A1.1 Analysis methods

A1.1.1 Rates

Rates are used to describe the incidence of an event or the prevalence of a condition in a population or a population subgroup. Incidence rates refer to the number of events occurring in a population over a specified time interval divided by the size of the population. Prevalence rates refer to the number of people with a specified condition within a population divided by the size of the population. For rare events, rates per 100,000 persons have been calculated. For less rare events or conditions, other bases (e.g. per 100 persons or percentage) have been used.

Population-based rates

Crude rates

Crude rates have been calculated by dividing the number of people with a condition in a population or the number of events that occurred in a population in a year by the size of that population at the middle of that year. The mid-year population is an estimate of the average population during the whole year.

$$n/\text{population} \times 100{,}000$$

where n=number of persons with a condition or number of events, and population is the mid-year population for the relevant year.

Age- and sex-specific rates

Where required, rates have been estimated separately for individual age groups and for males and females. In this case the relevant cases or events (for the numerator) are those within the specific age–sex group and the relevant population (for the denominator) is the specified age–sex group within the whole population.

Age-standardised rates

Age-standardised rates are used in this report to adjust for differences in population age structures when comparing rates for different periods of time, geographic areas, and/or population subgroups.

Age-standardised rates have been calculated using the following formula:

$$SR = \sum(r_i P_i)/\sum P_i$$

where

SR is the standardised rate for the population being studied

r_i is the sex- and age-group specific rate for sex and age group i in the population being studied

P_i is the population of sex and age group i in the standard population

The Australian population as at 30 June 2001 was the standard population in all analyses.

For trend data that are presented in broad age groups (e.g. 5–14 years, 15–34 years, 35–64 years, 65 years and over) the rates for these broad groups are age-standardised to adjust for variation in age structure within them.

Asthma case-based rates

For some analyses, in which the event or condition is only relevant to people with asthma (e.g. treatment), rates are expressed as case-based rates in which the population with asthma is the denominator. These are based on the number of people with asthma as estimated from the ABS National Health Survey conducted in 2001.

For some analyses, both population-based rates and case-based rates are presented. This demonstrates the extent to which variation in population-based rates (e.g. in hospitalisations for asthma) are attributable to variation in the prevalence of asthma.
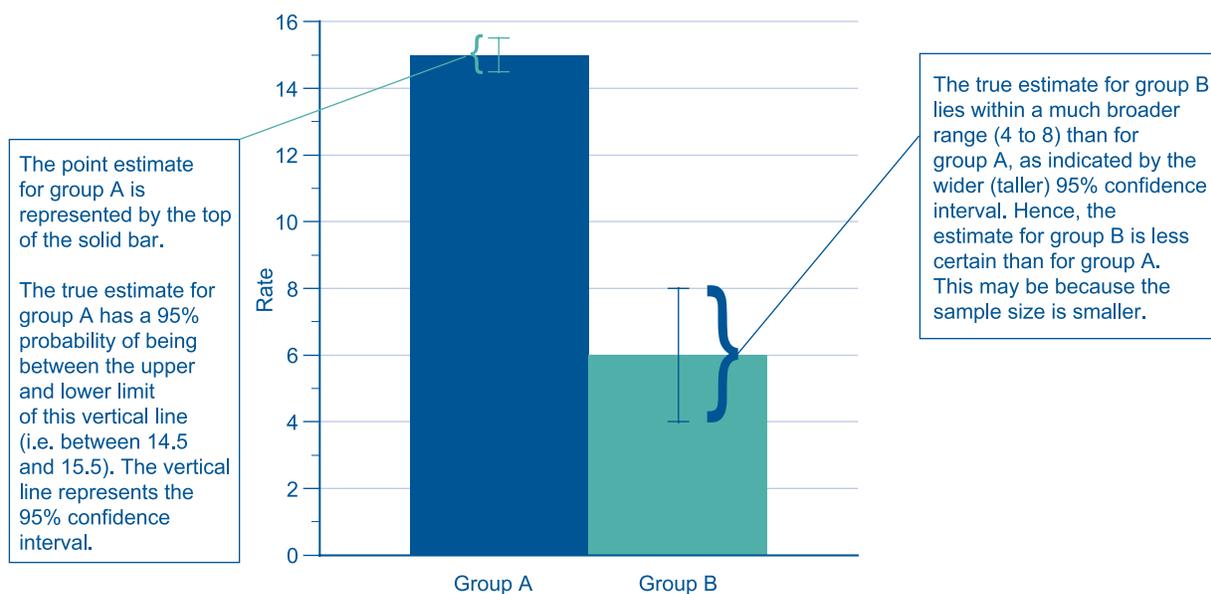
It should be noted that, for reasons discussed in this report, the estimation of the prevalence of asthma entails inherent uncertainty. Hence, rates that include this estimate as a denominator are subject to this uncertainty.

A1.1.2 Confidence intervals

The rates and proportions contained within this report represent estimates derived from the available enumerated sample or aggregated data. These estimates contain inherent uncertainty, which is larger where the size of the sample or population from which it was estimated is smaller. Confidence intervals are used to demonstrate the extent of this uncertainty (that is, the precision of the estimates). The 95% confidence interval is an estimate of the range of values within which the 'true' population value is expected to lie, with 95% certainty (see Figure A1.1).

In the tables, 95% confidence intervals are presented as ranges of values (in the form, xx to xx). In the figures, 95% confidence intervals are depicted by vertical lines extending above and below each point or column.

Figure A1.1

Point estimates and 95% confidence intervals

The point estimate for group A is represented by the top of the solid bar.

The true estimate for group A has a 95% probability of being between the upper and lower limit of this vertical line (i.e. between 14.5 and 15.5). The vertical line represents the 95% confidence interval.

The true estimate for group B lies within a much broader range (4 to 8) than for group A, as indicated by the wider (taller) 95% confidence interval. Hence, the estimate for group B is less certain than for group A. This may be because the sample size is smaller.

The quadratic method of Fleiss was used to calculate 95% confidence intervals for rates (Fleiss 1981). This method gives an asymptotic confidence interval that does not include logically impossible negative numbers. It differs from the more familiar normal approximation only for rates near zero.

A1.1.3 Tests of statistical significance

Linear trends in rates have been tested using the chi square test for trend. Differences in rates among groups have been tested by the chi square test.

Multivariate regression methods are used to assess the independent effects of age, gender, socioeconomic disadvantage (SEIFA quintile), remoteness (ASGC classification) and Indigenous status on mortality, hospitalisation rates and smoking status. Logistic models have been constructed in which the independent effects of these characteristics on event rates are estimated. Interactions between factors have been tested and, where these were found to be significant, subgroup analyses have been presented. Results are expressed as adjusted (independent) odds ratios, with 95% confidence intervals and/or as p values for the relevant chi square test.

A1.2 Asthma definitions used for measuring prevalence

A number of definitions for asthma have been applied in the various surveys cited in this report. These have been used where the estimation of the prevalence of asthma is the primary purpose or where the purpose is to measure the prevalence of outcomes or treatments in people with asthma. In the latter case, the definition of asthma is used to identify a denominator population. Table A1.1 lists the definitions of 'ever asthma' and 'current asthma' that have been used in the surveys most commonly cited within this report.

Table A1.1

Asthma definitions used in the National Health Survey and state CATI surveys

Ever asthma	Current asthma	Survey(s)
Have you ever been told by a doctor or a nurse that you have asthma?	Do you still get asthma?	2001 ABS National Health Survey
	In the last 12 months, have you had symptoms of asthma? In the last 12 months, have you taken treatment for asthma?	Western Australia Health and Wellbeing Surveillance System
Have you ever had asthma? Was your asthma confirmed by a doctor?	Do you still have asthma?	Social, Environmental and Risk Context Information System South Australian Omnibus Survey WANTS Health and Wellbeing Survey
	Symptoms of asthma include coughing, wheezing, shortness of breath and chest tightness when you don't have a cold or respiratory infection. During the past 12 months, did you have any symptoms of asthma? During the past 12 months, did you take asthma medication that was prescribed or given to you by a doctor? This includes using an inhaler, puffer or nebuliser.	South Australian Monitoring and Surveillance System
Have you ever been told by a doctor that you have asthma?	In the last 12 months, have you had asthma symptoms (wheezing, coughing, shortness of breath, chest tightness)?	Victorian Population Health Survey
Have you ever been told by a doctor or at a hospital that you have asthma?	Have you had symptoms of asthma or taken treatment for asthma in the last 12 months?	New South Wales Health Survey (child and adult) Queensland Omnibus Survey (2004)
	Symptoms of asthma include coughing, wheezing, shortness of breath and chest tightness when you don't have a cold or respiratory infection. During the past 12 months, did you have any symptoms of asthma? During the past 12 months, did you take asthma medication that was prescribed or given to you by a doctor? This includes using an inhaler, puffer or nebuliser.	Queensland Chronic Disease Survey 2000

A1.3 BEACH (Bettering the Evaluation and Care of Health) and SAND (Supplementary Analysis of Nominated Data)

The BEACH data are collected through a continuous survey of general practice activity in Australia, which began in 1998–99. BEACH is an activity of the General Practice Classification and Statistics Unit (GPSCU), a collaborating Unit of the Family Research Centre of the University of Sydney and the AIHW. A rolling random sample of GPs is selected from the HIC Medicare database (Britt et al. 2001). To be eligible to participate, GPs must have claimed at least 375 general practice Medicare items in the previous 3 months. Approximately 1,000 GPs participate annually, with about 20 GPs recording each week. Data are collected for 50 weeks each year. Each GP collects information on 100 consecutive encounters using a recording pack containing 100 forms. Each form is divided into two main sections. The first and larger section collects information on the current encounter for the BEACH data (see Section A1.3.1) and the data items/questions do not vary. The bottom section collects data for the SAND collection (see Section A1.3.2).

A1.3.1 BEACH data

The BEACH collection includes information about the following:

the encounter

- date and type of consultation;
- up to four diagnoses or problems managed; and
- Medicare/Veterans' Affairs item number.

the patient

- age and sex;
- postcode of residence;
- health care card status; Veterans' Affairs card status;
- non-English-speaking background status; and
- whether the patient identifies as Aboriginal and/or Torres Strait Islander;
- up to three reasons for the encounter.

the management of each problem

- medications prescribed, supplied or advised including brand, form, strength, and dosage; and
- non-pharmacological management including counselling, referrals, procedures, pathology and imaging ordered.

the GP characteristics

- age and sex;
- years working in general practice;
- number of sessions worked per week; and
- postcode of main practice, etc (Britt et al. 2001).

For further information on BEACH see www.fmrc.org.au/beach.htm.

A1.3.1.1 International Classification of Primary Care

Information on diagnosis and problem managed during GP encounters, obtained from the BEACH dataset, has been classified according to the International Classification of Primary Care—2nd edition (ICPC-2) (WICC Britt et al. 2001; 1998). To classify 'asthma' from BEACH data we have selected ICPC-2 rubric R96 and excluded code R96006 'extrinsic allergic alveolitis'. The following ICPC-2 PLUS codes were included:

R96001—asthma

R96002—bronchitis; asthmatic

R96003—bronchitis; allergic

R96005—status asthmaticus

R96007—bronchitis; wheezy

R96008—hyperactive airways

A1.3.1.2 Analysis of BEACH data

Estimating the rate of general practice encounters for asthma

The number of general practice encounters where asthma was managed (i.e. general practice encounters for asthma) per 100 encounters is estimated from the BEACH data using a method which adjusts for the cluster (practice-based) sampling used in BEACH and also incorporates post-stratification weights to account for differences in age between the GP sample and the GP population. The data are also weighted for each participant's Medicare activity level, in order to better reflect total GP–patient encounters for Australia. This has been implemented using the SURVEYMEANS® Procedure in SAS software version 8.1 (SAS Institute Inc. © 1999–2001).

The estimated number of general practice encounters for asthma per 100 population is then estimated using the following information and formula:

The estimated number of general practice encounters for asthma per 100 population =

$$\frac{\text{ARGPEs per 100 general practice encounters} \times \text{estimated total number of all general practice visits}}{\text{population}}$$

where

ARGPEs = number of general practice encounters for asthma based on analysis of BEACH data;

population = the mid-year population for the relevant year.

The estimated total number of general practice visits is based on Medicare data for MBS Category 1 Service Items. This category includes all unreferred (i.e. primary care) attendances (Health Insurance Commission 2002).

A1.3.1.3 Limitations of BEACH data

The response rate by GPs to the BEACH survey was 23.7% in 2003–04, 28.9% in 2002–03 and 32.3% in 2001–02 (Britt et al. 2004). The percentage of GPs practicing in remote areas is only 2.4%, hence, the sample from remote areas is relatively small (n=27 in 2003–04) (Britt et al. 2004). To improve the representativeness of the sample, BEACH data are weighted for differences between the GP sample and the general practitioner population and for participants' Medicare activity level.

The BEACH Program has a quality assurance program to ensure the reliability of data entry. This includes computer-assisted error-checking procedures during data entry, the validating of samples of data entered against original recording forms, and logical data checks during the data cleaning and analysis using specific SAS programming (Britt et al. 2002).

Britt et al. (1998) compared the recording of morbidity data by GPs for the BEACH Program, with two trained observers independently viewing a videotape of the encounters. They found good agreement (87%) between the general practitioners observed and the observers (who were also general practitioners) at the broad disease level (ICPC chapter), but agreement at the condition-specific level (ICPC rubric) was lower (67%). Thus the labelling of certain conditions varies between GPs. The GPSCU uses features of the ICPC classification structure to ensure synonymous terms are classified to the correct rubric but this cannot deal with variation among GPs in the way they use the labels 'asthma', 'COPD' or other respiratory disease labels.

A1.3.2 SAND data

The SAND data are collected as a supplementary dataset of the BEACH program (Britt et al. 2001). Organisations sponsoring blocks of SAND data collection ask questions on topics of their choice and have access to the detailed reports. GPs participating in SAND ask and record responses to specific questions in targeted patient groups. SAND modules relevant to asthma have been conducted in 1999, 2000–01 and 2002 (Henderson et al. 2004).

A1.4 Emergency department data

Data on emergency department (ED) visits for asthma have been derived from the New South Wales Emergency Department Data Collection (NSW EDDC) and the Victorian Emergency Minimum Dataset (VEMD). An ED attendance 'index' was calculated for various subgroups of the population as the number of attendances per year per 100,000 population or per 100 persons with asthma in that subgroup. Data are also presented as number of visits for asthma as a proportion of all ED visits.

ED visits for asthma are identified using the 'principal diagnosis' for the visit and are classified using the ICD-9 or ICD-10. Data from the NSW EDDC were accessed using the Health Outcomes Information Statistical Toolkit (HOIST) system. The Victorian Department of Human Services provided data to ACAM from VEMD for the period 1999–2004 for records where the principal diagnosis was asthma or a respiratory condition. In addition, aggregated data for all VEMD records were provided to enable calculation of ED visits for asthma as a proportion of all ED visits.

A 1.4.1 Limitations of emergency department data

In New South Wales, the ED dataset includes data from 56 of the 150 emergency departments in that state. Approximately two-thirds of ED visits in New South Wales are captured in the dataset. Emergency departments in metropolitan Sydney and larger rural hospitals are more likely to be included. In Victoria, the dataset includes information from all 24-hour EDs (38).

This incomplete coverage means that the denominator used in the calculation of the ED attendance index is an overestimate of the true population covered. Hence, the ED attendance index is an underestimate of the true population-based rate. Furthermore, the nature of the missing data means that the ED data tend to under-represent people visiting EDs in rural and remote areas.

A1.5   Expenditure data

Expenditure data used in this report were obtained from the Australian Institute of Health and Welfare's National Health Expenditure Database. This report considers recurrent health expenditure that has been allocated by health sector and disease. The analyses presented do not include non-recurrent (capital) health expenditure or expenditure that is not allocated to a specific health sector or disease (unallocated). Therefore, in this report, references to health care expenditure always imply 'allocated recurrent' health care expenditure. Expenditure within each age and sex group is described on a per capita basis. Per capita expenditure has been calculated by dividing the total allocated recurrent expenditure on persons within an age–sex category, by the Australian resident population in that age–sex group in 2000–01. All expenditure data are in 2000–01 dollars.

A1.5.1 Expenditure for hospital care

Expenditure for hospital care comprises expenditure for care of admitted and non-admitted patients. Expenditure estimates relating to admitted patients in public hospitals were obtained from those published in *Australian Hospital Statistics 2001–02* (AIHW 2003a). Expenditure relating to private hospitals was derived from the Australian Bureau of Statistics Private Health Establishments Survey.

Hospital encounters for asthma were identified as those where the principal diagnosis was asthma (International Classification of Diseases version 10 codes J45 or J46). The National Hospital Costs Data Collection was used to estimate the costs of individual episodes of acute hospitalisation, based on Diagnostic

Related Groups and length of stay, with adjustment for the type of hospital. Sub-acute and non-acute hospital costs were extrapolated from the sub- and non-acute patient (SNAP) study (Eagar et al. 1997) and adjusted to 2000–01 values (AIHW 2002b). Health Insurance Commission data were used to estimate the cost of specialist medical services for private inpatients.

Care administered by medical practitioners within a hospital and hospital-dispensed pharmaceuticals are included within this category, rather than other categories listed below (A1.5.2 and A1.5.3).

Non-admitted patients include those visiting emergency departments and attending outpatient services. Expenditure estimates for non-admitted patients were based on *Australian Hospital Statistics 2001–02* (AIHW 2003a). Individual episodes were differentiated by disease based on the demographic pattern in the 1993–94 non-admitted patient disease expenditure (Mathers & Penm 1999).

A1.5.2 Out-of-hospital medical care expenditure

This comprises expenditure for private medical services in the community including general practitioners (GPs) and specialists. The Bettering the Evaluation and Care of Health (BEACH) survey data (see Section A1.3) and earlier similar studies were used to allocate: (1) expenditure on out-of-hospital medical services by disease using BEACH disease codes; (2) expenditure for unreferred attendances such as imaging and pathology; and (3) expenditure for other medical services, such as specialists, based on referral patterns recorded in these data. Where there were multiple presenting problems in a GP encounter, allocation of expenditure was done on a pro-rata basis. Care administered by doctors in hospitals was included in hospital care expenditure.

A1.5.3 Pharmaceutical expenditure

This includes prescription and over-the-counter medications. Data on expenditure on prescription medications were obtained from the Pharmaceutical Benefits Scheme (PBS) and the Department of Veterans' Affairs Repatriation Pharmaceutical Benefits Scheme (RPBS). Data on expenditure for medications purchased on private (i.e. non-PBS/RPBS) prescriptions and for prescribed medications whose cost is below the co-payment threshold were obtained from the Pharmacy Guild Survey. The BEACH survey data were then used to allocate these expenditure data to diseases according the GP prescribing patterns for problems managed. To estimate expenditure for specialist-written prescriptions, an assumption was

made that specialist prescribing patterns were the same as GPs.

There are no data on over-the-counter pharmaceuticals. Total expenditure on over-the-counter pharmaceuticals was calculated by deducting expenditure on prescriptions below the co-payment threshold and private prescriptions from all non-benefit pharmaceutical expenditure, as reported in *Health Expenditure Australia 2001–02* (AIHW 2003b). Expenditure on over-the-counter medications was allocated to specific diseases, including asthma, using information on medication use obtained in the 1989–90 ABS National Health Survey (Mathers & Penm 1999). The same data were used for allocation of over-the-counter expenditure to disease in both the 1993–94 analysis and the 2000–01 analysis. For the latter analysis, the data were adjusted for demographic change over the interval between 1993–94 and 2000–01.

Hospital dispensed pharmaceuticals were included in hospital care costs.

A1.5.4 Other costs

Remaining expenditure for asthma is classified as 'other costs'. This comprises expenditure for other medical services, such as allied health outside of hospitals (e.g. physiotherapy) and research. Allied health expenditure was allocated to disease using the previous expenditure estimates from 1993–94, adjusted for demographic change. As such, these are approximations and should be interpreted with caution. Research expenditure was allocated using the Australian Bureau of Statistics research and experimental development surveys. This should also be interpreted with caution when reviewing expenditure in subgroups within the population.

A1.5.5 Limitations of expenditure data

Expenditure estimates for disease are based on the attribution of allocated recurrent health expenditure using the available information about the mix of diseases and health sector utilisation. The accuracy of the expenditure estimates is limited by the accuracy of the source data on health care utilisation. In relation to asthma there are substantial problems with diagnostic misclassification (Baker et al. 2004). These problems will particularly influence the estimates of expenditure on asthma in the elderly. Often in this age group, there is no certain clinical basis for distinguishing asthma from chronic obstructive pulmonary disease. However, the substantially higher cost-weight for chronic obstructive pulmonary disease, compared with asthma (National Centre for Classification

in Health 2004), is an incentive for health care providers to assign admissions to chronic obstructive pulmonary disease, rather than asthma. This may lead to underestimation of hospital bed utilisation, and, hence, expenditure for asthma in the elderly. There is less incentive for misclassification in the BEACH survey data but diagnostic uncertainty remains an issue.

Furthermore, in some instances, data were not available regarding how costs should be attributed. For example, there are no data relating to the patterns of prescriptions by specialists, therefore it was assumed these would be the same as for general practitioners. The validity of this assumption is untested and, hence, these data should be interpreted with some caution. Also, the data on expenditure for over-the-counter medications for asthma were derived from a survey conducted in 1989–90. These survey data may not reflect current patterns of use of over-the-counter medications.

A1.6 Health survey data

A1.6.1 National Health Survey

The National Health Survey (NHS), conducted by the ABS periodically since 1977, is designed to collect information on the health status, use of health services and facilities, and health and lifestyle characteristics of residents across Australia. It aims to obtain national information on a range of health issues, provide information on health indicators for National Health Priority Areas and for important population subgroups, and, where possible, enable trends to be monitored over time (ABS 2001b).

In this report, data from the 2001 survey are used. The 2001 survey collected information from 26,900 respondents between February and November of that year (ABS 2002a). The estimate of the prevalence of current asthma is derived from two questions asked in the survey (see Table A1.1). The proportion of the sample who had 'current' asthma (i.e. 'still get asthma') has been estimated. This subgroup of the population was asked additional questions from the asthma module of the survey described in Table A1.2.

The 2001 ABS National Health Survey data presented in this report have been accessed through the ABS Remote Access Data Libraries (RADL). This facility is available to authorised users to access Confidentialised Unit Record Files, which are de-identified record-level data. Grouping variables are incorporated in these data (e.g. region of birth, age group) to ensure that information from these records cannot be used to identify an individual.

Table A1.2

Questions from the asthma module of the ABS National Health Survey 2001

Question	Section of this report where data presented
Do you have a written asthma action plan?	Section 5.2 (Written asthma action plans)
Have you taken any medication for asthma in the last 2 weeks?	Section 5.3 (Medication)
What are the names or brands of all the asthma medication you have used in the last 2 weeks?	

Have you taken any of these actions for your asthma in the last 2 weeks:
    Had days(s) away from work/school?
    Had other days of reduced activity?
	Section 7 (Quality of life)

A1.6.2 National Health Survey (Indigenous)

Data on Indigenous Australians were obtained from 290 private dwellings from the 2001 National Health Survey (general) sample and a supplementary sample of 1,947 Indigenous residents from rural and urban areas of all states and territories (ABS 2002b). Sparsely settled areas were also included in the supplementary sample. It should be noted that the questionnaire administered to Aboriginal and Torres Strait Islander people living in sparsely-populated remote areas differed slightly from that used in other regions, for linguistic reasons. One difference relevant to this report is that this questionnaire did not distinguish between 'asthma' and 'breathing problems'. Hence, reported estimates of the prevalence of asthma in Aboriginal and Torres Strait Islander Australians living in sparsely-populated remote areas are actually estimates of the prevalence of asthma and 'breathing problems' in those areas.

A1.6.3 State/territory CATI surveys

Most Australian states and territories now regularly conduct general health surveys within their jurisdictions. These are usually carried out using computer-assisted telephone interview (CATI) surveys that sample the population using random digit dialling. In this report, CATI survey data have been provided by New South Wales Department of Health, Queensland Health, South Australian Department of Human Services, Victorian Department of Human Services and Western Australian Health Department. The questions used to define 'ever asthma' and 'current asthma' in these surveys is shown in Table A1.1.

A1.7 Medical Benefits Schedule statistics

The Health Insurance Commission (HIC) provides statistics on the claims submitted to and paid by the Medical Benefits Schedule (MBS). These include items claimed by general practitioners, doctors and specialists in the community. Data from the HIC were obtained for the Asthma 3+ Visit Plan Practice Incentive Program (PIP) and for spirometry. Online interactive data reports were accessed at: <http://www.hic.gov.au/statistics/dyn_mbs/forms/mbs_tab4.shtml> and collated by time period, state/territory, and age and sex (where available).

A1.7.1 Asthma 3+ Visit Plan Practice Incentive Program

The Asthma 3+ Visit Plan Practice Incentive Program (PIP) is an incentive scheme funded by the Australian Government since 2001–02. The scheme encourages a structured approach to diagnosis, assessment, and management of patients with moderate or severe asthma in general practice (DoHA 2002). The PIP item numbers that were analysed for this report were 2546–2559 and 2664–2677. These items can only be claimed when the requirements of the Asthma 3+ Visit Plan have been met for an individual patient. In other words, the items can only be claimed when three visits have been completed within one year.

A1.7.2 Spirometry

The principal items that are used in this report in the spirometry section are item numbers 11506 (office-based spirometry) and 11503, 11509 and 11512 (laboratory-based spirometry) (see Table A1.3 for MBS code descriptions).

Table A1.3
Medical Benefits Schedule item numbers for spirometry

MBS code	Description
Office-based spirometry	
11506	Measurement of respiratory function involving a permanently recorded tracing performed before and after inhalation of bronchodilator—each occasion at which one or more such tests are performed
Laboratory-based spirometry	
11503	Measurement of the mechanical or gas exchange function of the respiratory system, or of respiratory muscle function, or of ventilatory control mechanisms, using measurements of various parameters including pressures, volumes, flow, gas concentrations in inspired or expired air, alveolar gas or blood, electrical activity of muscles (the tests being performed under the supervision of a specialist or consultant physician or in the respiratory laboratory of a hospital)—each occasion at which one or more such tests are performed
11509	Measurement of respiratory function involving a permanently recorded tracing and written report, performed before and after inhalation of a bronchodilator, with continuous technician attendance in a laboratory equipped to perform complex respiratory function tests (the tests being performed under the supervision of a specialist or consultant physician or in the respiratory laboratory of a hospital)—each occasion at which one or more such tests are performed
11512	Continuous measurement of the relationship between flow and volume during expiration or inspiration involving a permanently recorded tracing and written report, performed before and after inhalation of a bronchodilator, with continuous technician attendance in a laboratory equipped to perform complex lung function tests (the tests being performed under the supervision of a specialist or consultant physician or in the respiratory laboratory of a hospital)—each occasion at which one ore more such tests are performed

Limitations of spirometry data from MBS

There is no published information on the quality of MBS statistics. These data only include those services that qualified for a Medicare benefit—that is, that were performed by a registered provider and for which a claim was processed by the HIC. Services that are not eligible for Medicare funding are not included in these data. For example, the data do not include services provided by public hospital doctors to public patients or for services qualifying for a benefit under the Department of Veterans' Affairs National Treatment Account, thus underestimating total episodes of care. Similarly, they do not include spirometry performed in community health centres, which are not funded through Medicare.

The MBS data do not include any information on the characteristics of the patients for whom claims were made. Hence, no diagnostic or demographic information is available. There are no available data directly linking asthma status with the performance of the spirometry. For this reason, we have included a secondary analysis of the data in the subset of people aged 5 to 34 years, in whom we believe most spirometry measurements would have been made for the assessment of asthma, as opposed to other respiratory diseases.

The other limitation of the HIC data is that, in the form available, they provide information on numbers of claims, not individuals. Hence, we cannot know the extent to which the number of claims for spirometry reflects multiple claims for individuals within a given year.

A1.8   Medication data

A1.8.1 IMS Health pharmaceutical data

Data on sales of pharmaceutical products into the Australian market are collected and provided by IMS Health Australia. The value of these data is that they reflect supply (and, hence, purchases) of specific medications. As many of these medications are sold without prescription or are below the PBS subsidy threshold, equivalent data are not available through the PBS.

We have calculated the annual aggregate number of packs (sale units) distributed each year for each product relevant to the treatment of asthma for the period January 1996 to December 2004. Parenteral forms were excluded. Data reflect sales from major manufacturers and wholesalers operating in Australia. Usage, measured in units of defined daily doses (DDDs)/1,000 persons/day were calculated according to methods presented in Section A1.8.3.

Limitations of IMS data

The nature of the IMS data is that they contain no information on the characteristics of the purchasers or consumers. As most of the drugs used by people with asthma are also commonly used by people with COPD, it is not possible to directly ascribe the trends and differentials observed in these data to the population with asthma. Furthermore, socioeconomic and geographic trends and differentials in the utilisations of drugs cannot be assessed using these data.

A1.8.2 Pharmaceutical Benefits Scheme and Repatriation Pharmaceutical Benefits Scheme data

Data on the number of subsidised prescriptions dispensed per year for each drug available on the PBS and the RPBS were calculated using HIC online interactive data reports at: <http://www.hic.gov.au/statistics/dyn_pbs/forms/pbs_tab1.shtml>. These data were then used to calculate the DDDs/1,000 persons/day for each PBS item using the methods described in Section A1.8.3.

Limitations of PBS and RPBS data

Most respiratory medications are subsidised under the PBS and the RPBS. However, some 'reliever' medications are frequently purchased without prescription (over-the-counter) and, when purchased on prescription, cost less than the minimum subsidy for general patients. These drugs do attract a subsidy when purchased on prescription by health care cardholders or pensioners. Leukotriene receptor antagonists only attract a PBS/RPBS subsidy when prescribed for children. Hence, for some medications the PBS/RPBS data only record purchase by a section of the Australian population and substantially underestimate total usage.

The PBS does not collect any information on the underlying disease or the reasons for prescribing. Thus, there is no way of identifying whether a patient using these medications has asthma, COPD or an acute respiratory infection. At present, data on the demographic characteristics of PBS/RPBS claimants linked to prescription items are not available.

A1.8.3 Calculation of defined daily dose per 1,000 population per day

Medication usage, measured as defined daily doses per 1,000 people per day (DDD/1,000/day), is used in this report to compare respiratory drug sales and reimbursed prescriptions dispensed over time and across drug groups where information about actual drug consumption is not available. The information in this report is based on unpublished data prepared and supplied by IMS Health Australia and published data from the PBS and RPBS item reports calculated at the HIC web site.

For each medication, the relevant defined daily dose (DDD) was obtained from the web site of the WHO Collaborating Centre for Drug Statistics Methodology (<www.whocc.no/atcddd>) (see Table A1.4). The DDD is defined as 'the assumed average maintenance dose per day for a drug used for its main indication in adults'. The DDD is used internationally as a unit of measurement for drug utilisation studies. Each medication pack or sale unit (for IMS Health data) or maximum quantity dispensed (for PBS or RPBS items) is converted to a number of DDDs per unit or item.

For each of these items the DDD/1,000 persons/day (DoHA 2004) is then calculated using the following formula:

$$\frac{N \times M \times Q \times 1{,}000}{DDD \times P \times D}$$

Where:

N = total number of subsidised prescriptions dispensed per year (HIC data) or total number of items sold per year (IMS Health data)

M = mass of each dosage unit (e.g. mg per tablet or mcg per inhaler dose)

Q = total number of dosage units dispensed per prescription or sold unit

P = mid-year Australian population (ABS mid-year population estimates) for year of data collection

D = number of days in the year

The DDD/1,000 persons/day for individual medications are then summed across the members of each class of medications to estimate the total number of DDD/1,000 persons/day for each class. Combined medications contribute DDDs to both classes of medications they contain.

Table A1.4

Classification of respiratory medications

Category	Medications included	DDDs / formulation
Short-acting beta agonists	Fenoterol	0.6 mg Inhalation aerosol 0.6 mg Inhalation powder 4 mg Inhalation solution
	Orciprenaline	60 mg Oral
	Salbutamol	0.8 mg Inhalation aerosol 0.8 mg Inhalation powder 10 mg Inhalation solution
	Terbutaline	2 mg Inhalation aerosol 2 mg Inhalation powder 20 mg Inhalation solution
Long-acting beta agonists	Salmeterol	0.1 mg Inhalation aerosol 0.1 mg Inhalation powder
	(e)Formoterol	24 mcg Inhalation aerosol 24 mcg Inhalation powder
Short-acting anti-cholinergics	Ipratropium	0.12 mg Inhalation aerosol 0.12 mg Inhalation powder 0.3 mg Inhalation solution
Long-acting anti-cholinergics	Tiotropium bromide	18 mcg Inhalation powder
Cromones	Cromoglycate	40 mg Inhalation aerosol 80 mg Inhalation powder 80 mg Inhalation solution
	Nedocromil	8 mg Inhalation aerosol
Inhaled corticosteroids	Beclomethasone	0.8 mg Inhalation aerosol 0.8 mg Inhalation powder 1.5 mg Inhalation solution
	Budesonide	0.8 mg Inhalation aerosol 0.8 mg Inhalation powder 1.5 mg Inhalation solution
	Fluticasone	0.6 mg Inhalation aerosol 0.6 mg Inhalation powder 1.5 mg Inhalation solution
Xanthines	Theophylline	0.4 g Oral
	Choline Theophyllinate	0.6 g Oral
Leukotriene receptor antagonists	Montelukast	10 mg Oral
	Zafirlukast	40 mg Oral

A1.9   Hospital data

The National Hospital Morbidity Database (NHMD) contains data on episodes of care for patients admitted to hospital, including demographic, procedural and length of stay information. Each of the states and territories collect data for hospital separations and provide a specified subset of these data to AIHW for inclusion in the NHMD. The data are organised in financial year periods. Whilst the dataset contains details of principal and additional diagnoses, in this report data relate to the principal diagnosis only, unless otherwise stated.

A1.9.1   Limitations of the National Hospital Morbidity Database

There are a number of issues affecting the reliability and validity of hospitalisations attributed to asthma. In particular, the reliability of coding of hospital separations will be influenced by variation in the propensity of attending medical practitioners to diagnose and label patients as having asthma. There has been no recent validation of the coding of diagnosis of asthma during hospital admissions in Australia. International evidence suggests that diagnostic coding of asthma is reasonably accurate in children and younger adults (Krueger et al. 2001; Osborne et al. 1992), but this accuracy decreases with age (Osborne et al. 1992).

A1.9.2   Hospital diagnosis codes

Hospital diagnosis is classified according to the principal diagnosis and was coded using the International Classification of Diseases 9th Revision, Clinical Modification (ICD-9-CM), for hospital separations from 1993 to 1997, and the International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM), for separations from 1998 onwards. A principal diagnosis is the diagnosis chiefly responsible for the episode of hospital care. Comparability factors were also applied to data on hospital separations prior to 1998, which were coded under ICD-9, to enable comparison with more recent data coded using ICD-10 (see Section A1.9.3).

A1.9.3   Comparability factors for hospitalisation data

Table A1.5 shows the age-group specific comparability factors calculated for converting ICD-9-CM to ICD-10-AM. The method for calculating these comparability factors has been described previously (ACAM 2003, Section A1.2).

Table A1.5

Comparability factors for hospital separations for asthma

Age group	Conversion factor
<35 years	1.0 (i.e. no conversion)
35 to 64 years	0.64
65 years and over	0.53

1.9.4 Mechanical ventilation

The National Hospital Morbidity Database includes information relating to specific aspects of care, such as the use of mechanical ventilation. Invasive mechanical ventilation is a medical intervention used in situations where patients become unable to breathe by themselves. It involves the use of a positive pressure ventilator to maintain respiration via an endotracheal tube. This intervention is generally administered in hospital intensive care units. The National Hospital Morbidity Database has collected data on the use of invasive mechanical ventilation since 1993–94. Where possible, data for the period 1993–94 to 2001–02 have been analysed, though some analyses have been restricted to the period 1995–96 to 2001–02 due to incomplete data from some jurisdictions.

The data presented in this report do not include episodes of non-invasive ventilation. Available data on non-invasive ventilation are incomplete and not suitable for analysis.

A1.9.5 Re-attendance data

In order to identify multiple health care attendances for asthma by the same individual in emergency departments (EDs) and/or hospitals, this report has used linked hospital attendance and ED data from New South Wales and Victoria where the principal diagnosis was asthma. In New South Wales, the Inpatients Statistics Collection (ISC) was linked with the Emergency Department Data Collection (EDDC), and in Victoria, the Victorian Admitted Episodes Dataset (VAED) was linked with the Victorian Emergency Minimum Dataset (VEMD).

Briefly, in New South Wales, this was done by extracting records where asthma was a principal diagnosis (classified using ICD-9-CM or ICD-10-AM) from the ISC and the EDDC for the period July 2000 to June 2003. Records consist of a range of demographic data items (e.g. name, date of birth, residential address, language spoken at home, country of birth), administrative variables (e.g. date of visit or admission, and date of separation or departure), and clinical items (such as procedure codes). Records were linked using many demographic and administrative variables available in the ISC and EDDC, and involved probabilistic record linkage using Automatch probabilistic record linkage software (MatchWare Technologies 1997).

In Victoria, the Department of Human Services carried out linkage of all records in the VAED and VEMD for the period July 1999 to June 2003. These records also contained a range of demographic and administrative variables that were used to implement a stepwise

deterministic linkage methodology developed for this purpose (Personal communication, Dr V. Sundararajan, 2004). Records where the principal diagnosis in either the VEMD or VAED was asthma or a related respiratory condition were provided to ACAM.

The linked datasets from New South Wales and Victoria have enabled the analysis of re-attendances for asthma by individuals who visited an ED or were admitted to hospital, and subsequently returned to an ED or were admitted to hospital within a defined period. The limitations of the ED data noted in Section A1.4 above also apply to these data.

A1.10 Mortality data

Registration of deaths is the responsibility of individual state and territory Registrars of Births, Deaths and Marriages. Information on the cause of death is provided to the Registrar by a medical practitioner certifying a death, or by the Coroner to whom a death is reported. This information is, in turn, supplied to the Australian Bureau of Statistics (ABS) for coding cause of death and compilation into aggregated statistics. Death data from all states and territories are supplied by the ABS to the AIHW for the National Mortality Database. As the registration of deaths is a legal requirement in Australia, this dataset is considered nearly complete, although there has been no formal validation of completeness. The ABS advises that Aboriginal and Torres Strait Islander Australians are probably under-enumerated in some states/territories.

Although data on multiple causes of death are available, death data throughout this report, relate only to the underlying cause of death reported on each certificate.

A1.10.1 Limitations in mortality data

There are a number of issues affecting the reliability and validity of certification of deaths. The reliability of death certification can be influenced by variation in the propensity of attending medical practitioners to diagnose and label patients as dying from asthma. Validation studies of asthma deaths coded on death certificates reveal that adult deaths from asthma can be under-enumerated (Guite & Burney 1996; Hunt et al. 1993; Smythe et al. 1996) or over-enumerated (Jones et al. 1999; Sears et al. 1986; Sidenius et al. 2000). It is generally considered that asthma diagnosis is fairly unambiguous in people aged less than 45 years and data are, therefore, more reliable in these ages. However, a recent study has also demonstrated under-enumeration in children and young adults (Jorgensen et al. 2000). Generally, in older people the attribution of death to asthma, or alternatively

to one of a range of illnesses with overlapping clinical features, is problematic and, therefore, the death data for asthma are less reliable in older people (Jones et al. 1999; Sidenius et al. 2000; Smythe et al. 1996). Changes in the classification scheme, or code, have a quantifiable impact on time trends in death data. However, the extent to which changes, over time, in diagnostic fashion affect death data is less well studied.

A1.10.2 Cause of death codes

The classification of asthma as the underlying cause of death was based on the ICD-9 for deaths from 1979 to 1997, and on ICD-10 for deaths from 1998 onwards (Table A1.6). Comparability factors were applied to data classified under ICD-9 to make the data comparable to that coded using ICD-10 (see Section A1.10.3).

Table A1.6
Disease codes

Classification	Codes used	Description
ICD-9	493.0	Extrinsic asthma
Code 493	493.1	Intrinsic asthma
	493.2	Chronic obstructive asthma
	493.9	Asthma, unspecified
ICD-10	J45.0	Predominantly allergic asthma
Codes J45 & J46	J45.1	Non-allergic asthma
	J45.8	Mixed asthma
	J45.9	Asthma, unspecified
	J46.0	Status asthmaticus

A1.10.3 Comparability factors for mortality data

Table A1.7 shows the age-group specific comparability factors calculated for converting number of asthma deaths from ICD-9 to ICD-10. The method for calculating these comparability factors has been described previously (ACAM 2003, Section A1.3).

Table A1.7
Comparability factors for asthma mortality data

Age group	Conversion factor
<35 years	1.0 (i.e. no conversion)
35 to 64 years	0.84
65 years and over	0.68

A1.11 Population data

This report uses population data sourced from the AIHW, which, in turn, are sourced from the ABS Demography section and are updated as revised or new estimates become available. All population estimates currently produced by the ABS are referred to as estimated resident populations.

Estimated resident populations are based on the 5-yearly Census of Population and Housing, to which three significant adjustments are made:

- All respondents in the census are placed in their state/territory, SLA, and postcode of usual residence. Overseas visitors counted in the census are *excluded*.

- An adjustment is made for persons missed in the census (approximately 2%).

- Australians temporarily overseas on census night (these are not counted in the census) are added to the usual residence census count adjusted for undercount.

Estimated resident populations are then updated each year from the census date using indicators of population change such as births, deaths and net migration. More information is available from <www.abs.gov.au>.

A1.12 Population groups

A1.12.1 Aboriginal and Torres Strait Islander Australians

'Indigenous Australians' refers to people who identify themselves as being of Aboriginal or Torres Strait Islander origin. It is important to identify health disadvantages, with respect to asthma, among Aboriginal and Torres Strait Islander Australians so that those issues can be addressed. It is also important to ensure an acceptable level of reliability and validity of the data that are used for this purpose. Data for Indigenous Australians are currently available via several collections, including the 5-yearly Census, other surveys conducted by the ABS, AIHW, state health departments and other agencies, and administrative datasets such as hospital statistics and mortality collections. However, data quality issues around the identification and enumeration of Indigenous Australians exist across the majority of these collections.

There have been substantial increases in the Indigenous Australian population between census collections that cannot be fully explained by natural increase (Ross 1999). The ABS has introduced an experimental methodology which attempts to account for the changing levels of 'unexplained growth' in estimating and projecting the Indigenous population. Using this methodology, ABS has produced consistent series of estimates of the Indigenous population from 1991 to 2009. For further information refer to *Experimental estimates and projections: Aboriginal and Torres Strait Islander Australians* (ABS cat. no. 3238.0).

Indigenous identification and the quality of Indigenous data have been improving over time in a number of data sets through efforts at all levels. Despite this, deficiencies in health data for Indigenous Australians continue to exist in the National Mortality Collection and the National Hospital Morbidity Dataset (NHMD). In 2000–01, all states and territories adopted a standard definition for use in the NHMD. However, data are still only considered acceptable in Western Australia, South Australia and the Northern Territory. Similarly, in the National Mortality Collection from 1990 onwards only data from South Australia, Western Australia and the Northern Territory are considered reliable, and from 1998 onwards Queensland data can be used.

Since 1995, the National Health Survey has over-sampled in Indigenous Australian populations to enable more reliable estimates of their health status. The validity and reliability of other general population surveys (including the state CATI surveys) is less certain. Finally, a voluntary Indigenous identifier has been included recently on Medicare forms. This should help improve data about access to health services by Indigenous Australians.

As there is not the same quantity or quality of information about Aboriginal and Torres Strait Islander health as there is for non-Indigenous Australians, it has not been possible in many cases to provide the same level of information on the prevalence of asthma in Australia's Indigenous population or how this is being managed. However, the information about people living in remote regions and people who are socioeconomically disadvantaged may also be applicable to a large number of Indigenous Australians.

A1.12.2 Culturally and linguistically diverse background

Factors associated with cultural background may have an impact on health status. People whose first language is not English have been identified as population groups who are likely to experience disadvantage when seeking access to health and related services (ABS 1999). As such, it is necessary to describe the health status of people from different backgrounds. The term 'non-English-speaking background' has been used throughout this publication to describe people who have re-settled in Australia but who come from countries where English is not the primary language spoken.

The Department of Immigration and Multicultural and Indigenous Affairs (DIMIA) has developed a classification from 1996 census data, which places every country into one of four groups based on the relative English proficiency of recent arrivals to Australia (DIMIA 2001).

English-speaking background is defined as those people born in Australia, New Zealand, the United Kingdom, Ireland, the United States of America, Canada or South Africa, which corresponds to the DIMIA English proficiency countries in group 1. These are the main countries from which Australia receives overseas settlers who are likely to speak English. Non-English-speaking background is defined as those people whose country of birth was somewhere other than one of these seven countries. This corresponds to the DIMIA English proficiency countries in the remaining groups 2 to 4.

A1.12.3 Socioeconomic disadvantage

The SEIFA Index of Relative Socioeconomic Disadvantage (IRSD) is one of five indexes developed by the ABS to measure socioeconomic characteristics associated with geographic locations (ABS 1998), based on information from the Australian census. Each index summarises information relating to a variety of social and economic characteristics associated with families and households, personal education qualifications and occupation.

This report uses the SEIFA index as it provides a summary score for a range of key socioeconomic variables that are related to health status, including household income and resources, education, occupation, fluency in English, and Indigenous status. The index is constructed so that relatively advantaged areas have high index values (Table A1.8).

Table A1.8
SEIFA quintiles and their corresponding IRSD score

Quintile	IRSD score
1st quintile (most disadvantaged)	<940.5
2nd quintile	940.5–<973.1
3rd quintile	973.1–<1,008.1
4th quintile	1,008.1–<1,064.4
5th quintile (most advantaged)	≥1,064.4
NSW average	1,006

Individual records were classified into quintiles of socioeconomic disadvantage according to the SEIFA index value associated with the statistical local area (SLA) of usual residence of the individual. Quintile 1 (SEIFA 1) includes the most disadvantaged households and quintile 5 (SEIFA 5) includes the most advantaged households.

It is important to note that the index reflects the relative disadvantage of all people living in an area, not an individual. Therefore, this measure probably underestimates the true inequality in health at the individual level.

A1.12.4 Urban, rural and remote areas

Accessibility to health and education services plays an important role in the successful treatment and management of asthma. For the majority of sections in this report, urban, rural and remote areas have been identified using the Australian Standard Geographical Classification (ASGC) of remoteness. The GP section of this report uses the Rural, Remote and Metropolitan Areas (RRMA) classification to define remoteness because this is the classification provided in the BEACH dataset.

ASGC categories of remoteness

The ASGC is based on the Accessibility/Remoteness Index of Australia (ARIA), which measures remoteness solely on the basis of geographical accessibility, and excludes urban/rural, socioeconomic and population size factors. This index can be applied to any location in Australia. It is based on physical geography, whereby locations are classified on the basis of the proximity (that is, the distance people must travel on a road network) to the nearest of 545 service centres, which differ in size and, hence, in the availability of education and health services.
The centres with small populations generally have a limited choice of general practitioners, specialists and hospital care.

Values of remoteness for populated localities are calculated by measuring the shortest road distance between a locality and the nearest of each of five different categories of service centres. Each of the populated localities across Australia has been assigned an ARIA index score to assess their remoteness from goods, services and opportunities for social interaction. (For full methodology, see ABS 2001a).

Table A1.9
ABS classes of remoteness, by ASGC and their definition

ASGC classification	ARIA index score	Definition
Major cities of Australia	0–0.2	Geographic distance imposes minimal restriction upon accessibility to the widest range of goods, services and opportunities for social interaction
Inner regional Australia	>0.2–2.4	Geographic distance imposes some restriction upon accessibility to the widest range of goods, services and opportunities for social interaction
Outer regional Australia	>2.4–5.92	Geographic distance imposes a moderate restriction upon accessibility to the widest r ange of goods, services and opportunities for social interaction
Remote Australia	>5.92–10.53	Geographic distance imposes a high restriction upon accessibility to the widest range of goods, services and opportunities for social interaction
Very remote Australia	>10.53–15	Locationally disadvantaged. Geographic distance imposes the highest restriction upon accessibility to the widest range of goods, services and opportunities for social interaction

This report examines data for the five ASGC/ARIA classes where these data are available. However, in some instances the three broader areas of major cities, inner regional, and outer regional or remote areas have been used where cell sizes are too small for accurate estimation in the more detailed classification.

RRMA classification of remoteness

The RRMA classification of remoteness is based on statistical local area (SLA) distances to service centres and other people (DPIE & DHSH 1994). Values of remoteness are calculated by combining a personal distance index (which is based on the population density of the SLA) and partial indices based on measurements of straight-line distances between each SLA and the nearest service centres. This yields three zones of remoteness (metropolitan, rural and remote), which comprise seven different classes (Table A1.10).

It should be noted that all capital cities are categorised as 'capital cities' using this classification, regardless of the relative remoteness of the city and the population size.

For the purposes of this report, we have presented four RRMA categories of remoteness by combining the three rural zones and the two remote zones to create a 'rural' category and a 'remote' category, respectively.

Table A1.10

RRMA classifications of remoteness and their definition

Zone	Class	Category used in this report
Metropolitan zone	Capital cities	Capital cities
	Other metropolitan centres (urban centre population ≥100,000)	Other metropolitan
Rural zone	Large rural centres (urban centre population 25,000–99,999)	Rural
	Small rural centres (urban centre population 10,000–24,999)	
	Other rural areas (urban centre population <10,000)	
Remote zone	Remote centres (urban centre population ≥5,000)	Remote
	Other remote areas (urban centre population <5,000)	