Drug Policy Modelling Program

DPMP Drug Policy Modelling Program

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System dynamics modelling using a stocks and flows approach

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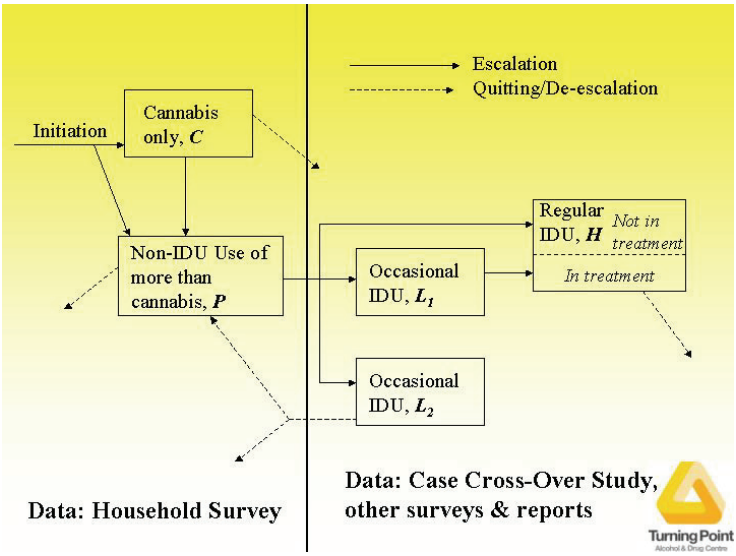
Rationale

One of the key components of the first phase of the DPMP project has been to develop a quantitative dynamic model of drug use in Australia. Using a stocks and flows approach, derived from similar work undertaken in the US on cocaine prevalence by Caulkins and collaborators, the key aim of this component of the DPMP has been to examine whether methods can be applied to the Australian context using available data. If a plausible model could be developed, then the subsequent aims were to use the model to describe: 1.The prevalence of drug use in Australia over time; and 2. the effects of changes in model parameters upon the prevalence of injecting drug use and the associated social costs.

Approach

The approach used was to apply methods from the study of the cocaine epidemic in the United States to the issue of injecting drug use in Australia. This model consists of a series of 'stocks' indicating states of drug use (e.g. cannabis use only, the 'C' state) with associated 'flows' (e.g. escalation to the use of other illicit drugs though non-injecting routes of administration). The final working model is shown in Figure 1, along with the associated data sources. The crucial output of the model is the size of the population in each of the stocks (i.e. the population prevalence of each state of drug use).

Figure 1: Diagrammatic representation of the stocks and flows included in the model



Results

One of the key issues in the development of the model detailed in Figure 1 has been the parameterisation of the flows between the various states included in the model along with the population size in any of the states. Table 1 details the final model parameters derived from the results of the parameterisation exercise that was undertaken, based on an analysis of the National Drug Strategy Household Survey as well as other available surveys (e.g. a case-crossover study of the risk factors for non-fatal heroin overdose).

The parameters detailed in Table 1 were further broken down according the flow splits detailed in Figure 1 (e.g. the escalation flow from the 'P' state was split into three, allowing for escalation to the three states of injecting drug use). Table 2 details these splits in terms of the percentages of the flow from each state.

After parameterisation, the models outputs could be evaluated in terms of the aims of the modelling exercise.

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Table 1: Parameters included in the final working model for stage 1

States		Quit Rate	Escalation Rate	Average Dwell Time (years)
Non-injecting states	C: Cannabis only	.091	.076	6.0
	P: Polydrug use (non-injecting)	.088	.052	7.1
Injecting states	L2*: Occasional, no escalation	.149	0	6.7
	L1: Occasional, will escalate	0	.218	4.6
	H: Frequent injecting	.05		20

*NB: "Quit" from L2 includes pure quitting and de-escalation to P

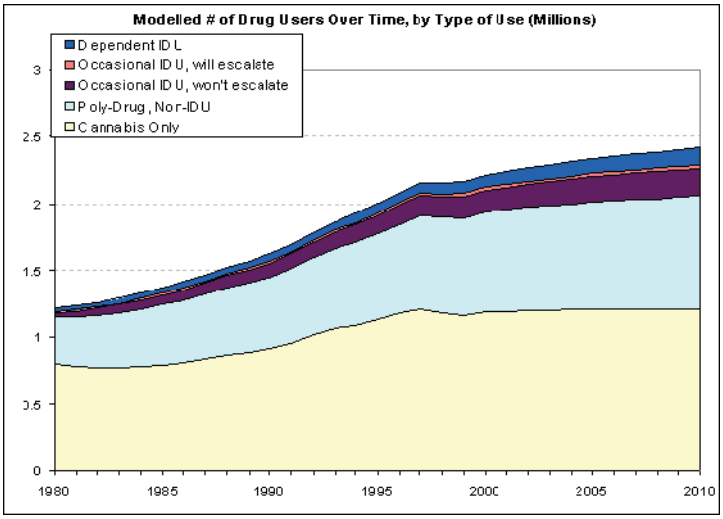
Table 2: Percentages of the flow splits in the final working model for stage 1

Initiation	91%	to C (Cannabis only) state
	9%	to P (Polydrug) state
Escalation to injection use	77%	to L2 (occasional; won't escalate) state
	14%	to L1 (occasional, will escalate) state
	9%	to H (frequent injecting) state
De-escalation from L2	64%	Quit
	36%	De-escalate to P (Polydrug use)

The prevalence of Australian drug use over time

Figure 2 shows the model's outputs in terms of modelling the prevalence of illicit drug use in Australia. As currently configured the model predicts the findings for cannabis-only and non-injecting use of other illicit drugs evident in the 1998 National Drug Strategy Household Survey within 6%. While the findings in relation to injecting drug use differ widely from the survey findings, this is not surprising given that it is known that this survey dramatically underestimates injecting drug use.

Figure 2: Modelled prevalence of illicit drug use in Australia for the states included in the model



Changing the trajectory of drug use in Australia

One of the key features of the model is that it can be used in policy simulation. To this effect the model can simulate the effects of interventions directly related to model parameters (e.g. increasing quit rates) and trace the impact of this change over time in terms of prevalence and social costs. Figure 3 details the effects of doubling the quit rate from the heavy IDU state in 2005 (e.g. through some new forms of treatment) upon prevalence (3a) and social costs (3b). These figures suggest, on the basis of the modelled results that the effect of such an intervention would be to cap the prevalence of heavy IDU at around 100,000 persons (which was modelled as increasing to 150,000 by 2015 assuming no change in quit rate) with associated annual costs of around $13,000 (which was modelled as increasing to $18,000 by 2015 assuming no change in quit rate).

Figure 3a: Modelled changes in IDU prevalence as a result of hypothetical changes in quit rate from heavy IDU state

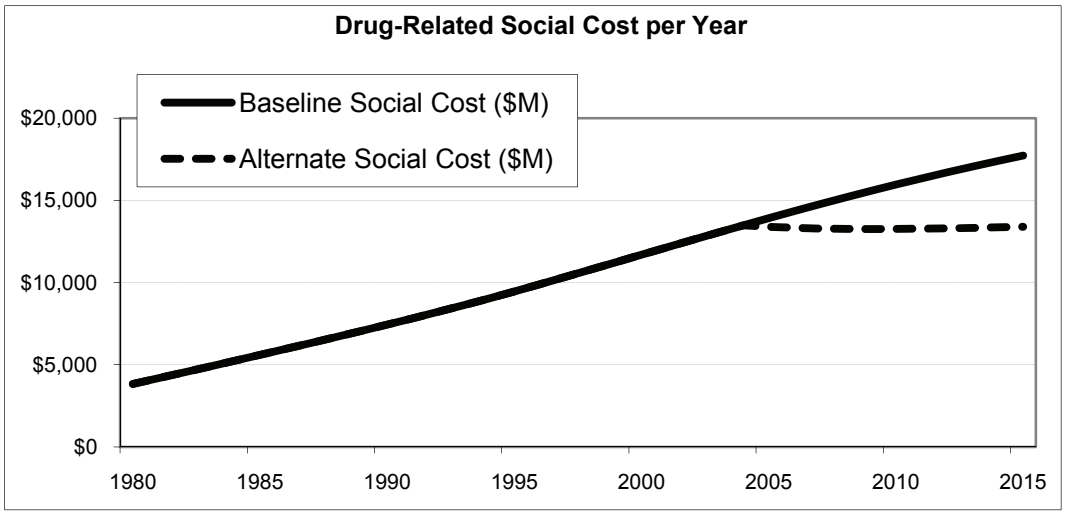
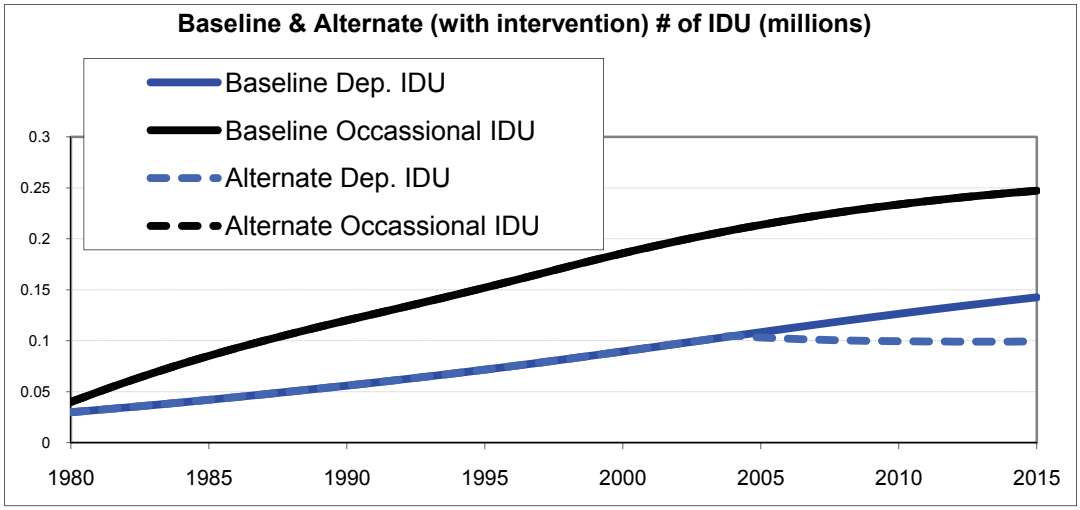


Figure 3b: Modelled changes in social costs associated with IDU as a result of hypothetical changes in quit rate from heavy IDU state



Implications

The modelling approach taken in this work is feasible using Australian data. The final working model developed for the first phase of DPMP successfully reproduces survey findings from 1998. Further, the model can examine the effects of any posited changes in model parameters that may result from interventions or effects within the drug field. This means that it is especially well-suited to engaging in experiments with policy makers in terms of the way in which they come to understand and value interventions and policy options.

Research Team

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