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A MICROSIMULATION MODEL OF HOSPITAL PATIENTS: NEW SOUTH WALES

Linc Thurecht, Durham Bennett, Andrew Gibbs, Agnes Walker, Jim Pearse and Ann Harding

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Director: Ann Harding

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Abstract

Late in 2000 NATSEM was awarded a three-year Australian Research Council Strategic Partnership with Industry Research and Training (SPIRT) grant. The grant involves:

- adding an indicator of socioeconomic status to patient-based hospitals administrative datasets for New South Wales over the period 1996-97 to 1999-00, in which expenditures have been allocated to each individual patient;
- building a microsimulation model capable of projecting future usage and costs of hospitals in New South Wales; and
- constructing a private health insurance model to facilitate estimation of the split of total demand and expenditures between private and public hospital, and analysis of the effects of certain policy changes.

This technical paper documents the development of the enhanced NSW hospitals micro datasets and the building of the microsimulation projection model. An approach to calibrating the model is also described. The Private Health Insurance Model will be documented in a separate technical paper.

Author note

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We would also like to thank John Agland and Jan Ustaszewski from the Information and Data Services Branch of the NSW Department of Health for providing the geocoded NSW hospitals data, and the NSW Health Centre for Epidemiology and Research for access to the linked patient record data on the Health Outcomes Information Statistical Toolkit.

Caveat and data security

The microdata used in this study do not contain any information that enables identification of the individuals or families to which they refer. The data are maintained on a dedicated computer that is accessible by only the investigators and the system administrator at NATSEM. All people who have access to the data have signed a deed attesting to their agreement to the privacy provisions set out in the NSW Department of Health Ethics Committee approval.

Contents

Abbreviations

ABS	Australian Bureau of Statistics
CD	census collection district
DRG	diagnosis related group
EFI	equivalent family income
ISC	Inpatient Statistics Collection (NSW Health)
NSW	New South Wales
SEIFA	socioeconomic indexes for areas
SLA	statistical local area
SRG	service related group

1 Project description

This project is being conducted under an Australian Research Council Strategic Partnerships with Industry Research and Training (SPIRT) grant entitled 'Health Policy and Socioeconomic Status in Australia: Improving Decision Support Tools'. The industry partners are the New South Wales Department of Health (NSW Health), the Productivity Commission and the Health Insurance Commission.

The major aims of the project are to:

- impute socioeconomic status and patient-level expenditures to each de-identified person[1] in time series administrative data covering all NSW hospitals (except public psychiatric hospitals) over the period 1996-97 to 1999-00; and
- carry out a series of distributional analyses of the NSW hospital patient population — for example, whether the poor use hospitals more or less often than the rich, and/or whether hospital expenditures on the poor and the rich are distributed broadly in proportion to health needs.

By imputing socioeconomic status onto individual-based administrative data — rich in information on services provided and associated costs — we expected that distributional issues could be analysed in considerably greater detail and in more complex ways than had been possible previously.[2]

Other aims are to develop a microsimulation projection model using the enhanced administrative datasets and construct a private health insurance model. The purpose of the latter model is to aid estimation of the split of total demand and expenditures between private and public

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1 The microdata used in this study do not contain any information that enables identification of the individuals or families to which they refer. See 'Caveat and data security' for a description of the measures NATSEM put in place to maintain confidentiality of the time series NSW data.

2 Examples of such analyses are in Thurecht et al. (2002).

hospitals under current and possible future policy parameters for private health insurance.[3]

This technical paper discusses the projection model and its underlying micro datasets. The private health insurance model will be the subject of a separate paper.

2 Data description

Two sources of data were used initially to construct the person-based datasets of hospital separations across New South Wales. These were the NSW Health Inpatient Statistics Collection and the NSW Hospital Cost Data Collection. Subsequently these data were enhanced by imputing patient-based socioeconomic status using an extract from the 1996 census and adding a projection facility using, among other things, the population projections of the Australian Bureau of Statistics (ABS).

The lowest level of spatial aggregation available in these datasets is the census collection district (CD). This was chosen as it is expected that income groups will be much more homogeneous within a CD than at higher levels of spatial aggregation. (Each CD comprises around 200 households.) However, higher levels of spatial aggregation can also be analysed by mapping the CD to appropriate larger boundaries such as statistical local area (SLA) or local government area.

The Inpatient Statistics Collection is a census of all admitted patient services provided by NSW public hospitals, public psychiatric hospitals, public multipurpose services, private hospitals and private day procedures centres. It includes demographic and administrative information and coded information on diagnoses related to and

3 Recent trends suggest that private health insurance policies can have a considerable impact on the split of patients between public and private hospitals. For example, the Australian Institute of Health and Welfare (2002a) reported that admissions to private hospitals in 2000-01 were 12 per cent higher than in 1999-00, and admissions to public hospitals were 0.1 per cent lower. The Australian Institute of Health and Welfare (2002b) stated: 'this increase in hospitalisations for private patients followed the rise in private health insurance coverage that occurred with the introduction of the Federal Government's "Lifetime health cover" insurance arrangements'. However, analysis of data for the first quarter of 2002-03 shows strong growth in public patient activity (4.1 per cent above what it was in the corresponding period in 2001-02), but a drop of 2.1 per cent in private patient activity.

procedures performed during a particular admission to a medical facility. The information is provided by the patient, the health service provider and the facility's administration. Data from this source cover the period 1996-97 to 1999-00 inclusive.[4] A list of all the variables available in the NSW hospitals datasets is provided in appendix A. (The methodology for combining hospital separations on a patient basis is outlined in section 2.1. Section 4 describes the additional variables that were either created, merged or imputed onto these datasets.)

The NSW Hospital Cost Data Collection includes costs for all acute inpatient episodes in NSW public hospitals with more than 2000 acute separations a year. The costs are collected at the episode level (clinical costing) or are average costs for a diagnosis related group (DRG) within a facility (cost modelling). As this project is concerned with the distribution of government benefits, gross costs needed to be reduced to net costs based on revenue received by the government for chargeable patients. (The methodology for calculating gross and net costs is outlined in section 2.2.)

The extract from the 1996 census was a count of the number of people in an equivalent family income quintile by sex, 10-year age group and CD. This was then used to impute the socioeconomic status of each patient. (The methodology for imputing socioeconomic status is outlined in section 4.2.)

The ABS (2000a) provides population projections for the period 1999–2019 as at 30 June for each year. The projections are at the SLA level by sex and five-year age group and were used in projecting future hospital use. (The methodology developed for projecting future hospital use is outlined in section 5.)

There are three key strengths to the datasets assembled. The first is that, in each year, they account for the full hospital-using population in New South Wales. A higher degree of accuracy can be achieved with full population data than with sample survey data. In particular, with such data it is possible to disaggregate the information into small cells defined by a wide range of variables such as age, sex, socioeconomic status, geographic location, disease type, health service type or cost (for example, patient/government shares in total costs).

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4 Approval from the NSW Health Ethics Committee to obtain data for 2000-01 and 2001-02 has been received. However, at the time of writing this information had not been geocoded by NSW Department of Health.

The second is that, prior to making the data available to NATSEM, NSW Health linked the hospital separations for each year at the patient level.[5] This allows variables such as the average cost per patient (for example, by age, sex, socioeconomic status and disease groups) to be estimated and co-morbidities in subsequent analyses to be accounted for.

The third is that, because NSW Health had access to each patient's residential address, it was able to geocode patient location at the CD level. NATSEM was then able to use this patient-level CD information to more accurately impute socioeconomic status to hospital users than has been possible in earlier studies that tend to estimate socioeconomic status on the basis of much broader SLA or postcode spatial boundaries.

2.1 NSW hospitals administrative datasets — linking patients

Starting with all separations from NSW hospitals, both public and private, the NSW Health Centre for Epidemiology and Research internally linked those separations from the same person and attached a unique match set number (called 'MSet') prior to de-identifying the dataset. The probabilistic matching occurs within, but not across, financial years. Each separation by a NSW resident from a hospital outside of the state was treated as being from a different person, with each allocated a separate MSet. The following details of the methodology adopted for this process have been extracted from Health Outcomes Statistical Information Toolkit (HOIST) documentation. A useful overview of probabilistically linking data and the AutoMatch software discussed below is provided by Jaro (1995).

Prior to matching, addresses from the data were standardised using AutoStan.[6] Match parameters were specified for eight passes. Blocking variables include hospital code, medical record number, alternative

5 This means that it is possible to follow individual patients within each year of the time series, but not across the various years of the time series data.

6 AutoStan is system used with AutoMatch to standardise addresses and names. (Automatch is a generalised record linkage system based on probabilistic record linkage methods.) Addresses are decomposed into single components such as dwelling number, dwelling number range, dwelling number suffix, unit value, street name, postal value, locality, postcode and state. Names are decomposed into components such as first name, middle name, alternative given name, surname and alternative surname. Refer to MatchWare Technologies (1997).

hospital code, date of birth, year of birth, month of birth, day of birth, sex, soundex[7] of locality, soundex of street names and postcode. Matching variables comprise date of birth, country of birth, sex, insurance status, language spoken at home, marital status, aboriginality, an array of admission and separation dates, postcode, hospital code, medical record number and standardised components of addresses. The UnDup program[8] in AutoMatch was chosen for the linkage. It is generally used for grouping records into sets having similar attributes. The objective in this instance is to group hospital records of the same patient.

AutoMatch selects a master record (also known as a match pair) that has the highest weight within a set of matched records. The master record is the most complete record, since a variable with missing values has less weight than variables with no missing values. Duplicate records are records belonging to the master record. The master record and its set of duplicates are known as a pseudo match. Records that are not linked are called 'residuals'.

After the record linkage, a match set number is generated for each set of matched patient records and for the unlinked records.

The linked data were also checked for false matches as it was found that some private day-surgery centres had a tendency to use the same medical record number for different patients. These records were therefore recoded as residual records. The results of this linkage process are in table 1.

Table 1 **Number of matched and unmatched records**

	Matched records		Unmatched records	
	Number	% of total	Number	% of total
1996-97	1 008 449	55.3	816 525	44.7
1997-98	1 078 347	56.1	844 799	43.9
1998-99	1 064 658	56.0	838 168	44.0
1999-00	1 075 898	56.3	833 751	44.7

Source: HOIST.

7 Soundex is a phonetic coding system that provides a means of identifying words by the way they sound.

8 UnDup is an option in Automatch that is used for unduplicating a single file or group of records into meaningful sets (for example, in the ISC link to group readmissions of patients).

Table 2 provides a summary of the number of separations and patients in each year for both NSW hospitals and NSW residents treated interstate.[9] It also includes the number of patients as a proportion of the estimated NSW population at the end of each year.

Table 2 **Number of separations and patients**

	Separations		Patients	NSW population	
	NSW hospitals	NSW residents treated interstate[a]		Estimated as at 30 June[b]	Proportion that were patients
1996-97	1 835 468	34 539	1 157 583	6 272 784	18.45
1997-98	1 895 187	40 802	1 187 765	6 333 515	18.75
1998-99	1 916 765	43 166	1 204 670	6 396 703	18.83
1999-00	1 923 438	34 446	1 192 333	6 462 499	18.45

[a] Due to limitations in the data available for NSW residents treated interstate these separations are not linked at the patient level. That is, each separation from an interstate hospital is treated as being for a different patient.
[b] Source: ABS (2002).

The record linkage process adopted here relies particularly on the person's address, date of birth, sex and medical record number. While linkage rates of people admitted to the same hospital are likely to be good, it is less likely to be the case for admissions by the same person to different hospitals. Also, separations by the same person would not be linked if they had changed address.

Table 2 suggests that each year around 19 per cent of the NSW population received treatment at a hospital at least once. However, the true figure is thought to be around 12–13 per cent of the population (NSW Government 2000). This suggests that the methodology for linking separations to the same patient is overstating the true number by around a half.

As an example, in an analysis of asthma readmissions relatively higher rates are seen in the Illawarra and Central Coast health areas than in other health areas (table 3). However, this should not be interpreted as high readmission rates, but rather good linkage rates due to the use of area-wide medical record numbers within each of these health areas.

9 The number of separations in table 2 will not equal the sum of matched records and unmatched records in table 1. This is because the data in table 1 are non-normalised and may contain up to four episodes where the patient is in the same facility stay (that is, contiguous episodes caused by statistical separation due to a change in service category). However, the results in table 2 are normalised such that there is only one separation per facility stay.

Caution should therefore be exercised whenever interpreting data based on the number of patients.

Table 3 **1996-97 asthma readmission rates since discharge for selected health areas**

Health area of hospital	1 month	3 months	6 months
	%	%	%
Central Sydney	9.4	13.8	17.5
Western Sydney	8.7	14.6	18.7
Central Coast	14.3	21.5	25.9
Illawarra	12.3	17.7	22.1
Northern Rivers	8.3	15.0	18.1
Mid Western	5.2	10.0	12.6

Source: NSW Health (2003).

A further caveat is that the quality of some of the reported variables may vary. This is particularly true for self-reported items such as private health insurance status and Aboriginal or Torres Strait Islander status. For example, the Senate Community Affairs References Committee (2000) reported that 61 per cent of privately insured people did not declare their private health insurance status and were admitted as public patients.

While the quality of the data is generally high, due to the use of the Inpatient Statistics Collection there is little scope to directly improve the data beyond that in which it has been received. Nevertheless, section 3 discusses further steps that were taken to improve the integrity of the data where this was possible.

Finally, while the data definitions for most variables are consistent across the four years, there are four for which this does not hold true. These are payment status (which was different in 1999-00), and DRG, diagnosis and procedure codes (which differed between the first and last two years).

2.2 NSW hospitals administrative datasets — gross and net costs

There are a number of different categories of separations for costing purposes within the separations datasets. Generally the cost of each separation was either calculated at the separation level or based on an average cost in that facility for the treatment received by the patient. The

average cost was primarily based on the DRG recorded for each separation, with DRG version 3.1 applying to 1996-97 and 1997-98, and DRG version 4.1 applying to 1998-99 and 1999-00. However, certain classes of separations had alternative methodologies applied to calculating the cost of the treatment received.

The cost initially calculated is a gross cost that does not take into account any revenue received for providing this treatment. For example, a patient admitted under motor vehicle accident compensation to a metropolitan hospital and receiving critical care would attract revenue of around $1700 a day. The net cost to government is therefore calculated by subtracting the revenue received from the gross cost.

Details of the methodology used for calculating both gross and net costs are outlined below.

Gross cost of separations — a focus on 1998-99

The cost of separations was calculated in essentially the same way for each year. For illustrative purposes, the following methodology uses rates and caps that applied in 1998-99.

Acute separations in acute public hospitals with more than 2000 acute separations a year had costs calculated in one of two ways. If the separation was from a patient-costing site, the cost was derived at a patient level. If the separation was from a cost-modelling site, the average cost for the particular DRG in that facility was used. In both instances the data are contained in the NSW Hospital Cost Data Collection.

If the separation was an acute separation from an acute public hospital with fewer than 2000 acute separations a year (peer group 'D1 — Community Acute Facilities') the cost was calculated as the average cost per casemix weighted separation for that hospital (including emergency department and intensive care unit costs) multiplied by the cost weight of the separation (sourced from the NSW Health Services Comparison Data Book 1998-99 and the NSW Costs of Care Standards 2000-01 (NSW Health 2000a, 2000b)).

If the separation was an acute separation from a non-acute public hospital with fewer than 2000 acute separations a year (peer group 'D2 — Community Non-Acute Facilities') the cost was calculated as the average

cost for that DRG in D1 facilities (where there is an average for that DRG). The average cost in D1 facilities is the average cost of separations costed as in the previous paragraph (NSW Health 2000a, 2000b). Where there is no average for that DRG in D1 facilities it is the average cost per weighted separation for the D1 group (including emergency department and intensive care) multiplied by the cost weight.

If the cost of an acute separation could not be found, or an acute separation was from Hawkesbury or Port Macquarie hospitals, the cost was calculated as the average cost per weighted separation (including emergency department and intensive care unit for that hospital, or of their peer group for Hawkesbury and Port Macquarie) multiplied by the cost weight of the separation (NSW Health 2000a, 2000b).

The cost for an acute separation from a private hospital was calculated by taking the average private hospital cost for that DRG (sourced from the Private Hospital Cost Collection).

The cost of a separation from a designated mental health unit in a public hospital was calculated by multiplying the average mental health bed day cost for that facility by the length of stay, subject to a cap of $25 425 (NSW Health 2000a).

The cost of a separation from a designated mental health unit in a private hospital was calculated at the rate of $247 a day for the first 42 days, $215 a day for days 43–65 and $186 a day after day 65, subject to a cap of $5434 (sourced from the Patient Benefit Classification Schedule).

The cost of a sub-acute or a non-acute separation from a public facility was calculated by multiplying the average cost per sub- or non-acute bed day for that facility by the length of stay, subject to a cap of $23 201 (NSW Health 2000a).

The cost of a sub-acute or non-acute separation from a private facility was calculated at the rate of $247 a day for the first 49 days, $215 a day for days 50–65, $186 a day after day 65, subject to a cap of $5434 (sourced from the Patient Benefit Classification Schedule).

The cost of separations for NSW residents treated interstate was not calculated.

Net cost of separations

For some patients the government receives revenue from a third party towards the cost of their treatment. This may occur, for example, if a patient is treated for a compensatable injury or if the person is admitted as a private patient. The daily revenue received by the government for each separation was determined primarily by the value of the 'payment status' variable. For the three years 1996-97 to 1998-99 Payment Status Version 3 was used while for 1999-00 Payment Status Version 4 was used.

The process of calculating the revenue received involved first identifying the daily revenue rate and then multiplying this by the length of stay. However, for some categories of payment status it was also necessary to identify the type of hospital and whether critical care was provided. Additionally, in the first three years of data, separations with a payment status of 'Private' needed to be allocated between overnight and same day. This was determined by the value recorded for the same day variable (DayOnly). A full list of the various revenue types and rates is provided in tables B1 and B2 in appendix B. No revenue was attributed to separations from private hospitals or NSW residents treated interstate.

For those payment statuses associated with 'workers compensation', 'motor vehicle accident compensation', 'ineligible' or 'other', the peer group must first be established. This determines whether the revenue-charging group is 'metro referral', 'metro non-referral', 'non-metro', 'pysch' or 'other'. A list of the revenue-charging group for each facility is provided in table B3 in appendix B.

If a separation with a payment status of metro referral, non-metro referral or non-metro received critical care,[10] the revenue was calculated as the sum of two parts. First, the daily rate for critical care was divided by 24 and multiplied by the number of hours in critical care. Second, the difference between the length of stay and the hours in intensive care was multiplied by the inpatient care rate. Because the revenue received for critical care is much greater than for inpatient care, this serves to prevent overstating the amount of revenue received.

The revenue calculation was subject to two constraints. First, if the hours in intensive care divided by 24 was greater than the length of stay, the

10 A separation was taken to include critical care if there was a positive entry for the hours in intensive care (HICare) variable.

revenue calculation was capped at the length of stay (using the critical care rate).[11]

Second, if the length of stay was greater than 365 days the revenue was calculated by multiplying the daily rate by 365 and dividing the result by two.[12] A stay of more than 365 days could arise if the hospital recorded incorrect data or if the patient had been treated by the hospital for more than one year. This may arise, for instance, in the case of long-term psychiatric patients. However, even if a length of stay of greater than 365 days was accurately recorded, the maximum revenue the medical facility would receive for that year would be based on 365 days.

A summary of the number of separations with either excess hours in intensive care or length of stay greater than 365 days is provided in table 4.

Table 4 **Number of separations with excess hours in intensive care or length of stay longer than one year**

	Intensive care[a]	Length of stay[b]
1996-97	1	240
1997-98	0	257
1998-99	42	245
1999-00	3	205

[a] Number of separations where the hours in intensive care are greater than the length of stay multiplied by 24 plus 23. [b] Number of separations where the length of stay is greater than 365 days.

Note: This extract was taken *after* the removal of certain separations. Refer to section 3 for further details.

11 Because of the way length of stay is calculated it is possible for the recorded hours in intensive care to be up to 23 hours greater than the length of stay multiplied by 24. This is because the length of stay is calculated with reference to the number of midnights that have occurred during the patient's stay in hospital. However, for simplicity and due to the high rates of revenue associated with critical care treatment, this approach to capping the revenue calculation has been adopted.

12 The annual figure was divided by two because it is not possible to determine at what point in the year the patient was discharged. A length of stay of greater than 365 could be legitimately recorded for a patient discharged on any day of the year. However, given that the datasets have been assembled on a annual basis, it was assumed that such patients would be evenly distributed throughout the year.

Table 5 summarises the total cost before and after the adjustment for revenue received by government.

Note that as a consequence of this methodology it is possible to generate negative net costs. This occurs because an average revenue rate is being used for all public medical facilities across the state whereas the average costs used to calculate the gross cost are hospital specific. However, analysis of separations with negative net costs reveals that only a very small proportion of records are so affected (around 0.5 per cent of total gross costs).

Table 5 **Summary of costs**

	Public medical facilities			Private medical facilities
Year	Gross cost	Revenue received	Net cost	Gross cost
	$m	$m	$m	$m
1996-97	3 525.1	208.8	3 316.3	930.2
1997-98	3 280.6	185.5	3 095.1	963.3
1998-99	3 411.3	178.1	3 233.2	940.3
1999-00	3 269.9	169.5	3 100.4	1 081.8

Note: This extract was taken *after* the removal of certain separations. Refer to section 3 for further details.

3 Data integrity

3.1 Checking for invalid data values

All variables for each year were checked to determine whether valid values were recorded and whether any values were missing. It should be noted that for some variables it is valid for there to be no value recorded while others should always have an entry. An example of the former is 'external cause of injury' and of the latter is 'marital status'.

A frequency check on the values recorded for each variable was therefore performed to identify the range of values recorded and how many separations did not have a value recorded for a variable. The results of this process are detailed in table C1 in appendix C.

Where invalid or missing values were identified, corrective action was taken where possible. First, if the value was invalid it was corrected where possible. An example of this type of error was an incorrect SLA number, which could be obviously attributed to the correct SLA.[13] Second, if the value was missing, the value was imputed where possible. This is discussed in section 3.2. Separations with remaining missing values were left unchanged.

3.2 Imputing missing values

Table C1 in appendix C shows that for many separations a number of related variables had not been recorded or were identified as unknown. In the literature these variables are generally called 'missing' values. To improve the completeness of the datasets, a number of steps were taken to impute a likely value for a missing variable.

The first step was to look for separations by the same patient and use these records to impute missing or unknown values onto the incomplete separation record. This process was used for the variables marital status (Marital), area health service of usual residence (RAHS), sex (Sex), whether born in Australia (Ctry_Code) and whether English is usually spoken at home (Lang_Code).

The second step related to geographic variables for which valid values were not recorded on the separation records. If an SLA was recorded as 'Unknown' or 'No Fixed Address', the SLA was set to equal the SLA of the medical facility the patient was treated in. If the CD was recorded as 'Unknown' or 'No Fixed Address' the CD was set to equal the CD of the medical facility the patient was treated in. If the area health service of usual residence (RAHS) was recorded as 'No Fixed Abode' or 'Not Stated/Other', the area health service of usual residence was set to equal the area health service of the medical facility the patient was treated in. Finally, if there was no value recorded for the CD the variable was set to equal the CD of the hospital the patient was treated in.[14]

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13 This occurred due to an administrative practice adopted by NSW Health.

14 This imputation method could not be applied to separations from private hospitals as the name and location of these hospitals could not be identified for reasons of confidentiality.

The final step involved separations where the sex was recorded as 'indeterminate'. This was found to occur in only the 0–4 years of age range and is thought to apply to only newborns. The dataset was first checked to determine whether the patient had any other separations from which the sex could be imputed. For any remaining separations, a sex was randomly assigned to the patient.

A summary of the number of separations where a missing or unknown value could be imputed for these variables is provided in table C2 in appendix C.

3.3 Removal of certain records

Table 2 shows the raw number of separations and patients for each year. However, for a variety of reasons some of these separations were removed from the dataset for ongoing analysis. The patients and separations not covered in the enhanced and final datasets include:

- those that had hospital-type treatment in a nursing home;
- patients with a usual residential address outside of New South Wales; and
- patients treated in public psychiatric hospitals.

All separations from nursing homes and those with a peer group (Peer) of 'Mothercraft' were removed.[15] In addition, those separations with a peer group of either 'Multi-Purpose Services: Current' or 'Multi-Purpose Services: Future' where the service category variable (C_SrvCat) was coded as 'Non-Acute' were removed. This is because the Commonwealth is responsible for the majority of nursing homes, so that including the state nursing homes would be markedly understating nursing home activity in New South Wales. Similarly the non-acute patients in 'Multi-Purpose Services' were removed, as these can be patients in residential aged-care beds. 'Mothercraft' are establishments where the primary role is to help mothers acquire mothercraft skills in an inpatient setting.

The next set of separations that were removed ensured that only NSW residents were included in the ongoing analysis of the hospitals data. If

15 However, separations relating to nursing home-type patients in non-nursing home medical facilities were retained, since these patients cannot otherwise be identified in the data.

the CD of the patient's usual residence was recorded as either 'Overseas' or a state other than New South Wales, the separation was removed. Additionally, if the area health service of usual residence (RAHS) was recorded as 'Interstate' the separation was removed.

If the area health service of hospital (HAHS) was recorded as 'Correctional' the separation was also removed. This was because patients from these facilities come from many different locations, which makes imputation of socioeconomic status problematic.

If the hospital type (HospType) was coded as 'Public Psychiatric Hospital' the separation was removed. This was because patients from these facilities are typically in long-term care and often not discharged within the year of admission. Furthermore, many of the patients had no fixed address. These two points imply that, like patients in correctional facilities, imputing their socioeconomic status would be problematic.

Finally, if the payment status (PaySt_3 or PaySt_4) was recorded as 'Other' the separation was removed. This was because these patients are of a variety of different cases that are not homogenous, making assignment of a payment rate difficult (PaySt_3) or are all visitors from overseas (PaySt_4).

Table C3 in appendix C summarises the number of separations that were removed for each of these variables.

4 New variables added

A number of variables were either merged onto the separations datasets or created to provide greater analytical insight into the socioeconomic and spatial distribution of patients.

4.1 Socioeconomic indexes for areas, and geographic and cost variables

Geographic and geographically based socioeconomic indicators were added to the NSW administrative hospitals datasets at two levels: the

location of public hospitals and the location of the patient's usual residence.

First, the CD of each public hospital was merged onto the datasets based on a listing provided by NSW Health. The SLA of the hospital was then merged onto the datasets by mapping the CD to the SLA. This procedure was not performed for private medical facilities as the names or locations of these facilities were not known for reasons of commercial confidentiality.

Second, the five ABS 1996 socioeconomic indexes for areas (SEIFA) were merged at the CD level onto each patient's record in the datasets based on the address of their usual residence (ABS 1998).[16] It is important to appreciate that the ABS assigns a particular SEIFA value to an *entire* CD. That is, all households within a particular CD have the same SEIFA value. These indexes are the traditional means of measuring relative socioeconomic status and health inequality. An urban flag or a rural flag for each patient was also created based on the urban index of relative socioeconomic advantage.

In addition, a new cost variable was created. The process of calculating net costs outlined in section 2.2 generated three revenue variables in addition to a net cost and new payment status variable. The three revenue variables are daily non-intensive care revenue, daily intensive care revenue and total revenue for the separation. The net cost variable is the gross cost minus the total revenue. To facilitate future analysis, a new payment status variable was created to identify the specific type of payment status the revenue was calculated under.[17]

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16 The five indexes are the index of education and occupation, the index of economic resources, the index of relative socioeconomic disadvantage, the rural index of relative socioeconomic advantage and the urban index of relative socioeconomic advantage.

17 This was an issue for separations in the first three years with a payment status of 'Workers Compensation', 'Motor Vehicle Accident', 'Ineligible' or 'Private', or in 1999-00 with a payment status of 'Compensable – Workers Compensation', 'Compensable – Motor Vehicle Accident' or 'Compensable – Other'. Refer to section 2.2 for further details.

4.2 Imputing socioeconomic status

The final variable added to the NSW hospitals datasets was an additional indicator of socioeconomic status — the equivalent family income (EFI) quintile. EFI is a measure of economic resources available to a family. In particular, it reflects how the composition of a family unit affects the relative resources available for a given family income.

Having patient-level data provided the opportunity to create this improved measure of socioeconomic status. The improvement partly arises from our ability to apply this measure at the level of individual patients rather than to an entire geographic area (at the CD level in the case of SEIFA, as described in section 4.1). Furthermore, equivalent gross family income is a better measure of the resources available to families than unadjusted gross income. For example, a single person with a gross income of $50 000 and a couple with three children with a gross income of $50 000 do not have the same level of resources, because the income of the second family is being used to support five people rather than just one. Applying an equivalence scale to the incomes of families of different size and composition is a way of improving the accuracy of the measure of relative economic wellbeing.

The specifics of the methodology for imputing socioeconomic status onto patient records are now outlined.

Distribution of socioeconomic status in the NSW population by census collection district

NSW Health datasets contain no information on family income or family composition — variables required to compute the EFI measure. Since such information cannot be obtained from available statistics for hospital patients but can be obtained for the total NSW population from the census, we obtained the sex and age distribution of the population in each CD by EFI quintile from the census. Then, using the CD information imputed to each patient (refer to section 2.1), we randomly allocated an EFI quintile to each hospital patient from the census-level EFI distribution in the *same* CD–sex–age cell.

A special extract from the 1996 census was therefore obtained from the ABS, to which an EFI variable had been added by the bureau using a NATSEM-provided definition of the family-level EFI formula (refer to

appendix D).[18] EFI was computed by the ABS, at the level of individual families in the 1996 census, using the modified OECD scale. The equivalence scale factor is the square root of the sum of 1.0 for the first adult, 0.5 for the second adult and 0.3 for each dependent child (refer to Mejer and Siermann 2000). The equation for EFI therefore was:

EFI = (Total family income)/(Equivalence scale factor)

These family-based EFI values were then assigned by the ABS to each member of the family. The observations were sorted and then ranked into EFI quintiles.[19] The EFI quintile ranges of weekly gross family income are shown in table 6.

Table 6 **1996 census equivalent family income quintile ranges** Weekly gross family income[a]

EFI quintile	EFI range
	$
1	nil – 193.33
2	193.34 – 304.29
3	304.30 – 453.00
4	453.01 – 661.33
5	661.34 – max

[a] Based on NSW residents only.

Due to legislative requirements the ABS is unable to release any data that would allow an individual to be identified. Any cell of a cross-tabulation that has a very small count is randomly perturbed to maintain confidentiality (refer to ABS 1996b). To reduce the number of perturbed cells we collaborated with the ABS to ensure that as many cells as possible were of sufficient size to remain unperturbed.

As noted above, the ABS allocated each person in the census to an equivalent gross family income quintile (rather than, for example, providing us with an average equivalent family income measure or with deciles of equivalent family income). This helped to increase the number of observations within each cell of the final matrix table provided by the ABS. A second important way of achieving this outcome was to

18 The CD of enumeration was used, rather than the CD of residence, as the lowest level of spatial aggregation in the 1996 census was the SLA.

19 Only NSW residents were included in this process.

aggregate the age variables into 10-year groups up to age 69 and then one group for 70 years and over. A count of the number of people within each CD – sex – age group – EFI quintile was then produced and it was in that form that NATSEM received the census extract from the ABS.

This level of aggregation implies that each CD will have a maximum of 80 non-zero cells.[20] However, in practice not every sex – age group – EFI quintile was represented in each CD. As a result the number of cells in which perturbed data were reported was very low (around 10 per cent of the NSW population). Refer to Thurecht et al. (2002) for details of validation checks that were performed on the census extract.

Imputing socioeconomic status from the 1996 census extract

The distribution of the socioeconomic status for all NSW residents by CD – sex – age group – EFI quintile was then used to impute the socioeconomic status of each patient in the NSW hospitals datasets. Whereas SEIFA assign the same index number to every person in a given CD, in this project we improved on the traditional techniques for estimating socioeconomic status by imputing socioeconomic status to each patient at the CD–sex–age level of disaggregation[21] based on the EFI measure.

This was accomplished by first totalling in the census extract the number of people in each CD – sex – age group combination. The proportion of people in this combination in each EFI quintile was then calculated. These proportions can be interpreted as the probability that a person living in a given CD and of a given sex and age group will be in a particular EFI quintile. Each combination was then sorted by EFI quintile and the cumulative proportion of people in the combination was summed from quintile 1 to quintile 5. This is analogous to the cumulative probability that a person from a particular CD and of a particular sex and age group is associated with socioeconomic status up to a given level.

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20 Two sexes multiplied by eight age groups multiplied by five EFI quintiles.

21 This technique also allows imputation at any higher level of spatial aggregation based on CDs — for example, at the SLA or local government area level. Refer to ABS (1996a) for further details on the spatial structure used in the 1996 census.

Each patient in the NSW hospitals datasets was then allocated a random number z where $z \sim U[0, 1]$. Next, each hospital patient was compared with the matching CD – sex – age group combination from the 1996 census extract, using the random number z allocated to individual patients. This random number was progressively compared with the EFI quintile cumulative probabilities for quintiles 1–4. The first time z was less than the cumulative probability to which it was being compared, that EFI quintile was assigned to the patient. If, however, z was greater than the cumulative probability for EFI quintile 4, EFI quintile 5 was assigned to the patient. This EFI quintile was then assigned to all other separations by the same patient in the NSW hospitals datasets.

Tables 7 and 8 provide a hypothetical example that demonstrates the application of this approach.

It should be noted that there are certain limitations associated with this imputation method. The first is that there is no direct link between the socioeconomic status of a given patient from year to year. This is because in the NSW hospitals datasets patients could be traced only within financial years and not across (see section 2.1). As a result, the process outlined above was repeated for each year with a potentially different random assignment of EFI quintile to each patient.

The second is that this imputation method assumes that those who use hospitals within a particular CD are matched by the sex – age group – EFI quintile distribution of all people living in that CD. For example, suppose that the NSW hospitals dataset for a given year contained four 0–9 year old males from a particular CD and that the 1996 census extract showed that there were twenty 0–9 year old males living in that CD, with half in EFI quintile 2 and half in EFI quintile 5. It would be expected that the methodology outlined above would have assigned two of the 0–9 year old males to quintile 2 and the other two to quintile 5.[22] However, there may be systematic links between socioeconomic status and hospital admissions such that, in reality, all four of the 0–9 year old males were from quintile 2.

22 Because z is a random variable this is not an assured outcome but an expected outcome.

Table 7 **Imputation of socioeconomic status using actual distribution: 1996 census data extract**

CD	Sex	Age	EFI quintile	Number of people	Probability[a]	Cumulative probability
		years				
1251405	Male	0–9	1	0	0.0	0.0
1251405	Male	0–9	2	10	0.5	0.5
1251405	Male	0–9	3	0	0.0	0.5
1251405	Male	0–9	4	0	0.0	0.5
1251405	Male	0–9	5	10	0.5	1.0

[a] 'Probability' refers to the proportion of people in that CD – sex – age – EFI quintile cell.

Table 8 **Imputation of socioeconomic status using actual distribution: NSW Health hospitals data**

CD	Person ID	Sex	Age	z[a]	EFI quintile assigned
			years		
1251405	356897	Male	0–9	0.4986	2
1251405	56897	Male	0–9	0.5877	5
1251405	219873	Male	0–9	0.8242	5
1251405	1856421	Male	0–9	0.2654	2

[a] $z \sim U[0,1]$.

Notwithstanding these limitations, the methodology outlined above is able to assign socioeconomic status with greater accuracy than SEIFA, as the latter would assign the *same* index value to all 0–9 year old males despite the underlying differences in EFI and associated socioeconomic status. That is, the richness of this distribution is lost when using a single index for an entire CD or when modelling socioeconomic characteristics at higher levels of spatial aggregation. However, at the patient level this detail is not lost, which adds to the accuracy with which modelling can proceed. This is particularly important in instances where a CD may be relatively polarised in terms of the socioeconomic status of its residents or where the effect of a change in policy may be particularly sensitive to the socioeconomic status of a person.

5 Projecting future hospital usage

Another aspect to the SPIRT project was to develop a facility for projecting future hospital usage and expenditures.

We adopted the standard projection assumption in the literature that the key drivers of future trends in hospital usage and costs were most likely to be population ageing and changes in hospital treatment patterns. We projected changes in the population by SLA, sex and five-year age group. A proxy for change in hospital treatment patterns was developed based on the propensity to use hospital services according to the SLA – sex – age – service related group (SRG). The SRG variable is intended to be a proxy, among other things, for changes in medical technology, morbidity patterns and clinical practices. Note that the SRG variable was first aggregated into eight categories, with a ninth category (coronary heart disease) created later. This approach was adopted to keep the model simple, yet capture the two main drivers of change.

The projection methodology used is outlined below. While it could be applied to any future period, for illustrative purposes the discussion focuses on projections five and ten years into the future.

5.1 'Ageing' the 1999-00 NSW hospitals dataset

The NSW hospitals dataset for 1999-00 was used as the base year and aged to 2004-05 and 2009-10 using population projections from the ABS (2000a). These projections are at the SLA level by sex and five-year age groups and are as at 30 June for each year from 1999 to 2019. The population projections used the 'series two' assumptions of the ABS (2000b).[23]

Each SLA – sex – age group combination was given an initial weight of one. The growth in each of these cells forecast by the ABS was then used to calculate a weight for the two projection years. The growth was measured by dividing the projected population by the base population

[23] The assumptions are a fertility rate of 1.6 births per woman and net overseas migration of 90 000 people a year. SLA projections were used, as this was the lowest level of spatial aggregation available.

in each SLA – sex – age group combination. For example, if the population in a particular SLA – sex – age group combination were projected to increase by 20 per cent over the first five years and then double over the subsequent five years, a population weight of 1.2 would be assigned for 2004-05 and 2.4 for 2009-10.

5.2 Propensity to use services

Trends in the propensity to use services were derived from separations data covering the four years 1996-97 to 1999-00 in combination with ABS population projections at the SLA – sex – age group level for each of these years. The propensity indicates the likelihood of a person from a particular SLA – sex – age group using a particular service.

To make the process more manageable and reduce sensitivity to small numbers, the SRG variable was aggregated from 40 to 8 categories. Coronary heart disease was created as a separate category to demonstrate how analysis of a specific morbidity could be performed. This brought the total number of new SRG categories to nine. The mapping of SRGs and coronary heart disease to the new classes is shown in appendix E.

To determine the trend in service usage, the propensity for service usage in each year at the SLA – sex – age group level was first calculated. This involved dividing the number of separations for each new SRG class in each year at the SLA – sex – age group level by the associated underlying population (of hospital and non-hospital users). Note that this implies that the propensity could be greater than one if enough people in the SLA – sex – age group had multiple separations for the same service during the year.

From these observations of propensity for service usage, a simple linear trend was used to project the likely propensity for service usage over the next five and ten years. However, this was subject to the constraint that if the trend suggested a negative propensity (which has no economic meaning) the propensity in 1999-00 was arbitrarily reduced by 10 per

cent for both projection years.[24] If the 10 per cent reduction still produced a negative propensity the value was set to zero.

The projected service usage propensities for 2004-05 and 2009-10 were then divided by the respective SLA – sex – age group propensities in 1999-00 to obtain the growth in service usage during the two projected periods. This produced a weight that could be applied to reflect change in service usage.

For example, if the 1999-00 propensity for a particular SLA – sex – age group service usage was 0.5 and was forecast to fall to 0.4 in 2004-05 and 0.3 in 2009-10, SRG weights of 0.8 and 0.6 would be assigned to the respective projection periods.

5.3 Weighting base year separations over the projection period

The final projection of future hospital usage takes the form of weights attached to base year separations. These were formed by multiplying the population weight by the SRG weight.

To demonstrate the intuition behind this approach, consider a given SLA – sex – age group – new SRG cell where the population is expected to double but the SRG usage propensity is expected to fall by half. In this case the expected growth in population is exactly offset by the decreased propensity by people in this cell to use this service. Therefore, the weight associated with that separation would remain at one. However, if the propensity for service usage were projected to increase by half, the weight attached to these separation records would be set to three, reflecting not only a larger population but also the increased propensity to use that service.

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24 Testing revealed that the change in the projected propensity was not sensitive to the arbitrary reduction applied. This is as would be expected because, to produce a negative forecast, the in-sample propensities would need to have fallen rapidly to a relatively low propensity in 1999-00 (that is, close to zero). Setting the forecast propensities to zero was also considered. This did not meaningfully change the projection but was considered inappropriate given the implicit across-the-board implication that these services would no longer be used in the projection period by that SLA – sex – age group combination. Note that the 2004-05 and 2009-10 projection years had 6.5 per cent and 16.6 per cent of cells respectively with an initial negative propensity.

As can be seen with this approach, the projections of usage are driven by *proportional changes* in the two driving factors of service usage and not the absolute level of either of the variables. This avoids the problem of 'double counting' in that an increase in the number of services to a particular group of people may be driven by population growth, change in propensity for service usage or any combination of both. Using proportional changes controls for this by scaling each factor for these potentially confounding effects.

There are, however, some important caveats with this methodology relating to the assumptions made in preparing the projections. The first is that the trend in propensity for service usage remains the same over the five and ten year projection periods. To the extent that changes in medical technology, morbidity patterns and clinical practices are reflected over the in-sample period, they should also be reflected in the projections.[25] While these and other factors could be separately projected (for example, to examine the impact of a posited specific advance in medical technology), this approach represents a base case projection against which alternatives can be developed and compared.

The second caveat is that the socioeconomic distribution based on the 1996 census holds over the forecast period.

The third is that for analysis at levels of spatial aggregation below SLA, the demographic and service usage distribution at the SLA – sex – age group level is assumed to be identical at all lower levels. For example, if analysing data at the CD level it is assumed that each CD within the SLA has the same demographic, socioeconomic and service usage profile.

5.4 Limitations associated with the projected hospital usage

The methodology developed for projecting hospital usage (presented above) has certain limitations. Perhaps the most significant is the interpretation that is attached to the projections themselves. Whereas interest is often focused on demand for hospital services, the methodology developed for projecting hospital usage does not address

[25] This implies that shocks to the system will not be captured. Such shocks are possible, for example, due to advances in genetic technology, which is perhaps not well represented during the in-sample period.

this issue directly, although demand is partly accounted for because population ageing is considered in the projections. Rather it projects hospital usage assuming that the trend in disease and hospital usage patterns continues over the projection period. If this assumption proves to be correct, then we have also taken demand into account comprehensively.

Apart from population ageing, modelling demand would also require consideration of trends in disease patterns within the NSW population. As well, trends in the hospital services resulting from such disease patterns would require explicit consideration of waiting lists and those would-be patients that choose not to enter the hospital system — perhaps due to perceptions of cost or delays in obtaining treatment because of waiting lists. Furthermore, the complicated issue of supply-induced demand would also need to be considered (because it can be argued that the creation of extra hospital facilities 'generates demand' that would not otherwise manifest itself in the hospital system were it not for the additional capacity that has been created). At the supply end, difficulties arise in considering how the throughput of patients may change over the projection period, as trends in admission rates and length of stay affect the volume of patients that might be treated.

Although complicated supply–demand models can be built, for this project we prepared projections on the basis of usage statistics, supplemented with the effect of a key demand factor, population ageing. Another important factor influencing demand, the cost of hospital services, is currently not considered an issue in Australia (because hospital services to patients are generally free).

Another limitation arises from the particular proxy that we developed for projecting service usage in hospitals. This limitation arises in part from asymmetry in the constraints placed on the projections of usage propensities. Negative propensities are prevented from occurring whereas no constraints are placed on the growth of positive propensities. Together, these influences are prone to producing an overestimate of the total level of future hospital usage.

A further caveat to these usage projections is that currently they are based on a static socioeconomic profile of hospital users, as depicted in the 1996 census. To remedy this situation, we have obtained an extract from the 2001 census based on the same methodology as for the 1996

census. Being able to consider trends across two censuses gives us the possibility of projecting likely changes in the socioeconomic profile of NSW hospital users as well as in their age and sex distributions. Further work is under way on this issue.

5.5 Opportunities to refine the projected future hospital usage

Having identified certain limitations in the usage projections, there are nevertheless a number of opportunities to address these problems to render the projections more robust.

With respect to the overestimation of projected usage, it is important to note that this will be weighted towards the level of the projections, not the demographic and distributional mix itself (which is where the strength of microsimulation modelling is greatest). That is, while the projected level of hospital usage may be too high, the demographic and socioeconomic profiles of hospital users and the pattern of disease in the projections should be reasonable (to the extent that the SRG propensities are a good proxy of changes in morbidity patterns, technology and clinical practices).

This suggests, as with most microsimulation modelling,[26] that the projections should be calibrated against some external source to bring the level of the projection more into line with an aggregate expectation. Such a source exists in the form of NSW Health Acute Projections Plus Interventions (APPI) forecasts. While these projections are prepared at a more aggregated level than the usage projections developed in this project, they nevertheless provide a benchmark against which to calibrate the usage projections. That is, the level of the projections is lowered while the demographic, socioeconomic and pattern of disease mix is retained. Calibration of the NSW hospitals model — described in this paper — to the projections is planned for later in 2003.

A further issue worth mentioning in relation to microsimulation models is that of the reliability of the estimates produced. Reliability is affected by, for example, survey sampling, parameter estimation and the probabilistic methods used in imputation procedures. In our case

26 See, for example, Walker, Percival and Fischer (1998, section 7) and Bækgaard (2002).

sampling error does not apply because we used full population datasets for both the hospitals and the census-based data. Parameter estimation has not been used in either. There remains the question of the errors that were introduced through the probabilistic processes used when imputing socioeconomic status to hospital patients. The usual way of gaining an idea of the importance of errors arising from the use of probabilistic methods is to replicate the simulations a number of times and compare the results with those obtained from a single simulation. In this respect Pudney and Sutherland (1994), using a UK model, and Abello, Kelly and King (2002), using an Australian model, found that replicating the results a number of times — compared with a single simulation — had a surprisingly small effect. For that reason, we have not carried out such a 'validation' exercise in this project.

A Variables in the datasets

Table A1 **Variables provided by NSW Health**

Variable	Meaning
AdmStat	Admission status
Age_Group	Age by five-year age band
C_SoRef	Source of referral
C_SrvCat	Service category
CD	Census collection district of usual place of residence
Cost	Gross cost of separation
Ctry_Code	Whether born in Australia
DayOnly	Day only or overnight stay
Diag1 – Diag19	Secondary diagnoses during episode of care[a]
Diag101 – Diag1019	Secondary diagnoses during episode of care[b]
DRGV31	Diagnosis-related group Version 3.1 (1996-97 and 1997-98 only)
DRGV41	Diagnosis-related group Version 4.1 (1998-99 and 1999-00 only)
Extern1	External cause of injury-poisoning-adverse effect
HAHS	Area health service of hospital
HICare	Hours in intensive care
Hosp	Medical facility code-label
Hosptype	Type of medical facility
Indig_Code	Whether of Aboriginal and Torres Strait Islander origin
Insur	Private health insurance status
Lang_Code	Whether English is usually spoken at home
LOS	Length of stay (in days)
Marital	Marital status
MSet	Master set number (unique to each patient)
PaySt_3	Source of payment for medical care Version 3 (1996-97, 1997-98 and 1998-99 only)
PaySt_4	Source of payment for medical care Version 4 (1999-00 only)
PDiag	Principal diagnosis during episode of care[a]
PDiag10	Principal diagnosis during episode of care[b]
Peer	Medical facility peer group
Place	Place of occurrence of external cause of injury
PProc	Principal procedure during episode of care[a]
PProc10	Principal procedure during episode of care[b]
Proc1 - Proc19	Secondary procedure during episode of care[a]
Proc101 - Proc1019	Secondary procedure during episode of care[b]
Psyc	Whether admitted to a designated psychiatric unit
RAHS	Area health service of usual residence
ReAdmis	Whether readmitted within 28 days to same medical facility
SepMode	Mode of separation
Sex	Biological sex of patient
SLA_ISC	Statistical local area of usual place of residence
SPIRT_ID	Unique identifier for each separation
SRG	Service-related group

[a] ICD-9-CM (1996-97 and 1997-98 only). [b] ICD-10-AM (1998-99 and 1999-00 only).

Table A2 **Variables merged or created**

Variable	Meaning
Geographic	
HospCD	The census collection district where the medical facility is located
HospSLA	The statistical local area where the medical facility is located
Revenue and cost	
Rev*	Revenue received per day for each separation, where * refers to the year of the dataset
ICURev*	Intensive care unit revenue received per day for each separation, where * refers to the year of the dataset
NetCost	Gross cost less revenue received
NewPayStat	The payment status of the separation, with an extra letter added to those separations that were 'Workers compensation', 'Motor vehicle accident', 'Ineligible' or 'Private' (1996-97 to 1998-99) or 'Compensable – workers comp', 'Compensable – motor vehicle accident' or 'Compensable – other' (1999-00).
Socioeconomic status	
EFI	Equivalent family income quintile
IEduOcc	Index of education and occupation
IER	Index of economic resources
IRSED	Index of relative socioeconomic disadvantage
RIRSEA	Rural index of relative socioeconomic advantage
UIRSEA	Urban index of relative socioeconomic advantage

B Revenue received by treatment category

Table B1 **NSW Health daily revenue charges, 1996-97 to 1998-99**

Payment status 3	Treatment category	1996-97	1997-98	1998-99
		$	$	$
1	General non-chargeable	0	0	0
2	Private – overnight	210	213	213
2	Private – same day	160	162	162
3	Workers compensation - metro referral – critical care	1 605	1 605	1 700
	Workers compensation - metro referral – inpatient care	645	645	685
	Workers compensation – metro non-referral – critical care	930	930	990
	Workers compensation – metro non-referral – inpatient care	485	485	515
	Workers compensation – non-metro – critical care	740	740	785
	Workers compensation – non-metro – inpatient care	450	450	475
	Workers compensation – psych – inpatient care	270	270	290
	Workers compensation – other – inpatient care	145	145	160
4	Motor vehicle accident – metro referral – critical care	1 680	1 700	1 700
	Motor vehicle accident – metro referral – inpatient care	675	685	685
	Motor vehicle accident – metro non-referral – critical care	980	990	990
	Motor vehicle accident – metro non-referral – inpatient care	510	515	515
	Motor vehicle accident – non-metro – critical care	775	785	785
	Motor vehicle accident – non-metro –- inpatient care	470	475	475
	Motor vehicle accident – psych – inpatient care	285	290	290
	Motor vehicle accident – other – inpatient care	160	160	160
5	Veterans' Affairs	0	0	0
6	Ineligible – metro referral -–- critical care	1 680	1 700	1 700
	Ineligible – metro referral – inpatient care	675	685	685
	Ineligible – metro non-referral – critical care	980	990	990
	Ineligible – metro non-referral – inpatient care	510	515	515
	Ineligible – non-metro – critical care	775	785	785
	Ineligible – non-metro – inpatient care	470	475	475
	Ineligible – psych – inpatient care	285	290	290
	Ineligible – other – inpatient care	160	160	160
7	Defence force	0	0	0
8	Public contract	0	0	0
9	Nursing home type – public	0	0	0
10	Psychiatric hospital – chargeable	285	290	290
11	Psychiatric hospital – non-chargeable	0	0	0
12	Nursing home type – private	28	28	28
99	Not stated	0	0	0

Table B2 **NSW Health daily revenue charges, 1999-00**

Payment status 4	Treatment category	1999-00
		$
20	Public – general and psych	0
21	Public – nursing home type with NH5	0
22	Public – nursing home type without NH5	0
23	Public – overseas eligible	0
24	Public – other eligible	0
25	Public – contract (private facilities only)	0
30	Private – general and psych (private facilities only)	0
31	Private – same day band 1	155
32	Private – same day band 2	174
33	Private – same day band 3	194
34	Private – same day band 4	216
35	Private – overnight shared ward	216
36	Private – overnight single room	372
37	Private – nursing home type	28
38	Private – overseas eligible	216
39	Private – other eligible	216
40	Compensable – NSW workers comp – metro referral – critical care	1 720
	Compensable – NSW workers comp – metro referral – inpatient care	695
	Compensable – NSW workers comp – metro non-referral – critical care	1 000
	Compensable – NSW workers comp – metro non-referral – inpatient care	520
	Compensable – NSW workers comp – non-metro – critical care	795
	Compensable – NSW workers comp – non-metro – inpatient care	480
	Compensable – NSW workers comp – psych – inpatient care	290
	Compensable – NSW workers comp – other – inpatient care	160
41	Compensable – NSW motor vehicle accident – metro referral – critical care	1 720
	Compensable – NSW motor vehicle accident – metro referral – inpatient care	695
	Compensable – NSW motor vehicle accident – metro non-referral – critical care	1 000
	Compensable – NSW motor vehicle accident – metro non-referral – inpatient care	520
	Compensable – NSW motor vehicle accident – non-metro – critical care	795
	Compensable – NSW motor vehicle accident – non-metro – inpatient care	480
	Compensable – NSW motor vehicle accident – psych – inpatient care	290
	Compensable – NSW motor vehicle accident – other – inpatient care	160
42	Compensable – other – metro referral – critical care	1 720
	Compensable – other – metro referral – inpatient care	695
	Compensable – other – metro non-referral – critical care	1 000
	Compensable – other – metro non-referral – inpatient care	520
	Compensable – other – non-metro – critical care	795
	Compensable – other – non-metro – inpatient care	480
	Compensable – other – psych – inpatient care	290
	Compensable – other – other – inpatient care	160
50	Veterans' Affairs	0
55	Defence force	0

Table B3 **NSW hospital peer groups**

Name of medical facility (public only)	Revenue-charging group
Albury Base Hospital and Nursing Home	Non-metro
Allandale Nursing Home	Other
Armidale and New England Hospital	Non-metro
Auburn District Hospital	Metro non-referral
Ballina District Hospital	Non-metro
Balmain Hospital – Hospital unit	Metro non-referral
Balranald District Hospital	Non-metro
Bankstown/Lidcombe Health Service – Hospital units	Metro non-referral
Baradine Hospital	Non-metro
Barham and Koondrook Memorial Hospital	Non-metro
Barraba and District Hospital	Non-metro
Batemans Bay District Hospital	Non-metro
Bathurst Base Hospital	Non-metro
Batlow District Hospital	Non-metro
Bega District Hospital	Non-metro
Bellinger River District Hospital	Non-metro
Belmont Hospital	Non-metro
Berrigan War Memorial Hospital	Non-metro
Bingara District Hospital	Non-metro
Blacktown Hospital	Metro non-referral
Blayney District Hospital	Non-metro
Bloomfield Psychiatric Hospital	Psych
Blue Mountains District ANZAC Memorial Hospital	Metro non-referral
Bodington Nursing Home	Other
Boggabri District Hospital	Non-metro
Bombala District Hospital	Non-metro
Boorowa District Hospital	Non-metro
Bourke District Hospital	Non-metro
Bowral and District Hospital	Non-metro
Braeside Public	Metro non-referral
Braidwood District Hospital	Non-metro
Brewarrina District Hospital	Non-metro
Broken Hill Base Hospital	Non-metro
Bulahdelah District Hospital	Non-metro
Bulli Hospital	Non-metro
Byron Bay District Hospital	Non-metro
Calvary Hospital, Kogarah	Metro non-referral
Camden Hospital	Metro non-referral
Campbell Hospital, Coraki	Non-metro
Campbelltown Hospital	Metro non-referral
Canowindra Soldiers' Memorial Hospital	Non-metro
Canterbury District Hospital	Metro non-referral
Carrington Centennial Nursing Home	Other
Casino – Bonalbo Subsidiary Hospital	Non-metro
Casino District Hospital	Non-metro
Cessnock District Hospital	Non-metro

(Continued on next page)

Table B3 **NSW hospital peer groups** (continued)

Name of medical facility (public only)	Revenue-charging group
Cobar District Hospital	Non-metro
Coffs Harbour and District Hospital	Non-metro
Coledale Hospital	Non-metro
Collarenebri District Hospital	Non-metro
Condobolin District Hospital	Non-metro
Coolah District Hospital	Non-metro
Coolamon/Ganmain	Non-metro
Cooma District Hospital	Non-metro
Coonabarabran District Hospital	Non-metro
Coonamble District Hospital	Non-metro
Cootamundra Hospital	Non-metro
Corowa Hospital and Nursing Home	Non-metro
Cowra District Hospital	Non-metro
Crookwell District Hospital	Non-metro
Cudal War Memorial Hospital	Non-metro
Culcairn District Hospital	Non-metro
Cumberland Psychiatric Hospital	Psych
David Berry Hospital	Non-metro
Delegate District Hospital	Non-metro
Deniliquin Hospital	Non-metro
Dorrigo Hospital	Non-metro
Dubbo Base Hospital	Non-metro
Dunedoo War Memorial Hospital	Non-metro
Dungog District Hospital	Non-metro
Eugowra Memorial Hospital	Non-metro
Eversleigh Home of Peace	Metro non-referral
Fairfield Hospital	Metro non-referral
Finley Hospital	Non-metro
Forbes District Hospital	Non-metro
Garrawarra Nursing Home	Other
Gilgandra District Hospital	Non-metro
Glen Innes	Non-metro
Gloucester – Nursing Home unit	Other
Gloucester Soldiers' Memorial – Hospital unit	Non-metro
Goodooga	Non-metro
Gosford Hospital	Metro non-referral
Goulburn Base Hospital	Non-metro
Governor Phillip – Nursing Home unit	Other
Gower Wilson Memorial, Lord Howe Is.	Non-metro
Grafton Health Service – Aruma	Other
Grafton Health Service – Grafton Base	Non-metro
Graythwaite Nursing Home	Other
Greenwich Home of Peace Hospital	Metro non-referral
Grenfell District Hospital	Non-metro
Griffith Base Hospital	Non-metro
Gulargambone Hospital	Non-metro
Gulgong District Hospital	Non-metro

(Continued on next page)

Table B3 **NSW hospital peer groups** (continued)

Name of medical facility (public only)	Revenue-charging group
Gundagai District hospital	Non-metro
Gunnedah District Hospital	Non-metro
Guyra	Non-metro
Hawkesbury	Metro non-referral
Hay Hospital	Non-metro
Henty District Hospital	Non-metro
Hillston District Hospital	Non-metro
Holbrook District Hospital and Nursing Home	Non-metro
Hornsby and Ku-Ring-Gai Hospital	Metro non-referral
Illawarra Regional	Metro referral
Inverell District Hospital	Non-metro
Inverell Tingha	Non-metro
Ivanhoe	Non-metro
James Fletcher Hospital – Morisset site	Psych
James Fletcher Hospital – Newcastle site	Psych
James Fletcher Hospital – Shortland	Psych
Jerilderie District Hospital	Non-metro
John Hunter Hospital	Metro referral
Junee District Hospital	Non-metro
Karitane Mothercraft Centre	Metro non-referral
Kempsey Hospital	Non-metro
Kenmore Psychiatric Hospital	Psych
Kiama	Non-metro
Kurri Kurri District – Hospital unit	Non-metro
Kyogle Memorial Hospital	Non-metro
Lake Cargelligo District Hospital	Non-metro
Leeton District Hospital	Non-metro
Lismore – Nimbin Subsidiary Hospital	Non-metro
Lismore Base Hospital	Non-metro
Lithgow District Hospital	Non-metro
Liverpool Hospital	Metro referral
Lockhart and District Hospital	Non-metro
Long Jetty	Metro non-referral
Lottie Stewart Nursing Home	Other
Lourdes Nursing Home, Dubbo	Other
Macksville and District Hospital	Non-metro
Maclean District Hospital	Non-metro
Macquarie Hospital	Psych
Macquarie Nursing Home, Bathurst	Other
Maitland Hospital	Non-metro
Manilla District Hospital	Non-metro
Manly District Hospital	Metro non-referral
Manning River – Wingham Subsidiary	Non-metro
Manning River Base Hospital	Non-metro
McCaughey Memorial Hospital, Urana	Non-metro
Mercy Care Centre, Albury	Non-metro
Mercy Care Centre, Young	Non-metro

(Continued on next page)

Table B3 **NSW hospital peer groups** (continued)

Name of medical facility (public only)	Revenue-charging group
Mercy/Mt St Joseph's, Young	Non-metro
Merriwa District Hospital	Non-metro
Milton–Ulladulla	Non-metro
Molong District Hospital	Non-metro
Mona Vale and District Hospital	Metro non-referral
Moree District Hospital	Non-metro
Moruya District Hospital	Non-metro
Mount Druitt Hospital	Metro non-referral
Mount St. Joseph's Nursing Home, Young	Other
Mudgee District Hospital	Non-metro
Mullumbimby and District War Memorial Hospital	Non-metro
Murrumburrah–Harden District	Non-metro
Murrumburrah–Harden Nursing Home	Other
Murwillumbah District Hospital	Non-metro
Muswellbrook – Denman Subsidiary	Non-metro
Muswellbrook District Hospital	Non-metro
Muswellbrook Nursing Home	Other
Narrabri District Hospital	Non-metro
Narrandera District Hospital	Non-metro
Narromine District Hospital	Non-metro
Nelson Bay Polyclinic Centre	Non-metro
Neringah Home of Peace Hospital	Metro non-referral
Newcastle Mater Misericordiae Hospital	Metro non-referral
Nyngan District Hospital	Non-metro
Oberon District Hospital	Non-metro
Orange Base Hospital	Non-metro
Our Lady of Loreto	Other
Pambula District Hospital	Non-metro
Parkes – Peak Hill Subsidiary Hospital	Non-metro
Parkes – Trundle Subsidiary Hospital	Non-metro
Parkes District Hospital	Non-metro
Nepean Hospital	Metro referral
Port Kembla	Non-metro
Port Macquarie Base	Non-metro
Portland District Hospital	Non-metro
POW Group	Metro referral
Prince Albert Memorial, Tenterfield	Non-metro
Prison Medical Service	Not applicable
Queanbeyan District Hospital	Non-metro
Queen Victoria Kings Tableland	Other
Queen Victoria Nursing Home, Thirlmere	Other
Quirindi District Hospital	Non-metro
Repatriation Hospital, Concord	Metro referral
Royal North Shore – Arndell Adolescent Unit	Psych
Royal Hospital for Women	Metro non-referral
Royal Newcastle Hospital	Metro referral
Royal North Shore Hospital	Metro referral

(Continued on next page)

Table B3 **NSW Hospital peer groups** (continued)

Name of medical facility (public only)	Revenue-charging group
Royal Prince Alfred Hospital	Metro referral
Royal Rehab – Coorabel/Moorong Units	Metro non-referral
Rozelle Psychiatric Hospital	Psych
Ryde Hospital	Metro non-referral
Rylstone District Hospital	Non-metro
Sacred Heart Hospital	Metro non-referral
Scott Memorial Hospital, Scone	Non-metro
Shellharbour Hospital	Metro non-referral
Shoalhaven and District Hospital	Non-metro
Singleton District Hospital	Non-metro
Springwood Hospital	Metro non-referral
St George Hospital	Metro referral
St John of God Hospital, Goulburn	Non-metro
St Joseph's Hospital, Auburn	Metro non-referral
St Joseph's Nursing Home, Lismore	Other
St Vincent's (Lismore) Public Rehab	Non-metro
St Vincent's Bathurst	Non-metro
St Vincent's Public Hospital	Metro referral
Sutherland Hospital	Metro non-referral
Sydney Children's Hospital	Metro referral
Sydney/Sydney Eye	Metro non-referral
Tamworth Base Hospital	Non-metro
Temora and District Hospital	Non-metro
The Children's Hospital at Westmead	Metro referral
Thomas Walker	Other
Tibooburra	Non-metro
Tocumwal Hospital	Non-metro
Tottenham Hospital	Non-metro
Trangie District Hospital	Non-metro
Tresillian Care Centre, Penrith	Metro non-referral
Tresillian, Petersham/Willoughby	Metro non-referral
Tullamore District Hospital	Non-metro
Tumbarumba District Hospital	Non-metro
Tumut District Hospital	Non-metro
Tweed Heads District Hospital	Non-metro
United Dental Hospital	Metro non-referral
Urbenville and District Hospital	Non-metro
Vegetable Creek	Non-metro
Wagga Wagga Base Hospital	Non-metro
Walcha District Hospital	Non-metro
Walgett District Hospital	Non-metro
Wallsend District Nursing Home	Other
Warialda District Hospital	Non-metro
Warren District Hospital	Non-metro
Wauchope District Memorial Hospital	Non-metro
Waverley War Memorial Hospital	Other
Wee Waa District Hospital	Non-metro

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Table B3 **NSW Hospital peer groups** (continued)

Name of medical facility (public only)	Revenue-charging group
Wellington Hospital	Non-metro
Wentworth District Hospital	Non-metro
Werris Creek District Hospital	Non-metro
Westmead (all units)	Metro referral
Wilcannia District Hospital	Non-metro
Wilson Memorial Hospital, Murrurundi	Non-metro
Wollongong Hospital	Metro referral
Woy Woy Hospital	Metro non-referral
Wyalong District Hospital	Non-metro
Wyong Hospital	Metro non-referral
Yass District Hospital	Non-metro
Young District Hospital	Non-metro

C Modifying the source hospitals datasets

This appendix summarises the number of separations that had missing or unknown values for each variable in the source datasets. The data are for NSW hospitals only — that is, NSW residents treated interstate are not included.

Table C1 **Number of missing or unknown values in the source datasets**

Variable	1996-97	1997-98	1998-99	1999-00
AdmStat	10 370	6 065	2	0
CD	13 652	13 152	12 334	14 584
Cost	3 365	5	3	14
C_SoRef	4 104	886	117	5 820
C_SrvCat	0	475	0	0
DayOnly	0	0	0	0
DRGV31	0	703	na	na
DRGV41	na	na	0	17
Extern1	0	0	0	0
HAHS	0	0	0	0
HICare	0	0	0	0
Hospital	0	0	0	0
HospitalType	0	0	0	0
Insur	92 806	44 867	38 657	1 894 959
LOS	0	0	0	0
Marital	87 623	87 726	96 669	80 469
MSet	0	0	0	0
PaySt_3	0	955	901	na
PaySt_4	na	na	na	0
PDiag10	0	3	0	0
Peer[a]	524 255	582 178	651 346	640 216
Place[b]	1 555 343	1 599 476	1 887 842	1 899 011
PProc10	524 573	518 364	499 723	481 843
Psyc	0	1 940	500	2 362
RAHS	2 321	105	406	851
ReAdmis	2 617	1 071	0	0
SepMode	0	0	0	0
Sex	803	55	24	1
SLA_ISC	298	0	0	1
SPIRT_ID	0	0	0	0
SRG	0	2 130	561	0
Age_Group	0	0	0	0
Ctry_Code	35 728	36 937	40 681	35 214
Indig_Code	0	0	0	0
Lang_Code	29 337	31 167	38 184	31 150

[a] The majority of these separations were from private hospitals. [b] The majority of these separations did not have an external cause of injury recorded. na Not applicable.

Table C2 **Imputed values**

	1996-97	1997-98	1998-99	1999-00
From same patient separation				
Marital	35 807	52 788	37 134	28 114
RAHS	342	19	4	16
Sex	0	0	0	0
Country code	16 382	17 389	18 833	14 527
Language code	8 847	14 672	16 294	11 563
From hospital at which treated				
SLA	298	1 168	2 218	2 694
CD	2 471	2 515	2 186	2 315
RAHS	134	345	48	381
Randomly assigned sex (M/F)	383/420	31/24	15/9	1/0

Table C3 **Separations removed**

	1996-97	1997-98	1998-99	1999-00
Nursing home	4 328	3 582	3 239	2 490
Mothercraft	5 446	6 246	4 858	5 863
Multipurpose services				
Current	27	65	108	219
Future	277	217	203	745
RAHS is overseas	847	4 158	3 270	4 850
RAHS is interstate	25 125	26 386	26 900	26 998
CD is interstate	10 472	8 907	8 986	9 729
HAHS is correctional	1 177	1 144	1 086	1 200
Public psychiatric hospital	48 122	55 428	49 497	47 924
Payment status is ‘Other’	19 143	16 353	20 191	7 164
Lady Davidson	1 547	453	nil	nil

D Specification of census extract

Overview

The data extracted from the 1996 census are at the CD level by sex, age and equivalent family income quintile. The extract is based on people enumerated in NSW only.

Variable definition

Sex: male; female.

Age: 10-year age groups from 0–9 years old up to 60–69 years old and then 70+ years old

Equivalent family income (EFI): (total gross weekly family income)/(equivalence scale factor)

where:

- *family* is interpreted as income units as defined in ABS (1996b, p. 37);
- *total gross weekly family income* is the sum of individual gross weekly incomes for each member of the family; and
- *equivalence scale factor* is the square root of the sum of 1.0 for the first adult, 0.5 for the second adult and 0.3 for each dependent child (refer to Mejer and Siermann 2000).

Assigning EFI quintiles

The EFI calculated above is assigned to each member of the family. All people are then sorted by EFI and assigned a quintile ranking.

E Aggregation of service related groups

New service related group	Variable(s) service identified from
General medicine and subspecialities	Service related groups: • Cardiology • Dermatology • Endocrinology • Gastroenterology • Haematology • Immunology/HIV • Medical Oncology • Neurology • Renal Medicine • Respiratory Medicine • Rheumatology • Miscellaneous Medicine Diagnostic related groups Version 4: • Non surgical Neck and Back Conditions W Pain Management Proc/Myelogram (DRGV41 = I68C) • Musculotendinous Disorders Age>69 W CC (DRGV41 = I71A) • Musculotendinous Disorders (Age<70 W CC) or (Age>69 W/O CC) (DRGV41 = I71B) • Musculotendinous Disorders Age<70 W/O CC (DRGV41 = I71C)
General surgery and subspecialties	Service related groups: • Breast Surgery • Cardiothoracic Surgery • Colorectal Surgery • Upper GIT Surgery • Head and Neck Surgery • Neurosurgery • Miscellaneous Surgery
Obstetrics and gynaecology	Service related groups: • Gynaecology • Obstetrics
Other specialities	Service related groups: • Dentistry • Ear, Nose and Throat • Orthopaedics • Ophthalmology • Plastic and Reconstructive Surgery • Urology • Vascular Surgery

(Continued on next page)

New service related group	Variable(s) service identified from
Non-acute services	Service related groups: • Rehabilitation • Geriatric Medicine • Palliative Care Service category: • Maintenance (Non-Acute Care including NHT) • Geriatric Evaluation and Management (if service related group is not Geriatric Medicine) • Psychogeriatric (if service related group is not Geriatric Medicine)
Special service list	Service related groups: • Renal Dialysis • Transplantation • Extensive Burns • Radiation Oncology Diagnostic related groups Version 4: • Implantation or Replacement of AICD, Total System (DRGV41 = F01Z) • AICD Component Implantation/Replacement (DRGV41 = F02Z) • Percutaneous Coronary Angioplasty W AMI (DRGV41 = F10Z) • Cardiac Pacemaker Implantation (DRGV41 = F12Z) • Percutaneous Coronary Angioplasty W/O AMI W Stent Implantation (DRGV41 = F15Z) • Percutaneous Coronary Angioplasty W/O AMI W/O Stent Implantation (DRGV41 = F16Z) • Cardiac Pacemaker Replacement (DRGV41 = F17Z) • Cardiac Pacemaker Revision Except Device Replacement (DRGV41 = F18Z) • Other Trans-Vascular Percutaneous Cardiac Intervention (DRGV41 = F19Z) • Circulatory Disorders W AMI W Invasive Cardiac Inves Proc W Cat or Sev CC (DRGV41 = F41A) • Circulatory Disorders W/O AMI W Invasive Cardiac Inves Proc W Complex DX/Pr (DRGV41 = F42A) • Circulatory Disorders W/O AMI W Invasive Cardiac Inves Proc W/O Complex DX/Pr (DRGV41 = F42B) • Other Colonoscopy W Catastrophic or Severe CC or Complicating Procedure (DRGV41 = G44A) • Other Colonoscopy W/O Catastrophic or Severe CC or Complicating Procedure (DRGV41 = G44B) • Other Colonoscopy, Sameday (DRGV41 = G44C) • Other Gastroscopy for Non-Major Digestive Disease (DRGV41 = G45A) • Other Gastroscopy for Non-Major Digestive Disease, Sameday (DRGV41 = G45B) • Tracheostomy Any Age, Any Condition (DRGV41 = A06Z)

(Continued on next page)

New service related group	Variable(s) service identified from
Paediatrics and perinatology	Service related groups: • Perinatology • Paediatric Medicine • Diagnostic Related Groups Version 4 (and Service Related Group not Perinatology) • Cardiothoracic/Vascular Procedures for Neonates (DRGV41 = P02Z) • Neonate, AdmWt 1000-1499 g W Significant O.R. Procedure (DRGV41 = P03Z) • Neonate, AdmWt 1500-1999 g W Significant O.R. Procedure (DRGV41 = P04Z) • Neonate, AdmWt 2000-2499 g W Significant O.R. Procedure (DRGV41 = P05Z) • Neonate, AdmWt > 2499 g W Significant O.R. Procedure W Multi Major Problems (DRGV41 = P06A) • Neonate, Adm Wt > 2499 g W Significant O.R. Proc W/O Multi Major Problems (DRGV41 = P06B) • Neonate, AdmWt < 750 g (DRGV41 = P61Z) • Neonate, AdmWt 750-999 g (DRGV41 = P62Z) • Neonate, AdmWt 1000-1249 g W/O Significant O.R. Procedure (DRGV41 = P63Z) • Neonate, AdmWt 1250-1499 g W/O Significant O.R. Procedure (DRGV41 = P64Z) • Neonate, AdmWt 1500-1999 g W/O Significant O.R. Proc W Multi Major Problems (DRGV41 = P65A) • Neonate, AdmWt 1500-1999 g W/O Significant O.R. Procedure W Major Problem (DRGV41 = P65B) • Neonate, AdmWt 2000-2499 g W/O Significant O.R. Proc W Multi Major Problems (DRGV41 = P66A)
Mental health and substance abuse	Service related groups: • Drug and Alcohol • Psychiatry
Coronary heart disease	Principal diagnosis: • 1996-97 and 1997-98 – Ischaemic heart disease (PDiag = 410 – 414) • 1998-99 and 1999-00 – Ischaemic heart disease (PDiag10 = I20 – I25)

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