CARDIOVASCULAR DISEASE SERIES
Number 27

Medicines for cardiovascular health: are they used appropriately?

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May 2007

Australian Institute of Health and Welfare
Canberra
AIHW cat. no. CVD 36

This publication is part of the Australian Institute of Health and Welfare's Cardiovascular disease series. A complete list of the Institute's publications is available from the Institute's website <www.aihw.gov.au>.

ISSN 1323-9236

ISBN 978 1 74024 689 7

Suggested citation

Australian Institute of Health and Welfare: Senes S and Penm E 2007. Medicines for cardiovascular health: are they used appropriately? Cardiovascular disease series no. 27. Cat. no. 36. Canberra: AIHW.

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Published by the Australian Institute of Health and Welfare

Printed by Union Offset

Please note that as with all statistical reports there is the potential for minor revisions of data in this report over its life. Please refer to the online version at <www.aihw.gov.au>.

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Acknowledgments

This report was prepared by Susana Senes and Elizabeth Penm of the National Centre for Monitoring Cardiovascular Disease at the Australian Institute of Health and Welfare (AIHW).

We are grateful for assistance with the conceptual design of this report given by Sharon Leigh (formerly at AIHW) and members of the Heart, Stroke and Vascular Health Data Working Group, which includes Andrew Tonkin (Monash University), Andrew Boyden (National Heart Foundation), Alan Cass (The George Institute for International Health), Annette Dobson (University of Queensland), Jeff Flack (Bankstown–Lidcombe Hospital), Noel Hayman (Queensland Health), Michael Hobbs (University of Western Australia), Catriona Bate (Australian Bureau of Statistics), Paul Magnus (AIHW), Richard McCluskey (Heart Support Australia), Suzanne Prosser (Department of Health and Ageing), Lynelle Moon (AIHW), Ian Ring (University of Wollongong), Mandy Thrift (Baker Heart Research Institute) and Gavin Turrell (Queensland University of Technology).

Many thanks to Ying Pan for extracting data from the BEACH study and to Chris Raymond, Andrew Kopras, John Dudley, Maxine Robinson, Vanna Mabbott and Ian Titulaer for supplying data on Pharmaceutical Benefits Scheme medicines and advice on their use. Terry Neeman and Chris Stevenson gave guidance on statistical methods.

Valuable comments were provided by Andrew Boyden (National Heart Foundation of Australia), Helena Britt (University of Sydney), Annette Dobson (University of Queensland), Garry Jennings (Baker Heart Research Institute), Mike Langan (Australian Bureau of Statistics), Paul Magnus (AIHW), Lynelle Moon (AIHW), Jane Reuter (AIHW), Elizabeth Roughead (University of South Australia), Emma Slaytor (National Prescribing Service), Mandy Thrift (Baker Heart Research Institute), Andrew Tonkin (Monash University), Lynn Weekes (National Prescribing Service) and the Pharmaceutical Health and Rational Use of Medicines (PHARM) Committee.

The AIHW gratefully acknowledges funding from the Australian Government to contribute to the production of this report.

Key points

This report draws on a range of sources to present national information on the use of medicines to prevent and treat heart, stroke and vascular disease (cardiovascular disease). It covers trends in prescription and supply of these medicines, patterns of supply by geographic area and patient socioeconomic level, whether patients take medicines as intended, adverse events associated with these medicines, initiatives to improve the quality of use of medicines and government expenditure on cardiovascular medicines.

Encouraging news

- Increasing use of 'best practice' is suggested by steady rises between 2000 and 2006 of prescriptions for the following:
  - cholesterol-lowering agents (statins) in coronary heart disease and diabetes
  - certain blood-pressure-lowering medicines (agents acting on the renin–angiotensin system) in hypertension and diabetes
  - clot-preventing medicines in coronary heart disease
  - beta-blocking agents in heart failure.
- People in the most socioeconomically disadvantaged group, who are at greater risk of cardiovascular disease, were dispensed cholesterol-lowering agents (statins) and some clot-preventing medicines at a higher rate than those in the least disadvantaged group.

Concerns

- Many people stop taking medicines that should be taken long-term to prevent or treat cardiovascular disease.
- Compared with those in major cities, people in rural and remote areas have higher death rates from cardiovascular disease, but are dispensed these medicines at:
  - half the rate in rural areas
  - about one-thirtieth the rate or less in remote areas.
- Adverse effects of these medicines were associated with 301 deaths and almost 28,500 hospitalisations in 2004.

More work needs to be done

- Some improvements were small and treatment gaps remain in coronary heart disease, stroke, heart failure and hypertension.
- The best data sources available are inadequate to fully assess whether medicines are used appropriately. The capacity to link health records to track information on individuals within and between datasets would support analysis of quality use of medicines and enhance patient safety.

1 Introduction

The National Chronic Disease Strategy calls for support for the appropriate use of medicines to maximise health outcomes and quality of life. This report aims to inform policy on chronic disease prevention and care regarding cardiovascular disease in Australians. Specifically, it attempts to shed some light on the question '*Are medicines to prevent and treat cardiovascular disease used appropriately?*' by presenting information from a range of data sources to cover various aspects of using medicines well.

The Background chapter of the report introduces the concept of 'quality use of medicines' and describes the challenges involved in using medicines appropriately. It also provides a snapshot of how many Australians are at risk of or affected by cardiovascular disease and summarises the types of medicines available for cardiovascular disease and their indications. Examples of known gaps between clinical practice and best practice in the use of medicines to prevent and treat cardiovascular disease are included.

Chapter 3 discusses patterns and trends of community supply and general practice prescription of cardiovascular medicines for any health problem.

Chapter 4 presents self-reported information on how many Australians use medicines to manage their cardiovascular conditions and the types of medicines they use.

Chapter 5 shows trends in the prescription of cardiovascular medicines by general practitioners to manage specific cardiovascular problems and risk factors. There is information on rates of supply of those medicines to patients by region of residence and socioeconomic level. Data on whether patients take selected cardiovascular medicines as intended are also included. This chapter also describes national initiatives to improve the quality of use of these medicines. Finally it presents information on adverse events associated with cardiovascular medicines, including deaths and hospitalisations, as well as initiatives to reduce them.

A detailed breakdown of government expenditure on these medicines, including trends, is given in Chapter 6.

The Discussion summarises the main findings of the report, draws conclusions from the data available and identifies gaps and limitations of the existing data.

The classification of medicines, data sources and analytical methods used in this report are presented in the Appendix. A brief description of the national bodies with responsibility for quality use of medicines is also included.

Clinical and technical terms are explained in the Glossary.

2 Background

Note: the term 'medicine' includes prescription, non-prescription and complementary medicines.

Medicines can save lives, help people stay healthy, relieve symptoms of disease, cure some diseases and improve quality of life. They are a part of most people's lives. In 1995, almost six in ten Australians took at least one medicine over a two week period, one in four took vitamins or minerals and one in ten used herbal remedies (ABS 1999). The use of medicines increases with age—86% of people aged 65 years and over take medicines, and over 75% of these take more than one medicine.

Australians spent $10.9 billion on medicines in 2004–05, including $7.1 billion on subsidised pharmaceuticals and $3.8 billion on other prescription, over-the-counter and complementary medicines (AIHW 2006b). Expenditure on pharmaceuticals grew by an average 8.9% per year between 1994–95 and 2004–05, and accounted for 13% of total recurrent health expenditure in 2004–05.

Medicines also have associated risks. There can be side effects and mistakes made in the prescribing, administration, dispensing or management of medicines. For the individual, the risk increases with the number of medicines taken. At the community level, the risk of errors increases with the volume of medicine use. Medicine problems can be related to over-use, under-use, misuse or adverse events.

2.1 Quality use of medicines

Australia began developing policies to ensure that essential, affordable medicines of acceptable quality, safety and efficacy were available as early as the 1950s. By the 1990s a comprehensive policy was in place and in December 1999 a formal policy document entitled Australia's National Medicines Policy was launched, with the following interdependent objectives:

- timely access to the medicines that Australians need, at a cost individuals and the community can afford
- medicines meeting appropriate standards of quality, safety and efficacy
- quality use of medicines
- maintaining a responsible and viable medicines industry (DHAC 1999).

In 2002 the National Strategy for Quality Use of Medicines was put in place as part of the National Medicines Policy. Quality use of medicines (also known as 'rational use of medicines') means:

- selecting management options wisely considering the place of medicines in treating illness and maintaining health, and recognising that there may be better ways to manage disorders than using medicines
- choosing suitable medicines if a medicine is considered necessary, taking into account the individual patient, clinical condition, risks and benefits, dose and length of treatment, any coexisting conditions, other therapies, monitoring considerations, and costs for the individual, the community and the health system

- using medicines safely and effectively by monitoring outcomes; minimising misuse, over-use and under-use; and improving the ability to solve any problems related to medicines (DoHA 2002).

This definition of quality use of medicines applies equally to decisions about use of medicines by individuals and by the population as a whole.

National bodies with a key role in promoting and ensuring quality use of medicines are described briefly in the Appendix.

Performance indicators to monitor the implementation and effect of the National Strategy for Quality Use of Medicines have been developed (DoHA 2003a). There have been improvements in the adoption of some practices supporting quality use of medicines, as measured by these indicators (DoHA 2003b).

2.2 Opportunities and challenges for quality use of medicines

The management of cardiovascular disease can be regarded as having three phases:

1. Prevention is usually done by general practitioners (GPs) in the community to identify and help people at risk before disease symptoms appear or a cardiovascular event occurs. Once a person has been assessed as at risk of cardiovascular disease, doctors may prescribe medicines, lifestyle changes or both.
2. Treatment during an acute event, such as a heart attack or stroke, typically happens in hospital.
3. Treatment and ongoing prevention after an acute event occur mainly in the community, involving GPs, nurses, rehabilitation health professionals and pharmacists.

At each phase there are opportunities and challenges for practising quality use of medicines, involving multiple stakeholders: health care consumers, carers and the general community; health practitioners and health educators; health and aged care facilities; medicines industry, media, health care funders and purchasers; and governments.

Some of the problems that may arise include:

- GPs, nurses and pharmacists unable to keep up to date with evidence for the best treatment options, especially if a patient is taking several medicines
- GPs lacking skills or resources, which often involve starting patients on a low dose of medicine and then slowly increasing the dose to therapeutic strength, and monitoring the medicine's effects
- specialist physicians focussing on their own disease area, not considering the patient as a whole with any coexisting health conditions and other medicines they may be taking
- poor communication between doctors and patients, leading to: patients not understanding the risks, their condition, treatment and desired outcomes; coexisting health conditions not considered; medicines taken for other health problems and complementary medicines not discussed and considered; increasing the risk of interactions and adverse events
- patients unable to take in and remember information on medicines given to them by health professionals

- patients not knowing what medications they are taking and why. This is a problem particularly for older people who may take several medicines for different coexisting health conditions and may use a form of dose aid, or where medicine brands are substituted
- patients refusing to continue treatment as they do not understand that initially doctors may need to change doses to find a form that is well tolerated and effective
- patients not understanding the importance of monitoring effects of medicines, such as warfarin and diuretics, putting themselves at risk of drug-adverse events
- patients not taking medicines because they forget to do so, or cannot afford medicines or visits to the doctor (see also Section 5.2 Concordance with medicines, later in this report)
- patients not taking medicines because they do not understand that their condition is chronic and has not been 'cured'; for instance for conditions such as hypertension where the doctor has told the patient that their blood pressure is controlled. Patients often misconstrue this as meaning that they can stop taking their medicines.
- patients hoarding medicines when the safety net threshold is reached (see Box 1 in Chapter 3), or unknowingly keeping expired medicines or empty medicine containers, or taking medicines prescribed for others
- on admission to hospital, lack of a full list of medicines the patient is taking, which may result in an adverse event
- at discharge from hospital, inadequate procedures and insufficient information given to patients and their carers, GPs, nurses and pharmacists to allow adequate follow-up treatment in the community
- risk of duplication of medicines when provided by more than one source
- poor communication between specialists and GPs and inadequate models of shared care.

According to the National Chronic Disease Strategy, medicine use should be reviewed regularly, and effective communication and sharing of information between specialist, acute and primary health care providers, including pharmacists, is essential. Health professionals also need to be skilled in behavioural interventions, support for self-management and other evidence-based approaches to encourage people to use medicines optimally (National Health Priority Council 2006).

A recent international study examined issues of safety, health care coordination, chronic disease care and access to care and found areas of concern (Schoen et al. 2005). Adults who had recently been hospitalised, had surgery or had health problems were interviewed in 2005. In Australia, 19% of participants believed they had experienced a medical mistake in care or were given the wrong medicine or dose, with 63% saying this had happened outside hospital. Although 92% of Australians surveyed had a regular doctor, a significant proportion of people with chronic disease reported problems with their doctor:

- clear instructions not given or treatment goals unclear (19%)
- no discussion of treatment choices (45%)
- no review of all medicines taken by patients including those prescribed by other doctors (46%)
- no explanation of medicine side effects (36%)
- patients not given a plan to self-manage their condition (50%).

One in four Australians participating in the survey reported using four or more prescription medicines regularly and one in five skipped doses or did not fill prescriptions owing to cost. Among Australians surveyed who had been hospitalised in the previous two years, at discharge 23% were prescribed new medicines without having their other medicines reviewed, 18% did not get instructions about symptoms to watch out for, 9% did not know who to contact with questions about their treatment, and 23% were left without follow-up care arrangements.

The study's findings highlight deficiencies in communication between patients and health professionals, poor care coordination, safety risks and inadequate care of patients with chronic disease.

2.3 Medicines and cardiovascular disease

Cardiovascular disease affects nearly one in five Australians—about 3.5 million people (Table 1). Based on self-reports, the most common conditions are hypertension, tachycardia, coronary heart disease and heart failure. The prevalence of cardiovascular disease increases with age to 54% in those aged 65 years and over. About 65% of those with cardiovascular disease report using medicines for their cardiovascular condition(s), amounting to 2.3 million people (ABS 2006). For further details of these medicines, see Chapter 4.

About 20% of people with diabetes also have a long-term cardiovascular condition. Among those aged 65 years and over, 27% had one or more cardiovascular conditions (ABS 2006). Diabetes is an important risk factor for cardiovascular disease and cardiovascular conditions, such as coronary heart disease, stroke and peripheral vascular disease, are important long-term complications of diabetes.

Table 1: Prevalence of selected conditions among Australians, 2004–05

Condition	People with condition All ages		People with condition Age 65 years and over	
	Number ('000)	Per cent	Number ('000)	Per cent
Hypertension	2,100.7	10.5	962.6	37.0
Tachycardia	417.4	2.1	212.0	8.1
Coronary heart disease	366.6	1.8	242.5	9.3
Heart failure and oedema	263.0	1.3	141.0	5.4
Diseases of arteries, arterioles and capillaries	203.6	1.0	120.0	4.6
Cerebrovascular diseases	90.8	0.5	59.6	2.3
All cardiovascular disease	**3,536.6**	**17.6**	**1,400.2**	**53.8**
High blood cholesterol	1,339.7	6.8	563.4	21.6
Diabetes	699.6	3.5	333.2	12.8

Note: These conditions are explained in the Glossary.

Source: ABS 2006.

Effective medicines to prevent and treat cardiovascular disease are available in Australia. The recommended indications for medicines used in cardiovascular disease are shown in Table 2. Note that some of the medicines listed also have other important uses outside the cardiovascular system, which have been excluded from the table. In this report we use the

Anatomical Therapeutic Chemical (ATC) classification of medicines, developed by the World Health Organisation, because this is the classification adopted by the main data sources analysed here. The ATC classification is the Australian standard for classifying medicines, but it does not align well with clinical practice or pharmacology and has confusing terminology (see also Note on page 9).

Areas needing improvements in clinical practice regarding the use of medicines to prevent and treat cardiovascular conditions have been identified (National Institute of Clinical Studies 2003, 2005; Australian Council for Safety and Quality in Health Care and National Institute of Clinical Studies 2004). Examples include:

- under-use of antithrombotic (clot-preventing) agents, such as warfarin, to prevent stroke in patients with atrial fibrillation
- under-use of Angiotensin-converting-enzyme (ACE) inhibitors and beta-blocking agents in patients with heart failure
- under-use of ACE inhibitors and beta-blocking agents in patients with, and following, acute coronary syndromes
- under-use of medicines to lower blood pressure in people with hypertension, including people at high risk of cardiovascular disease
- under-use of clot-busting medicines (thrombolysis) in eligible patients with stroke.

Table 2: Indications for medicines used in cardiovascular disease

Medicine type (example)	Indications	Comments
Antithrombotic agents		
Vitamin K antagonists (warfarin)	• Prevent and treat venous thromboembolism • Prevent stroke in patients with atrial fibrillation • Prevent thromboembolism in patients with prosthetic heart valves	These medicines have a narrow window between therapeutic use and toxicity, as well as many interactions with other medicines. They require careful monitoring for safe use.
Heparin group (enoxaparin)	• Prevent and treat venous thromboembolism in patients undergoing surgery and high-risk patients • Treat arterial thromboembolism in acute myocardial infarction, unstable angina • Prevent thrombosis during coronary angioplasty, cardiopulmonary bypass and dialysis	
Platelet aggregation inhibitors (aspirin)	• Prevent myocardial infarction and stroke in patients with cardiovascular risk factors • Prevent myocardial infarction and stroke in patients with previous myocardial infarction, stroke, transient ischaemic attack, angina, peripheral arterial disease or atrial fibrillation • Treat acute myocardial infarction and acute ischaemic stroke • Prevent thrombosis during and after percutaneous coronary interventions	
Thrombolytic enzymes (alteplase)	• Treat acute myocardial infarction and acute ischaemic stroke • Treat peripheral arterial thromboembolism	

(continued)

Table 2 (continued): Indications for medicines used in cardiovascular disease

Medicine type (example)	Indications	Comments
Cardiac therapy		
Cardiac glycosides (digoxin)	• Treat arrhythmias (atrial fibrillation or flutter) • Prevent worsening of heart failure	
Antiarrhythmics (amiodarone)	• Prevent life threatening arrhythmias that could lead to sudden cardiac death • Treat arrhythmias and relieve symptoms	
Cardiac-stimulants (adrenaline)	• Treat heart arrest • Treat heart failure • Treat low blood pressure • Treat cardiogenic shock due to myocardial infarction	
Vasodilators (isosorbide mononitrate)	• Prevent and treat angina	
Antihypertensives	• Treat hypertension to prevent disease and deaths from stroke, coronary heart disease, heart failure and aortic aneurysm • Treat hypertension to reduce microvascular disease affecting kidney, brain and retina	• Agents acting on arteriolar smooth muscle, such as hydralazine, are potent blood-pressure-lowering medicines reserved for refractory hypertension or for hypertensive emergencies. • Centrally acting antiadrenergic agents, such as methyldopa, are not recommended as first line treatment as they are less well tolerated than other blood-pressure-lowering medicines.
Diuretics (frusemide)	• Treat hypertension to prevent disease and deaths from stroke, coronary heart disease, heart failure and aortic aneurysm • Treat hypertension to reduce microvascular disease affecting kidney, brain and retina	Low-dose thiazide diuretics recommended as first line treatment for hypertension as they are at least as effective as all other medicine classes in lowering blood pressure and are the least expensive.
Peripheral vasodilators (oxpentifylline)	• Treat hypertension to prevent disease and deaths from stroke, coronary heart disease, heart failure and aortic aneurysm • Treat hypertension to reduce microvascular disease affecting kidney, brain and retina • Treat peripheral vascular disease	
Calcium-channel blockers (amlodipine)	• Treat hypertension to prevent disease and deaths from stroke, coronary heart disease, heart failure and aortic aneurysm • Treat hypertension to reduce microvascular disease affecting kidney, brain and retina • Prevent angina	

(continued)

Table 2 (continued): Indications for medicines used in cardiovascular disease

Medicine type (example)	Indications	Comments
Beta-blocking agents (atenolol)	• Treat hypertension to prevent disease and deaths from stroke, coronary heart disease, heart failure and aortic aneurysm • Treat hypertension to reduce microvascular disease affecting kidney, brain and retina • Treat angina • Treat arrhythmias • Prevent further cardiovascular events and death following myocardial infarction • Treat heart failure	• Atenolol, metoprolol and propanolol reduce risk of further cardiovascular events and death in patients after myocardial infarction and are recommended in these patients. • Used with an ACE inhibitor and a diuretic, several beta-blockers reduce risk of death and hospitalisation in patients with heart failure.
Agents acting on renin–angiotensin system	• Treat hypertension to prevent disease and deaths from stroke, coronary heart disease, heart failure and aortic aneurysm • Treat hypertension to reduce microvascular disease affecting kidney, brain and retina	
Angiotensin-converting-enzyme (ACE) inhibitors (ramipril)	• Treat heart failure and delay disease progression • Prevent development of heart failure following myocardial infarction • Reduce risk of myocardial infarction, stroke and cardiovascular death in selected patients with coronary heart disease, stroke, peripheral vascular disease or diabetes • Diabetic nephropathy • Prevent worsening of kidney failure	Recommended first line treatment in patients with heart failure, or with left ventricular dysfunction following myocardial infarction, or with diabetes and microalbuminuria.
Angiotensin II antagonists (irbesartan)	• Treat heart failure and delay disease progression in patient unable to tolerate ACE inhibitors • Reduce progression of kidney disease in selected patients	
Serum-lipid-reducing agents (atorvastatin)	• Treat lipid disorders to reduce progression of atherosclerosis and reduce risk of myocardial infarction and stroke in people with established cardiovascular disease • Treat lipid disorders to prevent cardiovascular disease and deaths in people at high risk of myocardial infarction and stroke due to the presence of multiple risk factors	• HMG CoA reductase inhibitors (statins) are the most effective medicines to reduce LDL cholesterol and are well tolerated. • For raised triglyceride, fibrates are first choice, but statins may be used instead if the patient has cardiovascular disease. • Nicotinic acid lowers cholesterol and triglyceride levels, but is often poorly tolerated.

Notes

1. Only those indications relevant to cardiovascular disease are listed here. However, some of the medicines in this table have other indications as well.
2. Medicines shown in this table are classified according to the Anatomical Therapeutic Chemical (ATC) system. For more information, see the Appendix.

Source: Australian Medicines Handbook 2006.

3 Use of cardiovascular medicines for any health condition

This chapter presents information on patterns of supply and prescription of cardiovascular medicines for any health condition in Australia. In this report we have used the medicines names and groupings of the Anatomical Therapeutic Chemical (ATC) classification of medicines, described in detail in the Appendix. Medicines used to prevent and treat cardiovascular conditions belong in the 'Cardiovascular system' and the 'Blood and blood-forming organs' groups.

> Note: throughout this report we have used the term 'antihypertensives' strictly to refer to the group of medicines so labelled in the ATC classification (see Appendix). However, there are many other medicines used to treat hypertension, which are commonly referred to as 'antihypertensives' elsewhere. Here we have referred to all medicines used to treat hypertension as 'medicines with blood-pressure-lowering effect'.

3.1 Supply of cardiovascular medicines in the community

Information on the supply of prescription medicines in the community is available from the Australian Government Department of Health and Ageing (DoHA). The information is derived from prescriptions submitted for subsidy payment under the Pharmaceutical Benefits Scheme (PBS) or the Repatriation Pharmaceutical Benefits Scheme (RPBS) and estimates of the use of non-subsidised prescription medicines, calculated from data collected for the Pharmacy Guild of Australia's ongoing survey of community pharmacies. For more information on the PBS see Box 1. Data are not available on the use of prescribed medicines in public hospitals and most private hospitals. Note that as a medicine may have more than one indication, and the condition for which the medicine is prescribed is not recorded, it is not possible to determine from these data sources the actual medicine use for specific conditions or purposes.

Medicine use can be expressed as defined daily dose per 1,000 population per day (DDD/1,000/day). This is based on the assumed average dose per day of a medicine used for its main indication in adults. It gives an estimate of how many people per 1,000 population are taking the standard dose of the medicine each day, on average. The DDD enables valid comparisons between medicines, independent of differences in price, preparation and quantity per prescription. However, it has several limitations. As the DDD is based on international experience, it does not necessarily reflect the recommended or average prescribed dose in Australia. This measure assumes that the amount of medicine supplied is the same as the amount used, but this is not always the case. Note also that the DDD is calculated for the whole population, while medicine use may be concentrated in certain age groups or a particular sex (DoHA 2005).

This section presents information on the community supply of cardiovascular medicines to manage any health condition (not limited to cardiovascular conditions), as explained above.

Box 1: The Pharmaceutical Benefits Scheme

In Australia community prescriptions (that is, not given in public hospitals) are dispensed either as private prescriptions or under one of two subsidisation schemes – the Pharmaceutical Benefits Scheme (PBS) and the Repatriation Pharmaceutical Benefits Scheme (RPBS). These schemes were established to provide Australians with access to necessary medicinal products, which are affordable, available and of acceptable standards.

A new medicine must gain approval for supply in accord with the requirements of the Therapeutic Goods Act 1989. *Approval is also required to extend the indications of an established medicine. Applications are dealt with by the Therapeutic Goods Administration (TGA) and, for prescription medicines, advice is sought from an expert committee, the Australian Drug Evaluation Committee (ADEC).*

Once a prescription medicine is approved for marketing, the company concerned usually applies to have the medicine listed on the PBS. Because of the attraction of the scheme to consumers, it is usually necessary for the company to have the medicine listed on the scheme for viable marketing to occur.

The Pharmaceutical Benefits Advisory Committee (PBAC) makes recommendations to the Australian Government about which medicines should be listed on the PBS. Whereas the pre-market evaluation examines the issues of quality, safety and efficacy, the PBAC considers effectiveness and cost-effectiveness of the product compared with other alternatives. Once a medicine has been recommended for listing on the PBS by the PBAC, the Pharmaceutical Benefits Pricing Authority (PBPA) negotiates the price paid with the company. The PBPA consists of government, industry and consumer representatives. After agreement is reached, the Australian Government considers the advice of both the PBAC and the PBPA and makes a decision on whether the medicine should be listed on the PBS.

Under the PBS, patients are grouped into two classes. General patients pay the first $29.50 of the cost of each prescription item (called patient co-payment). Pensioner and concessional patients (people with low incomes and sickness beneficiaries who hold a health care card) pay $4.70 per prescription item.

In addition, there is a safety net to protect people with high medicine needs. Once general patients and/or their immediate family spend $960.10 on PBS items in a calendar year, prescriptions for the remainder of that year cost the concessional co-payment amount of $4.70 per item. Once pensioners and concessionals spend $253.80 on PBS items in a calendar year, they receive all remaining prescriptions free of charge for the remainder of the year. These co-payments and safety net thresholds are indexed according to the Consumer Price Index from 1 January each year. The figures quoted here apply for the year 2006.

Patients may also be required to pay a surcharge where the doctor prescribes a more expensive brand of an item, when there are cheaper, equivalent brands of that item listed on the PBS.

As the general patient co-payment rises, the dispensed price of many of the cheaper medicines falls under this level. In such cases, the patient pays the full price and no claim for payment is recorded under the PBS. In 2003, under co-payment general prescriptions represented around 15% of all community prescriptions. There are also many medicines that are not listed on the PBS or RPBS and are available only on private prescription with the patient paying the full cost (these represented 7.3% of community prescriptions in 2003).

The Repatriation Benefits Scheme gives assistance to eligible war veterans and dependants. It is generally similar to the PBS for concessional beneficiaries.

Sources: DoHA 2005, 2006.

In 2003 there were 178.1 million subsidised (PBS/RPBS) prescriptions overall, of which 55.6 million (31.2%) were for 'cardiovascular system' medicines and 6.1 million (3.4%) were for 'blood and blood-forming organs' medicines (DoHA 2005). In addition, there were an estimated 42 million prescriptions that did not attract a subsidy, with 'cardiovascular system' medicines accounting for 3.5 million (8.4%) and 'blood and blood-forming organs' medicines 0.6 million (1.3%).

Seven 'cardiovascular system' medicines were among the top ten most commonly used medicines by the DDD/1,000/day measure (Table 3). Atorvastatin and simvastatin, both blood cholesterol-lowering medicines, were the leading medicines using this measure.

Table 3: Top ten medicines by defined daily dose/1,000 population/day, 2005

Rank	Medicine	Action	DDD/1,000/day
1	Atorvastatin*	Lowers blood cholesterol	106.8
2	Simvastatin*	Lowers blood cholesterol	57.5
3	Ramipril*	Lowers blood pressure	38.0
4	Diltiazem hydrochloride*	Lowers blood pressure	30.9
5	Salbutamol	Opens airways	26.2
6	Irbesartan*	Lowers blood pressure	21.9
7	Omeprazole	Lowers gastric acid	20.1
8	Frusemide*	Lowers blood pressure	19.6
9	Aspirin*	Antiplatelet, pain killer, anti-inflammatory	19.3
10	Sertraline	Antidepressant	17.8

Note: * Denotes medicine indicated for cardiovascular disease.

Source: Drug Utilisation Sub-Committee database, DoHA .

Over the period 1995–2005, there were important changes in the supply of medicines for cardiovascular disease in the community:

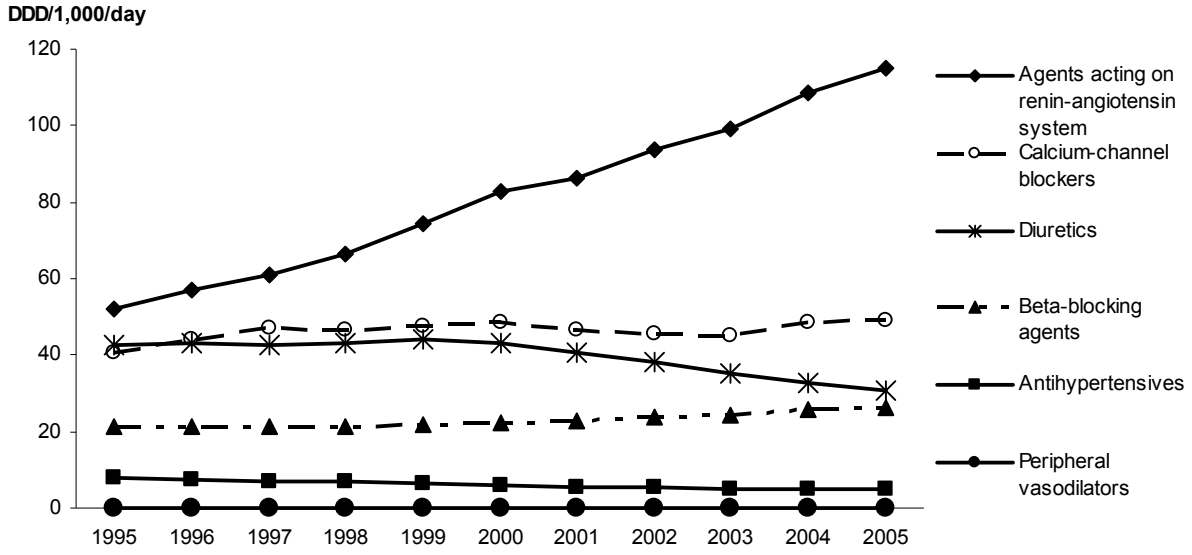
- Among medicines with blood-pressure-lowering effect, agents acting on the renin–angiotensin system were the most popular (121% increase), calcium-channel blockers and beta-blockers also increased by 21% each, while diuretics fell by 28%, antihypertensives fell by 37% and peripheral vasodilators, which were dispensed infrequently, fell by 90% (Figure 1).
- Among serum-lipid-reducing agents, statins rose markedly (1,218% increase). Other types of medicines in this group were supplied relatively rarely compared with statins (Figure 2).
- All types of antithrombotic agents increased considerably—platelet aggregation inhibitors particularly (4,668%), vitamin K antagonists (102%), heparins (846%) (Figure 3).
- Among cardiac therapy medicines, antiarrhythmics rose (49%) while the rest fell—vasodilators (–7%), cardiac glycosides (–44%) and cardiac-stimulants (–22%) (Figure 4).

Note that for agents acting on the renin–angiotensin system and diuretics, the figures presented here underestimate their real supply, as DDDs for combination products are not calculated and are therefore not included in the totals.

Compared with other OECD countries for which similar data are available (Table A1), Australia:

- has a considerably greater use of serum-lipid-reducing agents than any other country on the list
- is among the top users of agents acting on the renin–angiotensin system and calcium-channel blockers
- is among the countries that uses beta-blocking agents and diuretics the least.

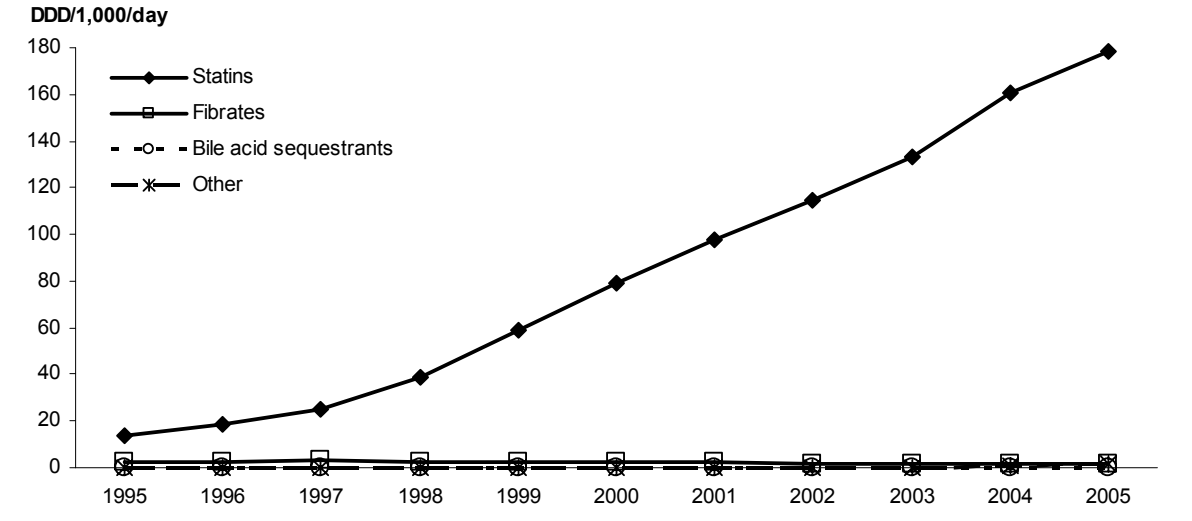
These differences in use of medicines might reflect differences in prevalence of cardiovascular disease, clinical practices, patients' preferences, access to medicines and affordability of medicines in the countries compared, and the rate and level of acceptance of new evidence.



Note: Excludes combinations of agents acting on renin–angiotensin system and diuretics, and combinations of diuretics.

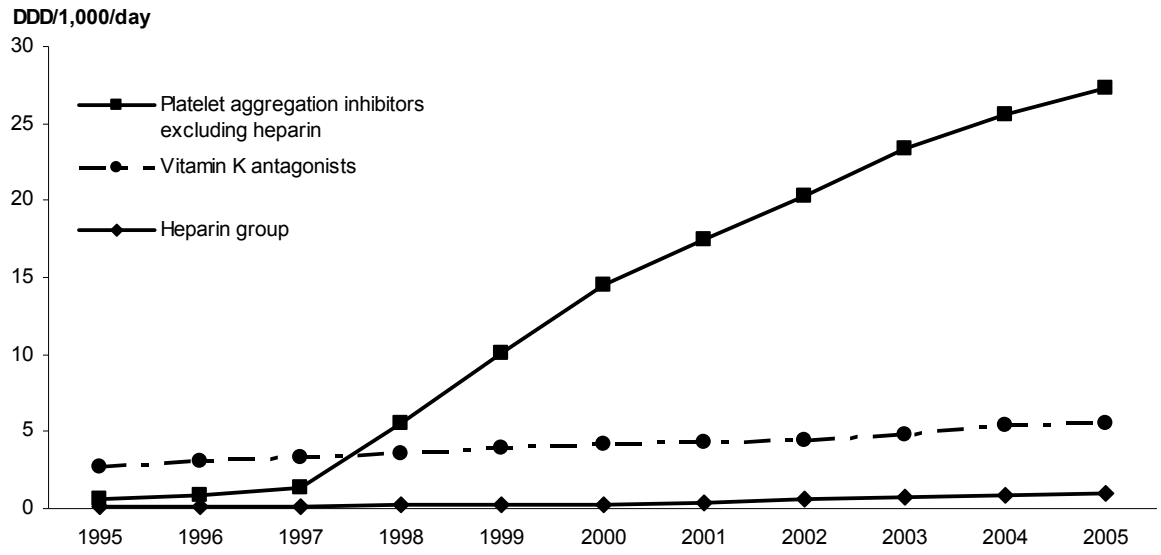
Source: Drug Utilisation Sub-Committee database, DoHA.

Figure 1: Supply of medicines with blood-pressure-lowering effect in the community



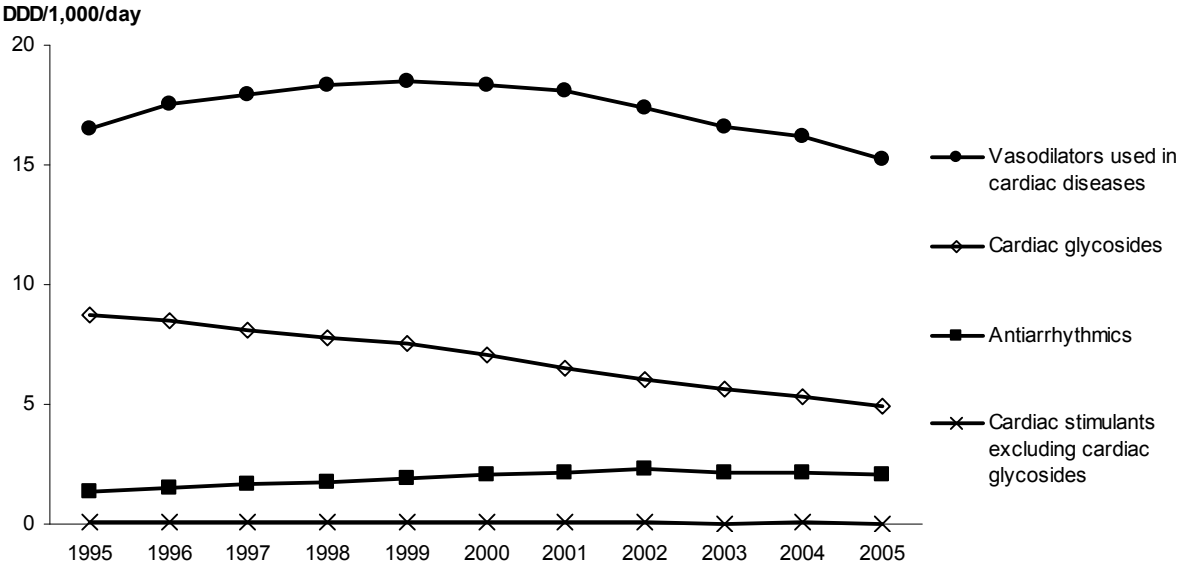
Source: Drug Utilisation Sub-Committee database, DoHA.

Figure 2: Supply of serum-lipid-reducing agents in the community



Source: Drug Utilisation Sub-Committee database, DoHA.

Figure 3: Supply of antithrombotic agents in the community



Source: Drug Utilisation Sub-Committee database, DoHA.

Figure 4: Supply of cardiac therapy medicines in the community

3.2 Cardiovascular medicines prescribed in general practice

This section presents information on cardiovascular medicines prescribed in general practice for any health problem, sourced from the BEACH study, described in the Appendix. The BEACH survey of general practice collects information on medicines that GPs prescribe and advise patients to buy over the counter, and those that GPs supply directly. However, in this report we have limited the analyses to those medicines prescribed or supplied by GPs.

Box 2: Definitions used in the BEACH study as presented in this report

General practitioner (GP): a medical practitioner who provides primary comprehensive and continuing care to patients and their families within the community.

Problem: a statement of the GP's understanding of a health problem presented by a patient.

Encounter: any professional interchange between a patient and a GP.

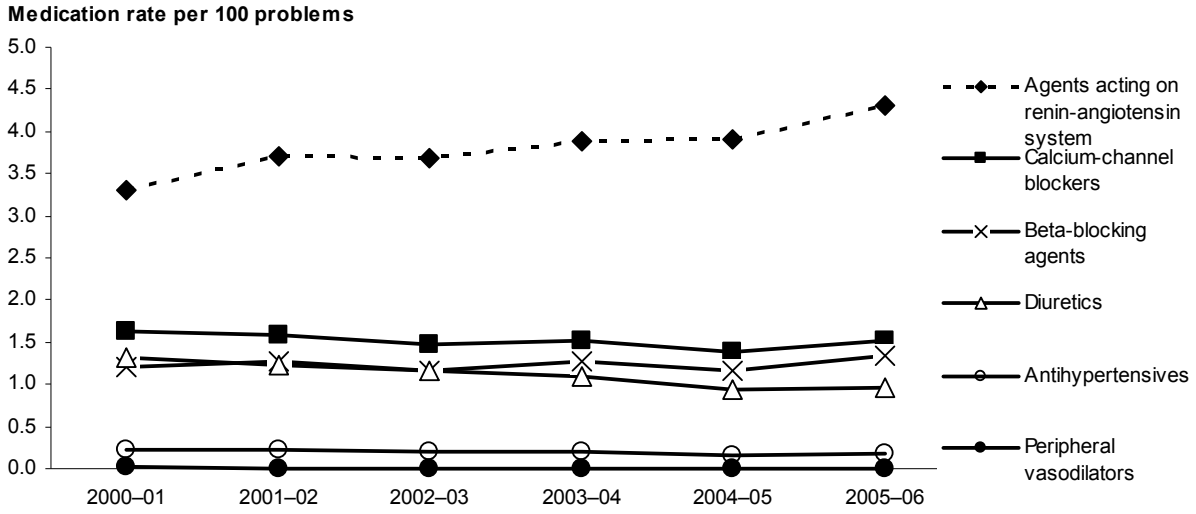
Medicine: a medicine prescribed or provided by the GP at the encounter.

Medication rate: medicines prescribed or supplied by the GP per 100 problems managed.

In 2004–05, GPs prescribed cardiovascular medicines to manage any health condition at a rate of 14.7 per 100 encounters, accounting for 17.7% of all general practice prescriptions (AIHW: Britt et al. 2005). Blood lipid lowering medicines were the most commonly prescribed cardiovascular medicines (3.0 per 100 encounters), followed by plain ACE-inhibitors (2.4 per 100 encounters) and beta-blocking agents (1.7 per 100 encounters).

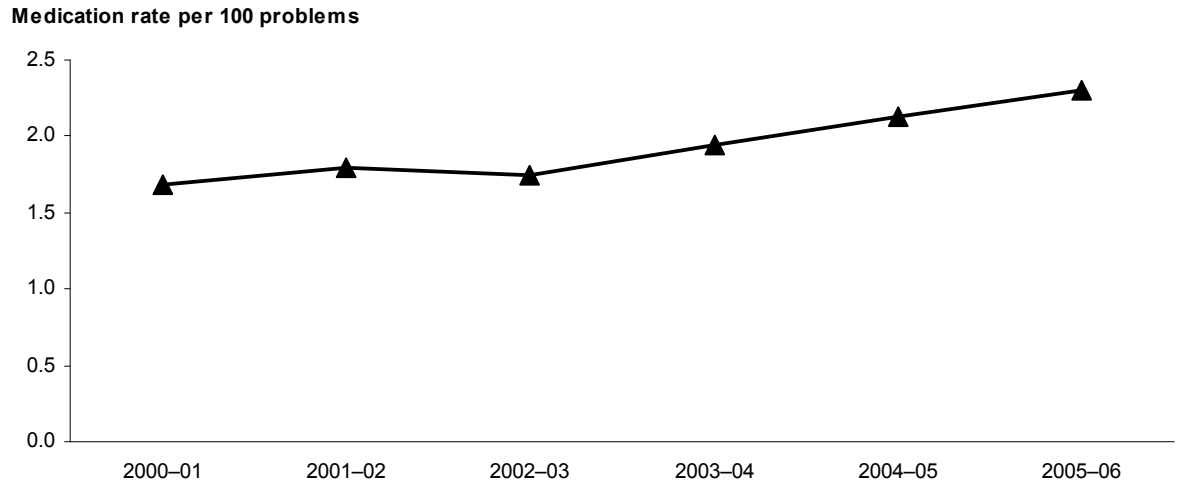
Comparing the rate at which GPs prescribed or supplied cardiovascular medicines for any problem in 2000–01 and 2005–06, there were statistically significant changes (p value <0.0001):

- Among medicines with blood-pressure-lowering effect, agents acting on the renin–angiotensin system increased, while diuretics fell (Figure 5). Other types of medicines in this category remained stable.
- Serum-lipid-reducing agents rose, with statins and 'other cholesterol and triglyceride reducers' accounting for the increase (Figure 6).
- Antithrombotic agents increased owing solely to the rise in platelet aggregation inhibitors such as aspirin (Figure 7).
- Cardiac therapy medicines fell as a result of reduced prescription of cardiac glycosides and nitrates (Figure 8).



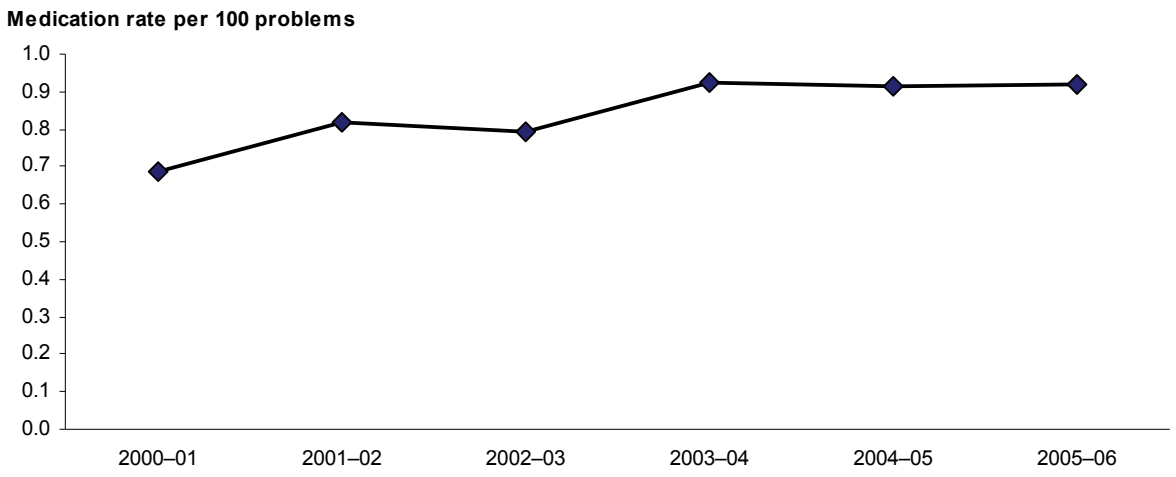
Source: BEACH study (unpublished).

Figure 5: Medicines with blood-pressure-lowering effect prescribed or supplied by GPs



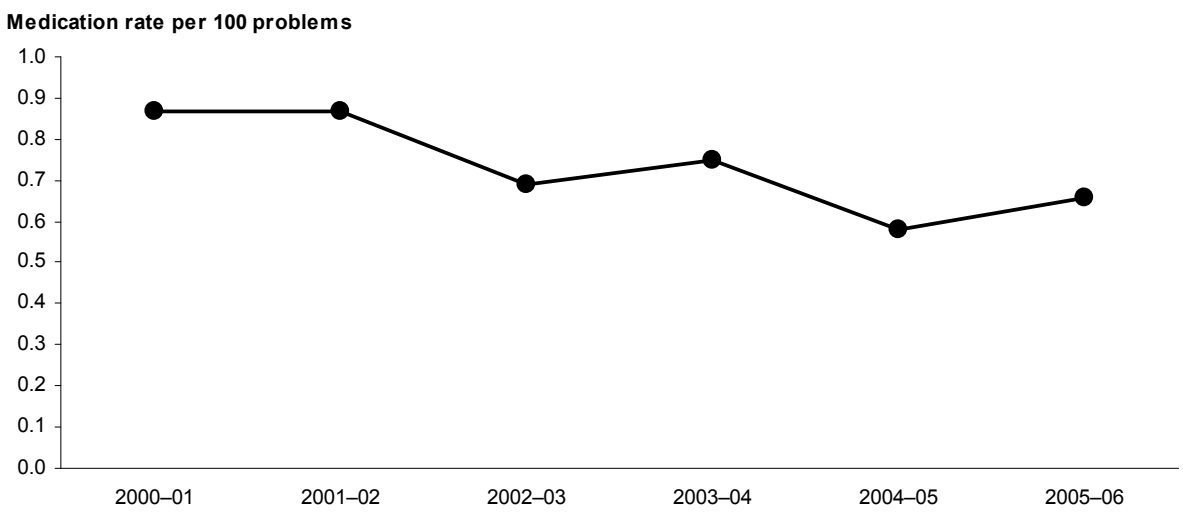
Source: BEACH study (unpublished).

Figure 6: Serum-lipid-reducing agents prescribed or supplied by GPs



Source: BEACH study (unpublished).

Figure 7: Antithrombotic agents prescribed or supplied by GPs



Source: BEACH study (unpublished).

Figure 8: Cardiac therapy medicines prescribed or supplied by GPs

4 Use of medicines for cardiovascular disease

The National Health Survey collected self-reported information on medicines used for any circulatory condition in the two weeks preceding the survey interview. Details of the survey are given in the Appendix.

Information about medical conditions in the survey is 'as reported' by participants—it was not medically verified and was not necessarily based on diagnosis by a doctor. Some people with multiple conditions who reported using multiple medicines did not know which medicine they were taking for each particular condition, so some medicines may have been incorrectly reported as used for a particular condition, or not reported at all because the respondent understood it was for a condition not covered in the survey. Therefore, we should be cautious when interpreting these results.

Note that in the National Health Survey aspirin was included in the category 'analgesics'—that is, pain killers—which is one of its effects. However, in the context of cardiovascular disease, aspirin is more likely to be taken for its antithrombotic effect and elsewhere in this report aspirin is included in the category 'antithrombotic agents'.

Overall, 65.2% of people who reported a cardiovascular condition also reported using medicine for it in the previous two weeks—coronary heart disease 67%, cerebrovascular diseases 59.3%, and hypertension 88.2% (Table 4).

The most commonly reported medicines for coronary heart disease were vasodilators used in cardiac disease (37.6%) (that is, cardiac therapy medicines), analgesics (26.4%), and beta-blockers (25.6%), but a relatively low proportion of people reported taking serum-lipid-reducing agents (12.7%).

For cerebrovascular diseases such as stroke, the survey generally does not provide much useful information on medicines owing to the small number of people with these conditions, except in the case of analgesics (probably aspirin) reported by 45.3% of people.

Among those who reported diseases of arteries, arterioles and capillaries, 37.3% reported using analgesics, 23.3% serum-lipid-reducing agents and 18.9% beta-blockers.

For hypertension, the medicines reported most often were agents acting on the renin–angiotensin system—plain ACE inhibitors (37.3%) and angiotensin II antagonists (31.8%); and calcium-channel blockers (23.0%).

Additionally, 12.9% of people with a cardiovascular condition reported taking vitamins, minerals and herbal treatments for it. For coronary heart disease, the proportion was 16.7% and for hypertension 9.8%.

A person may take more than one medicine simultaneously. People with coronary heart disease on average reported taking 1.5 cardiovascular medicines for their condition. But the overall average for all medicines taken by this group for any health condition surveyed was 1.8, including vitamins, minerals and herbal medicines. For people with cerebrovascular disease, the average number of cardiovascular medicines reported for this condition was 1.4 and the overall average number of medicines reported for any condition surveyed was 1.6. Those with hypertension reported an average of 1.4 cardiovascular medicines used for this condition and an average of 1.5 medicines overall for any condition surveyed. Note that the

National Health Survey collected information on medicines taken for selected conditions only, therefore the overall average number of medicines people reported taking may be an underestimate of their total consumption.

According to a different survey run in South Australia in 2004, which asked about all prescription medicines taken for any condition, 7.4% of participants aged 15 years and over used four or five medicines, and 5.7% used six or more (Goldney et al. 2005). The use of multiple medicines increased with age, so that among people aged 65 years and over, 25.4% used four or five medicines, and 17.7% used six or more.

Table 4: Medicines used for cardiovascular conditions, 2004–05[(a)]

	Coronary heart disease	Cerebrovascular diseases	Diseases of arteries, arterioles and capillaries	Hypertension	All cardiovascular conditions
Total persons with cardiovascular condition	**337,000**	**90,800**	**203,600**	**2,100,700**	**3,536,600**
Using medicine (%)	67.0	59.3	47.6	88.2	65.2
Not using medicine (%)[(b)]	33.0	40.7	52.3	11.6	34.8
Total persons using medicine for cardiovascular condition	**225,900**	**53,800**	**96,900**	**1,853,300**	**2,306,900**
Type of medicine used[(c)]			**Per cent of people using medicine**		
Vasodilators used in cardiac diseases	37.6	np	*4.8	0.9	5.1
Low-ceiling diuretics	**0.8	np	np	8.6	8.2
High-ceiling diuretics	*2.2	np	np	*0.5	4.6
Beta-blocking agents	25.6	*12.2	18.9	19.2	23.0
Calcium-channel blockers	13.3	**5.3	*6.5	23.0	21.4
ACE inhibitors, plain	15.3	*14.3	*9.4	37.3	33.6
Angiotensin II antagonists	*3.9	**5.5	*5.1	31.8	27.1
Serum-lipid-reducing agents	12.7	**6.1	23.3	2.8	5.0
Other medicines for heart and vascular conditions	20.8	49.4	35.7	7.2	15.0
Analgesics[(d)]	26.4	45.3	37.3	5.8	12.0
All other pharmaceutical medicine[(e)]	9.0	*12.3	**2.6	2.4	5.4
Vitamins, minerals and herbal treatments	16.7	*7.7	*14.2	9.8	12.9

(a) Medicines used for cardiovascular conditions in the 2 weeks before the survey interview, based on self-reports.

(b) Includes persons for whom use of medicine for cardiovascular conditions was not stated.

(c) The ABS uses for the National health survey a classification of medicines that is, based on the ATC classification, but differs from it in some cases. For instance, in the NHS aspirin is classified as an analgesic instead of an antithrombotic agent.

(d) Includes aspirin.

(e) Includes medicine reported by respondents as taken for cardiovascular conditions, but are in fact indicated for other conditions.

Notes

1. Persons may report more than one type of medicine.
2. Estimates marked with * have a relative standard error (RSE) of between 25% and 50% and should be interpreted with caution.
3. Estimates marked with ** have a relative standard error (RSE) of more than 50% and are considered to be too unreliable for general use.
4. np = not available for publication, but included in totals where applicable.

Source: ABS 2006.

5 Quality use of cardiovascular medicines

This chapter presents information on several aspects of the appropriate use of medicines for cardiovascular disease for which data are available and describes national initiatives aimed at achieving quality use of these medicines where deficiencies have been identified.

5.1 Medicines prescribed for cardiovascular disease

Data on cardiovascular medicines that GPs prescribed or supplied for specific cardiovascular conditions and risk factors (hypertension, lipid disorders and diabetes) were sourced from the BEACH study for the period April 2000–March 2006. For information on this study and details of the method used to analyse the data, see the Appendix.

Over the period 2000–2006, GPs prescribed or supplied medicines to manage most cardiovascular problems (Table 5).

Table 5: Medicines prescribed or supplied by GPs for specific problems, 2000–06

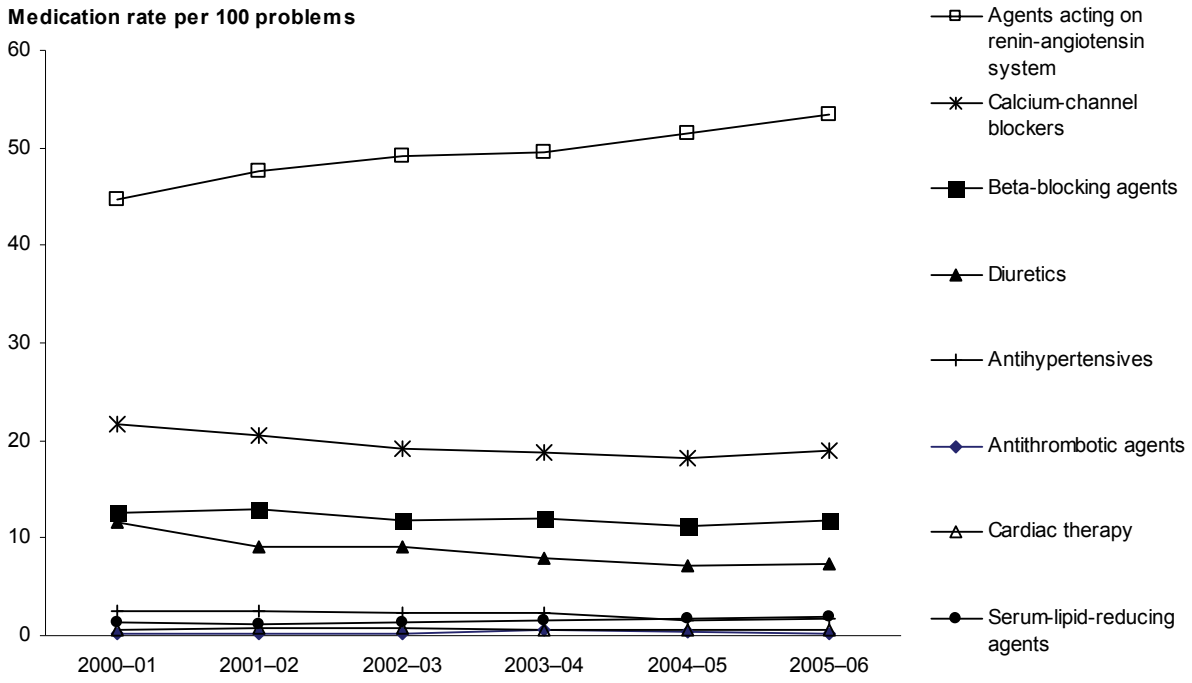
Problem managed	Medicine rate per 100 problems (95%CI)
Arrhythmia	81.1 (78.1–84.2)
Diabetes	72.3 (70.5–74.1)
Heart failure	118.6 (114.2–123.0)
Hypertension	96.5 (95.2–97.9)
Ischaemic heart disease	116.6 (113.1–120.1)
Lipid disorder	65.4 (64.4–66.5)
Peripheral vascular disease	37.4 (32.7–42.1)
Stroke	58.7 (53.3–64.1)

Source: BEACH study (unpublished).

Hypertension is the most common problem managed in general practice, at 6.5% of all problems in 2005–06. Between 2000–01 and 2005–06 the rate of management of hypertension by GPs increased (from 8.6 to 9.4 hypertension problems managed per 100 encounters). In 2005–06, agents acting on the renin–angiotensin system were by far the most popular medicines prescribed or supplied for hypertension (53.4 per 100 problems), followed by calcium-channel blockers (18.9 per 100 problems), beta-blocking agents (11.9 per 100 problems), and diuretics (7.4 per 100 problems), while antihypertensives were seldom prescribed (1.7 per 100 problems) (Figure 9 and Table e1).

Comparing the rate at which GPs prescribed or supplied cardiovascular medicines for hypertension in 2000-01 and 2005–06, there were statistically significant changes (p value <0.0001): agents acting on the renin–angiotensin system increased, while calcium-channel blockers, diuretics and antihypertensives all fell (Figure 9). Nationwide, these changes equate to an estimated 220,000 additional occasions each year when GPs prescribed or supplied agents acting on the renin–angiotensin system for hypertension, and an annual

reduction by 40,000 for calcium-channel blockers, 80,000 for diuretics and 10,000 for antihypertensives. These trends reflect GPs favouring the newer renin–angiotensin system medicines, which are generally better tolerated than other medicines with blood-pressure-lowering effect.

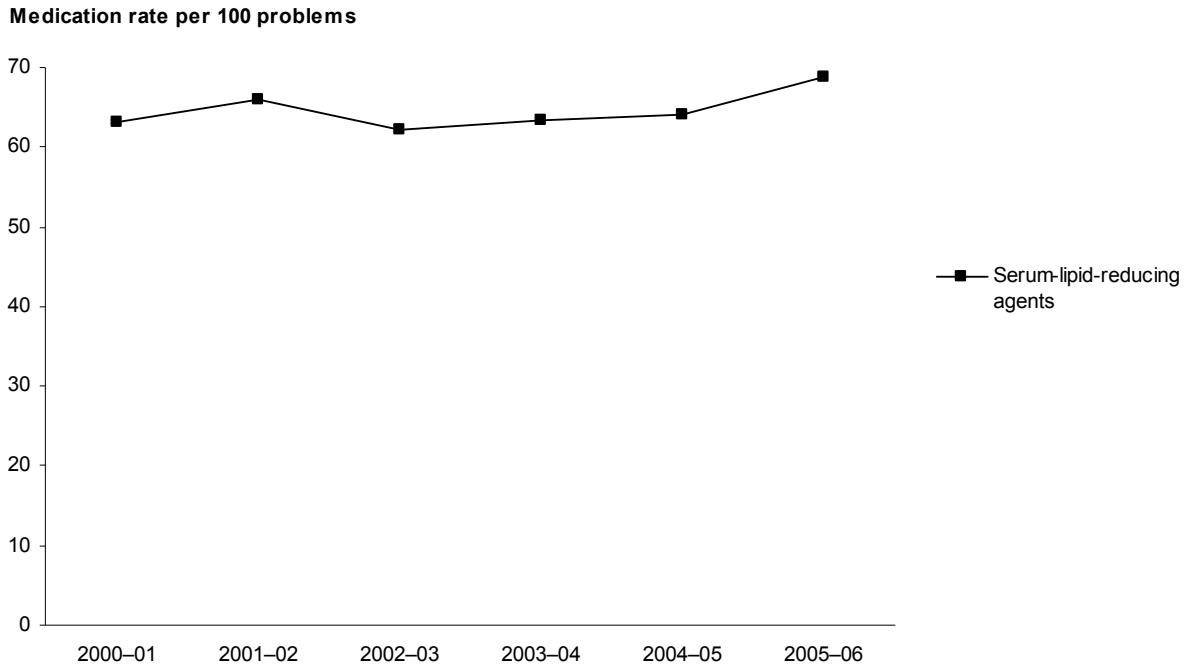


Source: BEACH study (unpublished).

Figure 9: Medicines prescribed or supplied by GPs in managing hypertension

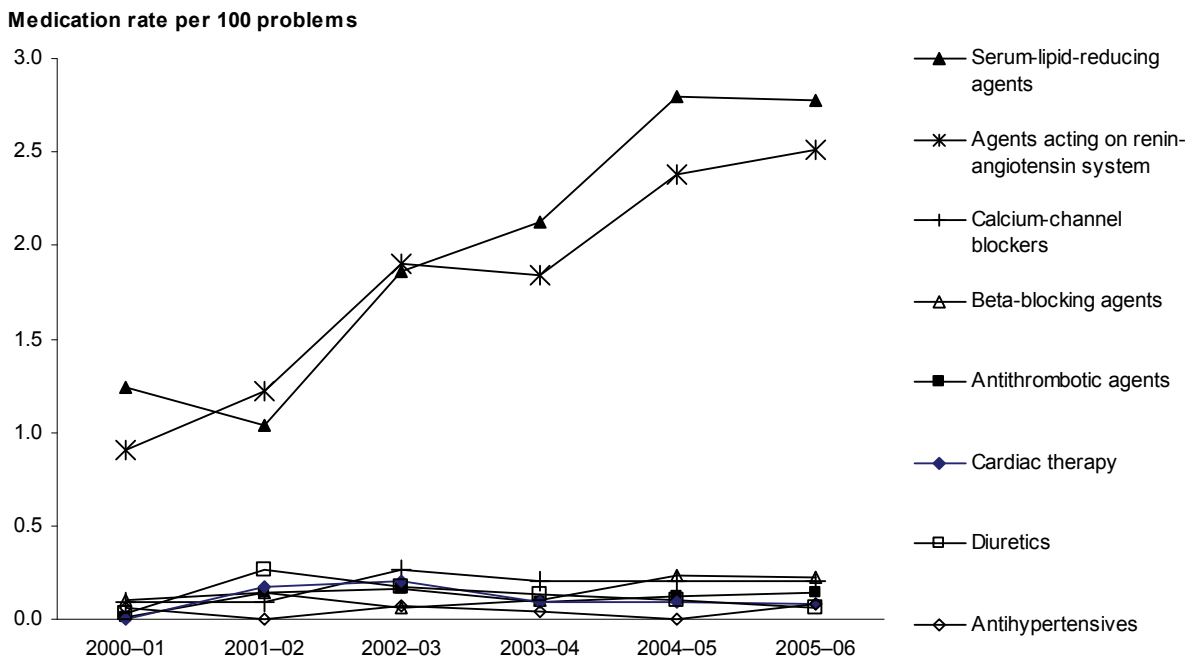
Lipid disorders represented 2.3% of all problems in general practice in 2005–06, with the rate of management of these problems by GPs rising between 2000–01 and 2005–06 (from 2.9 to 3.4 lipid disorder problems managed per 100 encounters). GPs prescribed or supplied serum-lipid-reducing agents in managing lipid disorders at a rate of 68.8 per 100 problems in 2005–06. This rate remained constant over the period 2000–01 to 2005–06 (Figure 10 and Table e2). This means that the increase in overall prescription of serum-lipid-reducing agents (see Figure 6) was due to more lipid disorder problems being managed.

Diabetes accounted for 2.4% of all general practice problems in 2005–06. The rate of management of diabetes by GPs rose between 2000–01 and 2005–06 (from 2.8 to 3.6 diabetes problems managed per 100 encounters). In 2005–06, GPs prescribed or supplied serum-lipid-reducing agents in managing diabetes at a rate of 2.8 per 100 problems and agents acting on the renin–angiotensin system at 2.5 per 100 problems. There was a statistically significant rise (p value <0.0001) in the prescription of both these types of medicines to manage diabetes from 2000–01 to 2005–06 (Figure 11 and Table e3). Nationwide, these changes equate to an estimated 10,000 additional occasions each year when GPs prescribed or supplied agents acting on the renin–angiotensin system for diabetes and the same applies to serum-lipid-reducing agents.



Source: BEACH study (unpublished).

Figure 10: Medicines prescribed or supplied by GPs in managing lipid disorders

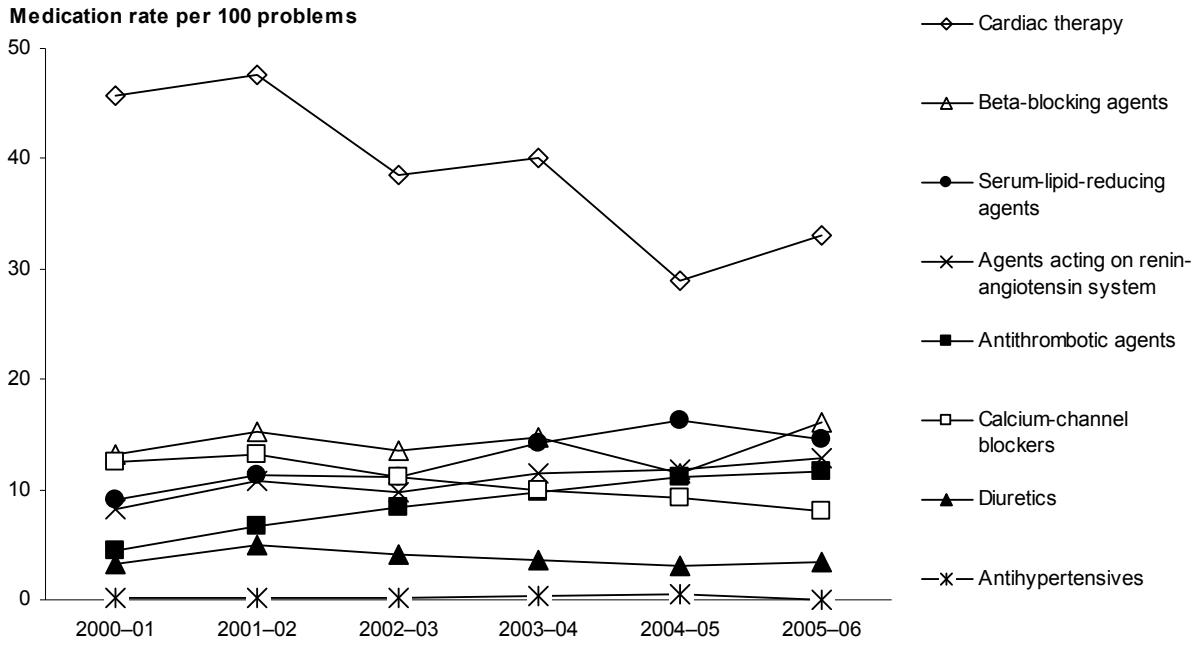


Source: BEACH study (unpublished).

Figure 11: Medicines prescribed or supplied by GPs in managing diabetes

Ischaemic heart disease represented 0.9% of all problems in general practice in 2005–06, with the rate of management of such problems remaining constant over the period 2000–01 to 2005–06 (1.3 ischaemic heart disease problems managed per 100 encounters). In 2005–06, cardiac therapy medicines were the most commonly prescribed or supplied by GPs in managing ischaemic heart disease (33.1 per 100 problems), followed by beta-blocking agents (16.2 per 100 problems), serum-lipid-reducing agents (14.5 per 100 problems), agents acting on the renin–angiotensin system (12.8 per 100 problems), and antithrombotic agents (11.7 per 100 problems) (Figure 12 and Table e4).

Comparing 2005-06 and 2000–01, there were statistically significant differences (p value <0.0001) in the rate of GP prescription and supply of certain medicines: cardiac therapy and calcium-channel blockers fell, while antithrombotic agents and serum-lipid-reducing agents increased (Figure 12). Nationally, these changes amount to an estimated 20,000 additional occasions each year when GPs prescribed or supplied antithrombotic agents for ischaemic heart disease and 10,000 extra occasions for serum-lipid-reducing agents. This suggests GPs are increasingly following recommended guidelines for the treatment of ischaemic heart disease (Therapeutic Guidelines Ltd 2003). Conversely, cardiac therapy medicines were prescribed or supplied for ischaemic heart disease at 40,000 less GP encounters each year and calcium-channel blockers at 10,000 less GP encounters annually.

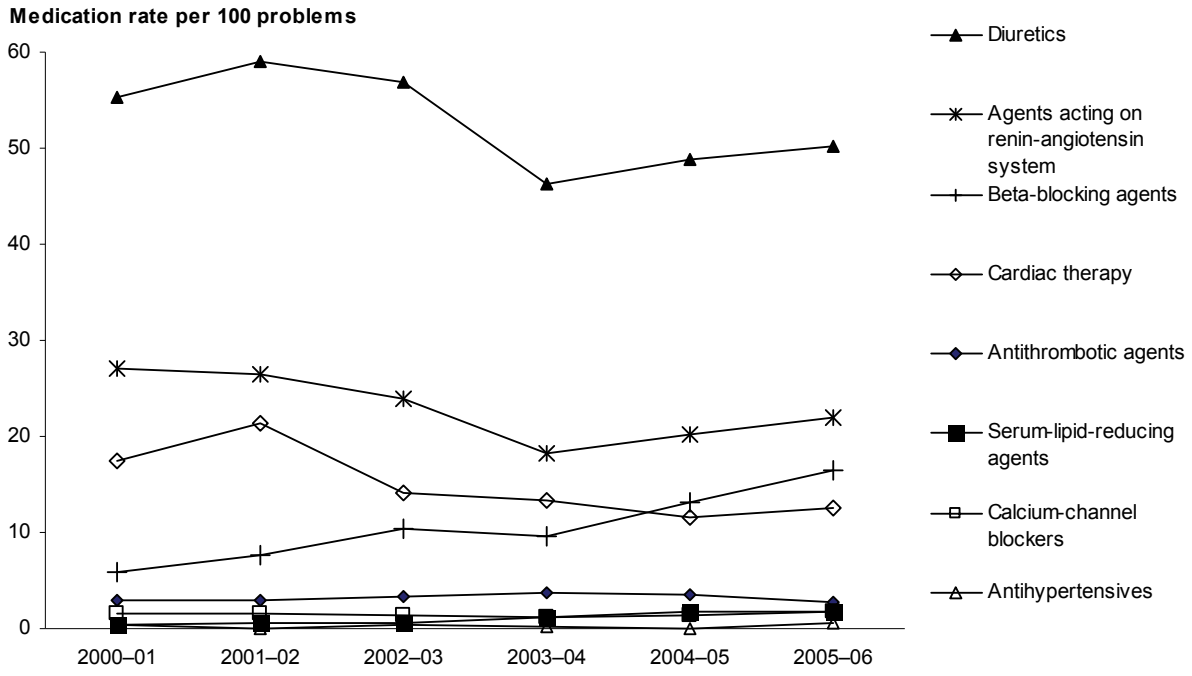


Source: BEACH study (unpublished).

Figure 12: Medicines prescribed or supplied by GPs in managing ischaemic heart disease

Heart failure made up 0.4% of all problems managed in general practice in 2005–06. Between 2000–01 and 2005–06 the rate of management of heart failure problems was constant (0.7 heart failure problems managed per 100 encounters). In 2005–06, GPs prescribed or supplied mostly diuretics in managing heart failure (50.2 per 100 problems), followed by agents acting on the renin–angiotensin system (21.9 per 100 problems), beta-blocking agents (16.5 per 100 problems), and cardiac therapy medicines (12.6 per 100 problems) (Figure 13 and Table e5).

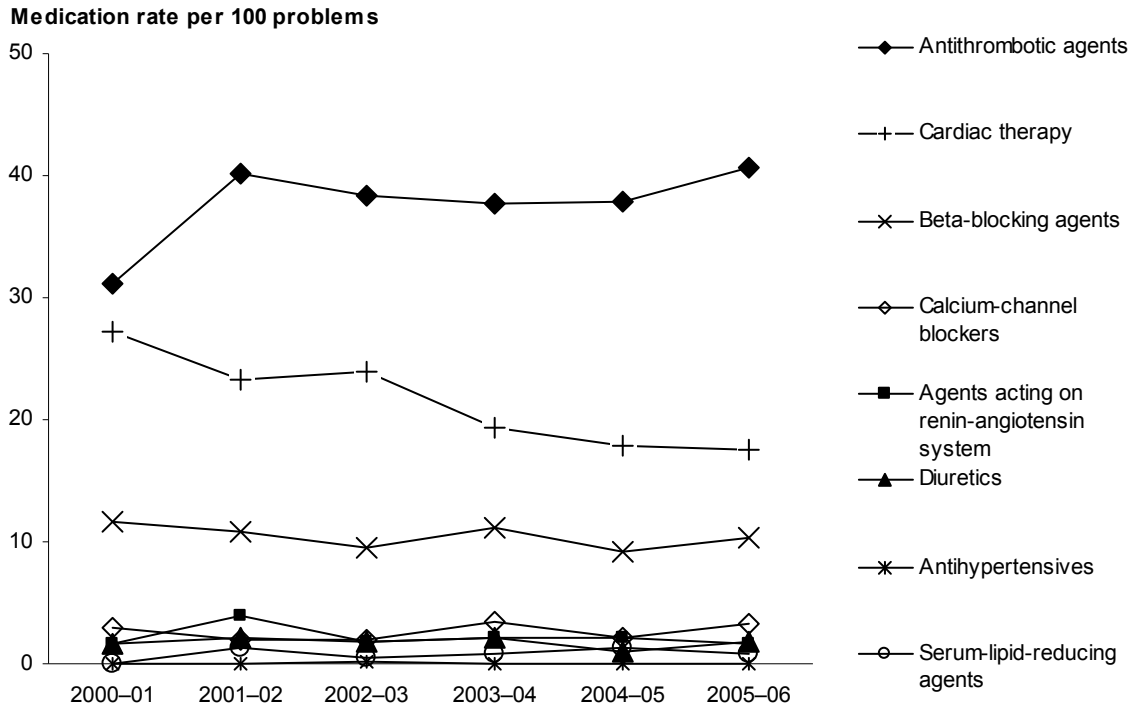
From 2000–01 to 2005–06 there has been a statistically significant increase in the rate at which GPs prescribed or supplied beta-blocking agents for heart failure (p value <0.0001). Nationally, this represents 10,000 extra occasions per year on which these medicines were prescribed or supplied for heart failure. This trend is encouraging in view of the known under-prescription of beta-blocking agents in people with heart failure but their rate of prescription is still relatively low.



Source: BEACH study (unpublished).

Figure 13: Medicines prescribed or supplied by GPs in managing heart failure

Arrhythmias accounted for 0.8% of all general practice problems in 2005–06. The rate of management of such problems rose over the period 2000–01 to 2005–06 (from 0.8 to 1.1 arrhythmia problems managed per 100 encounters). The medicines that GPs prescribed or supplied most frequently in managing arrhythmias in 2005–06 were antithrombotic agents (40.7 per 100 problems), followed by cardiac therapy (17.5 per 100 problems), and beta-blocking agents (10.3 per 100 problems) (Figure 14 and Table e6). There was a statistically significant fall (p value <0.0001) in the rate of GP prescription or supply of cardiac therapy medicines from 2000–01 to 2005–06.

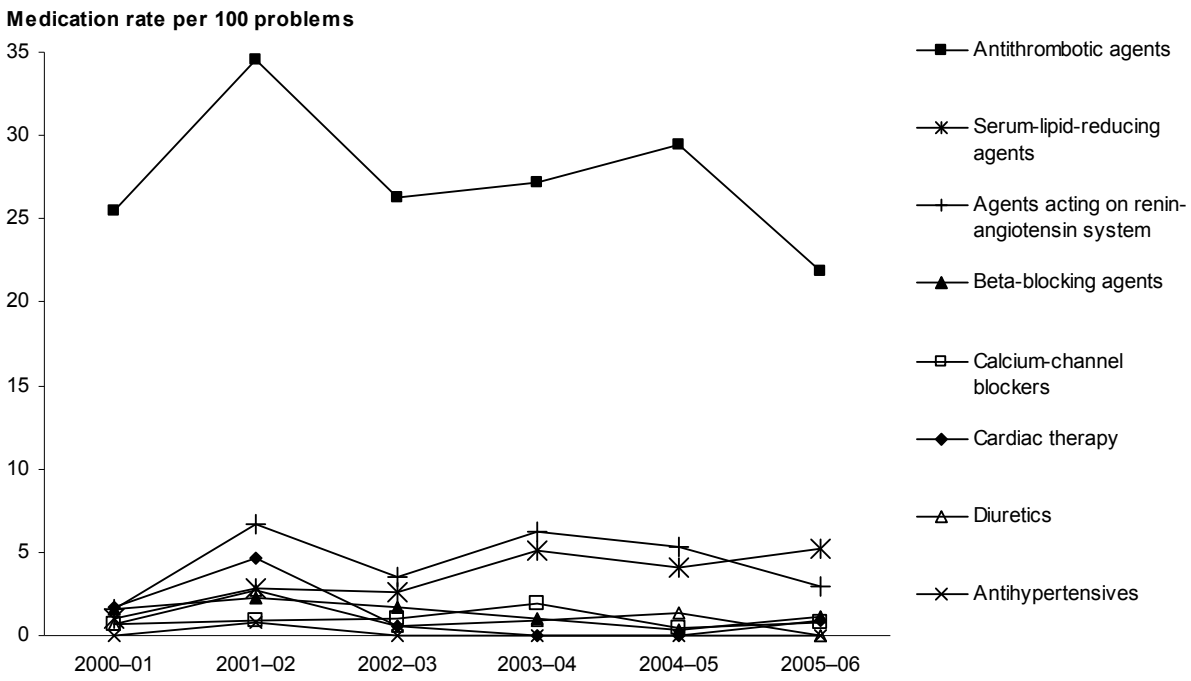


Source: BEACH study (unpublished).

Figure 14: Medicines prescribed or supplied by GPs in managing arrhythmias

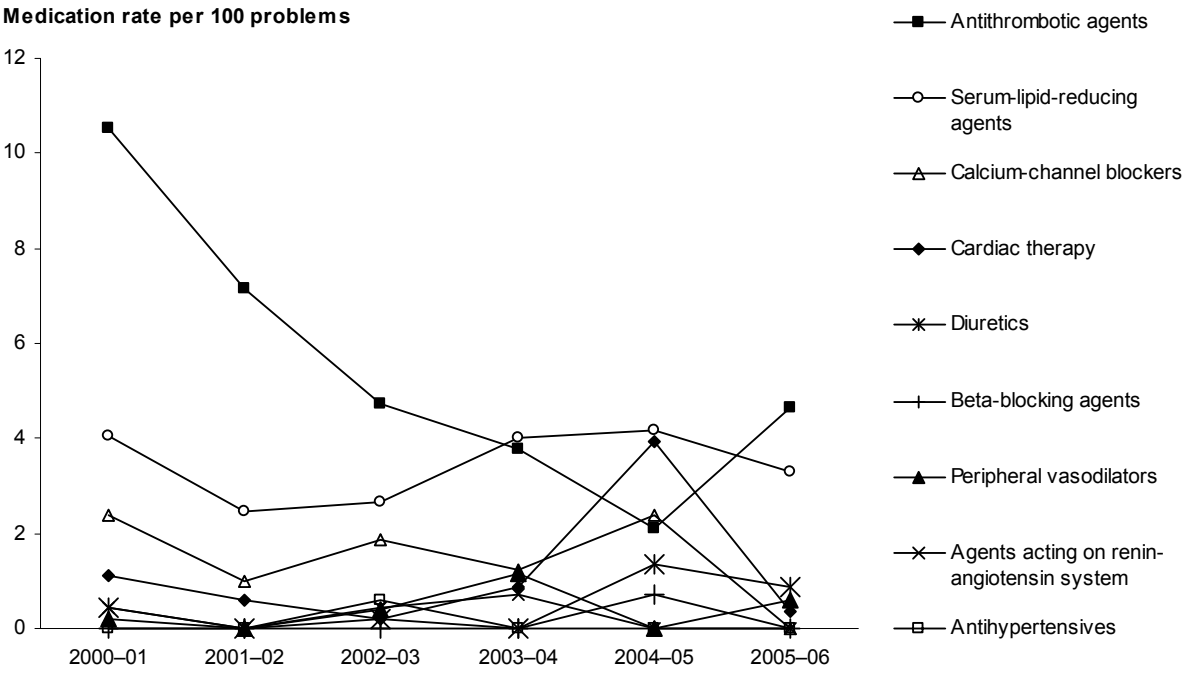
Stroke represented 0.1% of all problems managed in general practice in 2005–06. Between 2000–01 and 2005–06 the rate of management of such problems was relatively constant (0.2 stroke problems managed per 100 encounters). In 2005–06 the most commonly prescribed or supplied medicines in managing stroke were antithrombotic agents (21.8 per 100 problems), followed by serum-lipid-reducing agents (5.2 per 100 problems), and agents acting on the renin–angiotensin system (2.9 per 100 problems) (Figure 15 and Table e7). There were no statistically significant changes in the rate of GP prescription or supply of any medicines for stroke in 2005–06 compared with 2000–01. Note that these results are based on the small number of stroke problems seen in general practice and therefore should be interpreted with caution.

Peripheral vascular disease accounted for 0.1% of all general practice problems in 2005–06, with the rate of management of such problems being stable between 2000–01 and 2005–06 (0.1 problems managed per 100 encounters). Antithrombotic agents (4.7 per 100 problems) and serum-lipid-reducing agents (3.3 per 100 problems) were the medicines GPs prescribed or supplied most frequently in managing peripheral vascular disease in 2005–06 (Figure 16 and Table e8). There were no statistically significant changes observed in the rate of prescription or supply of medicines for peripheral vascular disease from 2000–01 to 2005–06. However, as the number of peripheral vascular disease problems managed by GPs was small, these results should be regarded with caution.



Source: BEACH study (unpublished).

Figure 15: Medicines prescribed or supplied by GPs in managing stroke



Source: BEACH study (unpublished).

Figure 16: Medicines prescribed or supplied by GPs in managing peripheral vascular disease

5.2 Concordance with medicines

Medicines can only be effective if patients actually take them. Concordance with medicines refers to patients using medicines as prescribed, which greatly affects outcomes. For example, people who do not adhere to their medicine therapy are more likely to have uncontrolled blood pressure (Chobanian et al. 2003), and have major cardiovascular events or die (La Rosa et al. 2000, Nelson et al. 2006, Psaty et al. 1990, Rudnicka et al. 2003). Concordance includes:

- compliance—taking medicines at the prescribed interval and dose (note that sometimes the term 'concordance' is used to refer to compliance)
- persistence—continuing taking medicines for the specified treatment period, which is usually lifelong in the case of medicines used to prevent cardiovascular disease or reduce the risk of events such as stroke and heart attack.

This section presents the results of analyses conducted by the Australian Institute of Health and Welfare of compliance and persistence with selected medicines commonly used to prevent and treat cardiovascular disease, in newly prescribed patients studied over 2003–06 using data from the Pharmaceutical Benefits Data System supplied by DoHA. Details of the medicines included, methods used and limitations of the study are given in the Appendix.

HMG COA reductase inhibitors (statins)

Most people dispensed statins in our study were aged 50–79 years, with roughly the same proportions of males and females (52% versus 48%) and more than half being concessional patients (Table 6). Statins were supplied to females at a statistically significant lower rate than for males but the difference was small (411.5 versus 442.4 per 100,000).

People in metropolitan areas were dispensed statins at twice the rate of those living in rural areas, and 30 times the rate of people in remote areas (Table 7). These differences applied to both males and females.

Patients were dispensed statins continuously for a period of 422 days on average (Table 8). At six months from the start of therapy, 83% of patients were persistent with their medicine (that is, one in six patients had discontinued statins), with this proportion dropping to 65% after 24 months (Table 8, Figure A1). These figures are comparable to those of previous studies—56% persistent after 6 months and 50% after 12 months (Benner et al. 2002); 70% persistent after 6 months (Simons et al. 2000).

The proportion of people who persisted with statins was slightly greater among those living in rural areas than in metropolitan or remote areas (85% versus 82%) after six months (Table A2). After 24 months, this pattern remained—68% in rural areas versus 62% in metropolitan or remote areas.

People in the most socioeconomically disadvantaged group were supplied statins at a higher rate than those in the least disadvantaged group—for males the difference was 13% and for females it was 27% (Table A3). The proportion of people who persisted with statins at six months in the most disadvantaged group was statistically significantly lower than that in the least disadvantaged group, although the difference was small (Table A4). This difference remained at 24 months.

In the first 12 months of therapy, 77% of newly prescribed patients were assessed as compliant with statins, that is, they had sufficient medicine to use it at the prescribed frequency and dose.

Agents acting on the renin–angiotensin system

For this group of medicines, analyses were limited to concessional and RPBS patients. Those supplied angiotensin II antagonists (plain or combinations) or ACE inhibitors (plain or combinations) in the study were mostly aged 60 years or over, and women represented a larger proportion than men (Table 6). Females were supplied angiotensin II antagonists at a rate 1.5 times that for males. Supply of ACE inhibitors combinations among females was 1.3 times the rate for males, but the difference was not as marked for plain ACE inhibitors.

People in metropolitan areas were dispensed angiotensin II antagonists at nearly twice the rate of those living in rural areas, and 47–58 times the rate of people in remote areas (Table 7). Supply of ACE inhibitors to people in metropolitan areas was 1.7 times the rate of their counterparts living in rural areas, and 29–36 times the rate in remote areas. These differences were present in both males and females.

On average, patients were continuously supplied with these medicines for a period ranging from 432 days for angiotensin II antagonists combinations to 364 days for ACE inhibitors combinations (Table 8). At six months from commencing medicine treatment, 88–91% of patients persisted with their treatment and after 24 months 75–79% were still taking the medicines, depending on the medicine studied (Table 8, Figure A2). International studies have reported similar results—after 12 months 71% persistent with plain ACE inhibitors, 73% with plain angiotensin II antagonists and 67% with medicine combinations, dropping to 58%, 59% and 50% respectively after 36 months (Perreault et al. 2005); 66% persistent with angiotensin II antagonists at 12 months and 56% at 24 months, 59% persistent with ACE inhibitors at 12 months and 47% at 24 months (Bourgault et al. 2005).

The proportion of people persistent with angiotensin II antagonists at six months was slightly greater in rural areas than in metropolitan areas (Table A2). This difference remained after 24 months. For ACE inhibitors, persistence was greatest among patients living in rural areas and lowest in remote areas after six and 24 months.

In the first 12 months of therapy, 87% of newly prescribed patients were assessed as compliant with ACE inhibitors or plain angiotensin II antagonists, and 89% were compliant with angiotensin II antagonists combinations.

Beta-blocking agents

Only concessional and RPBS patients were included in the study of beta-blockers. People dispensed beta-blocking agents were mainly aged 60 years and over, with similar representation of females and males (52% versus 48%) (Table 6). Females were supplied beta-blockers at a slightly higher rate than males (165.0 versus 149.4 per 100,000).

People in metropolitan areas were dispensed beta-blocking agents at 1.6 times the rate of those living in rural areas, and 31–37 times the rate of people in remote areas (Table 7). These differences applied to both males and females.

The average duration of persistence with beta-blocker treatment was 329 days (Table 8). At six months from the start of therapy, 75% of patients continued filling their prescriptions, falling to 53% at 24 months. International studies have shown comparable results—50% persistent at 12 months and 39% at 24 months (Bourgault et al. 2005); 68% persistent at 12 months and 57% at 36 months (Perreault et al. 2005).

Persistence with beta-blocking agents was slightly greater in rural areas compared with metropolitan areas (77% versus 74%) at six months (Table A2). We observed the same difference after 24 months (55% versus 51%).

Note that in some cases patients are prescribed beta-blocking agents for a limited period and we did not have access to information to identify and exclude those patients from our analysis. Therefore, this may partly account for the large discontinuation rate we found.

Warfarin

Analysis of warfarin supply was limited to concessional and RPBS patients. Most people supplied warfarin were aged 60 years and over, with males and females equally represented (Table 6). There was no difference between males and females in the rate of supply of warfarin.

Males in metropolitan areas were dispensed warfarin at 1.6 times the rate of those living in rural areas, and 36 times the rate of people in remote areas (Table 7). For females, those living in metropolitan areas had 1.9 times the rate of supply of their rural area counterparts and 48 times that of women in remote areas.

On average, patients were dispensed warfarin continuously for a period of 288 days (Table 8). At six months from commencement of therapy, 84% of patients persisted with treatment and by 24 months 57% were still taking the medicine (Table 8, Figure A3). An earlier study showed 85% persistence at 3 months and 77% at 12 months (Hamann et al. 2003).

There was very little difference in the proportion of patients who continued using warfarin in metropolitan, rural or remote areas (Table A2).

Note that in some cases patients are prescribed warfarin for a limited period and we did not have access to information to identify and exclude those patients from our analysis. Hence this may explain part of the large discontinuation rate observed at 24 months.

Other antithrombotic agents

Note that we excluded aspirin from the analysis because it is widely available over-the-counter and this supply is not recorded in the Pharmaceutical Benefits Data System. In addition, aspirin is indicated for other conditions outside the cardiovascular system.

In our study, the group 'other antithrombotic agents' included clopidogrel, dipyridamole and ticlopidine. People dispensed these medicines were mostly aged 60 years and over, with a higher proportion of males than females (59% versus 41%) (Table 6). Males were supplied these antithrombotic medicines at a rate 1.4 times that of females.

People in metropolitan areas were dispensed these antithrombotic agents at twice the rate of those living in rural areas, and 41–47 times the rate of people in remote areas (Table 7). These differences applied to both males and females.

Patients were continuously supplied these antithrombotic agents for a period of 391 days on average (Table 8). After six months of therapy, 90% of patients persisted with these medicines and this proportion fell to 76% after 24 months (Table 8, Figure A3). Previously reported figures are 82% of patients persistent with clopidogrel therapy at 3 months and 62% at 12 months (Hamann et al. 2003).

There was no difference in persistence with these antithrombotic agents in people living in metropolitan, rural or remote areas (Table A2).

People in the most socioeconomically disadvantaged group were supplied these antithrombotic agents at a higher rate than those in the least disadvantaged group—for males the increase was 5% and for females it was 8% (Table A3). The level of persistence with these medicines was similar in all socioeconomic groups (Table A4).

In the first 12 months of therapy, 90% of newly prescribed patients were assessed as compliant with these antithrombotic agents. This means they had enough medicine to take it at the prescribed frequency and dose.

Table 6: Characteristics of the patients studied

	Medicine class							
	HMG COA reductase inhibitors (statins)	Angiotensin II antagonists (plain)	Angiotensin II antagonists (combinations)	ACE inhibitors (plain)	ACE inhibitors (combinations)	Beta-blocking agents	Warfarin	Other antithrombotic agents[a]
Number	619,815	255,177	102,624	323,545	47,624	228,221	93,120	155,445
Age group								
0–39 (%)	5.5	2.6	2.2	3.3	2.9	5.0	4.4	1.5
40–49 (%)	14.7	5.6	5.4	6.0	6.3	6.3	3.8	6.2
50–59 (%)	28.7	12.1	12.9	12.1	13.6	12.7	8.0	16.5
60–69 (%)	25.6	29.5	31.9	27.0	30.2	27.3	24.1	24.6
70–79 (%)	18.0	33.4	33.5	31.1	31.9	30.0	37.1	30.1
80+ (%)	7.6	16.9	14.0	20.4	15.1	18.8	22.5	21.1
Females (%)	48.2	59.2	60.8	52.3	57.4	52.1	49.6	40.7
Males (%)	51.8	40.8	39.2	47.7	42.6	47.9	50.4	59.3
Females (rate) [95% CI]	411.5 (410.0–413.0)	209.5 (208.4–210.5)	86.6 (85.9–87.3)	234.2 (233.1–235.3)	37.9 (37.5–38.4)	165.0 (164.0–165.9)	64.2 (63.7–64.8)	87.4 (86.7–88.1)
Males (rate) [95% CI]	442.4 (440.9–443.9)	142.7 (141.8–143.6)	55.2 (54.6–55.7)	211.1 (210.0–212.1)	27.8 (27.4–28.2)	149.4 (148.5–150.3)	64.1 (63.5–64.7)	125.7 (124.9–126.5)
Patient category								
General (%)[b]	41.6	0.0	0.0	0.0	0.0	0.0	0.0	26.2
Concessional (%)[c]	54.2	92.3	93.5	91.6	93.2	92.0	89.5	66.6
RPBS (%)[d]	4.2	7.7	6.5	8.4	6.8	8.0	10.5	7.2

(a) Includes clopidogrel, dipyridamole and ticlopidine.

(b) Includes general ordinary patients and general patients on safety net.

(c) Includes concessional ordinary patients and concessional patients on safety net.

(d) Includes repatriation patients and repatriation patients on safety net.

Notes

1. Rate per 100,000 population, age standardised to the Australian population at 30 June 2001.
2. The study included newly prescribed patients only. For 'statins' and 'other antithrombotic agents' patients in all categories were included. For all other medicine groups, the analysis was limited to concessional patients and RPBS patients.
3. Age group and category of patients were determined at the time of their first prescription being dispensed.

Source: AIHW analysis of data supplied by DoHA from the Pharmaceutical Benefits Data System.

Table 7: Prescriptions supplied by region of patient residence

Region of residence	Medicine class							
	HMG COA reductase inhibitors (statins)	Angiotensin II antagonists (plain)	Angiotensin II antagonists (combinations)	ACE inhibitors (plain)	ACE inhibitors (combinations)	Beta-blocking agents	Warfarin	Other antithrombotic agents[(a)]
	Rate (95% CI)							
Males								
Metropolitan	285.61 (284.39–286.83)	89.38 (88.69–90.07)	36.19 (35.75–36.63)	125.03 (124.22–125.84)	17.10 (16.80–17.40)	88.71 (88.03–89.39)	38.69 (38.24–39.14)	82.42 (81.76–83.07)
Rural	147.24 (146.37–148.11)	51.41 (50.89–51.92)	18.30 (17.99–18.61)	81.59 (80.94–82.23)	10.13 (9.90–10.36)	57.69 (57.15–58.24)	24.29 (23.94–24.65)	41.29 (40.83–41.75)
Remote	9.55 (9.32–9.77)	1.93 (1.83–2.03)	0.71 (0.65–0.77)	4.35 (4.19–4.49)	0.54 (0.48–0.59)	2.93 (2.80–3.05)	1.06 (0.99–1.14)	1.99 (1.89–2.09)
Females								
Metropolitan	267.56 (266.38–268.75)	134.85 (134.00–135.69)	57.38 (56.82–57.93)	144.43 (143.56–145.30)	23.78 (23.42–24.14)	100.63 (99.89–101.36)	41.46 (40.98–41.93)	57.97 (57.42–58.53)
Rural	136.32 (135.48–137.15)	72.11 (71.49–72.72)	28.27 (27.88–28.65)	85.38 (84.72–86.05)	13.43 (13.16–13.69)	61.48 (60.91–62.05)	21.91 (21.57–22.24)	28.16 (27.78–28.55)
Remote	7.57 (7.37–7.76)	2.49 (2.39–2.61)	0.99 (0.92–1.06)	4.22 (4.07–4.37)	0.71 (0.65–0.77)	2.72 (2.61–2.84)	0.86 (0.79–0.93)	1.24 (1.16–1.32)

(a) Includes clopidogrel, dipyridamole and ticlopidine.

Notes

1. Rate per 100,000 population, age standardised to the Australian population at 30 June 2001.
2. The study included newly prescribed patients only. For 'statins' and 'other antithrombotic agents' patients in all categories were included. For all other medicine groups, the analysis was limited to concessional patients and RPBS patients.
3. Region of residence of patients was determined at the time of their first prescription being dispensed.

Source: AIHW analysis of data supplied by DoHA from the Pharmaceutical Benefits Data System.

Table 8: Persistence with medicines

Medicine class	Number of patients	Average duration of persistence	Proportion of patients persistent at:			
			6 months	12 months	18 months	24 months
		Days	Per cent (95%CI)			
HMG COA reductase inhibitors (statins)	619,815	422	83.44 (83.34–83.54)	74.65 (74.53–74.77)	68.97 (68.83–69.11)	64.92 (64.77–65.07)
Angiotensin II antagonists (plain)	255,177	393	88.79 (88.66–88.92)	82.38 (82.21–82.55)	78.13 (77.93–78.33)	74.89 (74.66–75.12)
Angiotensin II antagonists (combinations)	102,624	432	90.86 (90.67–91.05)	85.86 (85.62–86.10)	81.95 (81.66–82.23)	79.19 (78.86–79.51)
ACE inhibitors (plain)	323,545	369	88.38 (88.26–88.50)	82.13 (81.97–82.29)	77.99 (77.81–78.17)	74.81 (74.60–75.02)
ACE inhibitors (combinations)	47,624	364	90.62 (90.33–90.90)	85.43 (85.05–85.80)	81.65 (81.19–82.10)	78.82 (78.29–79.34)
Beta-blocking agents	228,221	329	75.15 (74.96–75.34)	63.66 (63.43–63.89)	57.26 (57.01–57.51)	52.89 (52.62–53.16)
Warfarin	93,120	288	83.75 (83.49–84.01)	71.94 (71.57–72.31)	63.23 (62.78–63.68)	56.60 (56.08–57.11)
Other antithrombotic agents[(a)]	155,445	391	90.02 (89.86–90.18)	83.87 (83.65–84.08)	79.42 (79.16–79.68)	76.08 (75.78–76.37)

(a) Includes clopidogrel, dipyridamole and ticlopidine.

Note: The study included newly prescribed patients only. For 'statins' and 'other antithrombotic agents' patients in all categories were included. For all other medicine groups, the analysis was limited to concessional patients and RPBS patients.

Source: AIHW analysis of data supplied by DoHA from the Pharmaceutical Benefits Data System.

As stated earlier, the medicines included in this study of concordance were selected because they are usually indicated for lifelong use in the prevention and treatment of cardiovascular disease. However, we observed that a considerable proportion of newly prescribed patients were dispensed one script only for these types of medicines, ranging from 14% to 27% (Table 9). Assuming patients were dispensed the cheapest PBS item in the relevant medicine class, this equates to a minimum cost to government and patients of $7.4 million. It is likely that this early discontinuation of medication is due to side effects that occur in the first month of therapy. Although the rates of side effects with many of these medicines are low in clinical trials, patients in the real world may attribute side effects to medicines more commonly and stop taking them.

Table 9: Newly prescribed patients dispensed one prescription only

Medicine class	Total newly prescribed patients (number)	Newly prescribed patients dispensed one script only		Minimum cost for patients dispensed one script only [(a)] ($)
		(number)	% of total newly prescribed patients	
Beta-blocking agents	393,879	105,460	26.8	834,189
ACE inhibitors (combinations)	61,701	11,462	18.6	265,918
ACE inhibitors (plain)	416,001	69,619	16.7	960,742
Warfarin	116,698	18,497	15.9	143,907
Other antithrombotic agents[(b)]	197,389	31,093	15.8	1,016,741
Angiotensin II antagonists (combinations)	127,190	18,962	14.9	414,130
Angiotensin II antagonists (plain)	317,389	46,862	14.8	908,186
HMG COA reductase inhibitors (statins)	792,338	110,022	13.9	2,857,271
Total				**7,401,084**

(a) Assumes that patients who filled one script only were dispensed the cheapest preparation in the relevant medicine class available on the Pharmaceutical Benefits Scheme in 2006. Calculations used 2006 prices.

(b) Includes clopidogrel, dipyridamole and ticlopidine.

Note: For 'statins' and 'other antithrombotic agents' patients in all categories were included. For all other medicine groups, the analysis was limited to concessional patients and RPBS patients.

Source: AIHW analysis of data supplied by DoHA from the Pharmaceutical Benefits Data System.

Overall, the results of our study indicate a high level of discontinuation of medicines that are generally intended to be taken long-term. This represents a significant waste of resources and a lost opportunity to prevent cardiovascular disease with medicines known to be effective. Note that due to the limitations of the data set, discontinuation rates may have been over-estimated to some extent (see Methods section in the Appendix for details).

Previous research has shown that, across a wide range of medical disorders, about 75% of medicines are taken as prescribed, and that compliance decreases as the number of daily doses increases (Cramer 2002, Claxton et al. 2001).

Factors associated with poor concordance with medicines include:

- treatment of a condition with no symptoms (such as high blood pressure and high blood cholesterol)
- presence of depression
- inadequate follow-up or discharge planning

- side effects of medicine
- poor communication between health professional and patient
- patient's lack of understanding of their condition
- patient's lack of belief in the benefit of treatment
- complexity of treatment
- missing doctor's appointments and
- cost of medicines (Osterberg et al. 2005, WHO 2003).

We do not have access to patient information that would allow us to explore the reasons for discontinuing medicine treatment in our study. The fact that for the most part our analyses were confined to concessional patients, for whom out-of-pocket expenses on medicines would be relatively low, suggests that cost does not play a big role. However, research indicates that one in five sicker Australians omits a medicine owing to cost (Schoen et al. 2005).

According to international studies, people with a history of coronary heart disease, stroke, heart failure, diabetes or hypertension are more likely to keep taking lipid-lowering and blood-pressure-lowering medicines than those without these conditions (Benner et al. 2002, Chapman et al. 2005). As patients' medical histories are not recorded in national databases in Australia, we were unable to look into this issue in our analyses.

5.3 National Prescribing Service initiatives

The National Prescribing Service (NPS) conducts a range of initiatives to promote quality use of medicines (National Prescribing Service 2004, 2005). For more information on the NPS, see the Appendix. Among NPS activities relating to cardiovascular disease medicines are:

- education and quality assurance programs for health professionals using a range of publications and interventions, including clinical audits, education visiting, peer group discussions and case studies. Over the period 1999–2004, a considerable proportion of GPs has participated in such a program covering hypertension (52%), lipid disorders (37%), heart failure (15%), antithrombotics (6%), as well as multiple medicine use (7%) and medicine reviews (8%). Note that these figures cannot be added together as GPs may have participated in more than one program activity.
- publications for health professionals on newly listed or revised cardiovascular medicines.
- telephone advice line for health professionals (Therapeutic Advice and Information Service) and for consumers (Medicines Line), where cardiovascular medicines are a frequent topic. Calls relate mostly to medicine interactions and adverse drug reactions.
- information material for consumers on self-management of heart failure
- information program for consumers to encourage older people to be more active in managing their medicines
- Medicines List to help consumers who take multiple medicines keep track of their medicines.

Clinical audits provide an opportunity for GPs to reflect on their prescribing practice. One-fifth of Australian GPs had reviewed their management of hypertension through NPS

clinical audits between 1999 and 2004. For management of lipid disorders, the corresponding proportion was one-tenth.

A NPS study involved 5,247 GPs who voluntarily participated in one of four clinical audits on hypertension held in 1999, 2001, 2003 and 2004, and provided self-reported data for 105,086 adult patients with a history of hypertension (National Prescribing Service, unpublished). The objectives of the audits were to review management of hypertension against guidelines, identify ideal target blood pressure for individual patients and optimise blood pressure control, and review the selection of antihypertensive medicine.

Note that as GPs participating in the clinical audits were self-selected and the data were self-reported, the sample of GPs or their patients may not represent the whole of Australia and therefore these results may not be generalised and we should be cautious when interpreting them. For some measures, the survey questions changed over time and direct year-to-year comparisons are not entirely appropriate, but the results give an indication of the trends.

Results showed that management of hypertension in general practice had improved between 1999 and 2004. Target blood pressures were likely to be consistent with guideline recommendations and more patients were achieving control of their blood pressure—70% in 2004. The proportion of patients using one blood-pressure-lowering medicine fell from 52% in 1999 to 45% in 2004, in favour of combinations of medicines (data not shown).

The most commonly prescribed agents with blood-pressure-lowering effect were ACE inhibitors, calcium-channel blockers and beta-blockers (Table 10). The increasing use of combination products resulted in increasing overall use of low-dose thiazide diuretics, ACE inhibitors and angiotensin II antagonists.

Table 10: Medicines with blood-pressure-lowering effect prescribed

Type of antihypertensive medicine prescribed	1999	2001	2003	2004
		Per cent of patients		
Low-dose thiazide diuretics	14	11	10	10
High-dose thiazide diuretics	7	7	5	4
Beta-blocking agents	24	24	24	24
Calcium-channel blockers	37	33	33	31
ACE inhibitors	46	41	36	36
Low-dose thiazide and ACE inhibitor combination	n/a	6	9	10
Angiotensin II antagonists	13	17	20	22
Low-dose thiazide and angiotensin II antagonist combination	n/a	8	13	14
Alpha-blocking agents	4	3	3	3
Other antihypertensive medicines	12	6	4	5

Source: National Prescribing Service, unpublished.

In accordance with guidelines (Therapeutic Guidelines Ltd 2003), there was an increase in patients using a blood-pressure-lowering medicine most suited to their coexisting health conditions (58% in 1999 versus 81% in 2004). However, the proportion of patients with coexisting heart failure prescribed ACE inhibitors was low at 54–62% (Table 11). Similarly, fewer than 52% of patients with a history of myocardial infarction were prescribed beta-blockers or ACE inhibitors. GPs reported simultaneous use of medicines known to

exacerbate hypertension in 24% of patients in 2001, 19% in 2003 and 17% in 2004. Complementary medicines that could raise blood pressure were reported in 1–2% of patients with hypertension.

Table 11: Patients with hypertension and a coexisting condition prescribed blood-pressure-lowering medicines with favourable or unfavourable effects on coexisting conditions

Coexisting condition	Medicines with effect on coexisting condition	2001	2003	2004
	Favourable effect	**Per cent of patients**		
Heart failure	ACE inhibitor	58	62	54
	Beta-blocking agent	26	35	32
Microalbuminuria/proteinuria	ACE inhibitor or angiotensin II antagonist	n/a	39	45
Previous myocardial infarction	Beta-blocking agent	49	45	49
	ACE inhibitor	52	50	51
	Beta-blocking agent plus ACE inhibitor	23	23	26
Angina	Beta-blocking agent or calcium-channel blocker	76	64	45
	Unfavourable effect			
Bradycardia	Beta-blocking agent	22	23	21
Bilateral renal stenosis	ACE inhibitor or angiotensin II antagonist	41	54	32

Source: National Prescribing Service, unpublished.

5.4 National Institute of Clinical Studies initiatives

The National Institute of Clinical Studies (NICS) has initiated a range of activities to improve clinical practice in Australia. For more information on NICS, see the Appendix. Two NICS initiatives relating to cardiovascular disease medicines are described here.

Reducing time to thrombolysis

Forty-seven hospitals came together in 2002 to form a national emergency department collaborative whose aim was to develop and implement programs that would reduce waiting times for treatment, including time to thrombolysis (National Institute of Clinical Studies 2004a). There is overwhelming evidence that early thrombolysis (treatment with clot-busting medicines) leads to less morbidity and deaths in patients with myocardial infarction. While patients get benefit from treatment up to 12 hours after the onset of symptoms, the beneficial effect is substantially higher if patients are treated within 90 minutes of the onset of symptoms.

The Australian national benchmark for time from assessment in the emergency department to start of thrombolysis ('door-to-needle' time) is 30 minutes. In South Australia three emergency departments participated in the collaborative, resulting in their average time to thrombolysis dropping from 58 minutes to 44 minutes, with 75% of patients receiving thrombolysis within 30 minutes after the collaborative, compared with 16% previously. Each organisation used different models and developed processes that suited them to achieve these improvements.

Heart failure

NICS developed a program to improve the quality of care for people with heart failure, which had been identified as an area with major gaps between actual clinical practice and best practice (National Institute of Clinical Studies 2004b). It is a collaboration with the National Prescribing Service, National Heart Foundation of Australia and Divisions of General Practice.

As part of the program, NICS conducted a study to identify barriers to managing heart failure in general practice (Phillips et al. 2004). Concerns about possible side effects of the medicines and lack of awareness of their effectiveness were common reasons for suboptimal use of ACE inhibitors. Under-use of beta-blocking agents was due mainly to concerns about side effects, contraindications and coexisting conditions, being unaware of their value and lack of experience initiating treatment with these medicines.

Among other objectives, the program encourages doctors to prescribe appropriate medicines at optimal doses, particularly ACE inhibitors and beta-blocking agents, through a range of interventions. Evaluation results of the program will be available in 2007.

5.5 National Primary Care Collaboratives

The Australian Primary Care Collaboratives program, an initiative of the Australian Government Department of Health and Ageing, aims to improve clinical health outcomes, reduce lifestyle risk factors and maintain good health in people with chronic and complex conditions. Its initial focus is on promoting quality improvement in primary health care in the prevention, management and underpinning clinical and business systems relating to cardiovascular disease and diabetes. Program activities started in February 2005 (National Primary Care Collaboratives 2006).

Results to date for participating practices show marked improvements in the:

- proportion of patients with coronary heart disease taking aspirin
- proportion of patients with coronary heart disease taking a statin (cholesterol-lowering agent)
- proportion of patients who had a myocardial infarction in previous year taking beta-blocking agents
- proportion of patients with coronary heart disease with blood pressure below 140/90 mm Hg (Table 12).

Table 12: Quality practices in management of coronary heart disease among participants in Australian primary care collaboratives

Indicator	Group 1		Group 2	
	At start	After 17 months	At start	After 9 months
	Per cent			
Patients with coronary heart disease taking aspirin	43	66	54	62
Patients with coronary heart disease taking a statin	41	73	62	71
Patients who had a myocardial infarction in previous year taking beta-blocking agents	29	63	41	64
Patients with coronary heart disease with blood pressure below 140/90 mm Hg	36	51	30	48

Notes

1. 157 general practices participated in Group 1 and 159 in Group 2 nationally. The mean of the results from all participating practices is shown.
2. Results shown here are current at the time of preparing this report but the collaboratives are continuing so more recent information will be available in future.

Source: National Primary Care Collaboratives 2006.

5.6 Section 100 initiative

Despite Indigenous Australians having poorer health than other Australians, expenditure on PBS medicines among Indigenous people was one-third that for other Australians in 2001–02 (AIHW 2005). The supply of PBS medicines to remote area Aboriginal and Torres Strait Islander Health Services under Section 100 of the National Health Act of 1953 is an initiative introduced in 1999 to improve access to PBS medicines for Indigenous people.

Under these arrangements, patients attending approved remote area Aboriginal and Torres Strait Islander Health Services are able to get medicines from an on-site dispensary at the health service, without the need for a prescription form and without charge.

In 2001–02 the Australian Government spent $35.9 million on all medicines for Indigenous people, including $10.9 million on PBS medicines supplied under Section 100 arrangements to remote area Aboriginal and Torres Strait Islander Health Services, compared with $4,671.4 million and $1.2 million for non-Indigenous people respectively (AIHW 2005).

The Section 100 arrangements benefit 36% of the Aboriginal and Torres Strait Islander population and have resulted in an increase of $36.4 million expenditure on PBS medicines for Indigenous people from 2000–01 to 2002–03 associated with, for example, increased access to ACE inhibitors (Kelaher et al. 2004).

5.7 Drug-adverse events

Drug-adverse events are medicine problems that result in harm to the patient. They may arise from over-use and under-use of medicines, as well as from reactions to medicines and interactions between medicines. Although there may be a low likelihood of individual drug-adverse events occurring, the large numbers of people taking medicines increase the potential for events and presents a major problem. The risk is higher for people taking

multiple medicines, particularly older people. It has been estimated that 2–3% of all unplanned hospitalisations in Australia are related to medicines, rising to about 20% among people aged over 65 years (Australian Council for Safety and Quality in Health Care 2002). Medicines for heart disease and hypertension and anticoagulants are among the most commonly involved indrug-adverse events.

According to a survey run in South Australia, 52% of respondents used complementary medicines in 2004, 50% had used conventional medicines on the same day, and 53% did not report the use of complementary medicines to their doctor (MacLennan et al. 2006). It is not unusual for younger women to give complementary medicines to older relatives with chronic diseases without first checking safety of interactions with conventional medicines (Gowan 2006).

One in ten patients presenting to a GP has had a medicine incident in the preceding six months, defined as an 'unintended event due to the use of medicine that could have harmed or did harm the patient' (Miller et al. 2006). About 8% of these patients were hospitalised as a result and GPs thought 23% of all medicine incidents could have been prevented. The most common reason given for a medicine incident was a recognised medicine side effect (72%), followed by medicine sensitivity (12%) and allergy (11%).

Factors that may lead to drug adverse events in hospital include omission of therapy, overdose, administration of the wrong medicine, failure to read or misreading the patient chart, prescription errors, and dispensing errors in hospital pharmacies. In general practice, there may be communication problems, inadequate review of patient history, lack of protocols, or errors in assessment leading to the use of an inappropriate medicine or dose, prescribing errors and administration errors. Problems with medicines may also arise from lack of communication in the transition between hospital and community care, and when patients consult several health care providers who may not know the patient's full medical history and medicines they are taking (Australian Council for Safety and Quality in Health Care 2002).

Information on deaths and hospitalisations associated with drug-adverse effects is available from the National Mortality Database and the National Hospital Morbidity Database, respectively. The data shown here refer to the ICD-10 and ICD-10-AM codes defined as 'drugs, medicaments and biological substances causing adverse effects in therapeutic use' and are limited to those medicines that are relevant to cardiovascular disease. This category includes correct medicine properly administered in a therapeutic or prophylactic dose as the cause of any adverse effect. It excludes accidents in the technique of administration of medicines, accidental overdoses of medicines, wrong medicines given or taken in error, and medicines taken inadvertently.

In 2004 there were 301 deaths with adverse effects of medicines that may be used to prevent or treat cardiovascular disease recorded (Table 13). Drug-adverse effects were the underlying cause in 29 deaths (9.6%) and an associated cause in 272 deaths (90.4%), indicating that for most of these deaths the drug-adverse effect was not considered the main cause of death. Anticoagulants were the medicines most commonly reported as causes of death.

Table 13: Deaths with adverse effects of medicines used to prevent or treat cardiovascular disease, 2004

Medicine class (ICD-10 code)	Underlying cause deaths	Associated cause deaths	Total deaths
Anticoagulants (Y44.2)	19	211	230
Anticoagulant antagonists, vitamin K and other coagulants (Y44.3)	0	21	21
Thrombolytic drugs (Y44.5)	0	10	10
Salicylates (Y45.1)	4	10	14
β-Adrenoreceptor antagonists, not elsewhere classified (Y51.7)	1	1	2
Cardiac-stimulant glycosides and drugs of similar action (Y52.0)	0	5	5
Other antidysrhythmic drugs, not elsewhere classified (Y52.2)	4	9	13
Angiotensin-converting-enzyme inhibitors (Y52.4)	1	1	2
Antihyperlipidaemic and antiarteriosclerotic drugs (Y52.6)	0	2	2
Loop (high-ceiling) diuretics (Y54.4)	0	1	1
Other diuretics (Y54.5)	0	1	1
Total	**29**	**272**	**301**

Notes

1. Some of the medicines listed in this table are used to treat a range of conditions outside the cardiovascular system. The particular condition for which the medicine was indicated is not recorded.
2. Underlying cause of death is the disease or injury initiating the sequence of events leading to death, that is, the main cause.
3. Associated cause of death is any disease or injury, other than the underlying cause of death, contributing to death.

Source: AIHW National Mortality Database.

There were 28,449 hospital separations with codes for adverse effects of medicines that may be used to treat or prevent cardiovascular disease recorded in 2004–05, representing 0.4% of all separations and 32% of all separations with adverse effects of any medicine (Table 14). Their number increased with age, with 81% of such hospitalisations occurring in patients aged 65 years and over. This probably reflects the fact that older people are both more likely to take medicines and to be hospitalised. Anticoagulants were the most commonly recorded medicines with adverse effects, accounting for 32% of the total (9,127 separations), followed by cardiac-stimulant glycosides and medicines of similar action (3,223 separations). Overall, most drug-adverse events occurred in hospital (42–91%), but up to 18% happened at home, depending on the medicine class considered. The proportion of hospitalisations with codes for adverse effects of medicines used to treat or prevent cardiovascular disease remained constant from 2003–04 to 2004–05.

A study conducted in Western Australia showed that between 1991 and 2002, rates of drug-adverse events causing admission to hospital or extending hospital stay doubled for people aged 60 years and over (Burgess et al. 2005). In those aged 80 years and over, the increase was even more marked and cardiovascular medicines were the most frequently associated with hospitalisations with drug-adverse events. For people aged 60 years and over, anticoagulants were the most common medicines implicated in drug-adverse events causing hospitalisation in 2002 and had had the largest increase over time.

Table 14: Hospitalisations with adverse effects of medicines used to prevent or treat cardiovascular disease, 2003–04 and 2004–05

	Number separations	
Medicine class (ICD-10-AM code)	**2003–04**	**2004–05**
Anticoagulants (Y44.2)	8,587	9,127
Anticoagulant antagonists, vitamin K and other coagulants (Y44.3)	115	71
Antithrombotic drugs (Y44.4)	37	364
Thrombolytic drugs (Y44.5)	146	91
Salicylates (Y45.1)	1,334	1,259
Predominantly β-adrenoreceptor antagonists, not elsewhere classified (Y51.5)	206	204
α-Adrenoreceptor antagonists, not elsewhere classified (Y51.6)	105	115
β-Adrenoreceptor antagonists, not elsewhere classified (Y51.7)	2,411	2,707
Cardiac-stimulant glycosides and drugs of similar action (Y52.0)	2,803	3,223
Calcium-channel blockers (Y52.1)	739	792
Other antidysrhythmic drugs, not elsewhere classified (Y52.2)	1,217	1,363
Coronary vasodilators, not elsewhere classified (Y52.3)	1,254	1,222
Angiotensin-converting-enzyme inhibitors (Y52.4)	1,445	1,564
Other antihypertensive drugs, not elsewhere classified (Y52.5)	2,443	2,803
Antihyperlipidaemic and antiarteriosclerotic drugs (Y52.6)	303	395
Peripheral vasodilators (Y52.7)	56	68
Antivaricose drugs, including sclerosing agents (Y52.8)	10	14
Other and unspecified agents primarily affecting the cardiovascular system (Y52.9)	119	118
Benzothiadiazine derivatives (Y54.3)	441	508
Loop (high-ceiling) diuretics (Y54.4)	773	846
Other diuretics (Y54.5)	1,588	1,595
Total separations with adverse effects of medicines used to treat or prevent CVD	**26,132**	**28,449**
Total separations with adverse effects of any medicine	**83,022**	**90,371**
Total separations	**6,841,225**	**7,018,850**

Notes

1. Some of the medicines listed in this table are used to treat a range of conditions outside the cardiovascular system. The particular condition for which the medicine was indicated is not recorded.
2. Hospitalisations with adverse effects of medicines coded as a principal or additional diagnosis are shown.

Source: AIHW National Hospital Morbidity Database.

Australian Council for Safety and Quality in Health Care initiatives

The former Australian Council for Safety and Quality in Health Care (now Australian Commission on Safety and Quality in Health Care) identified various strategies shown to reduce medicine problems. These include:

- computerised prescribing by doctors with clinical decision support systems
- computerised drug-adverse event alerts
- individual patient medicine supply in hospitals, where medicines are labelled, supplied and stored for individual patients

- clinical pharmacy services, which provide patient and staff education
- monitoring and medicine review
- effective transfer of information between hospital and community settings
- community-based medicine management and case conferencing, and
- discharge medicine management (Australian Council for Safety and Quality in Health Care 2004).

The Council sponsored a national medication safety breakthrough collaborative aimed at reducing patient harm associated with medicines by 50% in participating facilities (Australian Council for Safety and Quality in Health Care 2005). The collaborative began in September 2003 with 100 teams from all states and territories focussing on medicine processes in acute hospitals and improving medicine practices at the interface between acute hospitals and the community. Many teams achieved a 50% reduction in harm in the area they chose, such as antithrombotic agents and cardiovascular medicines. Strategies used included:

- taking a multidisciplinary approach to improvement
- implementing education programs to raise awareness
- revising systems with the potential to cause harm
- developing tools to reduce medicine omission
- developing systems to identify patients at risk of medicine mismanagement or harm
- developing guidelines for using high-risk medicines
- using patient information material and medicine cards to keep patients informed and involved in their own medicine management, and
- implementing systems for communication with general practitioners.

This initiative is now disseminating knowledge of successful practices to others.

Veterans' MATES

The Australian Government Department of Veterans' Affairs developed the Veterans' Medicines Advice and Therapeutics Education Services (Veterans' MATES) program to improve the use of medicines in the veteran community. The program uses data from RPBS prescription claims to identify veteran patients who may be at risk of drug-adverse events and provides information that may help improve the management of patients' medicines. Veterans' GPs are the main focus of the program, but it also involves patients, their carers, community pharmacists and other specialists to encourage better communication and raise awareness of patients' chronic conditions (Department of Veterans' Affairs 2006).

The program is delivered in modules every three months. Modules delivered to date include:

- a review of medicines among veterans who use five or more medicines each month to discuss the medicines being taken and why, and how patients were managing medicines and if there were any unwanted side effects (38,500 patients and their 11,000 doctors)
- medicines for heart failure (13,000 patients and their 6,500 doctors)
- heart medicines for patients with diabetes (17,500 patients, their 8,000 doctors and 5,000 community and hospital pharmacies)
- arthritis medicines and their risks for patients with heart failure or diabetes

- using multiple medicines safely (46,000 patients and their 12,500 doctors).

Home medicines reviews

The Australian Government introduced the Home Medicines Review (HMR) in October 2001. The HMR is a program where the patient's GP and a pharmacist collaboratively review their use of medicines and develop an agreed medicine management plan. It usually entails a visit to the patient's home by a pharmacist accredited to conduct medicine reviews, after a referral from the patient's GP and consent from the patient.

The objectives of the HMR are: to detect and resolve potential medicine-related problems that interfere with the desired health outcomes for the patient; to promote collaboration between the patient, their carer where appropriate, the GP, pharmacists and other relevant health professionals to improve the patient's health and quality of life; and to improve patients' and health professionals' knowledge and understanding about medicines.

An Australian study found that HMRs resolved medicine related problems in 56% of cases and in a further 20% the problem had improved at follow-up (Gilbert et al. 2002).

From the start of the program to April 2005 there were over 70,000 HMRs conducted nationally (Urbis Keys Young 2005). About 74% of HMRs were for people aged 65 years and over, and 62% were provided to women. Older men, young people with chronic disease, Indigenous Australians, people living in rural and remote areas, and people from diverse cultural and linguistic backgrounds have to date tended to have less access to HMRs than other Australians. Only about 15% of GPs have made referrals for HMRs so far, indicating that HMRs have not been used by a large number of patients who might benefit from them.

6 Expenditure on cardiovascular medicines

In 2005 the Australian Government spent $1.8 billion on 'cardiovascular system' medicines, accounting for 31% of the total spent on all pharmaceuticals for which benefits were paid. In addition, government expenditure on 'blood and blood-forming organs' medicines was $214 million in that year, representing 4% of the total (Table A5).

Serum-lipid-reducing agents (mainly statins) accounted for 55% of the total government expenditure on cardiovascular system medicines in 2005, while agents acting on the renin–angiotensin system represented 25%. Platelet aggregation inhibitors excluding heparin (such as aspirin) accounted for 86% of the total spent on blood and blood-forming organs medicines in that year.

Four medicines indicated for cardiovascular disease were among the top ten by cost to the Australian Government in 2005 (Table 15). The cholesterol-lowering medicines atorvastatin and simvastatin were ranked first and second, costing $481 million and $352 million, respectively.

Table 15: Top ten prescription medicines by cost to the Australian Government, 2005

Rank	Medicine	Action	Number of PBS/RPBS prescriptions ('000)	Cost to Australian Government ($million)
1	atorvastatin*	Lowers blood cholesterol	8,439	481
2	simvastatin*	Lowers blood cholesterol	6,318	352
3	omeprazole	Lowers gastric acid	4,334	169
4	salmeterol and fluticasone	Opens airways	2,817	166
5	clopidogrel*	Antiplatelet agent	2,038	159
6	esomeprazole	Lowers gastric acid	3,296	157
7	olanzapine	Antipsychotic agent	725	151
8	alendronic acid	Lowers bone breakdown	2,211	112
9	pravastatin*	Lowers blood cholesterol	2,062	112
10	pantoprazole	Lowers gastric acid	2,655	105

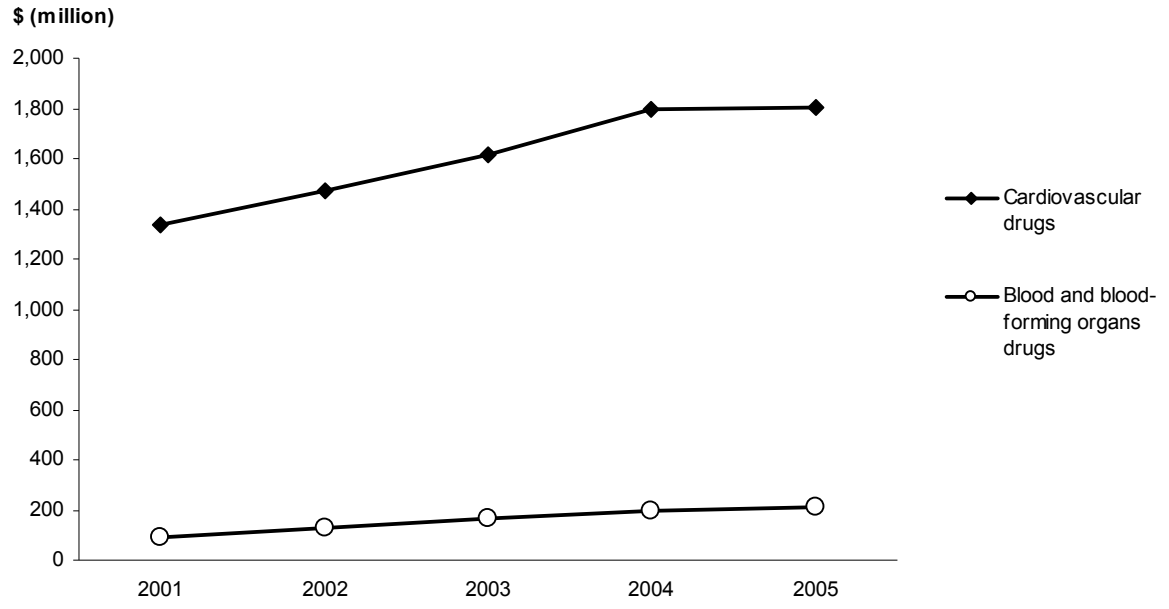
Note: * Denotes medicine indicated for cardiovascular disease.

Source: Pharmaceutical Benefits Data System, DoHA (unpublished).

Over the period 2001–05, government expenditure on 'cardiovascular system' medicines increased by 26%, while expenditure on 'blood and blood-forming organs' medicines rose by 56% (Figure 17 and Table A5). By comparison, government expenditure on all pharmaceuticals increased by 23% (DoHA unpublished).

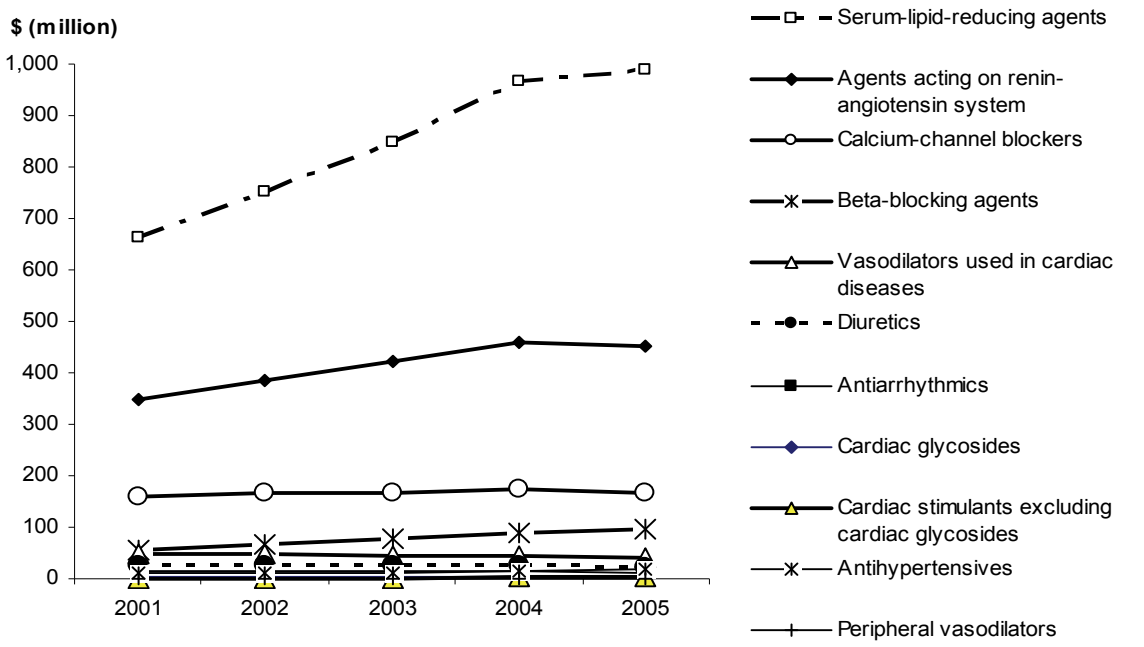
Among cardiovascular system medicines, there were increases in expenditure for cardiac-stimulants excluding cardiac glycosides (95%), beta-blocking agents (40%), antihypertensives (37%), serum-lipid-reducing agents (33%) and agents acting on the renin–angiotensin system (23%); while expenditure fell for cardiac glycosides (–33%), vasodilators used in cardiac diseases (–19%), diuretics (–16%), antiarrhythmics (–14%) and peripheral vasodilators (–9%) (Figure 18 and Table A5).

Expenditure on all types of blood and blood-forming organs medicines rose between 2001 and 2005: heparin group (59%), platelet aggregation inhibitors excluding heparin (58%), enzymes (42%), and vitamin K antagonists (20%) (Figure 19 and Table A5).



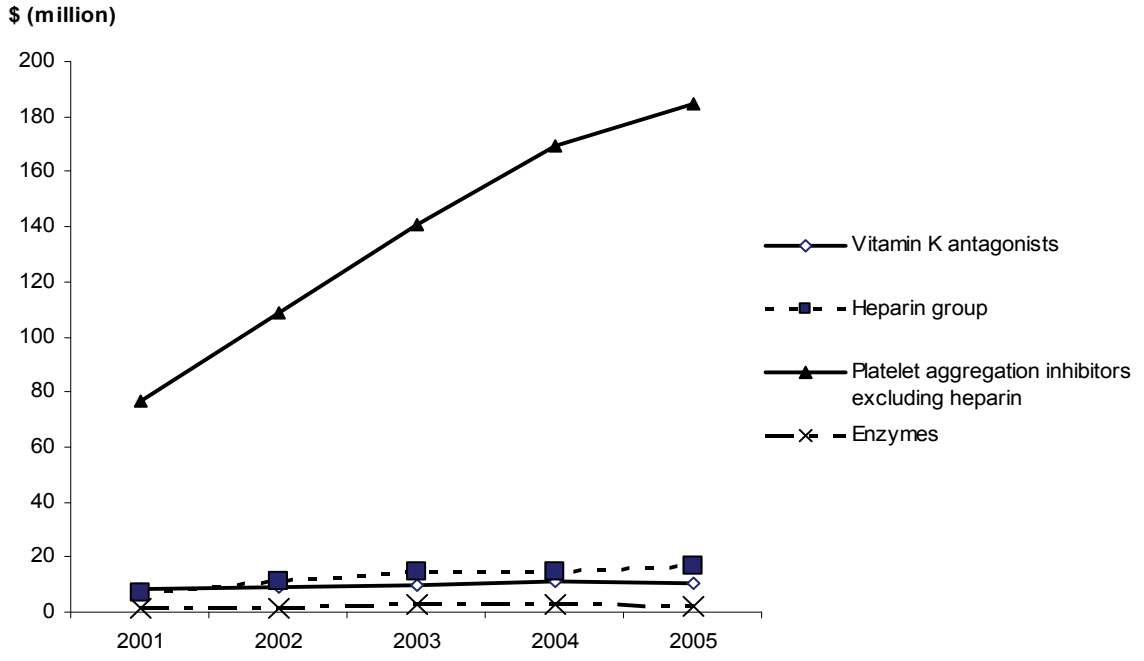
Source: Pharmaceutical Benefits Data System, DoHA.

Figure 17: Government expenditure on medicines to prevent and treat cardiovascular disease, 2001–05



Source: Pharmaceutical Benefits Data System, DoHA.

Figure 18: Government expenditure on cardiovascular medicines by class, 2001–05



Source: Pharmaceutical Benefits Data System, DoHA.

Figure 19: Government expenditure on blood and blood-forming organs medicines by class, 2001–05

7 Discussion

Medicines are a part of most people's lives. Their use increases with age, and most older people take more than one medicine. Medicines can save lives, help people stay healthy, cure some diseases and improve quality of life. But they can also have associated side effects and problems relating to over-use, under-use, misuse or adverse events.

Cardiovascular disease affects nearly one in five Australians and about 65% report using medicines for their cardiovascular condition(s), amounting to 2.3 million people. Government expenditure on medicines commonly used to prevent or treat cardiovascular disease amounted to $2 billion in 2005, representing 35% of the total spent on all subsidised medicines. It is in everybody's interest that cardiovascular medicines are used safely, responsibly and effectively.

This report documents important changes over the past decade in the supply of medicines that may be used to prevent and treat cardiovascular disease. In particular, there have been increases in supply of some blood-pressure-lowering medicines (agents acting on the renin–angiotensin system, calcium-channel blockers and beta-blockers), some serum-lipid-reducing agents (statins and 'other cholesterol and triglyceride reducers'), antithrombotic agents and antiarrhythmic medicines.

Similarly, between 2000–01 and 2005–06 there were significant changes in how GPs used medicines to manage people with cardiovascular conditions and risk factors. Specifically, we observed increased rates of prescription or supply of: agents acting on the renin–angiotensin system in managing hypertension and diabetes, serum-lipid-reducing agents in managing ischaemic heart disease and diabetes, antithrombotic agents in managing ischaemic heart disease, and beta-blocking agents in managing heart failure.

We found a higher rate of supply of some cholesterol-lowering agents (statins) and some clot-preventing medicines to newly prescribed people in the most socioeconomically disadvantaged group compared with the least disadvantaged group. This is consistent with the observed higher prevalence of cardiovascular disease and cardiovascular deaths in the most disadvantaged group compared with the least disadvantaged (AIHW 2006a). However, we do not know if the increased medicines supply to the most disadvantaged group meets their increased need.

The report also describes national initiatives to improve clinical practice relating to cardiovascular disease and promote quality use of medicines. Results to date show encouraging improvements in the management of people with hypertension or coronary heart disease—more patients achieving control of their blood pressure, using blood-pressure-lowering medicines suited to their coexisting health conditions, receiving early clot-busting treatment if having a heart attack, taking aspirin and a cholesterol-lowering agent if they have coronary heart disease, and taking beta-blocking agents if they have had a heart attack.

Together, these results suggest that doctors are increasingly following best practice guidelines for the management of cardiovascular conditions and that national interventions to this effect may indeed be starting to have a positive impact. However, it is worth noting that in some cases these improvements were small. On the other hand, we must also keep in mind that although most people with cardiovascular disease are older people, and therefore at higher risk of cardiovascular disease, with potentially more to gain with appropriate treatment, their doctors might deliberately undertreat them for fear of causing drug-adverse

events in patients using multiple medicines, due to the lack of good evidence on the effectiveness of medicines in older people with multiple chronic medical conditions, or in answer to patients' preferences (Gurwitz 2004, McLean & Le Couteur 2004, Tinetti et al. 2004).

Our analyses show a high level of discontinuation of medicines that are generally intended to be taken long term. This represents a significant waste of resources and a lost opportunity to prevent cardiovascular disease, or delay its progression and complications, with medicines known to be effective. We do not know for sure why so many people stop taking their medicines. Although most of the cost of medicines in our study was covered by government subsidies, suggesting that cost might not be a major factor, Schoen et al.'s work indicate that one in five sicker Australians omit a medicine owing to cost. Side effects of medicines may have led to their discontinuation, particularly in people using multiple medicines—nearly 28,500 hospitalisations were associated with adverse events of cardiovascular medicines and even in cases which did not require care in hospital, side effects can be annoying enough to affect persistence with medicines. Remoteness does not appear to have played a big part because any observed regional differences in persistence with medicines were small. Factors such as treating conditions with no symptoms, patients' lack of understanding of their condition or the benefits of treatment, and complexity of treatment are likely to have played a role. Previous research has shown deficiencies in communication between patients and health professionals, poor care coordination and inadequate care of patients with chronic disease in Australia (Schoen et al. 2005).

Our report reveals large disparities in the supply of cardiovascular medicines to newly prescribed patients—people living in metropolitan areas were dispensed these medicines at twice the rate of those in rural areas, and 29–58 times the rate of people in remote areas. Given that deaths from cardiovascular disease are higher in rural and remote areas of Australia compared with major cities, these inequalities are of particular concern (AIHW 2004a, AIHW 2006a). The BEACH study has shown no differences in the rates at which GPs manage circulatory problems or prescribe cardiovascular medicines in rural and remote areas compared with metropolitan areas (AIHW: Knox et al. 2005). However, the availability of doctors per head of population decreases with increasing geographic remoteness (AIHW 2004b), as does the average number of GP visits per year per head of population (AIHW: Knox et al. 2005), limiting access to doctors for people in rural and remote areas and opportunities to manage health conditions and prescribe medicines. It is therefore likely that the disparities in supply of medicines are due to problems accessing medical services and medicines in rural and remote areas. We do not know if, and to what extent, people in rural and remote areas access medicines from other sources such as state and territory government programs.

Safety is a concern too. Medicines that may be used to prevent or treat cardiovascular disease were associated with 301 deaths in 2004 and in 29 of these cases they were the main cause of death. Adverse effects of these medicines were recorded in almost 28,500 hospitalisations in 2004–05, with most of these occurring in patients aged 65 years and over. This figure is probably a gross underestimate as a large proportion of adverse events are not detected or recorded. Between 1991 and 2002, rates of drug-adverse events causing admission to hospital or extending hospital stay doubled for people aged 60 years and over. This is likely to be related to the observed use of multiple medicines (including complementary medicines) among older people, raising the potential for adverse medicine interactions, combined with the higher risk of adverse events in this group. There were also GP reports of patients with hypertension taking prescription or complementary medicines that could raise blood pressure. Home medicines reviews, with the potential to detect and prevent medicine related

problems, are underused. However, other national initiatives to reduce patient harm from medicines have achieved good results in participating centres.

The data presented in this report were drawn from the best national sources available, none of which is designed to elicit the sort of information we require to make a good assessment of whether medicines are used appropriately. The Pharmaceutical Benefits Data System allows us to build prescription histories for individual patients, but does not record the health condition for which a medicine was prescribed or the dose and medicine regimen prescribed. It also lacks coverage of patients dispensed unsubsidised prescriptions. The BEACH study gives us a valuable cross sectional snapshot of what happens in general practice, but does not provide information on how individual patients are managed over time. The National Health Survey asks participants about medicines taken for selected conditions only, and many people do not know which medicines they take for which condition, so the information on medicines in the survey is likely to be incomplete and unreliable. The National Hospital Morbidity Database contains information on episodes of care and drug-adverse events but does not record medicines used in hospital or patient identifiers so individual patients cannot be tracked through the system over time. Unique patient identifiers are needed to enhance patient transitions across parts of the health system and support quality use of medicines and patient safety.

The National Chronic Disease Strategy recognises that care for people with chronic disease, such as cardiovascular disease, generally involves multiple health care providers across multiple settings, including general practice, community health, hospitals, private providers and community and non-government organisations (National Health Priority Council 2006). It calls for integrated provision of disease prevention and care across services, settings, sectors and over time. The strategy states that multidisciplinary care must focus on the patient as a whole person, incorporate prevention, self-management and coexisting conditions, and be responsive to changing patient needs. The National Strategy for Quality Use of Medicines recognises the central role of health consumers and active partnerships in achieving quality use of medicines (DoHA 2002).

The approach taken for this report is narrow—focusing exclusively on cardiovascular disease. It does not reflect the reality of people living with multiple coexisting conditions. About 80% of Australians aged 65 years and over—the age group most affected by cardiovascular disease—have three or more chronic conditions (AIHW 2006a). Managing coexisting conditions affects the treatment choices health professionals make for their patients and the choices patients make for themselves. Our capacity to get some insight into this complexity is constrained by the data sources available. National administrative data sources in their current form do not make enough information available to allow linking of patient records. Such linkages between records of medical services delivered, medicines supplied, hospitalisations and deaths are needed to assess the quality of care given to patients at a national level and its impact on outcomes for them. Without linkages, we are restricted to using inadequate data sources that can at best provide only a broad picture, with no detail, from limited perspectives. Until individual electronic health records are adopted, or linking of health records nationally becomes possible, an integrated, multidimensional view of the whole person and their interaction with the whole health system, across all health care settings, throughout their life, will be lacking. At the state level, Western Australia and New South Wales have already established systems and protocols to link health records (Brook et al. 2005, Kelman et al. 2002, The Sax Institute 2007). Arrangements to do this at the national level have been proposed (Kelman et al. 2007).

This report has concentrated on some aspects of the quality use of medicines for cardiovascular health in Australia, but it has not looked into another side of the equation—the extent of excessive prescribing of medicines for those people at lower risk of cardiovascular disease. We hope to be able to tackle this issue in the near future.

Appendix

Appendix tables

Table A1: Supply of cardiovascular medicines in selected OECD countries, 2004

	Medicine class							
Country	**ARA**	**CCB**	**BBA**	**DIU**	**AHYP**	**ART**	**GLY**	**CHOL**
				DDD/1,000 population/day				
Australia	146.9	77.0	25.5	39.4	5.2	2.2	5.3	161.8
Belgium	91.3	40.4	66.6	43.7	5.4	8.0	5.0	104.1
Czech Republic	105.1	69.9	71.3	95.5	12.2	5.6	7.1	65.0
Denmark[(a)]	85.1	46.2	29.9	111.5	2.7	1.6	6.3	67.2
Finland[(a)]	125.3	48.3	68.1	61.9	1.7	1.8	6.6	81.7
Germany[(b)]	143.8	48.8	67.6	65.9	11.6	2.3	10.1	57.3
Greece	149.4	68.6	30.7	35.7	6.7	5.5	9.9	84.0
Iceland	80.9	31.5	46.4	67.3	1.4	3.3	3.2	75.2
Norway[(a)]	99.1	46.6	39.4	45.4	n/a	1.3	4.4	110.0
Portugal[(c)]	109.7	37.0	18.3	42.4	0.3	7.3	6.8	71.1
Slovak Republic	88.8	63.3	42.8	31.7	10.7	4.3	6.6	31.5
Sweden[(a)]	85.6	40.7	54.7	87.3	1.9	1.1	6.5	75.2

ARA agents acting on renin–angiotensin system
CCB calcium-channel blockers
BBA beta-blocking agents
DIU diuretics
AHYP antihypertensives
ART antiarrhythmics
GLY cardiac glycosides
CHOL serum-lipid-reducing agents
n/a not available

(a) Data for Denmark, Finland, Norway and Sweden cover supply of medicines in the community and in hospitals.
(b) Data for Germany refer to health insured persons only.
(c) Data for Portugal does not include medicines supplied to civil servants, army and police.

Note: Data shown here refer to prescription medicines supplied in the community. It does not include medicines supplied in hospital unless otherwise specified above.

Source: OECD Health Data 2006.

Table A2: Persistence with medicines by region of patient residence

Medicine class	Proportion of patients persistent at:			
	6 months		24 months	
Region of residence	Males	Females	Males	Females
	% (95% CI)			
HMG CoA reductase inhibitors (statins)				
Metropolitan	82.17 (81.99–82.34)	82.79 (82.61–82.97)	62.51 (62.25–62.77)	63.62 (63.35–63.89)
Rural	85.14 (84.92–85.36)	85.61 (85.38–85.84)	68.35 (68.00–68.69)	68.92 (68.56–69.28)
Remote	82.47 (81.49–83.40)	82.09 (80.99–83.14)	62.76 (61.26–64.22)	61.97 (60.30–63.60)
Angiotensin II antagonists (plain)				
Metropolitan	87.38 (87.10–87.65)	88.49 (88.27–88.70)	71.82 (71.34–72.29)	74.21 (73.84–74.58)
Rural	89.73 (89.40–90.05)	90.41 (90.14–90.67)	76.36 (75.77–76.94)	78.70 (78.23–79.16)
Remote	86.99 (84.98–88.75)	89.71 (88.11–91.11)	72.98 (69.65–76.01)	75.94 (73.19–78.45)
Angiotensin II antagonists (combin.)				
Metropolitan	88.82 (88.41–89.22)	90.87 (90.57–91.16)	75.59 (74.89–76.27)	78.65 (78.13–79.16)
Rural	91.92 (91.41–92.40)	92.76 (92.37–93.13)	81.13 (80.24–81.99)	83.16 (82.49–83.80)
Remote	88.78 (85.50–91.35)	91.49 (89.08–93.39)	80.60 (76.02–84.40)	84.05 (80.41–87.07)
ACE inhibitors (plain)				
Metropolitan	87.56 (87.32–87.79)	88.03 (87.81–88.25)	72.74 (72.34–73.13)	74.23 (73.85–74.61)
Rural	89.27 (89.00–89.53)	89.65 (89.38–89.91)	76.55 (76.09–77.00)	77.84 (77.38–78.30)
Remote	84.47 (83.05–85.78)	84.98 (83.54–86.30)	68.41 (66.14–70.57)	68.64 (66.26–70.89)
ACE inhibitors (combin.)				
Metropolitan	88.68 (88.06–89.27)	90.83 (90.34–91.29)	75.02 (73.92–76.08)	78.48 (77.56–79.36)
Rural	91.24 (90.52–91.91)	92.68 (92.09–93.22)	80.98 (79.70–82.19)	83.03 (81.93–84.07)
Remote	84.91 (80.65–88.30)	87.48 (84.03–90.23)	71.88 (65.14–77.54)	76.65 (71.31–81.13)
Beta-blocking agents				
Metropolitan	73.96 (73.60–74.32)	74.14 (73.80–74.48)	51.09 (50.57–51.61)	51.41 (50.92–51.90)
Rural	76.67 (76.24–77.10)	76.98 (76.56–77.39)	54.54 (53.91–55.17)	56.05 (55.44–56.65)
Remote	74.52 (72.48–76.44)	77.36 (75.33–79.25)	53.70 (50.83–56.48)	55.32 (52.31–58.22)
Warfarin				
Metropolitan	82.55 (82.05–83.03)	83.97 (83.50–84.43)	53.45 (52.52–54.37)	57.33 (56.40–58.25)
Rural	84.17 (83.57–84.75)	85.24 (84.61–85.85)	57.36 (56.21–58.50)	60.69 (59.42–61.93)
Remote	80.44 (77.19–83.28)	83.43 (79.88–86.41)	50.64 (44.99–56.01)	55.36 (48.48–61.69)
Other antithrombotic agents[(a)]				
Metropolitan	89.71 (89.44–89.97)	89.65 (89.33–89.96)	75.05 (74.56–75.54)	75.34 (74.77–75.90)
Rural	90.69 (90.33–91.04)	90.82 (90.39–91.24)	77.66 (77.00–78.31)	78.16 (77.38–78.91)
Remote	89.06 (87.20–90.66)	89.75 (87.42–91.67)	76.88 (73.76–79.68)	74.30 (70.07–78.03)

(a) Includes clopidogrel, dipyridamole and ticlopidine.

Notes

1. The study included newly prescribed patients only.
2. Rates age standardised to the Australian population at 30 June 2001.
3. Region of residence of patients was determined at the time of their first prescription being dispensed.

Source: AIHW analysis of data supplied by DoHA from the Pharmaceutical Benefits Data System.

Table A3: Prescriptions supplied to newly prescribed patients by socioeconomic level

Medicine class	Least disadvantaged group	Most disadvantaged group	Rate ratio
	Rate per 100,000 (95% CI)		
HMG COA reductase inhibitors (statins)			
Males	416.0 (412.8–419.1)	471.7 (468.3–475.2)	1.13
Females	363.8 (360.9–366.8)	461.5 (458.1–464.9)	1.27
Other antithrombotic agents[(a)]			
Males	122.7 (121.0–124.4)	128.4 (126.6–130.2)	1.05
Females	83.0 (81.6–84.3)	89.7 (88.1–91.2)	1.08

(a) Includes clopidogrel, dipyridamole and ticlopidine.

Notes

1. The study included newly prescribed patients only.
2. Socioeconomic level coded according to SEIFA. Rates shown for Level 1 (least disadvantaged) and Level 5 (most disadvantaged). For details see Methods section.
3. Rates age standardised to the Australian population at 30 June 2001.
4. The rate ratio is calculated as the rate in the most disadvantaged group divided by the rate in the least disadvantaged group.

Source: AIHW analysis of data supplied by DoHA from the Pharmaceutical Benefits Data System.

Table A4: Persistence with medicines by level of socioeconomic disadvantage

	Proportion of patients persistent at:			
	6 months		24 months	
Medicine class	Least disadvantaged	Most disadvantaged	Least disadvantaged	Most disadvantaged
	% (95% CI)			
HMG COA reductase inhibitors (statins)				
Males	83.15 (82.85–83.45)	81.72 (81.42–82.02)	63.64 (63.18–64.10)	62.80 (62.35–63.25)
Females	83.81 (83.50–84.12)	82.21 (81.91–82.51)	65.16 (64.86–65.63)	63.01 (62.55–63.46)
Other antithrombotic agents[(a)]				
Males	89.43 (88.95–89.89)	90.21 (89.75–90.65)	74.96 (74.08–75.82)	75.75 (74.89–76.58)
Females	89.56 (89.00–90.10)	89.41 (88.83–89.96)	75.66 (74.67–76.62)	75.34 (74.33–76.32)

(a) Includes clopidogrel, dipyridamole and ticlopidine.

Notes

1. The study included newly prescribed patients only.
2. Socioeconomic level coded according to SEIFA. For details see Methods section.

Source: AIHW analysis of data supplied by DoHA from the Pharmaceutical Benefits Data System.

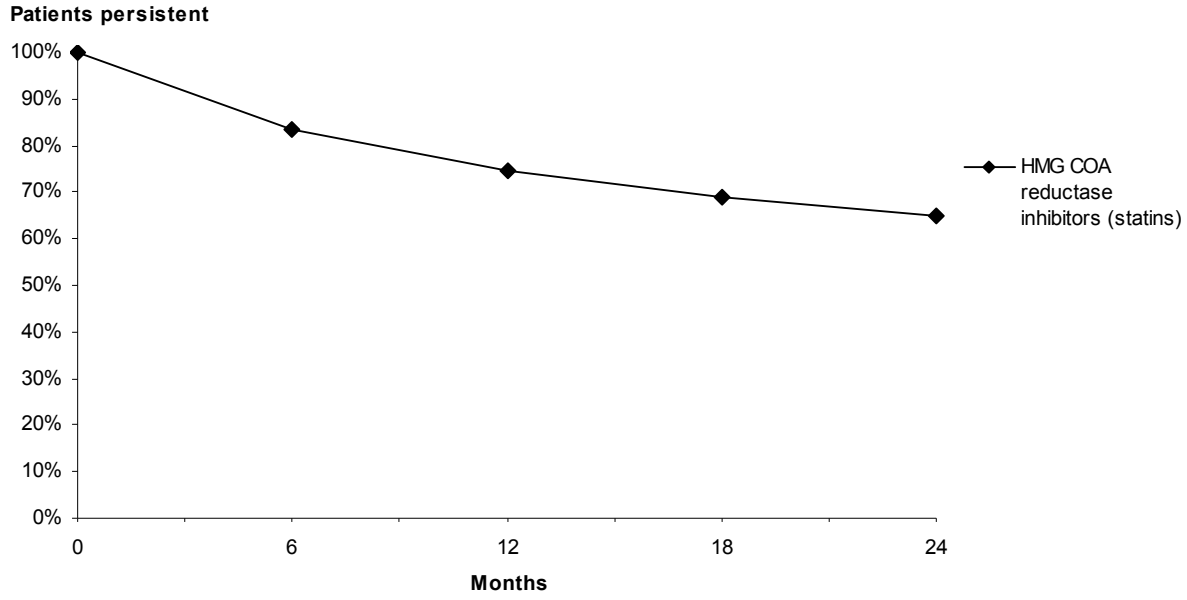
Table A5: Government expenditure on selected medicines (constant prices), 2001–05

Medicine class	2001	2002	2003	2004	2005	% change 2001–05
			($ million)			
Cardiac glycosides	3.4	3.2	3.1	2.9	2.5	–33.2
Antiarrhythmics	14.5	14.2	13.6	13.7	12.7	–14.2
Cardiac-stimulants excluding cardiac glycosides	0.2	0.2	0.6	2.9	4.9	95.1
Vasodilators used in cardiac diseases	49.3	47.6	44.5	44.4	41.6	–18.6
Antihypertensives	11.7	11.5	11.0	14.3	18.6	37.0
Diuretics	26.7	26.1	24.8	25.3	22.9	–16.4
Peripheral vasodilators	0.1	0.1	0.1	0.1	0.1	–8.7
Beta-blocking agents	57.1	67.0	76.6	89.6	94.8	39.7
Calcium-channel blockers	160.9	166.3	168.4	172.8	165.8	2.9
Agents acting on renin–angiotensin system	347.2	384.4	423.0	459.2	450.4	22.9
Serum-lipid-reducing agents	662.9	752.9	848.0	967.2	987.1	32.8
All cardiovascular medicines	*1,334.3*	*1,473.8*	*1,614.0*	*1,792.6*	*1,801.5*	*25.9*
Vitamin K antagonists	8.3	9.1	9.9	10.9	10.4	19.7
Heparin group	6.8	11.4	14.6	14.7	16.5	58.7
Platelet aggregation inhibitors excluding heparin	76.7	108.7	140.6	169.1	184.9	58.5
Enzymes	1.3	1.3	2.5	3.0	2.2	42.3
All blood and blood-forming organs medicines	*93.2*	*130.5*	*167.6*	*197.8*	*214.2*	*56.5*
All medicines	**4,445.2**	**4,883.4**	**5,235.2**	**5,767.1**	**5,803.7**	**23.4**

Note: All figures are expressed in constant price terms to remove the effects of inflation and allow comparison of expenditure in different years on an equal dollar-for-dollar basis.

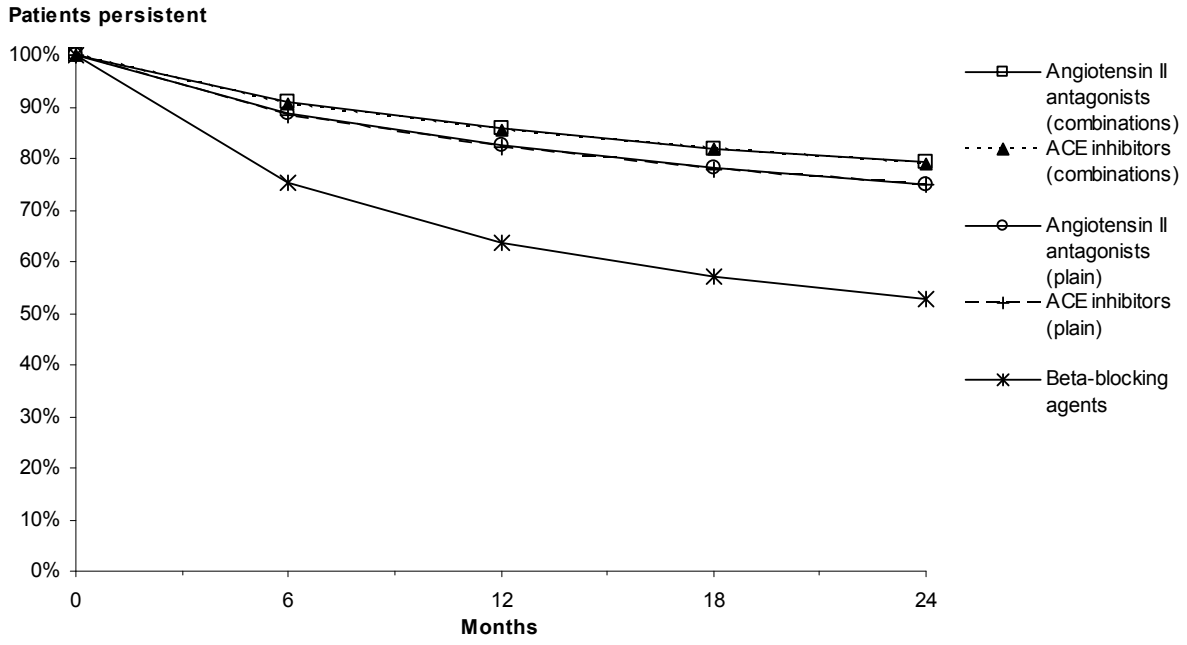
Source: Pharmaceutical Benefits Data System, DoHA (unpublished).

Appendix figures



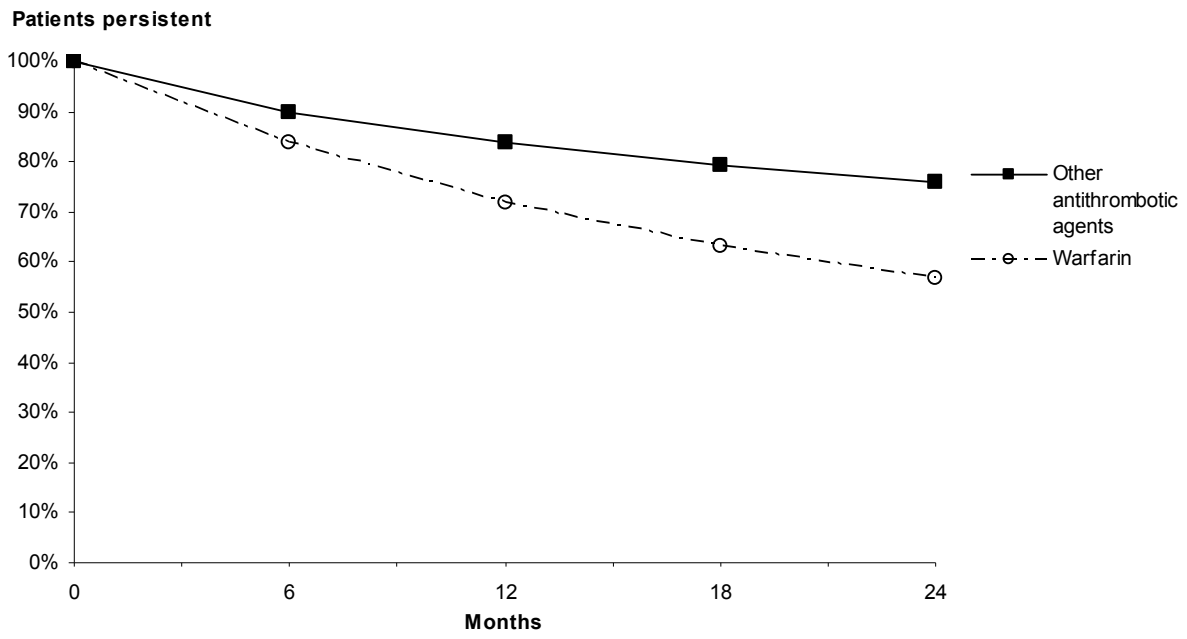
Source: AIHW analysis of data supplied by DoHA from the Pharmaceutical Benefits Data System.

Figure A1: Persistence with HMG COA reductase inhibitors (statins)



Source: AIHW analysis of data supplied by DoHA from the Pharmaceutical Benefits Data System.

Figure A2: Persistence with selected medicines with blood-pressure-lowering effect



Source: AIHW analysis of data supplied by DoHA from the Pharmaceutical Benefits Data System.

Figure A3: Persistence with antithrombotic agents

The Anatomical Therapeutic Chemical (ATC) classification system

Developed by the World Health Organisation, the ATC classification is the Australian standard for classifying medicines. In this system the medicines are grouped according to the system on which they act and their chemical, pharmacological and therapeutic properties. Medicines are classified into five levels. That part of the ATC classification relevant to cardiovascular disease is shown here.

ATC code	ATC Level 1	ATC Level 2	ATC Level 3	ATC Level 4	ATC Level 5[(a)]
B	**Blood and blood-forming organs**				
B01		Antithrombotic agents			
B01A			Antithrombotic agents		
B01AA				Vitamin K antagonists	
B01AA03					warfarin
B01AB				Heparin group	
B01AB05					enoxaparin
B01AC				Platelet aggregation inhibitors excl. heparin	
B01AC06					aspirin
B01AD				Enzymes	
B01AD01					streptokinase
C	**Cardiovascular system**				
C01		Cardiac therapy			
C01A			Cardiac glycosides		
C01AA				Digitalis glycosides	
C01AA05					digoxin
C01B			Antiarrhythmics, class I and III		
C01BA				Antiarrhythmics, class IA	
C01BA01					quinidine
C01BB				Antiarrhythmics, class IB	
C01BB01					lignocaine
C01BC				Antiarrhythmics, class IC	
C01BC04					flecainide
C01BD				Antiarrhythmics, class III	
C01BD01					amiodarone

ATC code	ATC Level 1	ATC Level 2	ATC Level 3	ATC Level 4	ATC Level 5[(a)]
C01C			Cardiac-stimulants excluding cardiac glycosides		
C01CA				Adrenergic and dopaminergic agents	
C01CA24					adrenaline
C01D			Vasodilators used in cardiac diseases		
C01DA				Organic nitrates	
C01DA14					isosorbide mononitrate
C01DX				Other vasodilators used in cardiac diseases	
C01DX16					nicorandil
C02		Antihypertensives			
C02A			Antiadrenergic agents, centrally acting		
C02AB				Methyldopa	
C02AB01					methyldopa
C02AC				Imidazoline receptor agonists	
C02AC01					clonidine
C02C			Antiadrenergic agents, peripherally acting		
C02CA				Alpha adrenoceptor blocking agents	
C02CA01					prazosin
C02D			Arteriolar smooth muscle, agents acting on		
C02DB				Hydrazinophthalazine derivatives	
CO2DB02					hydralazine
C02DC				Pyrimidine derivatives	
C02DC01					minoxidil
C02DD				Nitroferricyanide derivatives	
C02DD01					sodium nitroprusside

ATC code	ATC Level 1	ATC Level 2	ATC Level 3	ATC Level 4	ATC Level 5[(a)]
C03		Diuretics			
C03A			Low-ceiling diuretics, thiazides		
C03AA				Thiazides, plain	
C03AA01					bendrofluazide
C03B			Low-ceiling diuretics, excluding thiazides		
C03BA				Sulfonamides, plain	
C03BA11					indapamide
C03C			High-ceiling diuretics		
C03CA				Sulfonamides, plain	
C03CA01					frusemide
C03CC				Aryloxyacetic acid derivatives	
C03CC01					ethacrynic acid
C03D			Potassium-sparing agents		
C03DA				Aldosterone antagonists	
C03DA01					spironolactone
C03DB				Other potassium-sparing agents	
C03DB01					amiloride
C03E			Diuretics and potassium-sparing agents combinations		
C03EA				Low-ceiling diuretics and potassium-sparing agents	
C03EA01					hydrochlorothiazide with amiloride
CO4		Peripheral vasodilators			
C04A			Peripheral vasodilators		
C04AD				Purine derivatives	
C04AD03					oxpentifylline
C04AX				Other peripheral vasodilators	
C04AX02					phenoxybenzamine hydrochloride

ATC code	ATC Level 1	ATC Level 2	ATC Level 3	ATC Level 4	ATC Level 5[(a)]
C07		Beta-blocking agents			
C07A			Beta-blocking agents, plain		
C07AA				Beta-blocking agents, plain, non-selective	
C07AA07					sotalol
C07AB				Beta-blocking agents, plain, selective	
C07AB03					atenolol
C07AG				Alpha- and beta-adrenoceptor blocking agents	
C07AG01					carvedilol
C08		Calcium-channel blockers			
C08C			Selective calcium-channel blockers with mainly vascular effects		
C08CA				Dihydropyridine derivatives	
C08CA01					amlodipine
C08D			Selective calcium-channel blockers with direct cardiac effects		
C08DA				Phenylalkylamine derivatives	
C08DA01					verapamil
C08E			Non-selective calcium-channel blockers		
C08EX				Other non-selective calcium-channel blockers	
C08EX02					perhexiline
C09		Agents acting on the renin–angiotensin system			
C09A			ACE inhibitors, plain		
C09AA				ACE blockers	
C09AA05					ramipril

ATC code	ATC Level 1	ATC Level 2	ATC Level 3	ATC Level 4	ATC Level 5[(a)]
C09B			ACE inhibitors, combinations		
C09BA				ACE blockers and diuretics	
C09BA04					perindopril and indapamide
C09C			Angiotensin II antagonists		
C09CA				Angiotensin II antagonists, plain	
C09CA04					irbesartan
C09D			Angiotensin II antagonists, combinations		
C09DA				Angiotensin II antagonists and diuretics	
C09DA04					irbesartan and hydrochlorothiazide
C10		Serum-lipid-reducing agents			
C10A			Cholesterol and triglyceride reducers		
C10AA				HMG COA reductase inhibitors	
C10AA05					atorvastatin
C10AB				Fibrates	
C10AB04					gemfibrozil
C10AC				Bile acid sequestrants	
C10AC01					cholestyramine
C10AD				Nicotinic acid and derivatives	
C10AD02					nicotinic acid
C10AX				Other cholesterol and triglyceride reducers	
C10AX09					ezetimibe

(a) One generic medicine is shown as an example at this level.

Data sources

AIHW National Hospital Morbidity Database: contains demographic, diagnosis, procedure and duration of stay information on episodes of care for patients admitted to hospital. The collection is maintained by the AIHW using data supplied by state and territory health authorities.

AIHW National Mortality Database: contains information on the cause of death supplied by the medical practitioner certifying the death or by a coroner. Registration of deaths is the responsibility of the state and territory registrars of births, deaths and marriages. Registrars provide the information to the ABS for coding of cause of death and then it is given to the AIHW.

BEACH (Bettering the evaluation and care of health) survey of general practice: an ongoing national cross-sectional survey looking at aspects of general practice in Australia, conducted by the Australian General Practice Statistics and Classification Centre (an AIHW collaborating unit within the Family Medicine Research Centre, University of Sydney). BEACH began in April 1998 and involves a random sample of about 1,000 general practitioners per year, each of whom records details on 100 consecutive patient encounters.

Pharmaceutical Benefits Data System: held at the Australian Government Department of Health and Ageing (DoHA), it is used to monitor expenditure and use of prescription medicines subsidised by the Pharmaceutical Benefits Scheme (PBS) and the Repatriation PBS (RPBS). The database contains information pertinent to the payment of claims for pharmaceuticals from Medicare Australia for medicines subsidised by the PBS and the RPBS. Inpatient hospital prescribing is not included. It is the source for data on subsidised scripts in the Drug Utilisation Sub-Committee database. The data are based on the date of supply or dispensing of prescriptions.

Drug Utilisation Sub-Committee database: held at the Australian Government Department of Health and Ageing (DoHA), it monitors the community (that is, non-public hospital) use of prescription medicines in Australia. The database combines information supplied by Medicare Australia on medicines subsidised by the Pharmaceutical Benefits Scheme (PBS) and the Repatriation PBS, and an estimate of unsubsidised prescriptions (under co-payment and private prescriptions) calculated from a validated sample of community based pharmacies from the continuous Pharmacy Guild Survey. Inpatient hospital prescribing is not included.

National Health Survey 2004–05: conducted by the ABS, to obtain national information on the health status of Australians, their use of health services and other actions people had taken for their health, and health-related aspects of their lifestyle. The 2004–05 survey collected information from a sample of 25,900 people across all ages from all states and territories from August 2004 to June 2005. One adult and one child (where applicable) from each sampled dwelling were included in the survey. Information about use of medicines was collected as reported by participants for the following conditions only: asthma, circulatory conditions, diabetes, arthritis, osteoporosis and mental wellbeing. Medicines include pharmaceuticals, vitamin and mineral supplements, and natural and herbal medicines.

Methods

Codes used in this report

Data	Disease / problem / medicine class	Classification	Code
Deaths / Hospital separations (Drugs, medicaments and biological substances causing adverse effects in therapeutic use)	Anticoagulants	ICD-10 / ICD-10-AM	Y44.2
	Anticoagulant antagonists, vitamin K and other coagulants		Y44.3
	Antithrombotic drugs		Y44.4
	Thrombolytic drugs		Y44.5
	Salicylates		Y45.1
	Predominantly β-adrenoreceptor antagonists, not elsewhere classified		Y51.5
	α-Adrenoreceptor antagonists, not elsewhere classified		Y51.6
	β-Adrenoreceptor antagonists, not elsewhere classified		Y51.7
	Cardiac-stimulant glycosides and drugs of similar action		Y52.0
	Calcium-channel blockers		Y52.1
	Other antidysrhythmic drugs, not elsewhere classified		Y52.2
	Coronary vasodilators, not elsewhere classified		Y52.3
	Angiotensin-converting-enzyme inhibitors		Y52.4
	Other antihypertensive drugs, not elsewhere classified		Y52.5
	Antihyperlipidaemic and antiarteriosclerotic drugs		Y52.6
	Peripheral vasodilators		Y52.7
	Antivaricose drugs, including sclerosing agents		Y52.8
	Other and unspecified agents primarily affecting the cardiovascular system		Y52.9
	Benzothiadiazine derivatives		Y54.3
	Loop (high-ceiling) diuretics		Y54.4
	Other diuretics		Y54.5
Number of medicines taken for health condition (NHS)	Hypertensive disease		06
	Angina and other ischaemic heart diseases		07,08
	Cerebrovascular diseases		11
	Oedema and heart failure		12
	Diseases of arteries, arterioles and capillaries		13
	Other diseases of the circulatory system		09,10,14,15,16,17,18,19,20

Data	Disease / problem / medicine class	Classification	Code
General practice (BEACH)	Arrhythmia (atrial fibrillation/flutter, paroxysmal tachycardia, cardiac arrhythmia NOS)	ICPC/ICPC-2 PLUS	K78, K79, K80
	Diabetes (diabetes; insulin-dependent, diabetes; non-insulin-dependent, gestational diabetes)		T89, T90, W85
	Heart failure		K77
	Hypertension (uncomplicated hypertension, hypertension with involvement of target organs, hypertension pre-eclamptic, hypertension in pregnancy)		K86, K87 W81002 W81003
	Ischaemic heart disease (ischaemic heart disease without angina, Ischaemic heart disease with angina)		K74, K76
	Lipid disorder (lipid disorder, lipodystrophy)		T93 T99075
	Peripheral vascular disease (Claudication; intermittent, Buergers disease, peripheral vascular disease, gangrene, ischaemia; limb (gangrene))		K9201 K92001 K92003 K92004 K92006
	Stroke (stroke/cerebrovascular accident)		K90
PBS medicines in data set analysed for concordance with medicine	Antithrombotic agents	PBS	
	warfarin		2843P 2209G 2844Q 2211J
	aspirin		8202Q
	clopidogrel		8358X
	dipyridamole		8335Q
	dipyridamole with aspirin		8382E
	ticlopidine		2095G
	Beta-blocking agents		
	oxprenolol		2942W 2961W
	pindolol		3062E 3065H`
	propanolol		2565B 2566C 2899N
	sotalol		8398B 2043M
	atenolol		1081X
	bisoprolol		8604W 8605X 8606Y
	metoprolol succinate		8818D 8732N 8733P 8734Q 8735R
	metoprolol tartrate		1324Q 1325R

Data	Disease / problem / medicine class	Classification	Code
PBS medicines in data set analysed for concordance with medicine (continued)	carvedilol		8742D 8255L 8256M 8257N 8258P
	labetalol		1566K 1567L
	ACE inhibitors (plain)		
	captopril		1147J 1148K 1149L 8760C
	enalapril		1370D 1368B 1369C
	fosinopril		1182F 1183G
	lisinopril		2456G 2457H 2458J
	perindopril		3050M 3051N 8704D
	quinapril		1968N 1969P 1970Q
	ramipril		1944H 1945J 1946K 8470T 8668F 8937J
	trandolapril		2791X 2792Y 2793B 8758Y
	ACE inhibitors (combinations)		
	enalapril with hydrochlorothiazide		8477E
	fosinopril with hydrochlorothiazide		8400D 8401E
	perindopril with indapamide		8449Q
	quinapril with hydrochlorothiazide		8589C 8590D
	Angiotensin II antagonists (plain)		
	candesartan		8295N 8296P 8297Q 8889W
	eprosartan		8397Y 8447N
	irbesartan		8246B 8247C 8248D
	telmisartan		8355R 8356T

Data	Disease / problem / medicine class	Classification	Code
PBS medicines in data set analysed for concordance with medicine (continued)	Angiotensin II antagonists (combinations)		
	candesartan with hydrochlorothiazide		8504N
	eprosartan with hydrochlorothiazide		8624X
	irbesartan with hydrochlorothiazide		8404H 8405J
	telmisartan with hydrochlorothiazide		8622T 8623W
	HMG COA reductase inhibitors (statins)		
	atorvastatin		8213G 8214H 8215J 8521L
	fluvastatin		8023G 8024H
	pravastatin		2833D 2834E 8197K 8829Q
	simvastatin		2013Y 2011W 2012X 8173E 8313M

BEACH study data analysis

The methods used to collect and analyse BEACH data are described in detail in AIHW: Britt et al. 2005. Here is a brief account of the method used to analyse data shown in this report.

Rates of prescription or supply of medicines by general practitioners were compared for the period 2000–01 to 2005–06. Statistical significance was assessed based on a linear trend over the years, with non-overlapping confidence intervals between the 2000–01 results and the 2005–06 results. These trends were analysed using SAS V8.2 regression procedures, adjusting the standard error to allow for the design effect of the cluster sample.

Where significant changes over time were detected, we calculated the estimated annual rate of change. This is expressed as the mean annual increase or decrease over the study period in the number of general practice encounters for that problem where a particular medicine was prescribed or supplied, occurring in Australia each year.

Extrapolated estimates were calculated by multiplying the encounter rate for 2000–01 by the number of unreferred attendances (A1 and A2 items) claimed through Medicare in that year to give the estimated number of encounters at which a particular medicine was prescribed or supplied. The same was done for 2005–06. Where the change was linear over time, the difference between the two estimates was averaged over 5 years to give the estimated annual rate of change in encounters.

Analysis of concordance with medicines

The Australian Government Department of Health and Ageing (DoHA) holds the Pharmaceutical Benefits Data System, which contains national prescribing information on medicines subsidised by the Pharmaceutical Benefits Scheme (PBS) and the Repatriation PBS (RPBS) (see Box 1 in chapter 3). For medicines in the PBS and RPBS, the patient pays for the cost of a medicine up to the co-payment amount and the government pays the balance of the cost, if this is more than the co-payment amount. All prescriptions for which this government subsidy is paid are recorded in the database. Those prescriptions that fall below the co-payment level, and therefore attract no subsidy, are not recorded.

In 2002 it became compulsory to record Medicare numbers for patients being dispensed subsidised PBS and RPBS medicines. This allows the capacity to build prescription histories for individual patients as well as providing information on their age, sex and postcode of residence.

Data

We obtained from DoHA anonymous individual patient records of PBS medicines supplied over the period 1 January 2002–1 June 2006 for selected medicines commonly used in the prevention and treatment of CVD. Each data record included:

- unique patient identifier number (PIN)
- patient 5 year age group, sex and postcode of residence
- date of supply of prescription
- patient beneficiary category (general, concessional or repatriation and safety net status)
- PBS item number
- number of prescriptions supplied.

The following medicine classes were selected for analysis:

1. HMG COA reductase inhibitors (statins)
2. plain angiotensin II antagonists
3. combination angiotensin II antagonists
4. plain ACE inhibitors
5. combination ACE inhibitors
6. beta-blocking agents
7. warfarin
8. other antithrombotic agents (including clopidogrel, dipyridamole and ticlopidine).

We defined cohorts of patients by medicine class, as shown above. We followed each cohort over the study period and confined the analyses to medicines class; that is, we did not look at medicine switching within each medicine class or between medicine classes.

Inclusion and exclusion criteria

To ensure uniform populations for the medicines studied, we included only newly prescribed patients, defined as those with no scripts dispensed in the 12 months before the patient's first supply for each of the medicine classes, resulting in an effective study period of 15 January 2003–27 June 2006.

We included only patients who had been dispensed at least two prescriptions without discontinuation between them (see definition of persistence below), suggesting medicine use beyond a single prescription.

For the cohorts using 'HMG CoA reductase inhibitors (statins)' and 'other antithrombotic agents', we included patients in all beneficiary categories as all medicine items in these classes cost more than the co-payment level for general patients. Therefore, all prescriptions for these items are recorded in the Pharmaceutical Benefits Data System.

For all the other cohorts, we excluded general patients and focused the analyses on patients who had concessional or repatriation status for the whole study period. This was done because the Pharmaceutical Benefits Data System covers only subsidised prescriptions and many medicines in classes 2 to 7 above fall below the general co-payment level, so prescriptions are recorded only for concessional/repatriation patients and general patients on safety net. General patients can also move in and out of the safety net during each calendar year. Furthermore, patients may have changed their beneficiary status over the course of the study. These factors result in incomplete coverage in the database of prescriptions for these medicines supplied to general patients and inadequate follow-up of patients who changed their beneficiary status.

Records for patients dispensed more than one prescription for the same medicine on any given date were also excluded.

Records with 'dummy' PINs, used by data entry staff when patient identifying information was lacking, and records with missing information on age, sex or postcode were excluded as well.

Measures of concordance

In assessing concordance with medicines, we looked at compliance and persistence according to the definitions and measures in Halpern et al. 2006.

Compliance was defined as taking medicines at the prescribed frequency and dose and was measured using the medicine possession ratio (MPR).

MPR = days supplied/days between consecutive scripts dispensed

We measured MPR over the first 12 months from the start of therapy. We defined those patients with MPR of 80% or more as compliant and calculated the proportion of compliant patients in each cohort.

Persistence was defined as the continued use of medicines for the specified treatment period, which in the case of the medicines indicated for cardiovascular disease included in this study was assumed to be lifelong. It was measured from the start of therapy (first date of medicine supply—index date) until the date of treatment discontinuation or the end of the study period. Treatment discontinuation was defined as ≥ 90 days between one medicine supply and the subsequent supply of any medicine in the same class (that is, missed two script periods). Persistence was measured by

- percentage of patients persistent at 6 months, 12 months, 18 months and 24 months from the index date (using Kaplan–Meier analysis)
- average duration of persistence.

The 95% confidence intervals for persistence were calculated using the methods presented in Hosmer & Lemeshow (1999).

Analysis of inequalities

To measure inequalities in the supply of medicines, we looked at differences between populations by socioeconomic indexing and geographical classification.

Socioeconomic indexing for area (SEIFA) is based on the Index of Relative Socioeconomic Disadvantage (IRSD), which was constructed by the ABS to classify geographic areas on the basis of social and economic information (ABS 2003). The IRSD is derived from social and economic characteristics of a Statistical Local Area (SLA), such as income, educational attainment, unemployment, jobs in various occupations and variables that reflect disadvantage.

Individual patients were classified into fifths of socioeconomic disadvantage, based on the IRSD value for the SLA of usual residence. SLA estimates were assigned to patients according to their postcode by using postcode to SLA conversion factors. Level 1 includes the least disadvantaged households, while Level 5 covers the most disadvantaged households. Note that the IRSD relates to the average disadvantage of all people living in an SLA and does not necessarily reflect an individual's socioeconomic status. Rates were calculated for males and females separately, age standardised to the Australian population as at 30 June 2001.

Geographical classification uses the ABS Australian Standard Geographical Classification (ASGC) Remoteness Areas Classification to map regional areas by grouping areas with similar characteristics together (AIHW 2004c).

The ASGC Remoteness Areas assigns each SLA to one of six regional categories: major cities, inner regional, outer regional, remote, very remote and migratory. These categories were then regrouped into three larger zones: metropolitan, rural and remote. SLA estimates were assigned to patients using the postcode to SLA conversion factors. Rates were calculated for males and females separately, age standardised to the Australian population as at 30 June 2001.

Limitations of the study

Information on the diagnosis for which the medicines were prescribed is not recorded in the Pharmaceutical Benefits Data System. We assumed that the medicines studied had been prescribed to prevent or treat a cardiovascular condition, and were therefore intended for long-term use, but this may not have been true for all patients in the study. However, cardiovascular conditions are by far the most common indication for those medicines that can be used to treat other conditions.

Likewise, information on the dosing regime prescribed is not recorded in the Pharmaceutical Benefits Data System. We assumed a daily dose equal to the pack dose dispensed and medicine dosing regimes as set out in the Australian Medicines Handbook 2006, but there are instances where doctors might validly vary these, such as in older patients, in patients with coexisting conditions or those taking multiple medicines.

The database does not record patients' date of death, so we may have included in our analysis time periods beyond which some individuals were alive. This would result in an overestimation of discontinuation rates for medicines for those individuals.

In the case of warfarin and beta-blocking agents, there are some indications where these medicines are prescribed for a limited period only. As the database does not contain information to allow us to identify these patients, we could not exclude them from the analysis, resulting in overestimation of discontinuation rates for these medicines.

National bodies with responsibility for quality use of medicines

Australian Commission on Safety and Quality in Health Care

The Australian Commission on Safety and Quality in Health Care was established by Australian Health Ministers in 2006 to lead and coordinate national efforts to improve health care safety and quality. It succeeded the Australian Council for Safety and Quality in Health Care which operated from 2000 to 2005.

Pharmaceutical Health And Rational Use of Medicines (PHARM) Committee

The PHARM committee is a multidisciplinary committee that provides expert advice to the Australian Government Minister for Health and Ageing and the Department of Health and Ageing on the National Strategy for Quality Use of Medicines. It also promotes and reviews the National Strategy for Quality Use of Medicines and oversees its implementation, and encourages quality use of medicines educational activities and programs.

Members have expertise in general practice, pharmacy, nursing, pharmaceutical industry, consumer issues, health education and behavioural science and are appointed by the Minister for Health and Ageing.

Australian Pharmaceutical Advisory Council (APAC)

APAC is a consultative forum that advises the Australian Government on a wide range of medicines policy issues. The Council includes representatives of peak health professions (pharmacy, medical and nursing), pharmaceutical industry, consumer and medical organisations, as well as government members with an interest in implementing Australia's National Medicines Policy.

National Prescribing Service (NPS)

NPS is a non-profit organisation, independent of government and the pharmaceutical industry, operating since 1999 and funded by the Australian Government Department of Health and Ageing. Its members represent health professionals, government, industry and consumers.

The NPS aims: to achieve better health and economic outcomes as a result of quality use of medicines; to improve the quality of prescribing and use of medicines by using interventions designed to change prescribing behaviour and providing independent, reliable, timely information about medicines to prescribers and consumers; and to build awareness and competence among health professionals and the community that will lead to quality use of medicines, including choices between medicines and other approaches to health problems.

Pharmaceutical Benefits Advisory Committee (PBAC)

PBAC is an independent statutory body established in 1954 to make recommendations and advise the Australian Government Minister of Health and Ageing on which medicines should be made available as part of the PBS. It considers the effectiveness and cost of a proposed benefit compared to alternative therapies. The committee recommends maximum quantities to be dispensed and repeats of the medicine. It may also recommend restrictions to the indications for which PBS subsidy is available.

Therapeutic Goods Administration (TGA)

TGA is part of the Australian Government Department of Health and Ageing and is responsible for ensuring that therapeutic goods available in Australia are of an acceptable standard and that Australians have timely access to therapeutic advances. It controls the supply of therapeutic goods through pre-market assessment, licensing of manufacturers and post-market surveillance.

National Institute of Clinical Studies (NICS)

NICS, now part of the National Health Medical and Research Council, is Australia's national agency for improving health care by helping close gaps between best available evidence and current clinical practice. It was established by the Australian Government in 2000. NICS works with researchers, practitioners and other stakeholders to establish where gaps exist; raises awareness of these gaps; and supports health professionals to understand and overcome the barriers to applying evidence within Australian health care settings.

Glossary

Angiotensin-converting-enzyme (ACE) inhibitors	Medicines used to treat people with high blood pressure or heart failure. They limit the progressive enlargement of the heart that can occur after a heart attack and relieve heart failure symptoms. If given early during a heart attack, they can reduce the risk of death.
Acute coronary syndrome	Describes acute myocardial infarction (heart attack) or unstable angina when they first present as a clinical emergency with chest pain or other features.
Adverse event	An event or circumstance in which a person receiving health care was harmed.
Agents acting on renin–angiotensin system	Includes ACE inhibitors and angiotensin II antagonists.
Angina	A short episode of chest pain that occurs when the heart has a temporary deficiency in its blood supply due to a severe, but incomplete, blockage in one of its arteries.
Angiotensin II antagonists	Medicines used to treat people with high blood pressure or heart failure. They also reduce the progression of kidney disease in people with diabetes, high blood pressure and protein leaking from the kidneys into the urine.
Antiarrhythmics	Medicines given to restore the normal heart rhythm or prevent life-threatening abnormal heart rhythms (arrhythmias).
Antithrombotic agents	Medicines that prevent the formation of clots, which could block blood vessels, by interfering with the clotting process. They are given to certain patients with heart disease, such as those with atrial fibrillation, after some heart attacks, or to those with severe heart failure, with ischaemic stroke or peripheral vascular disease (except previous embolism) to lower their risk of subsequent disease. They are also commonly used during percutaneous coronary intervention.
Arrhythmia	A disturbed rhythm of the heart beat—either too fast, too slow or irregular.
Atrial fibrillation	A condition marked by an irregular rapid heart beat. It arises because the heart's collecting chambers (atria) stop beating rhythmically and quiver uselessly (fibrillate).
Beta-blocking agents	Medicines used to treat patients with high blood pressure, but they also have other important uses. Through their lowering of blood pressure, these medicines prevent strokes and heart attacks. Also, in people with angina or history of heart attack, beta-blockers can reduce pain and deaths, and prevent further heart attacks. Certain beta-blockers are often used in the treatment of heart failure.
Calcium-channel blockers	Medicines effective in reducing blood pressure and angina.

Cardiovascular disease	Any disease of the heart (cardio) and blood vessels (vascular). Includes myocardial infarction, angina, heart failure, stroke and peripheral vascular disease. Also known as circulatory disease.
Cerebrovascular disease	Cerebrovascular disease refers to any disorder of the blood vessels supplying the brain or its covering membranes.
Circulatory disease	See *cardiovascular disease*.
Complementary medicines	Also known as traditional or alternative medicines. They include vitamins, minerals, nutritional supplements, and herbal, aromatherapy and homeopathic products.
Coronary heart disease	Also known as ischaemic heart disease, it is the most common form of heart disease. There are two major clinical forms: acute myocardial infarction and angina.
Chronic disease	Condition with a long development period, some of which may have no symptoms; prolonged course of illness, perhaps leading to other health complications; and associated functional impairment or disability.
Diabetes	Condition in which the body cannot properly use its main energy source: the sugar glucose.
Diuretics	Medicines effective in reducing blood pressure, which reduces the occurrence of strokes and heart disease. Diuretics are also helpful for treating symptoms in people with heart failure.
Drug-adverse event	Medicine problem that results in harm to the patient.
Harm	Includes disease, injury, suffering, disability and death.
Heart attack	See *myocardial infarction*.
Heart failure	Heart failure occurs when the heart functions less effectively in pumping blood around the body. It can result from a variety of diseases and conditions that impair or overload the heart, notably heart attack, high blood pressure or a damaged heart valve. People with mild heart failure may have few symptoms, but in more severe cases it can result in chronic tiredness, reduced capacity to undertake physical activity and shortness of breath.
Hypertension	High blood pressure.
Myocardial infarction	Often referred as heart attack, it is a life threatening event that occurs when a blood vessel supplying the heart itself is suddenly blocked completely, threatening to disrupt the heart and its functions. Strictly, myocardial infarction refers only to those heart attacks that have caused death of some heart muscle.
Over-the-counter medicines	Private, non-prescription medicinal preparations that can be purchased from pharmacies, supermarkets and other retail outlets.
Peripheral vascular disease	Pain in the legs due to inadequate blood supply.

Plain ACE inhibitors	ACE inhibitors without a diuretic component.
Prescription medicines	Pharmaceutical medicines available only on prescription of a registered medical practitioner and available only from pharmacies.
Serum-lipid-reducing agents	Also known as lipid-lowering medicines, they are effective in preventing heart attacks and reducing coronary heart disease deaths. HMG CoA reductase inhibitors (statins), resin binders, nicotinic acid, fibrates and probucol all reduce blood LDL cholesterol and possibly increase HDL cholesterol to varying degrees, with statins being the most effective. They also have varying effects in lowering blood triglycerides.
Statin	See *serum-lipid-reducing agents*.
Stroke	Stroke occurs when a blood vessel to the brain is suddenly blocked or bleeds. This may result in part of the brain dying due to the lack of blood, leading to a loss of brain function or impairment in a range of activities including movement, thinking and communication, and may lead to death.
Tachycardia	An abnormally fast heart beat.
Thrombosis	Clotting of blood within a blood vessel.

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