



Australian Government

Australian Institute of  
Health and Welfare

# Diabetes-related deaths in Australia, 2001–2003

## Highlights

This report presents information on diabetes-related deaths in Australia between 2001 and 2003 using death certificate data. The term 'diabetes-related deaths' is used in this analysis to refer to deaths where diabetes was considered to have been either the primary (underlying), or a contributory (associated) cause of death when the underlying cause of death was a commonly recognised complication of diabetes.

- Over the period 2001–2003 there were 20,908 diabetes-related deaths registered for people aged 25 years or over in Australia; this represents 5.4% of all deaths registered over this period. Diabetes was recorded as the underlying cause of death in 9,772 of these cases, representing 2.5% of all deaths registered during 2001–2003 in Australia.
- The average annual diabetes-related death rate for people aged 25 years or over for 2001–2003 was around 68 per 100,000 in males and 41 per 100,000 in females.
- Deaths from diabetes-related causes became more common with age, from less than 1 death per 100,000 in those aged less than 35 years to an average of around 680 deaths per 100,000 in those aged 85 years and over in 2001–2003.
- Aboriginal and Torres Strait Islander people were 4 times as likely as other Australians to die of diabetes-related causes in 2001–2003. Further, they were almost 12 times as likely as other Australians to have diabetes recorded as the underlying cause of death.
- People from remote areas were more likely than those from regional areas or major cities to die from diabetes-related causes in 2001–2003.

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- Certain groups of overseas-born Australians have relatively high rates of diabetes-related deaths. In 2001–2003, people born in the South Pacific Islands, Southern or South Eastern Europe, Eastern Europe, the Middle East and North Africa were more likely to die of diabetes-related causes than people born in Australia.
- There was also variation by socioeconomic status. People living in the most disadvantaged areas of Australia were more likely to die of diabetes-related causes than people living in the least disadvantaged areas.

### Introduction

Diabetes has been labelled an epidemic worldwide, largely due to the rising prevalence of Type 2 diabetes (WHO & IDF 2004; Dunstan et al. 2001; Zimmet et al. 2001). In 2000 it was estimated that globally around 171 million people had diabetes. It is estimated that in Australia in 1999–2000 almost 1 million people had diabetes, with 85–90% of these people having Type 2 diabetes (ABS 1997b, p.19). Evidence suggests that up to half of all people with Type 2 diabetes may not be aware that they have it (WHO & IDF 2004; Dunstan et al. 2002). Undetected or poorly managed diabetes may lead to serious and potentially life-threatening complications including heart disease, stroke, eye problems which can cause blindness, and kidney disease.

Diabetes and its complications are among the leading causes of death, illness and disability in Australia. Diabetes has been one of the top ten underlying causes of death in Australia for a number of years. Complications of diabetes such as heart disease, stroke and kidney disease are also common causes of death. Results from the 2003 Survey of Disability, Ageing and Carers indicated that over 86,000 Australians had a disability caused mainly by diabetes (ABS 2004b), and that many others had disabilities relating to diabetes complications.

This bulletin provides details of diabetes-related deaths in Australia between 2001 and 2003 using data gathered at the time of death. Diabetes-related deaths are defined here to be those where diabetes was considered to have been either the primary (underlying) or a contributory (associated) cause of death when the primary cause of death was a **commonly recognised complication** of diabetes (see Methods, p. 3). This definition does not include all diabetes associated cases where diabetes was recorded in the death certificate as antecedent or other significant condition.

The purpose of this bulletin is to give a broader indication of the contribution diabetes makes to mortality (death) in Australia than can be obtained from statistics on underlying causes alone. The bulletin also examines patterns in diabetes deaths to see which population groups are at greater risk. This information will inform the work of health professionals, including those working in health policy, planning and administration.

### What is diabetes?

Diabetes is a chronic (long-term) condition in which blood glucose levels become too high because the body produces little or no insulin, or cannot use insulin properly. Insulin is a hormone produced by the pancreas that helps the body to use glucose (a type of sugar) as its main energy source. Diabetes can have both short-term and long-

term effects, the latter through damage to various parts of the body, especially the heart and blood vessels, eyes, kidneys and nerves (AIHW 2002).

There are three main types of diabetes: Type 1; Type 2; and gestational diabetes. Together these three types account for 98–99% of all diabetes in Australia. For more detailed information about diabetes, its risk factors and complications, see *Diabetes: Australian Facts 2002* (AIHW 2002). The data reported in this bulletin refer only to Type 1 and Type 2 diabetes combined (see Appendix 1). Deaths involving Types 1 and 2 diabetes in effect account for nearly all diabetes-related deaths in Australia in recent years, with the available mortality data suggesting that there has been only one death from gestational diabetes in Australia over the past 20 years.

## Methods

### The National Mortality Database

Data about diabetes-related deaths among Australians for the period 1998–2003 were extracted from the AIHW National Mortality Database. This database contains information from death certificates for deaths registered in Australia. Data are provided by the state and territory Registrars of Births, Deaths and Marriages and are encoded by the Australian Bureau of Statistics. Information available includes sex, age at death, date of death, area of usual residence, Indigenous status, country of birth, and cause of death. From 1997, multiple causes of death (underlying and all associated causes of death recorded on the death certificate) were coded using the International Classification of Diseases (ICD) 10th Revision.

Registration of deaths in Australia is a legal requirement and compliance is virtually complete. Registration of deaths is administered by the state and territory Registrars of Births, Deaths and Marriages, under state and territory legislation. All deaths that occur in Australia are within the scope of the collection, with the exception of foreign diplomatic personnel.

For the trend analyses reported in this bulletin, deaths registered in the years from 1998 to 2003 were extracted. For all other analyses, mortality data for 2001, 2002 and 2003 were combined. The majority of data presented in the bulletin relate to people aged 25 years and over only as the number of deaths from diabetes is very low in people under 25 years of age.

### What are ‘diabetes-related deaths’?

A number of different diseases or injuries may be listed on a death certificate. One of these will be classified as the *underlying cause*, that is the primary disease or injury causing the death. In addition, up to twenty *associated causes* may also be listed. Associated causes are all other conditions, diseases or injuries that were considered to have contributed to the death.

More than other disorders, diabetes often causes death indirectly because it is a strong risk factor for common causes of death such as heart and kidney disease, and stroke. These complications are likely to appear as the underlying cause of death, the basis for official mortality statistics. If only cases where diabetes as the underlying cause are counted, it will lead to considerable underestimates of diabetes’

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contribution to death in Australia. Previous publications have partially resolved this shortfall by examining diabetes wherever it is recorded as an associated cause of death (irrespective of the underlying cause) as well as an underlying cause of death (AIHW: Mathur et al. 2000; AIHW 2002). This method will include deaths for a wide range of conditions, some of which are unlikely to be complications of diabetes (e.g. deaths from external causes—see Table A2 for selected causes of death listed with diabetes as an associated cause of death). Consequently, in order to more accurately estimate the number of deaths from diabetes and its common complications, a combination of underlying and selected associated causes has been used in this bulletin—referred to here as ‘diabetes-related deaths’ or ‘deaths from diabetes-related causes’ (Box 1). A comparison of death rates and number of deaths using these different methods is presented in Table 1. As can be seen, care needs to be taken when comparing results produced using different methods.

**Table 1: Deaths from diabetes, 2003—a comparison of methods**

Definition	Number of deaths	Death rate per 100,000
Diabetes as the underlying cause of death	3,389	16.5
Diabetes-related deaths (including diabetes as the underlying cause of death and selected cases with diabetes as an associated cause) <sup>(a)</sup>	7,021	34.1
Diabetes as the underlying or an associated cause of death	11,400	55.4

(a) See Box 1 for definition.

### Notes

1. Age-standardised to the 2001 Australian population.
2. Data for all ages.

Source: AIHW National Mortality Database.

As described in Box 1, the term ‘diabetes-related death’ is used in this report to refer to deaths where either diabetes was recorded as the underlying cause of death, or where diabetes was recorded as an associated cause of death and the underlying cause of death was one of a specific list of commonly recognised diabetes complications (e.g. myocardial infarction, ischaemic heart disease, stroke or sequelae of stroke).

### **Box 1: Diabetes-related deaths**

For the purposes of this bulletin, diabetes-related deaths refer to deaths where:

- diabetes was listed as the underlying cause of death

OR

- diabetes was listed as an associated cause of death, where the underlying cause of death was one of:
  - myocardial infarction (heart attack)
  - ischaemic heart disease\*
  - stroke or sequelae of stroke\*
  - heart failure\*
  - sudden death (cardiac arrest)
  - peripheral vascular disease
  - kidney disease
  - hyperglycaemia
  - hypoglycaemia.

Note: 'Diabetes-related deaths' is based on the definition of 'deaths related to diabetes' used in the United Kingdom Prospective Diabetes Study (UKPDS 1998). The UKPDS definition has been modified by diabetes specialists on the National Diabetes Data Working Group to include ischaemic heart disease, sequelae of stroke and heart failure, other commonly recognised complications of diabetes.

\*Not included in the UKPDS definition of deaths related to diabetes.

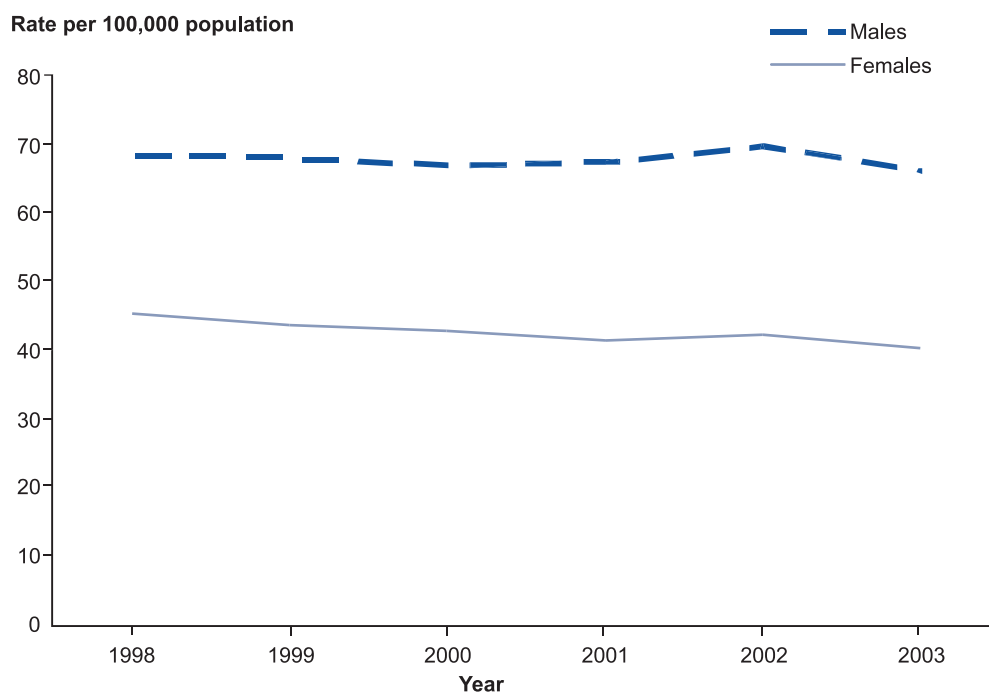
## **Results**

### **Trends in diabetes mortality, 1998–2003**

The diabetes-related death rate declined slightly in Australian males and females aged 25 years or over (a total decline of around 1% for both males and females) over the period 1998 to 2003 (Figure 1).

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**Figure 1: Aged-standardised mortality from diabetes-related causes, 1998–2003**



*Notes*

1. Age-standardised to the 2001 Australian population.
2. Data for people aged 25 years and over.

Source: AIHW National Mortality Database.

## Diabetes mortality 2001–2003

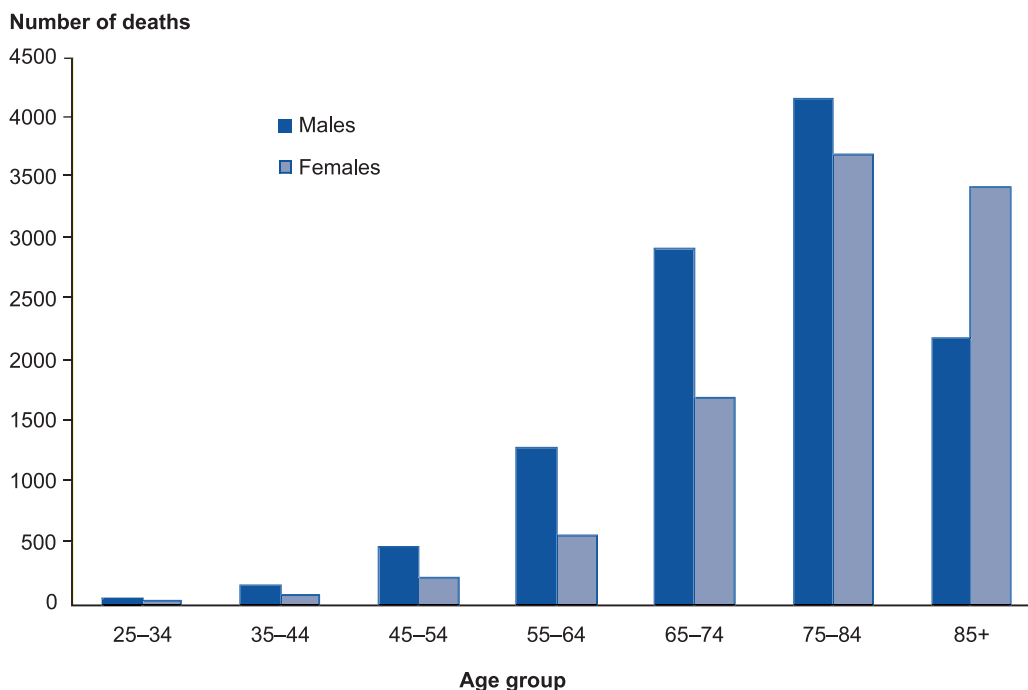
Over the period 2001–2003 there were 20,908 diabetes-related deaths registered for people aged 25 years and over in Australia; this represents 5.4% of all deaths registered over this period (Table A5). Diabetes was recorded as the underlying cause of death in 9,772 of these cases, representing 2.5% of all deaths registered during 2001–2003 in Australia.

There were substantially more male than female deaths from diabetes-related causes in 2001–2003, with Australian males being more than one-and-a-half times as likely to die from diabetes-related causes. The average annual diabetes-related death rate over 2001–2003 was around 68 per 100,000 in males and 41 per 100,000 in females.

## Diabetes mortality by age

Deaths from diabetes-related causes became more common with age, from less than 1 death per 100,000 in those aged less than 35 years to an average of around 680 deaths per 100,000 in those aged 85 years and over (Table A5). The increase was particularly rapid from age 55 onwards (Figure 2).

**Figure 2: Diabetes-related deaths by age, 2001–2003**



Source: AIHW National Mortality Database.

### Diabetes mortality by socioeconomic status

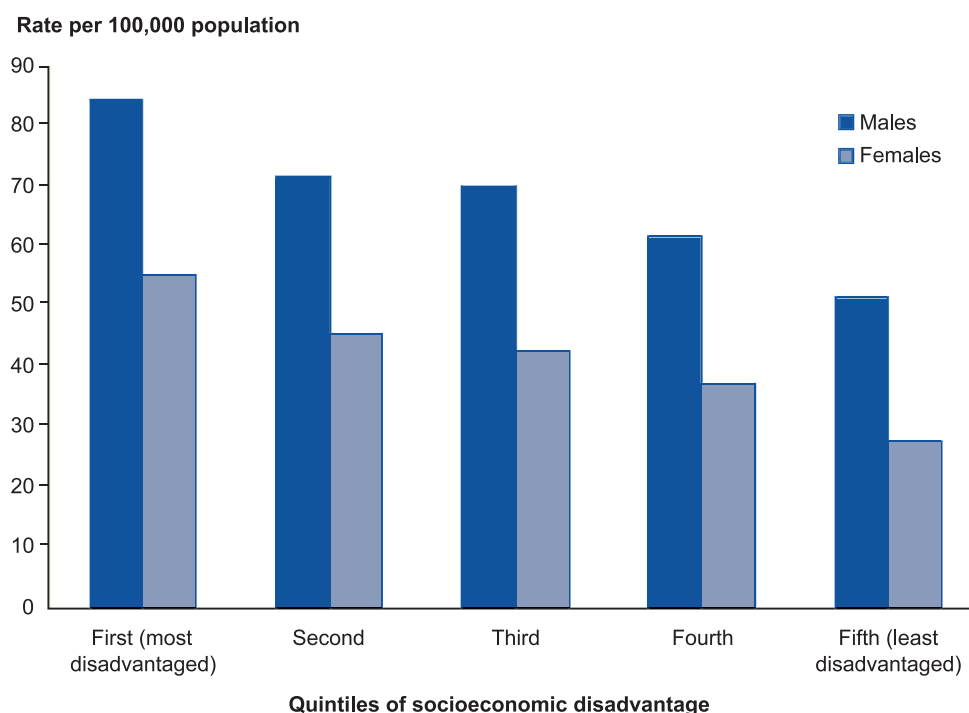
Numerous characteristics contribute to socioeconomic status, including education, employment status and income. In the absence of information on socioeconomic status from mortality data (apart from occupation), people (that is, deaths) in this section have been classified according to the level of socioeconomic disadvantage of their statistical local area of usual residence (the Index of Disadvantage). The Index of Disadvantage is derived from population census data on social and economic characteristics of the local area such as a low income, low educational attainment, high levels of public sector housing, high unemployment, and jobs in relatively unskilled occupations (for more details see Appendix 1: Statistical methods).

In 2001–2003 there was an upward gradient in diabetes-related deaths with increasing socioeconomic disadvantage (Figure 3). The age-standardised rate of diabetes-related deaths increased from 37.3 per 100,000 in quintile 5 (people from the least disadvantaged areas) to 68.0 in quintile 1 (people from the most disadvantaged areas) (Table A8). In other words, diabetes-related mortality in the most disadvantaged quintile was 82% higher than in the least disadvantaged quintile.

Males from the most disadvantaged group were 64% more likely to die from diabetes-related deaths than those from the least disadvantaged group. Among females this difference is even more striking, with females from the most disadvantaged group twice as likely to die from diabetes-related causes as those from the least disadvantaged group.

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**Figure 3: Diabetes-related deaths by quintile of socioeconomic disadvantage (SEIFA), 2001–2003**



**Notes**

1. Age-standardised to the 2001 Australian population.
2. Data for people aged 25 years and over.
3. Socioeconomic Indexes for Areas (SEIFA). The Index of Disadvantage is used in this analysis. The first quintile corresponds to the most disadvantaged group and the fifth to the least disadvantaged group.

Source: AIHW National Mortality Database.

## Diabetes mortality in Aboriginal and Torres Strait Islander people

Standardised mortality rate (SMR) comparisons show that Aboriginal and Torres Strait Islander people were 4 times as likely as other Australians to die of diabetes-related causes in 2001–2003 (Table 2). Further, Aboriginal and Torres Strait Islander people were almost 12 times as likely as other Australians to have diabetes recorded as the underlying cause of death. The difference in death rates is even larger for females where, over the period 2001–2003, Indigenous Australian females were almost 15 times as likely to die from diabetes as the underlying cause of death as non-Indigenous females.

**Table 2: Deaths from diabetes among Aboriginal and Torres Strait Islander people<sup>(a)</sup>, 2001–2003**

	No. deaths	SMR <sup>(b)</sup>
<b>Males</b>		
Diabetes-related	354	3.6*
Underlying only	162	10.3*
<b>Females</b>		
Diabetes-related	369	4.7*
Underlying only	191	14.9*
<b>Persons</b>		
Diabetes-related	723	3.9*
Underlying only	353	11.8*

\* Statistically significant difference when compared with non-Indigenous Australians.

(a) Data are for Indigenous deaths for usual residents of Queensland, Western Australia, South Australia and Northern Territory. See Appendix 1 for further details.

(b) SMR (standardised mortality ratio) is the ratio of the observed number of deaths to the number of expected deaths if Indigenous Australians had experienced the same age–sex-specific death rates as other Australians.

## Diabetes mortality by place of residence

### States and territories

Considerable variation exists across the states and territories in age-standardised death rates from diabetes-related causes. Reflecting the higher proportion of Indigenous Australians in the Northern Territory, the rate in that territory was substantially higher than that of the other states and the Australian Capital Territory, with the rate for males (128.4 deaths per 100,000) being almost twice the national average and the rate for females (102.1 deaths per 100,000) almost 2.5 times the national average (68.1 and 41.4 per 100,000 for males and females respectively) (Table A6). Diabetes-related death rates were also high in Tasmania and Victoria compared with the other states and the Australian Capital Territory. The lowest rate was observed in the Australian Capital Territory.

State and territory differentials in the age-standardised death rate from diabetes as the underlying cause of death were similar to those observed for diabetes-related deaths, with the highest rate observed for the Northern Territory (47.0 deaths per 100,000 population).

### Urban, rural and remote areas

Over the period 2001–2003, diabetes-related deaths were much more commonly registered in remote areas of Australia than in major cities and inner regional areas (for example, 94.0 deaths per 100,000 population in remote areas compared with 49.8 and 56.3 in major cities and inner regional areas respectively) (Table A7). This also reflects the higher proportion of Indigenous Australians in remote areas.

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## Diabetes mortality by international region of birth

Over the period 2001–2003, mortality from diabetes-related causes varied widely between Australians born in different regions (Table A9). The regions of birth with significantly more diabetes-related deaths than expected, compared with rates for Australian-born males and females, were: males and females born in the South Pacific, Southern Europe, South Eastern Europe, Eastern Europe, the Middle East and North Africa; and females from Southern and Central Asia. The regions with significantly fewer diabetes-related deaths than expected based on rates for Australian-born males and females were: males from New Zealand, the United Kingdom and Ireland and the Americas and Caribbean; and females from North East Asia.

## Discussion

This analysis of 2001–2003 diabetes-related mortality data demonstrates that diabetes continues to be involved in the death of a large number of Australians, despite evidence of a substantial fall in death rates from diabetes (as an underlying cause) during the second half of last century (AIHW 2004). Because of age dependency, this burden is only likely to become greater over the coming decades given the large and growing proportion of older Australians.

Not surprisingly, diabetes-related deaths are substantially more common among elderly Australians. In general, the higher mortality from diabetes among older Australians is consistent with age-specific hospitalisation rates for diabetes, which follow the same pattern (AIHW 2004).

Interestingly, while the rate of both diabetes-related deaths and diabetes as an underlying cause of death was consistently higher for men than for women, the prevalence of diabetes in men and women is quite similar. Based on data collected in the 1999–2000 AusDiab study, the prevalence of diabetes in Australian men and women is estimated to be around 8% and 7%, respectively (AIHW 2004). This disparity in death rates may reflect a combination of men being more likely to die of cardiovascular-type causes as well as women being more likely to look after their health than men.

The results of this analysis provide further evidence that socioeconomic disadvantage is an important predictor of mortality from diabetes. Diabetes-related deaths were found to be 82% higher among the most disadvantaged quintile of the Australian population compared with the least disadvantaged quintile. The proportion of diabetes-related deaths increased more markedly across the quintiles for females than males—a 100% increase between the least disadvantaged quintile and the most disadvantaged quintile for females compared with a 64% increase for males.

One explanation for the gradient in socioeconomic disadvantage observed in this analysis is the higher prevalence of diseases of the circulatory system and related risk factors in lower socioeconomic groups. Mortality from heart, stroke and vascular diseases (major complications of diabetes) has previously been found to be 21.4% higher in the most disadvantaged quintile compared with the least disadvantaged quintile (AIHW 2004). Compared with those living in more advantaged areas, people who live in disadvantaged areas are also more likely to be smokers, to be obese, have high blood pressure and to undertake low levels of physical activity—all risk factors for diabetes and its complications (AIHW 2004).

In considering the results by socioeconomic status it is important to keep in mind that the measures of socioeconomic inequality used in this bulletin are area-based measures, which tend to underestimate the inequality in mortality at the individual level.

The proportion of diabetes-related deaths was around four times as high among Aboriginal and Torres Strait Islander people compared with other Australians over 2001–2003. The difference was even greater when diabetes as the underlying cause was considered (where the proportion among Indigenous Australians was 12 times that of other Australians). The disparity is even larger for women, with Indigenous Australian women almost 15 times as likely to die from diabetes as the underlying cause of death as non-Indigenous Australian women. However, it is important to recognise that, although almost all deaths in Australia are registered, the Indigenous status of the deceased is not always recorded, or recorded correctly. The incompleteness of Indigenous identification means the number of deaths registered as Indigenous is an underestimate of deaths occurring in the Aboriginal and Torres Strait Islander population (ABS 1997a; ABS 2004a). The higher death rate for Aboriginal and Torres Strait Islander people reflects a combination of higher prevalence and earlier onset of the condition among this population (ABS 2001). Inequalities in access, utilisation and attitudes to health care are also likely to be key contributors to the disparity.

Death rates from diabetes vary markedly between Australians of different regions of birth. Men and women born in the South Pacific, Middle East and North Africa had the highest standardised rates of deaths from diabetes-related causes. This could reflect differences in prevalence rates (AIHW 2003) as well as disparities in access, utilisation and attitudes to healthcare among overseas-born groups (von Hofe et al. 2002).

This analysis also highlights the variation in diabetes-related deaths across the states and territories of Australia. Diabetes-related deaths were highest in the Northern Territory and lowest in the Australian Capital Territory when the differences in age structures of these populations were adjusted for. The markedly higher death rate in the Northern Territory is likely to be attributed mainly to the relatively large proportion of Aboriginal and Torres Strait Islander people living in the Territory, among whom death rates from diabetes are considerably higher. Conversely, the lower death rate from diabetes in the Australian Capital Territory may reflect the relatively higher social and economic circumstances of this population.

Not surprisingly, the rate of diabetes-related deaths was also found to be higher in remote areas than in major cities and inner regional areas of Australia. This finding is consistent with previous studies that have found that deaths from diabetes tend to be greater in more remote areas than in less remote areas (AIHW 2000; AIHW 2003). People who live in more inaccessible regions of Australia are increasingly recognised to be at a disadvantage with regard to education and employment opportunities, income, and access to goods and services (Garnaut et al. 2001; Bray 2000). This may make it more difficult to access health services. In certain remote areas, access to basic necessities such as clean water and fresh food can also be a problem. These disadvantages are reflected in the overall less favourable indicators of health and social wellbeing among people living in remote Australia. The high proportion of Aboriginal and Torres Strait Islander people living in rural areas also contributes to regional differences in death rates from diabetes.

# Diabetes-related deaths in Australia, 2001–2003

Some limitations of the mortality data presented in this bulletin should be noted. The lack of uniform practice among medical practitioners in completing death certificates for individuals with diabetes makes it difficult to determine the causal role of diabetes in specific causes of death (Knuiman et al. 1992) and it is possible that the role of diabetes in mortality is under-recognised. Selection of a single underlying cause of death is also likely to be difficult in people with multiple chronic diseases as is often the case in people with diabetes. Finally, differences in methods of counting deaths from diabetes mean that some of the data presented here are not directly comparable with previously published estimates. For example, Mathur et al. (2000) defined diabetes-related deaths as deaths where diabetes was the underlying or an associated cause of death (irrespective of the underlying cause).

## Conclusion

This analysis has taken steps toward more accurately quantifying the extent to which diabetes and its complications contribute to deaths in Australia. The findings also provide valuable information on key predictors of diabetes mortality in the population. Diabetes-related deaths are disproportionately high among elderly Australians, men, Australians living in lower socioeconomic and remote areas, and Aboriginal and Torres Strait Islander Australians.

## Appendix 1: Statistical methods

### Data classification and limitations

#### Identification of diabetes-related deaths

As described in Box 1 (see p. 5), this bulletin defines a diabetes-related death to be a death where either diabetes was recorded as the underlying cause of death, or where the underlying cause of death was one of a defined list of diabetes complications and diabetes was recorded as an associated cause of death. The ICD-10 codes used to identify these deaths are listed in Table A1.

A limitation of this definition is that it may capture some deaths that are unrelated to diabetes.

**Table A1: ICD-10 codes used to identify diabetes-related deaths**

Condition	ICD-10 code
Diabetes	E10–E14
Myocardial infarction	I21–I22
Ischaemic heart disease	I20, I24, I25
Stroke	I60–I64
Sequelae of stroke	I69.0–I69.4
Heart failure	I50
Sudden cardiac death	I46
Peripheral vascular disease	I70–I74
Kidney disease	N01–N28
Hypoglycaemia	E16.1–E16.2
Hyperglycaemia	R73

## Aboriginal and Torres Strait Islander people

For the period 2001–2003, the Indigenous identifier on the AIHW National Mortality Database was considered usable only for deaths registered in the Northern Territory, South Australia, Western Australia, and Queensland. Identification of Indigenous status in death records is not of sufficient quality for use in New South Wales, Victoria, Tasmania, or the Australian Capital Territory. This makes it difficult to get accurate national estimates of Indigenous mortality rates, make comparisons with the non-Indigenous population, and examine geographical variation. Trends in Indigenous mortality need to be interpreted with caution as differences may reflect changes in data quality, coverage, or collection methods rather than real changes in Indigenous health. The reliability of Indigenous status as reported by another person is also uncertain.

In this analysis, only persons specifically identified as being of Aboriginal and/or Torres Strait Islander origin were classified as Indigenous. All other persons were classified as non-Indigenous. The non-Indigenous group therefore includes deaths where the person's Indigenous status was unknown or not recorded.

## Overseas-born Australians

Country of birth of the deceased is recorded in the AIHW National Mortality Database and is encoded using Australian standard classification systems. For 2001 and 2002 the Australian Standard Classification of Countries for Social Statistics (ASCCSS) was used (ABS 1990). For 2003 the Standard Australian Classification of Countries (SACC) was used (ABS 1998). The SACC coding system was used to group countries into regions for this analysis. The SACC publication contains a map relating the ASCCSS and SACC codes, and this has been used to ensure consistency in country groupings over the 3 years.

Limitations of the country of birth data are similar to those concerning Indigenous status, in that the accuracy of country of birth information when reported by another person may be questionable, or indeed the country of birth may be unknown. Further, the quality and method of collection of country of birth data, and country boundaries, may change over time, making it difficult to interpret long-term trends. Records where the country of birth was unknown or not recorded (157 deaths, 0.7%) were excluded from the region of birth analysis in this bulletin.

## Diabetes type

The accuracy of identification of the type of diabetes a person had also presents difficulties for those certifying deaths. In ICD-10, diabetes is split into 'insulin-dependent' and 'non-insulin-dependent' diabetes rather than Types 1 and 2. Although the former terms should map directly to the latter, the use of the word 'insulin' may cause confusion and lead to classification based on treatment type rather than disease type. The accuracy of the classification of deceased persons into these two groups of diabetes is uncertain. Therefore, in this bulletin deaths from both types of diabetes have been combined.

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## Area of usual residence

In the AIHW National Mortality Database, area of usual residence is recorded at the Statistical Local Area (SLA) level. Since SLA boundaries may change from year to year, concordance files supplied by the ABS were used to map all data used in this analysis to the 2001 SLA boundaries. Geographical areas were therefore able to be defined consistently over time.

For this bulletin, three major geographical regions were defined: major cities, regional Australia, and remote Australia. SLAs are classified into these three regions based on their score on the Accessibility/Remoteness Index of Australia (DoHA & University of Adelaide 1999). This index is calculated based on how distant a place is by road from urban centres of different sizes, and therefore provides a relative indication of how difficult it might be for residents to access certain services such as health care and education. In 2001–2003, 65 deaths (0.3%) could not be mapped to one of the three regions. These records were excluded from the analysis.

## Socioeconomic status

In this report, the Index of Disadvantage was used to determine socioeconomic status (ABS 2004c). This index is one of several socioeconomic indexes derived by the Australian Bureau of Statistics from information collected in the Census of Population and Housing. The Index of Disadvantage is an area-based measure which represents the average level of disadvantage across a geographic area, in this case the SLA. It is derived from social and economic characteristics of the SLA such as low income, low educational attainment, high levels of public sector housing, high unemployment, and jobs in relatively less skilled occupations.

In this analysis, individual death records were classified into quintiles of socioeconomic disadvantage based on the Index of Disadvantage value of the SLA of the deceased person's usual residence. SLAs were grouped into quintiles so that each quintile contained approximately 20% of the total Australian population. Quintile 1 includes the most disadvantaged households and Quintile 5 the least disadvantaged households. In 2001–2003, 59 deaths (0.3%) could not be mapped to an Index of Disadvantage value. These records were excluded from the analysis.

It is important to note that the Index of Disadvantage is an area-based measure of disadvantage. It will therefore tend to understate the true inequality in health at an individual level.

## Statistical methods

### Age-specific rates

Age-specific death rates were calculated by dividing the number of deaths occurring in a particular age group by the mid-year estimated resident population for that age group.

### Age-standardised rates

Age standardisation is used to remove the influence of age when comparing populations with different age structures. This is done by applying age-specific rates

to a standard population. In this analysis the 2001 Australian population was used as the standard population.

### Direct age standardisation

This is the most common method of age standardisation, and is used in this report for all analyses except analysis by Indigenous status and region of birth for which indirect age standardisation has been used (see below). Direct age standardisation is used when the populations of interest are large and the age-specific rates are reliable. Direct age-standardised rates are calculated as follows:

- Step 1: Calculate the age-specific death rate for each age group in the population of interest.
- Step 2: Calculate the expected number of deaths in each age group by multiplying the age-specific rate by the corresponding standard population for each age group.
- Step 3: Add together the expected number of deaths in each age group and divide the total by the total standard population. This is the age-standardised death rate.

### Indirect age standardisation

This method of age standardisation is used when the populations of interest are small or when the age-specific rates may not be stable. In this report, indirect age standardisation is used to examine deaths in the Indigenous population and among overseas-born Australians.

Indirect age standardisation removes the effect of age but does not provide a result in terms of a rate. Instead the summary measure is a comparison of the number of deaths observed compared to the number expected if the age-specific death rates of the standard population applied in the population of interest. The method used is as follows:

- Step 1: Calculate the age-specific death rate for each age group in the standard population.
- Step 2: Multiply these age-specific rates by the number of people in each age group of the population of interest and sum to calculate the expected number of deaths in the population of interest.
- Step 3: Add together the number of deaths observed in the population of interest and divide this number by the expected number of deaths derived in Step 2. This is the Standardised Mortality Ratio (SMR).

An SMR of 1 indicates the same number of deaths occurred as were expected (suggesting death rates in the population of interest were similar to those in the standard population). An SMR greater than one indicates more deaths than were expected, while an SMR less than one indicates fewer deaths than were expected. For example, if there were twice as many deaths as were expected (SMR of 2.0) then the rate of death in the population of interest can be assumed to be twice that of the standard population.

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## Significance testing

Significance testing is a way of detecting differences between different population groups. In this report significance tests for differences in death rates between two population groups were performed by examining confidence intervals. The difference between the two rates was calculated and a 95% confidence interval was constructed around this value. Adjustments were made for multiple comparisons using the Bonferroni adjustment. If the confidence interval did not contain zero, the two rates were considered to be significantly different. The standard pooled variance formula was used to calculate confidence intervals (see Armitage & Berry 1994).

## Appendix 2: Statistical tables

Tables presented here give estimates for males, females and persons.

**Table A2: Selected underlying causes of death listed with diabetes as an associated cause of death, 2003**

Underlying cause of death	Number of deaths		
	Males	Females	Persons
Acute myocardial infarction*	813	600	1,413
Ischaemic heart disease*	620	489	1,109
Stroke or sequelae of stroke*	321	391	712
Heart failure*	65	73	138
Peripheral vascular disease*	39	31	70
Sudden death (cardiac arrest)*	—	1	1
<i>Circulatory disorder* subtotal</i>	<i>1,858</i>	<i>1,585</i>	<i>3,443</i>
Neoplasms	1,121	799	1,920
Respiratory disease	346	290	636
Kidney disease*	94	95	189
Infectious/parasitic diseases	76	74	150
External causes (e.g. accidents)	64	51	115
Hyper/Hypoglycaemia*	—	1	1
Other	703	854	1,557
<b>Total</b>	<b>6,069</b>	<b>5,331</b>	<b>11,400</b>

\* Common complications of diabetes.

Source: AIHW National Mortality Database.

**Table A3: Diabetes-related deaths and diabetes as an underlying cause of death, 1998 to 2003**

	Year					
	1998	1999	2000	2001	2002	2003
	Rate per 100,000 population (95% confidence interval)					
<b>Males</b>						
Diabetes-related	68.8 (66.4–71.2)	68.4 (66.1–70.8)	67.2 (64.9–69.5)	67.7 (65.5–69.9)	70.0 (67.8–72.3)	66.5 (64.3–68.6)
Underlying only	30.6 (29.0–32.2)	29.5 (28.0–31.0)	30.9 (29.3–32.4)	30.7 (29.2–32.2)	32.1 (30.6–33.6)	31.8 (30.3–33.3)
<b>Females</b>						
Diabetes-related	45.5 (43.9–47.1)	43.9 (42.3–45.4)	42.9 (41.4–44.4)	41.5 (40.0–43.0)	42.3 (40.8–43.7)	40.4 (39.0–41.7)
Underlying only	20.5 (19.4–21.6)	20.8 (19.7–21.9)	19.5 (18.5–20.5)	19.1 (18.1–20.1)	19.9 (18.9–20.9)	19.6 (18.6–20.6)
<b>Persons</b>						
Diabetes-related	55.5 (54.2–56.9)	54.6 (53.2–55.9)	53.4 (52.1–54.7)	52.8 (51.6–54.1)	54.3 (53.0–55.5)	51.7 (50.5–52.9)
Underlying only	24.8 (23.9–25.7)	24.6 (23.8–25.5)	24.3 (23.4–25.2)	24.1 (23.2–24.9)	25.2 (24.3–26.0)	25.0 (24.1–25.8)

**Notes**

1. Age-standardised to the 2001 Australian population.

2. Data for people aged 25 years and over.

Source: AIHW National Mortality Database.

**Table A4: Number of diabetes-related deaths, by age group, 2001 to 2003**

Age (years)	Males			Females			Persons		
	2001	2002	2003	2001	2002	2003	2001	2002	2003
	Number								
<25	2	4	2	4	5	6	6	9	8
25–34	14	7	15	5	9	7	19	16	22
35–44	58	52	48	28	20	21	86	72	69
45–54	174	164	135	82	71	64	256	235	199
55–64	438	442	401	208	185	168	646	627	569
65–74	946	999	979	562	593	547	1,508	1,592	1,526
75–84	1,323	1,414	1,416	1,207	1,267	1,227	2,530	2,681	2,643
85+	654	760	763	1,046	1,167	1,222	1,700	1,927	1,985
<b>All ages</b>	<b>3,609</b>	<b>3,847</b>	<b>3,759</b>	<b>3,142</b>	<b>3,319</b>	<b>3,262</b>	<b>6,751</b>	<b>7,166</b>	<b>7,021</b>
<b>25 and over</b>	<b>3,607</b>	<b>3,838</b>	<b>3,757</b>	<b>3,138</b>	<b>3,312</b>	<b>3,256</b>	<b>6,745</b>	<b>7,150</b>	<b>7,013</b>
<b>All ages (ASR)</b>	<b>44.6</b>	<b>46.1</b>	<b>43.7</b>	<b>27.3</b>	<b>27.9</b>	<b>26.6</b>	<b>34.8</b>	<b>35.7</b>	<b>34.1</b>
<b>25 and over (ASR)</b>	<b>67.7</b>	<b>70.0</b>	<b>66.5</b>	<b>41.5</b>	<b>42.3</b>	<b>40.4</b>	<b>52.8</b>	<b>54.3</b>	<b>51.7</b>

Note: Age-standardised to the 2001 Australian population.

Source: AIHW National Mortality Database.

# Diabetes-related deaths in Australia, 2001–2003

**Table A5: Diabetes-related deaths, by age group, 2001–2003**

Age (years)	Number			Age-specific rate per 100,000 population		
	Males	Females	Persons	Males	Females	Persons
<25	8	15	23	0.1	0.2	0.1
25–34	36	21	57	0.8	0.5	0.7
35–44	158	69	227	3.5	1.5	2.5
45–54	473	217	690	11.8	5.4	8.6
55–64	1,281	561	1,842	43.7	19.6	31.8
65–74	2,924	1,702	4,626	150.2	82.4	115.3
75–84	4,153	3,701	7,854	373.2	243.5	298.4
85+	2,177	3,435	5,612	843.3	602.2	677.3
<b>All ages</b>	<b>11,215</b>	<b>9,723</b>	<b>20,938</b>	<b>38.3</b>	<b>32.8</b>	<b>35.5</b>
<b>25 and over</b>	<b>11,202</b>	<b>9,706</b>	<b>20,908</b>	<b>58.9</b>	<b>48.8</b>	<b>53.7</b>
<b>All ages (ASR)</b>	..	..	..	<b>44.8 (44.0–45.6)</b>	<b>27.3 (26.7–27.8)</b>	<b>34.9 (34.4–35.3)</b>
<b>25 and over (ASR)</b>	..	..	..	<b>68.1 (69.3–66.8)</b>	<b>41.4 (40.5–42.2)</b>	<b>52.9 (52.2–53.6)</b>

.. not applicable

## Notes

1. Age-standardised to the 2001 Australian population.
2. Data for 2001, 2002 and 2003 are combined.

Source: AIHW National Mortality Database.

**Table A6: Diabetes-related deaths by state/territory, 2001–2003**

	State/territory								
	New South Wales	Victoria	Queensland	Western Australia	South Australia	Tasmania	Australian Capital Territory	Northern Territory	Australia
	Age-standardised rate per 100,000 population (95% confidence interval)								
<b>Males</b>	66.6 (64.5–68.8)	72.9 (70.3–75.5)	62.2 (59.4–65.1)	63.7 (59.5–67.8)	71.7 (67.3–76.0)	75.6 (67.3–84.0)	51.2 (40.2–62.1)	128.4 (99.6–157.2)	68.1 (69.3–66.8)
<b>Females</b>	38.3 (36.9–39.6)	44.7 (43.0–46.4)	40.1 (38.2–42.1)	41.4 (38.5–44.2)	42.2 (39.4–45.0)	47.1 (41.7–52.5)	29.9 (23.3–36.5)	102.1 (77.9–126.4)	41.4 (40.6–42.2)
<b>Persons</b>	50.6 (49.4–51.7)	56.8 (55.3–58.3)	49.8 (48.2–51.5)	51.2 (48.8–53.6)	54.6 (52.2–57.1)	59.4 (54.7–64.1)	38.8 (33.0–44.7)	113.8 (95.5–132.1)	52.9 (52.2–53.6)

## Notes

1. Age-standardised to the 2001 Australian population.
2. Data for 2001, 2002 and 2003 are combined.
3. Data for people aged 25 years and over.

Source: AIHW National Mortality Database.

**Table A7: Diabetes-related deaths by region, 2001–2003**

	Region		
	Major cities of Australia	Regional Australia	Remote Australia
	<b>Age-specific rate per 100,000 population (95% confidence interval)</b>		
<b>Males</b>	64.9 (63.3–66.5)	71.6 (69.3–73.8)	97.8 (86.8–108.9)
<b>Females</b>	38.6 (37.6–39.6)	44.2 (42.7–45.7)	90.2 (79.8–100.5)
<b>Persons</b>	49.8 (48.9–50.7)	56.3 (55.0–57.6)	94.0 (86.5–101.5)

*Notes*

1. Age-standardised to the 2001 Australian population.
2. Data for 2001, 2002 and 2003 are combined.
3. Data for people aged 25 years and over.

Source: AIHW National Mortality Database.

**Table A8: Diabetes-related deaths by quintile of socioeconomic disadvantage (SEIFA), 2001–2003**

	SEIFA quintile				
	First (most disadvantaged)	Second	Third	Fourth	Fifth (least disadvantaged)
	<b>Age-specific rate per 100,000 population (95% confidence interval)</b>				
<b>Males</b>	84.4 (81.3–87.6)	71.5 (68.6–74.3)	70.0 (67.1–72.9)	61.8 (58.8–64.8)	51.6 (49.2–54.0)
<b>Females</b>	55.3 (53.2–57.5)	45.5 (43.6–47.4)	42.6 (40.7–44.5)	37.1 (35.2–39.0)	27.5 (26.1–28.8)
<b>Persons</b>	68.0 (66.2–69.8)	57.0 (55.3–58.6)	54.7 (53.0–56.3)	48.0 (46.4–49.7)	37.3 (36.1–38.6)

*Notes*

1. Age-standardised to the 2001 Australian population.
2. Data for 2001, 2002 and 2003 are combined.
3. Data for people aged 25 years and over.
4. Socioeconomic Indexes for Areas (SEIFA). The Index of Disadvantage is used in this analysis. The first quintile corresponds to the most disadvantaged group and the fifth to the least disadvantaged group.

Source: AIHW National Mortality Database.

**Table A9: Diabetes-related deaths by region of birth, 2001–2003**

	Region of birth						
	New Zealand	South Pacific	UK & Ireland	Southern Europe	Northern & Western Europe	South Eastern Europe	Eastern Europe
	<b>Standardised mortality ratio (95% confidence interval)</b>						
<b>Males</b>	0.8 (0.6–1.0)	2.6 (1.8–3.5)	0.9 (0.8–1.0)	1.5 (1.3–1.6)	1.0 (0.9–1.2)	1.4 (1.3–1.6)	1.4 (1.3–1.6)
<b>Females</b>	0.8 (0.6–1.1)	3.0 (2.1–4.2)	1.0 (0.9–1.1)	2.1 (1.8–2.3)	1.2 (1.1–1.4)	2.0 (1.8–2.3)	1.3 (1.1–1.5)
<b>Persons</b>	0.8 (0.6–1.0)	2.7 (2.1–3.5)	0.9 (0.9–1.0)	1.7 (1.6–1.8)	1.1 (1.0–1.2)	1.6 (1.5–1.8)	1.4 (1.2–1.5)

# Diabetes-related deaths in Australia, 2001–2003

**Table A9 (continued): Diabetes-related deaths by region of birth, 2001–2003**

	Region of birth					
	Middle East & North Africa	Southeast Asia	Northeast Asia	Southern & Central Asia	Americas & Caribbean	Sub-Saharan Africa
	<b>Standardised mortality ratio (95% confidence interval)</b>					
<b>Males</b>	1.9 (1.6–2.3)	0.8 (0.6–1.1)	0.8 (0.6–1.0)	1.2 (0.9–1.5)	0.6 (0.4–0.9)	0.9 (0.6–1.3)
<b>Females</b>	2.6 (2.1–3.2)	1.2 (0.9–1.4)	0.7 (0.5–1.0)	1.4 (1.0–1.8)	0.9 (0.6–1.3)	0.9 (0.6–1.4)
<b>Persons</b>	2.2 (1.9–2.5)	1.0 (0.8–1.2)	0.8 (0.6–0.9)	1.3 (1.0–1.5)	0.7 (0.5–1.0)	0.9 (0.7–1.2)

*Notes*

1. By definition, the SMR for Australian-born is equal to 1.00.
2. SMR (Standardised mortality ratio) is the ratio of the observed number of deaths to the number of expected deaths if Australians born overseas had experienced the same age–sex-specific death rates as Australian-born Australians.
3. Data for 2001, 2002 and 2003 are combined.
4. Data for people aged 25 years and over.

Source: AIHW National Mortality Database.

## Acknowledgments

Valuable comments on drafts of this bulletin were received from Ilona Brockway, Louise Catanzariti, Mark Cooper-Stanbury, Paul Magnus, Lynelle Moon, Anne-Marie Waters, Robert van der Hoek and members of the National Diabetes Data Working Group.

The authors wish to thank Phil Trickett and Ilona Brockway for assistance with obtaining population data and concordance files.

Funding from the Australian Government Department of Health and Ageing contributed to the preparation of this bulletin.

## Glossary

<b>angina</b>	Temporary chest pain or discomfort when the heart's own blood supply is inadequate to meet extra needs, as in exercise.
<b>associated cause of death</b>	All morbid conditions, disease and injuries (other than the underlying cause of death) contributing to death.
<b>cardiac arrest</b>	The complete cessation of activity of the heart.
<b>cardiovascular disease</b>	Any disease of the heart or blood vessels, for example heart attack, stroke, angina, or peripheral vascular disease.
<b>coronary heart disease (CHD)</b>	Heart attack and angina. Also known as ischaemic heart disease.
<b>diabetes-related death</b>	Any death with an underlying cause of death of diabetes, or where the underlying cause was one of a specific list of common complications of diabetes and diabetes was recorded as an associated cause of death. See Box 1, p. 5.
<b>glucose</b>	A type of sugar the body uses for energy. The main source of glucose is carbohydrates in the diet.
<b>heart attack</b>	A life-threatening emergency that occurs when a vessel supplying blood to the heart muscle is suddenly blocked completely. The event may lead to the death of a part of the heart muscle. The medical term commonly used for a heart attack is myocardial infarction.
<b>heart failure</b>	When the heart cannot pump strongly enough to keep the blood circulating around the body at an adequate rate.
<b>hyperglycaemia</b>	High blood glucose levels.
<b>hypoglycaemia</b>	Low blood glucose levels.
<b>ischaemic heart disease</b>	See <i>coronary heart disease</i> .
<b>mortality</b>	Death.
<b>myocardial infarction</b>	See <i>heart attack</i> .
<b>peripheral vascular disease</b>	Refers to diseases of arteries outside the heart and brain. It occurs when fatty deposits build up in the inner walls of these arteries and affect blood circulation.
<b>sequelae</b>	A condition following as a consequence of a disease.
<b>stroke</b>	An event in which an artery supplying blood to the brain suddenly becomes blocked or bleeds.
<b>sudden death</b>	Sudden (unexpected) death caused by cardiac arrest.
<b>underlying cause of death</b>	The main disease or injury initiating the sequence of events leading directly to death.

# Diabetes-related deaths in Australia, 2001–2003

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AIHW Cat. No. AUS 69

ISSN 1446-9820

ISBN 1 74024 520 2

### **Suggested citation**

AIHW: Dixon T & Webbie K 2005. Diabetes-related deaths 2001–2003. Bulletin No. 32. AIHW Cat. No. AUS 69. Canberra: AIHW.

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Dr Richard Madden

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

Cardiovascular Disease, Diabetes and Risk Factor Monitoring Unit  
Australian Institute of Health and Welfare  
GPO Box 570  
Canberra ACT 2601  
Phone: (02) 6244 1000  
Email: [diabetes@aihw.gov.au](mailto:diabetes@aihw.gov.au)

Published by the Australian Institute of Health and Welfare

Printed by Union Offset Printers