rehabilitation

Based on the ATOS data, the average length of time in a residential rehabilitation programme is 76.3 days (n = 133). Baseline heroin use for both treatments was based on the pharmacotherapy maintenance sample, because the baseline level of use by residential rehabilitation respondents was affected by preceding detoxification interventions. Before treatment, ATOS respondents were using heroin 20.01 days per month (n = 266), while those still in residential rehabilitation at the 3-month follow-up were using heroin 0.22 days per month (n = 54). The proportional reduction in use when in the programme is therefore estimated to be 99%. At 12 months, 64.2% (n = 67) of those who had been in residential rehabilitation (and were not in any other treatment at the time of the 12-month follow-up) were abstinent.

Direct programme costs of residential rehabilitation in Australia has been estimated to be $98 per day [16], making the average cost per person admitted $7475. However, as their costs were estimated for programmes not connected with the criminal justice system, programme costs associated with probation were added. In Australia, the average cost of community corrections (which included probation, community service orders, home detention, bail supervision and drug rehabilitation orders) is $10 per person per day [18]. It is presumed these costs last an entire year (i.e. the criminal justice scrutiny lasts as long as prison), increasing costs by $3650 and making the total average cost of residential rehabilitation $11 125.

Pharmacotherapy maintenance

The average length of time in the programme in the first year was 222.4 days (n = 215). At the end of the first year, when ATOS concluded, 44% were still in treatment. We do not have information on how long these people remain in treatment. Those in the pharmacotherapy maintenance treatment using heroin 2.39 days per month at 3 months (n = 171) and 1.84 days per month at 12 months (n = 94). Taking the simple average of these (2.12 days per month) and the initial level of use (20.01 days per month), the average reduction in use is estimated to be 89%. The direct programme costs of methadone maintenance have been estimated at $11 per day [16], making the average cost per person $2446. Adding probation costs brings the total average cost of this option to $6096.

The 1-year abstinence rate for those who had left pharmacotherapy maintenance (and were not in any other treatment) was 57.4% (n = 47). Having 44% still in treatment at 1 year may lead to an under- or over-estimation of the abstinence from pharmacotherapy maintenance; this is addressed in the sensitivity analyses.

Post-intervention effects

The difference between heroin use before and after a programme is not necessarily attributable to the programme. Changes in market conditions and personal circumstances can affect heroin use over time, and it is possible that heroin users come to the attention of the criminal justice system at a time where their use is higher than normal. To address this, it was assumed that a proportion of the reduction in heroin use was due to ‘non-treatment’ factors. This proportion was estimated initially using information on the heroin use of a non-randomised ‘not in treatment’ ATOS control group, and then by comparing the outcomes of those who stayed in a programme for periods matching clinical guidelines with those that did not.

Post-intervention effects were estimated as the difference between the abstinence rates of programme participants and those of the control group. As the abstinence rates for both programmes are taken from the 12-month follow-up, the abstinence rate for the no-treatment control group was taken from the same follow-up. At that stage, 24.5% of the no-treatment control group were abstinent (n = 53), although some of this abstinence could have been due to some interventions (prison and/or treatment) begun between baseline and follow-up. The post-intervention effects for pharmacotherapy maintenance and residential rehabilitation are the abstinence rates less 24.5%; the potential for the relative performance of different programmes being affected by the control group outcomes are explored via sensitivity analyses.
Prison

Victorian data indicate positive opiate urine screen results are quite rare, around 1% per annum for all prisoners [19]. Some authors (e.g. Black, Dolan & Wodak [20]) report higher rates of in-prison drug use. However, as the results below suggest prison performs less well than the other interventions, a conservative or ‘prison-friendly’ assumption was adopted to ensure that the results were not due to unduly pessimistic assumptions about high in-prison drug use. Therefore a 1-year prison sentence is assumed to produce a 100% reduction in drug use during prison. The average cost in Australia in 2002–03 was $202 per prisoner per day ($73 840 per person per year) [18].

No local outcome data regarding post-release abstinence rates from prison were available. Internationally, Inciardi et al. [21] reported abstinence rates post-prison in a no-treatment control group of 16%, while Martin et al. [22] reported 38% abstinence rate post-release for no-intervention control subjects. The average of the two values (27%) was used. Like the treatment programmes, it is likely that there was an underlying abstinence rate due to factors other than prison. However, again the most ‘prison-friendly’ assumption is made: that all abstinence observed when these studies were conducted was attributable to prison. In this comparison, only 75.5% of participants could be made abstinent (as 24.5% would be abstinent in any case), so the intervention effect of prison is estimated to be 20.4% (27 × 75.5%). In addition, we focused on this parameter in the sensitivity analysis; it is not until nearly all prisoners remain abstinent after release that this can change the programme rankings.

Treatment completers and non-completers

Another more conservative approach to analysing programme effectiveness is to allocate positive outcomes only to programme completers. There is no broad agreement on the ideal length of a treatment programme (‘it takes as long as it takes’). However, a way of overcoming the difficulties with programme length is to use a ‘threshold’ retention period to define programme completers. This threshold period is defined as the required length of time in a programme in order to achieve reductions in drug use. For pharmacotherapy maintenance, the threshold programme length is 1 year; for residential rehabilitation it is 3 months [23].

The post-intervention effects for programme completers (as defined by retention for the threshold period) were taken from the ATOS data. The average percentage abstinent was calculated for those who remained in the intervention for the specified time and for those who did not (non-completers). The difference between these two figures was taken as the post-intervention treatment effect. The proportion of programme completers for prison was set at 100%. The proportion of programme completers for residential rehabilitation was 32.3% (n = 133) and the proportion of programme completers for pharmacotherapy maintenance was 46.0% (n = 215).

For residential rehabilitation, the abstinence rate for programme completers was 72.7% at 12 months and the abstinence rate for non-completers was 59.5% (a difference of 13.2%). For pharmacotherapy maintenance, the abstinence rate for non-completers at 12 months was 57.5%, but ATOS data do not have sufficient information to estimate abstinence rates for programme completers because there is no information beyond 1 year. The UK National Treatment Outcome Research Study (NTORS) assessed pharmacotherapy outcomes at 1, 2 and 4/5 years after treatment commenced [24–26]. Information from the NTORS methadone maintenance sample was used to infer a percentage abstinence estimate for programme completers of 68.8%. The difference in abstinence rates for completers and non-completers was therefore 11.3%.

There is no distinction between completers and non-completers for the prison group, hence the earlier intervention effect of 20.4% was used.

Duration of drug use (drug-use career)

Australian heroin users tended to cease use in their mid-30s [27]. In their drug court evaluation, Lind et al. [28] reported an average age of 26 years in their control group and 27 in their treatment group. Together, these observations suggest that the duration of drug use in the absence of any intervention would be in the order of 9 years, which is longer than treatment effects are typically assumed to exist. Hence, assumptions about the duration of treatment effects, not drug user career lengths, drive estimates of how many years of use are averted when someone becomes abstinent due to treatment.

Sensitivity analyses

Uncertainty can be addressed via sensitivity analyses. The first sensitivity analysis used the more conservative approach of estimating post-intervention abstinence effects only for ‘programme completers’ who remain in the programme for the ‘threshold’ treatment period. The second was to vary the duration of post-intervention effects. The third sensitivity analysis involved exploring whether the
effects of treatment may have been artificially inflated, as the ATOS data reflect a particular period in Australia’s history when heroin was in relatively short supply [29–31]. This was carried out by introducing data on pharmacotherapy treatment collected between 1997 and 1999. Fourthly, parametric sensitivity analyses were conducted on the cost parameters used in the analysis.

Finally, a hybrid treatment-plus-prison option was tested: arrestees diverted into a treatment programme are sent to prison to serve the remainder of their 1-year term if they do not complete the treatment programme. Upon exiting prison, they are then presumed to have abstinence rates similar to those sent directly to prison. The average periods in treatment for non-completers—108 days for pharmacotherapy maintenance and 29 days for residential rehabilitation—were used to determine the period of time in prison.

Results

No post-intervention effects

The cost–consequences analysis, presuming no post-intervention reduction in heroin use, used the following parameters:

\[ L = \text{average length of time spent in the programme (days)}; \]
\[ p = \text{proportional reduction in drug use when in the programme (%)}; \]
\[ C = \text{programme cost per person ($)}. \]

Given these parameters, the programmes’ costs and effects on drug use is defined as:

\[ T_1 = p \times L/365 \text{ years of drug use averted during the programme period per person admitted.} \]

The cost per year of drug use averted is \( C/T_1 \). Table 1 presents the results. Without any post-intervention effects, the cost-effectiveness of pharmacotherapy maintenance per drug use year averted is $11 188. For residential rehabilitation it is $53 827 and for prison $73 840.

Post-intervention effects

For cost–consequences that includes post-intervention treatment effects, the additional parameters are:

\[ i = \text{the proportion abstinent due to the intervention (%)}; \]
\[ U = \text{period for which intervention has an effect (years)}, \]

and

\[ T_2 = i \times U \text{ years of drug use averted after the programme period}; \]
\[ T = T_1 + T_2 \text{ total drug use years averted.} \]

The cost per year of drug use averted is \( C/T \). As described in the Methods section, the post-intervention effects are the abstinence rates at the end of 1 year less, for the treatments, the abstinence rates of the no-treatment control group \( (i = 39.7\% \text{ for residential rehabilitation}; 31.9\% \text{ for pharmacotherapy maintenance}; 20.4\% \text{ for prison}). Without knowing the actual length of the post-programme effect, we can estimate the cost–consequences ratio for varying lengths of effect, as displayed in Table 2.

Given uncertainty about how long abstinence is sustained beyond the first year, Figure 1 plots relative effectiveness as a function of all the possible lengths of these abstinence effects, up to the duration of drug use that occurs in the absence of intervention.

Unless the post-intervention effects of residential rehabilitation are significantly longer than that of pharmacotherapy maintenance, these calculations point to pharmacotherapy as the most effective for a given amount of resources. To give a greater sense of what these figures mean, if the post-intervention abstinence effects lasted 2 years for all programmes and the government had $1 million in funds, then spending that on pharmacotherapy maintenance averts nearly 200 person-years of heroin use. If it is spent on residential rehabilitation then 90 heroin use years are averted, while spending it on prison averts 19 years of heroin use.

Sensitivity analyses

The results are quite robust to the magnitude of the treatment effect. Figure 2 shows the cost of averting a year of drug use for the full range of post-intervention abstinence effects, assuming these effects last 2 years

<table>
<thead>
<tr>
<th>Length of post-programme effect</th>
<th>Pharmacotherapy maintenance</th>
<th>Residential rehabilitation</th>
<th>Prison</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 months</td>
<td>$8594</td>
<td>$27 457</td>
<td>$67 010</td>
</tr>
<tr>
<td>1 year</td>
<td>$6976</td>
<td>$18 429</td>
<td>$61 336</td>
</tr>
<tr>
<td>2 years</td>
<td>$5068</td>
<td>$11 118</td>
<td>$52 454</td>
</tr>
<tr>
<td>5 years</td>
<td>$2784</td>
<td>$5076</td>
<td>$36 568</td>
</tr>
<tr>
<td>8 years</td>
<td>$1919</td>
<td>$3289</td>
<td>$28 067</td>
</tr>
</tbody>
</table>
Within reason, the size of the post-intervention abstinence effect does not affect the rank order of programmes’ performance. In the primary analysis, the intervention effect (the variable \(i\)) was 31.9% for pharmacotherapy maintenance, 39.7% for residential rehabilitation and 20.4% for prison. Even if the intervention effect for residential rehabilitation reached the maximum value of 75.5% (as 24.5% of participants would have been abstinent anyway), it would still be less effective than pharmacotherapy, unless additionally the intervention effect for pharmacotherapy fell from 32.9% to 19.8%.

Pharmacotherapy is preferable to prison at all possible combinations of intervention effects, even though the analysis intentionally has aspects that are favourable to prison.

Nevertheless, there are several ways in which the cost–consequence ratios of the treatment modalities may be inflated, as discussed in the Methods section. One variation is ascribing post-intervention effects only to those who completed their programme (with the intervention effect \(i\) now characterised as the difference in abstinence rates between completers and non-completers).

Then if:

\[
M = \text{the proportion of those entering a treatment who complete it (\%), the formula for drug use years averted after the programme (T_2) is now:}
\]

\[
T_2 = i \times U \times m \text{ years of drug use averted after the programme period.}
\]
The calculations are shown in Table 3. With this restricted characterisation of the post-intervention treatment effect and the assumption that it lasts 2 years, pharmacotherapy maintenance remains the best performing in terms of costs and consequences.

The ranking of the programme ratios is insensitive to the presumed duration of the post-intervention effects.

Other parametric sensitivity analysis

Using data collected before the Australian heroin shortage, we replaced the ATOS-derived 89% reduction in heroin use during pharmacotherapy maintenance with 76%—a figure taken from trials conducted between 1997 and 1999, a period when heroin was readily available [32]. The recalculated cost–consequences ratio for pharmacotherapy maintenance with no post-intervention effects is $13 166, still significantly less than the residential rehabilitation ratio ($53 827).

ATOS data may also reflect a higher ‘no-intervention’ abstinence rate than would pertain at other periods of time. In the preceding analyses, the interventions can affect only 75% of participants (as 25% would be abstinent anyway). A change to the no intervention abstinence rates does not change the ranking of the programmes.

The final parameters to consider are the cost parameters. There is firm evidence for the costs that are applied, but even under the most favourable scenarios it is improbable that the programmes’ ranking would change. Pharmacotherapy maintenance costs need to increase sixfold before it becomes less effective than prison, while the common imposition of community corrections costs mean the pharmacotherapy maintenance component would have to increase ninefold before it was less effective than residential rehabilitation.

Combined treatment and prison

A hybrid treatment plus prison option was considered, both because it may produce a lower cost–consequences ratio and it also may be inappropriate to sentence heroin users to treatment programmes they can walk away from at any time they choose. In this scenario, non-completers are sent to prison. Table 4 provides the results of this scenario. Because residential rehabilitation has more non-completers than pharmacotherapy (67% versus 54%) and those non-completers drop out sooner, the cost per drug use year averted for residential rehabilitation increases by more than pharmacotherapy maintenance. Hence, pharmacotherapy maintenance remains significantly more effective than residential rehabilitation (e.g. $21 085 vs. $37 089 if post-intervention abstinence effects last 2 years). When the threat of incarceration has no effect on completion rates, hybrid programmes perform less well than treatment by itself, but much better than prison alone ($52 454).

This is most probably a ‘worst-case’ scenario, as it would be expected that the possibility of going to prison would increase programme completion. This increases the years of drug use averted and also decreases the non-completion-induced prison costs. For example, if the ‘stick’ of prison increased pharmacotherapy maintenance completion to 70% then, if the post-intervention effect lasted 2 years, the cost per drug use year averted would fall to $13 115. Nevertheless, completion rates would have to increase markedly—from 46% to between 95% and 98%, depending on which post-intervention effect is used—in order for the

<table>
<thead>
<tr>
<th>Period for which intervention has an effect (years)</th>
<th>Pharmacotherapy maintenance</th>
<th>Residential rehabilitation</th>
<th>Prison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programme completion rate</td>
<td>46.0%</td>
<td>32.3%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Completers’ abstinence rate</td>
<td>68.8%</td>
<td>72.7%</td>
<td>20.4%</td>
</tr>
<tr>
<td>Non-completers’ abstinence rate</td>
<td>57.5%</td>
<td>59.5%</td>
<td>n.a.</td>
</tr>
<tr>
<td>Intervention effect</td>
<td>11.3%</td>
<td>13.2%</td>
<td>20.4%</td>
</tr>
<tr>
<td>Drug use averted during programme (years)</td>
<td>0.54</td>
<td>0.21</td>
<td>1.00</td>
</tr>
<tr>
<td>Drug use averted after programme (years)</td>
<td>0.10</td>
<td>0.09</td>
<td>0.41</td>
</tr>
<tr>
<td>Total drug use averted (years) (T)</td>
<td>0.64</td>
<td>0.30</td>
<td>1.41</td>
</tr>
<tr>
<td>Programme costs</td>
<td>$2446</td>
<td>$7475</td>
<td>$73 840</td>
</tr>
<tr>
<td>Community corrections costs</td>
<td>$3650</td>
<td>$3650</td>
<td>$0</td>
</tr>
<tr>
<td>Total costs (C)</td>
<td>$6096</td>
<td>$11 125</td>
<td>$73 840</td>
</tr>
<tr>
<td>Cost per drug use year averted (C/T)</td>
<td>$9525</td>
<td>$37 083</td>
<td>$52 369</td>
</tr>
</tbody>
</table>
Table 4. Effectiveness of hybrid programme (when non-completers go to prison), assuming post-intervention effects last 2 years and there is no effect on programme completion rates

<table>
<thead>
<tr>
<th></th>
<th>Pharmacotherapy maintenance</th>
<th>Residential rehabilitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportion of non-completers</td>
<td>54.0%</td>
<td>67.7%</td>
</tr>
<tr>
<td>Non-completers’ average time in treatment (days)</td>
<td>108.3</td>
<td>29.3</td>
</tr>
<tr>
<td>Non-completers’ average time in prison (days)</td>
<td>257</td>
<td>336</td>
</tr>
<tr>
<td>Average costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost of treatment</td>
<td>$2446</td>
<td>$7475</td>
</tr>
<tr>
<td>Cost of community corrections</td>
<td>$2265</td>
<td>$1378</td>
</tr>
<tr>
<td>Cost of prison</td>
<td>$28 018</td>
<td>$45 962</td>
</tr>
<tr>
<td>Drug use during the programme period</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drug use averted during treatment (years)</td>
<td>0.54</td>
<td>0.21</td>
</tr>
<tr>
<td>Drug use averted during prison (years)</td>
<td>0.38</td>
<td>0.62</td>
</tr>
<tr>
<td>Drug use after the programme period</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drug use averted after treatment—completers (years)</td>
<td>0.41</td>
<td>0.31</td>
</tr>
<tr>
<td>Drug use averted after prison—non-completers (years)</td>
<td>0.22</td>
<td>0.28</td>
</tr>
<tr>
<td>Results</td>
<td></td>
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</tr>
<tr>
<td>Total drug use years averted</td>
<td>1.55</td>
<td>1.42</td>
</tr>
<tr>
<td>Total average cost ($)</td>
<td>$32 729</td>
<td>$52 544</td>
</tr>
<tr>
<td>Cost per drug use years averted ($)</td>
<td>$21 115</td>
<td>$37 003</td>
</tr>
</tbody>
</table>

Discussion and conclusions

The costs and consequences of three interventions for arrested dependent heroin users when considering within-programme effects alone was extended to include post-intervention abstinence effects and tested against a variety of sensitivity analyses. Pharmacotherapy maintenance was consistently the most effective intervention for a given amount of resources; imprisoning users was consistently the most expensive way for taxpayers to avert a year of heroin use. The various analyses suggest pharmacotherapy maintenance is between one-and-a-half and three times more effective than residential rehabilitation and between three and 10 times more effective than prison for a given amount of resources.

A hybrid model that combined pharmacotherapy maintenance treatment with prison (prison for treatment non-completers) was more effective than prison alone, but completion rates would need to reach 95% to 98% for this combined option to become the most cost-effective.

There are limitations to these analyses. Programme outcomes have been combined into a relatively crude measure. Data have been drawn from a number of sources, some of which include heroin users that may not come to the attention of the authorities in the way characterised here.

Some of the gaps in the analysis are not easy to address. Even if a commitment were made to develop a comprehensive study of the long-term behaviours and

Figure 3. Cost per drug use year averted for pharmacotherapy with and without prison for programme non-completers (post-intervention effect of 2 years).
treatment outcomes of Australian heroin users, it would be several years before a better value for post-intervention effects was available. Further research is still warranted, particularly about whether criminal and health outcomes are well-represented by considering only the reduction in drug use. However, for policymakers who must make decisions immediately, this analysis provides one basis for making funding decisions.

The strengths of this analysis are its transparency and the extensive sensitivity analysis. We can be reasonably certain that for an average dependent heroin user, pharmacotherapy is the most cost-effective intervention and more cost-effective than incarceration. Furthermore, it seems that intervening in such a way may deliver a net benefit to society. Clark et al. [28] estimated that a person using heroin actively in Victoria generates on average social costs of approximately $30,000 per annum, more than the cost of averted year of heroin use via pharmacotherapy under all the various scenarios. For policy-makers who need to cope with significant uncertainties, it seems that diversion to pharmacotherapy maintenance is the best option if cost–consequences comparison is the decision-making criterion used.

This is an important conclusion. However, it does not mean that residential rehabilitation and prison have no role. The results use averages across heterogeneous heroin users. So, for an individual who is heavily involved in violent crime (high social costs per year) and has no previous positive pharmacotherapy maintenance experience (perhaps he/she has consistently diverted their medication, adding further to social cost), prison is likely to be most cost-effective. Examination of sub-types of heroin users and their respective effectiveness would be valuable future research.

The least certain aspect of the analysis is whether a pharmacotherapy–prison option is preferable to pharmacotherapy by itself. More research into what role the threat of prison may have on the outcomes achieved would be desirable. Better understanding of the deterrence effects of prison would also be useful for analysing this choice.

Given the many unknowns surrounding illicit drug use and drug markets, simple quantitative policy analysis of the kind conducted here could prove useful for assessing policy options in a timely fashion. In addition, understanding the role of different variables provides insights that should improve priority setting in illicit drug research in Australia.

Acknowledgements

This work was funded by a grant from the Humanities Trust, Qatar Foundation, and the Colonial Foundation Trust and forms part of the Drug Policy Modelling Project (DPMP). Tracey Holt, the Victorian ATOS co-ordinator, provided much assistance in accessing and interpreting the ATOS data. We wish to thank two anonymous referees for their helpful comments.

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