Patterns of asthma medication use in Australia

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Australian Centre for Asthma Monitoring

May 2007

Australian Institute of Health and Welfare
Canberra

AIHW cat. no. ACM 11

ISBN 978 1 74024 680 4

Suggested citation

Australian Centre for Asthma Monitoring 2007. Patterns of asthma medication use in Australia. AIHW cat. no. ACM 11. Canberra: Australian Institute of Health and Welfare.

Any enquiries about or comments on this publication should be directed to:

Australian Centre for Asthma Monitoring
Woolcock Institute of Medical Research
GPO Box M77
Missenden Road
Camperdown NSW 2050
Phone: (02) 9515 5226 (International +61 2 9515 5226)
Email: acam@asthmamonitoring.org

Published by the Australian Institute of Health and Welfare

Printed by

Contents

Acknowledgments

Rosario Ampon, Patricia Correll, Leanne Poulos, Guy Marks, Anne-Marie Waters and Margaret Williamson from the Australian Centre for Asthma Monitoring were responsible for the preparation of this report.

The authors also acknowledge Phillip Dunne, Adam Majchrzak, Chris Raymond and Richard Solon from the Department of Health and Ageing for their insightful assistance in accessing and working with the Pharmaceutical Benefits Scheme data.

Valuable input was received from the team at the Asthma, Arthritis and Environmental Health Unit at the Australian Institute of Health and Welfare

The members of the Steering Committee of the Australian System for Monitoring Asthma are also acknowledged for their very helpful comments and guidance in the interpretation and implications of these findings.

This publication was funded by the Australian Government Department of Health and Ageing through the National Asthma Management Program.

Abbreviations

ABS	Australian Bureau of Statistics
ACAM	Australian Centre for Asthma Monitoring
AH	accuhaler
ASGC	Australian standard geographic classification
ATC	Anatomical Therapeutic Chemical
CI	confidence interval
COPD	chronic obstructive pulmonary disease
DDD	Defined daily dose
MDI	metered dose inhaler
mg	milligram(s)
NHS	National Health Survey
PBS	Pharmaceutical Benefits Scheme
PIN	Patient identification number
RPBS	Repatriation Pharmaceutical Benefits Scheme
RR	rate ratio
SEIFA	Socio-Economic Index for Areas
TH	turbuhaler
µg	microgram(s)

Summary

The issues

Drug therapy is the cornerstone of treatment for controlling asthma and preventing and relieving attacks. It is important that the medications are used in the appropriate manner and this varies with the type of medication. Past studies have looked at how people use their asthma medications, but these have been of relatively small scale. This study is the first to use national data to examine the patterns of medication use for asthma.

The methods

Records of medications commonly used to treat asthma that were dispensed during the period July 2002 to June 2004 were obtained from the Pharmaceutical Benefits Scheme (PBS) database. To ensure complete confidentiality, each record had a patient identification number (PIN) representing the person to whom the medication was prescribed. This PIN enabled multiple prescriptions for the same person to be identified, and the person's basic demographic characteristics, such as age, sex and postcode, to be included in the record, without revealing the identity of the person. Using these data it was possible to look at the patterns of asthma medication use and to compare this with the recommendations contained in guidelines for asthma care. It was also possible to study the influence of a person's demographic characteristics on their patterns of medication use.

The findings

Incorrect use

Most people who use inhaled corticosteroids use them intermittently, even though guidelines recommend that these drugs be used regularly by those who need them. Most adults also use the strongest formulations of inhaled corticosteroids, even though less potent formulations are often effective and have fewer side effects.

Correct use

Most people take short-acting reliever drugs (such as Ventolin™) occasionally, suggesting better use of this medication class, which should not be needed regularly if symptoms are under control.

Barriers to use

People living in remote areas use asthma medications less than people living in cities. This may reflect differences in the accessibility of health care services.

People with concession cards, who are able to purchase medications at a much cheaper price than general patients, use more inhaled corticosteroids than general patients. This raises the possibility that the price charged to general asthma patients represents a barrier to the use of inhaled corticosteroids.

Some limitations

- Although this report focuses on the use of medications for asthma, the available data do not contain information on the reason for which the drug was prescribed. The medications that are used for asthma are also used for the treatment of some other medical conditions, in particular, chronic obstructive pulmonary disease. However, this disease occurs predominantly in older individuals. For this reason the subgroup of people aged 5 to 34 years was also investigated. In this subgroup the medications were highly likely to have been used for asthma.
- A further limitation is that there was no information on the patient's level of disease severity, which made it difficult to determine how well particular drugs are being used.
- Not all medications used for the treatment of asthma come through the PBS. In particular, short-acting bronchodilators are often bought without a prescription, and are usually only acquired through the PBS when the patient holds a government concession card. Therefore some of the analyses had to be limited to patients who have a concession card.

Further study

The inclusion of demographic information in the PBS database has expanded the opportunities for further studies into medication use. The methods used in this study could prove useful for investigations of medication use for other conditions and diseases. Such studies will provide some important insights into how well the current use of drugs compares with best practice standards.

1 Introduction

Key points

- Drug therapy is the cornerstone of asthma care and is used to relieve and prevent day-to-day symptoms, and prevent and treat exacerbations.
- Drug classes commonly used to treat asthma include short-acting beta agonists, which are used for short-term symptom relief; inhaled corticosteroids and long-acting beta agonists, used for symptom prevention and disease control; and oral corticosteroids, which are used during episodes of more severe asthma.
- The Pharmaceutical Benefits Scheme (PBS) data comprises records of all prescriptions subsidised by the scheme.
- All prescriptions for inhaled corticosteroids and long-acting beta agonists are subsidised by the PBS. Prescriptions of short-acting beta agonists and oral corticosteroids are only consistently subsidised for patients with concession cards.
- Recently, the PBS has enabled the linkage of multiple prescriptions for the same person and includes some of their basic demographic details. Here, this information is used to investigate the patterns of asthma medications in Australia.

1.1 Background

Asthma is a National Health Priority Area in Australia because it is a common chronic disease that has a sizeable impact on individuals and the community, but with well-tried treatments that can reduce this impact. Drug therapy is the cornerstone of asthma treatment and is used to relieve and prevent day-to-day symptoms, and prevent and manage episodes of disease exacerbation.

Drugs commonly used to treat asthma include short-acting beta agonists, which are used, as needed, for short-term bronchodilation to relieve symptoms, and inhaled corticosteroids, which are used to control the underlying disease process and hence prevent symptoms and also prevent exacerbations.

Some people with asthma may choose to rely solely on short-acting beta agonists to manage their disease. However, people with asthma who rely on short-acting beta agonists, without using inhaled corticosteroids, have been shown to be more likely to suffer exacerbations or attacks of asthma requiring an emergency department visit or an admission to hospital (Anis et al. 2001; Suissa et al. 2002).

Inhaled corticosteroids are most effective when used regularly (usually twice daily) and continuously, including when the person does not have any symptoms of asthma. It has been shown that regular use of inhaled corticosteroids can control asthma symptoms (Adams N et al. 2003, 2004, 2005), prevent hospital admissions (Rowe et al. 2000) and possibly also reduce lung damage (Dijkstra et al. 2006; Lange et al. 2006) among people with asthma. Asthma in most people can be well controlled with quite low doses of inhaled corticosteroids resulting in a low risk of harmful effects (Powell & Gibson 2003).

When the disease cannot be well controlled with a regular, modest dose of inhaled corticosteroids, a long-acting beta agonist is often added. This allows equivalent or greater effectiveness in disease control with lower doses of inhaled corticosteroids (Greening et al. 1994; Ind et al. 2003; Woolcock et al. 1996). Formulations combining a long-acting beta agonist with an inhaled corticosteroid are now available.

Other classes of drugs may also be used regularly to control symptoms and prevent exacerbations. These include theophylline, leukotriene receptor antagonists and cromones. During episodes of more severe asthma, oral corticosteroids may also be used to gain control of the disease. A very small number of people with asthma need long-term treatment with oral corticosteroids to control their disease.

Current international (GINA 2006) and Australian (NAC 2006) guidelines recommend that people with persistent asthma of all levels of severity use inhaled corticosteroids regularly. These guidelines are based on the latest research and give clear information to guide doctors in the current best practice standards for the care of asthma. They are updated regularly and circulated to all general practitioners, respiratory physicians and others, such as asthma educators, throughout Australia, as well as being available on the internet.

The investigation of the pattern of use of asthma medications and how this varies by age, sex, socioeconomic status and remoteness of residence matters for our understanding of how the condition is being managed and the extent to which this is consistent with current evidence and practice guidelines. It can also help in identifying population groups that may be at risk of poor quality treatment practice and in planning policy responses to areas of concern.

Overseas, there are already several examples of studies that have used prescription information to review trends in asthma care and compliance with guidelines, including in the United States (Stafford et al. 2003; Terr & Bloch 1996), United Kingdom (Majeed et al. 1999), Italy (Poluzzi et al. 2002) and Canada (Lynd et al. 2002; Stafford et al. 2003). Often, these studies have found that many people with persistent asthma do not regularly use inhaled corticosteroids (Janson et al. 2005; Poluzzi et al. 2002). For instance, Lynd and colleagues (2002) in Canada found that, despite the active development and distribution of asthma management guidelines, the use of inhaled corticosteroids fell and the use of inhaled short-acting bronchodilators rose between 1996 and 1998, particularly among those receiving social assistance. More encouraging was a study from the United Kingdom that found that there was a rise in prescriptions for inhaled corticosteroids between 1992 and 1998 (Majeed et al. 1999).

Currently, there is limited information about the use of asthma medications in Australia, although a study in New South Wales in 1997 reported that only 43% of people who had features of persistent asthma used inhaled corticosteroids daily or on most days (Marks et al. 2000). In 2004–05, the National Health Survey (NHS) reported that only 28.4% of young adults with asthma had used inhaled corticosteroids in the previous 2 weeks (ACAM 2007). These studies suggest that inhaled corticosteroids are probably also underused here.

The Australian Centre for Asthma Monitoring (ACAM) has previously explored asthma medication use in Australia using pharmaceutical supply data from Intercontinental Medical Statistics in Health Pty Ltd and prescription data from the PBS (ACAM 2005). However, these studies were limited because there was no information about the people who received the drugs.

Since early 2002, PBS prescriptions have included the patients' Medicare numbers. Use of the Medicare number has created the ability to anonymously identify prescriptions for the same

individuals within the PBS data and also to link information on age, sex and home postcode. This is done using an encrypted Medicare patient identification number (PIN) so that patient confidentiality is protected.

ACAM has obtained these data from the Australian Government Department of Health and Ageing for people who were prescribed asthma medications during the period July 2002 to June 2004. In this study ACAM has used these newly available PBS data to investigate the patterns of use of asthma medication by Australians.

The University of Sydney Human Research Ethics Committee provided ethical approval for this study.

1.2 Study aims

This study investigates the pattern of use of medications for asthma in Australia including the demographic variation in their use. The observed pattern of use is compared with the use recommended in asthma management guidelines. The study aims to answer the following questions:

1. How does the use of asthma medications vary with demographic factors, namely age, sex, socioeconomic status and remoteness of residence?
2. What is the frequency of their use by individuals in Australia?
3. How potent are the inhaled corticosteroids prescribed to most people in Australia, and how does this vary with demographic factors?
4. How does the pattern of inhaled corticosteroid use relate to the use of other classes of asthma medication?

1.3 Study data

In Australia, national prescribing data are available from the PBS, which has been administered by the Australian Government for over 50 years (DoHA 2006b). For drugs that are included in this scheme, the person to whom the medication is dispensed pays the cost of that medication up to a 'copayment' amount, and the PBS pays the balance of the total cost if this is more than the copayment amount. At time of this report, this amount was $30.70 for general patients and $4.90 for people with government concession cards. In this way, all drugs that are listed on the PBS do not cost any more to the patient than their respective copayment amounts, with the remainder subsidised by the PBS. All prescriptions for which this subsidy was paid are recorded on the PBS database. The PBS currently subsidises the cost of approximately 80% of prescription medications dispensed in Australia (DoHA 2006c).

The PBS data for this study were obtained from the data custodians at the Pharmaceutical Pricing and Estimates Section of the Department of Health and Ageing. These data were in the form of one data record per subsidised PBS item. Fields included:

- anonymous unique PIN
- demographic variables (5-year age group, sex, postcode)
- date the prescription was supplied
- beneficiary category (general, concessional or Repatriation Pharmaceutical Benefits Scheme (RPBS), and safety net status)

- PBS item number (uniquely identifies a medication at a particular strength)
- number of prescriptions supplied on the occasion.[1]

The PBS data do not contain any information on the condition for which the drug was prescribed. The medications that are used for asthma are also used for the treatment of some other medical conditions, in particular, chronic obstructive pulmonary disease (COPD). However, COPD mostly occurs in older individuals and for this reason secondary analyses were conducted among people in the age group 5 to 34 years, in whom the medications were most likely to have been prescribed for asthma.

Inclusions and exclusions

The data set for this study included all prescriptions in Australia for medications that were subsidised by the PBS in the selected classes between July 2002 and June 2004 inclusive. This comprised 19,177,841 records from 2,597,951 separate individuals. Appendix 1 shows the PBS item codes included, the medication names and their classifications.

As oral corticosteroids are also used to treat many non-respiratory conditions, 281,204 individuals who were only dispensed oral corticosteroids and no other asthma medications were excluded, leaving 17,834,976 records after exclusion of those PINs. This was to increase the likelihood that the oral corticosteroid prescriptions in the data set were used for obstructive airways disease (asthma and COPD). However, it remains possible that some people with asthma and COPD may have used oral corticosteroids for other, unrelated illnesses.

Of the remaining records, 174,202 (0.98%) had PINS that were 'dummy' PINs. Data entry staff used these when the patient's Medicare number was not available with the prescription details to link records of the same individual. These were removed, leaving 17,660,774 records and 2,277,294 'real' PINs.

In analyses that were based on PINs and their associated demographic information, two further exclusions were applied:

1. In each medication class, individuals whose first date of supply was after 23 June 2004 (that is, in the last week of the study period) were further excluded. This was to avoid overestimating average medication use from first date of supply to the end of the study, and excluded between 0.5% and 0.7% of PINs from each medication class.
2. Where a person had filled more than 96 prescriptions for an item in a single medication class (that is, on average more than four prescriptions per month), that person's records for the item were excluded from the analyses of that medication class. This was to leave out observations in which it appeared likely that there were clerical errors in the generation of the PIN, and also excluded only a small proportion of subjects (0% to 0.4%) from the analysis.
   Appendix 2 gives details of the data processing steps and exclusions.

1. This was greater than 1 in only 0.2% of records, where, under the provisions of regulation 24 of the National Health (Pharmaceutical Benefits) Regulations 1960, a medical practitioner may authorise all the repeats to be dispensed at one time (Medicare Australia 2006).

The impact of concessions on the data analysis

The PBS copayment differs between patients who are general (non-concessional) beneficiaries and those who are concession card holders. As the database only includes records for prescriptions that were subsidised by the PBS, prescriptions for items that were not subsidised because they cost less than the copayment are not included in the database. However, as the copayment for concession card holders is much lower, a wider range of medications are subsidised by the PBS (and hence included in the PBS database) for patients who are concession card holders.

Virtually all inhaled corticosteroid preparations, all long-acting beta agonist preparations and all combined long-acting beta agonist and inhaled corticosteroid preparations are dispensed at a price that is higher than all PBS copayment. Hence the PBS database contains a complete record of prescriptions in Australia for these medication classes, and the entire data set has been included in analyses that involve only these classes of medications.

Short-acting beta agonists and oral corticosteroids, however, cost less and are only subsidised by the PBS when the patient is a concession card holder. For this reason, analyses involving these medication classes have been limited to prescriptions dispensed to concessional patients.

Short-acting beta agonists are also available 'over the counter', that is, without a prescription. However, the over-the-counter cost is greater than the copayment for a concession card holder who uses a prescription, which means there is a financial incentive for concession card holders to purchase short-acting beta agonists with a doctor's prescription. Therefore, it is assumed that most short-acting beta agonists dispensed to concessional patients are supplied with a prescription and recorded on the PBS database.

One potential difficulty with this approach is that it is possible for individuals to change concession card holder status over time (for example, people who change from being unemployed to employed). Such individuals would potentially have different medications recorded in the PBS database when they are concession card holders from when they are not. The extent to which people who were dispensed inhaled corticosteroids changed beneficiary status in the study data set was evaluated. Approximately 4% were recorded as both general beneficiaries and concessional beneficiaries during the study period (6% among those aged 5 to 34 years) (Table 1.1). Hence, change between general and concessional beneficiary status by individuals during the study period is likely to have had only a very small effect on the estimates contained in this report.

Table 1.1: Beneficiary status among people who received at least one prescription of inhaled corticosteroids, July 2002 to June 2004

Beneficiary status	All ages	Age 5 to 34 years
Always general	42%	52%
Always concessional	54%	42%
Both	4%	6%

A further issue affecting the inclusion of data in the PBS is that once an individual or family reaches a threshold level of out-of-pocket expenses in a given calendar year, their copayment reduces. This threshold level is referred to as the 'safety net', and both the level of copayment and safety net thresholds has often changed since the PBS was introduced.
Table 1.2 shows the changes in copayments and safety net thresholds for general and concessional beneficiaries during the study period from 2002 to 2004.

General patients who have reached the safety net have the same copayment as concession card holders and, therefore, the same prescriptions are captured on the PBS data set for general patients who have reached the safety net as for concession card holders. However, as these general patients changed copayment threshold during the course of the calendar year, their data were not included in those analyses that were restricted to concession card holders (see Section 2.2).

Table 1.2: PBS copayments and safety net thresholds applicable during the period July 2002 to June 2004

	Concessional beneficiaries			General beneficiaries		
Date of change	Pre–safety net copayment ($)	Safety net copayment ($)	Safety net threshold ($)	Pre–safety net copayment ($)	Safety net copayment ($)	Safety net threshold ($)
1.1.2002	3.60	Nil	187.20	22.40	3.60	686.40
1.1.2003	3.70	Nil	192.40	23.10	3.70	708.40
1.1.2004	3.80	Nil	197.60	23.70	3.80	726.80

Source: DoHA 2004.

1.4 Structure of this report

This chapter introduces the background to the study, the questions posed, the data that were used and the issues taken into account in the analyses. The subsequent chapters will address each of the four main study questions described in the study aims (Section 1.2).

In Chapter 2, asthma medication use in different demographic groups in the population is evaluated and compared. In Chapter 3, the average daily use of each of the main medication classes dispensed to individuals is estimated. In Chapter 4, the potency of inhaled corticosteroids dispensed to individuals is evaluated. Also, the relationship of inhaled corticosteroid potency to people's demographic characteristics is examined. The last study question is addressed in Chapter 5, where the relationships between asthma medication classes is examined through the comparison of each individual's use of inhaled corticosteroids with their use of the other medication classes. The concluding chapter of this report summarises the main findings across all chapters and considers the limitations as well as the future possibilities for studies using these data.

2 Population distribution of asthma medication use

Key points

- Between July 2002 and June 2004 there were 17,660,774 prescriptions subsidised by the PBS for asthma medications among 2,277,294 people in Australia.
- Fifty-five per cent of those who were dispensed asthma medications were female, 36% were aged 5 to 34 years and two-thirds lived in major cities.
- Use of all asthma medications increased with age.
- Use of inhaled corticosteroids and long-acting beta agonists, alone or in combination, was lowest in remote areas.
- Over half of all people who were prescribed inhaled corticosteroids were concession card holders, which is considerably higher than the proportion of concession card holders in the Australian population overall.
- The volume of inhaled corticosteroids dispensed to concession card holders was at least twice as great as that given to patients who were general beneficiaries. This raises the possibility that lack of affordability may limit use among general patients.

2.1 Introduction

Understanding the patterns of asthma medication use and how this varies in different population groups enables a better understanding of how the condition is being managed in the community and whether some groups are at risk of poorer quality asthma care. The aim of these analyses was to describe the rate of medication use for asthma in the community as a whole, and to assess variation by age group, sex, socioeconomic status and remoteness of residence. This will help to guide programs that will improve the use of medications for asthma.

2.2 Methods

Defining populations of interest

The following age groups were defined: 0 to 4 years, 5 to 14 years, 15 to 34 years, 35 to 64 years, and 65 years and over. For the analyses that were limited to concessional beneficiaries, that is, for short-acting beta agonists and oral corticosteroids, there were no population denominator data for children aged less than 15 years (see 'Population denominator data sources' below). Hence the age classification for these analyses was 15 to 34 years, 35 to 64 years and 65 years and over.

Analysis of socioeconomic status used the Socio-Economic Indexes for Areas (SEIFA), published by the Australian Bureau of Statistics (ABS 2003), as locality-based indicators of socioeconomic status. For the analysis presented here we used the Index of Relative Socio-Economic Disadvantage, which is derived from Census data on educational attainment, income, occupation, wealth, living conditions and access to services. Localities, based on postcode of residence, were classified into five quintiles of socioeconomic disadvantage (where 1 = most disadvantaged localities and 5 = most advantaged localities).

Using postcode, remoteness of residence was classified using the Australian Standard Geographical Classification (ASGC). This was developed by the ABS as an indicator of remoteness and allows a quantitative comparison between 'city' and 'country' Australia (ABS 2001a). Using this classification, postcodes were categorised into five Remoteness Area classes: *Major cities*, *Inner regional*, *Outer regional*, *Remote* and *Very remote*.

As prescriptions for inhaled corticosteroids and long-acting beta agonists are subsidised for all beneficiary categories, people who had been dispensed any inhaled corticosteroids or long-acting beta agonists were categorised as either concession card holders (including RPBS concession card holders) or general beneficiaries.

Where an individual's demographic characteristics changed during the study period, the characteristics were categorised based on the earliest record for that individual in the study data set.

Population denominator data sources

In the analyses of inhaled corticosteroids and long-acting beta agonists, the source of the denominator population of interest was the estimated resident population of Australia in 2001, obtained from the ABS. Further analyses of inhaled corticosteroids and long-acting beta agonists were carried out using the total estimated number of people in Australia with asthma or COPD as the denominator population, which was obtained from the 2001 National Health Survey (NHS) for people aged 15 years and over.

Because the analyses of short-acting beta agonists and oral corticosteroids were restricted to concession card holders, the population values were estimated as the average number of concession card holders in 2001. This estimate was also obtained from the 2001 NHS, in which people were asked to indicate possession of a Department of Veterans' Affairs entitlement card, health care card, pensioner concession card or Commonwealth Seniors Health card (ABS 2001b). This information was only acquired for people aged 15 years and over. The denominator populations are shown in Appendix 3.

Calculations

Medications were quantified in defined daily doses by assigning the defined daily dose (DDD) units to each PBS item using the Anatomical Therapeutic Chemical (ATC) classification system. DDD units (usually in milligrams or micrograms) are 'the assumed average maintenance dose per day for a drug used for its main indication in adults' (WHO Collaborating Centre for Drug Statistics Methodology 2006). This transforms the doses of different medications into a common unit of measurement that enables the addition of doses of different drugs in the same medication class and also enables comparisons to be made between different medication classes. All PBS items are classified by the ATC classification system, and can be directly linked to DDD units using the ATC Index available at

<www.whocc.no/atcddd/indexdatabase>. ATC codes are shown in Appendix 1. For instance, among inhaled corticosteroids, one DDD unit of budesonide is 800 μg, one DDD unit of beclomethasone is 800 μg and one DDD unit of fluticasone is 600 μg. Therefore, 800 μg of budesonide plus 600 μg of fluticasone is equivalent to 2 DDDs of inhaled corticosteroid.

First, the total number of DDDs dispensed in each record of the PBS data set was calculated for the dose strength represented by each PBS item code using the following formula:

Equation 2.1

$$DDDs = \frac{N \times M \times Q}{DDD\ unit}$$

where N is the number of prescriptions dispensed per record, M is the strength of each dose (milligrams or micrograms), Q is the average quantity of doses per prescription and *DDD unit* is one defined daily dose for the particular PBS item. In each medication class, the total DDDs dispensed in the population were calculated by summing DDDs within the populations of interest, that is, a selected combination of age group, sex, SEIFA quintile and ASGC category.

Therefore:

Equation 2.2

Total DDD in population = sum of DDDs in the population of interest

For formulations that combined medications from more than one class, in this case inhaled corticosteroids plus long-acting beta agonists, each drug was counted separately as contributing to both inhaled corticosteroids and to long-acting beta agonists.

Where the demographic data for a PIN changed during the course of the study period, the data associated with the earliest prescription supplied to that PIN were used. If demographic data were missing for a PIN, it was not included in the analyses related to the missing variables. This affected only a small proportion of PINs (Table 2.1).

Table 2.1: Missing demographic data

Demographic characteristic	Number of PINs with data missing	Per cent of PINs with data missing
Age group	1,289	0.06
Sex	840	0.04
Postcode	554	0.02
SEIFA category[(a)]	17,592	0.77
ASGC category[(a)]	765	0.03

(a) Postcodes were used to generate SEIFA and ASGC categories. It is noteworthy, however, that as some postcodes (e.g. new postcodes) could not be mapped to a category, missing SEIFA and ASGC categories were more common than missing postcodes.

The rate was then calculated as follows:

Equation 2.3

$$DDD \text{ per } 1{,}000 \text{ population per day} = \frac{Total\ DDD\ in\ population \times 1{,}000}{P \times Y}$$

where P is the denominator population of interest and Y is the total number of study days (in this case Y was 2 years or 731 days, including allowance for the leap year in 2004).

The independent effects of demographic characteristics on the population rate of use of asthma medications were quantified using log binomial models assuming the response

$$\frac{DDD / day}{population}$$

was a binomial proportion. The log function was used as the link so that rate ratios (RRs) could be calculated directly from the parameter coefficients of each model. To adjust for over-dispersion of the data, a Pearson's scale factor was used. The models were adjusted for age group, sex, socioeconomic status (SEIFA quintiles) and ASGC categories of remoteness.

2.3 Results

Demographic characteristics of the study population

Between July 2002 and June 2004 there were 17,660,774 prescriptions (after exclusions as outlined in Section 1.3) subsidised by the PBS for asthma medications among 2,277,294 people in Australia. A large proportion of the study population lived in localities in the most disadvantaged SEIFA quintile. This is likely to be because data for two of the medication classes on which the study data set was based (short-acting beta agonists and oral corticosteroids) were only complete for concessional beneficiaries who are more likely to be socioeconomically disadvantaged. Fifty five per cent of the study population were female, 36% were aged 5 to 34 years and two-thirds lived in *Major cities*. Among people aged 5 to 34 years, in whom the diagnosis of asthma was more certain, the distribution of demographic characteristics was similar to that for all ages (Table 2.2). It should be noted that while these medication classes are commonly used to treat asthma, they might also be used to treat other conditions. As also noted previously, not all asthma medications are dispensed through the PBS. Therefore, the number of individuals who are included in this dataset does not equate to the number of individuals with asthma in Australia.

Table 2.2: Demographic characteristics of people who were dispensed asthma medications that were subsidised by the PBS, Australia, 2002–03 to 2003–04

	All ages		Age 5 to 34 years	
Demographic characteristics	**Number**	**Per cent**	**Number**	**Per cent**
Sex				
Male	1,012,761	44.5	393,529	48.2
Female	1,263,633	55.5	423,044	51.8
Age group				
0 to 4 years	96,426	4.24	—	—
5 to 14 years	314,754	13.8	314,754	38.6
15 to 34 years	501,819	22.1	501,819	61.5
35 to 64 years	791,970	34.8	—	—
65 years and over	570,596	25.1	—	—
Socioeconomic status				
SEIFA 1 (most disadvantaged)	521,387	23.1	188,845	23.3
SEIFA 2	370,422	16.4	130,092	16.1
SEIFA 3	426,050	18.9	154,450	19.1
SEIFA 4	498,380	22.1	181,298	22.4
SEIFA 5 (most advantaged)	442,952	19.6	155,971	19.2
Remoteness category[(a)]				
Major cities	1,515,577	66.6	551,645	67.6
Inner regional	494,325	21.7	171,230	21.0
Outer regional	228,038	10.0	79,763	9.77
Remote	29,981	1.32	10,966	1.34
Very remote	8,165	0.36	2,880	0.35
All persons[(b)]	**2,277,294**	**100**	**816,573**	**100**

(a) Remoteness category based on Australian Standard Geographical Classification (ASGC).

(b) The overall number may be slightly greater than the sum of the subgroups as a small proportion of records were missing demographic data (see Table 2.1) and does not exclude individuals whose first date of supply was after 23 June 2004 or records of items where a person had filled more than 96 prescriptions for the item in a single medication class.

Concession card holder status

The beneficiary status of study subjects who had received inhaled corticosteroids was examined because all patient beneficiary categories are subsidised by the PBS for this medication class.

Over half (56%) of all people who were dispensed inhaled corticosteroids were holders of government concession cards at the time of their earliest inhaled corticosteroid prescription. Forty-five per cent of those aged 5 to 34 who were dispensed inhaled corticosteroids were concession card holders (Table 2.3).

The proportion of concession card holders among those dispensed inhaled corticosteroids is substantially higher than the proportion of concession card holders in the general population and in the subset of people with asthma or COPD. In the 2001 NHS, 35% of the general population and 41% of those who reported a diagnosis of asthma or COPD were concession

card holders (data obtained from ABS NHS 2001 confidentialised unit record files) (Table 2.3). This suggests that people who were dispensed inhaled corticosteroids were more likely to be concession card holders than people in the general population or people with a diagnosis of asthma or COPD.

Table 2.3: Beneficiary status in comparison populations in Australia

	At earliest inhaled corticosteroid prescription (PBS data 2002–04)		All persons (NHS 2001)		People who report having asthma or COPD (NHS 2001)	
Beneficiary status	All ages	Age 5 to 34 years	All ages	Age 5 to 34 years	All ages	Age 5 to 34 years
General	44%	55%	65%	76%	59%	71%
Concessional (including RPBS)	56%	45%	35%	24%	41%	29%

Medication use and demographic characteristics

In the Australian population, use of both inhaled corticosteroids and long-acting beta agonists increased with age (Table 2.4). Eighty-one DDDs of inhaled corticosteroids and 35 DDDs of long-acting beta agonists were used per day for every 1,000 people aged 65 years and over. This pattern of increasing use with age was also observed for inhaled corticosteroids and long-acting beta agonists that were used in combination formulations (Table 2.5). Use of asthma medications did not differ greatly with socioeconomic status, although in the population as a whole there tended to be higher rates of use among people living in areas of greater socioeconomic disadvantage. However, this was not observed when the analysis was limited to people aged 5 to 34 years. People living in more remote areas had lower rates of use of inhaled corticosteroids and long-acting beta agonists, both alone and in combined formulations. There were much higher rates of inhaled corticosteroids and long-acting beta agonists dispensed to concession card holders than to general beneficiaries, both alone and in combined formulations. This higher rate of dispensing of inhaled corticosteroids to concession card holders was not attributable to any real difference in the prevalence of asthma or COPD between concession card holders and general beneficiaries.

Table 2.4: Use of inhaled corticosteroids and long-acting beta agonists, Australia, 2002–03 to 2003–04

	DDD/1,000 persons/day			
	Inhaled corticosteroids[a]		Long-acting beta agonists[a]	
Demographic characteristics	**All ages**	**Age 5 to 34 years**	**All ages**	**Age 5 to 34 years**
Age group (years)				
0 to 4	1.66	—	1.21	—
5 to 14	7.81	7.81	5.73	5.73
15 to 34	13.7	13.7	6.03	6.03
35 to 64	27.4	—	11.4	—
65 and over	81.4	—	35.4	—
Sex				
Male	24.0	11.5	10.6	5.94
Female	27.9	12.1	12.3	5.92
Socioeconomic status				
SEIFA 1 (most disadvantaged)	28.2	11.1	12.2	5.52
SEIFA 2	28.3	11.3	12.6	5.80
SEIFA 3	27.3	11.9	12.2	6.13
SEIFA 4	25.5	11.5	11.3	5.81
SEIFA 5 (most advantaged)	25.8	12.7	11.5	6.25
Remoteness category (ASGC)				
Major cities	26.2	12.3	11.5	6.12
Inner regional	27.7	11.7	12.4	6.10
Outer regional	24.2	10.1	11.0	5.29
Remote/very remote	14.3	6.46	6.08	3.18
Beneficiary category[b]				
Concession card holders	60.7	24.4	26.2	10.8
General beneficiaries	17.2	10.9	7.22	4.78
All persons	**26.0**	**11.8**	**11.5**	**5.93**
	DDD/1,000 persons with asthma or COPD/day			
Beneficiary category[b]				
Concession card holder	375	126	162	56.1
General	139	74.0	58.3	32.4

(a) Examples of 1 DDD unit:
Inhaled corticosteroids = budesonide/beclomethasone 800 µg or fluticasone 600 µg
Long-acting beta agonists = salmeterol 100 µg, (e)formoterol 24 µg.

(b) Age 15 years and over. Denominator based on data from 2001 National Health Survey.

Table 2.5: Use of combined formulations of inhaled corticosteroids and long-acting beta agonists, Australia, 2002–03 to 2003–04

	DDD/1,000 persons/day			
	Inhaled corticosteroid in combined formulations[a]		Long-acting beta agonist in combined formulations[a]	
Demographic characteristics	**All ages**	**Age 5 to 34 years**	**All ages**	**Age 5 to 34 years**
Age group (years)				
0 to 4	0.61	—	1.15	—
5 to 14	3.94	3.94	5.37	5.37
15 to 34	7.93	7.93	5.50	5.50
35 to 64	15.9	—	9.65	—
65 and over	45.3	—	27.8	—
Sex				
Male	13.8	6.48	8.97	5.50
Female	15.5	6.76	10.3	5.41
Socioeconomic status				
SEIFA 1 (most disadvantaged)	16.2	6.26	10.3	5.12
SEIFA 2	16.2	6.37	10.5	5.33
SEIFA 3	15.8	6.84	10.3	5.66
SEIFA 4	14.4	6.50	9.41	5.33
SEIFA 5 (most advantaged)	14.0	6.94	9.55	5.70
Remoteness category (ASGC)				
Major cities	14.9	7.01	9.70	5.65
Inner regional	15.6	6.44	10.30	5.56
Outer regional	13.5	5.50	9.05	4.83
Remote/ very remote	7.66	3.32	5.09	2.91
Beneficiary category[b]				
Concession card holder	34.7	14.5	21.2	9.80
General	9.69	6.22	6.26	4.38
All persons	**14.7**	**6.62**	**9.62**	**5.46**
	DDD/1,000 persons with asthma or COPD/day			
Beneficiary category[b]				
Concession card holder	214	74.9	131	50.8
General	78.2	42.1	50.5	29.6

(a) Examples of 1 DDD unit:
Inhaled corticosteroids in the combined formulations Seretide: fluticasone 600 µg (inhaled corticosteroid) and salmeterol 100 µg (long-acting beta agonist) Symbicort: budesonide 800 µg and formoterol 24 µg.

(b) Age 15 years and over only. Denominator based on data from 2001 National Health Survey.

Differences in demographic characteristics did not explain the higher rate of inhaled corticosteroid and long-acting beta agonist use with age, the lower rates among people living in remote areas and the much higher rate among concession card holders (Table 2.6 and Table 2.7). Among people of all ages and those aged 5 to 34 years, concession card holders

used at least 2.5 times the amount of inhaled corticosteroids and long-acting beta agonists that general beneficiaries used.

Among people of all ages, use of these medication classes was slightly higher among people in more disadvantaged socioeconomic quintiles. However, this was not observed when the analysis was limited to those aged 5 to 34 years. Use of inhaled corticosteroids and long-acting beta agonists was slightly higher in females when all ages were combined; however, there was little difference among those aged 5 to 34 years.

Table 2.6: Effect[a] of demographic characteristics on use of inhaled corticosteroids, Australia, 2002–03 to 2003–04

	All ages		Age 5 to 34 years	
Demographic characteristics	**Unadjusted[b] RR (95% CI)[a]**	**Adjusted[c] RR (95% CI)[a]**	**Unadjusted[b] RR (95% CI)[a]**	**Adjusted[c] RR (95% CI)[a]**
Age group (years)				
0 to 4	0.33 (0.23–0.49)	0.33 (0.23–0.48)	—	—
5 to 14 (reference category)	1.00	1.00	—	—
15 to 34	1.76 (1.50–2.07)	1.75 (1.51–2.04)	—	—
35 to 64	3.53 (3.04–4.11)	3.53 (3.08–4.05)	—	—
65 and over	10.5 (9.06–12.2)	10.4 (9.07–12.0)	—	—
Sex				
Male (reference category)	1.00	1.00	1.00	1.00
Female	1.16 (0.92–1.45)	1.07 (1.02–1.13)	1.06 (0.94–1.18)	1.05 (0.94–1.18)
Socioeconomic status				
SEIFA 1 (most disadvantaged)	1.10 (0.77–1.55)	1.17 (1.07–1.27)	0.87 (0.73–1.04)	0.93 (0.78–1.11)
SEIFA 2	1.12 (0.78–1.63)	1.17 (1.06–1.28)	0.89 (0.73–1.08)	0.95 (0.79–1.16)
SEIFA 3	1.07 (0.75–1.53)	1.12 (1.03–1.22)	0.94 (0.78–1.12)	0.98 (0.82–1.17)
SEIFA 4	1.00 (0.71–1.41)	1.04 (0.96–1.13)	0.91 (0.77–1.08)	0.94 (0.80–1.10)
SEIFA 5 (most advantaged) (reference category)	1.00	1.00	1.00	1.00
Remoteness category (ASGC)				
Major cities (reference category)	1.00	1.00	1.00	1.00
Inner regional	1.05 (0.80–1.39)	0.97 (0.90–1.03)	0.95 (0.82–1.09)	0.95 (0.82–1.10)
Outer regional	0.92 (0.62–1.36)	0.87 (0.79–0.96)	0.80 (0.66–0.98)	0.81 (0.66–1.00)
Remote	0.72 (0.26–2.04)	0.77 (0.60–0.98)	0.65 (0.39–1.08)	0.66 (0.40–1.10)
Very remote	0.34 (0.04–2.60)	0.40 (0.25–0.65)	0.27 (0.10–0.73)	0.28 (0.10–0.75)
Beneficiary category[d]				
Concession card holder	3.56 (3.00–4.23)	2.50 (2.24–2.78)	2.23 (1.86–2.68)	2.40 (2.06–2.81)
General	1.00	1.00	1.00	1.00

(a) Measured as rate ratios (RR) with 95% confidence intervals (95% CI).

(b) Unadjusted rate ratios were estimated with a log binomial model and may differ slightly from rate ratios calculated from the crude rates.

(c) Adjusted for the effects of other variables in the model except beneficiary category.

(d) Adjusted for the effects of all other variables in the model, but limited to ages 15 years and over.

Table 2.7: Effect[a] of demographic characteristics on use of long-acting beta agonists, Australia, 2002–03 to 2003–04

	All ages		Age 5 to 34 years	
Demographic characteristics	Unadjusted[b] RR (95% CI)[a]	Adjusted[c] RR (95% CI)[a]	Unadjusted[b] RR (95% CI)[a]	Adjusted[c] RR (95% CI)[a]
Age group (years)				
0 to 4	0.27 (0.20–0.37)	0.27 (0.21–0.36)	—	—
5 to 14 (reference category)	1.00	1.00	—	—
15 to 34	1.05 (0.93–1.19)	1.05 (0.94–1.18)	—	—
35 to 64	2.01 (1.80–2.24)	2.01 (1.82–2.22)	—	—
65 and over	6.25 (5.61–6.96)	6.18 (5.59–6.82)	—	—
Sex				
Male (reference category)	1.00	1.00	1.00	1.00
Female	1.16 (0.93–1.44)	1.08 (1.03–1.13)	1.00 (0.92–1.07)	0.99 (0.93–1.06)
Socioeconomic status				
SEIFA 1 (most disadvantaged)	1.07 (0.76–1.49)	1.12 (1.04–1.21)	0.88 (0.79–0.99)	0.93 (0.84–1.03)
SEIFA 2	1.13 (0.79–1.61)	1.15 (1.06–1.25)	0.93 (0.82–1.05)	0.97 (0.87–1.09)
SEIFA 3	1.08 (0.76–1.52)	1.11 (1.03–1.21)	0.98 (0.88–1.10)	1.01 (0.91–1.12)
SEIFA 4	0.99 (0.71–1.38)	1.03 (0.96–1.11)	0.93 (0.84–1.04)	0.95 (0.86–1.04)
SEIFA 5 (most advantaged) (reference category)	1.00	1.00	1.00	1.00
Remoteness category (ASGC)				
Major cities (reference category)	1.00	1.00	1.00	1.00
Inner regional	1.07 (0.82–1.40)	0.99 (0.93–1.05)	1.00 (0.92–1.08)	1.00 (0.92–1.09)
Outer regional	0.95 (0.66–1.38)	0.90 (0.83–0.98)	0.85 (0.76–0.96)	0.85 (0.76–0.96)
Remote	0.70 (0.25–1.93)	0.74 (0.59–0.93)	0.65 (0.48–0.88)	0.65 (0.48–0.89)
Very remote	0.33 (0.05–2.40)	0.40 (0.26–0.62)	0.27 (0.15–0.49)	0.28 (0.15–0.51)
Beneficiary category[d]				
Concession card holders	3.05 (2.65–3.52)	2.46 (2.20–2.75)	2.27 (1.87–2.74)	2.46 (2.08–2.89)
General beneficiaries	1.00	1.00	1.00	1.00

(a) Measured as rate ratios (RR) with 95% confidence intervals (95% CI).

(b) Unadjusted rate ratios were estimated with a log binomial model and may differ slightly from rate ratios calculated from the crude rates.

(c) Adjusted for the effects of other variables in the model except beneficiary category.

(d) Adjusted for the effects of all other variables in the model, but limited to ages 15 years and over.

Among government concession card holders aged 15 years and over, use of short-acting beta agonists and oral corticosteroids also increased with age. Those aged 65 years and over used 88 DDDs of short-acting beta agonists per 1,000 persons per day and 22 DDDs of oral corticosteroids per 1,000 persons per day (Table 2.8). There were slight differences in use between males and females. As this was limited to concession card holders, a greater proportion were represented in the two most disadvantaged quintiles than in the general population and therefore socioeconomic impacts could not be investigated in this population.

Table 2.8: Use of short-acting beta agonists and oral corticosteroids, concession card holders, Australia, 2002–03 to 2003–04

	DDD/1,000 persons/day			
	Short-acting beta agonists[a]		Oral corticosteroids[a],[b]	
Demographic characteristics	**Age 15 years and over**	**Age 15 to 34 years**	**Age 15 years and over**	**Age 15 to 34 years**
Age group (years)				
15 to 34	46.7	46.7	4.56	4.56
35 to 64	66.3	—	12.0	—
65 and over	88.4	—	21.9	—
Sex				
Male	73.0	48.6	13.9	3.90
Female	68.1	45.5	14.2	4.99
Remoteness category (ASGC)				
Major cities	70.7	47.0	14.2	4.64
Inner regional	69.9	47.8	14.3	4.49
Outer regional, Remote, Very remote	68.2	43.1	12.8	4.30
All persons	**70.2**	**46.7**	**14.1**	**4.56**

(a) Examples of 1 DDD: Short-acting beta agonists = Salbutamol MDI 800 µg or Salbutamol nebuliser 10 mg. Oral corticosteroids = Prednisone 10 mg.

(b) Oral corticosteroids are only those dispensed to individuals who had also been dispensed other respiratory medications.

Multivariate analyses adjusting for demographic variables indicated that the observed increase in use of short-acting beta agonists or oral corticosteroids with age was not explained by differences in other demographic characteristics. Females had slightly higher use of oral corticosteroids than males, though there was little difference among people aged 15 to 34 years. Remoteness category did not have significant effects on the use of these medication classes (Table 2.9 and Table 2.10).

Table 2.9: Effect[a] of demographic characteristics on use of short-acting beta agonists, concession card holders, Australia, 2002–03 to 2003–04

	Age 15 years and over		Age 15 to 34 years	
Demographic characteristics	**Unadjusted[b] RR (95% CI)[a]**	**Adjusted[c] RR (95% CI)[a]**	**Unadjusted[b] RR (95% CI)[a]**	**Adjusted[c] RR (95% CI)[a]**
Age group (years)				
15 to 34 (reference category)	1.00	1.00	—	—
35 to 64	1.43 (1.21–1.69)	1.43 (1.21–1.69)	—	—
65 and over	1.89 (1.61–2.21)	1.89 (1.61–2.21)	—	—
Sex				
Male (reference category)	1.00	1.00	1.00	1.00
Female	0.93 (0.80–1.08)	0.95 (0.85–1.06)	0.94 (0.75–1.18)	0.94 (0.74–1.18)
Remoteness category (ASGC)				
Major cities (reference category)	1.00	1.00	1.00	1.00
Inner regional	0.99 (0.83–1.18)	1.00 (0.87–1.14)	1.01 (0.77–1.33)	1.01 (0.77–1.33)
Outer regional, Remote, Very remote	0.95 (0.76–1.19)	0.96 (0.81–1.14)	0.90 (0.63–1.29)	0.90 (0.63–1.29)

(a) Measured as rate ratios (RR) with 95% confidence intervals (95% CI).

(b) Unadjusted rate ratios were estimated with a log binomial model and may differ slightly from rate ratios calculated from the crude rates.

(c) Adjusted analysis presents the results for each variable after adjusting for the effects of other variables.

Table 2.10: Effect[a] of demographic characteristics on use of oral corticosteroids[b], concession card holders, Australia, 2002–03 to 2003–04

	Age 15 years and over		Age 15 to 34 years	
Demographic characteristics	**Unadjusted[c] RR (95% CI)[a]**	**Adjusted[d] RR (95% CI)[a]**	**Unadjusted[c] RR (95% CI)[a]**	**Adjusted[d] RR (95% CI)[a]**
Age group (years)				
15 to 34 (reference category)	1.00	1.00	—	—
35 to 64	2.63 (2.05–3.38)	2.64 (2.05–3.39)	—	—
65 and over	4.80 (3.79–6.08)	4.81 (3.79–6.10)	—	—
Sex				
Male (reference category)	1.00	1.00	1.00	1.00
Female	1.02 (0.79–1.31)	1.06 (0.93–1.20)	1.28 (1.01–1.63)	1.28 (1.00–1.64)
Remoteness category (ASGC)				
Major cities (reference category)	1.00	1.00	1.00	1.00
Inner regional	1.01 (0.75–1.35)	1.03 (0.89–1.20)	0.97 (0.72–1.30)	0.97 (0.73–1.29)
Outer regional, Remote, Very remote	0.89 (0.60–1.31)	0.92 (0.76–1.12)	0.91 (0.62–1.34)	0.92 (0.64–1.32)

(a) Measured with rate ratios (RR) with 95% confidence intervals (95% CI).

(b) Oral corticosteroids are only those dispensed to individuals who had also been dispensed other respiratory medications.

(c) Unadjusted rate ratios were estimated with a log binomial model and may differ slightly from rate ratios calculated from the crude rates.

(d) Adjusted analysis presents the results for each variable after adjusting for the effects of other variables.

2.4 Discussion

Inhaled corticosteroids and long-acting beta agonists

The use of inhaled corticosteroids and long-acting beta agonists increased with age, was lower in those living in remote areas, and was higher among holders of government concession cards. There were no consistent differences between males and females.

Age

The higher rate of use in older people, compared with younger people, may be due to the presence of COPD in older persons. Among people aged 5 to 34 years, most of the medications included in this study would be used for asthma, and total medication use was much lower when analyses were confined to this age group. In older persons, these medications are commonly used to treat COPD, as well as asthma. This extra reason for use may explain the higher use of 'asthma' medications in older persons.

Remoteness

The lower use of inhaled corticosteroids and long-acting beta agonists in remote areas may reflect differences in access to health care. This could signal the need for further effort to focus on people in rural and remote regions of Australia. However, it is noteworthy that Remote Area Aboriginal Health Services have access to medications under s. 100 of the National Health Act and these are not included in the PBS data (DoHA 2006a). This may account for some of the apparent under-use in remote areas.

Socioeconomic status

Among people of all ages, the use of inhaled corticosteroids and long-acting beta agonists rose with greater socioeconomic disadvantage. Interestingly, this trend was not observed among people aged 5 to 34 years. Generally, pharmaceutical use has been observed to be highest among people with lower socioeconomic status and this is put down to poorer health in this subgroup of the population (Metge et al. 1999). However, use of inhaled corticosteroids in the United States was reported to be higher among people of higher socioeconomic status (Adams R et al. 2002). The differences among these findings may reflect inconsistency in the measurement of socioeconomic status. In our study, this is based on locality rather than individual characteristics such as income and level of education. More fundamental differences between countries in the nature of their health care systems and socioeconomic gradients may also explain these different patterns. In countries without subsidised access to medications, it is very likely that the cost of medications represents a substantial barrier to their use among people with limited economic resources.

Concession card holder status

Over half of the subjects who were dispensed inhaled corticosteroids were concession card holders, which was disproportionately high in comparison with the general population or people with asthma or COPD. The volume of inhaled corticosteroids and long-acting beta agonists dispensed in relation to the number of people in the population was more than twice as great among those who were concession card holders than among those who were

general beneficiaries. This was also true when the analysis was limited to people aged 15 to 34 years who were most likely to have asthma. When analyses were adjusted for other demographic variables, concession card holders were dispensed at least 2.5 times more inhaled corticosteroids or long-acting beta agonists than general beneficiaries. It seems most likely that this higher rate of use by concessional beneficiaries is attributable to greater affordability, because concession card holders pay a much lower copayment than general patients.

Getting a valid estimate of the number of Australians holding concession cards presented several difficulties. All methods to quantify the number of concession card holders in Australia are limited by the constantly changing nature of peoples' concession card status (for example, due to changing employment or pension status). Data from the 2001 NHS was used to estimate the total number of people with government health concession cards as the population denominator for the analyses of short-acting beta agonist and oral corticosteroid use. As this information was not available for all age groups, analyses of the population distribution of asthma medication use among concession card holders were restricted to those aged 15 years and over. Data from the NHS was also used to estimate the number of people in Australia with asthma or COPD. Although these data are based on self-report, they indicate that the higher rate of use of inhaled corticosteroids among concession card holders is not attributable to a higher prevalence of asthma and COPD in this population.

Short-acting beta agonists and oral corticosteroids

Among concession card holders, the use of short-acting beta agonists and oral corticosteroids was also higher for older people. The need to limit these analyses to concession card holders meant it was not possible to judge the impact of socioeconomic status, as concession card holders already represent a more socioeconomically disadvantaged subgroup. Therefore, it is not possible to draw conclusions about short-acting beta agonist and oral corticosteroid use by socioeconomic status. Studies elsewhere have explored this. In Canada, Lynd and colleagues (2004) found that higher short-acting beta agonist use was associated with greater levels of socioeconomic disadvantage even when controlling for level of asthma severity.

Unlike the observations made of inhaled corticosteroids and long-acting beta agonists, no link was found between remoteness of residence and use of short-acting beta agonists and oral corticosteroids. This could be due to limiting the populations to concession card holders who might be more highly represented in regional and remote localities. Further study will be necessary to investigate this relationship.

3 Individual use of asthma medications

Key points

- Inhaled corticosteroid and long-acting beta agonist users were dispensed, on average, one-quarter of a standard daily dose during the study period. This probably indicates irregular use of these drugs.
- Similarly, people who used short-acting beta agonists or oral corticosteroids also took, on average, around a quarter of the standard daily dose. This may indicate better use, as these drugs should only be used as needed and are not usually recommended for regular use.
- Of the people who used short-acting beta agonists, 14% were dispensed, on average, more than the standard dose per day over the entire study period. This represents very high use and may distinguish individuals with poorly controlled disease.

3.1 Introduction

Current international (GINA 2006) and Australian (NAC 2006) guidelines give recommendations for best practice in the management of asthma. This chapter describes the rates of asthma medication use by individuals during the study period. These rates of use are then compared with asthma management guidelines to assess whether the patterns observed in these data are consistent with current recommendations for asthma care.

3.2 Methods

The calculations in this chapter used the number of DDDs dispensed per record as calculated in Equation 2.1 of the previous chapter. In each medication class the DDDs dispensed in records with the same PIN were summed to get the total number of DDDs dispensed to each person. Therefore:

Equation 3.1

$$\textit{DDDs dispensed to each person} = \textit{sum of DDDs in each PIN}$$

As in previous analyses, formulations that combined medications from more than one class were counted separately as contributing to both medication classes.

The average daily use of each medication class per person was then calculated as follows:

Equation 3.2

$$DDD/person/day = \frac{DDDs\ dispensed\ to\ each\ person}{d}$$

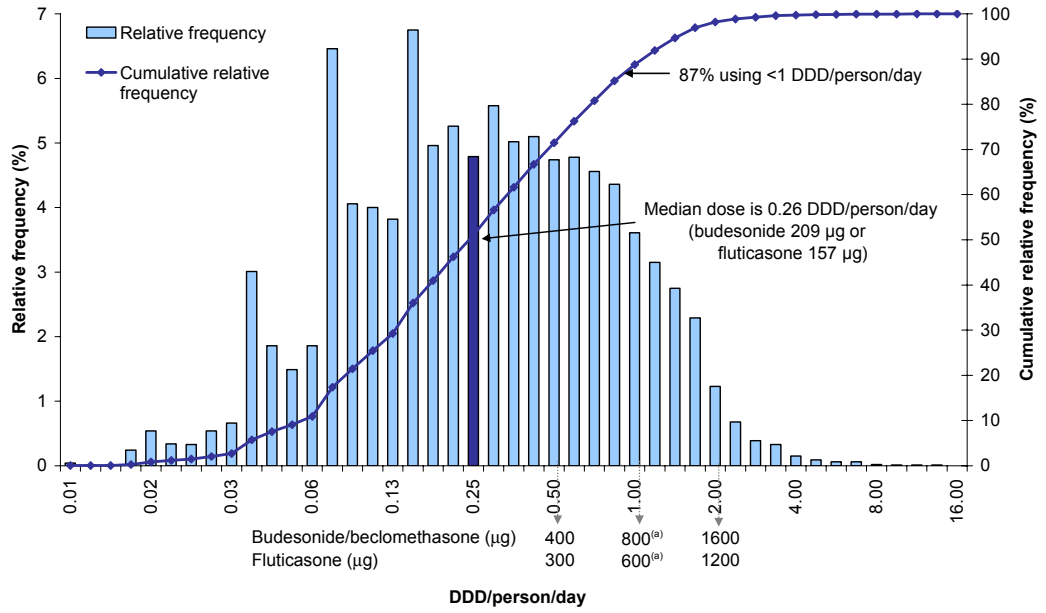
where d is the number of days from the time each person was first dispensed a medication in that class to 30 June 2004 (the end of the period of observation).

For each medication class the frequency distribution of DDD/person/day, median DDD/person/day and the proportion of those whose average daily use was greater than or equal to one DDD/person/day was examined.

3.3 Results

Figures 3.1 to 3.8 show the relative and cumulative frequency distribution of average daily use of each class of asthma medication among those who had at least one prescription for that class dispensed.

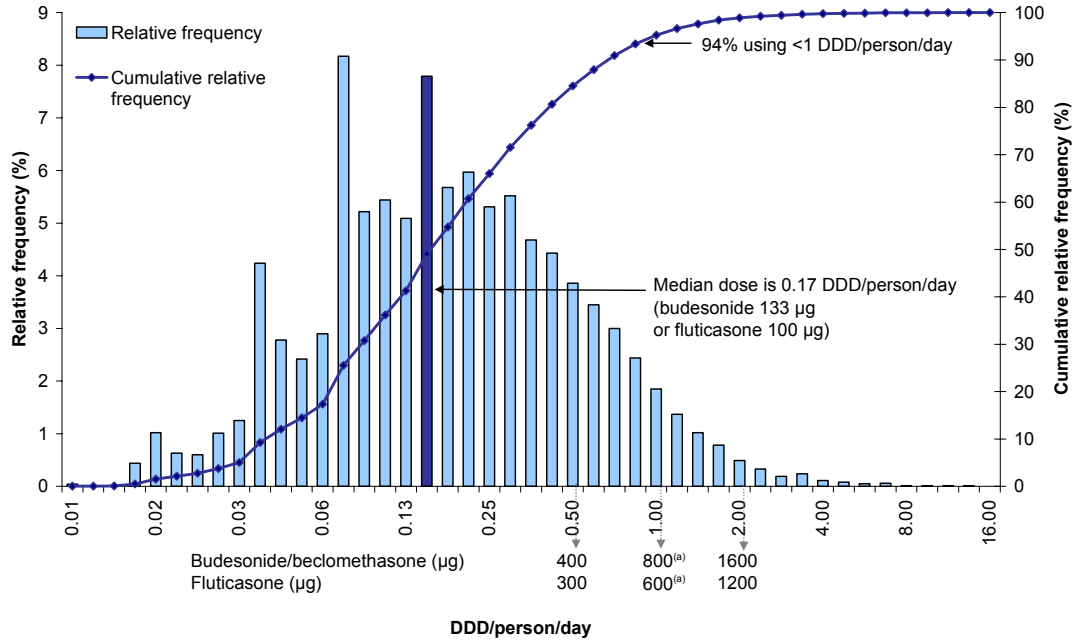
One DDD of inhaled corticosteroid is equivalent to budesonide 800 µg, beclomethasone 800 µg or fluticasone 600 µg. People who used inhaled corticosteroids had a median use of 0.26 DDD/person/day and approximately 13% used an average of one or more DDD/person/day (Figure 3.1). Among people aged 5 to 34 years, the median use was 0.17 DDD/person/day and approximately 6% used one or more DDD/person/day (Figure 3.2).



(a) Examples of inhaled corticosteroid medication doses corresponding to 1 DDD/person/day.

Source: PBS 2002–2004.

Figure 3.1: Average daily use of inhaled corticosteroids, alone or in combination, all ages, Australia, 2002–03 to 2003–04

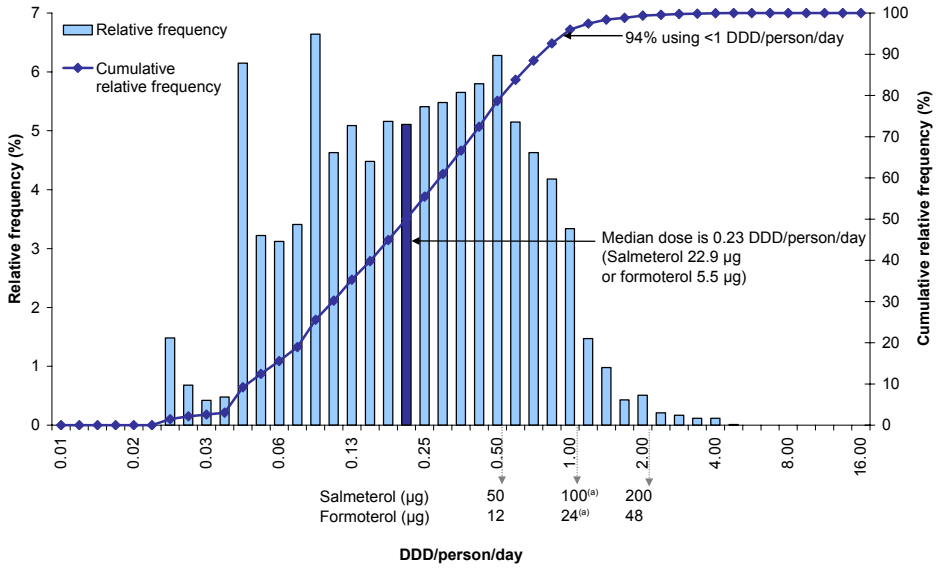


(a) Examples of inhaled corticosteroid medication doses corresponding to 1 DDD/person/day.

Source: PBS 2002–2004.

Figure 3.2: Average daily use of inhaled corticosteroids, alone or in combination, persons aged 5 to 34 years, Australia, 2002–03 to 2003–04

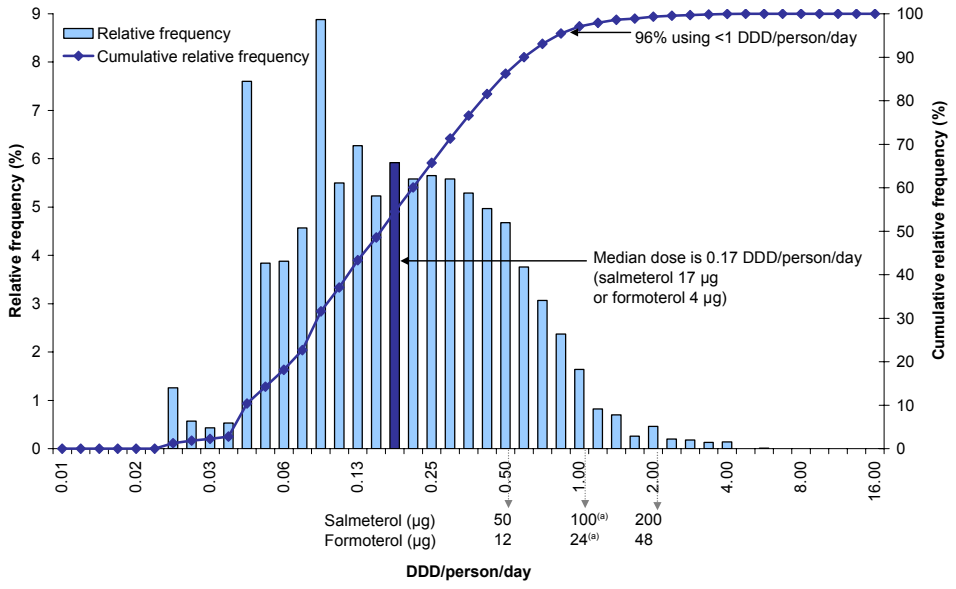
People who were using long-acting beta agonists had a median use of 0.23 DDD/person/day, with 6% using one or more DDD/person/day (equivalent to salmeterol 100 µg or (e)formoterol 24 µg per day) (Figure 3.3). Among people aged 5 to 34 years, the median use was 0.17 DDD/person/day and approximately 4% used one or more DDD/person/day (Figure 3.4).



(a) Examples of long-acting beta agonist medication doses corresponding to 1 DDD/person/day.

Source: PBS 2002–2004.

Figure 3.3: Average daily use of long-acting beta agonists, alone or in combination, all ages, Australia, 2002–03 to 2003–04

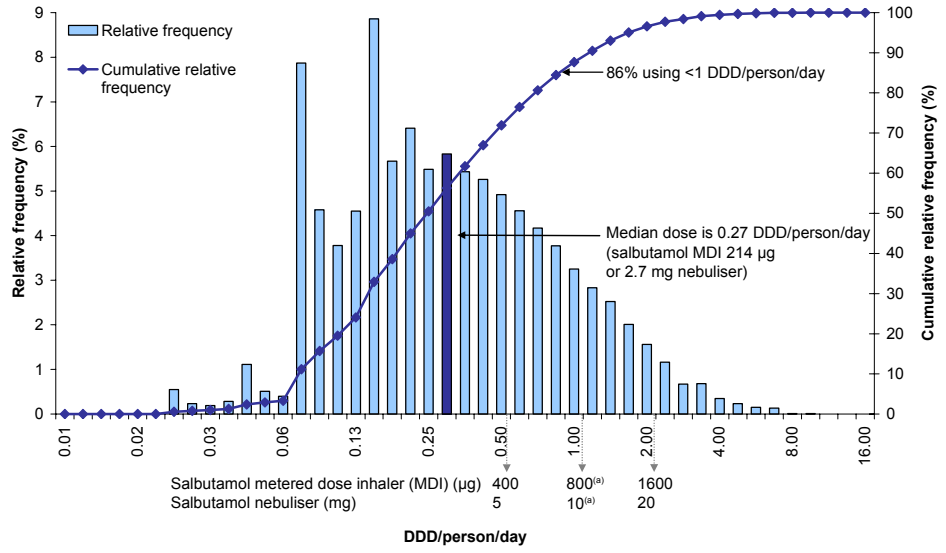


(a) Examples of long-acting beta agonist medication doses corresponding to 1 DDD/person/day.

Source: PBS 2002–2004.

Figure 3.4: Average daily use of long-acting beta agonists, alone or in combination, persons aged 5 to 34 years, Australia, 2002–03 to 2003–04

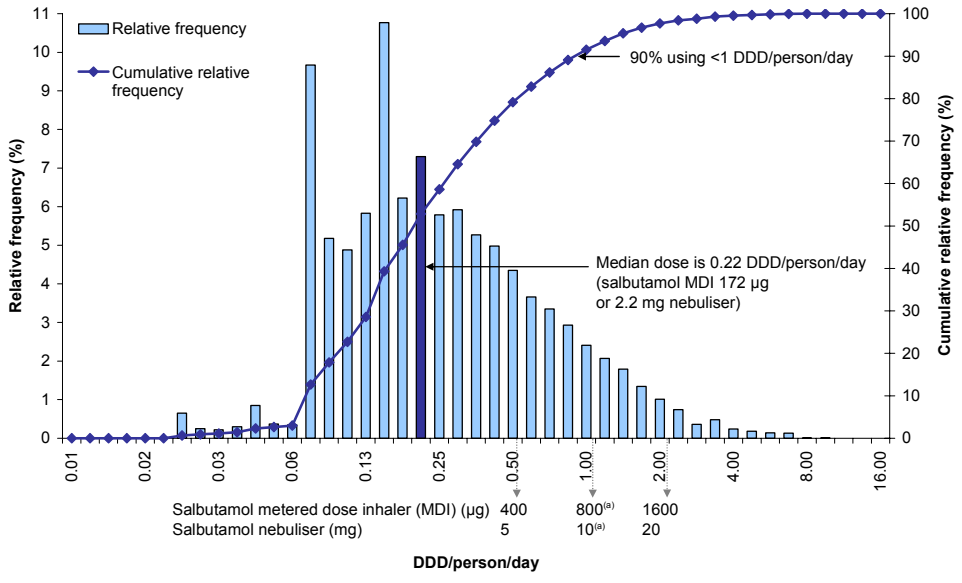
One DDD of short-acting beta agonists is equivalent to salbutamol 800 µg by metered dose inhaler or salbutamol 10 mg by nebuliser. The overall median use of short-acting beta agonists dispensed to concession card holders was 0.27 DDD/person/day and 14% used one or more DDD/person/day (Figure 3.5). Those who were aged 5 to 34 years had a median use of 0.22 DDD/person/day and 10% used one or more DDD/person/day (Figure 3.6).



(a) Examples of short-acting beta agonist medication doses corresponding to 1 DDD/person/day.

Source: PBS 2002–2004.

Figure 3.5: Average daily use of short-acting beta agonists, concessional patients, all ages, Australia, 2002–03 to 2003–04



(a) Examples of short-acting beta agonist medication doses corresponding to 1 DDD/person/day.

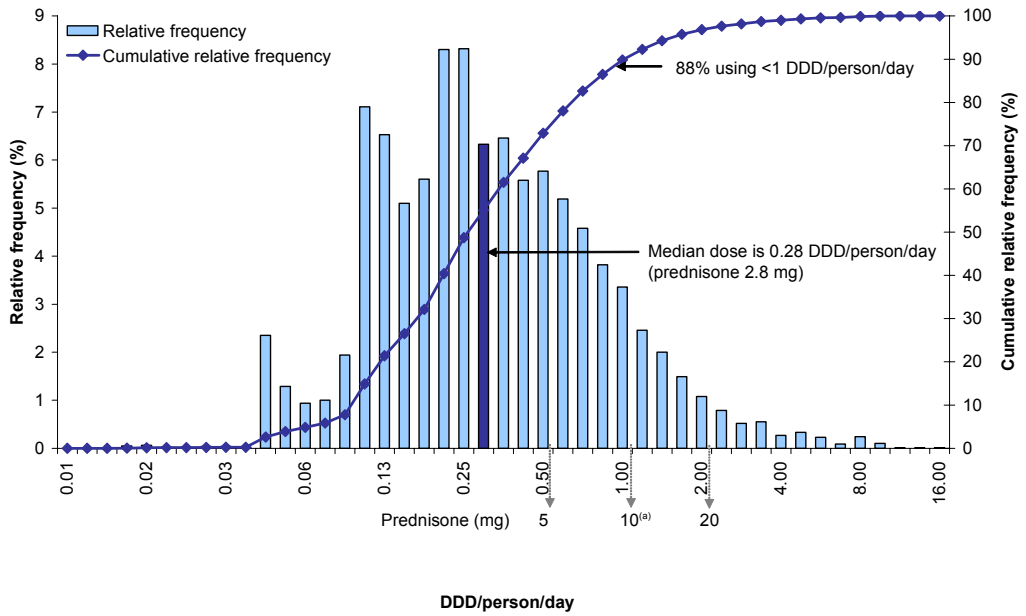
Source: PBS 2002–2004.

Figure 3.6: Average daily use of short-acting beta agonists, concessional patients, aged 5 to 34 years, Australia, 2002–03 to 2003–04

Short-acting beta agonists can be divided into those administered by metered dose inhaler or dry powder inhaler and those administered by nebuliser. The median use of short-acting beta agonists administered by nebuliser was 0.13 DDD/person/day and 9% were using one or more DDD/person/day. Among those aged 5 to 34 years, the median use was 0.08 DDD/person/day and 2% used one or more DDD/person/day (data not shown).

The median use of short-acting beta agonists administered by metered dose inhaler or dry powder inhaler was 0.28 DDD/person/day and 13% were using one or more DDD/person/day (data not shown). This was similar to the overall median daily doses for short-acting beta agonists. Among those aged 5 to 34 years, the median use of short-acting beta agonists administered by metered dose inhaler or dry powder inhaler was 0.22 DDD/person/day and 10% used one or more DDD/person/day (data not shown).

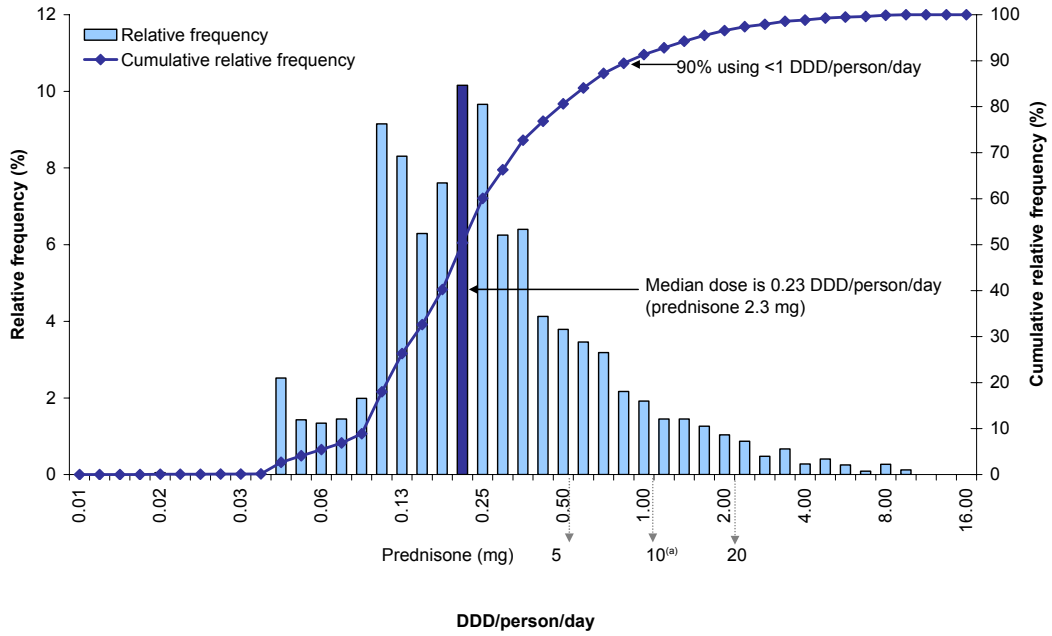
One DDD of oral corticosteroids is equivalent to prednisone 10 mg. The median use of oral corticosteroids dispensed to concession card holders who had also been dispensed other asthma medications was 0.28 DDD/person/day and 12% used one or more DDD/person/day (Figure 3.7). Among those aged 5 to 34 years, median use was 0.23 DDD/person/day and 10% used one or more DDD/person/day (Figure 3.8).



(a) Dose of prednisone corresponding to 1 DDD/person/day.

Source: PBS 2002–2004.

Figure 3.7: Average daily use of oral corticosteroids, concessional patients who had also been dispensed other respiratory medications, all ages, Australia, 2002–03 to 2003–04



(a) Dose of prednisone corresponding to 1 DDD/person/day.

Source: PBS 2002–2004.

Figure 3.8: Average daily use of oral corticosteroids, concessional patients who had also been dispensed other respiratory medication, aged 5 to 34 years, Australia, 2002–03 to 2003–04

Table 3.1: Summary of use of asthma medication classes by people who had at least one prescription for a medication class, by age group, Australia, 2002–03 to 2003–04

Age group (years)	Measures	Inhaled corticosteroids	Long-acting beta agonists	Short-acting beta agonists[a]	Oral corticosteroids[a, b]
	Examples of 1 DDD unit	*Fluticasone 600 μg Budesonide 800 μg*	*Salmeterol 100 μg (e)formoterol 24 μg*	*Salbutamol: MDI 0.8 mg Nebuliser 10 mg*	*Prednisone 10 mg*
0 to 4	Number of persons	39,953	15,292	62,367	289
	Median use (DDD/person/day)	0.08	0.21	0.16	0.16
	Proportion with DDD/person/day ≥ 1	2.2%	5.3%	8.7%	9.7%
5 to 14	Number of persons	205,727	110,247	173,837	13,388
	Median use (DDD/person/day)	0.11	0.18	0.20	0.22
	Proportion with DDD/person/day ≥ 1	2.5%	3.7%	7.2%	9.8 %
15 to 34	Number of persons	370,915	229,563	231,307	39,031
	Median use (DDD/person/day)	0.21	0.16	0.23	0.23
	Proportion with DDD/person/day ≥ 1	7.5%	3.8%	12%	9.7%
35 to 64	Number of persons	614,958	404,799	330,942	93,580
	Median use (DDD/person/day)	0.30	0.23	0.30	0.28
	Proportion with DDD/person/day ≥ 1	14%	5.4%	16%	13%
65 and over	Number of persons	393,107	278,325	429,209	163,517
	Median use (DDD/person/day)	0.47	0.35	0.33	0.31
	Proportion with DDD/person/day ≥ 1	23%	8.4%	17%	12%
All persons	**Number of persons[c]**	**1,625,414**	**1,038,747**	**1,228,463**	**309,997**
	Median use (DDD/person/day)	**0.26**	**0.23**	**0.27**	**0.28**
	Interquartile range	**0.11, 0.62**	**0.10, 0.49**	**0.14, 0.61**	**0.15, 0.58**
	Proportion with DDD/person/day ≥ 1	**13%**	**5.6%**	**14%**	**12%**

(a) Short-acting beta-agonists and oral corticosteroids limited to prescriptions that were dispensed when the patients were concession card holders.

(b) Oral corticosteroids are only those dispensed to individuals who had also been dispensed other respiratory medications.

(c) Overall number may be slightly greater than the sum of the subgroups as a small proportion of records were missing demographic data (see Table 2.1) and does not exclude individuals whose first date of supply was after 23 June 2004 or records of items where a person had filled more than 96 prescriptions for the item in a single medication class.

The median use of all four drug classes was approximately 0.25 DDD/person/day. Use was less in younger individuals and increased with age. The proportion of people taking more than one DDD per day was 12–14% for inhaled corticosteroids, short-acting beta agonists and oral corticosteroids, and 6% for long-acting beta agonists (Table 3.1).

Use tended to be lower among younger people and increased with age for all drug classes. Up until age 35 years, the proportion of people taking more than one DDD per day was highest for oral corticosteroids, and after this age it was highest for inhaled corticosteroids.

Concession card holders who were dispensed inhaled corticosteroids and long-acting beta-agonists used more of these medications (median use 0.36 and 0.27 DDD/person/day respectively) than general beneficiaries (median use 0.26 and 0.20 DDD/person/day respectively) (data not shown).

3.4 Discussion

Most individuals who were dispensed medications for asthma did not use one DDD every day. In fact, on average, individuals used approximately one-quarter of the total amount of medication that would be consistent with one DDD every day. From this analysis it cannot be ascertained whether the lower use was attributable to regular use at less than one DDD per day, or irregular use of a full DDD, or a combination of both of these.

Inhaled corticosteroids and long-acting beta agonists

The low use observed in this study is of most concern in relation to those medications that are intended to be used on a regular basis to control the disease, in particular, inhaled corticosteroids. There is general consensus that patients with moderate to severe persistent asthma should be using inhaled corticosteroids on a regular basis. The best way to use inhaled corticosteroids when persistent asthma is only mild remains a subject of some controversy. However, current asthma management guidelines still recommend the regular use of inhaled corticosteroids in all patients with persistent asthma (NAC 2006). The role of inhaled corticosteroids in the control of intermittent asthma is not established. There is little evidence to support the use of inhaled corticosteroids on an irregular basis and existing guidelines do not recommend this mode of use.

One explanation for these findings is that these medications may be prescribed by doctors at doses that are lower than the defined daily doses. This may be the case in children, for whom recommended doses are lower than adult doses. It may also apply to people who are prescribed inhaled corticosteroids combined with long-acting beta agonists. While intentional prescription of lower doses may contribute to the low use observed in those who were prescribed this class of medication, it is unlikely to fully account for it. Another explanation is that many people who are prescribed inhaled corticosteroids do not use them regularly. Similar findings have been reported elsewhere (Janson et al. 2005; Poluzzi et al. 2002). Possible reasons for this include:

- under-use of asthma medications in the community, linked to barriers such as cost and poor education
- tendency to only use or prescribe medications when ill (such as when experiencing a viral respiratory infection) or when more vulnerable (such as during the winter months)
- management of intermittent asthma, which is very common among children, and may often be managed by irregular use of inhaled corticosteroids
- sporadic use and/or prescription for indications other than asthma.

Short-acting beta agonists

Other drug categories, including oral corticosteroids and short-acting beta agonists, should not usually be taken regularly for long periods to treat asthma. Therefore, the observation that those who had prescriptions for these medications used appreciably less than one DDD per day is consistent with correct use of these medications for asthma. Indeed, use of one or more DDD of short-acting beta agonists per day over a prolonged follow-up period probably distinguishes individuals who have poorly controlled asthma (Anis et al. 2001). Among people of all ages who took short-acting beta agonists, 14% were taking one or more DDD per day, and among people aged 5 to 34 years, 10% took one or more DDD per day. Data on people who took short-acting beta agonists via nebulisers were separately analysed. A lower proportion of people aged 5 to 34 years used one or more DDD per day of nebulised short-acting beta agonists (2%), and among all ages this proportion was 9%. This method of delivery is typically used during episodes of more severe asthma symptoms. However, some individuals, in particular older patients, use nebulisers regularly, even during periods of good control.

Generally, high rates of use of short-acting beta agonists are an indicator of poor asthma control. Campaigns that focus on the subgroup of people with asthma who are high users of short-acting beta agonists may lead to gains in a range of asthma outcomes.

Oral corticosteroids

Like short-acting beta agonists, oral corticosteroids are mainly used by people with asthma during disease exacerbations or periods of poor disease control. Among those who had used oral corticosteroids (along with other asthma medications), 12% were dispensed more than one DDD (equivalent to > 10 mg prednisone) per day during the follow-up period (Figure 3.7).

It is difficult to assess the appropriateness of this pattern of use of oral corticosteroids. However, a key aim of effective asthma management is to promote the episodic use of oral steroids for exacerbations that do not respond to simpler approaches but to try to avoid the harmful effects that arise from long-term, regular use of oral corticosteroids. More detailed knowledge of how oral corticosteroids are used by patients with asthma would help in planning interventions in this area.

4 Inhaled corticosteroid potency

Key points

- Asthma can be well controlled in most people by using relatively low potency inhaled corticosteroids. This is especially the case when they are used with long-acting beta agonists.
- The majority of inhaled corticosteroids were prescribed in the most potent formulations.
- Children used less potent inhaled corticosteroids than adults.
- In the whole population, females used less potent inhaled corticosteroids than males. However, among people aged 5 to 34 years, females used more potent inhaled corticosteroids than males.
- In the whole population, individuals living in the most disadvantaged localities used more potent inhaled corticosteroids than those in more advantaged localities. However, among people aged 5 to 34 years, this was reversed.

4.1 Introduction

Recent clinical trials have shown that asthma can be well controlled in most people with relatively low doses of inhaled corticosteroids, reducing the risk of harmful side effects (Powell & Gibson 2003). This is especially the case when they are used in combination with long-acting beta agonists (Greening et al. 1994). Use of less potent formulations, with reduced risk of side effects, may enhance the acceptability of regular inhaled corticosteroid use. However, previous reviews of medications used in Australia have suggested that most inhaled corticosteroids are supplied in the most potent available formulations (ACAM 2005). This chapter describes the number of prescriptions and potency of inhaled corticosteroids dispensed to individuals, and the effect of demographic characteristics on the potency of inhaled corticosteroids.

4.2 Methods

Inhaled corticosteroid medication–dose combinations were categorised into three levels of potency (Table 4.1). The number of prescriptions dispensed for inhaled corticosteroids was summed for each individual in each potency level. The distribution of prescriptions for inhaled corticosteroids dispensed to individuals was then examined for each potency level. The relationship between potency levels and demographic factors was evaluated using a logistic regression model. Polychotomous logistic regression was used to estimate the effects of age group, sex, SEIFA quintiles and ASGC categories of remoteness on the three inhaled corticosteroid potency levels (UCLA Academic Technology Services 2006). Results were expressed as odds ratios for a single-step increase in potency level.

Table 4.1: Potency level categories of inhaled corticosteroids

Potency level	Inhaled corticosteroids
Level 1 (least potent)	Flixotide/Seretide AH 100, MDI 50
	Pulmicort TH/MDI 100
	Symbicort 200
	Qvar 50
	BDP (CFC) 100
Level 2	Flixotide/Seretide AH 250, MDI 125
	Pulmicort TH/MDI 200
	Symbicort 400
	Qvar 100
	BDP (CFC) 250
Level 3 (most potent)	Flixotide/Seretide AH 500, MDI 250
	Pulmicort TH 400

4.3 Results

Most individuals only had one prescription for inhaled corticosteroids, regardless of the potency of the medication prescribed (Figure 4.1). Overall, most prescriptions for inhaled corticosteroids were for the most potent formulations of this class of medications. However, people aged 5 to 34 years were more likely to have prescriptions in the middle potency category (Figure 4.2).

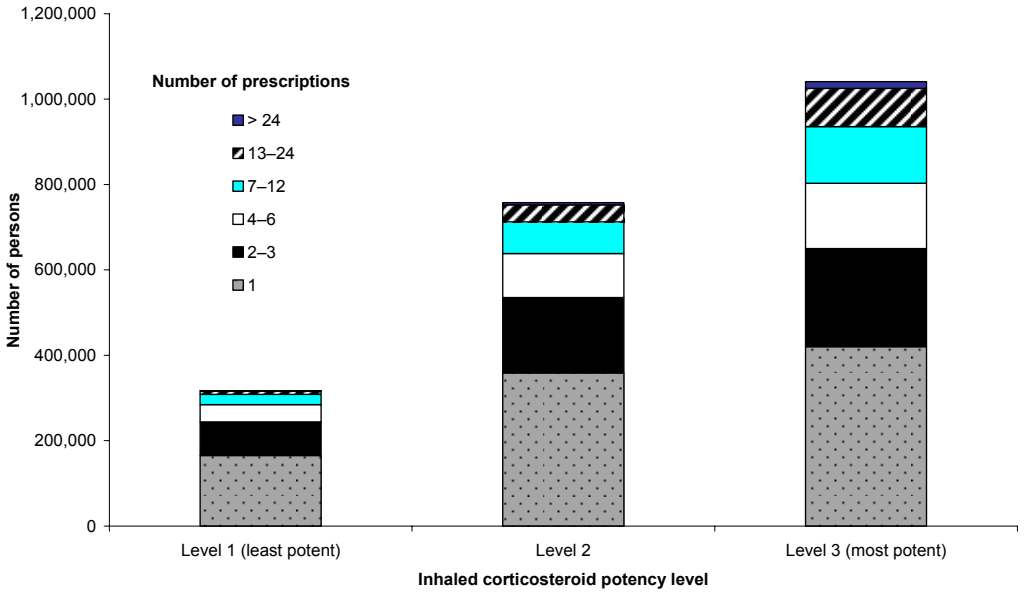


Figure 4.1: Number of prescriptions for inhaled corticosteroids, by potency class, all persons, Australia, 2002–03 to 2003–04

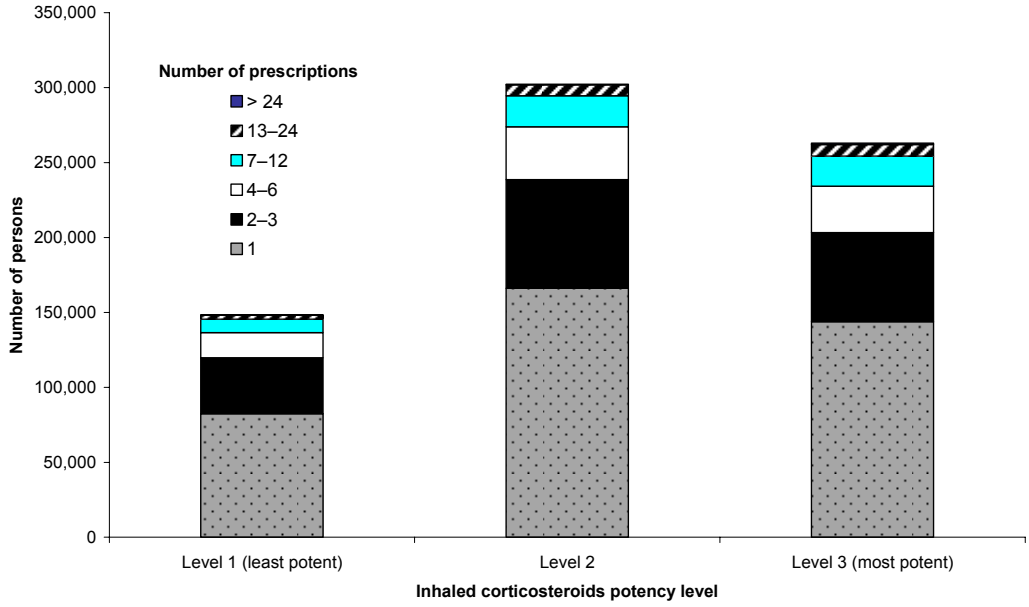


Figure 4.2: Number of prescriptions for inhaled corticosteroids, by potency class, age 5 to 34 years, Australia, 2002–03 to 2003–04

The distribution of potency of inhaled corticosteroids prescribed did not differ greatly by sex, socioeconomic status or remoteness of residence (Table 4.2). Similar distributions in these characteristics were observed among those aged 5 to 34 years (Table 4.3). However, substantial differences between age groups were observed (Figure 4.3). Children were usually given the least potent form of inhaled corticosteroids. From age 15 years onwards, the majority were given the most potent inhaled corticosteroids.

Table 4.2: Number of prescriptions for inhaled corticosteroids by potency[(a)] and demographic variables, all persons, Australia, 2002–03 to 2003–04

Demographic variables	Level 1: least potent (%)	Level 2 (%)	Level 3: most potent (%)	Total
Age group (years)				
0 to 4	63,509 (63.7)	33,129 (33.2)	3,083 (3.09)	99,721
5 to 14	268,487 (40.8)	317,935 (48.3)	72,374 (11.0)	658,796
15 to 34	110,124 (8.39)	506,811 (38.6)	695,438 (53.0)	1,312,373
35 to 64	223,516 (6.77)	992,302 (30.1)	2,086,573 (63.2)	3,302,391
65 and over	230,320 (7.22)	912,111 (28.6)	2,045,644 (64.2)	3,188,075
Sex				
Male	443,503 (11.2)	1,231,977 (31.1)	2,281,290 (57.7)	3,956,770
Female	452,703 (9.83)	1,531,231 (33.2)	2,623,725 (56.9)	4,607,659
Socioeconomic status				
SEIFA 1 (most disadvantaged)	196,639 (10.9)	546,800 (30.4)	1,054,288 (58.6)	1,797,727
SEIFA 2	145,265 (10.5)	437,492 (31.7)	799,405 (57.8)	1,382,162
SEIFA 3	167,629 (10.5)	509,278 (32.0)	915,428 (57.5)	1,592,335
SEIFA 4	196,250 (10.3)	619,068 (32.3)	1,086,650 (57.1)	1,901,968
SEIFA 5 (most advantaged)	184,280 (10.1)	627,676 (34.4)	1,013,270 (55.5)	1,825,226
Remoteness category (ASGC)				
Major cities	594,676 (10.5)	1,808,874 (31.9)	3,266,093 (57.6)	5,669,643
Inner regional	199,845 (10.5)	624,008 (32.8)	1,077,606 (56.7)	1,901,459
Outer regional	89,150 (10.5)	282,860 (33.2)	480,173 (56.4)	852,183
Remote / Very remote	12,437 (8.80)	47,382 (33.5)	81,511 (57.7)	141,330
All persons[(b)]	**905,219 (10.4)**	**2,799,792 (32.3)**	**4,968,435 (57.28)**	**8,673,446**

(a) Level 1 (least potent): includes Flixotide/Seretide AH 100, MDI 50; Pulmicort TH/MDI 100; Symbicort 200; Qvar 50; BDP(CFC) 100.
Level 2: includes Flixotide/Seretide AH 250, MDI 125; Pulmicort TH/MDI 200; Symbicort 400; Qvar 100; BDP(CFC) 250.
Level 3 (most potent): includes Flixotide/Seretide AH 500, MDI 250; Pulmicort TH 400.

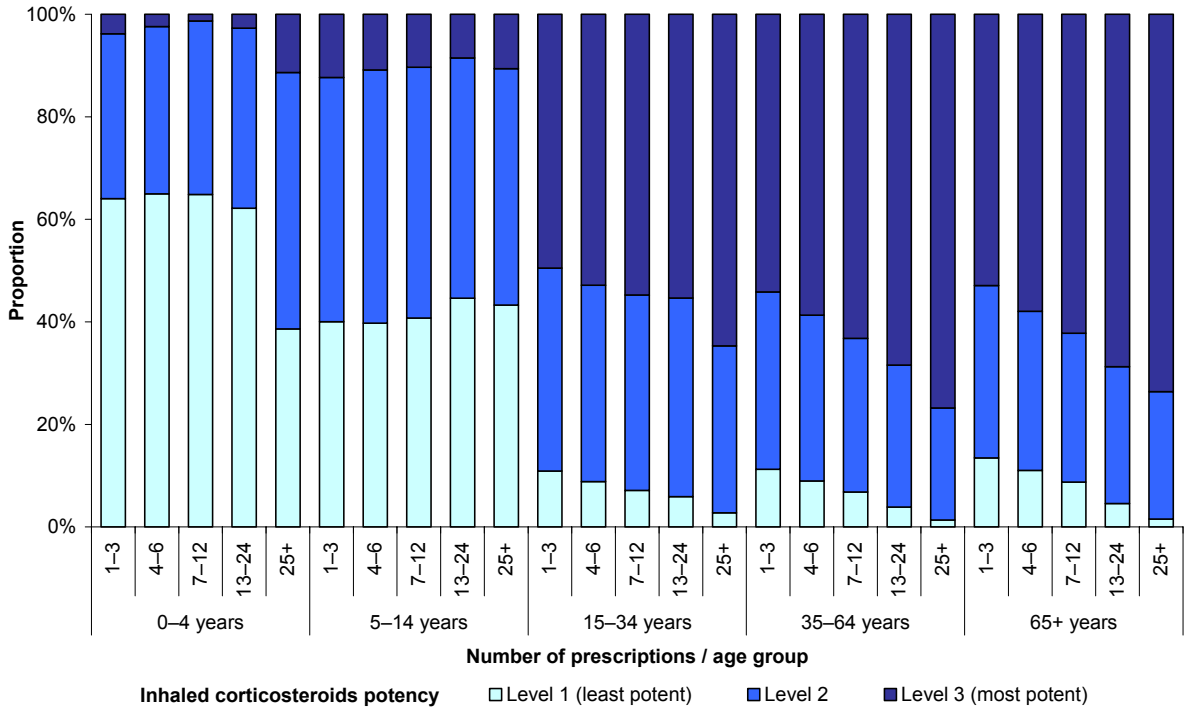
(b) Overall number may be slightly greater than the sum of the subgroups as a small proportion of records were missing demographic data (see Table 2.1) and does not exclude individuals whose first date of supply was after 23 June 2004 or records of items where a person had filled more than 96 prescriptions for the item in a single medication class.

Table 4.3: Number of prescriptions for inhaled corticosteroids by potency[a] and demographic variables, age 5 to 34 years, Australia, 2002–03 to 2003–04

Demographic variables	Level 1: least potent (%)	Level 2 (%)	Level 3: most potent (%)	Total
Age group (years)				
5 to 14	268,487 (40.8)	317,935 (48.3)	72,374 (11.0)	658,796
15 to 34	110,124 (8.4)	506,811 (38.6)	695,438 (53.0)	1,312,373
Sex				
Male	212,356 (21.1)	424,045 (42.2)	369,553 (36.7)	1,005,954
Female	166,255 (17.2)	400,701 (41.5)	398,259 (41.3)	965,215
Socioeconomic status				
SEIFA 1 (most disadvantaged)	85,603 (22.0)	154,687 (39.8)	148,623 (38.2)	388,913
SEIFA 2	60,393 (20.8)	120,681 (41.5)	109,770 (37.7)	290,844
SEIFA 3	72,623 (19.8)	151,400 (41.3)	142,500 (38.9)	366,523
SEIFA 4	84,227 (18.5)	191,943 (42.2)	178,664 (39.3)	454,834
SEIFA 5 (most advantaged)	73,260 (16.1)	198,969 (43.8)	182,295 (40.1)	454,524
Remoteness category (ASGC)				
Major cities	250,616 (18.4)	563,610 (41.3)	549,616 (40.3)	1,363,842
Inner regional	82,886 (21.0)	169,336 (42.8)	143,386 (36.2)	395,608
Outer regional	38,969 (21.8)	77,206 (43.2)	62,485 (35.0)	178,660
Remote / Very remote	6,107 (18.6)	14,455 (44.1)	12,210 (37.3)	32,772
All persons aged 5 to 34 years[b]	**378,611 (19.2)**	**824,746 (41.8)**	**767,812 (39.0)**	**1,971,169**

(a) Level 1 (least potent): includes Flixotide/Seretide AH 100, MDI 50; Pulmicort TH/MDI 100; Symbicort 200; Qvar 50; BDP(CFC) 100.
Level 2: includes Flixotide/Seretide AH 250, MDI 125; Pulmicort TH/MDI 200; Symbicort 400; Qvar 100; BDP(CFC) 250.
Level 3 (most potent): includes Flixotide/Seretide AH 500, MDI 250; Pulmicort TH 400.

(b) Overall number may be slightly greater than the sum of the subgroups as a small proportion of records were missing demographic data (see Table 2.1) and does not exclude individuals whose first date of supply was after 23 June 2004 or records of items where a person had filled more than 96 prescriptions for the item in a single medication class.



Note: Level 1 (least potent): includes Flixotide/Seretide AH 100, MDI 50; Pulmicort TH/MDI 100; Symbicort 200; Qvar 50; BDP(CFC) 100. Level 2: includes Flixotide/Seretide AH 250, MDI 125; Pulmicort TH/MDI 200; Symbicort 400; Qvar 100; BDP(CFC) 250. Level 3 (most potent): includes Flixotide/Seretide AH 500, MDI 250; Pulmicort TH 400.

Figure 4.3: Proportion of people using inhaled corticosteroids, by age group, number of prescriptions and potency level, all persons, Australia, 2002–03 to 2003–04

The difference between children and adults in the potency of inhaled corticosteroids dispensed was independent of differences in other demographic characteristics (Table 4.4). The multivariate analysis demonstrated that, in the population as a whole, females used less potent inhaled corticosteroids than males, while individuals living in the most disadvantaged localities used more potent inhaled corticosteroids than those living in the most advantaged localities.

Among people aged 5 to 34 years, females used more potent inhaled corticosteroids than males (Table 4.4). In contrast to the findings in the population as a whole, those aged 5 to 34 years who were living in more disadvantaged areas used less potent inhaled corticosteroids.

Table 4.4: Effect[a] of demographic factors on the potency of inhaled corticosteroids used, Australia, 2002–03 to 2003–04

	All ages		Age 5 to 34 years	
Demographic characteristics	**Unadjusted OR (95% CI)[a]**	**Adjusted[b] OR (95% CI)[a]**	**Unadjusted OR (95% CI)[a]**	**Adjusted[b] OR (95% CI)[a]**
Age group (years)				
0 to 4	0.74 (0.73–0.75)	0.41 (0.41–0.42)	—	—
5 to 14 (reference category)	1.00	1.00	—	—
15 to 34	7.12 (7.07–7.15)	7.40 (7.36–7.44)	—	—
35 to 64	10.57 (10.51–10.63)	11.07 (11.01–11.13)	—	—
65 and over	10.91 (10.85–10.97)	11.33 (11.27–11.39)	—	—
Sex				
Male (reference category)	1.00	1.00	1.00	1.00
Female	1.00 (1.00–1.00)	0.86 (0.86–0.86)	1.24 (1.23–1.24)	1.23 (1.23–1.24)
Socioeconomic status				
SEIFA 1 (most disadvantaged)	1.10 (1.10–1.10)	1.17 (1.16–1.17)	0.84 (0.84–0.85)	0.89 (0.89–0.89)
SEIFA 2	1.08 (1.07–1.08)	1.13 (1.13–1.14)	0.86 (0.85–0.87)	0.92 (0.91–0.93)
SEIFA 3	1.06 (1.06–1.07)	1.13 (1.12–1.13)	0.90 (0.90–0.91)	0.96 (0.95–0.97)
SEIFA 4	1.05 (1.05–1.06)	1.09 (1.09–1.10)	0.94 (0.93–0.94)	0.97 (0.96–0.97)
SEIFA 5 (most advantaged) (reference category)	1.00	1.00	1.00	1.00
Remoteness category (ASGC)				
Major cities (reference category)	1.00	1.00	1.00	1.00
Inner regional	0.97 (0.97–0.97)	0.90 (0.90–0.91)	0.86 (0.85–0.86)	0.87 (0.87–0.88)
Outer regional	0.96 (0.96–0.97)	0.89 (0.89–0.90)	0.81 (0.80–0.81)	0.83 (0.82–0.84)
Remote	1.05 (1.04–1.06)	1.02 (1.01–1.04)	0.93 (0.91–0.96)	0.95 (0.93–0.98)
Very remote	0.96 (0.94–0.98)	0.90 (0.88–0.92)	0.96 (0.92–1.00)	0.99 (0.94–1.03)

(a) Measured as odds ratios (OR) for a one-step change in potency level with 95% confidence intervals (95% CI).

(b) Adjusted analysis presents the results for each variable after adjusting for the effects of other variables.

4.4 Discussion

This analysis confirmed that most adults were prescribed inhaled corticosteroids in the most potent form. Given the evidence that less potent formulations are effective in gaining good disease control in most people with asthma (Powell & Gibson 2003), it is unlikely that this dosage level was needed for all those who were receiving it. Since 2003, most inhaled corticosteroids have been combined with long-acting beta agonists (ACAM 2005). This should allow less potent inhaled corticosteroids to be used.

Despite the common use of potent inhaled corticosteroids, many people did not seem to use these drugs regularly. Most people only had one to three prescriptions during the study period. This is likely to include people who would benefit from using inhaled corticosteroids regularly.

Older people and those living in areas of greater socioeconomic disadvantage used more potent inhaled corticosteroids. This trend across age groups may reflect the use of inhaled corticosteroids to treat COPD rather than asthma, although there is no evidence to suggest that people with COPD need higher doses of inhaled corticosteroids than people with asthma.

The relatively low use of high potency inhaled corticosteroids in children reflects greater caution among doctors, and probably many parents, in using them in this age group.

Those who were living in very remote areas used less potent forms of inhaled corticosteroids than those in metropolitan areas.

There were important differences in the findings among people aged 5 to 34 years, in whom most inhaled corticosteroids would be used to treat asthma. Notably, people who lived in areas of greater socioeconomic disadvantage used less potent inhaled corticosteroids, and females were dispensed more potent formulations than males. Although the differences are small, the implication is that, in this age group, women and girls have more severe asthma, or are likely to be prescribed more intensive treatment, than men and boys with asthma.

5 Relationship between asthma medication classes

Key points

- Individuals who were dispensed more prescriptions for inhaled corticosteroids were also more likely to be dispensed more prescriptions for other classes of asthma medication.
- Among concession card holders who had used inhaled corticosteroids, 72% had one or more prescriptions for short-acting beta agonists and 26% were also prescribed oral corticosteroids.
- Approximately 62% of people who were prescribed inhaled corticosteroids were also prescribed long-acting beta agonists.
- Only 3.3% of individuals who were dispensed long-acting beta agonists were not dispensed any inhaled corticosteroids during the study period.

5.1 Introduction

The ability to identify prescriptions that were dispensed to the same individuals in the PBS data presents an opportunity to study the relationship between the use of different asthma medications by the same person. The use of two or more asthma medications by the same person may give valuable insights into the patterns of asthma medication use. In particular, inhaled corticosteroids are used to control persistent asthma and if underused may result in poorly controlled asthma with higher use of short-acting beta agonists and oral corticosteroids (Anis et al. 2001; Suissa et al. 2002). Furthermore, the combination of long-acting beta agonists with inhaled corticosteroids would ideally lead to reduced amounts of inhaled corticosteroids without requiring greater amounts of short-acting beta agonists and oral corticosteroids.

In this chapter, the use of short-acting beta agonists, oral corticosteroids and long-acting beta agonists was assessed in relation to use of inhaled corticosteroids.

5.2 Methods

Analysis of the use of short-acting beta agonists and oral corticosteroids with inhaled corticosteroids was limited to the subgroup of people in whom data on all medication classes were available (that is, concession card holders). However, the analysis of long-acting beta agonists with inhaled corticosteroids included data for all patient beneficiary categories. The number of prescriptions dispensed in each medication class to each individual were summed and the following were then calculated:

- the proportion of people taking short-acting beta agonists, oral corticosteroids or long-acting beta agonists who also used inhaled corticosteroids

- the number of prescriptions dispensed for short-acting beta agonists, oral corticosteroids or long-acting beta agonists in relation to the number of prescriptions dispensed for inhaled corticosteroids.

5.3 Results

Nearly 30% of concession card holders who had been dispensed inhaled corticosteroids did not have a record of short-acting beta agonists dispensed through the PBS (Figure 5.1). Most people who had not been prescribed inhaled corticosteroids had been dispensed three or fewer prescriptions for short-acting beta agonists. However, 8% had been dispensed seven or more prescriptions for short-acting beta agonists. In general, individuals who had more prescriptions dispensed for inhaled corticosteroids were more likely to also have more prescriptions dispensed for short-acting beta agonists (Figure 5.1).

Similar patterns were observed when the analysis was limited to people aged 5 to 34 years (Figure 5.2), except that there was less use of short-acting beta agonists for each level of inhaled corticosteroid use.

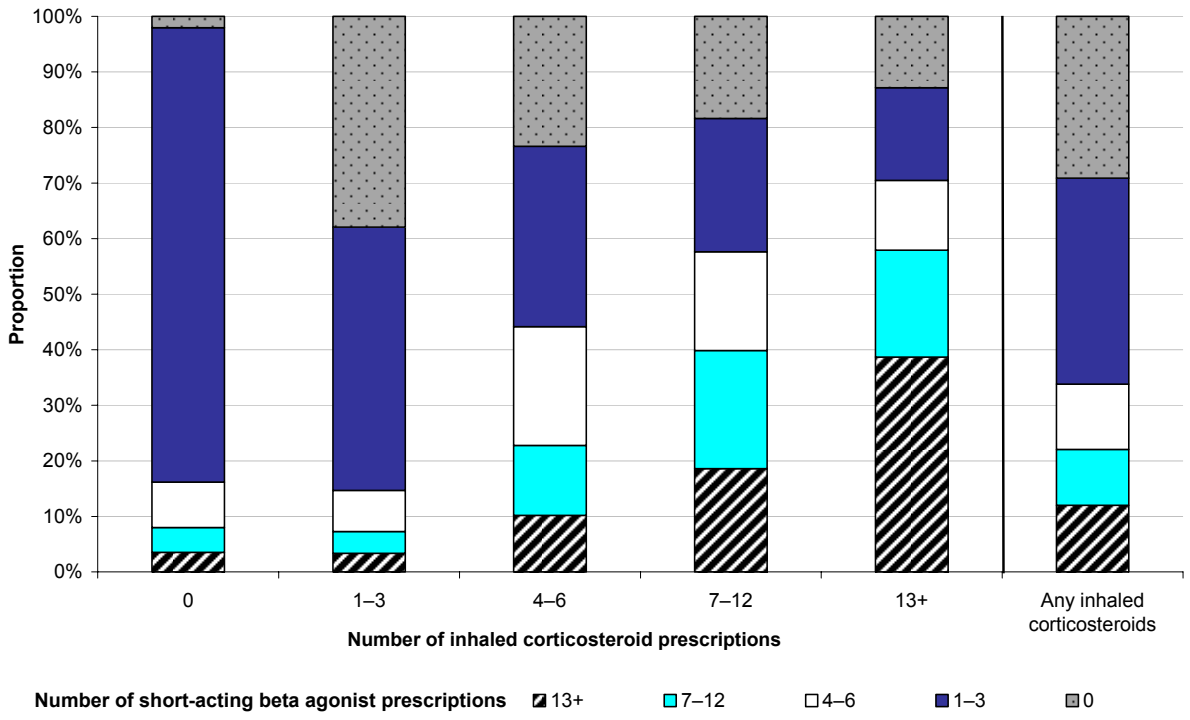


Figure 5.1: Proportion of concessional patients using any inhaled corticosteroids and/or short-acting beta agonists, by number of prescriptions, Australia, 2002–03 to 2003–04

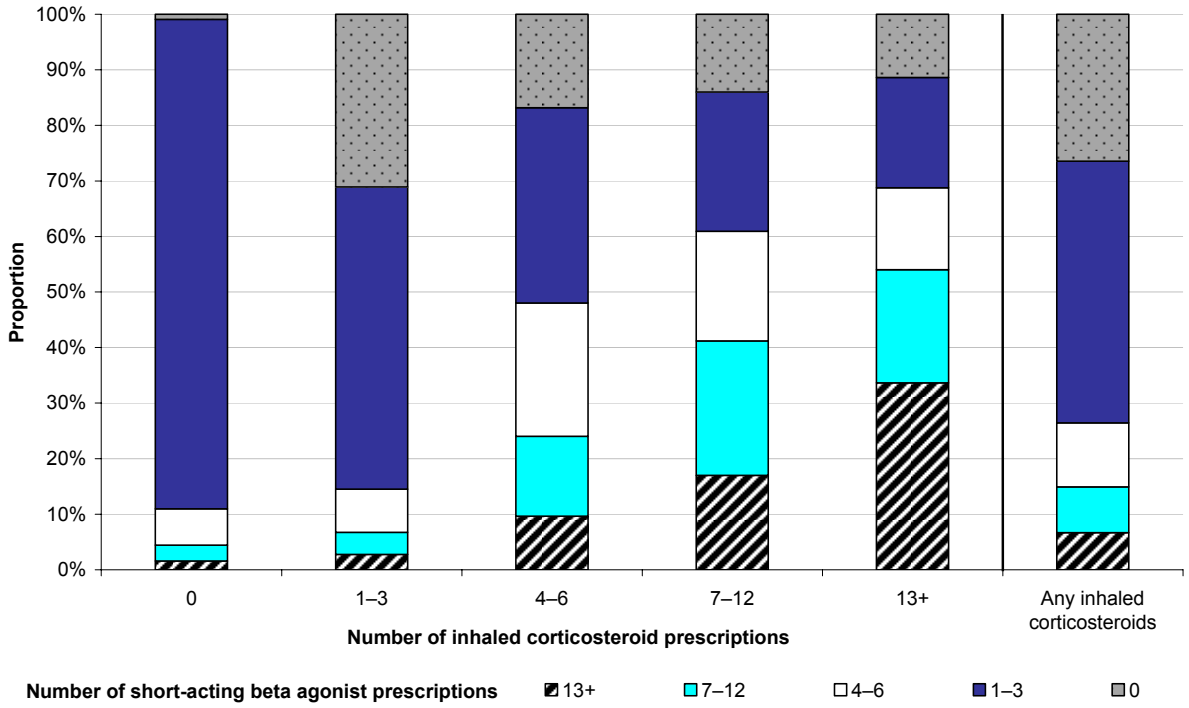


Figure 5.2: Proportion of concessional patients aged 5 to 34 years who were using inhaled corticosteroids and/or short-acting beta agonists, by number of prescriptions, Australia, 2002–03 to 2003–04

Among all concessional patients who had a prescription dispensed for short-acting beta agonists, long-acting beta agonists and/or inhaled corticosteroids during the study period, 20% also had at least one prescription for oral corticosteroids over the same period. Overall, 26% of concession card holders who had used any inhaled corticosteroids had one or more prescriptions dispensed for oral corticosteroids (Figure 5.3). The proportion of these individuals who had received oral corticosteroids and the number of prescriptions for oral corticosteroids rose with increasing use of inhaled corticosteroids (Figure 5.3). A smaller proportion of people aged 5 to 34 years who had used respiratory medications had a prescription dispensed for oral corticosteroids during the study period. The trend for increasing use of oral corticosteroids with increasing use of inhaled corticosteroids was also observed in this age group (Figure 5.4).

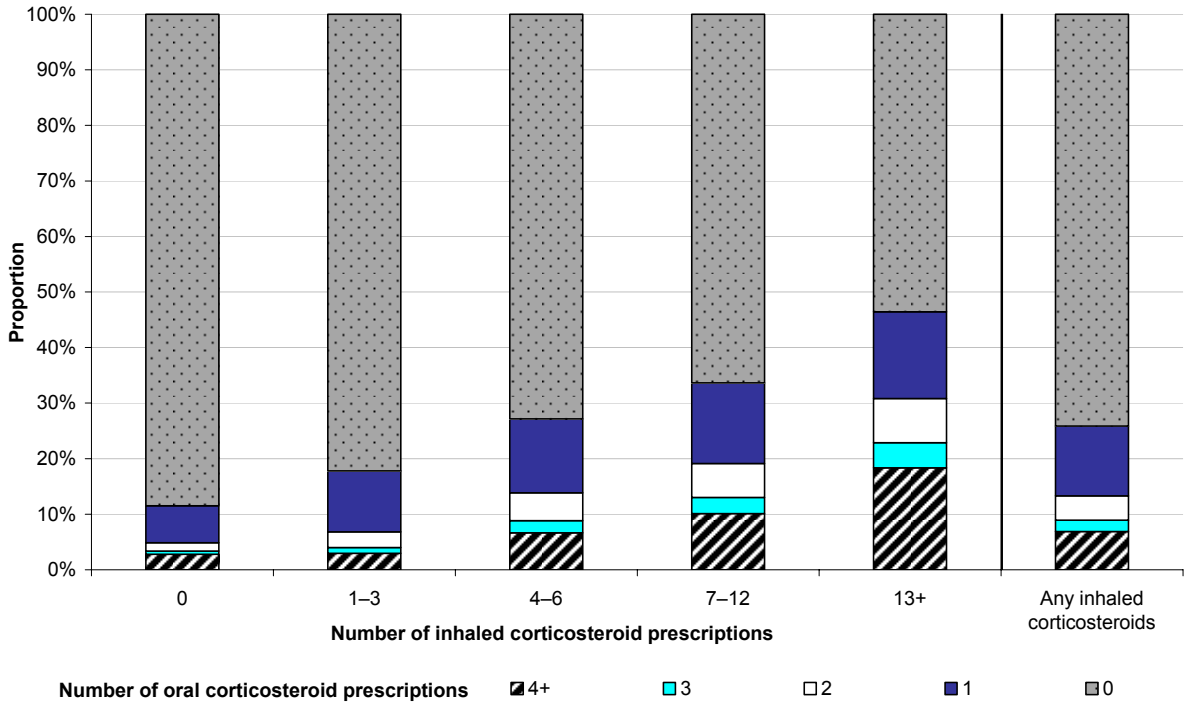


Figure 5.3: Proportion of concessional patients using any inhaled corticosteroids and/or oral corticosteroids, by number of prescriptions, Australia, 2002–03 to 2003–04

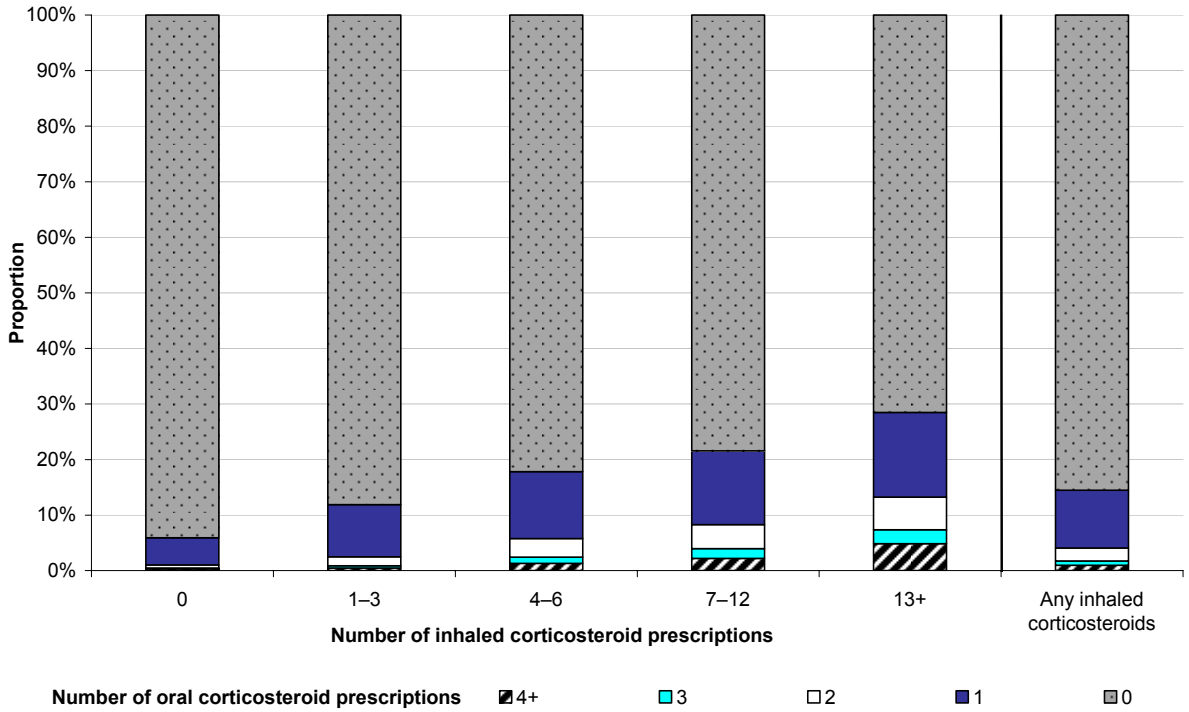


Figure 5.4: Proportion of concessional patients aged 5 to 34 years who were using any inhaled corticosteroids and/or oral corticosteroids, by number of prescriptions, Australia, 2002–03 to 2003–04

Approximately 62% of individuals who had a prescription dispensed for inhaled corticosteroids had at least one prescription for long-acting beta agonists. This included 6.8% of users of inhaled corticosteroids who had one or more prescriptions for long-acting beta agonists in a non-combined formulation and 58.9% who had one or more prescriptions for long-acting beta agonists in a combined formulation (that is, combined with inhaled corticosteroids) (data not shown). Among 5 to 34 year olds, these proportions were 59.6% overall, with 3.7% using non-combined and 57.6% using combined formulations respectively (data not shown).

Only 5% of individuals who were not using any inhaled corticosteroids used long-acting beta agonists. As the number of inhaled corticosteroid prescriptions increased, the number of long-acting beta agonist prescriptions also increased (Figure 5.5). Among people who used any long-acting beta agonists, 3.3% were not dispensed any inhaled corticosteroids during the study period (data not shown). A similar pattern was observed among people aged 5 to 34 years (Figure 5.6).

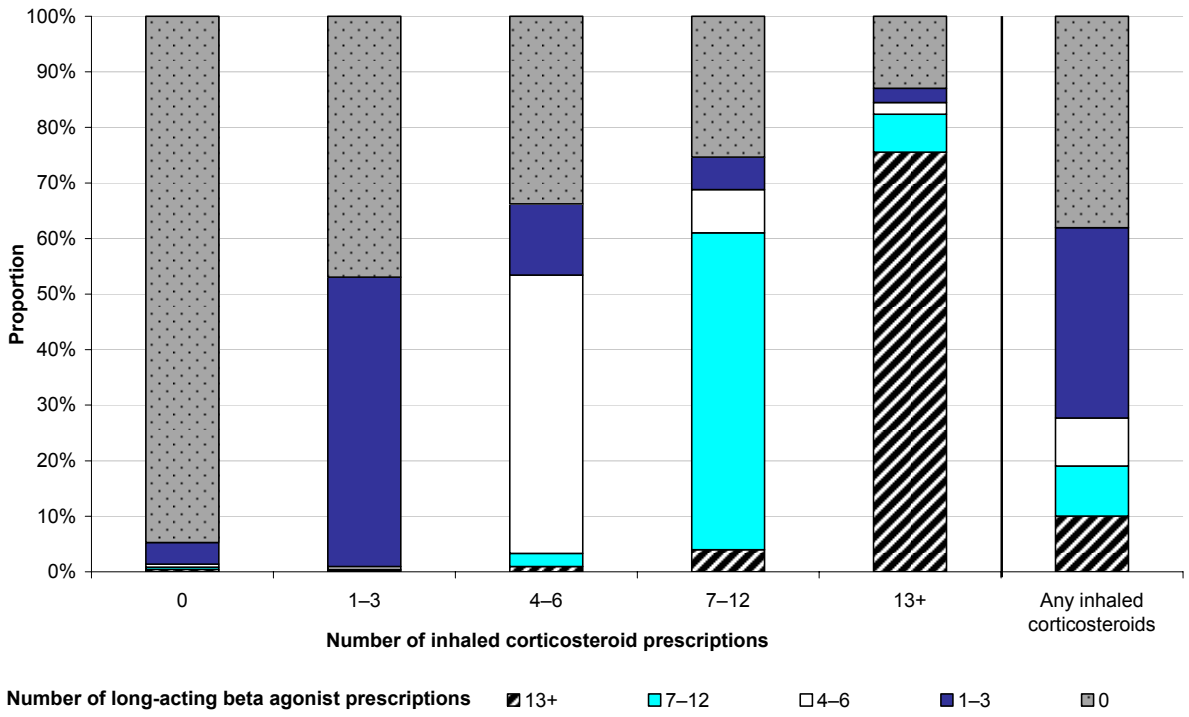


Figure 5.5: Proportion of patients using any inhaled corticosteroids and/or any long-acting beta agonists, by number of prescriptions, 2002–03 to 2003–04

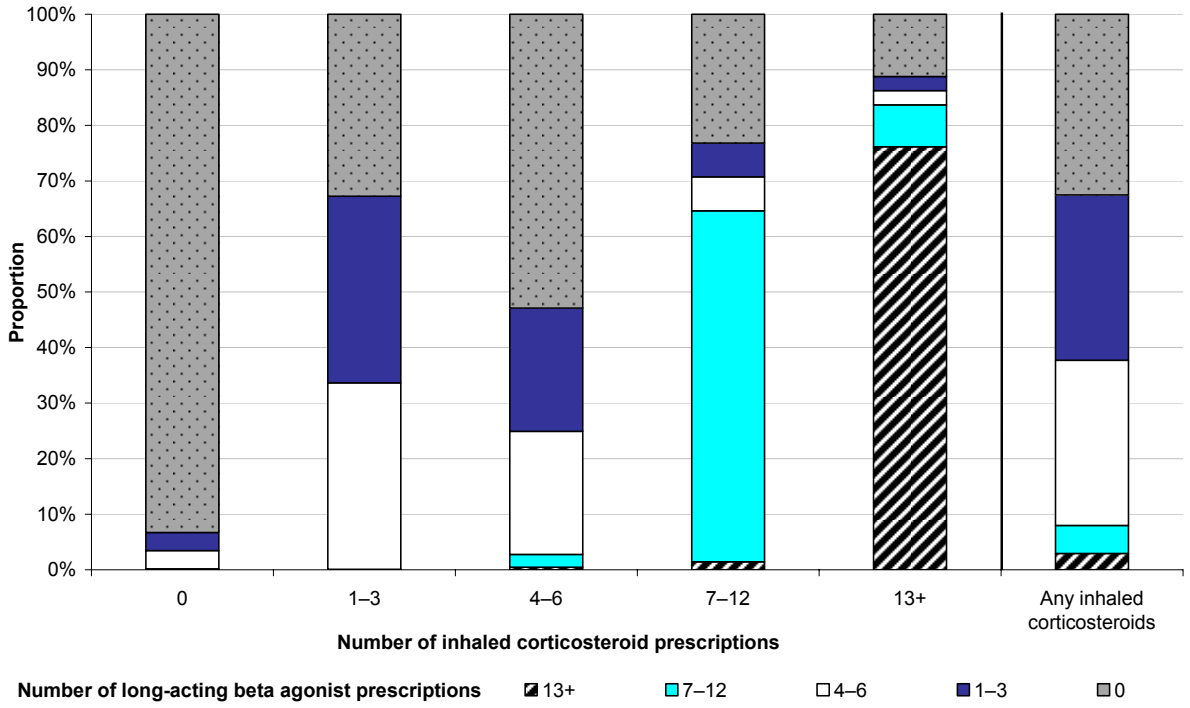


Figure 5.6: Proportion of patients aged 5 to 34 years using any inhaled corticosteroids and/or any long-acting beta agonists, by number of prescriptions, Australia, 2002–03 to 2003–04

5.4 Discussion

Individuals who had more prescriptions dispensed for inhaled corticosteroids were more likely to also have more prescriptions dispensed for short-acting beta agonists and oral corticosteroids. Interpretation of these findings is not straightforward. On the one hand, people with more severe asthma are more likely to require higher amounts of all medications and so this finding may simply reflect disease severity. On the other hand, correct use of inhaled corticosteroids should ideally control asthma symptoms in most individuals. If the disease is well controlled by regular use of inhaled corticosteroids, then the use of short-acting beta agonists and oral corticosteroids should reduce.

Around 30% of concession card holders who had been prescribed inhaled corticosteroids had not been subsidised for any short-acting beta agonist prescriptions. This may reflect a group of individuals who had well-controlled asthma, not requiring any 'reliever' medications. However, it is likely that some of these people purchased short-acting beta agonist inhalers over the counter, even though, as concession card holders, they were entitled to receive this medication at a cheaper price on prescription.

More inhaled corticosteroids were also associated with greater use of long-acting beta agonists. This probably reflects the dominant use of combination therapy that has been observed in recent years (ACAM 2005).

Further studies are needed to explore the relationships and effects of different asthma medications taken by the same individual.

6 Conclusions

Key points

- Many people for whom asthma management guidelines would recommend using inhaled corticosteroids are not using them regularly. At the same time, most inhaled corticosteroids that are dispensed to adults are in the strongest formulation, which may add to the risk of harmful side effects.
- People with concession cards use inhaled corticosteroids and long-acting beta agonists at more than twice the rate of general patients. This may reflect the impact of the large subsidy available to concession card holders and that the sixfold greater costs to general patients may be a barrier to the use of inhaled corticosteroids.
- The PBS database was designed for administrative purposes. Adapting the PBS database for use as an epidemiological data source requires consideration of the limitations of administrative data.
- Future studies could be enhanced through linkage of the PBS with other clinical data such as hospitalisations and mortality.
- The principles applied to the PBS data in this study could prove useful for investigations of medication use for other conditions and diseases.

6.1 Summary and implications of findings

This study represents the first time that data from the PBS have been used to describe the patterns of asthma medication use by individuals. The purpose of this study was to examine the effect of demographic characteristics on the use of asthma medications; quantify the frequency of use of these medications by individuals; investigate the potency of inhaled corticosteroids used in Australia; and explore the relationship between the use of inhaled corticosteroids and other respiratory medications.

Barriers to use of inhaled corticosteroids

Use of inhaled corticosteroids and long-acting beta agonists was higher among people living in more socioeconomically disadvantaged localities. Concession card holders also represent a more socioeconomically disadvantaged subgroup of the population. Consistent with the finding in socioeconomically disadvantaged localities, rates of dispensing of inhaled corticosteroids and long-acting beta agonists among concession card holders were over double that of general beneficiaries. Although only 35% of the population are concession card holders, 56% of people dispensed inhaled corticosteroids were concession card holders. Average daily use of inhaled corticosteroids and long-acting beta agonists was much higher among people who were concession card holders than among those who did not have concession cards. These observations may be explained by a price barrier that exists for general patients. The cost of inhaled corticosteroids to general beneficiaries is at least six

times more than the cost to concession card holders. The evidence suggests that this is an important barrier to best practice in asthma care.

Lower use of inhaled corticosteroids and long-acting beta agonists was also identified in remote areas compared to major cities. However, the reported prevalence of asthma is similar in these localities (ACAM 2005). In order to improve the management of respiratory disease in rural and remote locations it may be of value to focus on access issues in non-metropolitan locations.

Low average rates of medication use

The finding that, on average, individuals taking asthma medications took approximately a quarter of the World Health Organization's defined daily dose (DDD) per day throughout the study period has different implications in each of the drug classes. For short-acting beta agonists and oral corticosteroids this is a reassuring finding because these drugs should only be used as required.

On the other hand, inhaled corticosteroids and long-acting beta agonists are recommended for regular use by people with persistent asthma. The low rates of use of these drugs, measured as both DDDs per day and number of prescriptions dispensed, indicate that most people who take these medications used them intermittently. While more than 10 out of` every 100 people in Australia have asthma (ACAM 2005), only 2.6 daily doses per 100 people were dispensed per day. This implies that only a minority of people with asthma use this class of medications regularly.

Use of high potency inhaled corticosteroids

A further concern about the use of inhaled corticosteroids is that most adults are dispensed the most potent formulations of this class of medications, despite evidence that lower doses are effective, with fewer side effects, especially when used with long-acting beta agonists. This pattern of sporadic use of high potency inhaled corticosteroids is consistent with observations using other data sources (ACAM 2005). It suggests that use of inhaled corticosteroids for asthma is suboptimal in Australia.

The lower rates of use of potent inhaled corticosteroids in children are reassuring and reflect the general caution about use of this class of medication in children.

High rates of multiple asthma medication use

Generally, higher rates of use of inhaled corticosteroids were associated with higher rates of dispensing of short-acting beta agonists, oral corticosteroids and long-acting beta agonists. This implies that inhaled corticosteroids are used more regularly by people with more severe or less well controlled asthma. However, these data are limited in being able to investigate this thoroughly as, apart from the amount of short-acting beta agonist and oral corticosteroids dispensed, there are no other indicators of asthma severity or control. The absence of an observable reduction in short-acting beta agonist and oral corticosteroid use with higher amounts of inhaled corticosteroids further raises the concern that use of inhaled corticosteroids is suboptimal.

6.2 Limitations

The purpose of the PBS database is to support the data custodians in the Department of Health and Ageing in the administration of the PBS. However, in this study, the PBS data was used for a rather different purpose, that is, to acquire epidemiological information about the use of asthma medications in Australia. As the PBS data set was not designed for this purpose, there were a number of limitations and complexities that had to be addressed in the analyses.

Lack of clinical information

A chief constraint in this study is that PBS data on prescriptions dispensed cannot be linked to any clinical data about the person to whom the medications were dispensed. Many of the medications used to manage asthma can be used to treat other acute and long-term respiratory illnesses, especially COPD among older people and wheezy bronchitis. This limitation was addressed by carrying out further analyses among people aged 5 to 34 years in whom it is most likely that these medications were used to treat asthma. This is a major advance on previous analyses of population-wide asthma medication data in Australia where age groups have not been available. Patterns among people aged 5 to 34 years were often similar to those observed for all ages. However, there were some key differences, such as the lower use of inhaled corticosteroids among people aged 5 to 34 years. Among older age groups, which made up the largest proportion of the users, many would have been prescribed their medications for COPD.

A central issue in determining the appropriateness of asthma medication is the underlying severity of asthma or the level of asthma control at the time medications were dispensed. In the absence of clinical data, these cannot be directly assessed. Frequency of dispensing of short-acting beta agonists was used as a proxy indicator of asthma control. However, these data were only available for concessional patients and may not be complete even in that population.

Seasonal variation

Another limitation of this study is that the primary unit of measurement is the number of prescriptions dispensed, not medications consumed. While it seems plausible that most prescriptions that are dispensed will largely correlate with the amount of medication consumed, it is possible that there will be a difference in these two parameters, for example, when people either do not take their medications or 'stockpile' medications. There is some case for the latter by the striking seasonal variation in medication use on the PBS, in which higher rates of purchase of all drugs occurs at the end of each calendar year (data not shown). This is when the number of people on the safety net is greatest and suggests that reaching the safety net acts as an incentive to boost medication purchase once the out-of-pocket price drops. By contrast, hospitalisation and emergency department data suggest that illness due to asthma is more common in the early part of the year among children and during the early winter months among adults (ACAM 2005). Therefore, it was not possible to reliably investigate seasonal variation in asthma medication use in these data.

Interestingly, this seasonal pattern in medication purchase further supports the finding that out-of-pocket cost is an important barrier to regular medication use.

Copayment issues

A particular difficulty with these data is the copayment rates in different subgroups of the population. In this study, the authors were only able to investigate short-acting beta agonists and oral corticosteroids that were dispensed to concession card holders. This is because the retail cost of these medications is lower than the copayment rate for general (non-concessional) beneficiaries. Short-acting beta agonists are available without prescription ('over the counter') and this is a convenient method of purchasing this class of medications, which many patients take advantage of. For general patients, there is no price disincentive to purchasing short-acting beta agonists over the counter, and it is assumed that most do purchase them in this manner. However, the finding that 30% of concessional beneficiaries who were dispensed inhaled corticosteroids had not been dispensed any short-acting beta agonists through the PBS implies that, despite the price disincentive, some concession card holders do purchase short-acting beta agonists over the counter. The convenience of quickly purchasing medication over the counter rather than waiting to see a doctor for a prescription may, in some instances, outweigh the modest extra cost, particularly if such purchases are infrequent.

Data quality

As the PBS system is used in the administration of the Australian Government subsidy for pharmaceutical products, there is considerable investment in ensuring these data are of high quality. However, the presence of 'dummy' PINs and a small number of PINS with implausibly large numbers of prescriptions (defined as a person receiving > 96 prescriptions for one drug in 2 years) indicate likely inaccuracies in these data. This may reflect limitations in the linkage of prescription data to demographic data using PINs generated from the Medicare numbers. For instance, data entry errors could potentially lead to unusual results for a small number of PINs. While PINs ensure patient anonymity, retracing and verifying the accuracy of records and subsequent linkage becomes very difficult. Further research is needed to validate the accuracy of the creation of PINS and linkage.

6.3 Possible future uses of PBS data

The inclusion of demographic information in the PBS database opens the opportunity for future studies to investigate the outcomes of medication treatments. For instance, it is feasible to conduct ecological studies that investigate the trends in medication supply and asthma hospitalisations and mortality within different demographic profiles.

Greater linkage between data sources may enhance this by enabling future studies linking outcomes such as mortality, hospitalisations and visits to emergency departments to prescription data. Such studies will be valuable for understanding the effectiveness of asthma management strategies and the ongoing monitoring of respiratory health in Australia.

The methods used in this study to investigate asthma could also be applied to the use of PBS data to investigate medication use in other diseases. Table 6.1 summarises a number of principles from the current study that can be adopted for this purpose. Such studies will provide some important insights into how well the current use of drugs compares with best practice for the disease in question.

Table 6.1: Principles of analysis of PBS data as applied to asthma

Principle	Application in the study of asthma medication classes
Determine the prescription history of an individual?	Link records pertaining to the same person using the patient identification number (PIN).
Group related drugs together into medication classes?	Use defined daily dose (DDD) as a common currency and add DDDs across members of the same class, as defined by the Anatomical Therapeutic Classification.
Are the medication classes specific to (i.e. exclusively used for) the disease or condition?	All asthma medication classes were also used for COPD in older age groups. Most specific to asthma among age 5–34 years, therefore conduct subsidiary analyses in this age group.
	Oral corticosteroids are used for many other conditions; therefore improve specificity by excluding individuals who did not use any asthma medication classes other than oral corticosteroids.
Is the medication class subsidised by the PBS?	All prescriptions of inhaled corticosteroids and long-acting beta agonists were subsidised and included in analysis.
	Prescriptions of short-acting beta agonists and oral corticosteroids were subsidised to concession card holders only, therefore restrict analysis of these medication classes to these patients.
Were there administrative issues that may affect epidemiological analysis?	Dummy PINS were used during data entry when Medicare numbers were unavailable. Identify and remove 'dummy' PINs from data set.
	If an individual's demographic characteristics change over time, use the values associated with the earliest record for that individual.
Is the apparent prescription rate realistic?	In each medication class, exclude individuals who averaged more than four prescriptions per month of one drug over the study.
Is the estimate of average dose realistic?	In each medication class, exclude individuals who were first dispensed a prescription in the last 7 days of the study period.

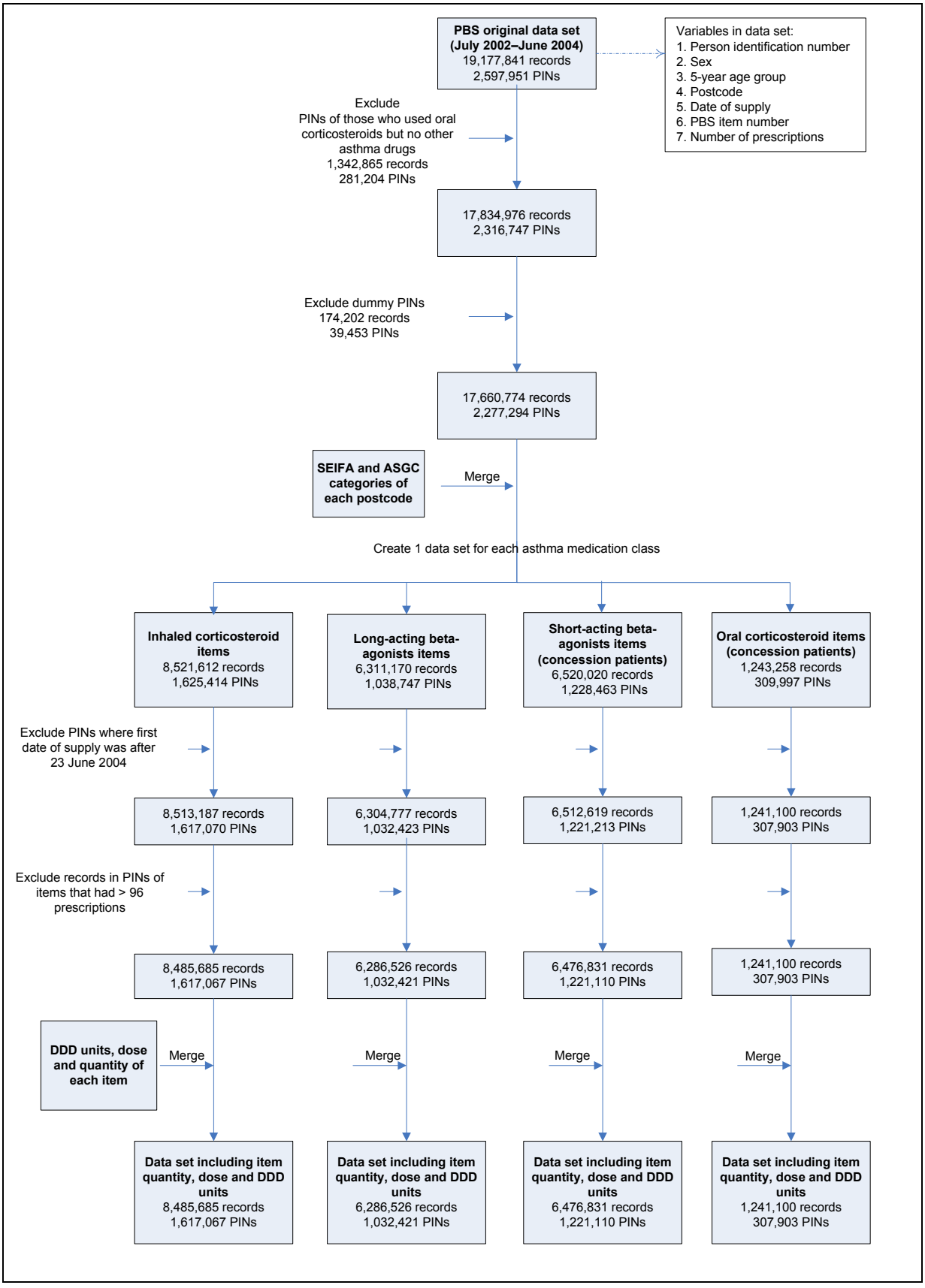
Appendix 1: PBS items included in the asthma medications data set

Medication included	ATC Code	PBS item code	Proprietary name	Strength of each dose	Quantity of doses	Defined daily dose unit
Short-acting beta agonists						
Salbutamol	R03AC02	1099W	Ventolin rotacaps	200 µg	200	800 µg
		2000G	Asmol, Salbutamol	2.5 mg	60	10 mg
		2001H	Asmol, Salbutamol	5.0 mg	60	10 mg
		2003K	Ventolin	5.0 mg	60	10 mg
		8288F	Asmol CFC- free, Epaq, Airomir, Ventolin CFC-free	100 µg	400	800 µg
		8354Q	Airomir autohaler	100 µg	400	800 µg
Terbutaline sulphate	R03AC03	1243K	Bricanyl	10 mg/mL	50	20 mg
		1251W	Bricanyl respules	5 mg/2 mL	30	20 mg
		1252X	Bricanyl turbuhaler	500 µg	200	2000 µg
Long-acting beta agonists						
Salmeterol	R03AC12	3027H	Serevent	25 µg	120	100 µg
		8141L	Serevent accuhaler	50 µg	60	100 µg
Eformoterol	R03AC13	8136F	Foradile	12 µg	60	24 µg
		8239P	Oxis turbuhaler	6 µg	60	24 µg
		8240Q	Oxis turbuhaler	12 µg	60	24 µg
Inhaled corticosteroids						
Beclomethasone Dipropionate	R03BA01	1650W	Becotide	50 µg	200	800 µg
		1651X	Becotide 100	100 µg	200	800 µg
		8406K	Qvar 50	50 µg	200	800 µg
		8407L	Qvar 100	100 µg	200	800 µg
		8408M	Qvar 50 autohaler	50 µg	200	800 µg
		8409N	Qvar 100 autohaler	100 µg	200	800 µg
Budesonide	R03BA02	2065Q	Pulmicort respules	0.5 mg/2 ml	15	1500 µg
		2066R	Pulmicort respules	1 mg/2 ml	15	1500 µg
		2070Y	Pulmicort turbuhaler	100 µg	200	800 µg
		2071B	Pulmicort turbuhaler	200 µg	200	800 µg
		2072C	Pulmicort turbuhaler	400 µg	200	800 µg

(continued)

Medication included	ATC Code	PBS item code	Proprietary name	Strength of each dose	Quantity of doses	Defined daily dose unit
Fluticasone	R03BA05	8147T	Flixotide jnr accuhaler	100 µg	60	600 µg
		8148W	Flixotide accuhaler	250 µg	60	600 µg
		8149X	Flixotide accuhaler	500 µg	60	600 µg
		8345F	Flixotide	125 µg	120	600 µg
		8346G	Flixotide	250 µg	120	600 µg
		8516F	Flixotide jnr	50 µg	120	600 µg
Long-acting beta agonists combined with inhaled corticosteroids						
Salmeterol and Fluticasone	R03AK06	8430Q	Seretide accuhaler 100/50	Salmeterol = 50 µg Fluticasone = 100 µg	60	100 µg 600 µg
		8431R	Seretide accuhaler 250/50	Salmeterol = 50 µg Fluticasone = 250 µg	60	100 µg 600 µg
		8432T	Seretide accuhaler 500/50	Salmeterol = 50 µg Fluticasone = 500 µg	60	100 µg 600 µg
		8517G	Seretide MDI 50/25	Salmeterol = 25 µg Fluticasone = 50 µg	120	100 µg 600 µg
		8518H	Seretide MDI 125/25	Salmeterol = 25 µg Fluticasone = 125 µg	120	100 µg 600 µg
		8519J	Seretide MDI 250/25	Salmeterol = 25 µg Fluticasone = 250 µg	120	100 µg 600 µg
Budesonide with Eformoterol fumarate dihydrate	R03AK07	8625Y	Symbicort turbuhaler 200/6	Budesonide = 200 µg Eformoterol = 6 µg	120	800 µg 24 µg
		8750M	Symbicort turbuhaler 400/12	Budesonide = 400 µg Eformoterol = 12 µg	120	800 µg 24 µg
Oral corticosteroids						
Prednisolone	H02AB06	1916W	Panafcortelone, Solone	25 mg	30	10 mg
		1917X	Panafcortelone, Solone	5 mg	60	10 mg
		3152X	Predsolone, Panafcortelone	1 mg	100	10 mg
Prednisone	H02AB07	1934T	Predsone, Panafcort	1 mg	100	10 mg
		1935W	Panafcort, Sone	5 mg	60	10 mg
		1936X	Panafcort, Sone	25 mg	30	10 mg

Appendix 2: PBS data processing



Appendix 3: Denominator populations

Demographic characteristics	2001 general population	Number of government concession card holders[(a)]
Age group (years)		
0 to 4	1,277,949	n.a.
5 to 14	2,708,978	n.a.
15 to 34	5,548,595	1,288,888
35 to 64	7,532,644	1,860,612
65 and over	2,461,108	2,058,228
Sex		
Male	9,691,946	2,214,734
Female	9,837,328	2,992,994
Socioeconomic status		
SEIFA 1 (most disadvantaged)	3,768,031	1,444,427
SEIFA 2	2,888,603	1,200,375
SEIFA 3	3,431,135	1,006,303
SEIFA 4	4,419,244	952,791
SEIFA 5 (most advantaged)	4,213,282	602,226
Remoteness category (ASGC)		
Major cities	12,869,792	3,218,772
Inner regional	4,023,030	1,288,709
Outer regional	2,050,574	700,248[(b)]
Remote/ very remote	566,349	
People with asthma or COPD		
Age 15 to 34 years	853,826	248,452
Age 15 years and over	2,052,121	841,661
All persons	**19,529,274**	**5,207,729**

(a) *Source:* ABS, National Health Survey CURF, 2001, age 15 years and over.

(b) Combined *Outer regional/Remote/Very remote* categories.

Glossary

Asthma medication	A drug that is commonly used to treat asthma. In this study, asthma medications were defined as all medications classed as: 1. inhaled corticosteroids 2. long-acting beta agonists 3. short-acting beta agonists 4. oral corticosteroids. Note that all of these medication classes are also used to treat other diseases and conditions.
Anatomical Therapeutic Chemical (ATC) classification system	A widely used system for classifying drugs using unique ATC codes.
Beneficiary	In this report this refers to a person who is dispensed prescription medications that are subsided by the PBS.
Concessional beneficiary	Individuals who possess a government-issued health card (including repatriation health care cards) that entitles them to additional subsidy from the PBS.
Copayment	The maximum amount paid by an individual for a dispensed medication that is subsidised by the PBS. The PBS pays the balance of the total cost to the pharmacist, if this is more than the copayment amount.
Defined daily doses (DDDs)	The quantity of defined daily dose units. The calculation of DDDs enables the addition of doses across various medications in the same drug class and the comparison between different classes of drug.
Defined daily dose unit (DDD unit)	The assumed average maintenance dose (usually in mg or µg) per day for a drug used for its main indication in adults.
General beneficiary	Individuals who are dispensed medications subsidised by the PBS who are not categorised as concessional beneficiaries.
Inhaled corticosteroids	A class of medications used to prevent asthma symptoms and exacerbations. Recommended for regular use by people with persistent asthma. These medications are inhaled to suppress airway inflammation. Sometimes referred to as 'preventer' medications.
PBS Item	A specified drug at a given strength classified on the PBS by a unique code.
Long-acting beta agonists	A class of long-acting medications that reverse bronchoconstriction and hence help to control asthma symptoms. They are recommended to be taken regularly in combination with inhaled corticosteroids by people

	with moderate to severe persistent asthma and are administered by inhalation. Their use can result in reduced doses of inhaled corticosteroids being required.
Medication class	A categorisation of several drugs or PBS items under a common mechanism of action. Compare with *Asthma medication*.
Oral corticosteroids	A class of medications which, when used to treat asthma, are used primarily to treat exacerbations of the disease by reducing acute airway inflammation. Administered orally for short periods to regain control of the disease during acute phases.
Patient identification number (PIN)	A numeric variable that anonymously identifies records for the same individual in the PBS data set.
Pharmaceutical Benefits Scheme (PBS)	The PBS is a program administered by the Australian Government that subsidises most prescription drugs dispensed to Australian citizens and residents.
Prescription	A written order from a medical officer for a medication to be dispensed to an individual.
Safety net	A preset threshold of total copayment expenses incurred by the beneficiary in one calendar year. Once a beneficiary has reached this threshold, the copayment reduces for the remainder of the year. The safety net differs for general and concessional beneficiaries.
Short-acting beta agonist	A class of medications that are taken as needed by people with asthma to rapidly reverse bronchoconstriction and hence relieve asthma symptoms. These medications are usually inhaled, either by metered dose inhaler or nebuliser, and are sometimes referred to as 'reliever' medications.

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