

A system dynamics model of Australian opioid pharmacotherapy maintenance treatment

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Abstract

Pharmacotherapy maintenance treatment is a highly cost-effective intervention for opioid dependence. Despite this, there has been almost no research examining the relationship between the supply of opioid pharmacotherapy treatment and demand for treatment. Nor has much attention been paid to the implications of policy changes for the service system.

This paper reports on a study that explores the ways in which Australia's system of pharmacotherapy programs for the treatment of opioid dependence could better meet demand for pharmacotherapy treatment in relation to availability, accessibility and affordability of treatment. The primary methodological tool is a *system dynamics* model of the pharmacotherapy system, based on the flows of opioid dependent people in and out of treatment and between the various modes of treatment provision in Australia. The model is designed to be a tool for policy makers that describes the system in its entirety, explains the machinations of the system and the way that patients use the system, and predicts likely consequences of policy options.

The paper will present the system dynamics model and illustrate how the model can be used to consider a number of policy questions. In so doing, it will describe the process of development of the model. Key to the success of the modeling process is the discovery of those aspects of the system and of the ways that opioid dependent people use the system, that need to be represented in the model so as to provide a picture pertinent to the questions faced by policy makers.

Introduction

The Australian system for providing pharmacotherapy maintenance for opioid dependent people (henceforth pharmacotherapy treatment system) is much admired internationally. Pharmacotherapy maintenance has been demonstrated to be a highly cost effective intervention (Belenko et al., 2005; Connock et al., 2007). This is not to say that there aren't aspects of the system that could be improved. Of particular concern is the potential for the system to better meet demand for treatment in relation to availability, accessibility and affordability of treatment. The research literature has barely broached this topic of inquiry. Nor has much attention been paid to the implications of policy changes for the service system as a whole. This paper is an attempt to open up the dialogue about policy options for alleviating unmet demand for treatment. It presents a *system dynamics* model of the pharmacotherapy system, based on the flows of opioid dependent people in and out of treatment and between the various modes of treatment provision in Australia. We designed the model as a tool for policy makers that: describes the system in its entirety, explains the machinations of the system and the way that patients use the system, and simulates likely consequences of policy options in the arena of supply and demand.

It is difficult to explore the impacts of policy changes in the real world. Case studies are expensive, difficult and time-consuming to run. Simulation models are a useful tool for providing a safe, risk-free environment for experimenting with future policy options and gaining consensus among stakeholders. In this context the system dynamics approach is particularly useful. Rather than focusing on the complex behaviour patterns of individuals and aggregating them to describe community wide trends, system dynamics elicits the structures, policies and "local" informal rules of the system from a range of qualitative and quantitative sources. This "top-down" model is expressed as a computable representation of stocks (accumulations), flows (rates) and the information feedbacks that represent the patterns of decisions that drive overall behaviour over time. In this policy arena, there is little individual data about the life course of people who move in and out of methadone and other therapies. Therefore the joint, iterative, aggregated, pattern-oriented approach to model development and calibration with pooled data makes the system dynamics method well suited to examining differences among the impacts of future policy options.

The model was developed to accommodate to explore the issues of concern to policy makers. One significant issue in Australia is the payment of fees by patients (Muhleisen et al., 2005; ANCD Alcohol and Drug Agency Forum¹). We explore with the model various cost consequences associated with the removal of patient fees. A second priority issue for decision makers has been concerns about the ability of the current system to meet increasing future demand, for example through increased pharmaceutical misuse. We take the opportunity to explore increases in opioid dependence in the population. Thirdly, policy makers are concerned about the potential fragility of the system in relation to service provision. What would happen if a number of service providers ceased to exist? We explore the implications of limiting entry to prescribers in our third policy scenario.

¹ <http://www.ancd.org.au/publications/forums/forum7.htm>: accessed 15 September 2007.

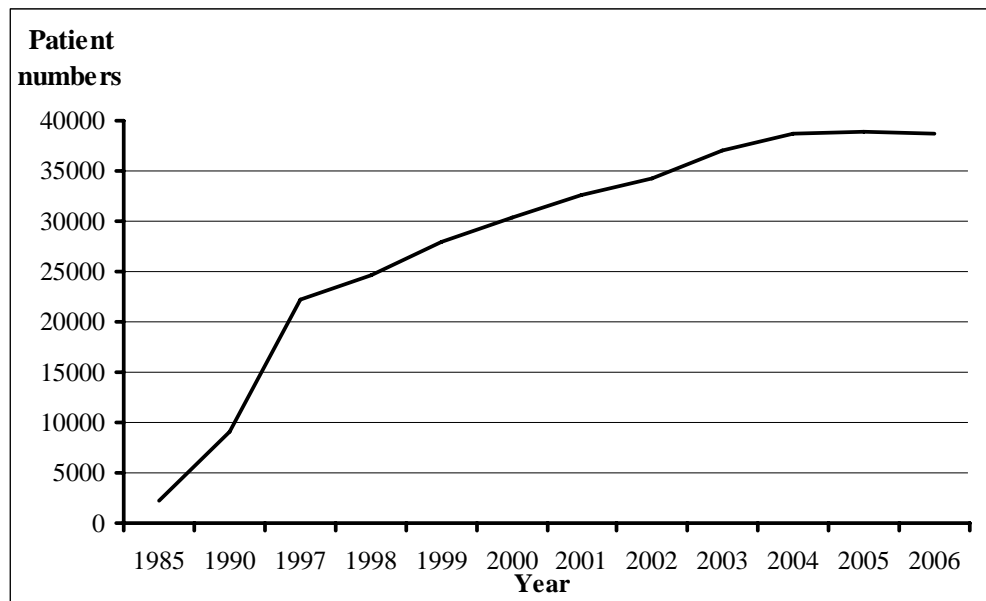
In the remaining sections of the paper we firstly briefly introduce Australia's pharmacotherapy maintenance treatment system before presenting the three areas of policy concern. We then introduce the model, and taking each policy concern in turn set out the simulation results. Finally we set out the conclusions.

Background

Methadone was introduced into Australia in 1970 but did not have a major role within heroin treatment until the mid 1980's, with the injection of new funds to support methadone maintenance programs. Numbers in pharmacotherapy maintenance treatment have increased progressively since then. Up until the year 2000 methadone was the only maintenance medication available to treat heroin dependence. Buprenorphine was introduced in 2001. The service system established for buprenorphine treatment in Australia paralleled that for methadone. That is, the same prescribers and dispensers were trained and able to provide buprenorphine treatment.

As at 2005/06 methadone was still the most widely prescribed pharmacotherapy (71%), followed by buprenorphine alone, then buprenorphine-naloxone (accounting for about five per cent of doses in 2005/06). The following figure shows the numbers of patients registered to be in pharmacotherapy treatment in Australia at 30 June of each year from 1985 to 2006.

Figure 1 Pharmacotherapy treatment patients from 1985 to 2006*



Source: AIHW (2002-2007); Shannon (undated).

* For the years 1985 through 2000 methadone is the only pharmacotherapy drug. From 2000 onwards buprenorphine and ultimately buprenorphine-naloxone are included. In 2006 there were 27, 588 methadone patients; just over 70 per cent of all patients.

A range of models of provision of pharmacotherapy treatment have developed across the Australian states². The systems of care in Australia can be divided into the prescribing

² Australia has a federal system of government. Responsibility for pharmacotherapy treatment system development rests with the state (and territory) governments.

and dispensing systems. Prescribing of opioid maintenance pharmacotherapies occurs in four primary settings: in specialist pharmacotherapy clinics (usually referred to as ‘public clinics’), staffed by specialist addictions practitioners; in General Practitioner (GP) or psychiatrist settings (sometimes referred to as office-based care, or primary health care); in private clinics where the prescriber is a GP or psychiatrist; and in prisons. Patients may be prescribed their maintenance medication from any one of these settings and it is likely that within any one continuous episode of care, they are transferred between settings, for example: patients inducted in a public clinic could be transferred to a GP prescriber, once stabilized. The system for dispensing the opioid pharmacotherapies is equally layered. Dispensing can occur in a public specialist clinic; in a chemist/pharmacy; at a private clinic, in prison or in a hospital. Dispensing sites are associated with different fee arrangements. There is no direct concordance between the prescriber arrangements and the dispensing arrangements. For example, some patients are both prescribed and dispensed within public clinics, some prescribed in public and dispensed in local pharmacies and so on.

Pharmacotherapy treatment is provided in Australia through the health system and funded jointly by the Commonwealth and state governments. Table 1 summarises the current service delivery systems and the proportion of patients prescribed and dispensed in each of the models. The bearer of the costs depends on the location of the prescribing and dispensing. Table 1 outlines the primary bearer of costs in each of the systems.

Table 1: Proportion of pharmacotherapy patients by prescriber and dispenser type in 2006 and bearer of costs of treatment in each of the prescriber and dispenser (%)

	Proportion of patients (%)*	Bearer of costs of treatment (%)		
		Patient	Cwlth	State
Prescriber type				
Public clinic	28	0	0	100
GP**	64	0	100	0
Correctional facility	7	0	0	100
Dispenser type				
<i>Dispensing</i>				
Public clinic	12	0	0	100
Community pharmacy***	79	0	100	0
Correctional facility	7	0	0	100
<i>The drug</i>				
Public clinic	12	0	100	0
Community pharmacy***	79	0	100	0
Correctional facility	7	0	100	0

Source: AIHW (2007a): Tables 6.3 and 6.4

*proportions do not add to 100% because some treatment centres cannot be classified along these lines.

** includes those prescribed in private clinics.

***includes those dispensed in private clinics.

Three policy concerns

In this section we introduce three issues of concern about Australia's pharmacotherapy maintenance system that we judged to be both the most topical and able to be productively explored through the lens of a system dynamics model.

i) Impost of dispensing fees on patients

Probably the most talked about issue for Australian pharmacotherapy programs is that of patient dispensing fees. While the cost of methadone and buprenorphine medication is funded by the Commonwealth, the cost associated with dispensing the drug is not. In public-funded clinics, the cost of dispensing the medication is generally paid for by the state government, but sometimes by the patient. All patients who receive their medication in community pharmacies (and private

clinics) pay a dispensing fee. Based on official figures of the location of patients dispensed by state in 2005-06 we estimate that over 80 per cent of pharmacotherapy patients pay something for dispensing (AIHW, 2007a: Table 6.4).

The most obvious concern with dispensing fees is that patients simply cannot afford them. Patients without takeaways, regardless of whether they are in receipt of methadone or buprenorphine, could be paying up to \$70 per week (Chalmers et al., 2008). A significant number of patients rely on welfare payments for their primary source of income. A survey of methadone patients in the mid 1990s found that in Victoria (the second most populous of the Australian States), an estimated one third of methadone patients were working or studying, which left approximately two thirds of methadone patients are unemployed (Lintzeris et al., 1996). Hence, the majority of methadone patients were reliant on welfare payments as their primary source of income. To illustrate the impost of dispensing fees, consider that the current maximum rate of welfare for a single person of at least 21 years of age is Disability Support Pension at \$537.70 per fortnight or \$268.85 per week³. A weekly dispensing fee of \$70 represents one third of income and leaves \$199 per week for accommodation, food etc. It is common patients reliant on welfare income to run up debts at pharmacies. The implications of running up a debt depend on the pharmacist. For example, some pharmacies refuse to continue dispensing. Others clear the debt on the condition that the patient 'direct debits' his/her dispensing fees (Rowe 2007). Another study found that some pharmacies charge penalty fees for prolonged failure to pay (Healthcare Management Australia, 2007).

Another concern with patient dispensing fees is the inherent inequity. The Commonwealth Government has the financial responsibility for providing pharmaceutical services through the pharmaceutical benefits scheme (PBS), a scheme that is designed to provide equity of access to prescription drugs.

In the first policy scenario we explore the implications of the Commonwealth subsidising the dispensing costs of methadone for patients dispensed in pharmacies (and private clinics). There is surprisingly little research that sets out to quantify the impact of fees (dispensing or otherwise) on patients in opioid treatment. While it seems self-evident that patient fees impact on patient retention in some way the evidence base for the extent of the impact is lacking. What we do know derives from the US and it is also fair to say that the US evidence is not entirely convincing. Research cited in Maddux et al. (1994) suggests that treatment fees impair retention in methadone treatment. For example, Des Jarlais et al. (1982) found that during the mid 1970s one year retention rates in publicly supported methadone programmes (at low or no cost to patients) in New York were 58-59 per cent compared with those of proprietary programs (fee-for-service treatment) of 37-38 per cent. But it is not clear that their analysis controlled for differences in the types of patients that entered the two programmes.

Booth et al. (2004) used a group of street-recruited drug injectors who may not have contemplated treatment to consider what factors mattered for uptake and retention in

³ Centrelink website: accessed 20 September 2007

methadone maintenance treatment for 90 days. To test the fee issue all were told that the customary \$US40 fee to enter treatment was waived and 50 per cent were randomly selected to receive a coupon for 90 days of free treatment. The authors concluded that free treatment was strongly associated with entering and remaining in treatment on the basis that 75 per cent of those that were in treatment at the end of 90 days had a free coupon compared with 43 per cent of those that had already left treatment. A survival analysis was not conducted by the authors. However, the evidence that this study provides for fees impacting on entry into treatment is more convincing. In response to receiving a coupon for 90 days of free treatment Booth et al. (2003) found that 66 per cent entered treatment. Overall 30 per cent entered treatment.

Given this uncertainty in patient response to the removal of dispensing fees we explore the implications of a range of possible responses in terms of time spent in treatment and time taken to enter treatment.

ii) Increased demand for treatment

System capacity is a concern often raised by stake-holders. The Australian pharmacotherapy service system is reliant upon having sufficient practitioners (prescribers and dispensers). There is concern that there are insufficient numbers to meet demand – as assessed by waiting lists for programs and difficulties with accessibility in particular locations (Chalmers et al., 2008). Even if the system was not currently at capacity there are concerns as to whether it could deal with increased demand.

In the second policy scenario we assess the implications of increased demand for treatment stemming from increases in the population of the opioid using population, perhaps through increased supply of heroin or increased usage of prescription opioids. There was a sudden reduction in the availability of heroin in Australia in 2001, which has been largely sustained since then. The fear of a turn-about in supply is not groundless. In recent months there has been anecdotal evidence of increased availability of heroin on the streets of Sydney and Melbourne. We could not locate any Australian data on the rates of pharmaceutical misuse of opioids in pharmacotherapy maintenance patients. Recent research from the USA indicates that 69 per cent of methadone maintenance treatment patients reported abusing pharmaceutical opioids (Rosenblum et al., 2007).

iii) Decreased supply of treatment

All prescribers in Australia are required to undertake some form of additional training in order to prescribe opioid pharmacotherapies. The GP workforce is aging, and there are a number of GPs approaching retirement age with substantial numbers of pharmacotherapy clients on their books. There is concern about the ease with which replacement GPs will be found. GPs are already overburdened and take increasing responsibility for all manner of public health and primary health care especially screening and assessment.

The third policy scenario explores the implications of a shock to the system that markedly reduces the places in GP prescribers, perhaps through GP retirement in locations not serviced by GPs willing to take on pharmacotherapy patients or take on more patients. The only prescribing alternative is public clinics, but there are limits there as well. There

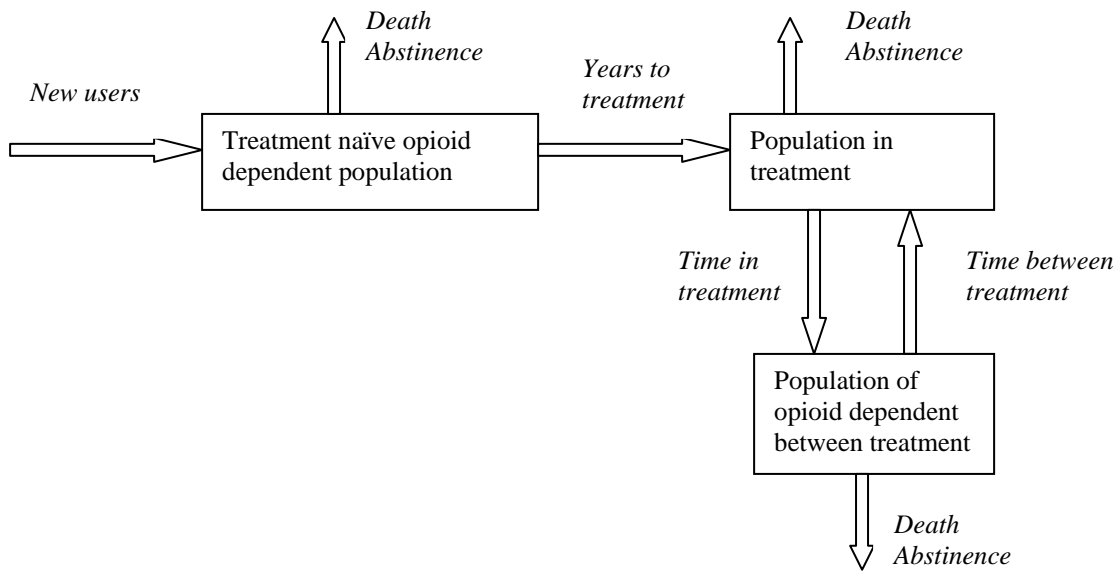
is concern that public clinics are silted up with patients who could be dispensed in pharmacies but, as public clinic service providers explained when questioned about the low rate of flow from public clinics to pharmacies, the patient do not want to pay for their treatment, or are anxious about the change (Winstock, 2007). Furthermore, apparently the majority of new clients in public clinics are from priority groups, such as those transferring from gaol or diversion programmes (Winstock, 2007).

The simulation model

The model was designed to characterise the pharmacotherapy system in the simplest possible way whilst being recognizable to the stake holders and able to depict the repercussions of the three policy scenarios on numbers in treatment and costs borne by patients and the two levels of government. The simulation model was constructed using the *iTHINK* software (<http://www.iseesystems.com/>), a purpose-built software package for system dynamics modeling. The mathematical underpinning of system dynamics models is differential equations.

The typical pattern of pharmacotherapy treatment usage in Australia is that of cycling through multiple episodes of care: that is, patients commence then cease treatment reasonably rapidly, but many return to treatment after a break (Bell et al., 2006). This cycling behaviour formed the basis of the model. Figure 1 is a representation of the major stocks and flows in the system. The rectangles represent stocks of opioid dependent people, before entering pharmacotherapy treatment, when in treatment and between treatment. The 'between treatment' stock contains opioid dependent people that have experienced at least one episode of care. The modeling process highlighted the importance of differentiating between the treatment naïve opioid dependent group and this group. The arrows represent flows of opioid dependent people, where the direction of flow is indicated by the arrowhead. The boundary of the model can be seen where an arrow head or arrow base does not connect with a stock. Attached to each arrow is a descriptor of the information used to construct the rate of that flow. For example, the flow rate into treatment for the first time, from the population of opioid dependent people depends on the average time that it takes to seek pharmacotherapy treatment, once an opioid user becomes dependent on opioids.

Figure 1 The main stocks and flows



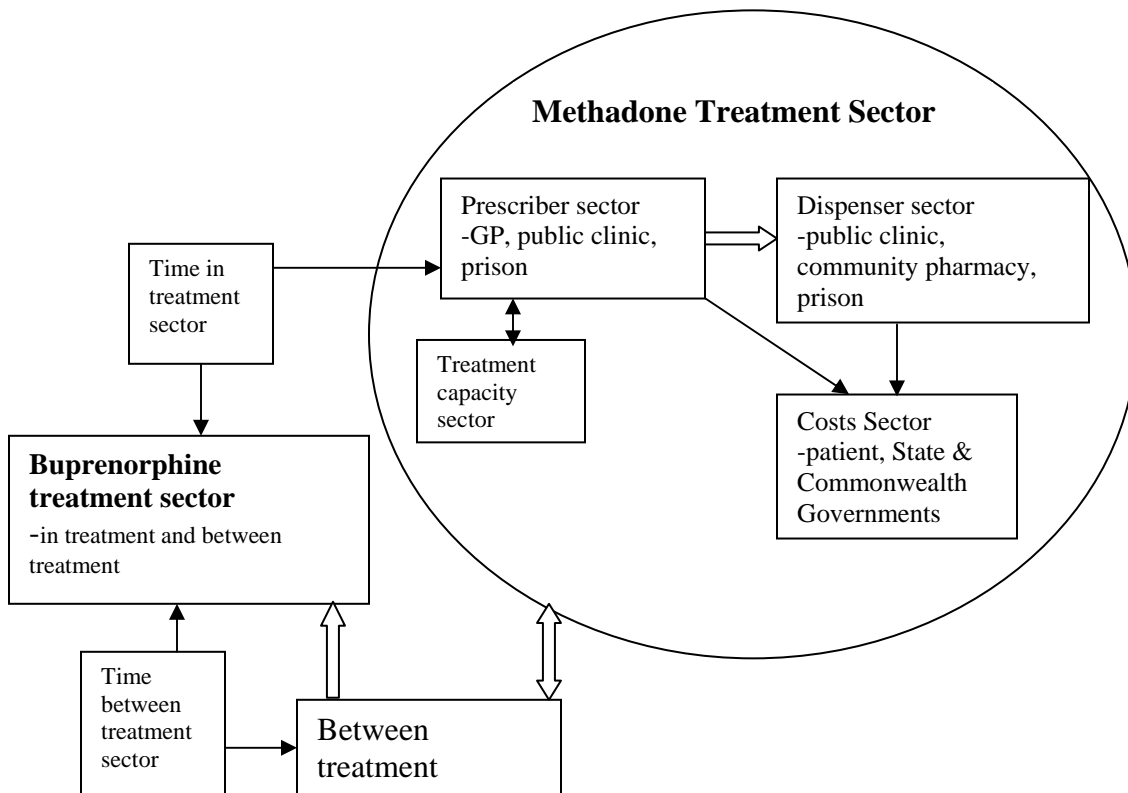
The model centres on flows into and out of treatment, and that part of the model encompassing the experiences of those with treatment experience can be divided into the following functionally related sectors or modules (Figure 2). Physical flows are designated by the white arrows and information flows by the thin dark arrows. While the focus of this model is on methadone treatment, in terms of patient's prescribing and dispensing settings and the associated costs, we have included a sector for buprenorphine to account for all pharmacotherapy patients in treatment and acknowledge that some of the patients between treatment will be loyal to buprenorphine.

Within the methadone treatment sector there are a number of sub-sectors. To enter treatment patients must be prescribed methadone by a medical practitioner, registered to prescribe methadone. The model differentiates between three types of prescribing medical practitioners, on the basis of who pays for the prescribing and the cost of that prescribing; those employed by public treatment clinics, those working in private practices (including those prescribing out of private clinics) and those employed to work in the prison system. The Commonwealth government pays for prescribing in private practices while the state government covers the cost of prescribing in prisons and public clinics. The cost of prescribing in prisons and public clinics differs. Patients flow between the three prescriber types, as well as flowing in and out of treatment. There is also a dispensing sub-sector differentiating again between methadone dispensing locations on the basis of who pays for dispensing and the cost of that dispensing. Dispensing is undertaken under the control of a pharmacist. Prison patients are all prescribed and dispensed in prison pharmacies. While the majority of patients prescribed in a public clinic will be dispensed their methadone in that clinic some are dispensed methadone by community pharmacists in the pharmacy. The pharmacy might be more convenient; perhaps closer to home than the public clinic. All of the patients whose prescriber is a medical practitioner in private practice are dispensed in a community

pharmacy. The State government pays for dispensing undertaken in public clinics and in prisons while the patient pays for dispensing in community pharmacies. Hence there is a patient flow from the prescribing sector to the dispensing sector and information flows from both those sectors to the costs sector. Here the model calculates the costs borne by the patient, State and Commonwealth Governments. Those costs only accrue when the patient is in treatment, that is, when the patient is taking his/her methadone prescription.

Methadone patients can move between prescriber and dispenser types in one continuous spell of treatment. Both methadone and buprenorphine patients can terminate a spell of treatment and flow into the between treatment group, from which there is a flow back into treatment. Those flows are determined by information from two other sectors: the time in treatment sector (which describes the average time in treatment by prescriber type for those in methadone treatment and the average time in treatment, regardless of prescriber type, for those in buprenorphine treatment); and the time between treatment sector.

Figure 2 The main sectors of the model for the opioid dependent population with experience of treatment



Model calibration

The key model parameters are reported in Appendix 1. We collected the parameters for the model from a variety of sources, and these sources are reported alongside the

parameters. For example, the jurisdictions report the numbers in treatment on a census day each year. There have been academic studies of the cycling behaviour of opioid dependent people into and out of episodes of treatment. The NEPOD study costed treatment from the ground up. Two of the jurisdictions have provided us with specific information about entry to treatment for the first time and the relative shares of buprenorphine and methadone. We synthesized a view of the numbers between treatment based on numbers in treatment and the relative time in treatment to time between treatment. Our view was supported by numbers provided by one of the state governments. We also ran the parameters by experts in the field – through informal and formal discussions with state government policy makers, the project’s advisory committee (comprised of some of Australia’s experts in pharmacotherapy treatment, both academic and practitioners), and drug user groups representing pharmacotherapy patients and opioid users that are not in treatment.

Model assumptions

Although the systems of treatment delivery have had the opportunity to develop differently in each of the eight Australian states (and territories), the model is Australia-wide. It is based on Australia-wide data and assumes that each system of prescribing and dispensing pharmacotherapy is consistent across Australia. The focus of the model is on methadone maintenance, for simplicity. We have accommodated buprenorphine by allowing some new entrants to treatment to move onto buprenorphine. We assume no net flow between buprenorphine and methadone once treatment is entered. From the patients’ perspective, take-away dosing creates the potential for more independence and autonomy, enables flexible schedules and the opportunity to travel. Takeaway doses may also make treatment more attractive to new patients resulting in more people seeking treatment. However, in this version of the model we have not included take-aways. We are working towards a more complex version of this model that will incorporate the issue of take-away doses and dispensing supervision. Furthermore, although patients do not necessarily turn up for dispensing every day they should we assume they do. Finally we assume that the patients’ experience of treatment is identical, regardless of whether it is the first episode or the 100th episode, in relation to the time spent in treatment. Similarly each between-treatment episode is of the same length.

Model testing

We set out to construct a model that could be used by policy makers to explore feasible policy scenarios. We had no intention for the model to generate forecasts of the implications of policy changes. Rather, we intended that the model communicate a particular understanding of the system that could be used as a shared basis for debate on policy issues. The model needed to be able to simulate implications of policy changes, given the current state of the system. Crucial to the calibration of the model was discussion with policy makers to ensure that the model’s depiction of the system was sufficiently realistic, without being cumbersome. In that process we learned, for example, that realism warranted a system in equilibrium with constant numbers in treatment over the life of the simulation in status quo, rather than a constant upward or downward trend. We also benefitted from discussions about the tradeoffs between subtlety in our depiction of patient flows through the treatment system and the information required to build that

subtlety. For example, we could not differentiate between the first and subsequent treatment episodes in terms of length because there is no available evidence. Yet there is strong feeling that as patients progress through the treatment maze their episodes lengthen. An important output of the modeling process will be the documentation of pieces of information that are unknown to policy makers and the research community but integral to a fuller understanding of policy reform.

While building the model the structures and parameters are constantly tested against internal consistency. This process is difficult to document. We also tested the model simulations against available information. For example, our model simulates that there are a little over 90,000 opioid dependent people at any one time (including those in treatment). According to Razalie et al. (2007) there are approximately 70,000 injecting drug users in Australia.

The Policy experiments

The model was calibrated, initial conditions were set and a base case simulation was produced. A series of policy experiments were undertaken, each of them growing our knowledge base of the implications of policy levers for numbers in treatment, the increased costs associated with pulling that policy lever and just who pays.

- i) *The Commonwealth pays the dispensing fees for patients dispensed in pharmacies*

At the end of the base-case simulation a little over 80 per cent of the patients in treatment are dispensed in pharmacies. Dispensing fees can differ markedly both within a state and between states. We attribute a dispensing cost of \$5 per day.

The question posed in this policy experiment is what costs the Commonwealth would face if it were to subsidise the dispensing of methadone, as it does other PBS registered drugs. We can but guess. There are several unknowns. Firstly, if the Commonwealth was to subsidise pharmacotherapy drugs it would need to reach an agreement with the Australian Pharmacy Guild as to the cost of dispensing.⁴ In a study of a small number of pharmacies consultants to the Pharmacy Guild recently calculated the average cost of dispensing a daily dose as \$3.27 (\$1.61-\$7.37) for methadone, based on 10 pharmacies, and \$3.29 (\$1.03 - \$8.18) for buprenorphine, based on 8 pharmacies (healthcare Management Australia, 2007). More striking than the average cost was the degree of heterogeneity in costs faced by pharmacists. Then there is the issue of when the PBS safety net would cut in. We decided to use \$5 per day dispensed and assume that patients are dispensed daily.

Given the lack of knowledge on patient responses to fees we consider three scenarios. Firstly, there is no change to patient behaviour; secondly, patients stay in treatment longer, with the average length of a treatment spell increasing by 50 per cent; and thirdly,

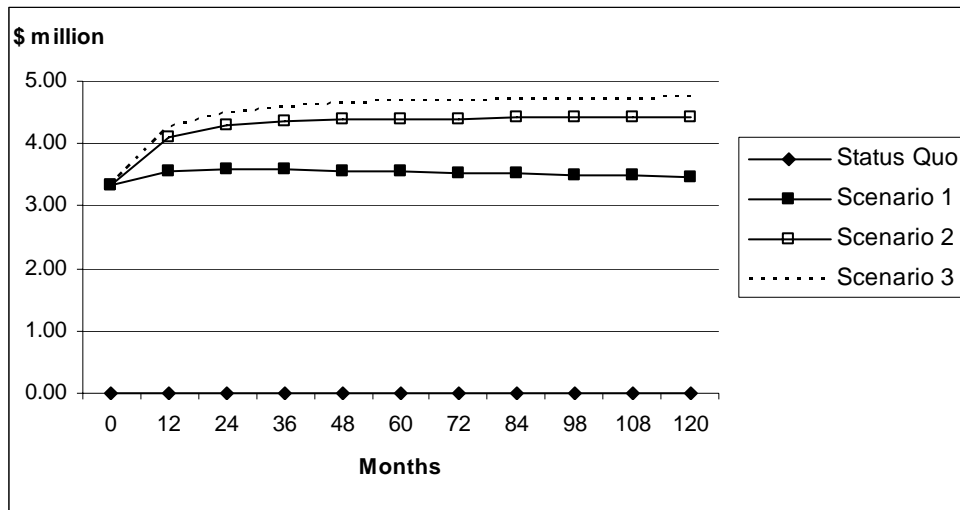
⁴ Since the early 1990s the Australian Government has negotiated a series of five-year Agreements with the Pharmacy Guild of Australia (the Guild), including the formula for the pharmacy mark up on the cost of PBS drugs and pharmacist dispensing fee.

on top of the increased length of stay in treatment we assume that treatment naïve opioid dependent people are encouraged to enter treatment by free dispensing and halve the average time to enter treatment from four years to two years.

Figure 3 sets out the dispensing costs met by the Commonwealth under the three scenarios. Figure 4 shows the Commonwealth’s dispensing costs at the end of the simulation. The line entitled status quo shows that, under the current arrangement the Commonwealth Government does not contribute at all to dispensing fees. Under scenario 1 there is a simple transfer of dispensing fees from patients to the Commonwealth amounting to almost \$3.5 million per month at the end of the simulation period. Under scenario 2 numbers in treatment increase by 6,368 by end simulation, a more than 20 per cent increase. This further increases the Commonwealth costs of dispensing by \$0.9 million per month. Under scenario 3 there are a further 2,544 more in treatment at simulation end with Commonwealth spending on dispensing increasing by another \$0.3 million per month.

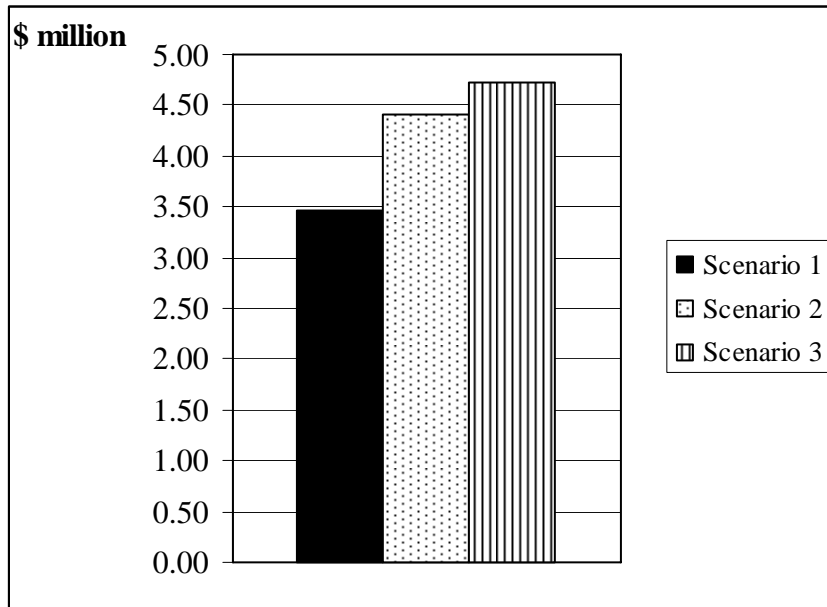
In comparison with total expenditure on other PBS drugs, expenditure on methadone ranks just below the 20 most expensive drugs for the year ended 2006 (DOHA, undated: Table 13(a)) Comparison was made on the basis of total cost (ie Commonwealth plus patient) since we assumed that the Commonwealth cover all costs.

Figure 3: Commonwealth dispensing and prescribing Costs on a monthly



Notes: Status Quo: Patient pays dispensing fees at pharmacies
 Scenario 1: Commonwealth pays dispensing fees.
 Scenario 2: In response the average length of stay in treatment for patients dispensed in pharmacies increases by 50 per cent.
 Scenario 3: A secondary response is that the time it takes for an opioid dependent person to enter treatment for the first time is halved, on average, from 4 years to 2 years

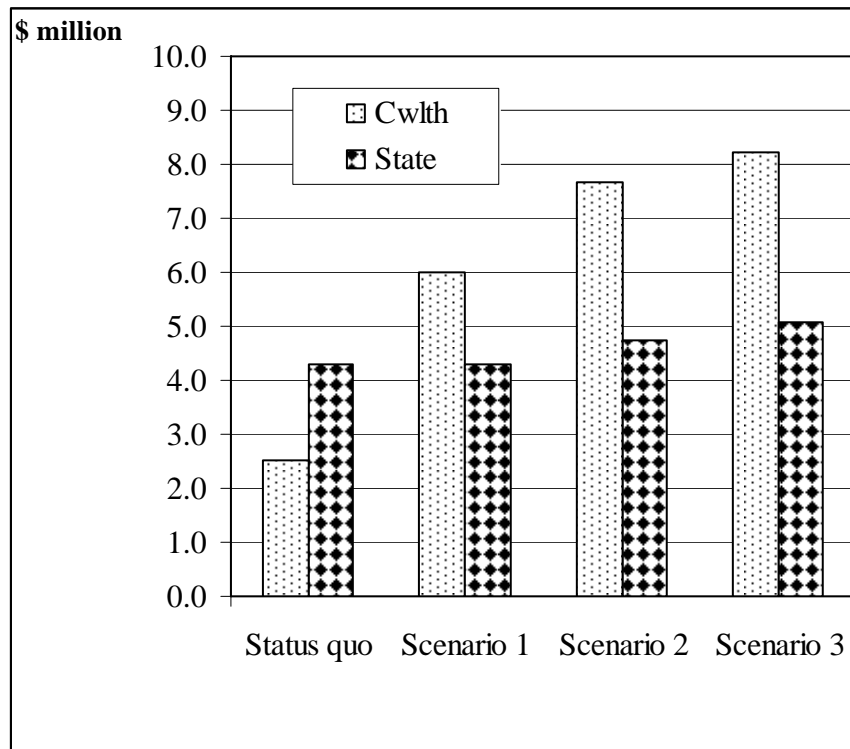
Figure 4 Commonwealth dispensing costs on a monthly basis at the end of the simulation



Notes: Scenario 1: Commonwealth pays dispensing fees.
 Scenario 2: In response the average length of stay in treatment for patients dispensed in pharmacies increases by 50 per cent.
 Scenario 3: A secondary response is that the time it takes for an opioid dependent person to enter treatment for the first time is halved, on average, from 4 years to 2 years.

The impact on patient numbers in treatment also has ramifications for prescribing and drug costs. Some of the patients prescribed in public clinics are dispensed in pharmacies, so we need to account for the increased prescribing costs faced by State governments. The increase in the Commonwealth costs of GP prescribing and the cost of methadone itself need also to be described. Under scenario 2 the Commonwealth faces an additional \$0.7 million prescribing and drug costs and the States cover an extra \$0.4 million. Under scenario 3 the combined Commonwealth costs of GP prescribing and the drug increase by \$0.2 million and the State government costs increase by \$0.3 million. All costs appear in Figure 5.

Figure 5: Total Commonwealth and State monthly costs at the end of the simulation*



* Prescribing, dispensing and drug costs

Notes: Status Quo: Patient pays dispensing fees at pharmacies

Scenario 1: Commonwealth pays dispensing fees.

Scenario 2: In response the average length of stay in treatment for patients dispensed in pharmacies increases by 50 per cent.

Scenario 3: A secondary response is that the time it takes for an opioid dependent person to enter treatment for the first time is halved, on average, from 4 years to 2 years

What are the benefits of increasing the treatment spell length and increasing the inflow to treatment? One of the benefits is reduced deaths of opioid dependent people over the simulation period. Compared with the status quo there are simulated to be 1,264 less deaths over the 10 years under scenario 2. Compared with the status quo there are 2,727 less deaths under scenario 3. While still more likely to die than the average person, research shows that opioid dependent people in treatment are significantly less likely to die than those not in treatment. Treatment naïve opioid dependent people are substantially more likely to die than those that have entered the “treatment maze”. Scenario 2 sees 6,350 extra patients in treatment (by simulation end) while scenario 3 sees a further 2,544 patients in treatment. There is a relatively bigger response in the death rate under scenario 3 because more of the treatment naïve are pulled into treatment.

ii) Increased demand for treatment

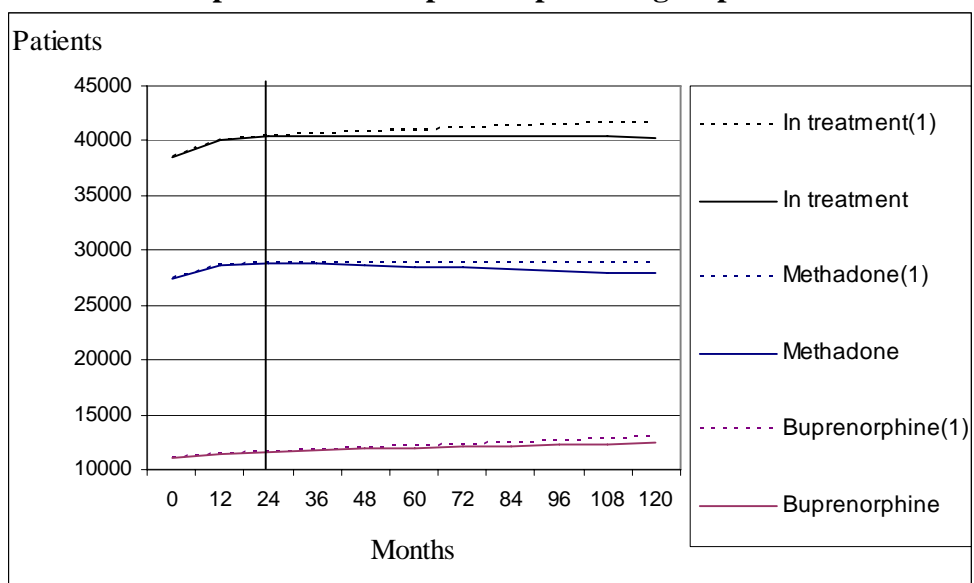
Increased demand for treatment is characterised by an increase in the opioid using population (pre dependence) which leads a 20 per cent increase in the annual inflow into the population of pre-treatment opioid dependent people (from 3,500 to 4,200 ie 700 per

year) from year 2 in the simulation. Our goal is to show the implications for the system, in terms of increased numbers of patients in treatment and the time it would take for those patients to flow into treatment.

Figure 6 illustrates that there is little impact on numbers in treatment. The impact on Government expenditure for methadone maintenance over the simulation period is likewise minimal, as Figure 7 reveals. At the end of simulation there are only 1,444 more patients in treatment as a whole (a four per cent increase); 902 more in methadone treatment and 542 more in buprenorphine. Why does the response to a 20 per cent increase in the inflow to the opioid dependent population seem so small? While the annual inflow to the pre-treatment group is 700 the annual increase in the flow from the opioid dependent group into treatment is only 470, at simulation end. It takes four years, on average, for a newly opioid dependent person to enter treatment and in that time there is a significant risk of death ie five per cent per year. There are over 90 more deaths per year at simulation end. Furthermore, not everyone that becomes dependent requires treatment. Over the simulation period, we also see a similar increase in the number of people becoming abstinent before entering treatment. Finally, even those who enter treatment cycle in and out of treatment. At simulation end there are a little over 1000 more in the between treatment population.

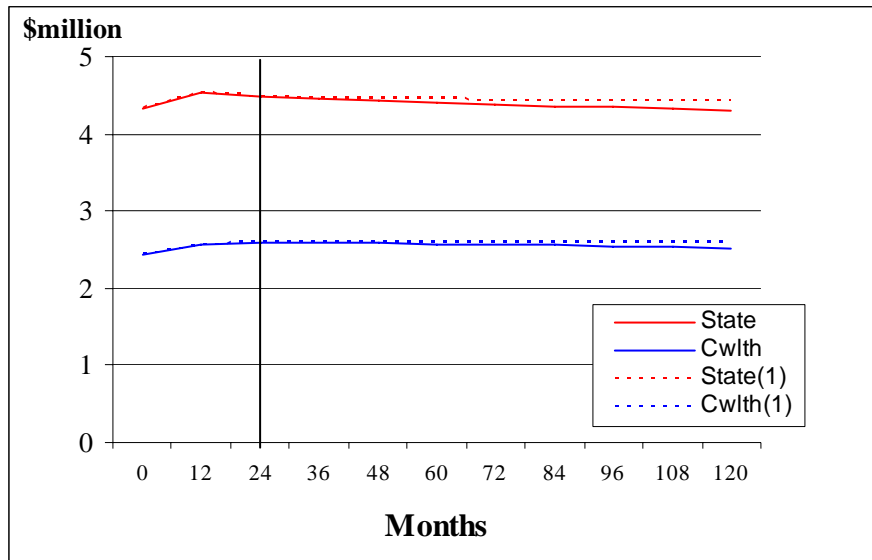
For those concerned about whether the treatment system could deal with this, the modeling shows that there is a slow build-up to the increased patient numbers. Our depiction in system form shows that things do not necessarily occur instantaneously. The population increase commences in year two of the simulation, and it takes four years for that increase to work its way through to the numbers in treatment.

Figure 6 Patients in treatment on a monthly basis before and after a 20% increase in inflow to the pre treatment opioid dependent group.



Notes: Scenario 1: 20 per cent increase in the annual inflow into the population of pre-treatment opioid dependent people

Figure 7 State and Commonwealth costs associated with the increased ‘demand’

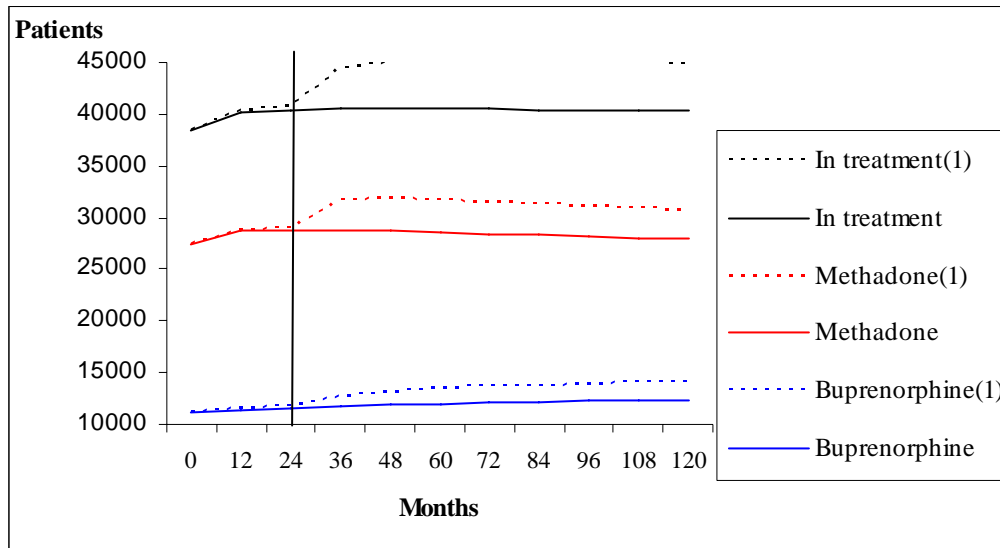


Notes: Scenario 1: 20 per cent increase in the annual inflow into the population of pre-treatment opioid dependent people

As a point of comparison we also simulate the impact of a policy intervention characterised by a 20 per cent reduction in the time it takes to return to another episode of treatment after leaving an episode. Such a policy intervention might be the decision to contact anyone who has ever been a patient to encourage and/or facilitate their re-entry to treatment, perhaps through phone-calls or out-reach workers. Again the reduction takes place two years into the simulation. At that point the time between spells of methadone treatment is reduced from 12 months to 9.6 months and the time between spells of buprenorphine treatment is reduced from 6 months to 4.8 months.

As a result we find that there are 4,561 (or 11 per cent) more patients in treatment at the end of the simulation, over three-fold the increase of the previous example (Figure 8). Furthermore the increased inflow of patients is almost instantaneous, so that within two years we have seen the maximum response. Indeed it would take a 60 per cent increase in the flows into treatment naïve opioid dependent group to match this increase in patients in treatment.

Figure 8 Patients in treatment on a monthly basis before and after a 20 per cent reduction in the time between treatment



Notes: Scenario 1: 20 per cent reduction in time between treatment

This finding highlights the power of the model to contextualise fears of policy makers and service providers about the capacity of the system to deal with increased numbers of treatment naïve opioid dependent people. It also talks to those that think there is more purchase in directing policy initiatives at the treatment naïve – well at least in relation to increasing numbers in treatment. The modelling process and resultant consultations with policy makers revealed that there are probably just as many opioid dependent people with treatment experience that are no longer in treatment as there in treatment, that is just over 40, 000.

iii) Service system changes

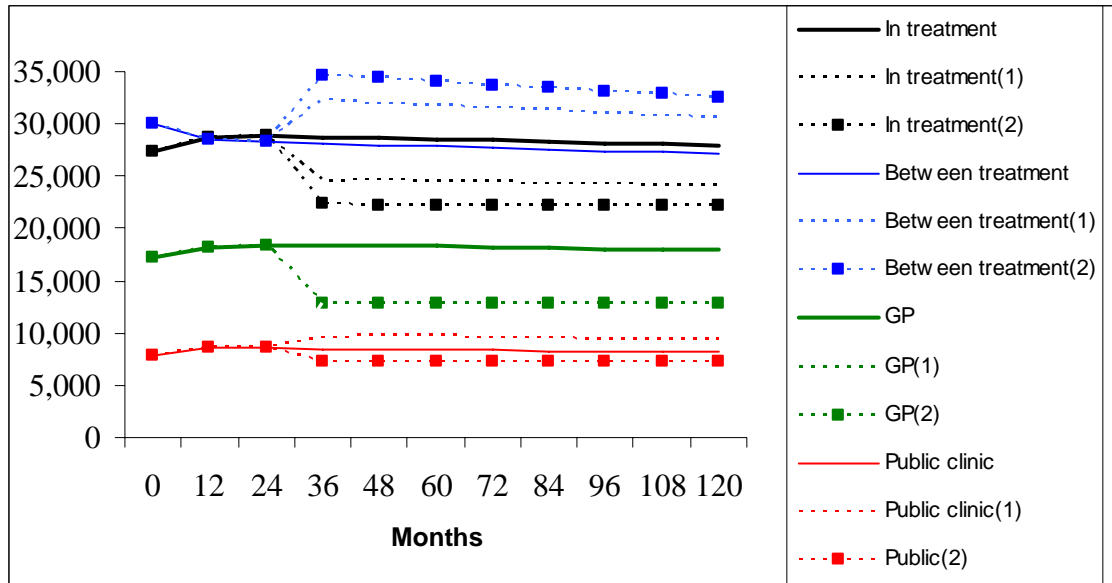
The service system change, perhaps amounting to the retirement of a few GPs with heavy patient loads, is characterised in scenario 1 by the limiting of GP methadone places to 80 per cent of the initial number in treatment. This limiting takes place 2 years into the simulation. Scenario 2 similarly limits public clinic places. Patients are not asked to leave treatment, but once they do leave there are limits on re-entering treatment.

Figure 9 illustrates the impact of these capacity limits. As a consequence of limiting entry to methadone places with GPs, the end of simulation numbers of people between treatment increase by 3,467. The numbers of patients in treatment fall by 3,785. The reduction in patients prescribed in GPs is partially offset by increased access to public clinics, that is a 1,138 increase in patients prescribed there. The impact on the length of time between episodes of treatment is an increase from 12 to 14.7 months at simulation end.

When we introduce the further constraint that public clinics cannot accommodate the extra patients, we see more dramatic responses. The end-simulation time between

treatment increases to 17.7 months under scenario 2 and there are nearly 2,000 less people in treatment.

Figure 9: Impact of capacity limits on numbers between and in methadone treatment by prescriber



Notes: Scenario 1: limiting of GP methadone places to 80 per cent of the initial number in treatment
 Scenario 2: continuation of GP limit plus a similar limit on public clinic places

The lesson of this simulation moral is that a loss of one-fifth of GP capacity has substantial implications on the time taken to re-enter treatment. This might have the knock on effect of reducing a person’s tendency to re-enter treatment. It might also discourage patients from leaving treatment in the first place. An important assumption underlying this policy experiment is that there is no spare capacity in the system. There is conflicting anecdotal evidence about the existence of spare capacity, perhaps due to geographical issues, system differences across jurisdictions etc.

Conclusion

This paper presents system dynamics based analysis of the implications of three key issues facing the Australian policy makers with responsibility for the opioid pharmacotherapy system. It provides insights to questions about the repercussions of increased demand for treatment, reduced supply of treatment places and a reduction in the costs faced by patients in treatment.

The overarching purpose of the modeling process was to inform the efforts of policy makers in their bid to find ways to better meet demand for pharmacotherapy treatment in relation to availability, accessibility and affordability of treatment. The power of this process lies in its capacity to form a spring-board for debates about policy directions. To this end we explored three policy scenarios. With one we were able to contextualise fears held by policy makers and service providers about the capacity of the system to deal with increased numbers of treatment naïve opioid dependent people. We found, in terms of

potential demand for treatment places, it is far more important to be concerned about surges in demand emanating from the group of opioid dependent people with treatment experience that are no longer in treatment. It takes approximately four years for newly opioid dependent people to enter treatment and there are around 40,000 Australians currently dependent on opioids “between” treatment. We also showed the financial implications for the Commonwealth if it were to subsidise the dispensing of methadone, as it does other PBS registered drugs. Currently around 80 per cent of pharmacotherapy maintenance patients pay approximately \$35 per week for dispensing, amounting to approximately \$40 million per year. While there is substantial concern about this financial impost there is little evidence about the impact of fees on patient behaviour in relation to treatment seeking. If we were to assume that fees encourage patients to leave treatment more quickly than they otherwise would and discourage the treatment naïve from entering treatment our simulations show that a full Commonwealth subsidy of dispensing fees would amount to a \$72 million annual increase in Commonwealth funding. Thirdly we explored the implications of limiting entry to GP prescribers. There is concern about the fragility of the GP prescribing system because of the historical high numbers of patients attached to single GPs, many of whom are approaching retirement. Assuming that the rest of the system is at capacity this resulted in a substantial increase in the time taken for opioid dependent people to return to treatment.

We are currently working on revising the model to incorporate a more nuanced view of constraints faced by patients and to add the issue of dispensing supervision to the mix. The three often-mentioned constraints on patients are affordability, the stigma attached to maintenance treatment and accessibility.

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Appendix 1 Model parameters

Variable	Parameter	Reference / Notes
<i>Stocks at commencement of simulation</i>		
Treatment naïve opioid dependent population	12,000	Calibrated from model: Based on average time to treatment of four years (see below under flows) and annual inflow to treatment figure of 3000 (based on data supplied by two largest states, NSW and Victoria). AIHW(2007b: Table 4.2)
Methadone treatment	27,346	
	Prescribers	
	Public 7,853	
	GP 17,169	
	Prison 2,324	
Buprenorphine treatment	11,100	AIHW(2007: Table 6.2)
Between treatment	30,000 (methadone) 11,100 (buprenorphine)	Calibrated from the model, based on length of stay in treatment relative to length of stay between treatment with requirement that numbers between treatment be in equilibrium over life fo simulation. Supported by state figures on numbers ever in treatment (Victoria)
<i>Flows</i>		
Entrants to opioid dependency	3,500 per annum	Calibrated from model so as to maintain opioid dependent population of 12, 000 given flows into treatment and annual outflows of 10% (to death and abstinence).
Flow from treatment naïve opioid dependent population into treatment for first time	Average time to treatment is 4 years	Estimate. Dietze et al (2003) median 3 yrs for methadone; Ross et al. (2004) 4 yrs (avge age first treatment is 24-25 yrs, became regular injector at avge age 20-21 yrs).
<i>Other</i>		
Allocation of inflow into first treatment by drug	43%: buprenorphine 57%: methadone	Calibrated from model ie steady state equilibrium in buprenorphine and methadone numbers Supported by state figures (NSW and Victoria).
Allocation of inflow into first treatment prescriber	Public 25% GP 60% Prison 15%	Calibrated from model so as to ensure static proportions in each prescriber over life of simulation Supported by Bell et al. (2006).
Allocation of patient to dispenser by prescriber		Calibrated with model using data on patients with dispensers AIHW(2007b: Table 4.3) and anecdotal information.
• Public	Public 40%	
• GP	Pharmacy 60%	
• Prison	Pharmacy 100%	
	Prison... 100%	
Length of stay		Bell et al., (2006); Ross et al.(2004), state data supplied by NSW
<i>Methadone</i>		
• Public	7 month	
• GP	12 months	
• Prison	3 months	

• Between treatment	12 months	
Buprenorphine		
• In treatment	6 months	
Death rate		Byrne, 2000, Caplehorn, 1996; Davoli et al. 2007
• Pre treatment	5% per annum	
• In treatment	0.8% per annum	
• Between treatment	2% per annum	
Abstinence rate (in and between treatment)	1.5% per annum	Darke et al., 2007; Byrne, 2000; Hser (2001); Gossop et al. (2003)
Pre-treatment abstinence rate	5% per annum	Razali et al., 2007; Caulkins et al., 2007
 <i>Costs (methadone)</i>		
Drug cost (per dose)	\$0.54	PBS cost is \$36 per litre; 1mg = 0.72c. Avge dose 70mg (Winstock and Lea, 2007; Lintzeris et al., 2007)
Costs – maintenance		
• public	\$14.58 per day	NEPOD data (authors' calculations)
• GP	\$3.78 per day	NEPOD data (authors' calculations)
• Prison	\$9.26 per day	Warren and Viney, 2004
Costs – dispensing		
• Public	\$1.05	NEPOD data (authors' calculations)
• GP	\$5.00	Chalmers et al. (2008)
• Prison	\$1.05	Assumed same as public – no other data
