NATSEM
National Centre for Social and Economic Modelling
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AN ECONOMIC FORECASTING MICROSIMULATION MODEL OF THE AUSTRALIAN PHARMACEUTICAL BENEFITS SCHEME (VERSION 00-01)

Annie Abello, Laurie Brown,
Agnes Walker and Linc Thurecht

Technical Paper no. 30

November 2003

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NATSEM aims to be a key contributor to social and economic policy debate and analysis by developing models of the highest quality, undertaking independent and impartial research, and supplying valued consultancy services.

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Director: Ann Harding

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Abstract

In 2001 NATSEM was asked to develop a prototype model of Australia's Pharmaceutical Benefits Scheme (PBS) for the then Australian Pharmaceuticals Manufacturers' Association, now Medicines Australia, making use of a model built in the late 1990s for the then Department of Health and Family Services. Towards the end of that year, NATSEM was awarded an Australian Research Council Linkage Grant, with Medicines Australia as industry partner, to further improve the model and to develop within it the facility not only to forecast expenditures and estimate the distributional effect of the PBS, but also to quantify the health benefits of future pharmaceutical innovations.

This technical paper documents the current status of the model (version 00-01) and serves as the starting point to examine features of the model that could be enhanced. It also provides the necessary reference for developing a facility within the model to quantify the benefits of improved health outcomes, which would represent a major advance in modelling the PBS.

Author note

Annie Abello is a Research Fellow at NATSEM, Laurie Brown and Agnes Walker are Principal Research Fellows, and Linc Thurecht is a Senior Research Fellow.

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General caveat

NATSEM research findings are generally based on estimated characteristics of the population. Such estimates are usually derived from the application of microsimulation modelling techniques to microdata based on sample surveys.

These estimates may be different from the actual characteristics of the population because of sampling and nonsampling errors in the microdata and because of the assumptions underlying the modelling techniques.

The microdata do not contain any information that enables identification of the individuals or families to which they refer.

Contents

Abbreviations

ABS	Australian Bureau of Statistics
APMA	Australian Pharmaceutical Manufacturers Association
C1	Concessional patients that have not reached the safety net
CPI	Consumer price index
CSHC	Commonwealth Seniors Health Card
CURF	Confidentialised unit record files
DALY	Disability adjusted life years
DHA	Department of Health and Ageing
DVA	Department of Veterans' Affairs, Australia
G1	General patients that have reached the safety net
G2	General patients that have not reached the safety net
HBC	Health Benefit Card
HCC	Health Care Card
HIC	Health Insurance Commission
HES	ABS Household Expenditure Survey, 1993-94 or 1998-99
IMS	IMS Health Inc. (where IMS stands for Intercontinental Marketing Services)
MA	Medicines Australia
NHS	ABS National Health Survey, 1995 or 2001
PBS	Pharmaceutical Benefits Scheme
PCC	Pensioner Concession Card
QALY	Quality adjusted life years
SFR	Self-funded retirees
SNT	Safety net threshold

Explanations

Variable	Description
Card	Variable indicating that a person (or family) is entitled to PBS drugs at concessional costs (that is, a person with a Commonwealth Seniors Health Card, Health Care Card and/or Pensioner Concession Card).
Copayments	Patients' contributions to the total cost of medicines subsidised under the PBS.
Family	An income unit as defined in ABS surveys — a nuclear family, meaning a couple with dependent children, a couple without dependent children, a sole parent with dependent children, or a single person. In the model, family dependants include all children aged 0–14, full-time students aged 15–24, and non-full-time students aged 15–20 who did not qualify for the Youth Allowance but are considered dependants for Family Tax Benefit purposes. With respect to the HIC's PBS, family dependants include children under 16 years of age and full-time dependent students under 25 years of age.
Patient spending or contributions	Patient payments at the pharmacy for prescribed PBS-listed drugs (same as 'copayment' for subsidised PBS medicines).
Group 1 drugs	Drugs with a cost to government under the PBS ('benefit' drugs).
Group 2 drugs	PBS-listed prescribed drugs not attracting a government subsidy, or drugs with a total cost or price below the PBS copayment level (below copayment drugs).
Group 3 drugs	Prescribed drugs not listed under the PBS or private medicines.

Variable	Description
Safety net threshold	Total annual amount that individuals and families pay in a calendar year for PBS-listed drugs at the regular copayment rate before the patient copayment per PBS item decreases from the regular rate to the concessional rate. The safety net protects families from large overall expenses on PBS-listed drugs. In 2002 the regular and concessional rates were: • $22.40 and $3.60 for general patients • $3.60 and $0 for concessional patients.
Subsidy	Government contribution to the cost of PBS drugs.

1 Introduction

In the late 1990s NATSEM developed a patient-based microsimulation model for the Pharmaceutical Benefits Branch of the then Department of Health and Family Services. Documentation for this model — called the PBS model — is provided in NATSEM Technical Paper no. 15 (Walker, Percival and Fischer 1998). Policy-relevant applications of that model have been detailed by Walker, Percival and Harding (2000) and Walker (2000).[1]

In 2001 NATSEM was contracted by the then Australian Pharmaceuticals Manufacturers' Association (APMA), now Medicines Australia (MA), to develop a model of the distributional and economic impact of Australia's pharmaceutical industry and the PBS. The resulting model links a very detailed new Medicine Module, based on data covering the period 1992–93 to 2000–01, to an updated and extended version of the original PBS model, now called the Patient Module. We refer to the model as the MA model to be consistent with the change in name of the funding organisation, while reports on earlier versions call it the APMA model.

Starting with the original model, NATSEM successively added the Medicine Module, revised the drug classification, updated the input database and the model to 2000-01, and developed a forecasting (up to five years) capability. This technical paper documents the development and current status of the model of Australia's PBS (version 00-01) that NATSEM developed for Medicines Australia. Its primary aim is to document the current status of the patient-based microsimulation module. The paper also describes features of the current model that need to be revised or further developed. The aim is to extend the MA model concerning subsidised prescribed pharmaceuticals into a socioeconomic model that incorporates health outcomes. This significant advancement is being funded by a three-year Australian Research Council Linkage Grant, with Medicines Australia as the industry partner.

The Medicine Module will be the subject of a separate technical paper.

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1 These latter-refereed publications were based on NATSEM Discussion Papers nos 31 and 45.

2 Overview of the PBS

The Commonwealth Government's Pharmaceutical Benefits Scheme aims to provide Australians with timely, reliable and affordable access to necessary and cost-effective prescription medicines. The PBS was designed originally in 1948 to provide access for all Australians to a 'free list' of life-saving medicines. Medicines must be approved for use in Australia and then be assessed as being cost effective in order to be listed on the scheme. The scheme covers Australian residents and eligible foreign visitors (unless they are treated in institutions — for example, hospitals).

Today, a comprehensive range of medicines is listed on the PBS. As at 1 May 2002 the PBS covered 593 drug substances (generic drugs), available in 1461 forms and strengths (items) and marketed as 2506 different drug products (brands). A restricted listing applies to 785 of the items, 286 of which require an authority from the Health Insurance Commission (HIC) for prescribing (for details see the following website <www.health.gov.au/pbs/general/aboutus.htm>).

Patients are required to make a contribution to the cost of prescribed medicines listed on the PBS. Individuals and families eligible for certain federal government (Centrelink) pensions and allowances are able to access PBS medicines at concessional rates. The PBS also has 'safety net' arrangements to protect individuals and families from large overall expenses for PBS-listed medicines. The levels of patient copayments and the PBS safety net arrangements are referred to as the PBS policy settings. Patient copayments and safety net thresholds (SNTs) are revised annually in line with the consumer price index (CPI) from 1 January each year.

Patients may pay more than the copayment if a PBS item is priced above the benchmark price for different brands of the same drug or the benchmark price for a particular therapeutic group of drugs. The government pays the additional cost of drugs exceeding patient copayments up to the benchmark price only. Brand or therapeutic group premiums do not count towards safety nets.

Since the early 1990s expenditure on the PBS has grown at more than 10 per cent a year — well above the growth in the health budget (6 per cent) or the economy (4 per cent in terms of gross domestic product) while PBS settings in general have increased only in line with inflation.

Demographic, economic and technological changes are expected to intensify the pressures on the PBS during the next few decades. The OECD (2000) notes that in Australia, as in most other developed countries, real public expenditures per person on pharmaceutical goods had more than doubled in the previous two decades. In recent budgets the government has increased the level of contributions to be met by PBS patients and delisted certain medicines from the Pharmaceutical Benefits Schedule. Further, the 2002-03 budget aimed to introduce an increase of close to 28 per cent in PBS copayments and SNTs effective from August 2002 and January 2003 respectively.[2]

The majority of prescribed drug sales are covered by the scheme and, on average, the government subsidises patients to the extent of 84 per cent of PBS drug costs. Currently nearly 80 per cent of total government subsidies through the PBS accrue to concessional patients — that is, those with the specified Centrelink cards[3] — and 20 per cent to general patients.

The policy settings of the PBS for 2000-01, the base year for the model simulations, are given in table 1. The figures show that:

- for *general* patients the maximum contribution for each PBS medicine is $21.90, the government paying for the rest; and
- for *concessional* patients an additional subsidy applies, so that their maximum contribution is only $3.50 per PBS medicine.

Although some PBS medicines can cost over $1000 per prescription, patients are required to pay at most $21.90. If the full price of the medicine is below $21.90 (or $3.50) the patient pays the full price.

The PBS safety net protects families from high expenditure in any one year on PBS medicines. Once a family[4] that does not have concessional benefits records spending on PBS medicines beyond the SNT of $669.70 in a calendar year, they are required to pay only $3.50 for each further PBS medicine within the same year. For concessional patients there is no cost

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2 These budget measures are currently blocked in the Senate and therefore have not been implemented.

3 These are the Pensioner Concession Card, the Commonwealth Seniors Health Card and the Health Care Card. For details, see the relevant Department of Family and Community Services fact sheets.

4 A 'family' is defined as including a spouse (or de facto spouse), children under 16 years of age and full-time dependent students under 25 years of age.

once their families have a record of spending beyond the SNT of $182.00 in a calendar year. In this case the government pays the full price of all further PBS medicines prescribed within the year. Each year on 1 January, each family's expenditure on PBS-listed prescribed medicines is reset to zero for administrative purposes.

Table 1 **Policy settings of the Pharmaceutical Benefits Scheme, 2000-01**

	1 January 2000	1 January 2001
	$	$
Copayment — concessional		
Below safety net threshold	3.30	3.50
Above safety net threshold	0	0
Copayment — general		
Below safety net threshold	20.60	21.90
Above safety net threshold	3.30	3.50
Safety net threshold — concessional	171.60	182.00
Safety net threshold — general	631.20	669.70

Source: Department of Health and Ageing, <www.health.gov.au/pbs/pbs/copayment.htm>.

3 Conceptual structure of the model

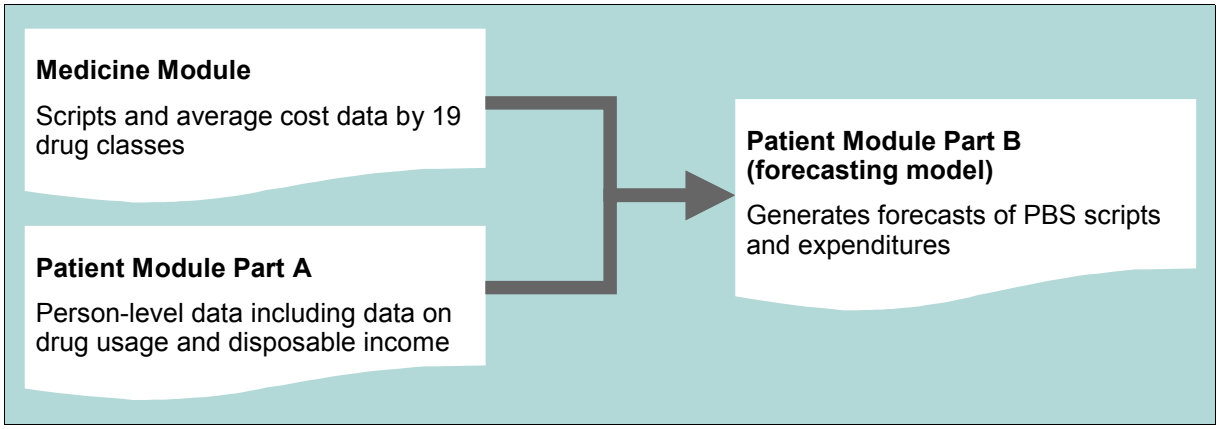
The MA model version 00-01 is made up of an econometric Medicine Module and a microsimulation Patient Module (figure 1).

The Medicine Module projects the total number of scripts and the average cost per script for 19 drug classes, and trends in these data serve as inputs to the forecasting version of the Patient Module.

The Patient Module's main input dataset is at the person level (that is, each record is for an individual with links between family members), with data on drug usage across 36 drug classes[5] by gender, age and card status. The unit of analysis can be the individual, the family or more aggregate levels (for example, groups by income ranges and/or drug classes). In forecasting mode, the scripts data in the person-level dataset are revised each year to be consistent with the aggregate level of scripts estimated in the Medicine Module.

5 The Patient Module was built to have 36 drug classes. The first 18 drug classes in the Medicine Module correspond to the first 18 drug classes in the Patient Module, while the 19th drug class in the Medicine Module was disaggregated into 18 additional drug classes in the Patient Module.

Figure 1 **Components of the MA model**



Individual-level data on demographic, socioeconomic and drug usage patterns for the model's base year (2000-01) were constructed using several sources and covering several years. Data from these sources were then consolidated and aged or uprated to the base year. A second dataset on the costs of the pharmaceuticals used was then prepared, using the average per script costs observed administratively for each of the drug classes in that year. The cost data were then merged onto the patient-based dataset, allowing estimation of the costs of the drugs used by each individual in the Patient Module. By aggregating individual-level costs the model is able to estimate total patient and government expenditures on prescribed PBS drugs over the base year. These aggregates were 'aligned' to match actual administrative data on PBS scripts for 2000-01. In forecasting mode the module can project PBS scripts and expenditures for five years (2001-02 to 2005-06).

3.1 Overview of the Medicine Module

The Medicine Module is based on data provided by the Health Insurance Commission on monthly government expenditure and scripts between January 1992 and June 2001 for all items listed on the PBS. It was also constructed taking into account data derived from the Pharmaceutical Benefits Schedule that provides information on policies that apply to drugs under the PBS. Because the HIC data have information on whether each script was purchased by a concessional or a general patient, we were able to estimate patient-level expenditure.

Drug classes were classified by therapeutic class for the Medicine Module by mapping, first, the HIC PBS codes to the anatomical

therapeutic chemical (ATC) codes and, second, the ATC codes to the 19 forecast groups used in the Medicine Module. The concordance schedule is given in appendix A.

Regression equations were constructed for both the average cost and script data for each of the 19 forecast groups. The regressions were based on monthly HIC data for the period January 1992 to June 2001, these data being provided via Medicines Australia. The Medicine Module provides five-year forecasts (from July 2001 to June 2006) for each forecast group, using a monthly forecast interval. The predictive statistical and policy variables included in the module are in table 2.

Table 2 **Variables used in the Medicine Module forecast regression equations**

Variable	Description
Trend	Trend variable
Seasonality	Eleven dummy variables representing month of the year
TGP	A single dummy variable representing Feb 1998 (groups 5, 7, 8, 13 only)
Copay	A single dummy variable representing Jan 1997 (script only)
MolEntry	Count variable representing entry of new molecules (as provided by Medicines Australia)
BioEqGen	Count variable representing entry of bioequivalent molecules (as provided by Medicines Australia)
Authorities & Restrictions	Major events only, represented by dummy variables: Group 1 – Dec 1992 Group 2 – Apr 1995 Group 6 – Nov 1997 and May 1998 Group 8 – Dec 1994 Group 12 – Nov 1996 Group 13 – Dec 1994

The aim was to keep the Medicine Module simple in terms of the predictive variables used in the forecast regression equations and, where possible, the functional form of the regression models. For example, interaction terms have been excluded, and the Authority Required (AR) and Restricted Listing (RL) variables have been applied to only certain forecast groups/therapeutic classes and are dummy variables associated with significant changes in the listing/prescribing requirements for the forecast groups/therapeutic class. The two policy variables used in the Medicine Module are MolEntry (molecule entries) and BioEqGen (bioequivalent molecules). The definition of and data for these two variables were provided by Medicines Australia. The data series contain

actual data for January 1992 to June 2001 and were extrapolated to June 2006 in the following ways.

- For molecules, the series increases in July of every forecast year by the average annual increase over the previous five years.
- For bioequivalence, a new bioequivalent count is registered each time a patent expires.

As noted in section 1, a separate technical paper is planned for the detailed description of the Medicine Module.

3.2 Overview of the Patient Module

Stage 1 — Creating the main input dataset

Four main sources of data were used to prepare the input dataset for the Patient Module.

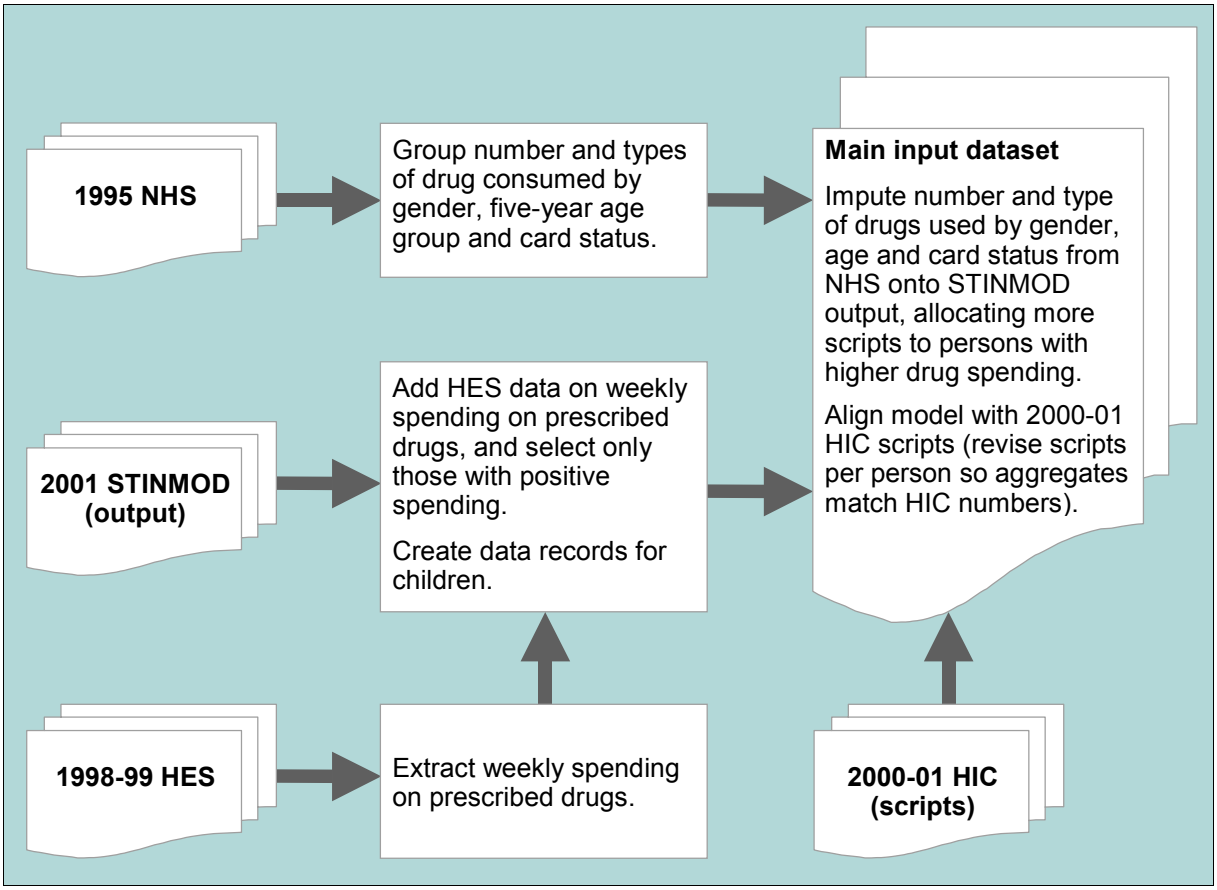
- Individual records were derived from the 2001A version of STINMOD[6] based on the 1998-99 Household Expenditure Survey (HES) by the Australian Bureau of Statistics (ABS). The variables extracted included a range of demographic and economic indicators such as age, gender, family structure, after-tax family income and concessional (card) status under the PBS.
- The ABS 1995 National Health Survey (NHS) was used to derive information on the use of prescribed pharmaceuticals across the 36 drug classes, by age, gender and concessional (card) status.
- Weekly household expenditure on prescribed pharmaceuticals was obtained from the ABS 1998-99 Household Expenditure Survey, which was merged onto the STINMOD dataset.
- Administrative data on PBS scripts and costs across the 36 drug classes came from the HIC time series collection (see appendix B).

The process of combining the datasets is outlined in figure 2. The four data sources were combined at the unit-record level — that is, the

6 STINMOD is NATSEM's static microsimulation model that models the impact of the personal income tax and social security systems on Australian families (Lambert et al. 1994).

combined dataset is comprised of individuals, each described by a set of pooled relevant characteristics.

Figure 2 **Combining the NHS, STINMOD, HES and HIC datasets**



The STINMOD output dataset formed the main dataset on which the Patient Module is based. It was important for that dataset to contain a separate record for each adult and child, since PBS medicine usage by age group and drug type was a key output expected from the MA project. However, links between families also had to be maintained since the PBS rules regarding SNTs concerned total expenditures by families on prescribed drugs.

Thus the MA model's population database is the household sample from the non-institutionalised Australian population (from the HES) who spent on prescribed medicines[7], plus a proportion of households with

7 To select persons/families who had spent on prescribed drugs, HES data on weekly spending on prescribed drugs were merged onto the STINMOD output

concessional safety net status. That is, a proportion of families with concessional card status that did not spend on prescribed drugs were included in the dataset to represent concessional cardholders that had reached the safety net. For the most part, however, the model's population database excludes individuals (and their families) that had no expenditure on prescribed drugs. It also excludes people living in institutionalised care — for example, hospitals and nursing homes. Prescribed drug usage figures at ages above 70 years, therefore, are likely to be underestimates.

Adding indicators on script usage from the NHS was more difficult as the individuals interviewed for the NHS were different from those interviewed for the HES. Individuals in STINMOD and the NHS were first classified by gender, five-year age group and card status (2 x 16 x 2 = 64 groups) (see appendix C). The number and types of drug consumed by each of these 64 groups were then imputed from the NHS to the Patient Module's main dataset. This was done within each card, age and gender cell by imputing the *number* of drugs used (from one drug to a maximum of seven drugs) and then the *types* of drug used (from among 36 drug classes). As a result, each person in the Patient Module had one or more of the 36 drug types allocated to them, so that within each card, age and gender cell the drug usage pattern in the model matched the usage pattern in the NHS.

The process of imputing the number of drugs was done differently for general and concessional patients.

- For general patients, individuals within each cell were ranked by family expenditure on drugs from highest to lowest. First, seven drugs were allocated to persons with the highest expenditure until the weighted share for that cell was equal to the weighted share for the same cell in the NHS dataset. Then, six drugs were allocated, and so on, with one drug allocated last.
- For concessional patients, the allocation proceeded randomly within each cell until the NHS shares had been reached. Expenditure was not used in the allocation process since concessional patients that have reached the SNT pay nothing for drugs they consume.

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file. This was a simple matter as the two data files contained the same individuals (since the version of STINMOD we used was HES-based).

Finally, the dataset was further modified such that total number of scripts by the 36-drug classification (based on data on script usage imputed for each individual using prescribed drugs) was consistent with HIC data on actual scripts for the base year 2000-01. While aligning the model to administrative data in this way, the pool of prescribed medicine was separated into three groups:

- **Group 1** scripts for drugs with a cost to government under the PBS (known elsewhere as 'benefit' drugs);
- **Group 2** scripts for PBS-listed prescribed medicines not attracting a government subsidy — that is, scripts with a total cost (or price) below the PBS copayment level (below copayment drugs); and
- **Group 3** scripts for prescribed drugs not listed under the PBS (private medicines).

Note that, because the alignment process needs to be carried out against observed administrative data, it was only done once for the base year (2000-01). Then throughout the forecasting period, the group assignment of each observation is assumed to remain unchanged. Consequently, the alignment process needs to be carried out before the model can be run for purposes of simulating base year or scenario options.

Stage 2 — Simulating the PBS and forecasting scripts and expenditures

Once the main person-based dataset of the Patient Module had been prepared, the PBS was modelled by applying the rules of the scheme to each individual (or family) in the dataset. Basically, the Patient Module uses, as input, an individual (or family) based dataset describing people's pattern of usage of 36 types of PBS drug categories, as well as the average cost of each of these categories. It then simulates expenditures by patients and the government under the PBS, applying the rules of the scheme to each individual or family separately over an 18-month period on a two-weekly basis starting on 1 January (when each family's expenditure on prescribed medicines is reset to zero, which allows patient spending to accumulate from a zero base).

Results are aggregated for four groups of patients — concessional patients above the SNT (C0), concessional patients below the SNT (C1), general patients above the SNT (G1) and general patients below the SNT (G2) — for the last twelve months of the simulation. This enables

outcomes to be presented for a full financial rather than a calendar year for the concessional and general groups.

Briefly, the steps carried out within the second stage of the Patient Module for the base year involve:

- allowing users of the model to specify the policy settings of the scheme (copayment levels and SNTs over the simulation period for concessional and general patients);
- simulating the scheme by computing the costs associated with the scripts imputed to individuals (based on the average cost per script for each of the 36 drug classes[8]) and identifying below and above SNT patient expenditures for concessional and general patients;
- computing government contributions as total costs less patient contributions; and
- creating detailed output datasets for concessional and general patients.

The same process is carried out to generate scripts and expenditures for the forecast years (2001-02 to 2005-06) except that, instead of using actual data on scripts and average costs, the model reads in estimated data on scripts and costs based on trends of aggregate scripts and costs (the sum for concessional and general patients) as generated by the Medicine Module for each of the 36 drug classes.

A schedule of all the SAS programs developed to create the database and run the model for the base year and forecast years is shown in figures 3 and 4.

Because of our reliance on survey data, difficulties were encountered in fully modelling the effects of the safety net. To compensate for this, the proportion of scripts beyond the SNTs is constrained in the model to be equal to the actual share reached in the base year based on administrative data, on a calendar year basis. This results in accurate cost estimates by drug type.

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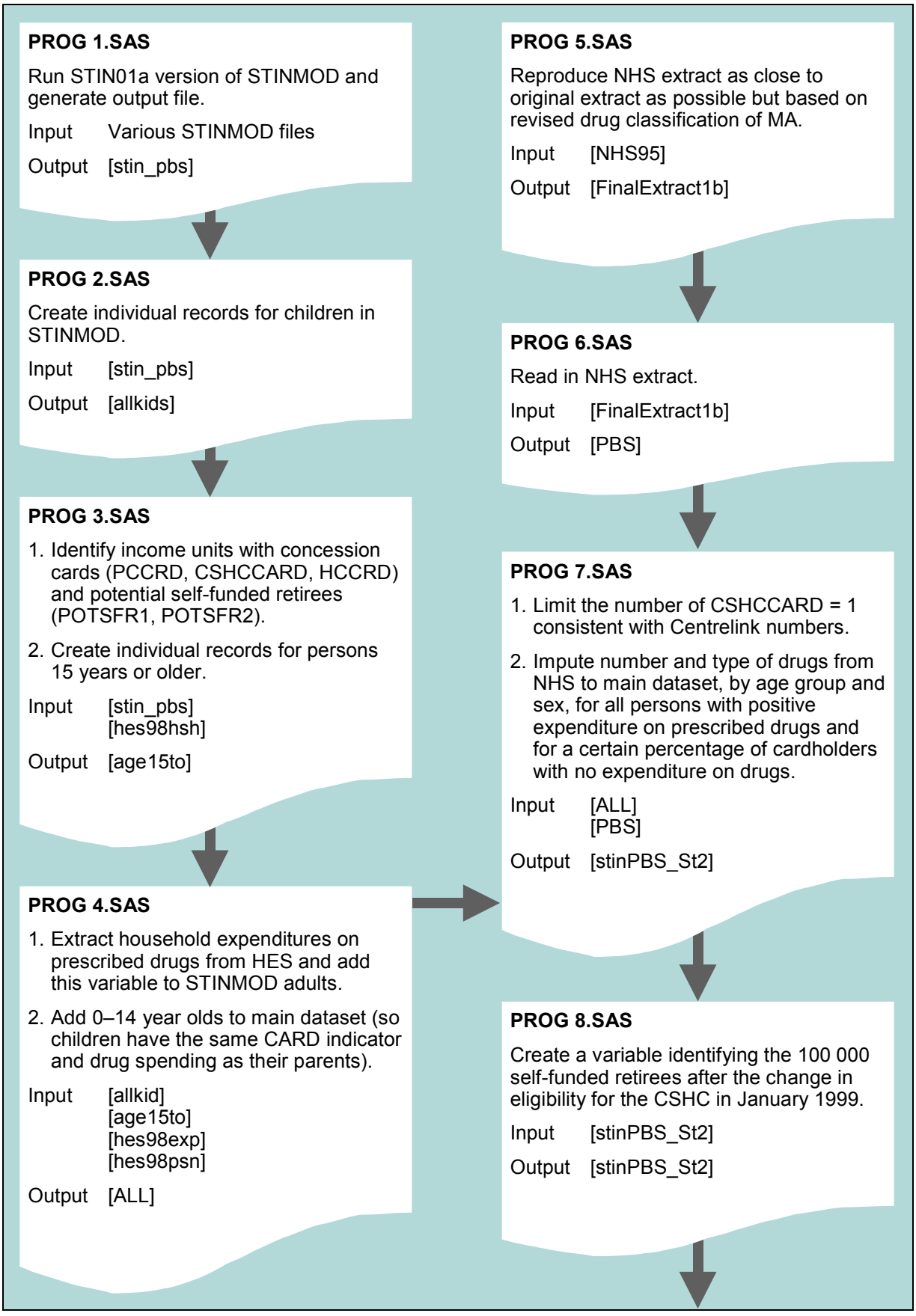
8 The current version of the model uses as input average costs for C0, C1 and G1 patients and G2 patients separately. In actuality there is only one set of average costs for all types of patient, but this distinction was made to separate out the G2 patients, who pay a higher copayment rate and shoulder a greater proportion of the price of PBS-listed medicines.

Figure 3 **MA model control program, base year**



(Continued on next page)

Figure 3 **MA model control program, base year** (continued)

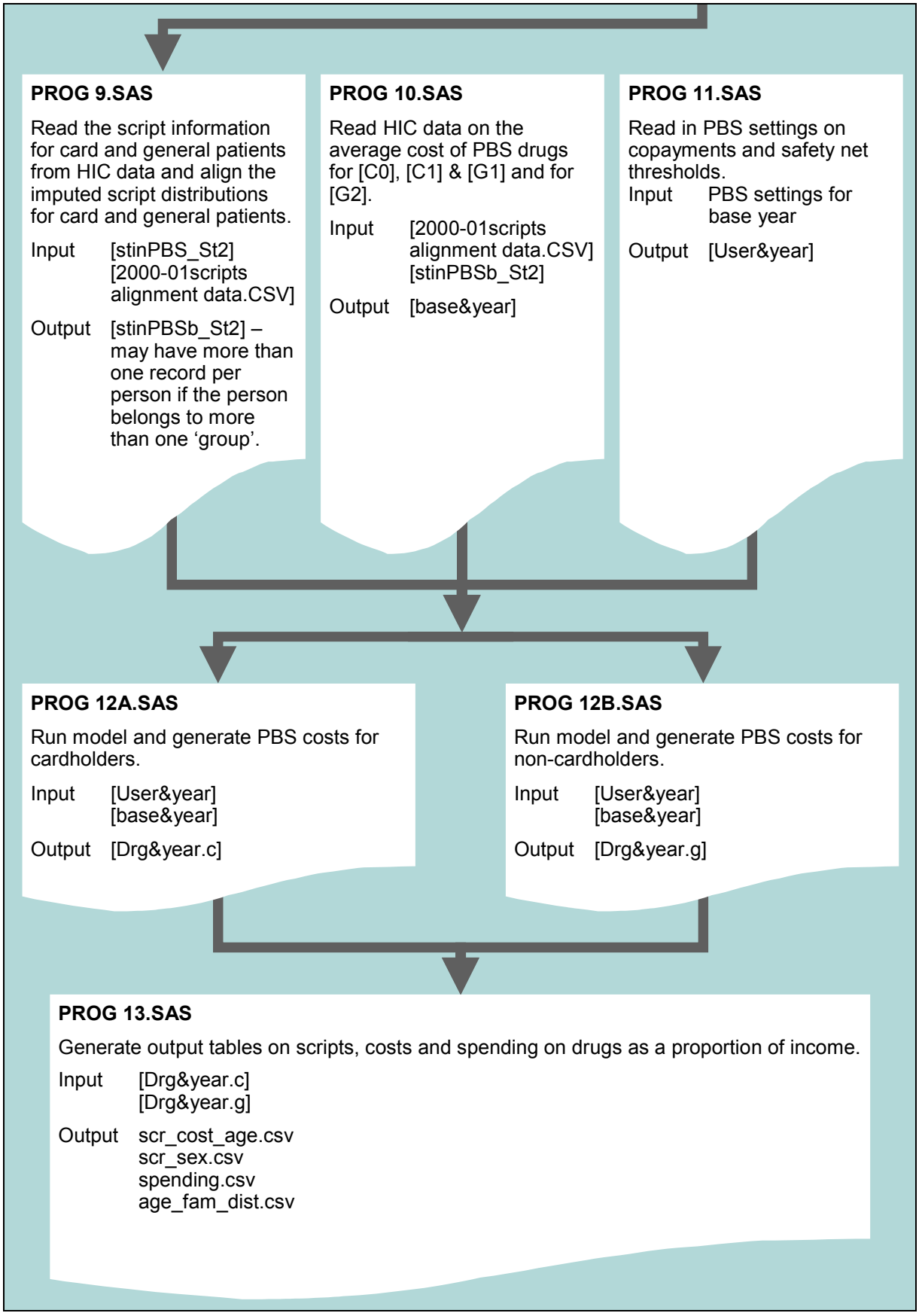
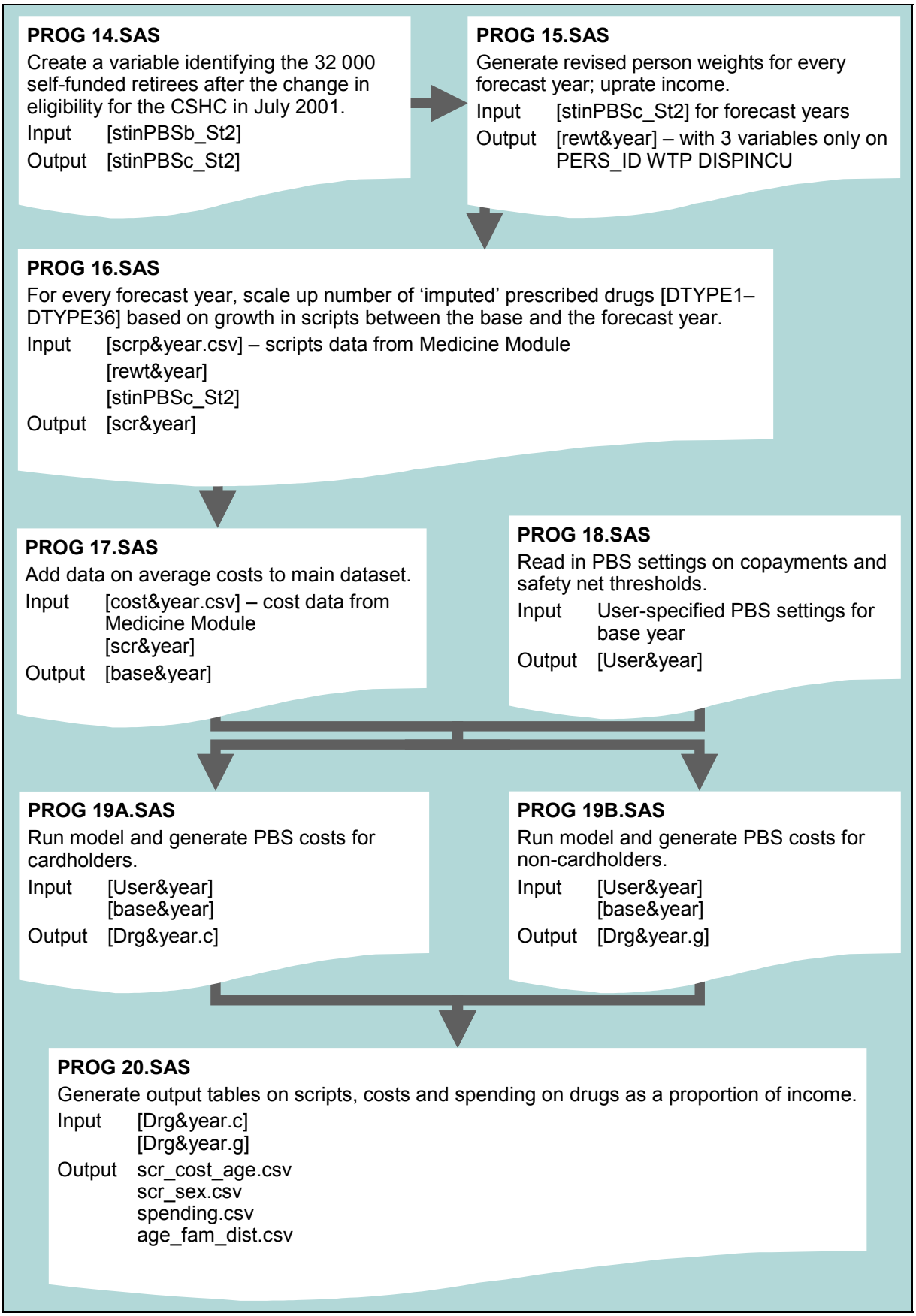


Figure 4 **MA model control program, projections 2001–06**



An important output of the model, in addition to the script and cost information, is an indicator of expenditure on PBS medicines by poor and rich Australian families. This is a particular strength of the microsimulation approach, since distributional issues are much harder to handle with other types of model. However, at this stage of the model's development we were able to estimate only PBS medicine patient expenditures as a proportion of disposable income (at the level of the family) in a notional 1–14 January 'window' — when expenditure on prescribed medicines has just been reset to zero. What cannot be obtained at this stage is a yearly estimate of a particular family's (or an income-based group of families) expenditure as a proportion of their after-tax income.

4 Improvements made on the original model

4.1 Database

Household Expenditure Survey 1998-99

The original Patient Module, which was based on the 1993-94 HES, was upgraded using the confidentialised unit record files (CURF) of the 1998-99 HES. The 1998-99 database comprises 6892 household records and 13 964 person records. Person records exist for only individuals aged 15 years or over, although limited information on children aged less than 15 years (for example, the number of children per household) is included within the household data. Expenditure data were collected on over 600 items, one being prescribed medicines. At the expenditure level, there are a total of 545 613 records in the HES 1998-99 dataset (ABS 2000).

Where possible, the ABS has maintained comparability in the concepts, classifications and methodology used in the 1998-99 HES with those from the 1993-94 survey.

National Health Survey 1995

The original model was based on an extract by the ABS from the full 1995 NHS dataset. The extract was purchased by NATSEM, as the unit

record NHS files were not available at that time. The extract contained 13 942 records.

In the updated model, the drugs have been grouped in a different way to accommodate the classification adopted for the Medicine Module. This reclassification required the creation of a new extract from the unit record files of the 1995 NHS. This extract contains 18 782 records (having removed from the NHS CURF respondents who did not use prescribed medicines).

A number was assigned to each medicine type linking the NHS drug classes to an ATC code and to the 36 drug classes used in the Patient Module. (The first 18 are the same as in the Medicine Module, and the remaining 18 classes, when aggregated, are the same as the forecast group 19 of the Medicine Module.) Note that the NHS does not specifically identify all the medicines by the ATC codes required for the MA forecast groups. Profiles of medicine usage for forecast groups that fall into this category therefore were created based on 'all other medicines' and actual proportional use, as advised by Medicines Australia. As per the original Patient Module, the extract is truncated to read in only the first seven medicines used per NHS respondent.

Two modifications needed to be made to the new NHS extract: one to discount Department of Veterans' Affairs (DVA) cardholders and the second to assign concession cardholder status to 'eligible' children.

DVA cardholders

The extract totals in the new NHS dataset were higher than in the original ABS extract as DVA cardholders were excluded from the original extract. However, DVA cardholders cannot be separately identified in the NHS CURF. This is because the survey question on DVA status — available to the ABS when preparing the original extract — was excluded from the CURF for reasons of confidentiality. We therefore adjusted the extract to 'remove' the effect of DVA respondents. To do this, the weight attached to each record (wtp) was deflated. The deflator was calculated as the weighted total from the original extract divided by the weighted total in the new extract. When the deflated weight was applied to each record, the number of medicines used and number of cardholders were reduced accordingly.

Children

Initially, there were no children aged less than 15 years in the NHS extract with a positive cardholder status. Children whose parents had a concession card were not identified in the NHS CURF as being cardholders themselves. Thus, the extract had to be modified so that children aged less than 15 years could have the same card status as their parent/s. This adjustment resulted in 624 children changing card status.

The variables contained in the final version of the NHS95 extract used in constructing the MA model are given in table 3.

Table 3 **Variables in the NHS95 final extract**

Variable name	Description
Sex	Sex of person: 1 = male; 2 = female
Pers_id	Unique person identifier
Inc_id	Unique income unit or family identifier
NewAge (renamed to Age_PBS)	5-year age grouping (1–16): 1 = 0–4 years 2 = 5–9 years 3 = 10–14 years 4 = 15–19 years 5 = 20–24 years 6 = 25–29 years 7 = 30–34 years 8 = 35–39 years 9 = 40–44 years 10 = 45–49 years 11 = 50–54 years 12 = 55–59 years 13 = 60–64 years 14 = 65–69 years 15 = 70–74 years 16 = 75 years and above
Cardholder	Whether person holds a concession card: 0 = no 1 = yes
Rev_ Cardholder (renamed to Card)	Whether adults in family hold a concession card: 0 = no 1 = yes

(Continued on next page)

Table 3 **Variables in the NHS95 final extract** (continued)

Variable name	Description
Med1	First type of drug by Patient Module bin
Med2	Second type of drug by Patient Module bin
Med3	Third type of drug by Patient Module bin
Med4	Fourth type of drug by Patient Module bin
Med5	Fifth type of drug by Patient Module bin
Med6	Sixth type of drug by Patient Module bin
Med7	Seventh type of drug by Patient Module bin
Q614	0 = med1 not prescribed, 1 = med1 prescribed
Q625	0 = med2 not prescribed, 1 = med2 prescribed
Q636	0 = med3 not prescribed, 1 = med3 prescribed
Q647	0 = med4 not prescribed, 1 = med4 prescribed
Q658	0 = med5 not prescribed, 1 = med5 prescribed
Q669	0 = med6 not prescribed, 1 = med6 prescribed
Q680	0 = med7 not prescribed, 1 = med7 prescribed
NumMedUsed (renamed to MedCount)	Number of prescription drugs used
Wtp (renamed to wtp_nhs)	Deflated person weight variable for this extract file

STINMOD/01A

The current MA model uses the output data file of STINMOD/01A. The original model used the output data file of STINMOD/96A. The latter version of the model was based on the 1993-94 HES and reflected the federal government income support payments and income tax systems as they were in 1996. Since that time, however, the tax reform package 'A New Tax System' has been implemented and the more up-to-date 1998-99 HES data have been released. Hence, STINMOD/01A reflects the income tax and social security systems as they were in the 2000-01 financial year, and is based on the 1998-99 HES. It is the output dataset from this version of STINMOD that has been used in the current version of the MA model.

This derived dataset contains 8653 income unit records. Income unit records exist only for family heads aged 15 years or more.

An individual record for each adult and child within each income unit was generated from the STINMOD/01A database.

4.2 Changes to the Patient Module

Key tasks

The following tasks were undertaken in updating the model:

- adjustment of the Patient Module's drug groupings to match the 19 forecast groups used in the Medicine Module;
- reconstruction of the Patient Module database, updating to the 1998-99 HES and the related STINMOD files (uprated to 2001);
- realignment of the model to the 2000-01 HIC PBS script and cost data; and
- testing plus validation of the base year results for the upgraded Patient Module.

Drug classification and concordance

The drug classification for the Patient Module was arranged so that it aligned with the first 18 forecast groups in the Medicine Module (that is, the first 18 groups were kept intact — neither disaggregated nor combined with another medicine forecast). The 19th forecast (residual) group was allocated across the remaining 18 bins available in the Patient Module. This disaggregation was decided by Medicines Australia.

The basis of the split for the residual 18 bins was initially the ATC type — keeping the B*s together (blood and blood forming organs medicines), keeping the remaining M*s together (musculoskeletal system medicines excluding forecast Group 1), etc. However, because this did not result in 36 classes, some ATC types were further divided. For example, the remaining cardiovascular drugs were divided into three classes — 20, 21 and 22. This disaggregation produced bin sizes that were large enough to generate non-zero results from the Patient Module.

When extracting drugs based on the new classification from the NHS, the NHS 'drugs used' classes of 25, 27 and 99 were split between the 18 bins based on the actual proportional usage of drugs included in these bins in 1999-00 as advised by Medicines Australia.

The final classification of medicines used in the Patient Module is given in table 4.

Table 4 **Drug classes used in the Patient Module**

Drug class	Description	As a proportion of		
		Government cost	Patient cost	Scripts
		%	%	%
1	Anti-inflammatories	1.26	1.75	3.05
2	Asthma medications	7.70	8.16	7.00
3	Diabetes medications	3.58	1.78	2.51
4	Vasodilators & beta blockers	2.60	2.71	4.48
5	ACE inhibitors	6.86	10.83	7.15
6	Angiotensin IIs	1.70	3.24	1.84
7	Calcium channel blockers	4.68	6.45	5.53
8	Cholesterol & triglyceride reducers	14.91	10.97	7.03
9	Analgesic medications	2.50	3.51	6.50
10	Antipsychotics	3.61	1.05	1.42
11	Anxiolytics & hypnotics	0.88	2.50	4.66
12	Antidepressants	6.53	9.34	5.95
13	Stomach medications	9.98	9.09	6.69
14	Antibiotics	4.07	5.74	8.24
15	Antineoplastics	6.12	0.90	0.55
16	Genitourinary	3.09	3.52	4.38
17	Anti-epileptics	2.08	1.46	0.99
18	Direct acting antivirals	1.81	0.55	0.19
19	Decongestants & antihistamines	0.57	1.04	0.95
20	Cardiac glycosides & anti-arrhythmics	0.45	0.55	0.71
21	Antihypertensives	0.39	0.50	0.60
22	Fluid & diuretic medications	0.80	1.13	1.99
23	Vitamin & mineral supplements	1.01	0.65	1.03
24	Cough & cold medications	0.10	0.14	0.25
25	Skin ointments & creams	1.97	1.86	2.11
26	Laxatives	0.26	0.22	0.39
27	Other medication – alimentary tract & metabolism (excluding diabetes & stomach medications)	1.93	1.90	1.66
28	Other medication – blood & blood forming organs	1.23	1.34	2.16
29	Other medication – systemic hormonal preparations (excluding sex hormones)	0.60	1.06	1.52
30	Other medication – general anti-infectives (excluding antibacterials & antivirals)	0.65	0.49	0.55
31	Specific antirheumatic agents	0.05	0.03	0.02
32	Other musculoskeletal system medications – topical products, muscle relaxants, antigout & bone disease	1.26	0.73	0.98
33	Other medication – antimigraine, psychostimulants & neotropics, anti-Parkinson & parasympathomimetics	0.96	0.71	0.86
34	Other medication – antiparasitic products, insecticides & repellents	0.27	0.48	0.73
35	Other medication – sensory organs	2.14	2.84	4.45
36	Other medication – various	1.27	0.54	0.58

Note: See appendix A for Drug Concordance PBS and ATC codes.

Changes to variables

The SAS coding was revised in all programs in the database creation and alignment phase of the Patient Module to correct for changes to data items included in the HES, STINMOD and NHS input datasets. Key changes are now described.

Expenditure on prescribed drugs (HES)

Two particular changes to the HES dataset, at the expenditure level, should be noted. First, a key change to the 1998-99 HES database was the introduction of the household expenditure classification that replaced the HES commodity code list used in previous surveys. The household expenditure classification is a five-level hierarchical classification, items at the most detailed level such as prescriptions, being represented by a 10-digit code rather than the 3-digit commodity code value used in the 1993-94 HES.

In the 1993-94 HES the expenditure item code (for variable COMCODE) for prescriptions was 459, for which there were 2201 (0.3 per cent) records. This represented 1 645 915 persons whose households spent on prescribed drugs or 24.9 per cent of the population. In the 1998-99 survey, prescriptions were coded under the variable COMCOD10, as item number 0903010101. There were 2108 (0.4 per cent) record counts, representing 2 025 008 persons or 28.4 per cent of the population.

Second, the data item identifier for expenditure value was changed. In the 1993-94 HES dataset, expenditure value was represented by the variable EXPVALUE. In the 1998-99 survey, this was relabelled to SUMEXP.

Other definitional and data item changes in the 1998-99 HES were indirectly incorporated into the Patient Module through the STINMOD/01A database since this version of STINMOD was based on the 1998-99 HES.

PBS concessional patients (STINMOD)

Important changes to the variables and SAS code in the Patient Module had to be made to reflect changes in the definition and eligibility of individuals and families to federal government pensions and allowances. Centrelink now issues three types of concession and health

care cards that allow cardholders access to PBS medicines at the concessional rate. These are the Pensioner Concession Card, the Health Care Card and the Commonwealth Seniors Health Card. The Health Benefits Card previously issued to sickness allowance beneficiaries, which was included in the initial Patient Module, no longer exists and has been deleted from the revised module code.

The uprated STINMOD database incorporates changes to the federal government pension and allowance schedules. The eligibility criteria for the three health concession cards were checked against Centrelink documentation. Potential cardholders were then identified using the STINMOD/01A revised variable classifications and Centrelink's updated income thresholds.[9] With the abolition of the Health Benefits Card, individuals receiving a sickness allowance are now eligible to apply for the Health Care Card, and thus were included in the revised coding for this group of cardholders.

Automating the alignment procedure

The pattern of drug usage from the 1995 NHS by sex and age group was imputed onto the 2000-01 MA model base data. As the data in the 1995 NHS covered all prescribed drugs, there was a need to select from this group a subset representing drugs attracting a government contribution under the PBS. This was done by aligning the scripts in the 2000-01 model to the scripts appearing in the HIC 2000-01 data (grouped into the same 36 drug classes as the Patient Module's base data). The alignment was carried out separately for concessional and general patients.

In the previous version of the model, the script alignment was done by hand and for only total scripts (for example, a 10 per cent fit at the aggregate level was considered adequate). Moreover, particular drug groups with a low volume of scripts were represented as having zero scripts.[10] For the current 2000-01 model, NATSEM automated the

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9 For reasons explained in section 5.3 (on concession cardholders) we opted to identify Commonwealth Seniors Health Cardholders using pre-January 1999 income thresholds.

10 This occurred when the script usage of the first observation in the dataset using that particular drug group exceeded the HIC fortnightly scripts for the same drug group.

alignment process and carried out the alignment separately for each of the 36 classes. The result is that we were able to exactly match the actual number of scripts in the HIC data. Script numbers were aligned for every year from 2000 to 2006 so the script forecast of the Medicine Module was exactly equal to the script output of the Patient Module for each of the 36 drug classes. Through a modification in the input dataset and alignment procedure, there were no longer any drug classes having zero scripts. This was done by creating multiple observations, with each observation having a proportionally smaller weight. The smaller weight was calculated by taking the original weight divided by the number of multiple observations created.

The 'fit' for costs is not as good as for scripts, in part because the ratio of above-SNT scripts to total scripts remained modelled only at the aggregate level. Considerable changes to the SAS program would be required to consider this ratio at the 36 drug class level so as to obtain a better fit.

Handling drugs 'dropping out' of the PBS

As the model covers only PBS-subsidised drugs, in the original PBS model when the average price of a drug fell below the copayment, the drug 'dropped out' of the model and the associated scripts and costs were no longer counted. This feature of the model posed problems when formulating alternative scenarios wherein the price of some drugs fell below copayment. In such cases, the model would stop counting the associated scripts and costs and results were not comparable with the base case. For example, if a particular scenario raised the copayment such that some drugs dropped out of the PBS, one would expect patient costs to increase but in some cases there was a decline in patient costs as a result of drugs dropping out of the PBS.

To address this problem, Medicines Australia requested that NATSEM continue to count in all drugs even when the settings in a particular scenario would have caused some to drop out of the PBS. NATSEM revised the code such that all scripts and costs were counted in but additional tables were generated on the proportion of drugs dropping out of the PBS that had been counted in.

5 Focus on the Patient Module

5.1 Summary of key model constructs

- The MA model predicts script numbers and expenditure only for prescribed drugs subsidised under the PBS (defined in the modelling as Group 1). It does not include prescribed drugs whose prices fall below the PBS copayment levels (Group 2) or prescribed drugs not listed on the PBS (Group 3).
- The model's population database is a sample of households from the non-institutionalised Australian population who spent on prescribed medicines plus a selection of households with concessional card status who did not spend on prescribed medicines, included to represent those with concessional safety net status.
- For each of the 36 drug classes, expenditure is computed as (scripts)*(average cost) and is expressed in current dollars.
- The model is able to provide annual forecasts.
- The 'base case' represents the situation where no policy changes occur (except CPI indexed copayment increases).
- The input script and cost data to the Patient Module (for the base and forecast years) are obtained from the Medicine Module.

5.2 Computation of input script and cost data

The script and cost data used in the base case forecasts (and scenarios) were derived by applying annual growth rates predicted by the Medicine Module to the Patient Module base year data — the HIC 2000-01 administrative data.

Aggregate script numbers and total costs for each of the 36 drug classes used in the Patient Module were obtained from the Medicine Module for each of the forecast years. The average cost of each drug class was computed for each forecast year. The total number of scripts and the average cost for each medicine bin for each forecast year were then

compared with the respective base year figures, and the growth rate between the base and forecast year determined.

Script numbers and average costs, split into concessional and general components, were then obtained for each forecast year by applying the growth rates to the base year script and average cost figures for concessional and general patients for each drug class. That is, the base year concessional and general numbers were adjusted, year by year, in line with the aggregate growth rate forecast within the Medicine Module. Thus the numbers of concessional and general scripts for each drug group have the same growth rate, as do concessional and general average costs for each drug group.

5.3 Uprating the population base

Concession cardholders

From 1 January 1999 the federal government raised the income thresholds for self-funded retirees' eligibility to the Commonwealth Seniors Health Card (CSHC). The CSHC reduces the cost of prescription medicines for Australians of 'Age Pension' age, but who do not qualify for the Age Pension (dependants of CSHC holders are not eligible for concessions using the cardholder's card).

From 1 January 1999 self-funded retirees qualified for the CSHC if they had an annual income of:

- less than $41 000 for singles — increased from $21 000; or
- less than $68 676 combined for couples — increased from $34 000.

Centrelink indicated that they expected about 220 000 additional self-funded retirees to qualify for the CSHC and a take-up rate of about 50 per cent. Based on these numbers, NATSEM estimated that there would be about 100 000 additional CSHCs held by self-funded retirees as a result of this policy.

From 1 July 2001 the federal government again raised the income thresholds for self-funded retirees' eligibility to the CSHC. Self-funded retirees qualified for the CSHC if they had an annual income of:

- less than $50 000 for singles — increased from $41 000;

- less than $80 000 combined for couples — increased from $68 676; or
- less than $100 000 combined for couples who are separated due to ill health.

These limits are increased by $639.60 for each dependent child cared for and the level of this allowance did not change.

Centrelink identified that these changes increased the number of CSHC holders by approximately 31 760 individuals.

When incorporating these policy changes into the model, we had to take into account the fact that the input datasets on which the model was based were all pre-1999. Income thresholds prior to January 1999 were applied to check eligibility of potential CSHC holders (CSHCCARD) prior to January 1999. Two variables identifying potential self-funded retirees for the first and second policy changes were created (POTSFR1 and POTSFR2) based on income, age and sex criteria.[11]

Based on the pre-January 1999 income thresholds, the model originally had about 46 000 CSHC holders. The 100 000 and 32 000 self-funded retirees based on the two policy changes were initially considered as non-cardholders. The effect of this was that these retirees were imputed the drug usage of non-cardholders. There is a large difference in drug usage between concession cardholders and non-cardholders, with concession cardholders having about 60 per cent more scripts per person each year than non-concession cardholders. Thus, in later stages of creating the base data for the model, these self-funded retirees were transferred from the non-cardholders group to the concession cardholders group.[12] Since the pool of potential cardholders (POTSFR1 = 1 and POTSFR2 = 1) was greater than 100 000 and 32 000 respectively, self-funded retirees were selected from the pool of potential cardholders on a random basis.

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11 For males the cut-off age is 65 years while for females it is 62.5 years. Since the age variable in the model is a categorical variable representing five-year age groups, for females we chose those aged 60 or more rather than 62.5 or more.

12 The database stinPBSb_St2 (for 2000-01) had about 146 000 CSHC holders while stinPBSc_St2 (for 2001–06) had about 178 000 CSHC holders.

Population projections

The Patient Module's population was uprated year by year over the forecast period in line with the ABS five-year age–sex group projections. The ABS population projections were scaled down so that the population represented only people who lived in households and who bought prescribed drugs.

The ABS population projection figures for the five-year age–sex groups were obtained from the ABS publication catalogue series 3222.0. The ABS produces alternative projections of the resident population of Australia based on different assumptions about fertility, mortality and migration. Figures from Series1a[13], the 'high growth' series, were used. To derive the household population that bought prescribed drugs, each of the age–sex cells was scaled — first, by the proportion of the resident population living in private dwellings (with the proportion assumed to have remained unchanged from the 1993-94 HES) and, then, by the percentage of each five-year age–sex group in the household population that bought prescribed drugs as identified from the 1998-99 HES data. Next, the growth rates between the base year (2000-01) and successive years in the scaled projected populations were calculated. These rates were then applied to the Patient Module's base year population to derive 'target' forecast year populations. The 'target' five-year age–sex groups for each of the forecast year populations were then entered into the software package 'CALMAR' to derive new person weights. Finally, the module's population was uprated by changing the person weights (originating from the 1998-99 HES) to those generated by CALMAR.

The forecast year 2001-02 is the financial year July 2001 to June 2002; the other years are also financial years. Since the ABS calculates its population projections as at 30 June, we use the ABS population data for 30 June 2001 for the first forecast year, and so forth for the other years, ending with 30 June 2005 for the forecast year 2005-06.

The age distribution of the model's population (Group 1 patients) for the base year (2000-01) and the 2005-06 forecast year is given in figure 5. The most notable feature is the growth in numbers in the 55 years or more age groups.

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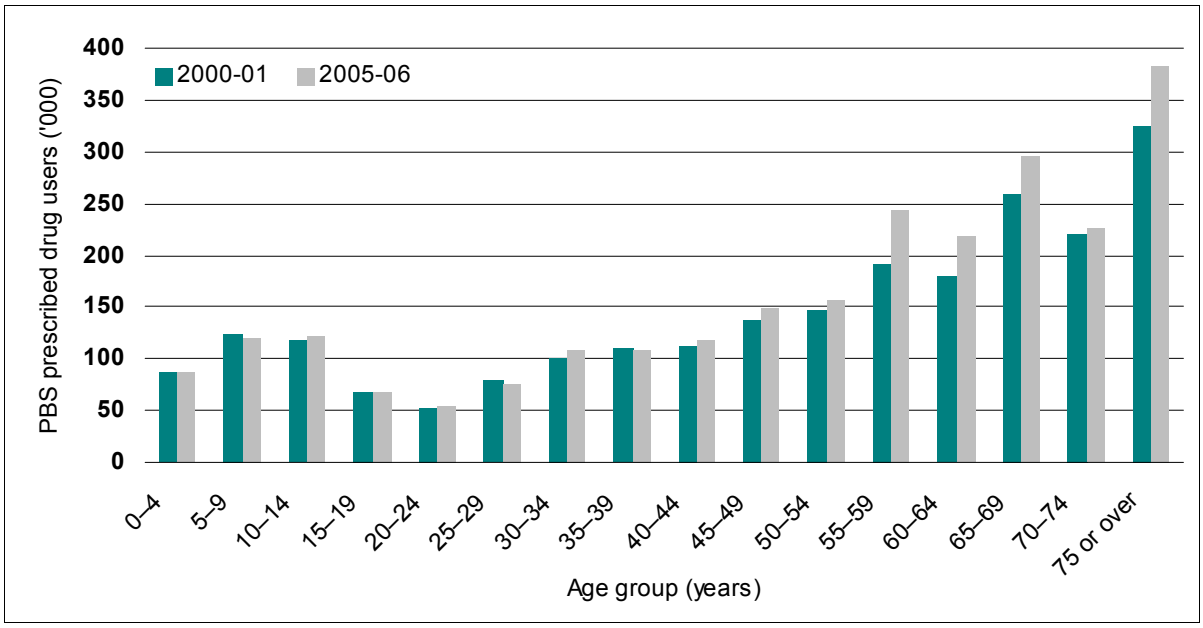
13 Assuming a fertility rate of 1.75 births per woman and net overseas migration of 110 000. (One mortality rate assumption is used for all series.)

Figure 5 **Model populations: spenders on PBS subsidised prescribed drugs, 2000-01 (base year) and 2005-06 (base case forecast)**



Family incomes

The Patient Module's population database was also uprated to reflect likely increases in family disposable incomes. A uniform rate of change in income, regardless of income level, was assumed. Since growth in gross domestic product is expected to be lower in the next few years than in the recent past, it is reasonable to adopt the relatively conservative trend growth in male average weekly earnings rather than growth in the mean gross weekly income. Mean gross weekly income increased on average by 4.4 per cent a year over the past five years while average weekly earnings increased by 3.07 per cent a year during the years 1991–01. Family disposable incomes were uprated by the growth factor in average weekly earnings.

5.4 PBS copayment and safety net threshold settings

In addition to updating concessional status, NATSEM uprated the PBS policy settings — copayments and SNTs — to the settings that came into effect from 1 January 2001.

Projections of PBS settings for the forecast period were made by uprating current PBS settings in line with expected changes in the CPI. Given that there seems to be no reason why CPI changes over the next few years

should diverge markedly from longer term trends, we assumed for the base case forecasts that copayments and SNTs will increase by 2.5 per cent a year — the percentage change in the CPI from the September quarter of 2000 to the September quarter of 2001 and over the previous 10 years.

The levels of copayment and the SNTs for the base year were given in table 1. Assuming a growth rate of 2.5 per cent a year from 1 January 2001, the copayment reached by 1 January 2006 is $3.96 for concessional patients below the SNT and $24.77 for general patients below the SNT. The SNT is $205.91 for concessional patients and $757.70 for general patients.

We also assumed that the proportion of total scripts of families whose script costs were allowed to reach the SNT would remain at the 2000-01 (base year) levels throughout the forecasting period — that is, at 20.38 per cent for concessional patients and 18.93 per cent for general patients on a calendar year basis.[14] These proportions were based on PBS data provided by HIC on the actual number of scripts per patient category.

5.5 Presentation of results

Standard tabulations are generated for the base year, for each of the forecast years of the base case and, where appropriate, for alternative scenarios on the following:

- scripts and costs (patient, government and total) for 36 drug classes for concessional, general and all patients;
- scripts, patient costs and government costs by five-year age groups of concessional and general patients;
- scripts by gender and 36 drug classes for concessional and general patients;

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14 The safety net operates on a calendar year basis and therefore needed to be modelled within this period. To reconcile this with the need to generate statistics on a financial year basis, the safety net was modelled over an 18-month period and statistics were based on scripts and costs for the financial year or the last 12 months. For alignment purposes, the proportion of families reaching the SNT in the last 6-month period was restricted to 0.5 of 20.38 per cent for concessional patients and 0 per cent for general patients.

- family spending on subsidised PBS drugs as a share of family disposable income, by income quintile, for concessional and general patients that use PBS-subsidised drugs; and
- distribution of concessional and general patients that use PBS-subsidised drugs by age of family head, family type and income quintile.

6 Model validation

6.1 Comparing imputed and original script distribution

One of the most complex tasks in developing the model was imputing script usage from the NHS onto the model's input dataset. As stated, this was done by first imputing the number of drugs used (from one drug to a maximum of seven drugs) and then the types of drug used (from among 36 classes).

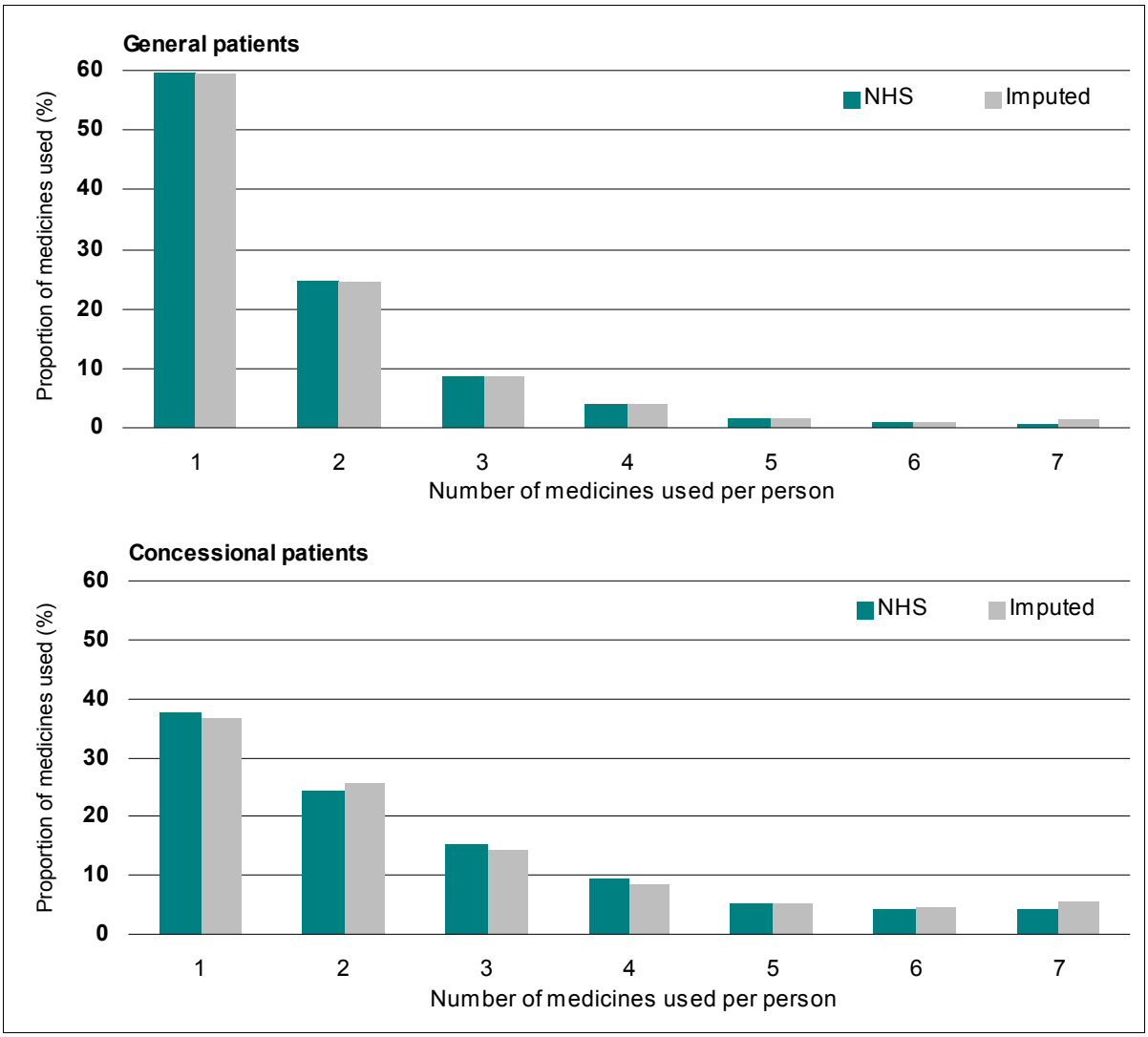
With respect to the first part of the imputation process, figure 6 shows that the distribution of the number of drugs used per person in the model's input dataset for all prescribed drugs, closely matches the original distribution for both general and concessional patient groups.

6.2 Comparing the Medicine Module's output with the Patient Module's output on aggregate scripts and costs

The model's output on aggregate scripts and costs was also validated. The output of the Patient Module for total scripts and patient and government costs (for both concessional and general patients) for the base year and forecast years was compared with output of the Medicine Module. This was done because in the previous version of the model, only scripts (at the 36 drug group level) for the base year were aligned with data generated by the Medicine Module. Data on scripts for the forecast years were also read in from the Medicine Module but, because of differences in individual person weights in the forecast years[15], the aggregate number of scripts generated by the Patient Module for the forecast years did not

15 Individual person weights vary across the forecast years to reflect population ageing across time.

Figure 6 **Distribution of the number of medicines used per person, National Health Survey and imputed**



correspond exactly with the number of scripts forecast by the Medicine Module.

Table 5 shows that the Patient Module is able to replicate total scripts (as well as scripts for each of the 36 drug classes) as forecast by the Medicine Module. However, it is less accurate with respect to replicating total costs as forecast by the Medicine Module. It underestimates patient costs for concessional patients by 4 percentage points, and overestimates patient and government costs for general patients by 7 and 10 percentage points respectively. The reason for the lack of consistency in costs generated by the modules is differences in average cost breakdown. In the Patient Module C+G1 average costs were used for the concessional group, and G2 costs for the general group. The justification is that G1

Table 5 **Base year: Patient Module output, Medicine Module output and actual data compared**

	Unit	Patient Module output	Medicine Module output	Actual data	Patient Module: Medicine Module	Patient Module: Actual data
Concessional						
Scripts	'000	124 121	124 121	124 705	1.00	1.00
Patient cost	$'000	323 737	336 811	337 378	0.96	0.96
Government cost	$'000	3 044 146	3 019 895	3 019 946	1.01	1.01
Total cost	$'000	3 367 883	3 356 707	3 357 324	1.00	1.00
General						
Scripts	'000	22 686	22 686	22 866	1.00	0.99
Patient cost	$'000	436 103	405 549	406 784	1.07	1.07
Government cost	$'000	871 558	790 269	790 270	1.10	1.10
Total cost	$'000	1 307 662	1 195 818	1 197 054	1.09	1.09
Concessional and general						
Scripts	'000	146 807	146 807	147 571	1.00	0.99
Total cost	$'000	4 675 545	4 552 525	4 554 378	1.03	1.03

Sources: MA model output; Department of Health and Ageing <www.health.gov.au/pbs/pubs/HICexp/pbjun/book02.htm>.

patients (general patients that have reached the SNT) pay the lower copayment rate charged concessional patients.

The Medicine Module's output is very close to actual figures for 2000-01. Therefore the comparison of Patient Module output with actual figures follows the same pattern.[16]

As with the base year, total scripts (as well as its breakdown for each of the 36 drug classes, although not presented here) for the forecast years are replicated exactly (table 6). For the forecast years, total costs (the total of patient and government expenditures) generated by the Patient Module also compared favourably with the output of the Medicine Module (the ratio being 1.02 and 1.03 over the forecast years).

16 We had to choose between using actual data from the HIC or DHA. (There is some inconsistency between HIC and DHA figures.) Both organisations generate data on PBS scripts and government costs, although DHA also generates data on patient costs. While the MA model relied mainly on HIC data inputs, we opted to use DHA 'actual' data in table 5 so that a comparison could be made of both government and patient costs. Had we used HIC data, the fit between the model's output and actual data would have been even closer.

Table 6 **Forecast years: Patient Module and Medicine Module output compared**

	Patient Module output	Medicine Module output	Patient Module: Medicine Module
Scripts	'000	'000	ratio
2000-01	146 807	146 807	1.00
2001-02	148 018	148 018	1.00
2002-03	151 316	151 316	1.00
2003-04	156 017	156 017	1.00
2004-05	161 028	161 028	1.00
2005-06	166 686	166 686	1.00
Total cost	$'000	$'000	ratio
2000-01	4 675 545	4 552 525	1.03
2001-02	4 934 234	4 806 629	1.03
2002-03	5 191 677	5 058 557	1.03
2003-04	5 577 435	5 438 334	1.03
2004-05	5 971 422	5 826 390	1.02
2005-06	6 216 991	6 065 888	1.02

Source: MA model output.

6.3 Validation against change in PBS settings announced in 2002

As the key function of the model is to be able to examine the implications of policy changes, it is crucial that the model produces reliable and accurate results when running scenarios. It should be acknowledged that the credibility of any model depends on the reliability of the input data and the construction of the model. The validity of the outcomes of the scenarios is subject to both the use of appropriate data and the capacity within the Medicine and Patient modules to make the necessary policy changes. The accuracy and reliability of the model can be tested and validated by simulating, for example, the projected outcomes from changes in the PBS settings as announced in the 2002 federal budget.

Simulation results by the model therefore were compared with expected outcomes from PBS-related policy changes announced in the 14 May 2002 federal budget. The government proposed increasing the levels of patient copayment for both concessional and general patients by approximately 28 per cent. The announced new PBS settings are listed in the table 7. If these proposed changes had been passed by the Senate, the rise in copayments was due to come into effect on 1 August 2002 and the increase in SNTs on 1 January 2003. When announcing the new policy

settings, the related changes were estimated to result in about $1056 million in net savings to government[17] over the following four years (Treasury 2002).

Table 7 **Copayment and safety net thresholds at 1/1/2002 and as per budget announcement effective on 1/1/2003**

	Actual 1/1/2002	Budget proposal 1/1/2003
	$	$
Copayment — concessional		
Below safety net threshold	3.60	4.60
Above safety net threshold	0	0
Copayment — general		
Below safety net threshold	22.40	28.60
Above safety net threshold	3.60	4.60
Safety net threshold — concessional	187.20	239.20
Safety net threshold — general	686.40	874.90

The above policy change was simulated using the MA model, assuming that after January 2003 that the increases in PBS copayments and thresholds would be in line with the expected increases in the CPI of 2.5 per cent a year. The results of the simulation were compared with the base case where PBS settings increased in line with annual CPI growth of 2.5 per cent. Government expenditures for the financial year 2002-03 as currently generated by the MA model are lower than expected.[18] We corrected for this by using scripts forward one year[19], and fixing the proportion of families reaching the SNT at 21 per cent for concessional patients and 20 per cent for general patients for all forecast years. As a result of these changes, the model estimate of total PBS government expenditure for 2001-02 was virtually identical to the budget estimate and for the period 2002–06 the model estimates closely approximated government estimates — within 5.5 per cent (table 8).

17 These are the savings to the Department of Health and Ageing portfolio from changes in the PBS settings. Further savings of $59.7 million accrue to the Department of Veterans' Affairs through savings from the Repatriation Pharmaceutical Benefits Scheme.

18 There were unanticipated increases (blow-outs) in script volumes and costs for some specific drug items.

19 The number of scripts per drug group in 2006-07 was estimated by applying the growth rate for 2004-05 to the number in 2005-06. The average cost per drug group in 2005-06 was assumed to be unchanged in 2006-07.

Table 8 **Savings to government from changes in PBS settings as announced in the 2002 federal budget**

	Unit	2001-02 base data	2002-03	2003-04	2004-05	2005-06	Total
Budget estimates							
Total govt expenditure	$m	4 379.0	4 311.0	4 641.0	5 015.0	5 394.0	19 361.0
Concessional	$m	3 479.0	3 522.0	3 803.0	4 102.0	4 420.0	15 847.0
General	$m	900.0	789.0	838.0	913.0	974.0	3 514.0
Savings	$m		284.3	266.4	256.9	247.9	1 055.5
Estimated change in govt expenditure	%		-6.2	-5.4	-4.9	-4.4	-5.2
MA model estimates							
Total govt expenditure	$m	4 382.0	4 501.6	4 803.8	5 020.3	5 104.0	19 429.8
Concessional	$m	3 358.9	3 511.6	3 746.8	3 881.2	4 003.0	15 142.6
General	$m	1 023.1	990.0	1 057.0	1 139.1	1 101.0	4 287.2
Savings	$m		208.5	240.0	199.7	278.2	926.4
Estimated change in govt expenditure	%		-4.4	-4.8	-3.8	-5.2	-4.6

Focusing on the effect of the policy on government expenditures, the proposed 28 per cent increase in copayments is expected to result in overall savings to the government of 4–5 per cent in each of the simulation years. The savings would be smaller for concessional patients (3 per cent for all years) than for general patients (7–13 per cent). For general patients, the estimates for the last two years of the simulation involve dropping out certain drug groups prescribed to general patients, as the average cost of these drug groups fell below the copayment level. They dropped out because such drugs were no longer eligible for government assistance under the PBS.[20] With no drug dropping out, the savings on general patients would have been greater — at 11–14 per cent.

In summary, for both concessional and general patients over the four years of the scenario, the simulations show government costs declining by $926.4 million relative to the base case. This is lower than, but not too far off from the estimate of $1055.5 million in the budget papers. The estimated savings to government of 4–6 per cent based on budget estimates is slightly lower than the 4–5 per cent based on MA model

20 This involved ACE inhibitors (drug class 5), angiotensins (drug class 6) and calcium channel blockers (drug class 7) whose average prices fell below the copayment for general patients of $30.05 starting in January 2005 and $30.80 starting in January 2006.

estimates. Differences in assumptions may have widened the gap between budget estimates and those generated using the model. For instance, there is a marked decline in budget figures on government expenditure on general patients in 2002-03 that may be due to some assumptions about price response that had not been factored into the MA model.

Apart from assessing the accuracy of the model's output on government expenditure, the validation exercise also points to the need to check the model's assumptions on scripts and average prices per drug group for the simulation years, in order to be able to more closely target actual or expected government expenditure. It also highlights the need to examine the proportionality between estimates of expenditures on concessional and general patients. For example, model estimates of government spending on general patients exceed budget estimates by 25 per cent for nearly all forecast years. In contrast, model estimates of government spending on concessional patients are virtually the same in 2002-03, but fall behind gradually to 91 per cent of budget estimates by 2005-06.

Two additional examples of standard output from the model for the base year and final forecast year of the scenario (28 per cent increase in PBS settings) are presented in table 9 and figure 7. Table 9 shows the total number of scripts and the total costs for each of the 36 drug classes and figure 7 shows the proportion of family income spent on PBS-subsidised drugs by the general patient population who used these drugs.

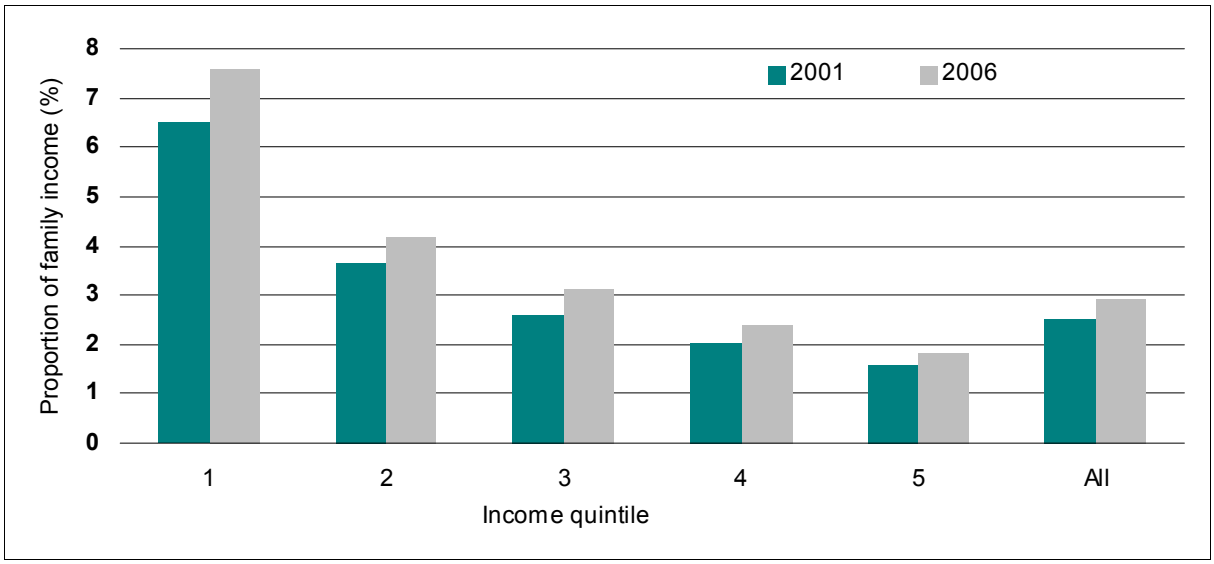
As mentioned, a particular strength of the microsimulation approach is its capability to generate an indicator of the affordability of PBS medicines to poor and rich Australian families. Figure 7 shows the type of distributional information that the model is able to provide. The general patient population using PBS-listed and subsidised drugs ranked by disposable (after-tax) family income is divided into five equal groups or income quintiles, and shows the proportion of each group's income being spent on PBS-subsidised drugs in January 2001 and January 2006. In preparing the figure, as described previously, PBS copayments were assumed to increase by about 28 per cent, with the rise in copayments coming into effect on 1 August 2002 and the increase in safety net thresholds on 1 January 2003. We further assumed that increases in PBS settings in subsequent years would be in line with inflation, while income was assumed to increase in line with the expected growth of male average weekly earnings.

Table 9 **Scripts and costs: 2000-01 (base year) and 2005-06 (scenario, 28 per cent increase in PBS settings)**

Drug class	Description	Scripts			Total costs		
		2000-1	2005-6	Change	2000-1	2005-6	Change
		'000	'000	%	$ million	$ million	%
1	Anti-inflammatories	6 744	7 363	9	241	250	4
2	Asthma medications	9 804	9 734	-1	334	370	11
3	Diabetes medications	3 810	5 634	48	169	261	55
4	Vasodilators & beta blockers	6 339	6 094	-4	113	109	-3
5	ACE inhibitors	10 029	8 539	-15	290	215	-26
6	Angiotensin IIs	4 329	5 458	26	125	116	-7
7	Calcium channel blockers	7 387	6 824	-8	187	157	-16
8	Cholesterol & triglyceride reducers	11 313	23 373	107	658	1 265	92
9	Analgesic medications	9 249	9 729	5	122	143	17
10	Antipsychotics	2 027	2 233	10	158	311	97
11	Anxiolytics & hypnotics	6 419	6 571	2	47	48	2
12	Antidepressants	9 494	14 051	48	391	577	47
13	Stomach medications	9 334	12 343	32	386	494	28
14	Antibiotics	11 287	8 904	-21	182	158	-13
15	Antineoplastics	887	1 247	41	275	599	118
16	Genitourinary	6 277	6 246	0	146	155	6
17	Anti-epileptics	1 426	1 634	15	83	111	34
18	Direct acting antivirals	276	324	17	63	80	28
19	Decongestants & antihistamines	672	1 350	101	12	39	216
20	Cardiac glycosides & anti-arrhythmics	982	1 013	3	19	25	31
21	Antihypertensives	789	860	9	15	22	50
22	Fluid & diuretic medications	2 652	2 841	7	34	50	48
23	Vitamin & mineral supplements	1 402	1 471	5	37	42	14
24	Cough & cold medications	336	351	4	4	6	38
25	Skin ointments & creams	2 938	3 005	2	84	101	21
26	Laxatives	564	556	-1	10	12	14
27	Other medication – alimentary tract & metabolism	2 024	2 367	17	70	98	40
28	Other medication – blood & blood forming organs	3 569	3 084	-14	89	69	-22
29	Other medication – systemic hormonal preparations (excluding sex hormones)	2 166	2 167	0	30	46	50
30	Other medication – general anti-infectives	766	783	2	25	28	12
31	Specific antirheumatic agents	22	28	29	1	2	38
32	Other musculoskeletal system medications	1 496	1 391	-7	57	50	-11
33	Other medication – antimigraine, psychostimulants & neotropics, anti-Parkinson & parasympathomimetics	1 264	1 222	-3	43	42	-2
34	Other medication – antiparasitic products, insecticides & repellents	1 018	1 040	2	12	19	55
35	Other medication – sensory organs	6 473	6 347	-2	99	125	27
36	Other medication – various	1 241	833	-33	63	45	-28
All		**146 807**	**167 013**	**14**	**4 676**	**6 241**	**33**

Figure 7 shows at the family level that the poorest general patients who used PBS-subsidised drugs (quintile 1) are most affected financially by Australia's PBS system. In 2000-01 they are estimated to have spent 6.5 per cent of their families' disposable income[21] on PBS-subsidised drugs (7.6 per cent by 2005-06), compared with 2.3 per cent on average for all patients (general and concessional). In summary, the simulations show that these families spend 7–8 per cent of their after-tax family income on PBS-listed prescribed medicines, which is considerable, even though it is only part of the families' total expenditure on health. The group of poorest general patients includes families with incomes just above the levels needed to qualify for PBS concessional status — for example, large families (three or more children) with parents in low skilled and/or non-permanent jobs, with three-fifths of family heads aged 40–64 years.

Figure 7 **Proportion of family income spent on PBS subsidised drugs by general patients who used PBS medicines, January 2001 and January 2006**



Note: The proportion of family income spent was measured over the fortnight 1–14 January (see pp. 15 and 42–44 for discussion on modelling the safety net). Quintiles refer to disposable cash incomes computed for the prescribed drug user population subsidised under the PBS (that is, they are not quintiles for the whole Australian population).

21 Average family disposable income was calculated after setting negative incomes to zero. In this example, we chose to set the negative incomes in the model's main dataset (arising from the HES) to zero. The issue of negative incomes in surveys is a much researched area (see Walker and Abello 2000, sections 3.1 and 6). As a result, the average income level of quintile 1 general patients increases somewhat compared with the original survey incomes.

For all quintiles, the proportion of family income spent on PBS drugs in 1–14 January 2006 was higher than in 1–14 January 2001 because the expected rate of increase in drug spending (that depends on increases in script numbers and PBS copayments) was higher than the expected rate of increase in incomes.

7 Capability and limitations of the Patient Module, and future enhancements

While much work has been undertaken in the past year to upgrade the model, there is still scope for both minor improvements and major advancements to the model. This section of the paper analyses various features of the model, with emphasis on the model's current capability and limitations. It presents possible areas in which the model could be further developed and enhanced with respect to various technical aspects of modelling and expanded into a broader field of policy and research on pharmaceuticals in general and the PBS in particular. The work needed in scoping and implementing the possible changes to the model form the basis of the research planned for the Australian Research Council Linkage Grant.

7.1 'Minor' model improvements

Rescaling the weight of observations

In the model, scripts are the product of 'unit scripts' per person, multiplied by the weight of that person in the dataset (the WTP variable). Depending on the script numbers for the drug and the weight of the person, some drugs may be represented by only one record or individual if the script volume is low and the weight of the person is high. For some drug groups —laxatives (drug class 26), other medication for blood and blood-forming organs (drug class 28) and antirheumatics (drug class 31) — among general patients, the script volumes were so low and the weights of the potential individuals consuming those drug

types so high that, if adjustments had not been made, these drug classes would have had zero representation.[22]

One remedy for the above is to revise the weights of some observations in the dataset such that the weight of each observation or record is, for example, 100 instead of ranging from 20 to over 7000, and to create multiple observations for the records whose weights had been rescaled, so that aggregate figures such as those on population size and drug usage do not change.

Such a procedure would also have the additional benefit of simplifying the alignment procedure because the adjustment procedure of sorting observations by drug group by their weight (from lowest to highest) could be dispensed with. This adjustment procedure had the unintended effect of selecting observations with lower weights and resulted in higher scripts per person for the concessional group relative to previous years. Further, it would facilitate using a distributional approach to pricing as such an approach would require several observations per drug group. The main drawback to rescaling the weight of observations would be the longer processing time involved.

Using a distributional approach to drug pricing

Patient and government expenditures on the Patient Module drug classes are currently estimated using the average price of each drug class as generated by the Medicine Module. For each of the 36 drug classes, the average price is computed as the total expenditure on PBS prescribed drugs in that drug group divided by the total number of corresponding scripts:

$$\text{Average price} = \text{total expenditure / no. of scripts}$$

$$= \sum w^i p^i / \sum w^i$$

where

w^i = no. of scripts for drug subgroup i, i = 1 to n and n = no. of subgroups;

22 Adjustments were made such that these three drug classes were represented in the model with only one individual recorded as consuming each drug, with the weight of each individual being a fraction of its original weight.

p^i = average price of drug subgroup i; and

$\sum w^i$ = total no. of scripts for all drug subgroups.

Average prices for specific drugs (for example, Amoxillin capsules of a given dosage) would be the same for all patient types. However, average prices for drug *classes*, an aggregation of various specific drugs categorised into one group, may vary across different patient types depending on the composition and cost of specific drugs within each drug group.

For most drug groups, there is a significant difference between the average prices for concessional and general patients, the average price for general patients being significantly higher for most drug groups. The major reason for this is *not* differences in consumption (or that general patients consume the more expensive drugs), but rather the difference in scope or definition. Recall that the PBS data cover only PBS prescribed drugs. Since general patients have a much higher copayment rate, lower cost drugs whose average price falls below the copayment rate for general patients are not included in the PBS data, whereas these are included for concessional patients whose copayment rate is much lower. (When we reach the stage in building the model that *all* prescribed pharmaceuticals are included rather than just PBS or government prescribed pharmaceuticals, we expect to see an evening out of average prices for the concessional and general groups as the copayment rate would cease to be a factor restricting the inclusion of drug subgroups for general patients.)

Two different sets of average prices are read in by the Patient Module — one set of average prices for C0, C1 and G1 patients and another set of average prices for G2 patients.

C0 patients pay nothing for drugs they consume. C1 and G1 patients pay the lower copayment rate for concessional patients, while G2 patients pay the copayment rate for general patients. We chose to aggregate C0, C1 and G1 patients since the average price they pay per drug group is not too dissimilar. G2 patients are classified into another group since the average price they pay per drug group is much higher.

The use of average prices in the MA model is justified on the basis of simplicity. As we move from a simple model to a more complex one, one option to better approximate reality is to input a *distribution* of prices for

each of the 36 drug classes (at a greater level of disaggregation) rather than use the average price per drug class.

For example, antihypertensives (drug class 21) had an average price of $26.79 in 2000-01. This is composed of three subgroups:

ATC code	Average price (P^i)	% scripts ($w^i/\sum w^i$)
CO2A	$27.98	47.2%
CO2C	$25.26	51.3%
CO2D	$50.45	1.5%

While the present model produces accurate results at the aggregate level, some drug groups do 'drop out' of the model in scenarios where the average price falls below the simulated copayment levels for general patients. For example, a 22 per cent increase in copayments would cause all of drug class 21 to drop out. This weakness of the model would be overcome by incorporating the price distributions within drug groups in the model. With the price distribution instead of average prices in the model, we would retain CO2A and CO2D or about half of drug class 21.

In conclusion, the incorporation of a set of prices rather than one average price would overcome to some extent the dropping out of some drug groups in the model in scenarios where the average price for that drug group falls below simulated copayment levels for general patients.

If a particular drug type is represented by only one observation, the resulting distribution of drug consumption will not be close to actuality. Thus the adoption of the distributional approach to drug pricing needs to be implemented hand in hand with the 'rescaling weights' option.

Updating script and cost data (updating the Medicine Module)

The Medicine Module database will be updated by including the actual HIC data (PBS script and cost data) for the period July 2001 to June 2002.

7.2 'Major' enhancements

Modelling the safety net

Currently, the proportion of the total number of scripts that reach the SNT is a user-specified variable in the model, with the default (defined

separately for general and concessional patients) being the actual proportion reached in the base year 2000-01.

The SNT is modelled at the family level. Two conditions specified in the model for a family to reach the SNT are that the family's drug *expenditure* reaches the SNT and that the share of total *scripts* of families that have already reached the SNT does not exceed the default value specified. Given that these conditions relate to both costs and the number of scripts, there needs to be some consistency between model inputs relating to these.

Due to reliance on survey data, difficulties were encountered in fully modelling the effects of the safety net. This was because the safety net rule applies to the total spending on PBS medicines by a family in a calendar year. However, data on the drugs used during a year by a particular family are not available. Instead, all that is available is the two-week sample of drug use provided by the NHS.

To derive annual estimates, the standard practice is to multiply the two-week figures by 26. For most purposes this provides fairly reliable estimates, but it is not adequate for modelling the PBS safety net. For chronic conditions (when drugs are used regularly throughout the year), multiplying the NHS two-weekly figures by 26[23] should give a fair estimate of annual drug consumption. For non-chronic conditions, multiplying by 26 would give correct aggregate estimates within the age–sex–card cells but overestimate drug consumption for individuals and families. Thus, families consuming drugs for non-chronic conditions may incorrectly be shown to reach the safety net when the consumption of such drugs should have been spread over several families, none of whom may have reached the safety net.

As a result, the current version of the model constrains the proportion of scripts beyond the SNTs to that available from administrative data. This results in aggregate cost estimates by patient type that closely approximates actual figures for the base year.

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23 Based on preliminary analysis of annual patterns of drug usage, 13 seems to be the more realistic factor as the majority of scripts cover a 30-day supply of the prescribed drug.

Most of the scenarios specify either a proposed change in copayment levels or drug prices. Such changes are likely to involve changing the number of families reaching the SNTs. While for the base case the model can be run without changing the SNT-related information, this is not necessarily so when running the scenarios. The user would need to specify the likely change in the proportion of scripts reaching the SNT following the changes in copayments, etc. that are being simulated (Walker, Percival and Fischer 1998, pp. 27–31).

The model could be modified so that it would be able to simulate changes to the safety net features of the PBS. To do this, first its population base would need to be extended from the prescribed drug users identified in the two-week window covered by the NHS to all prescribed drug users in the population over a full year. Also, there would need to be a distinction between drugs for chronic conditions and non-chronic conditions. Finally, data on annual rather than fortnightly drug usage would be required.

With these modifications, there would be no need to constrain the proportion of scripts beyond the SNTs or the likely change in the proportion of scripts reaching the SNTs following changes in copayments that are being simulated. Further, the analysis of patient PBS medicine costs as a proportion of disposable income, by income quintile, need not be restricted to the 1–14 January 'window'. We would then expect lower PBS spending as a proportion of family incomes in the revised model, because the same number of scripts would be spread across more families. As a result, a lower proportion of families would reach the SNTs.

A review of actual data on the proportion of families reaching the SNTs shows that this varies across the different drug classes. This factor should be considered in modelling the SNTs in order to more closely approximate actual costs incurred. (The current model is able to align (match) scripts in the base year model with actual HIC statistics by each of the 36 drug classes, but expenditures are not as closely matched.)

Incorporating elasticities of demand

Each scenario is based on static (non-behavioural) modelling. We assume no patient response (behavioural change) to any changes proposed in copayment rates or prices. Other than being a standard practice in

microsimulation modelling, it is reasonable to make this assumption as we have no real world data on how patients react, and therefore to date have not been able to build reliable estimates into the model.

NATSEM has run some scenarios incorporating price elasticities in a simple way by modifying script inputs read in by the Patient Module, using estimates on price elasticity provided by Medicines Australia. Such price responses could be built into the model if appropriate data were available. The price responses could be estimated differentiating between drug groups, concessional and general patients, the price responses one year after the change in price or copayment and the responses for longer periods thereafter. If such price responses were built into the model, care should be taken that the price responses are not overstated or double counted in cases of drugs dropping out when the average drug price falls below copayment levels.

Broadening the focus of the model to cover all prescribed drugs

The original model focused on only PBS prescribed drugs. As previously stated, if some drugs dropped out of the PBS the associated scripts and costs for those drugs were not counted in. Several of the scenarios were likely to lead to a number of drug groups dropping out of the model, as costs for general patients fell below proposed copayment levels. To retain these drug groups in the model and to be able to identify related script numbers and costs, NATSEM built into the model, in addition to the 'expenditure buckets' for government expenditure and patient copayments, a third bucket that would pick up the patient expenditure on these particular PBS drugs whose prices were below the copayment.

The third bucket was constructed by retaining *all* scripts and costs even when the average cost of some drugs fell below the proposed copayment, with a flag variable created to distinguish between costs and scripts falling within and outside the scope of the PBS. The model's standard output presents total scripts, patient costs and government costs (regardless of whether these fall within or outside the PBS) by drug type. The proportion of total scripts and costs falling outside the PBS is indicated at the end of the table. Additional tables presenting scripts and costs (number and percentage to total scripts and costs) by drug type for drugs 'out' of the PBS may also be generated.

If the scope of the model were to be expanded to cover below copayment drugs (Group 2 scripts) and private medicines (Group 3 scripts) then the utility of the model would be enhanced and issues such as those described above avoided. Further, including these medicines would give a more complete picture of total expenditure on medicines by patients.

We currently have data on only the volume and the value of PBS prescribed drugs. This phase of the work would require other data sources such as the Australian Statistics on Medicines and/or the IMS warehouse data of the pharmaceuticals industry. Considerable benchmarking and adjustments would need to be made to match this industry data with HIC data on prescribed drugs.

7.3 Major advancement — adding a health outcomes module

To date, the primary utility of the model has been based on its capability to generate PBS expenditures based on various price and copayment assumptions, as well as to estimate the corresponding effect on families belonging to various income groups. While the model has provided valuable insights into the effects of various policies on government expenditure on PBS medicines and equity, it does not have the capability to quantify the value that pharmaceutical spending delivers. To present a more comprehensive picture of the contribution of pharmaceuticals to the economy, the model needs to present not only the *costs* but also the *benefits* of pharmaceuticals, particularly the improved health outcomes. This is the purpose of the three-year industry partner grant that was mentioned in section 1.

This extension will be more complex and resource intensive than the modelling attempted to date. Modelling health outcomes presents a range of theoretical and practical challenges (see, for example, McManus et al. 1996, p. 392), particularly at the high level of aggregation at which the MA model currently operates. There are limitations in the methodology and data available for health outcomes modelling, which will need to be explored and overcome in extending the model.

The introduction of diseases into the model's dataset would be the necessary first step to developing a facility in the model to measure health outcomes. Adding variables on disease patterns to the model would complement the variables already available on drug usage and

cost patterns. This would enable us to examine, for example, options that raise copayment thresholds for general patients but simultaneously protect the chronically ill through safety net provisions.

For various reasons, the existing Patient Module produces adequate aggregate estimates, but the usage of pharmaceuticals as imputed onto the person-level dataset is not based on actual disease patterns, and the patterns of drug usage for individuals are not in accordance with disease profiles and clinical practice. We need to overcome the current clinical inconsistency in the allocation of multiple drugs to individual users, and to ensure that drug usage at the level of the individual matches disease patterns in the model.

At this stage, the best way to add these enhancements to the Patient Module appears to be to replace the existing Patient Module database with the 2001 ABS NHS confidentialised unit record files, as these files contain the latest person-level information on health conditions, drug usage for priority conditions, and health risk factors. However, since the 2001 NHS contains less detail on prescribed drugs, it is not intended that this be the sole basis of the enhanced Patient Module concerning drug usage and health conditions. The 1995 NHS records will also be used to effectively retrieve additional information for those who do not suffer from priority diseases and/or do not have long-term health conditions.

The next step would be to quantify health outcomes. Since the feasibility of actually incorporating a health outcomes module has not been fully established, the approach would be to start off with a scoping study that ultimately would identify a recommended approach for adding a health outcomes module to the current MA model. This would involve an extensive literature review, discussion with national and international experts in health outcomes research, a workshop, an evaluation of alternative measures of health outcomes and methods for assessing health outcomes (for example, use of quality adjusted life years (QALYs), disability adjusted years (DALYs) and cost-effectiveness ratios), exploration of an appropriate microsimulation methodology, and assessment of data requirements and possible data sources. QALYs and DALYs could be estimated the same way as in the study of the burden of disease undertaken by the Australian Institute of Health and Welfare (Mathers, Vos and Stevenson 1999). An example of how DALYs can be used as a health outcomes measure in a modelling context can be found in Walker (2001).

QALYs and DALYs are standard 'broad brush' measures used in cross-sectional studies by organisations such as the World Health Organization and the Australian Institute of Health and Welfare. The scoping study, however, may indicate that, while broad-brush measures are a good first step, greater detail may be required for the model to accurately simulate health outcomes for specific diseases or treatments. The accuracy of the simulated health effects of drug use will depend on the degree of detail available in the 1995 and 2001 NHS at the disease level.

The scoping study could also investigate the possibility of adding further direct and indirect economic and social costs, such as other direct health care costs, labour force participation (for example, early retirement) and productivity (for example, absenteeism), school attendance and indirect costs of caregiving.

Once a modelling approach has been developed, this could be piloted in one of the model's therapeutic areas and then rolled out to other selected therapeutic areas. Candidate areas for the pilot would be chosen on the basis of the ease of modelling outcomes and the availability of data. Asthma and schizophrenia are possible candidates, but the choice of therapeutic class would need to be based on the outcomes of the scoping paper and discussion and agreement between Medicines Australia and NATSEM.

The pilot would be developed initially 'outside' of the main model, in order to test the feasibility of a health outcomes module. However, the data used in the pilot would mimic the data that would eventually be generated by the model. Thus, once the new model has been completed, the 'pilot' could undergo testing within the model.

On completion, the health outcomes extension would ideally be able to quantify the benefits that additional spending in different therapeutic areas would deliver in terms of:

- reduced mortality
- reduced morbidity
- indirect savings to the health system
- indirect savings to the welfare system
- other social and economic benefits.

The extension would enable the industry to show the desirability of increased expenditure on pharmaceuticals, both in terms of health benefits and relative to expenditure in other areas of health and welfare. With health outcomes added to the model, it would be possible to compare projected increases in PBS costs with the health benefits expected from increased spending on medicines in terms of, for example, the number of life years saved. Using the model's outputs, it would also be possible to assess the economic benefits of keeping patients 'operational' in terms of, for example, keeping their jobs rather than receiving a government benefit, or living independently rather than having a carer or going into a nursing home.

8 Summary and conclusions

This version of the microsimulation model that NATSEM developed for Medicines Australia to model the distributional and other impacts of the PBS has provided valuable insights into the effects of various policies on government expenditure on PBS medicines and on patient equity. By focusing the analysis on PBS costs, however, there is the risk of further entrenching the cost containment mentality that currently dominates the debate on PBS sustainability. The authors recognise the need to consider not only the costs associated with pharmaceuticals, but also the associated benefits such as continued access to new medicines in Australia.

The opportunity to further improve the model was realised when late in 2001 NATSEM won a large three-year Australian Research Council Linkage Grant for this purpose. The most important features of the model that can be improved are in the areas of modelling the safety net, using a distributional approach to drug pricing, expanding the scope of the model to cover all prescribed pharmaceuticals rather than only PBS-subsidised prescribed drugs, and quantifying the health benefits of future pharmaceutical innovations.

The project will result in an immensely powerful model that can be used to help influence policy and public debate about pharmaceuticals and the PBS.

Examples of the types of policy question that could be analysed follow.

- What is the impact of expected changes in PBS-subsidised drug prices and scripts over the next five to ten years on government PBS outlays, on patient out-of-pocket expenditure and on related revenues to industry?
- What is the likely impact of the introduction of new PBS listed drugs?
- What effects could demographic and socioeconomic changes have on outlays on the PBS over the next five to ten years and on the costs to consumers?
- What would be the distributional and revenue impacts of changes in the rules of the PBS (for example, changes in copayment levels, the introduction of differential copayment levels, and changes in 'concessional' eligibility rules or in certain drug-related PBS rules)?

More advanced questions could be addressed.

- Which diseases are the major contributors to the usage and cost patterns observed for particular classes of prescribed drugs?
- What would be the cost and distributional impacts of changing the safety net provisions of the current PBS scheme?
- How would pharmaceutical usage and costs respond to the earlier onset of diseases expected from the significant increases in obesity over the past five years among Australia's children and young adults?
- How would the introduction of a new drug able to control obesity alter the above results?
- What would be the ranking of various future pharmaceutical policy options in terms of their health benefits relative to their costs?

If Australia is to enjoy ongoing access to new medicines, the debate must be broadened to consider the benefits that these medicines will bring. Current trends, including the imminent introduction of new biotechnology therapies and the sharp increases in PBS outlays in recent years, suggest that Medicines Australia and its members can expect growing public attention to be focused on pharmaceuticals and the PBS in the next few years. The proposed project offers Medicines Australia an opportunity to begin extending the public debate to include the benefits of improved health outcomes. Such an extension appears vital to the future success of the pharmaceuticals industry in Australia.

A Classification of medications

Table A1 **Drug concordance schedule**

Drug class	Overall NHS class	NHS class	NHS description	ATC code	ATC description
1	Arthritis drugs	1	Anti-inflammatories	M01A	Anti-inflammatory and antirheumatic products, non-steroids
2	Asthma medications	5	Adrenergics	R03A	Adrenergics, inhalants
		6	Anti-asthmatics	R03B	Other anti-asthmatics, inhalants
		7	Anti-asthmatics for systemic use	R03D	Other anti-asthmatics for systemic use
3	Diabetes medications	8	Insulins	A10A	Insulins and analogues
		9	Blood glucose lowering drugs	A10B	Oral blood glucose lowering drugs
4		12	Vasodilators	C01D	Vasodilators used in cardiac diseases
		17	Beta blockers	C07A	Beta blocking agents
5		16	ACE inhibitors	C09A	ACE inhibitors, plain
				C09B	ACE inhibitors, combinations
6			Angiotensin II antagonists	C09C	Angiotensin II antagonists, plain
				C09D	Angiotensin II antagonists, combinations
7		18	Calcium channel blockers	C08C	Selective calcium channel blockers with mainly vascular effects
				C08D	Selective calcium channel blockers with direct cardiac effects
				C08E	Non-selective calcium channel blockers
8	Serum lipid reducing agents	24	Cholesterol and triglyceride reducers	C10A	Cholesterol and triglyceride reducers
9	Analgesic medications	25	Opioids	N02A	Opioids
		26	Other analgesics	N02B	Other analgesics and antipyretics
10	Psycholeptic medications	27	Antipsychotics	N05A	Antipsychotics
11		28	Anxiolytics	N05B	Anxiolytics
		29	Hypnotics and sedatives	N05C	Hypnotics and sedatives

(Continued on next page)

Table A1 **Drug concordance schedule** (continued)

Drug class	Overall NHS class	NHS class	NHS description	ATC code	ATC description
12	Medications for anxiety/depression/ nervous conditions	30	Antidepressants	N06A	Antidepressants
13		34	Stomach medications	A01A	Stomatological preparations
				A02A	Antacids
				A02B	Drugs for treatment of peptic ulcer
				A02E	Antiregurgitants
14				J01A	Tetracyclines
				J01B	Amphenicols
				J01C	Beta-lactam antibacterials, penicillins
				J01D	Other beta-lactam antibacterials
				J01E	Sulfonamides and trimethoprim
				J01F	Macrolides and lincosamides
				J01G	Aminoglycoside antibacterials
				J01M	Quinolone antibacterials
				J01X	Other antibacterials
15				L01A	Alkylating agents
				L01B	Antimetabolites
				L01C	Plant alkaloids and other natural products
				L01D	Cytotoxic antibiotics and related substances
				L01X	Other antineoplastic agents
				L02A	Hormones and related agents
				L02B	Hormone antagonists and related agents
				L03A	Cytokines and immunomodulators
				L04A	Immunosuppressive agents
16				G01A	Antiinfectives and antiseptics, excl. comb. with corticosteroids
				G02A	Oxytocics
				G02C	Other gynecologicals
				G03A	Hormonal contraceptives for systemic use
				G03B	Androgens
				G03C	Estrogens
				G03D	Progestogens
				G03F	Progestogens and estrogens in combination

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Table A1 **Drug concordance schedule** (continued)

Drug class	Overall NHS class	NHS class	NHS description	ATC code	ATC description
				G03G	Gonadotropins and other ovulation stimulants
				G03H	Antiandrogens
				G03X	Other sex hormones and modulators of the genital system
				G04A	Urinary antiseptics and antiinfectives
				G04B	Other urologicals, incl. antispasmodics
17				N03A	Antiepileptics
18				J05A	Direct acting antivirals
19	Allergy drugs	3	Decongestants	R01A	Decongestants and other nasal preparations for topical use
		4	Antihistamines	R06A	Antihistamines for systemic use
20	Heart and blood pressure drugs	10	Cardiac glycosides	C01A	Cardiac glycosides
		11	Antiarrhythmics	C01B	Antiarrhythmics, class I and III
21		13	Anti-adrenergics, centrally acting	C02A	Antiadrenergic agents, centrally acting
		14	Anti-adrenergics, peripherally acting	C02C	Antiadrenergic agents, peripherally acting
		15	Muscles acting on arteriolar smooth muscle	C02D	Arteriolar smooth muscle, agents acting on
22	Fluid/diuretic medications	19	Low ceiling diuretics, thiazides	C03A	Low-ceiling diuretics, thiazides
		20	Low ceiling diuretics, excl. thiazides	C03B	Low-ceiling diuretics, excl. thiazides
		21	High ceiling diuretics	C03C	High-ceiling diuretics
		22	Potassium-sparing agents	C03D	Potassium-sparing agents
		23	Diuretics/potassium-sparing agents	C03E	Diuretics and potassium-sparing agents in combination
23	Other medications	31	Vitamin and mineral supplements	A11C	Vitamin A and D, incl. combinations of the two
				A11D	Vitamin B1, plain and in combination with vitamin B6 and vitamin B12
				A11H	Other plain vitamin preparations
				A12A	Calcium
				A12B	Potassium

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Table A1 **Drug concordance schedule** (continued)

Drug class	Overall NHS class	NHS class	NHS description	ATC code	ATC description
24		32	Cough and cold medications	R05C	Expectorants, excl. combinations with cough suppressants
				R05D	Cough suppressants, excl. combinations with expectorants
				R05X	Other cold combination preparations
25		33	Skin ointments and creams	D	Dermatologicals
				D01A	Antifungals for topical use
				D01B	Antifungals for systemic use
				D02A	Emollients and protectives
				D04A	Antipruritics, incl. antihistamines, anesthetics
				D05B	Antipsoriatics for systemic use
				D06B	Chemotherapeutics for topical use
				D07A	Corticosteroids, plain
				D08A	Antiseptics and disinfectants
				D10B	Anti-acne preparations for systemic use
				D11A	Other dermatological preparations
26		35	Laxatives	A06A	Laxatives
27		36	Other medication	A03A	Synthetic antispasmodic and anticholinergic agents
				A03B	Belladonna and derivatives, plain
				A03F	Propulsives
				A04A	Antiemetics and antinauseants
				A07A	Intestinal anti-infectives
				A07B	Intestinal absorbents
				A07C	Electrolytes with carbohydrates
				A07D	Antipropulsives
				A07E	Intestinal anti-inflammatory agents
				A09A	Digestives, incl. enzymes
				A14A	Anabolic steroids
				A15	Appetite stimulants

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Table A1 **Drug concordance schedule** (continued)

Drug class	Overall NHS class	NHS class	NHS description	ATC code	ATC description
28				B01A	Antithrombotic agents
				B02A	Antifibrinolytics
				B03A	Iron preparations
				B03B	Vitamin B12 and folic acid
				B05A	Blood and related products
				B05B	I.V. solutions
29				H01A	Anterior pituitary lobe hormones and analogues
				H01B	Posterior pituitary lobe hormones
				H01C	Hypothalamic hormones
				H02A	Corticosteroids for systemic use, plain
				H03A	Thyroid preparations
				H03B	Antithyroid preparations
				H04A	Glycogenolytic hormones
				H05B	Antiparathyroid hormones
30				J02A	Antimycotics for systemic use
				J04A	Drugs for treatment of tuberculosis
				J06A	Immune sera
				J07A	Bacterial vaccines
				J07B	Viral vaccines
31		2	Antirheumatics	M01C	Specific antirheumatic agents
32				M02A	Topical products for joint and muscular pain
				M03B	Muscle relaxants, centrally acting agents
				M03C	Muscle relaxants, directly acting agents
				M04A	Antigout preparations
				M05B	Drugs affecting mineralisation
33				N02C	Antimigraine preparations
				N04A	Anticholinergic agents
				N04B	Dopaminergic agents
				N06B	Psychostimulants and nootropics
				N07A	Parasympathomimetics
34				P01A	Agents against amoebiasis and other protozoal diseases
				P01B	Antimalarials
				P02C	Antinematodal agents
				P02D	Anticestodals
				P03A	Ectoparasiticides, incl. scabicides

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Table A1 **Drug concordance schedule** (continued)

Drug class	Overall NHS class	NHS class	NHS description	ATC code	ATC description
35				S	Sensory organs
				S01A	Anti-infectives
				S01B	Anti-inflammatory agents
				S01E	Antiglaucoma preparations and miotics
				S01F	Mydriatics and cycloplegics
				S01G	Decongestants and anti-allergics
				S01H	Local anesthetics
				S01X	Other ophthalmologicals
				S02A	Anti-infectives
				S02C	Corticosteroids and anti-infectives in combination
				S03A	Anti-infectives
				S03B	Corticosteroids
36				C01C	Cardiac stimulants excl. cardiac glycosides
				C04A	Peripheral vasodilators
				C05A	Antihemorrhoidals for topical use
				R03C	Adrenergics for systemic use
				V01A	Allergens
				V03A	All other therapeutic products
				V04B	Urine tests
				V04C	Other diagnostic agents

B Patient Module base year input data

Table B1 **Script numbers by the 36 drug classes and patient category, 2000-01**

Drug class	Concessional – above SNT (C0)	Concessional – below SNT (C1)	Total concessional scripts	Proportion of concessional scripts	General – above SNT (G1)	General – below SNT (G2)	Total general scripts	Proportion of general scripts	Total scripts	Proportion of total scripts
	no.	no.	no.	%	no.	no.	no.	%	no.	%
1	1 078 454	4 546 339	5 624 793	4.53	190 203	928 984	1 119 187	4.93	6 743 980	4.59
2	2 024 189	5 688 039	7 712 228	6.21	354 277	1 737 372	2 091 649	9.22	9 803 877	6.68
3	867 842	2 566 764	3 434 606	2.77	198 426	176 571	374 997	1.65	3 809 603	2.59
4	1 405 126	4 624 521	6 029 647	4.86	202 165	107 677	309 842	1.37	6 339 489	4.32
5	1 318 637	5 970 369	7 289 006	5.87	338 415	2 401 507	2 739 922	12.08	10 028 928	6.83
6	484 472	2 340 017	2 824 489	2.28	144 447	1 360 272	1 504 719	6.63	4 329 208	2.95
7	1 223 532	4 814 566	6 038 098	4.86	286 475	1 062 239	1 348 714	5.95	7 386 812	5.03
8	1 535 690	6 395 084	7 930 774	6.39	405 035	2 976 791	3 381 826	14.91	11 312 600	7.71
9	2 372 917	6 641 901	9 014 818	7.26	142 095	92 252	234 347	1.03	9 249 165	6.30
10	300 102	1 584 828	1 884 930	1.52	33 254	109 148	142 402	0.63	2 027 332	1.38
11	1 507 428	4 791 267	6 298 695	5.07	103 128	17 537	120 665	0.53	6 419 360	4.37
12	1 140 317	5 364 265	6 504 582	5.24	229 114	2 759 973	2 989 087	13.18	9 493 669	6.47
13	1 727 578	5 584 677	7 312 255	5.89	274 008	1 747 682	2 021 690	8.91	9 333 945	6.36
14	1 192 872	9 599 295	10 792 167	8.69	252 763	242 226	494 989	2.18	11 287 156	7.69
15	103 932	476 649	580 581	0.47	34 609	272 043	306 652	1.35	887 233	0.60
16	741 319	4 941 274	5 682 593	4.58	274 793	319 129	593 922	2.62	6 276 515	4.28
17	133 840	940 287	1 074 127	0.87	28 765	323 415	352 180	1.55	1 426 307	0.97
18	9 079	92 377	101 456	0.08	3 945	170 919	174 864	0.77	276 320	0.19
19	140 263	439 798	580 061	0.47	23 638	68 092	91 730	0.40	671 791	0.46
20	219 682	665 403	885 085	0.71	28 124	68 703	96 827	0.43	981 912	0.67
21	155 127	545 927	701 054	0.56	30 830	56 662	87 492	0.39	788 546	0.54
22	618 193	1 919 659	2 537 852	2.04	90 008	24 005	114 013	0.50	2 651 865	1.81

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Table B1 **Script numbers by the 36 drug classes and patient category, 2000-01** (continued)

Drug class	Concessional – above SNT (C0)	Concessional – below SNT (C1)	Total concessional scripts	Proportion of concessional scripts	General – above SNT (G1)	General – below SNT (G2)	Total general scripts	Proportion of general scripts	Total scripts	Proportion of total scripts
	no.	no.	no.	%	no.	no.	no.	%	no.	%
23	342 741	992 643	1 335 384	1.08	26 432	40 238	66 670	0.29	1 402 054	0.96
24	73 266	255 596	328 862	0.26	4 844	2 727	7 571	0.03	336 433	0.23
25	422 897	2 206 802	2 629 699	2.12	55 689	252 926	308 615	1.36	2 938 314	2.00
26	154 446	395 886	550 332	0.44	7 035	7 041	14 076	0.06	564 408	0.38
27	405 873	1 242 027	1 647 900	1.33	67 714	308 723	376 437	1.66	2 024 337	1.38
28	825 368	2 540 795	3 366 163	2.71	86 142	116 764	202 906	0.89	3 569 069	2.43
29	428 829	1 565 162	1 993 991	1.61	85 677	86 403	172 080	0.76	2 166 071	1.48
30	23 771	689 787	713 558	0.57	5 960	46 950	52 910	0.23	766 468	0.52
31	3 942	10 779	14 721	0.01	1 194	6 116	7 310	0.03	22 031	0.02
32	297 134	1 053 268	1 350 402	1.09	56 498	89 502	146 000	0.64	1 496 402	1.02
33	229 382	884 219	1 113 601	0.90	61 275	88 730	150 005	0.66	1 263 606	0.86
34	211 277	752 089	963 366	0.78	23 618	30 978	54 596	0.24	1 017 962	0.69
35	1 311 243	4 881 129	6 192 372	4.99	115 049	165 936	280 985	1.24	6 473 357	4.41
36	261 077	825 833	1 086 910	0.88	28 978	125 385	154 363	0.68	1 241 273	0.85
All	25 291 837	98 829 321	124 121 158	100.00	4 294 622	18 391 618	22 686 240	100.00	146 807 398	100.00

Source: HIC.

Table B2 **Government, patient and total costs by the 36 drug classes and patient category, 2000-01**

Drug class	Govt cost (C0)	Patient cost (C0)	Total cost (C0)	Govt cost (C1)	Patient cost (C1)	Total cost (C1)	Govt cost (G1)	Patient cost (G1)	Total cost (G1)	Govt cost (G2)	Patient cost (G2)	Total cost (G2)	Total
	$	$	$	$	$	$	$	$	$	$	$	$	$
1	38 168 775	0	38 168 775	128 085 984	15 512 487	143 598 471	5 739 493	640 868	6 380 361	29 440 123	19 891 163	49 331 286	237 478 893
2	69 831 348	0	69 831 348	155 351 389	19 373 660	174 725 049	34 111 065	3 592 598	37 703 663	36 374 697	36 886 391	73 261 088	355 521 148
3	26 496 823	0	26 496 823	72 875 760	8 762 520	81 638 280	6 032 227	667 304	6 699 531	24 535 962	3 757 750	28 293 712	143 128 347
4	25 574 196	0	25 574 196	57 010 116	15 773 071	72 783 187	2 897 455	679 896	3 577 351	2 737 442	2 294 858	5 032 300	106 967 034
5	38 422 659	0	38 422 659	148 561 506	20 349 359	168 910 865	9 166 410	1 137 903	10 304 313	20 539 785	51 018 521	71 558 306	289 196 143
6	14 058 364	0	14 058 364	59 419 873	7 997 892	67 417 765	3 804 161	486 144	4 290 305	10 467 379	29 015 855	39 483 234	125 249 668
7	30 351 551	0	30 351 551	100 560 507	16 406 724	116 967 231	6 415 989	962 934	7 378 923	8 596 817	22 508 697	31 105 514	185 803 219
8	89 305 238	0	89 305 238	345 905 604	21 822 874	367 728 478	23 018 965	1 362 427	24 381 392	112 692 279	63 397 492	176 089 771	657 504 879
9	31 364 263	0	31 364 263	52 251 127	22 654 110	74 905 237	2 936 404	477 107	3 413 511	3 487 360	1 971 045	5 458 405	115 141 416
10	12 279 815	0	12 279 815	115 959 984	5 398 589	121 358 573	1 538 595	111 729	1 650 324	16 690 649	2 325 261	19 015 910	154 304 621
11	10 207 034	0	10 207 034	16 855 838	16 347 078	33 202 916	441 894	346 103	787 997	156 169	373 142	529 311	44 727 258
12	30 182 637	0	30 182 637	179 548 272	18 302 096	197 850 368	7 159 489	770 164	7 929 653	92 014 099	58 816 374	150 830 473	386 793 132
13	65 111 630	0	65 111 630	195 051 809	19 051 827	214 103 636	11 768 875	921 081	12 689 956	53 789 880	36 968 034	90 757 914	382 663 136
14	18 745 380	0	18 745 380	97 835 181	32 572 045	130 407 226	3 653 761	846 875	4 500 636	10 386 681	5 130 302	15 516 983	169 170 225
15	22 195 987	0	22 195 987	133 619 710	1 624 328	135 244 038	9 508 418	116 476	9 624 894	98 295 997	5 790 789	104 086 786	271 151 705
16	15 927 910	0	15 927 910	79 180 616	16 825 036	96 005 652	4 116 174	925 301	5 041 475	11 918 937	6 782 176	18 701 113	135 676 149
17	6 903 314	0	6 903 314	51 198 104	3 201 409	54 399 513	1 752 927	96 942	1 849 869	12 753 257	6 872 675	19 625 932	82 778 627
18	2 091 974	0	2 091 974	20 564 431	314 577	20 879 008	932 160	13 269	945 429	35 265 603	3 635 178	38 900 781	62 817 192
19	2 490 034	0	2 490 034	6 453 778	1 460 090	7 913 868	370 733	78 207	448 940	112 335	1 402 736	1 515 071	12 367 912
20	3 926 174	0	3 926 174	9 405 416	2 268 390	11 673 806	553 383	94 567	647 950	1 060 969	1 463 041	2 524 010	18 771 940
21	2 680 222	0	2 680 222	7 706 584	1 859 035	9 565 619	493 923	103 718	597 641	313 916	1 204 247	1 518 163	14 361 645
22	6 816 289	0	6 816 289	16 399 233	6 538 935	22 938 168	896 997	302 997	1 199 994	375 642	510 116	885 758	31 840 209
23	8 028 680	0	8 028 680	20 826 192	3 382 916	24 209 108	669 981	88 888	758 869	1 697 442	855 758	2 553 200	35 549 857
24	941 492	0	941 492	2 194 288	865 890	3 060 178	53 448	16 208	69 656	30 622	57 975	88 597	4 159 923
25	5 823 304	0	5 823 304	30 734 179	7 510 703	38 244 882	1 135 326	187 447	1 322 773	26 808 866	5 365 580	32 174 446	77 565 405
26	2 766 544	0	2 766 544	5 832 119	1 351 788	7 183 907	109 572	23 623	133 195	42 229	149 173	191 402	10 275 048

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Table B2 **Government, patient and total costs by the 36 drug classes and patient category, 2000-01** (continued)

Drug class	Govt cost (C0)	Patient cost (C0)	Total cost (C0)	Govt cost (C1)	Patient cost (C1)	Total cost (C1)	Govt cost (G1)	Patient cost (G1)	Total cost (G1)	Govt cost (G2)	Patient cost (G2)	Total cost (G2)	Total
	$	$	$	$	$	$	$	$	$	$	$	$	$
27	9 964 874	0	9 964 874	27 776 024	4 228 104	32 004 128	2 629 615	227 366	2 856 981	15 462 002	6 543 812	22 005 814	66 831 797
28	15 037 711	0	15 037 711	41 754 610	8 663 040	50 417 650	1 795 431	289 870	2 085 301	10 723 006	2 492 783	13 215 789	80 756 451
29	4 113 028	0	4 113 028	12 300 656	5 330 479	17 631 135	607 217	288 417	895 634	2 533 378	1 835 508	4 368 886	27 008 683
30	1 964 810	0	1 964 810	16 505 547	2 397 437	18 902 984	710 189	20 177	730 366	2 441 449	1 009 641	3 451 090	25 049 250
31	264 373	0	264 373	685 059	36 744	721 803	69 587	4 015	73 602	276 143	129 965	406 108	1 465 886
32	9 472 049	0	9 472 049	34 111 065	3 592 598	37 703 663	1 222 805	190 306	1 413 111	4 290 619	1 909 165	6 199 784	54 788 607
33	7 678 024	0	7 678 024	24 087 500	3 014 790	27 102 290	1 700 484	206 002	1 906 486	2 806 307	1 888 891	4 695 198	41 381 998
34	2 296 393	0	2 296 393	5 565 920	2 564 716	8 130 636	242 146	79 458	321 604	453 548	658 780	1 112 328	11 860 962
35	19 541 494	0	19 541 494	52 076 272	16 643 088	68 719 360	1 555 896	386 789	1 942 685	2 377 430	3 531 025	5 908 455	96 111 994
36	9 260 918	0	9 260 918	35 359 926	2 812 935	38 172 861	1 344 019	97 534	1 441 553	10 147 589	2 665 086	12 812 675	61 688 007
All	660 285 311	0	660 285 311	2 359 610 179	336 811 362	2 696 421 541	151 155 214	16 840 707	167 995 921	662 096 608	391 108 985	1 053 205 593	4 577 908 365

Source: HIC.

C Key variables in the model

Table C1 **Key variables in the MA model**

Variable	Description
AGEFAMHD	Age group of head of family: 2 15–39 years 3 40–64 years 4 65–74 years 5 75 + years
AGE_GRP	Broad age groupings: 1 0–14 years 2 15–39 years 3 40–64 years 4 65–74 years 5 75 + years
AGE_PBS	Age groupings in 5-year intervals: 1 0–4 years 2 5–9 years 3 10–14 years 4 15–19 years 5 20–24 years 6 25–29 years 7 30–34 years 8 35–39 years 9 40–44 years 10 45–49 years 11 50–54 years 12 55–59 years 13 60–64 years 14 65–69 years 15 70–74 years 16 75+ years
AVPC [1-37]	Average total cost of PBS drugs — concessional patients (Group 1) (= C0 + C1 + G1)
AVPG [1-37]	Average total cost of PBS Group 1 drugs above copayment prior to simulations — general patients (= G2)
CARD	Card status — indicates eligibility to the PBS concessions (from CSHCCARD, HCCARD and PCCARD subcomponents) 0 No card 1 Yes card
CLASS	Card status 0 PBS general patients 1 PBS concessional patients
DISPINCU	Weekly disposable income of the family (income unit)

(Continued on next page)

Table C1 **Key variables in the MA model** (continued)

Variable	Description
DRGCOUNT	Number of Group 1 drugs used by each person over the two week survey period
DR[1-37]	Scripts totals for last 12 months of the simulations (ie 2000-01 for the base case) by drug type for both concessional and general patients
DTYPE[1-37]	Type of drug prescribed to each patient (eg DTPYE 3 will be 1 for each patient using diabetes medications) 1 Anti-inflammatories 2 Anti-asthmatics 3 Diabetes medications 4 Vasodilators and beta blockers 5 ACE inhibitors 6 Angiotensin IIs 7 Calcium channel blockers 8 Cholesterol and triglyceride reducers 9 Analgesic medications 10 Antipsychotics 11 Anxiolytics and hypnotics 12 Antidepressants 13 Stomach medications 14 Antibiotics 15 Antineoplastics 16 Genitourinary 17 Anti-epileptics 18 Direct acting antivirals 19 Decongestants and antihistamines 20 Cardiac glycosides and antiarrhythmics 21 Antihypertensives 22 Fluid and diuretic medications 23 Vitamin and mineral supplements 24 Cough and cold medications 25 Skin ointments and creams 26 Laxatives 27 Other medication – alimentary tract & metabolic (excl. diabetes & stomach medications) 28 Other medication – blood and blood forming organs 29 Other medication – systemic hormonal preparations (excluding sex hormones) 30 Other medication – general antiinfectives (excluding antibacterials antivirals) 31 Specific antirheumatic agents 32 Other muscoskeletal medication – topical products, muscle relaxants, anti-gout & bone disease 33 Other medication – antimigraine psychostimulants & nootropics, anti-Parkinsons & parasympathomimetics 34 Other medication – antiparasitic products, insecticides and repellents 35 Other medication – sensory organs 36 Other medication – various (+37) *
DTP1-DTP1443	Drug type by individual over time

(Continued on next page)

Table C1 **Key variables in the MA model** (continued)

Variable	Description
FAMTYPE	Family type 1 Married couple, no dependants 2 Married couple, with dependants 3 Sole parent 4 Single taxpayer
FAMSIZE	Number of persons in each income unit (average)
GOV	Government cost over last 12 months of simulation — concessional and general patients
GOVDR [1-37]	Government cost totals for last 12 months of the simulations (ie 2000-01 for the base case) by drug type for both concessional and general patients
GROUP	Groups of drugs falling within and outside the PBS 1 For PBS drugs which attract a government subsidy 2 For PBS drugs with below copayment charges prior to simulations (of relevance mainly to general patients) 3 For prescribed drugs not under the PBS.
INC_ID	Income unit identification number, common to all members of a family
PAT	Patient expenditures over last 12 months of simulation — concessional and general patients
PATDR [1-37]	Patient contribution totals for last 12 months of the simulations (ie 1996-97 for the base case) by drug type for both concessional and general patients
PERS_ID	Unique identification number for each person
SEX	Sex of person: 1 Male 2 Female
SEXFAMHD	Sex of family head: 1 Male 2 Female
SUMCP27	Spending by families on Group 1 drugs in the two weeks 1–14 January 2001 (concessional and general)
TGC1 to TGC1443	Government costs over time, by drug and by individual — concessional patients
TGG1 to TGG1443	Government costs over time, by drug and by individual — general patients
TPC1 to TPC1443	Patient contributions over time, by drug and by individual — concessional patients
TPG1 to TPG1443	Patient contributions over time, by drug and by individual — general patients
WTP	Weight of person (or family)

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