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Use of medicines by Australians with diabetes

Highlights

This bulletin presents information from a range of sources, including the Drug Utilisation Sub-Committee Database, the 2001 National Health Survey and the 1999–2000 Australian Diabetes, Obesity and Lifestyle Study. It investigates medicines used in the control of blood glucose levels ('antidiabetic medicines') as well as those used for related reasons such as the prevention or control of common diabetes complications.

- Use of the major antidiabetic medicines (insulin and oral blood glucose–lowering medicines) in Australia has increased substantially since the early 1990s and the trend is continuing.
- Between 1990 and 2004 there was a twofold increase in the use of insulin and a threefold increase in the use of oral blood glucose–lowering medicines.
- Metformin is the most frequently used oral blood glucose–lowering medicine in Australia, followed by gliclazide and glimepiride; these findings comply with current recommendations for oral blood glucose medicine use in Type 2 diabetes.
- The growing use of antidiabetic medicines is consistent with the rise in the number of Australians being diagnosed with Type 2 diabetes and the trend to a more aggressive approach to blood glucose control in diabetes.
- People with diabetes also report greater use of medicines for associated conditions such as high blood pressure and high blood cholesterol.

CONTENTS

Use of medicines by Australians with diabetes

Introduction

Diabetes is a chronic (long-term) condition that can have a major impact on life expectancy and quality of life, especially if undetected or poorly controlled (Box 1). It is estimated that in 1999–2000 around 1 million Australians (7.4% of the population) had diabetes (Dunstan et al. 2002). During the course of the disease, diabetes can damage numerous parts of the body. Complications can be life-threatening and include diseases of the large blood vessels (macrovascular disease), such as coronary heart disease, stroke and peripheral vascular disease; as well as diseases of the small blood vessels (microvascular disease), such as some forms of kidney disease and eye disease.

People with diabetes often require medication regimes to control high blood glucose levels. Further, people with the condition frequently have associated health problems such as high blood pressure and high blood lipids (cholesterol and related substances) that may necessitate taking multiple medicines and visiting a number of different health professionals. Clinical trials have shown that good control of blood glucose, blood lipids and blood pressure in patients with diabetes delays the onset and slows the progression of complications (DCCT Research Group 1993; HPS Collaborative Group 2003; UKPDS Group 1998b).

Box 1: Diabetes

What is diabetes?

Diabetes is a condition in which the body cannot properly use its main energy source, the sugar glucose. This is due to a deficiency in insulin, a hormone produced by the pancreas. Insulin's role is to help glucose enter the body's cells from the bloodstream. With diabetes, there is an abnormal build-up of glucose in the blood and this can have serious short- and long-term effects.

This bulletin is concerned with the two most common types of diabetes. Type 1 diabetes mostly occurs before the age of 40 and is distinguished by a total or near-total lack of insulin. It accounts for about 10–15% of all diabetes cases. Type 2 diabetes usually occurs after the age of 40 and accounts for 85–90% of all diabetes cases. It is distinguished by reduced insulin production or the inability of the body to use insulin properly (insulin resistance), and is more common in people who are overweight or obese or have low physical activity levels. Consequently, this type of diabetes is highly preventable.

What are its effects?

The short-term effects of untreated diabetes often include tiredness, frequent urination and thirst. This can lead to weight loss, dehydration, and impaired consciousness due to energy disturbances. There is also more susceptibility to infection and poor healing of wounds.

The longer term effects of diabetes include a greatly increased risk of heart attack and stroke, as well as damage to the eyes, kidneys, nerves and blood circulation in the legs.

For more detailed information about diabetes, its risk factors and complications, see Diabetes: Australian facts 2002 *(AIHW 2002).*

In Australia available research has identified the need for improved quality of diabetes care (Georgiou et al. 2004; Kemp et al. 2005). For example, in 1999 in divisions of general practice providing data for the National Divisions Diabetes Program (NDDP) less than 60% of patients were receiving care consistent with best-practice guidelines (Carter et al. 2000). Improved health professional and consumer knowledge about the use of medicines in diabetes is an integral part of improving diabetes care and achieving the best possible health outcomes for people with diabetes.

This bulletin presents data on the use of medicines by people with diabetes in Australia between 1990 and 2004. It investigates medicines used in the control of blood glucose levels (commonly referred to as 'antidiabetic medicines') as well as those used for related reasons such as the prevention or control of common diabetes complications. Some data on the cost of diabetes medicines to the government and patients are also presented.

The term 'medicines' refers here to prescription, non-prescription and complementary medicines (herbal medicines, vitamin and mineral supplements, other nutritional supplements, traditional medicines such as traditional Chinese medicines, homeopathic medicines and some aromatherapy oils) (Commonwealth of Australia 2002). Other pharmaceuticals such as diagnostic agents and appliances also play a vital role in diabetes management but are beyond the scope of this bulletin.

Management of diabetes

Diabetes management involves a combination of medical and non-medical approaches. The overall goal is for the patient to have a life that is as healthy, and also as normal, as possible. This can be a demanding task because the condition requires strong attention and monitoring by the patient, their doctor and other health professionals.

The medical aims of diabetes management are to remove the symptoms and short-term risks of high blood glucose, to prevent longer term complications, and to detect and treat any complications early if they do arise. Symptom control and longer term prevention can be achieved by maintaining normal blood glucose levels and by attention to lifestyle and its associated risk factors (such as diet and physical activity). Research studies have shown the benefits of improved blood glucose control in reducing the risk of complications in people with diabetes (UKPDS Group 1998a; Stratton et al. 2000).

For both Type 1 and Type 2 diabetes, as well as with medication, a degree of blood glucose control can be brought about through non-medication approaches such as a healthy diet, regular exercise and resulting weight control. Along with avoiding smoking and maintaining good control of blood pressure and blood cholesterol levels, these lifestyle approaches also help reduce the risk of complications such as heart attack and stroke.

Type 1 diabetes

People with Type 1 diabetes require insulin injections daily, usually several times a day. Insulin is a hormone that enables the body to process its energy sources, particularly its main source, glucose. Giving a suitable dose of insulin to people with diabetes restores their ability to use glucose and to process other nutrients (carbohydrates, fats and proteins), thereby normalising

the level of glucose in the blood. The effect is temporary, however, and the doses must be repeated. There are several types of manufactured insulin available commercially; they vary in terms of the speed with which they start working and how long they remain in the body.

Glucose monitoring is also essential to help keep glucose levels within healthy limits and to help identify episodes of dangerously high and low blood glucose levels, particularly among people with Type 1 diabetes (IDF Clinical Guidelines Task Force 2005). To effectively manage the condition, people with insulin-treated diabetes must balance their insulin injections against their blood glucose level and the timing and amount of their meals and exercise.

Type 2 diabetes

Many Type 2 patients can achieve a healthy blood glucose level through lifestyle changes such as healthy eating, regular physical activity and weight reduction (Tuomilehto et al. 2001). However, many of these patients may find it too difficult to modify their lifestyle substantially and, even if they can, it may not prove sufficient to achieve adequate glucose control. In such cases, oral medicines that lower blood glucose levels are required. In time, many people with Type 2 diabetes also require insulin treatment.

The most common oral antidiabetic agents, their actions and uses are summarised in Table 1. It is relatively common for Type 2 patients to move on from non-medical management approaches alone to monotherapy (therapy using a single antidiabetic medicine), then to a combination of two, and sometimes three, medicines (referred to as 'combination therapy') (Williams & Pickup 1999). This is because of the progressive nature of Type 2 diabetes and the potential for reduced effects of a single antidiabetic medicine over time (Rossi 2006).

Table 1: Oral blood glucose–lowering medications

Medications	Mode of action	Common uses	Generic names
Sulfonylureas	Stimulate insulin secretion	Monotherapy or in combination with metformin	Glibenclamide Gliclazide Glimepiride Glipizide Tolbutamide
Biguanides	Lower blood glucose by improving cell response to insulin and lowering hepatic (liver) glucose production	Monotherapy or in combination with a sulfonylurea	Metformin
Alpha-glucosidase inhibitors	Delay intestinal absorption of glucose	Adjunct to other oral antidiabetic agents	Acarbose
Thiazolidinediones	Lower blood glucose by improving cell response to insulin	Monotherapy or in combination with either sulfonylureas or metformin	Pioglitazone Rosiglitazone

Sources: Adapted from Rossi (2006) and NPS (2001).

Medicines for associated health problems

People with diabetes often have other cardiovascular risk factors, notably high blood pressure and high blood lipids. General treatment of these problems in diabetes involves improving blood glucose control and lifestyle measures such as weight reduction, a low-fat, low-salt diet, regular physical activity, reduced alcohol intake and cessation of smoking (Williams & Pickup 1999). Even with these measures, however, it may be necessary for people with diabetes to take blood pressure and lipid-lowering medicines to reduce their risk of cardiovascular disease. Doctors are often more aggressive in managing blood pressure and blood lipids when a person also has diabetes. Research suggests that tight control of blood pressure in particular can substantially reduce the risk of diabetes complications (UKPDS Group 1998b).

Complementary medicines

'Complementary medicines' includes herbal medicines, vitamin and mineral supplements, other nutritional supplements, traditional medicines such as Ayurvedic medicines and traditional Chinese medicines, homeopathic medicines, and some aromatherapy oils. The Australian Register of Therapeutic Goods (ARTG), a database maintained by the Therapeutic Goods Administration, contains details of all therapeutic goods that are imported into, supplied in or exported from Australia (ECCMHS 2003). In 2003 approximately 16,000 complementary medicines were listed in the ARTG.

According to Dunning (2003), many people with diabetes turn to complementary therapies with the aim of helping them cope with and control the chronic nature of the disease. Although some complementary therapies have been shown to be beneficial to people with diabetes, their use can lead to adverse events. There is also the risk that people with diabetes may self-diagnose and self-treat and consequently delay seeking appropriate, timely management advice (Dunning 2003).

This bulletin presents data on vitamin and mineral supplements and herbal and natural medicines only. Data on the use of other complementary medicines by people with diabetes are not readily available.

Trends in the use of diabetes medicines

The trend analysis presented in this section is based on data from the Drug Utilisation Sub-Committee (DUSC) Database (Box 2) for 1990 to 2004. Only information on products dispensed through community pharmacies is included in the DUSC Database; medicines provided in public hospitals and highly specialised medicines available to outpatients through public hospital pharmacies are not included.

Medicine use is expressed as:

- the number of prescriptions (also referred to as scripts) dispensed
- the defined daily dose per 1,000 population per day (DDD/1,000/day).

The DDD is the international unit of drug use established by the World Health Organization on the basis of assumed average dose per day of the drug used for its main indication by adults (DoHA 2004). It enables valid comparisons between medicines, independent of differences in price, preparation and quantity per prescription.

Use of medicines by Australians with diabetes

During the 1990s the use of insulins and oral glucose–lowering medicines in Australia increased and the trend has continued in the past few years (Figure 1). This reflects, at least in part, an increase in the number of people diagnosed with diabetes (AIHW 2002). A trend to a more aggressive treatment approach may also be a factor in the increasing use of diabetes medicines in the past couple of decades. Results from clinical trials have led to management guidelines emphasising the importance of blood glucose control to reduce vascular complications in people with diabetes (IDF Clinical Guidelines Task Force 2005; Stratton et al. 2000; UKPDS Group 1998a).

Box 2: The DUSC Database

The DUSC database is held at the Australian Government Department of Health and Ageing and is used for monitoring the community (that is, non public hospital) use of prescription medicines in Australia. The database combines information from the Pharmaceutical Benefits Scheme (PBS) and the Repatriation PBS (RPBS) and an estimate of unsubsidised prescriptions from the Pharmacy Guild Survey.

The PBS and RPBS aim to provide affordable access to medications for Australians by subsidising the cost of prescription medications. Around 80% of all prescription medications available in Australian pharmacies are listed on the PBS or the RPBS. Data on the value and volume of PBS and RPBS services are processed by Medicare Australia and provided to DUSC.

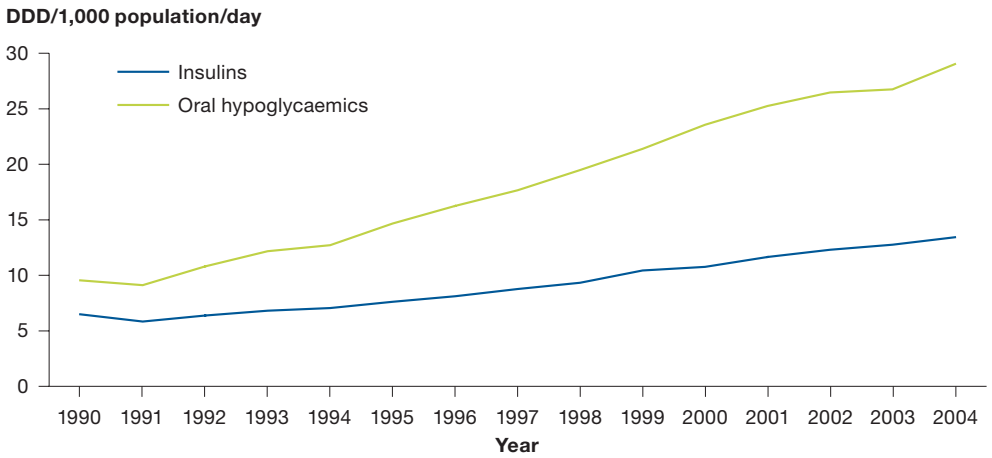
The Pharmacy Guild Survey estimates the number of prescriptions issued from community pharmacies that are not covered by the PBS or the RPBS.

Source: *DoHA 2004.*

As Figure 2 shows, metformin became increasingly popular in the 1990s and in 2004 was the most frequently dispensed oral hypoglycaemic medication overall (13.7 DDD/1,000/day), followed by gliclazide (7.4 DDD/1,000/day) and glimepiride (4.0 DDD/1,000/day) (Table B1). While the use of metformin has continued to increase since 1990, gliclazide use peaked in 2000 and 2001 and has since decreased slightly. This coincided with the inclusion of glimepiride in the PBS and RPBS during 2000.

Metformin is among the top 20 most commonly prescribed medicines in general practice; in 2003–04 it accounted for 1.2% of all prescriptions issued by general practitioners (AIHW: Britt et al. 2004).

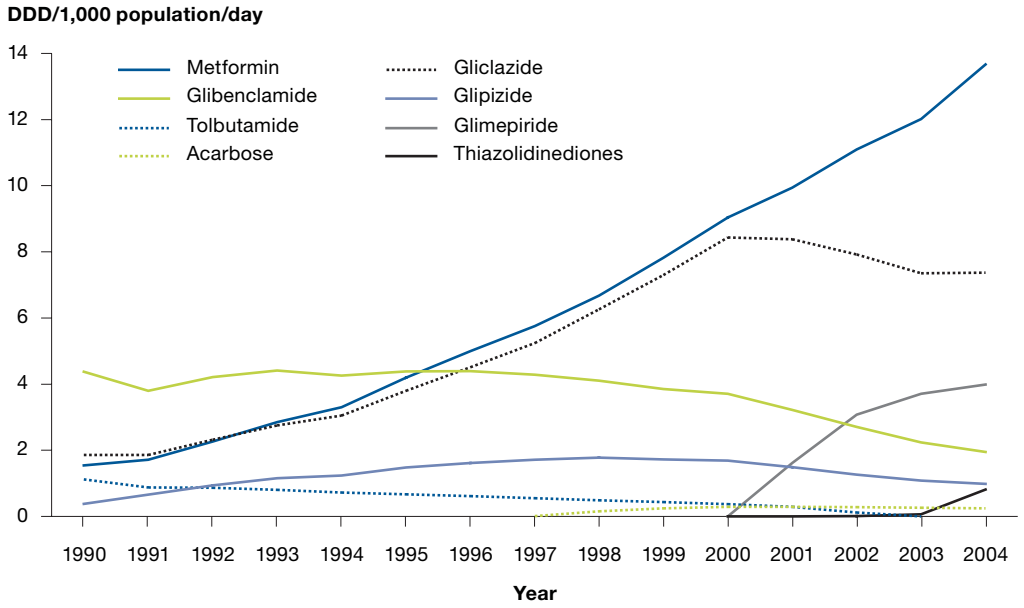
Thiazolidinedione agents (including glitazones such as rosiglitazone and pioglitazone) have been listed on the PBS only since 2003. In general, thiazolidinediones are recommended when either metformin or a sulfonylurea is contra-indicated or not tolerated, when combination therapy with metformin and a sulfonylurea fails, or when insulin (with or without oral medications) no longer maintains blood glucose control (NPS 2004). In 2004 thiazolidinediones were dispensed at a rate of 0.8 DDD/1,000/day (Table B1).



Note: Data relate to products dispensed through community pharmacies only; medicines provided in public hospitals and highly specialised medicines available to outpatients through public hospital pharmacies are not included.

Source: DoHA Drug Utilisation Sub-Committee Database.

Figure 1: Community use of insulins and oral blood glucose–lowering medicines, 1990–2004



Note: Data relate to products dispensed through community pharmacies only; medicines provided in public hospitals, and highly specialised medicines available to outpatients through public hospital pharmacies are not included.

Source: DoHA Drug Utilisation Sub-Committee Database.

Figure 2: Community use of oral blood glucose–lowering medicines, 1990–2004

Use of medicines by Australians with diabetes

Self-reported medicine use

Diabetes medicines

Self-reported data on medicine use are available from the Australian Bureau of Statistics series of National Health Surveys and the 1999–2000 Australian Diabetes, Obesity and Lifestyle Study (AusDiab study). Data available from the 2001 National Health Survey (NHS) include self-reported diabetes status and type of diabetes treatment. The AusDiab study is the most recent survey to estimate the national prevalence of diabetes in Australia through measurement of blood glucose levels. The study was designed to provide estimates of both previously diagnosed and undiagnosed diabetes and also collected self-reported information on treatments currently being received for diabetes. When interpreting data on medication use from the 2001 NHS and the AusDiab study, it is important to note that self-reported data are not medically verified. Nevertheless, data from these surveys can be useful for assessing treatment patterns and related health behaviours.

In the 2001 NHS people who reported having diabetes were asked what type of treatment they used for their diabetes (for example, insulin injections or any other medications for diabetes or high sugar levels). Among those who reported having diabetes, 21% were using insulin, 60% were using pharmaceutical medicines other than insulin, and a total of 76% were using medication of one form or another for their diabetes or high blood glucose levels (Table 2). Of those who used diabetes medicines other than insulin, two in five were using metformin, one in five were using gliclazide, and nearly one in five were using other blood glucose lowering agents. Metformin and gliclazide were also the most common medications prescribed for diabetes in general practice (28.3 and 14.7 per 100 problems managed respectively) in the 2003–04 Bettering the Evaluation and Care of Health (BEACH) study.

In the AusDiab study people with previously diagnosed diabetes were asked about treatments they were receiving for diabetes (e.g. diet, insulin and oral blood glucose–lowering tablets).

All people with Type 1 diabetes require insulin to control their blood glucose levels; in the AusDiab study 97% of people with Type 1 diabetes reported using insulin only and 3% reported taking blood glucose–lowering tablets in addition to insulin for their diabetes (Table 3). In comparison, 58% of respondents with previously diagnosed Type 2 diabetes reported using blood–glucose lowering tablets only and around 10% were using insulin (6% using insulin only and 3% using insulin and tablets).

Just under one-third of people with previously diagnosed Type 2 diabetes reported using dietary modification alone to manage their diabetes; this decreased with age, from 35% of 25–44 year olds to 30% of people aged 65 years and over (Table 4). Insulin use was fairly constant across the age groups, with one in 10 reporting its use. Oral hypoglycaemic tablets were the most common treatment, with with their use increasing with age.

Table 2: Type of diabetes treatment, 2001

	Males	Females	Persons	Males	Females	Persons
Treatment		**Number**			**Per cent**	
Insulin (daily injections)	61,700	55,600	117,300	22.7	19.4	21.0
Insulin (used at all)	61,700	56,100	117,800	22.7	19.6	21.1
Pharmaceutical medicines other than insulin:						
Metformin	110,600	120,000	230,500	40.7	41.8	41.3
Gliclazide	60,900	52,600	113,500	22.4	18.4	20.3
Other oral blood glucose–lowering[a]	50,900	44,500	95,400	18.7	15.5	17.1
All other medicines[b]	15,400	12,900	28,300	5.7	4.5	5.1
Other antidiabetic[c]	10,400	7,800	18,300	3.9	2.7	3.3
Total	*171,900*	*163,100*	*335,000*	*63.3*	*56.9*	*60.0*
Total using insulin or pharmaceutical medicines other than insulin	*211,000*	*208,700*	*419,600*	*77.7*	*72.8*	*75.2*
Vitamin/mineral supplements	10,900	15,400	26,200	4.0	5.4	4.7
Herbal/natural medicines	2,000	6,600	8,700	0.8	2.3	1.6
Any of the above	211,500	214,700	426,200	77.9	74.9	76.3

(a) Includes acarbose, chlorpropamide, glibenclamide, glipizide and tolbutamide.

(b) All other pharmaceutical medicines.

(c) Diabetes medication not elsewhere classified.

Notes

1. These data are derived from self-reported information.
2. People may report more than one type of medication.

Source: AIHW analysis of the 2001 National Health Survey.

Table 3: Treatment currently being received for diabetes, 1999–2000

Treatment	Type 1 diabetes	Type 2 diabetes
	Per cent	
Diet only	—	30.3
Insulin only	96.9	6.4
Tablets only	—	58.0
Insulin and tablets	3.1	3.2
Other (herbal or alternative therapies)	—	2.2

— Nil or rounded to zero.

Note: These data are derived from self-reported information for people with previously diagnosed diabetes only.

Source: AIHW analysis of the 1999–2000 Australian Diabetes, Obesity and Lifestyle Study.

Use of medicines by Australians with diabetes

Table 4: Treatment currently being received for Type 2 diabetes, by age group, 1999–2000

	Age group (years)			
Treatment	25–44	45–64	65+	All ages
		Per cent		
Diet only	35.1	31.4	30.2	31.0
Insulin[a]	9.0	10.0	9.7	9.8
Tablets	55.9	58.6	60.1	59.2

(a) Includes people on insulin or insulin and tablets.

Notes

1. These data are derived from self-reported information for people with previously diagnosed diabetes only.
2. Excludes 'other' (herbal or alternative therapies).

Source: AIHW analysis of the 1999–2000 Australian Diabetes, Obesity and Lifestyle Study.

While data on diabetes treatment by type of diabetes are not readily available, some data are available from the BEACH survey, which is an ongoing encounter-based study of patients for whom a general practice service is provided. The survey includes information about the encounter itself, the patient and the management for each problem (including medications and non-pharmacological treatments).

Results from general practice encounters in the period April 1998 to March 1999 for people with diabetes were published by type of diabetes in 2001. Among people with Type 1 diabetes, medications were given at a rate of 78.5 per 100 problems managed (AIHW: Senes & Britt 2001). Insulin was the most commonly prescribed medication (85.5% of medications given). Other treatments were used at a rate of 29.7 per 100 problems managed and included advice on medication (6.7 per 100), advice on nutrition/weight (5.7 per 100) and advice on treatment (3.9 per 100). It should be noted, however, that the number of cases of Type 1 diabetes in the study sample was very low, so such estimates should be interpreted with caution.

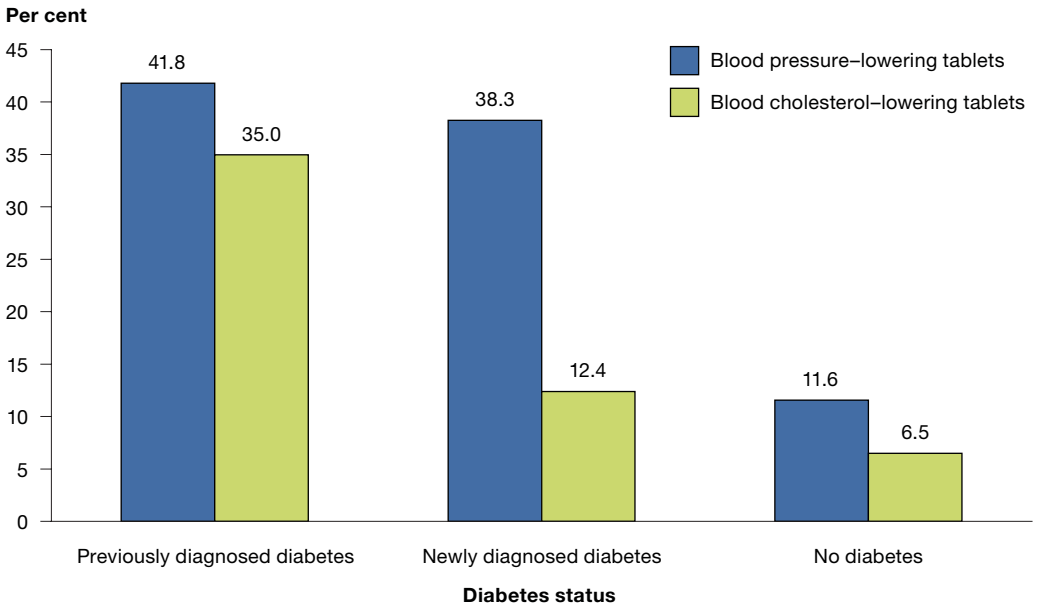
Among patients with Type 2 diabetes, medications were given at a rate of 75.6 per 100 problems managed (AIHW: Senes & Britt 2001). Oral hypoglycaemics accounted for 68.3% of medications given. Metformin was the most commonly prescribed medication (28.7 per 100 problems), followed by gliclazide (18.4 per 100 problems). Other treatments were used at a rate of 41.2 per 100 problems managed and included advice on nutrition/weight (15.0 per 100), glucose tests done in the doctor's surgery (8.7 per 100) and advice on treatment (4.0 per 100).

Data on treatments received among patients attending diabetes clinics are available from the Australian National Diabetes Information Audit and Benchmarking (ANDIAB) survey. In the 2004 ANDIAB survey 7.4% of adults were being treated by diet only, 37.6% were taking tablets, 27.7% were using insulin only, and 23.4% were using insulin and taking tablets (Flack & Colagiuri 2005). The majority of adult patients had Type 2 diabetes (80.3%). In contrast, all the paediatric and adolescent patients had Type 1 diabetes. Accordingly, 96.8% of paediatric and adolescent patients were receiving insulin only therapy, and the remaining 3.2% were using insulin and taking tablets. A key limitation of the ANDIAB survey is that the data are obtained from specialist diabetes clinics, which are likely to see more people with severe diabetes and resultant complications. As a consequence, these data are unlikely to be an accurate reflection of conditions prevailing in the general community of people with diabetes.

Medicines for associated conditions

The 1995 NHS showed that adults with diabetes were more likely than those without diabetes to report using medicines such as aspirin, frusemide (a diuretic), ACE inhibitors (used in the treatment of high blood pressure) and digoxin (used to treat congestive heart failure), although the problem for which the medicines were taken was not recorded (AIHW 2002). This information was not collected in subsequent surveys.

In the 1999–2000 AusDiab study a similar proportion of people with previously and newly diagnosed diabetes reported taking blood pressure–lowering medication (42% and 38% respectively), over three times the proportion of people without diabetes (12%) (Figure 3). However, more than twice the proportion of people with previously diagnosed diabetes reported taking blood cholesterol–lowering medication than those with newly diagnosed diabetes (35% and 12% respectively).



Note: 'Previously diagnosed diabetes' includes people with either Type 1 or Type 2 diabetes.

Source: AIHW analysis of the 1999–2000 Australian Diabetes, Obesity and Lifestyle Study.

Figure 3: Use of tablets for high blood pressure and high blood cholesterol, by diabetes status, 1999–2000

Complementary medicines

Information from the 2001 NHS on the use of complementary medicines to treat diabetes is presented in Table 2. Around 5% of people with diabetes reported using vitamin and mineral supplements, while only 2% used herbal or natural medicines for their diabetes. Females with diabetes were more likely to report using vitamin and mineral supplements (5.4%) and herbal or natural medicines (2.3%) than males (4.0% and 0.8% respectively).

Use of medicines by Australians with diabetes

Multiple medicines

People with diabetes often require a regimen of multiple medicines to control blood glucose levels and associated complications such as high blood pressure and high blood lipids.

The 2001 NHS asked respondents with current long-term diabetes about other medications they may have used or taken for their diabetes or high blood sugar levels (apart from insulin injections). Around one in four people with diabetes reported taking two or more medicines (apart from insulin injections) (Table 5). Respondents not having insulin injections were more likely to report using multiple medicines compared with those having insulin injections. This may reflect the need for many people with Type 2 diabetes to use a combination of oral medicines to control their blood glucose levels.

Table 5: Number of medicines used (apart from insulin injections) by people with diabetes, by insulin injection status

Number of medicines (apart from insulin injections)	Having insulin injections		Not having insulin injections		All[a]	
	Number	Per cent	Number	Per cent	Number	Per cent
None	82,900	70.4	138,700	31.5	221,600	39.7
One	20,000	17.0	173,100	39.3	193,200	34.6
Two	11,000	9.4	108,800	24.7	119,900	21.5
Three	2,800	2.3	16,100	3.7	18,800	3.4
Four or more	1,000	0.8	3,900	0.9	4,800	0.9

(a) Includes all people reporting diabetes, regardless of whether they are using insulin or not.

Note: Derived from self-reported information. Refers to medications taken in the two weeks prior to interview.

Source: AIHW analysis of the 2001 National Health Survey.

Costs of medicines for diabetes

This section presents information about costs of antidiabetic medicines (insulins, insulin analogues, and oral blood glucose–lowering medicines). Two sources of data are used—the PBS and the RPBS. The data refer to the use of prescription medicines in the community only (excludes public hospitals).

Almost 5,250,000 prescriptions for antidiabetic medicines were subsidised by the PBS and RPBS in 2003–04 (Table 6). The total cost (cost to government plus patient contributions) of these prescriptions was around $193.8 million. This comprised almost $116.5 million and over 550,000 prescriptions for insulin and $77.3 million and nearly 4.7 million prescriptions for oral blood glucose–lowering medicines. Interestingly, insulins accounted for only 11% of all antidiabetic medicine prescriptions but made up 60% of the $193.8 million spent on antidiabetic medicines (64% of government costs and 25% of patient costs).

Analysis of allocatable recurrent health expenditure data from the AIHW Disease Expenditure Database showed that direct health care expenditure on diabetes was almost $784 million in 2000–01, representing 1.7% of the year's total (AIHW: Dixon 2005). Of this, around $177 million was spent on antidiabetic medicines by the Australian Government and people with diabetes. It is important to note that these figures do not represent all health expenditure on diabetes. Expenditure that could not be allocated includes that on

ambulances, public health programs, health administration, health aids and appliances, and community health. Further, the costs do not include expenditure on conditions for which diabetes is a contributing cause (such as dialysis for end-stage renal disease). For more information see AIHW: Dixon (2005).

Table 6: Costs of diabetes medicines subsidised by the PBS and the RPBS, 2003–04

Medicine type	Number of prescriptions	Government cost ($)	Patient cost ($)	Total cost[a] ($)
Insulin	*553,153*	*111,921,239*	*4,575,036*	*116,496,275*
Oral blood glucose–lowering medicines	*4,683,450*	*63,421,642*	*13,877,849*	*77,299,491*
Metformin	2,592,387	33,228,705	7,660,199	40,888,904
Gliclazide	1,057,471	13,490,178	2,870,235	16,360,413
Glimepiride	503,650	5,635,654	1,414,838	7,050,492
Rosiglitazone	44,408	2,926,841	343,220	3,270,061
Pioglitazone	35,565	2,958,378	269,287	3,227,665
Acarbose	75,071	2,336,021	339,896	2,675,917
Glibenclamide	254,474	1,873,319	669,090	2,542,409
Glipizide	120,424	972,547	311,084	1,283,631
Total	**5,236,603**	**175,342,882**	**18,452,884**	**193,795,766**

(a) Government plus patient costs.

Source: AIHW analysis of PBS and RPBS data (supplied by DoHA).

Adverse episodes

There are risks associated with using medicines. Medicine over-use increases the risk of side-effects (and the likelihood of side-effects being more severe) and can result in blood levels of the medicine becoming unsafe. Under-use can lead to withdrawal or reduce the beneficial effects and lead to increased risk of future complications. Medicines can also have unwanted effects even when properly used—for example, excessive side-effects, reactions with other medicines, and occasionally adverse reactions.

There is little published information available on adverse reactions to medication in people with diabetes. However, the National Hospital Morbidity Database contains data on hospital separations for patients admitted to hospital in Australia for adverse drug reactions or who have an adverse event while in hospital. Of particular interest are hospitalisations for hypoglycaemia (low blood glucose). Hypoglycaemia can result from either incorrect prescription or improper administration of insulin or oral hypoglycaemic agents ('accidental poisoning') but can also occur when the dosage is correct or being adjusted ('other adverse events').

Not surprisingly, hypoglycaemia due to 'accidental poisoning' and 'other adverse events' increased consistently with age for both males and females in 2003–04 (Table 7). This is in line with the increasing prevalence of diabetes with age and the well-established relationship between the risk of adverse drug events and increasing age. According to McLean and Le Couteur (2004), older people are four times more likely to be admitted to hospital as a result of an adverse drug reaction.

Table 7: Hospital separations for hypoglycaemic episodes in people with a principal diagnosis[(a)] of diabetes, 2003–04

	Hypoglycaemia (accidental poisoning)			Hypoglycaemia (other adverse events)		
Age group (years)	Males	Females	Persons	Males	Females	Persons
	Number of separations					
<25	10	6	16	15	22	37
25–44	13	13	26	29	14	43
45–64	35	19	54	50	43	93
65+	39	53	92	135	178	313
Total	**97**	**91**	**188**	**229**	**257**	**486**

(a) Diabetes is coded as the principal diagnosis when it is the primary reason for the patient being hospitalised.

Note: See Appendix A for definitions of hypoglycaemia due to poisoning and adverse effects.

Source: AIHW National Hospital Morbidity Database 2003–04.

Discussion

This analysis provides a useful insight into the current use of medicines by Australians with diabetes. The results show that use of the major antidiabetic medicines (insulins and oral blood glucose–lowering medicines) has increased substantially since the early 1990s and this trend is continuing. This is consistent with the rise in the number of people diagnosed with Type 2 diabetes during this period (Dunstan et al. 2002). There is also evidence of an increase in the incidence of Type 1 diabetes, particularly in children (AIHW 2006; Haynes et al. 2004; Taplin et al. 2005; Karvonen et al. 2000).

Changes in medication approach may also be a factor in the increasing use of antidiabetic medicines. Significant benefits in morbidity and mortality have been shown with aggressive control of blood glucose in diabetes (DCCT Research Group 1993; UKPDS Group 1998b). The number of people taking more than one medicine to control their blood glucose may be increasing accordingly. Combination therapy using a regimen of different diabetes medicines is considered a useful way of treating Type 2 diabetes since it can address several problems simultaneously (Poulsen et al. 2003). In addition, because of the progressive nature of diabetes, it is often necessary to increase medication therapy over time in order to maintain glucose control. According to Turner et al. (1999), 50% of patients with Type 2 diabetes require more than one antidiabetic medicine by three years after diagnosis, rising to 75% by nine years after diagnosis.

While the use of insulins has increased considerably in the past couple of decades, the increase in oral hypoglycaemic use has been even more marked. Once again, this is likely to reflect changes in both the number of people detected with Type 2 diabetes and in medication treatment for diabetes in recent times—in particular, combination therapy.

The 1999–2000 AusDiab study found that, of those who had previously been diagnosed with Type 2 diabetes, around 10% used insulin and 58% were on tablets only to control their blood glucose levels (see Table 3). Data from the 2001 NHS, BEACH and ANDIAB are reasonably consistent with these results, with far more people with Type 2 diabetes using oral blood glucose–lowering medicines compared with insulin to treat their diabetes. It should be noted, however, that a large proportion of people with Type 2 diabetes have not been diagnosed with

the condition (Dunstan et al. 2002) and therefore would not be receiving any treatment or management specifically for their diabetes (although some may be receiving treatment for concurrent conditions).

Results from the 1999–2000 AusDiab study suggest that around one in three people with Type 2 diabetes are using dietary modification alone to manage the condition. Encouraging a healthy diet is considered a priority in diabetes management. Results from the United Kingdom Prospective Diabetes Study showed that dietary change was effective in lowering blood glucose after diagnosis for some patients. Further, some patients were able to maintain target glucose control for many years using dietary modification alone (UKPDS Group 1990; Turner et al. 1999). There is also considerable evidence demonstrating the benefits of physical activity in diabetes management. Increased physical activity can assist in weight reduction and control of blood glucose in people with diabetes, in addition to having positive effects on cardiovascular fitness and blood pressure (Pedersen & Saltin 2006; Therapeutic Guidelines 2004).

In general, medication therapy for Type 2 diabetes is the recommended approach only when lifestyle modification cannot control blood glucose adequately or when severe symptoms are present or blood glucose levels are consistently at dangerous levels (Therapeutic Guidelines 2004; Rossi 2006). In such cases, metformin is considered the medicine of first choice (particularly in obese patients). When metformin is contra-indicated or not tolerated for some reason, sulfonylureas are usually the preferred option. The data presented here are in line with these recommendations: metformin is by far the most commonly used oral blood glucose–lowering agent in Australia, followed by gliclazide and glimepiride (both sulfonylureas). It is noteworthy that medication therapy is not a substitute for a healthy diet and exercise; even when medication is required, lifestyle approaches should be encouraged as an important part of diabetes management (Rossi 2006). Unfortunately, there are no data on the contribution of lifestyle approaches once medication has been introduced.

The use of prescribed medicines for diabetes places a substantial financial burden on people with the condition, their families and carers, health services and governments. The total cost (cost to government plus patient contributions) of prescribed antidiabetic medicines in the community in 2003–04 was around $193.8 million. Although insulins accounted for only 11% of all antidiabetic medicine prescriptions, this group of medicines made up almost 60% of the $193.8 million spent. Note that not all medication use is captured by the PBS and RPBS (see Appendix A for more information); these data therefore underestimate the financial burden imposed by diabetes.

Data on the use of non-prescription medications by people with diabetes are much more limited. More information is needed to understand not only why people with diabetes take alternative and non-prescription medicines but also how much money is spent in this area in Australia.

Implications and considerations

There is evidence that safe and effective interventions can successfully delay, and even prevent, the development of complications in diabetes. In addition to lifestyle modification (diet, physical activity, and removing or reducing risk factors), medicines are often crucial to the goal of achieving combined control of blood glucose, blood cholesterol and blood pressure in people with diabetes.

Use of medicines by Australians with diabetes

The analysis presented in this bulletin demonstrates increasing use of antidiabetic medicines in Australia, particularly oral hypoglycaemic medicines. This reflects changes in both the number of people with diabetes (increasing prevalence and increasing detection) and in medical treatment for diabetes (e.g. combination therapy) in recent times. The analysis also highlights gaps and deficiencies in the information available, such as the paucity of data on the use of non-prescription medicines by people with diabetes. This information has important implications for achieving improvements in the medical management of people with diabetes in the future.

Appendix A: Data sources and methods

Australian Bureau of Statistics National Health Surveys, 1995 and 2001

The 1995 and 2001 National Health Surveys conducted by the Australian Bureau of Statistics, were designed to obtain national information on the health status of Australians, their use of health services and facilities, and health-related aspects of their lifestyles. The 1995 survey collected information from a sample of 57,600 people (ABS 1996) and the 2001 survey collected information from approximately 26,900 people between February and November 2001 (ABS 2002).

Australian Diabetes, Obesity and Lifestyle Study

The AusDiab Study was conducted in 1999–2000 by the International Diabetes Institute and was partially funded by the then Commonwealth Department of Health and Aged Care. It is the most comprehensive survey to date of the prevalence and impact of diabetes. Information was collected on self-reported and measured diabetes and cardiovascular risk factors, health knowledge, attitudes, and health services use and practices. The study collected information from 11,247 adults aged 25 years and over throughout Australia (excluding the Australian Capital Territory).

Diagnosis of diabetes was based on self-reported physician diagnosis of diabetes confirmed either by self-reported use of hypoglycaemic medication or results from a 75-gram oral glucose tolerance test. Participants who started insulin treatment within two years of diagnosis were classified as having Type 1 diabetes. If diabetes onset was at age 40 years or older, body mass index also had to be less than 27 kg/m^2. All other cases were classified as Type 2 diabetes (Kemp et al. 2005).

The AusDiab data in this bulletin were weighted to the age and sex distribution of the 1998 Australian population aged 25 years and over.

Australian National Diabetes Information Audit and Benchmarking

ANDIAB is a collection by the National Association of Diabetes Centres and is based on an audit of patients attending a selection of specialist diabetes centres and specialist endocrinologists in private practice. In 2004 it reported data on 3,108 individuals with diabetes receiving specialist clinical management. A limitation of the sample is that it does not accurately reflect the conditions prevailing in the general community of people with diabetes.

Bettering the Evaluation and Care of Health Survey of General Practice

BEACH is an ongoing survey looking at the clinical activities of general practitioners; it is conducted by the General Practice Statistics and Classification Unit (an AIHW collaborating unit within the Family Medicine Research Centre at the University of Sydney). The survey obtains information about the encounter itself, the patient, and management for each problem (including medications and non-pharmacological treatments). Only those medications that were prescribed, given or advised for over-the-counter purchase during the course of the recorded encounter are included (AIHW: Senes & Britt 2001). If a prescription was not provided for a given problem it does not necessarily mean that the patient was not already taking medication for the problem or that a prescription may be given at a subsequent encounter for the same problem.

Drug Utilisation Sub-Committee Database

DUSC monitors community (i.e. non public hospital) use of prescription medicines in Australia. The DUSC Database combines information on prescriptions subsidised by the PBS and the RPBS and an estimate from the Pharmacy Guild Survey of those prescriptions that are not subsided (i.e. private prescriptions and PBS prescriptions priced under the general patient co-payment). The Pharmacy Guild Survey collects dispensing information each month from a random sample of about 150 pharmacies throughout Australia. Information on drugs prescribed in public hospitals and on highly specialised drugs available to outpatients through public hospital pharmacies under section 100 of the *National Health Act 1953* is not included in the DUSC Database.

National Divisions Diabetes Program Data Collation Project

The National Divisions Diabetes Program Data Collation Project was conducted in 1999–2000 and comprised four components: a paper-based collation of qualitative and quantitative data from divisions of general practice describing their diabetes programs; a pilot electronic collation of diabetes data from seven divisions, using the CARDIAB database; a scoping study of databases in use and their compliance with the National Diabetes Outcomes and Quality Review Initiative national diabetes minimum data set; and a paper outlining a set of principles to guide the collation of divisions' data. The project reports data from people with diabetes who are managed primarily by their general practitioner, rather than in a specialist centre. It is not appropriate therefore to extrapolate from this information to the entire Australian population with diabetes.

National Hospital Morbidity Database

The National Hospital Morbidity Database contains demographic, diagnostic, procedural and duration-of-stay information on episodes of care for patients admitted to hospital. The data items are supplied by state and territory health authorities to the AIHW for storage and custodianship. The database provides information on the number of hospitalisations for a particular condition or procedure, so it is not possible to count patients individually.

Use of medicines by Australians with diabetes

The data in this bulletin are for 2003–04 and are coded to the ICD-10-AM Version 3 for principal or additional diagnosis of diabetes.

Hypoglycaemia (accidental poisoning) was coded as:

Principal diagnosis:	E1–.64 (diabetes mellitus with hypoglycaemia)
Additional diagnosis:	T38.3 (poisoning by insulin and oral hypoglycaemic drugs)
External cause:	X44 (accidental poisoning by and exposure to other and unspecified drugs, medicaments and biological substances)

Hypoglycaemic (other adverse effects) was coded as:

Principal diagnosis:	E1–.64 (diabetes mellitus with hypoglycaemia)
External cause:	Y42.3 (insulin and oral hypoglycaemic drugs)

For more information see NCCH (2002).

Pharmaceutical Benefits Scheme and Repatriation Pharmaceutical Benefits Scheme

The PBS and the RPBS aim to provide affordable access to medications for Australians by subsidising the costs of prescription medications. Around 80% of all prescription medications available in Australian pharmacies are listed on the PBS or RPBS. Data on the value and volume of PBS and RPBS services are processed by Medicare Australia, and are available on Medicare Australia's website <http://www.medicareaustralia.gov.au>; they are also provided to the Drug Utilisation Sub-Committee for inclusion on its database for community prescription monitoring. Further data on volume, government and patient costs by state and territory and drug type are available on the PBS website <http://health.gov.au/pbs/>. Only information on pharmaceutical products dispensed in the community is included by the PBS and the RPBS; these data sources do not include any information on medicines prescribed in public hospitals or highly specialised medicines available to outpatients through public hospital pharmacies. Further, only prescriptions attracting a PBS benefit are included; for example, items for general patients and costing less than $29.50 do not receive a benefit.

Appendix B: Statistical information

Table B1: Use of antidiabetic medicines, 1990–2004

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2000	2003	2004
	DDDs/1,000 population/day														
Insulins	6.5	5.8	6.4	6.8	7.0	7.6	8.1	8.8	9.3	10.4	10.8	11.7	12.3	12.8	13.4
Oral hypoglycaemics	9.6	9.1	10.8	12.2	12.7	14.7	16.2	17.7	19.5	21.4	23.5	25.3	26.5	26.7	29.0
Metformin	1.5	1.7	2.3	2.9	3.3	4.2	5.0	5.8	6.7	7.8	9.0	9.9	11.1	12.0	13.7
Gliclazide	1.9	1.9	2.3	2.8	3.1	3.8	4.5	5.2	6.3	7.3	8.4	8.4	7.9	7.4	7.4
Glibenclamide	4.4	3.8	4.2	4.4	4.3	4.4	4.4	4.3	4.1	3.8	3.7	3.2	2.7	2.2	2.0
Glimepiride	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	—	1.6	3.1	3.7	4.0
Glipizide	0.4	0.7	0.9	1.2	1.2	1.5	1.6	1.7	1.8	1.7	1.7	1.5	1.3	1.1	1.0
Tolbutamide	1.1	0.9	0.9	0.8	0.7	0.7	0.6	0.6	0.5	0.4	0.4	0.3	0.1	—	n.a.
Acarbose	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	0.0	0.2	0.2	0.3	0.3	0.3	0.3	0.2
Thiazolidinediones	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	—	—	—	0.1	0.8

n.a. Not available.

— Nil or rounded to zero.

Source: DoHA Drug Utilisation Sub-Committee Database.

Use of medicines by Australians with diabetes

Glossary

cholesterol	A fatty substance produced by the liver and carried by the blood to supply the rest of the body. Its natural function is to supply material for cell walls and for steroid hormones, but if levels in the blood become too high this can lead to atherosclerosis and heart disease.
complementary medicines	Complementary medicines (also referred to as 'traditional' or 'alternative' medicines) includes herbal medicines, vitamin and mineral supplements, other nutritional supplements, traditional medicines such as Ayurvedic medicines and traditional Chinese medicines, homeopathic medicines and some aromatherapy oils (where they make therapeutic claims). Other terms used to describe complementary medicines are 'natural medicines', 'non-conventional medicines' and 'holistic medicines'.
defined daily dose	The international unit of drug use established by the World Health Organization on the basis of assumed average dose per day of the drug used for its main indication by adults.
glucose	A type of sugar the body uses for energy. The main source of glucose is carbohydrates in the diet.
insulin	A hormone produced by the pancreas that enables the body to use the glucose it gets from food. Giving suitable doses of insulin to people with diabetes temporarily restores their ability to use glucose and to process other nutrients (carbohydrates, fats and proteins).
lipids	Fats found in the blood, such as cholesterol and triglycerides.
medicines	Includes **prescription**, non-prescription and **complementary medicines.**
oral hypoglycaemic medicines	Medicines that help maintain blood glucose control in people with Type 2 diabetes.
prescription medicines	Medicines for which a doctor's prescription is needed to buy them from a pharmacist or that authorised health care professionals can supply (such as in a hospital setting).

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