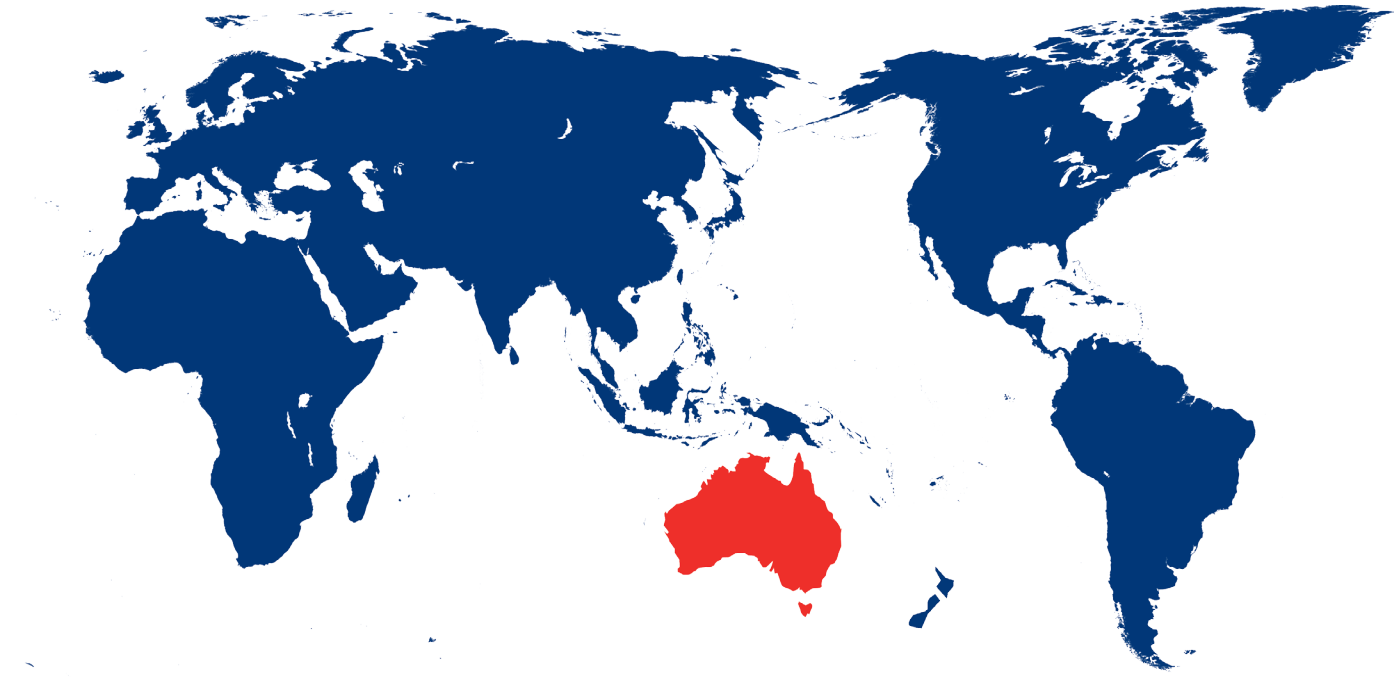
diabetes: the silent pandemic and its impact on Australia



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In partnership with:

Diabetes
AUSTRALIA

JDRF
IMPROVING LIVES. CURING TYPE 1 DIABETES.

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EXECUTIVE SUMMARY

What is diabetes?

Diabetes is a challenging problem for public health worldwide. It is a chronic disorder in which a person has high blood sugar, either because the body does not produce enough insulin, or because cells do not respond adequately to the insulin that is produced. There are two main types of diabetes:

- type 1 diabetes, which is characterised by the autoimmune destruction of the insulin-producing cells in the pancreas
- type 2 diabetes, which is the most common form and is characterised by a reduced production of insulin and an inability of the body tissues to respond fully to insulin.

As there is currently no cure for diabetes, the condition requires lifelong management. In the case of type 1 diabetes, this means keeping blood glucose levels within safe levels through multiple daily insulin injections or a continuous infusion of insulin through an insulin pump. For type 2 diabetes, blood glucose levels are managed through medication, diet, and exercise or a combination of these. People with diabetes frequently also require treatment to lower cholesterol and blood pressure levels. However, despite reaching epidemic levels globally, type 2 diabetes remains under-reported, in part because often people do not realise they have it until they develop complications.

Diabetes in Australia

Approximately 1 million Australians have been diagnosed with diabetes. The prevalence of particularly type 2 diabetes, rises with age and is higher in men than in women. The onset of type 1 diabetes is typically at an early age, thus it is the most common form of childhood diabetes although it can occur at any age. Australia is ranked 7th highest in the world for prevalence of type 1 diabetes in children aged 0-14 years and 6th highest for incidence. Adding to this, there is a growing number of children and adolescents who are now affected by type 2 diabetes.

The impact of diabetes in Australia

Diabetes is associated with a myriad of complications which affect the feet, eyes, kidneys, and cardiovascular health. Nerve damage in the lower limbs affects around 13% of Australians with diabetes, diabetic retinopathy occurs in over 15% of Australians with diabetes, and diabetes is now the leading cause of end-stage kidney disease. In people with diabetes, cardiovascular disease (CVD) is the primary cause of death, with around 65% of all CVD deaths in Australia occurring in people with diabetes or pre-diabetes. Furthermore, 41% of people with diabetes also report poor psychological well-being with reports of anxiety, stress, depression and feeling ‘burned-out’ from coping with their diabetes. Moreover, diabetes is ranked in the top 10 leading causes of death in Australia.

Indigenous health

Indigenous Australians are 3 times more likely to have type 2 diabetes compared to non-Indigenous Australians. This number of people with diabetes is even higher for those Indigenous Australians living in remote areas. Indigenous Australians are also at greater risk of complications than non-Indigenous Australians, with a 10-fold higher risk of kidney failure and up to 8-fold higher risk of high blood pressure.

Growth of diabetes

If diabetes continues to rise at the current rates, up to 3 million Australians over the age of 25 years will have diabetes by the year 2025. For type 2, this is likely driven by rising obesity, the ageing population, dietary changes, and sedentary lifestyles. Obesity is a major contributor to type 2 diabetes with estimates showing that eliminating obesity from the population can potentially reduce the incidence of type 2 diabetes by over 40%. The rising incidence of type 1 diabetes is also contributing to the growth of diabetes in Australia, and the prevalence of type 1 diabetes is predicted to increase by 10% between 2008 and 2013.

The financial costs of diabetes

The total annual cost for Australians with type 2 diabetes is up to $6 billion including healthcare costs, the cost of carers and Commonwealth government subsidies. The average annual healthcare cost per person with diabetes is $4,025 if there are no associated complications. However this can rise to as much as $9,645 in people with both micro- and macrovascular complications. For type 1 diabetes, the total annual cost in Australia is $570 million, with the total average annual cost per person being $4,669. The average total annual cost is $3,468 for people without complications, however this can rise to $16,698 for people with both micro- and macrovascular complications.

Prevention

Primary prevention is aimed at stopping the development of type 2 diabetes through a healthy diet and lifestyle or medication. Early intervention with intensive lifestyle changes in people with pre-diabetes can reduce the risk of developing diabetes by nearly 60% over a three-year period, and is estimated to produce a lifetime healthcare cost saving of around $1087 per person. Currently, there is no established means of preventing the development of type 1 diabetes.

Secondary prevention aims to stop the development of diabetic complications through lifestyle changes and medication, as well as early detection of type 2 diabetes. Aggressive therapy has been shown to reduce the risks of developing diabetic complications. For example, tight glycaemic control in type 1 diabetes can lead to a 42% reduction in cardiovascular events and a 50% reduction in developing impaired kidney function.

Current diabetes health in Australia

Data from 2010 show that only about half of Australians with diabetes were achieving adequate control of their blood glucose levels. Poor control of blood glucose means a higher risk of developing diabetes complications.

What this means for Australia

Within 20 years, there may be over 3 million Australians with diabetes. This will also mean more people with complications of diabetes. This is even more challenging for Indigenous Australians. Even now, most Indigenous families have at least one person already affected by the complications of diabetes.

As diabetes already costs the Australian economy at least $6 billion annually, investment in prevention for type 2, and research to find a cure for type 1 diabetes, is of great importance.

Australian diabetes policy

Diabetes was declared as a National Health Priority by the Federal government in 1997, and state and federal governments have supported programs to monitor and improve diabetes prevention, detection and management. Nevertheless, diabetes prevalence is still on the rise indicating the need for more to be done.

Call to action

The United Nations and the European Union have both acknowledged the growth of diabetes as a major issue and the importance of preventive measures alongside effective management and care. Whilst Australia has begun to develop strategies for implementation of diabetes prevention programs, much investment and development is still required and, as noted by the UN, the role of government in developing a multi-sectoral approach to prevention is essential. As a first priority, focussed, timely and integrated action must be taken to ensure national diabetes strategies are reviewed and strengthened, as necessary, to reflect the UN Resolution and enable effective implementation.

Conclusion

Diabetes is a huge challenge to our nation's health and economy. Much more work still needs to be done to continue to improve outcomes and alleviate the burden on individuals, families and the community. Adoption of a healthy lifestyle, which requires both societal support and governmental leadership, is essential for the prevention of type 2 diabetes.

Likewise, increased government funding for research to help find a cure and improved treatments for type 1 diabetes is essential as there is no mechanism for the prevention of this disease. Accurate and up to date information on the burden of disease and successful intervention strategies will also help facilitate better outcomes.

ORGANISATIONAL MESSAGES

JDRF:

JDRF's founding vision was a future free of type 1 diabetes, and our efforts must continue to increase due to the growing numbers of children and adults in Australia that are diagnosed every year with this lifelong disease. Over our four decades of research support, investment and partnerships, we have seen a much better understanding of the nature and causes of type 1 diabetes. We also acknowledge and applaud the advances in treatments and technology that have helped people with type 1 diabetes live healthier, longer lives, with improved glucose control and better treatments of common diabetes complications. But we still do not have a cure for type 1 diabetes so more research is vital. It is one of the most common chronic diseases amongst children, and Australia has one of the highest rates of this disease in the world.

Collaborative efforts are needed to speed the progress of research. Partnerships across business, government and not-for-profits are essential to this, as well as enabling those who live with diabetes to be part of enacting change for a healthier future.

Diabetes Australia:

Diabetes Australia welcomes the publication of this comprehensive and up to date briefing on diabetes and its impact in Australia. There are now approximately 1 million Australians living with diabetes and around 100,000 new diagnoses each year.

There is an urgent and growing need to promote the issues surrounding this out-of-control pandemic. We need to focus the minds of the general public, of practitioners and researchers, of the media and of politicians, bureaucrats and policy makers on diabetes and related chronic diseases. There is also an urgent need for increased understanding of the economic, and societal seriousness of diabetes and its complications, and of the escalating costs to individuals, families, workplaces, society and governments.

We need sustained, nationally consistent programs to prevent, detect and manage diabetes in Australia. Too many plans and strategies have been designed and not properly implemented or evaluated.

The opportunity cost of doing too little to stem this pandemic is apparent to many, but not, it would seem, to those who need to take hard and firm policy decisions to create healthier environments in schools, homes, hospitals and workplaces. We also need to ensure funding for quality treatment is available and accessible to all to prevent or delay the onset of diabetes and its complications.

Baker IDI Heart and Diabetes Institute:

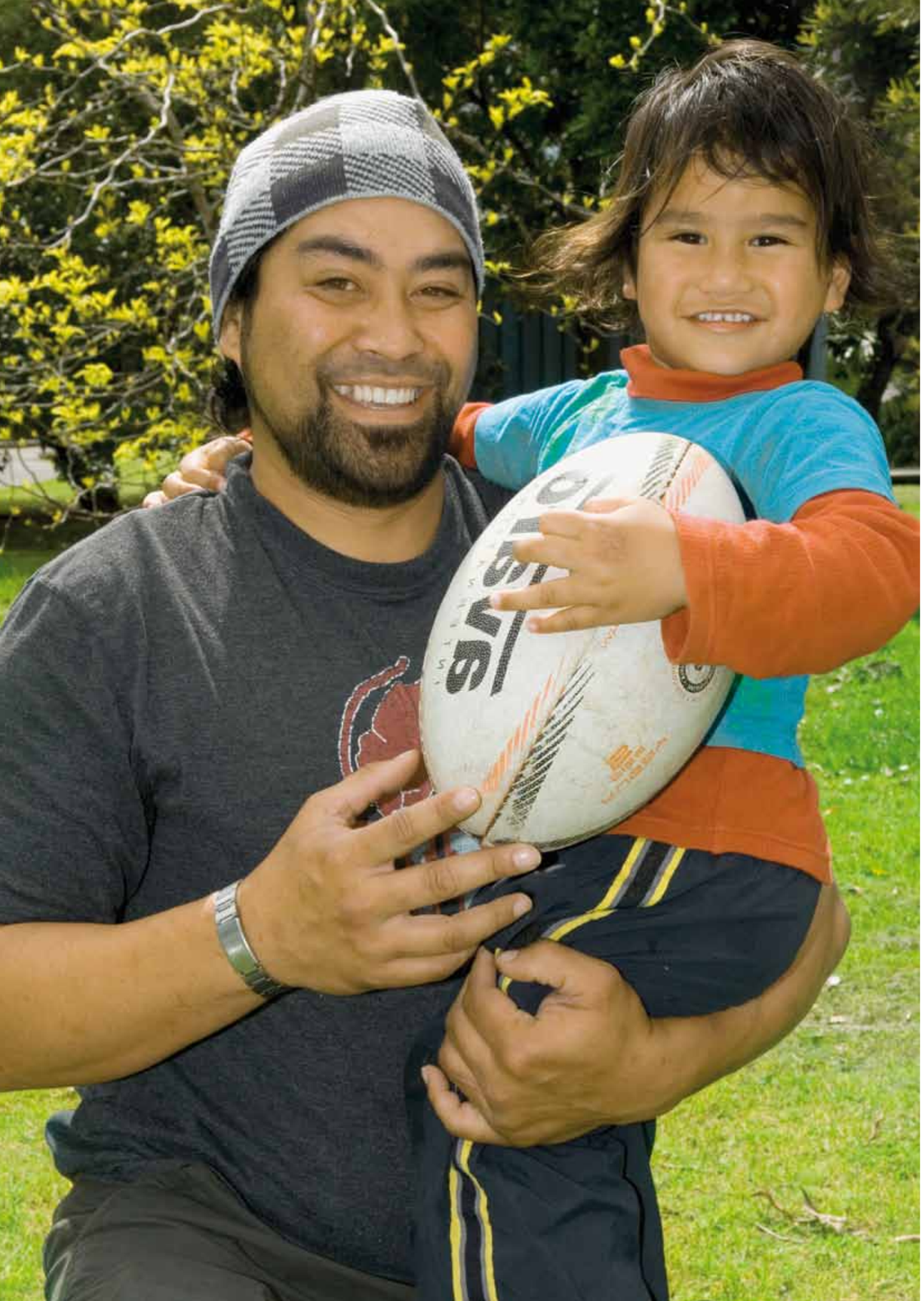
Our Institute has been responsible for much of the data that has shown diabetes now represents one of the major challenges to public health nationally and globally. Its effects on individuals, families, communities and nations mandate a well-funded, carefully planned and co-ordinated response at all levels of society. This report provides a timely update of the state of diabetes in Australia, and indicates some of the ways in which the challenge of diabetes can be approached.

Much is already known about how to improve the care of people with diabetes. More needs to be done to ensure that such information is available to all people with diabetes and their families, and that proven treatments and technologies are made available to every person with diabetes, irrespective of their socio-economic background.

Prevention of type 2 diabetes is now a reality, but understanding how to implement the appropriate lifestyle changes for the large numbers of people who need it remains uncertain. However, considering this entirely as a matter of personal responsibility will certainly fail to address the public health challenge. Changes in policy, legislation and attitudes will be essential to provide an environment within which healthy lifestyle choices can and will be made.

What is diabetes?

Diabetes mellitus currently represents one of the most challenging public health problems of the 21st century. There are over 1.5 million Australians with diabetes including those who are undiagnosed. This results in substantial morbidity and mortality, particulary from cardiovascular complications, eye and kidney diseases and limb amputations.



What is diabetes?

Diabetes mellitus has become one of the most common non-communicable diseases in the world, representing one of the most challenging public health problems of the 21st century. It is a metabolic disease characterised by high blood glucose levels (hyperglycaemia) which may arise from defects in the secretion of insulin, defects in insulin action, or both. Diabetes results in substantial morbidity and mortality, particularly from cardiovascular complications, eye and kidney diseases and limb amputations.

There are two main types of diabetes:

Type 1 diabetes

Type 1 diabetes typically results from the autoimmune destruction of the pancreatic beta cells, the producers of insulin. As the body's own insulin production is impaired, treatment with multiple insulin injections or a continuous infusion of insulin through an insulin pump is a necessary daily activity for survival. People who have this type of diabetes often need to conduct around 6 to 8 finger pricks a day to monitor their blood glucose levels. This group accounts for approximately 10% of all people with diabetes in Australia. Type 1 diabetes can occur at any age, although most cases develop amongst children, teenagers and young adults. There is currently no means of preventing or curing type 1 diabetes. It is one of the most common chronic diseases amongst children and Australia has one of the highest rates of type 1 in the world (Australian Institute of Health and Welfare 2009).

Type 2 diabetes

Type 2 diabetes is characterised by insulin resistance, impaired insulin secretion, or both. It is the most common form of diabetes, contributing more than 85% to the total number of people with diabetes in Australia. This type of diabetes is typically diagnosed after the age of 40, though recently type 2 diabetes has also been diagnosed in younger and younger adults, and occasionally among adolescents. Type 2 diabetes has a strong genetic (familial) predisposition, which is unmasked by lifestyle factors including obesity and lack of exercise. Thus it is potentially preventable in a substantial proportion of people. Type 2 diabetes can initially be controlled through a healthy diet, weight loss and physical activity. However, most people will eventually require medication, which may include insulin therapy (Kemp *et al*., 2005, Clifford *et al*., 2004, Bruce *et al*., 2000).

A related condition is pre-diabetes, which affects nearly 1 in 6 adults (more than 2 million individuals) over the age of 25 years. Pre-diabetes is a condition whereby blood glucose levels are higher than normal but not high enough to be diagnosed as diabetes. There are two conditions that fit into this category: impaired fasting glucose (IFG) and impaired glucose tolerance (IGT). Individuals with pre-diabetes are at high risk of developing type 2 diabetes and have increased risk of cardiovascular disease (Magliano *et al.*, 2008a, Barr *et al*., 2007, The DECODE Study Group on behalf of the European Diabetes Epidemiology Group, 2001). The treatment for pre-diabetes involves the same lifestyle changes that are recommended for people diagnosed with type 2 diabetes.

What does diabetes mean to the individual?

There is no cure for diabetes and so people with diabetes, and their families, face a huge challenge in understanding and adapting to the condition. Living with diabetes inevitably entails a number of physical problems which affect both private and working life and may require additional support from friends or family. The management of diabetes involves constantly trying to keep blood glucose within safe levels, which may require regular use of medication, and control of the timing and amount of food consumed. If the body's blood glucose falls too low (hypoglycaemia), as a result of an imbalance between medication and food and exercise, then palpitations, sweating, tremor, difficulties in concentrating, confusion, and ultimately loss of consciousness can occur. On the other hand, if blood glucose remains too high (hyperglycaemia), symptoms such as tiredness, thirst and frequent urination may occur. If very high blood sugar levels persist for many hours, severe, life-threatening metabolic disturbance (diabetic ketoacidosis or diabetic hyperglycaemic non-ketotic coma) may occur, requiring emergency hospital admission.

Beyond the immediate consequences of blood glucose levels outside the normal range described above, the long-term consequences of inadequately controlled diabetes include eye, kidney, nerve and circulatory diseases. Indeed, these long-term complications of diabetes account for most of the ill health associated with diabetes. Furthermore, the stress involved with the day-to-day management of diabetes can often lead to depression, anxiety and/or distress, especially for young people, so support from health professionals and family members is vital and beneficial (Anderson, 2007). Disciplined or tight control of blood glucose levels (and other important risk factors, such as blood pressure and cholesterol) significantly reduces the risk of developing the complications of diabetes (The Diabetes Control and Complications Trial Research Group, 1993, UK Prospective Diabetes Study Group, 1998b, Turner *et al.*, 1998).

Diabetes as the 'silent pandemic'

Diabetes represents one of the most challenging public health problems of the 21st century and is reaching epidemic levels globally (Shaw *et al.,* 2010). Nevertheless, it remains seriously under-reported, partly because many people with type 2 diabetes do not realise they have it (International Diabetes Federation, 2008) and do not seek help until they have developed complications, which may be many years after diabetes actually began. It has been estimated that, in Australia, for every 5 diagnosed cases of diabetes, there are 4 undiagnosed cases (Valentine *et al.*, 2011). A further source of the under-recognition of the importance of diabetes, even amongst those in whom the diagnosis has been clearly established, is the failure to record diabetes as a contributory cause of death where the main cause may have been one of the typical diabetes complications such as heart attack, stroke or kidney failure (Yorkshire & Humber Public Health Observatory, 2008).

The high prevalence of undiagnosed diabetes and the increased risk of diabetes and cardiovascular disease in those with pre-diabetes emphasise the significant socio-economic burden of diabetes, and the importance of early detection of disease.

Diabetes in Australia

Approximately 1 million Australians have been diagnosed with diabetes including an estimated 130,000 people with type 1 diabetes. Australia has the 7th highest prevalence and 6th highest incidence of type 1 diabetes in children aged 0-14 years (Australian Institute of Health and Welfare 2010, 2011).

Classifications of diabetes

Type 1 diabetes – Due to destruction of the insulin-producing cells in the pancreas, and typically begins in childhood or early adulthood, though can develop at any age. Treated with insulin injections or a continuous infusion of insulin through an insulin pump.

Type 2 diabetes – Characterised by a reduction in the production of insulin and an inability of the body to respond fully to insulin. It typically develops after the age of 40, but can occur in younger adults, and even adolescents. Treated with lifestyle change, tablets or insulin injections.

Pre-diabetes – blood glucose levels that are above normal, but not high enough to be classified as diabetes.

Gestational diabetes – diabetes that is first identified during pregnancy. It typically disappears when the baby is born, but there is a high risk of the mother developing type 2 diabetes in the next 10-15 years.

Known diabetes – diabetes that has been diagnosed by a health care professional.

Undiagnosed diabetes – diabetes that is identified as part of a health survey, through blood testing, in a person not previously known to have diabetes.

Approximately 1 million Australians (4.4% of the total population) have been diagnosed with diabetes at some time in their lives, including an estimated 130,000 people with type 1 diabetes (Australian Institute of Health and Welfare 2011). Given the large number of people with undiagnosed diabetes, it is likely that the total number of Australians with diabetes is well over 1.5 million.

Diabetes is more common in men (4.9%) than in women (3.8%) and, within Australia, is most prevalent in the Northern Territory (10.6%) and least prevalent in the Australian Capital Territory (3.0%). The high prevalence of diabetes in the Northern Territory mainly reflects the high burden of type 2 diabetes in Indigenous Australians (Australian Institute of Health and Welfare 2011). The prevalence of diabetes, particularly type 2 diabetes, rises markedly with age, such that only 0.3% of Australians aged <35 have been diagnosed with diabetes, rising to around 14-16% of those aged >65 (Figure 1).

The prevalence of diabetes is higher in Australia than in nearly all western European nations, but is lower than in North America, North Africa, the Middle-East and many Asian countries (Whiting *et al.*, 2011). Within Australia, the risk of having diabetes is considerably higher among people born in North Africa, the Middle-East and many Asian countries compared to people born in Australia (Australian Institute of Health and Welfare: Holdenson *et al*., 2003).

In children

More than 5,700 Australian children aged 0-14 years had type 1 diabetes in 2008. Among the 34 countries that are currently members of the Organisation for Economic Co-operation and Development (OECD), Australia had the 7th highest prevalence and 6th highest incidence (Australian Institute of Health and Welfare 2010) of type 1 diabetes in children aged 0-14 years. For reasons that are not well understood, but relate partly to genetics, type 1 diabetes is most common in populations originating from northern Europe, with the highest rates seen in Scandinavia. Although type 1 diabetes remains the most common form of childhood diabetes, type 2 diabetes is also now emerging in children and adolescents. Accurate figures for the numbers of youth with type 2 diabetes are not yet available for Australia, but many of the reported cases have been amongst indigenous children (Maple-Brown *et al*., 2010).

A geospatial map which presents population data on Australians diagnosed with diabetes can be found at: **http://www.ndss.com.au/en/Australian-Diabetes-Map/** The data contained are derived from the National Diabetes Services Scheme (NDSS) Registrant database and show the numbers of people diagnosed with diabetes who are registered on the scheme for each state and for several levels of administrative regions across Australia. The NDSS is an initiative of the Australian Government administered by Diabetes Australia.

Figure 1. Australians diagnosed with diabetes by age group in 2007-08 (Australian Institute of Health and Welfare 2011)

The impact of diabetes in Australia

Diabetes is the leading cause of non-traumatic lower limb amputation (Siitonen *et al*., 1993, The Global Lower Extremity Amputation Study Group, 2000) and end stage kidney disease (ANZDATA, 1980-2009), and it is also associated with eye disease, particularly diabetic retinopathy (Tapp *et al*., 2003b). In people with diabetes, cardiovascular disease is the most common cause of death (Tapp *et al.*, 2004).

Foot complications

Diabetes is associated with nerve damage (peripheral neuropathy) and poor circulation (peripheral arterial disease (PAD)) in the lower limbs, either of which may lead to foot ulcers and infections, and eventually to amputations. Diabetes is the leading cause of non-traumatic lower limb amputation (Siitonen *et al*., 1993, The Global Lower Extremity Amputation Study Group, 2000). Nerve damage affects the legs and feet of approximately 13% of Australians with known diabetes and 7% of those with undiagnosed diabetes, while the prevalence of poor circulation in the legs and feet is almost 14% in those with known diabetes and 7% in those with undiagnosed diabetes. Risk factors for these forms of nerve damage and poor circulation include duration of diabetes, age, blood pressure, blood glucose levels and smoking (Tapp *et al.*, 2003a).

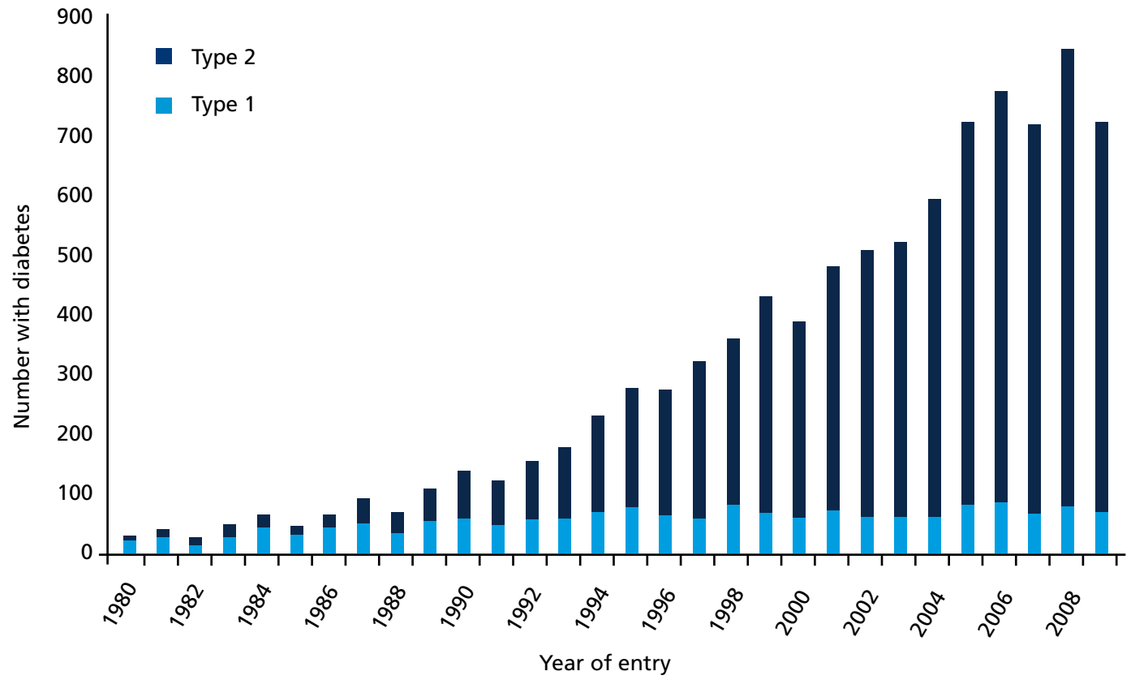
Eye disease

Individuals with diabetes are at increased risk of eye disease. Diabetic retinopathy (a condition affecting the blood vessels at the back of the eye) only occurs in people with diabetes, and is found in over 15% of Australians with diabetes (Tapp *et al*., 2003b). The prevalence is almost 4 times higher in those with diagnosed type 2 diabetes (21.9%) than in those with undiagnosed diabetes (6.2%). Risk factors for diabetic retinopathy include age, gender, duration of diabetes, cholesterol and blood glucose levels (Tapp *et al*., 2003b). Other eye conditions, though not specific to people with diabetes, are also associated with diabetes: glaucoma occurs approximately twice as commonly in people with than without diabetes (Mitchell *et al.*, 1997), while the risk of cataract is approximately 60% higher in those with diabetes (Tan *et al.*, 2008). Each of these conditions can lead to major vision impairment and in severe cases to blindness (Australian Institute of Health and Welfare 2008), with diabetes being the leading cause of visual impairment in people of working age. In one Australian study, untreated, vision-threatening retinopathy, defined by the presence of proliferative diabetic retinopathy or macula oedema, was present in 1.2% of the population with diabetes (Tapp *et al*., 2003b), which raises concern as all individuals with diabetes are recommended to have their eyes examined every 1-2 years (Australian Diabetes Society for the Department of Health and Ageing, 2008).

Kidney disease

Diabetes is also commonly associated with kidney disease, as the high levels of blood glucose damage the blood-filtering capillaries in the kidneys resulting in a condition known as diabetic nephropathy. The manifestations of diabetic kidney disease range from asymptomatic leakage of protein into the urine (microalbuminuria, macroalbuminuria and proteinuria) to end-stage kidney disease, which requires treatment with kidney dialysis or a kidney transplant. It is estimated that around 16% of the Australian adult population has some evidence of kidney damage (protein or blood in the urine or reduced kidney function) (Chadban *et al.*, 2003). In those with diabetes, microalbuminuria is present in 21.0% of the population while macroalbuminuria is present in 4.3% (Tapp *et al.*, 2004). The prevalence of micro- and macroalbuminuria increases with increasing glycaemia, affecting 9.3-11.0% of those with pre-diabetes, 17.8% of those with undiagnosed diabetes, and as many as 32.6% of those with known diabetes (Tapp *et al.*, 2004). Figure 2 shows that within Australia the annual number of people with diabetes who began dialysis or had a kidney transplant has risen dramatically since 1980, with almost all the rise being due to type 2 diabetes. Diabetes is now the single most common cause of end-stage kidney disease (ANZDATA, 1980-2009). Risk factors for micro- and macroalbuminuria include age, duration of diabetes, smoking, body mass index, blood pressure and blood glucose levels (Tapp *et al.*, 2004).

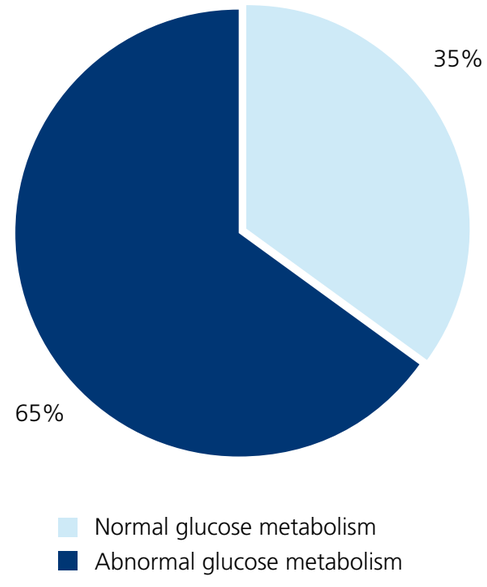
Figure 2. The annual number of people with diabetes in Australia commencing kidney dialysis or having a kidney transplant (ANZDATA, 1980-2009).



Cardiovascular disease

A major complication of diabetes is cardiovascular disease (CVD), which is also the leading cause of death in those with diabetes. Hypertension has been reported in around 70% of people with known or undiagnosed diabetes, and in 43% to 53% of people with pre-diabetes. Almost 29% of people with known diabetes and 16% of those with undiagnosed diabetes reported a previous CVD event (angina, coronary heart disease or stroke), while 11% of those with pre-diabetes reported a previous CVD event. There is also a greater than 2-fold increased risk of CVD mortality in those with diabetes and those with pre-diabetes, compared to those with normal blood glucose levels (Barr *et al.*, 2007). Furthermore, in the AusDiab study of 11,247 participants from the general population across Australia, approximately 34% of all deaths over a 5-year period were due to CVD, of which two thirds occurred in people with either diabetes or pre-diabetes (Figure 3) (Barr *et al*., 2007).

Figure 3. The percentage of all cardiovascular deaths that are associated with diabetes and pre-diabetes (Barr *et al.*, 2007).



Hypoglycaemia

Hypoglycaemia is a blood glucose level below the normal range. If not treated quickly (usually by eating something sweet), it can progress to confusion, loss of consciousness and, in very rare circumstances, to death. Hypoglycaemia is not directly caused by diabetes, but is a consequence of treatment with insulin or with sulphonylurea tablets. If occurring frequently or without good warning, it can have a major impact on the life of a person with diabetes, and can be a significant barrier to achieving good glycaemic control.

In type 1 diabetes, mild hypoglycaemia (hypoglycaemia that a patient can treat without the assistance of a third party) occurs on average one to two times per week, whilst it is estimated that there are 1.0-1.7 episodes of severe hypoglycaemia (needing third party assistance to recover) per patient per year (Graveling and Frier, 2009). Data on hypoglycaemia in type 2 diabetes are less well established. However, a UK study of hospital clinic patients reported that over 9-12 months, severe hypoglycaemia occurred in 7% of those on sulphonylureas or on insulin for less than 2 years, and in 25% of those on insulin for more than 5 years (Noh *et al*., 2011).

Diabetic ketoacidosis

Diabetic ketoacidosis (DKA) is an acute, severe, life-threatening complication of diabetes that is almost entirely confined to type 1 diabetes. DKA is a severe metabolic disturbance, and requires urgent treatment with insulin and intravenous fluids. It results from an almost total lack of insulin, and so is often the presenting feature at the time when type 1 diabetes is diagnosed. Among children with type 1 diabetes, DKA is reported to affect three per hundred children per year in Australia, with higher rates (up to 26 per 100 per year) reported in some Asian countries (Craig *et al.*, 2007).

Mortality

Diabetes is ranked in the top 10 leading causes of death in Australia (Australian Institute of Health and Welfare 2008). It is listed as the underlying cause of death in almost 3% of all deaths. When taking into account cases where diabetes is listed as an associated cause of death, this number rises to 9%. Fourteen percent of the total number of deaths due to diabetes occurred in people aged less than 65 years. Furthermore, mortality due to diabetes is greater in men than women. Between 1980 and 2005, the age-standardised death rate with diabetes as the underlying cause of death in men has increased at an average annual rate of 0.7% while in women it has decreased at an average annual rate of 0.5% (Australian Institute of Health and Welfare 2008).

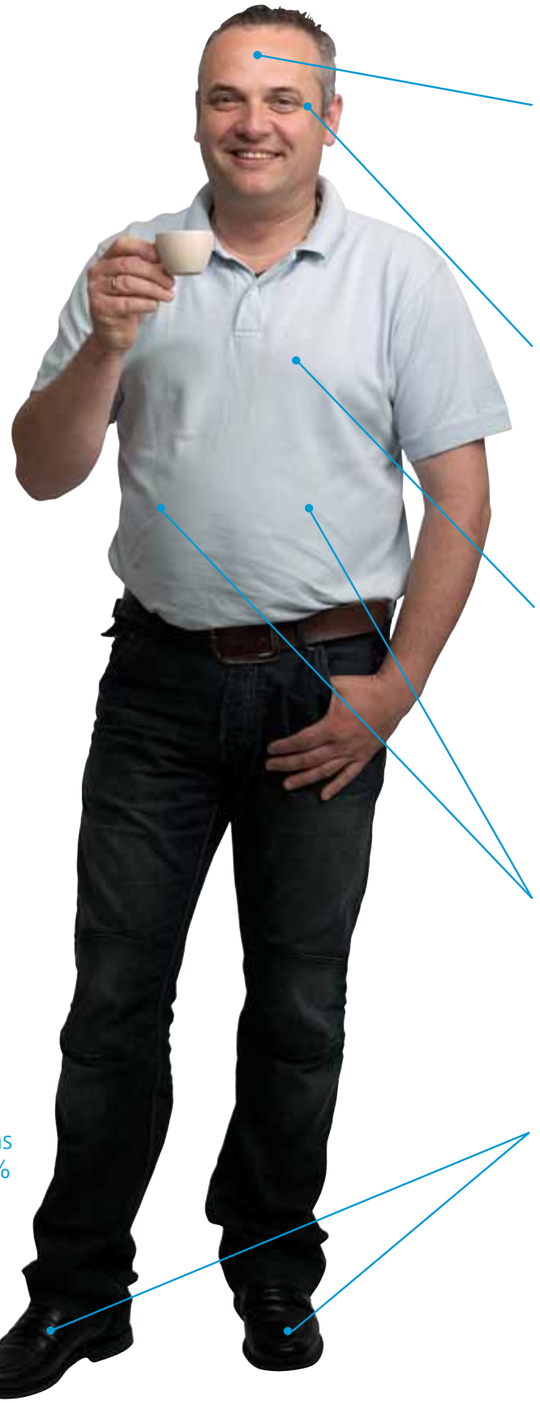
When diabetes is listed as the underlying cause of death, coronary heart disease is listed as an associated cause in 67% of deaths, kidney-related disease in 30% of deaths and heart failure in 20% of deaths. In instances where diabetes is listed as the associated cause, the main underlying causes of death are cancer (25%) and stroke (8%) (Australian Institute of Health and Welfare 2008).

Psychosocial

Poor psychological well-being affects around 41% of individuals with diabetes in Australia. Nevertheless, there is little emphasis on the psychological aspects of diabetes in contemporary health care for people with diabetes. Despite health care providers recognising psychological symptoms in many patients, only 10% are referred for psychological assessment or care (Rutherford *et al.*, 2004).

Individuals with type 1 diabetes report even higher levels of anxiety, stress and feeling 'burned-out' from coping with their diabetes compared to individuals with type 2 diabetes (Rutherford *et al.*, 2004).

Of note, Australians were rated as average/above average, in being 'effective self-managers' when compared to people with diabetes from other countries. Effective self-management was identified by good or moderate well-being, being well informed about diabetes, satisfaction with family support, no dependent children, low levels of tension, not working and satisfactory health care provision (Rutherford *et al.*, 2004).



Diabetes
A chronic disease where blood glucose is too high, either because insulin is not produced or is insufficient.

Symptoms
Tiredness, increased thirst, frequent urination, blurred vision.

Complications
Serious complications can result from elevated blood glucose, some of which are illustrated here. These are largely preventable, and can be delayed with early and effective treatment.

Stroke
Risk:
Up to four times as likely.

Effective treatment:
Reduces strokes by more than a third.

Blindness
Risk:
Diabetes is a leading cause of blindness.

Effective treatment:
Reduces deterioration of vision by more than a third.

Heart attack
Risk:
Three times as likely, and heart disease is up to four times as likely.

Effective treatment:
More than halves the risk of heart failure.

Kidney failure
Risk:
Three times as likely.

Effective treatment:
Reduces risk of kidney failure by more than a third.

Effective treatment can reduce costly diabetes complications by approximately 50%

Amputation
Risk:
The leading cause of non-traumatic lower limb amputations.

Effective treatment:
Reduces the number of amputations and foot ulcers.

Sources: United Kingdom Prospective Diabetes Study; Steno-2 Study, Gæde et al., 2008.

Indigenous health

The risk of kidney failure due to diabetes is more than ten times greater in Indigenous compared to non-Indigenous Australians (Grace *et al*., 2011).

Diabetes is a significant problem not only in the non-Indigenous population, but it also greatly affects Aboriginal and Torres Strait Islanders, who represent around 2.5% of the Australian population. The prevalence of self-report diagnosed diabetes in the Indigenous population is estimated at 6% (approximately 28,460 people), with Indigenous Australians being more than 3 times as likely to report diabetes than non-Indigenous Australians (Trewin and on behalf of the Australian Bureau of Statistics). However, the picture is very varied across different communities, with studies of individual communities (including a number of studies that identified people with undiagnosed diabetes as well as diagnosed diabetes) reporting prevalences ranging from 3.5 to 33.1% (Minges *et al*., 2011). Among Indigenous Australians, those living in remote areas are more likely to have diabetes than those living in non-remote areas and women are more commonly affected than men (Minges *et al*., 2011).

When compared to non-Indigenous Australians, the Indigenous Australian population has a 2.5 to 5.3-fold higher risk of proteinuria, and 3.1 to 8.1-fold higher risk of high blood pressure (Hoy *et al*., 2007). Whilst Indigenous people make up only 2.5% of the total population, they account for 16.7% of the new cases of kidney failure (requiring dialysis or kidney transplant) caused by diabetes (Grace *et al*., 2011). After accounting for other risk factors, the risk of kidney failure due to diabetes is more than ten times greater in Indigenous compared to non-Indigenous Australians (Grace *et al*., 2011). Diabetes is listed as the underlying cause of death in 8% of all deaths in the Indigenous population (Australian Bureau of Statistics).

Growth of diabetes

Projection of the burden of diabetes in Australia suggests that if there are no changes in the incidence of diabetes (the number of new cases per year), there will be at least 2 million adults over the age of 25 years with diabetes by 2025. However, if we continue to see diabetes incidence increasing at current rates, there will be 2.5-3 million people with diabetes by 2025 and around 3.5 million by 2033 (Magliano *et al*., 2009). An estimated one third of today's young adults will develop diabetes during their lifetime. Based on current incidence and mortality rates, this means that on average 14% of their remaining life will be lived with diabetes (Magliano *et al*., 2008).

Whilst numerically, most of the growth is due to type 2 diabetes, the incidence of type 1 diabetes in Australian children aged 0-14 years is also rising - at an average rate of 2.8% per year (Catanzariti *et al*., 2009). This places Australia among the top 10 countries in relation to incidence rates of type 1 diabetes in children.

Causes for growth

It has been estimated that if we were to eliminate obesity from the population, we could potentially reduce the incidence of type 2 diabetes by 38.0% in men and 47.4% in women (Cameron *et al*., 2009).

The prevalence of diabetes around the world is increasing. This is mainly driven by rising numbers of people with type 2 diabetes as a result of the ageing of the population, dietary changes, reduction in physical activity, the obesity epidemic (Wild *et al*., 2004), and decreased mortality in those with diabetes (Lipscombe and Hux, 2007). Obesity is a major risk factor for type 2 diabetes, with a prevalence of type 2 diabetes approximately 3 times greater in obese individuals compared to their normal weight counterparts (Dalton *et al*., 2003). Between the years 2000-2025, the proportion of normal weight Australian adults is expected to decrease from 40.6% to 28.1% and the proportion of obese adults to increase from 20.5% to 33.9%. Thus, if current trends continue, normal weight adults will constitute less than a third of the population by 2025 (Walls *et al*., 2011). It has been estimated that if we were to eliminate obesity from the population, we could potentially reduce the incidence of type 2 diabetes by 38.0% in men and 47.4% in women (Cameron *et al*., 2009).

Intra-uterine conditions (the environment a baby is exposed to during pregnancy) may also be important for diabetes risk in later life. Convincing evidence now shows that low birth weight babies, and foetuses exposed to high blood glucose as a result of maternal gestational diabetes are at significantly higher risk of type 2 diabetes in later life (Whincup *et al*., 2008, Dabelea *et al*., 2000), suggesting that prevention of type 2 diabetes begins with good maternal health.

Much attention has been focussed on the rise of type 2 diabetes, but it is also now being recognised that the incidence of type 1 diabetes (particularly in very young children) is rising sharply. If current trends were to continue, it is estimated that the prevalence of type 1 diabetes in children will increase by 10% between 2008 and 2013 (Australian Institute of Health and Welfare 2011). The causes of this are much less clear than for type 2 diabetes and further research is required to better understand the disease. Hence, increased government funding for research to help find a cure and improved treatments for type 1 diabetes is essential as there is no mechanism for the prevention of this disease.

The financial costs of diabetes

The total annual cost for people with type 2 diabetes in Australia is estimated at $6 billion (Colagiuri *et al*., 2003) and $570 million for people with type 1 diabetes (Colagiuri *et al*., 2009a). The average annual cost per person increases greatly with the presence of complications, from $4,025 per person with type 2 diabetes without complications and $3,468 per person with type 1 diabetes without complications, to $9,645 per person with type 2 diabetes with micro- and macrovascular complications and $16,698 per person with type 1 diabetes with micro- and macrovascular complications.

Several factors contribute to the costs of diabetes, including costs to the health system, out-of-pocket expenses for individuals with diabetes and their carers, and community resources used by people with diabetes. The total annual cost for people with type 2 diabetes in Australia was estimated for 2001 at $2.2 billion, increasing to $3.1 billion when the cost of carers was included (Colagiuri *et al*., 2003). The largest contributors to the direct health care costs are medication and the costs of in-patient care (figure 4). Ironically, diabetes medication only makes up 7% of the costs, with the cost of diabetes consumables contributing a further 10%. Direct costs refer to the resources used by individuals with diabetes, and can be divided into health care costs and non-health care costs (see figures 4 and 5), while indirect costs refer to potential resources lost by these individuals, such as annual lost wages. When indirect costs and government benefits (e.g. aged pension, sickness allowance) are also accounted for, the total annual cost rises to $6.0 billion. For type 1 diabetes, the total annual cost was estimated for 2008 at $570 million (Colagiuri *et al*., 2009a). Hospitalisation accounted for almost half of the direct health care costs while medications accounted for 32% (Figure 6). A recent analysis of the national AusDiab study has suggested that in 2005, the total direct cost for diabetes in Australians aged ≥ 30 years was $4.8 billion, with an extra $7.6 billion being spent as government subsidies.

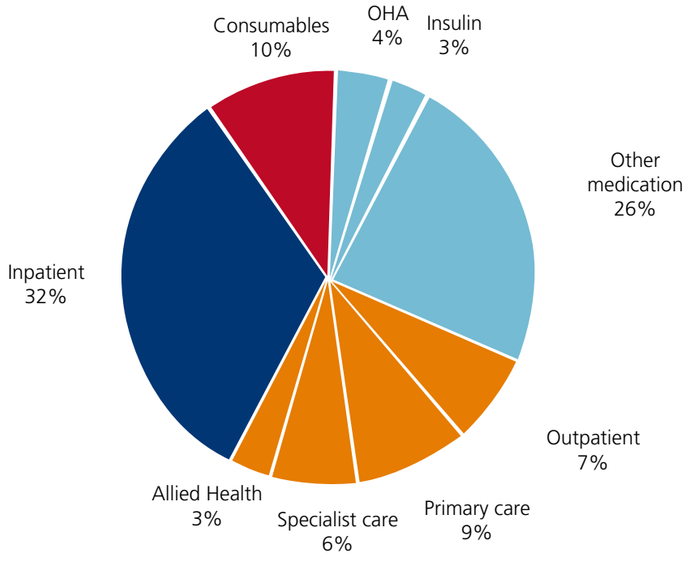
The presence of complications greatly increases the costs, as demonstrated in Table 1.

Table 1. The average annual healthcare cost of diabetes per person (Colagiuri *et al*., 2003, Colagiuri *et al*., 2009a).

	Type 1 diabetes	Type 2 diabetes
No complications of diabetes	$3,468	$4,025
Microvascular complications only	$8,122	$7,025
Macrovascular complications only	$12,105	$9,055
Micro- and macrovascular complications	$16,698	$9,645

Costs associated with diabetes involve direct health care, direct non-health care and indirect costs. Figures 4 and 5 describe the different components that contribute to direct health care and non-health care costs, respectively, for those with type 2 diabetes, and figure 6 describes the different components that contribute to direct health care costs for those with type 1 diabetes. Indirect costs refer to the present and future impact of opportunities that may be lost to an individual due to diabetes, which may include morbidity, disability, premature mortality.

Figure 4. Direct health care costs for people with type 2 diabetes (Colagiuri *et al*., 2003).



OHA – oral hypoglycaemic agents

Figure 5. Direct non-health care costs for people with type 2 diabetes (Colagiuri *et al*., 2003).

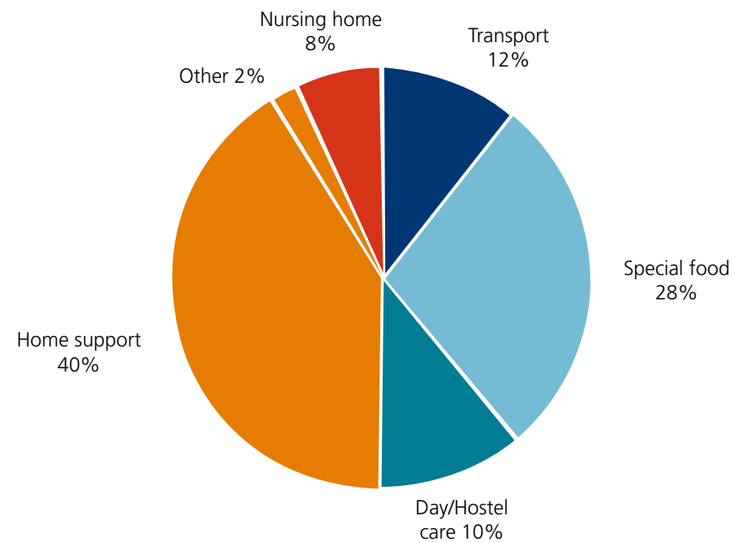
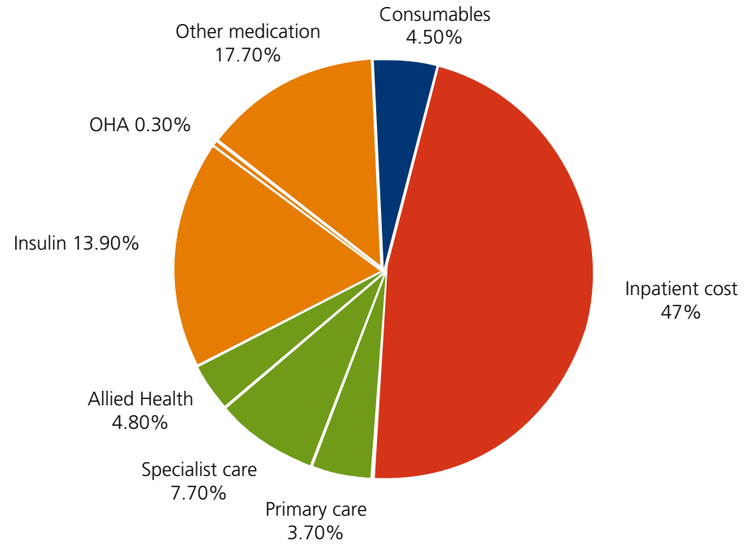


Figure 6. Direct health care costs for people with type 1 diabetes (Colagiuri *et al*., 2009a).



OHA – oral hypoglycaemic agents

Prevention

Primary prevention aims to stop the development of type 2 diabetes. This can be achieved by encouraging a healthy lifestyle, with a good, balanced diet and moderate physical activity, or by use of medication. The behaviour changes required for primary prevention are unlikely to succeed across the population without a range of societal and legislative changes that support and facilitate healthy behaviour choices. To date there is no known prevention for the development of type 1 diabetes, thus continued research to better understand the disease is of great importance.

Secondary prevention aims to stop costly diabetes complications for both type 1 and type 2 diabetes and involves a combination of early identification of people with type 2 diabetes, support for changes to their lifestyle and enchanced treatment for both type 1 and type 2 diabetes.

It has been shown that preventive measures have a positive effect on being able to curb the pandemic of diabetes and the subsequent socio-economic impact. These measures can be divided into “primary” and “secondary” prevention.

Primary prevention

Primary prevention aims to stop the development of type 2 diabetes by encouraging a healthy lifestyle, with a good, balanced diet and moderate physical activity.

Changing population groups’ behaviours to become healthier is both a political and a practical challenge, but it can be done effectively. Success in this area will require measures aimed at modest changes in the whole population, and interventions aimed at more significant lifestyle changes in individuals with risk factors for diabetes or with pre-diabetes. It is essential to recognise that it is unlikely that substantial population behaviour changes will occur when interventions are targeted only at individuals. The importance of the legislative, physical and attitudinal aspects of the environment in producing health behaviour change is clearly demonstrated by the raft of legal, political and societal changes that have been implemented to successfully reduce smoking rates and improve road safety.

Recent studies have concluded that screening for diabetes and pre-diabetes is cost-effective in those aged over 40 years (Waugh *et al*., 2007, Colagiuri and Walker, 2008, Gillies *et al*., 2008). Early intervention in people with pre-diabetes produces significant long term savings in healthcare costs. Intensive lifestyle changes in people with pre-diabetes, which involves physical activity for 30 minutes per day and a loss of 5-7% of initial body weight, have been estimated to result in a reduction in lifetime healthcare cost by around $1087 per person within the Australian healthcare setting (Palmer *et al*., 2004b).

The Diabetes Prevention Project (2002) (Knowler *et al*., 2002) found that people with pre-diabetes are able to reduce their risk of development of type 2 diabetes by making changes in their diet, increasing their level of exercise or using medication. They may even be able to return their blood glucose level to the normal range. Just 30 minutes of moderate physical activity a day, coupled with a 5-10% reduction in body weight, produced a 58% reduction in diabetes incidence. Participants aged 60 years and older reduced their risk by 71%. Similarly The Da Qing study in China (1997) (Pan *et al*., 1997), the Finnish diabetes prevention study (2003) (Lindstrom *et al*., 2006) and the Indian Diabetes Prevention Programme (2006) (Ramachandran *et al*., 2006) also showed that the incidence of diabetes could be reduced through lifestyle modifications or by oral anti-diabetic medication.

An Australian community-based study examined diabetes prevention outside the high-cost intensive clinical trial setting. The intervention consisted of 6 structured 90 minute group sessions over a period of 8 months. The content of the group sessions was based on the Health Action Process Approach which uses psychosocial theories of behavioural change. There was a reported risk reduction of 40% for type 2 diabetes and 16% for cardiovascular disease following the intervention. Improvements were seen in a range of clinical measures including weight, plasma glucose, blood lipids and diastolic blood pressure, as well as in measures of psychological distress (Laatikainen *et al*., 2007). Overall, this trial demonstrates that benefits seen in research trials are reproducible in community settings.

Unfortunately there is currently no known prevention for the development of type 1 diabetes. This highlights the importance of continued research, both in Australia and overseas, to better understand the disease.

Secondary prevention

Secondary prevention aims to stop costly diabetes complications and involves a combination of early identification of people with type 2 diabetes, support for changes to their lifestyle and enhanced treatment of both type 1 and type 2 diabetes (Colagiuri *et al*., 2009b, Craig *et al*., 2011). The progression of the disease must be monitored closely, including the onset of complications.

The United Kingdom Prospective Diabetes Study (UKPDS) (UK Prospective Diabetes Study Group, 1998a, UK Prospective Diabetes Study Group, 1998b, Stratton *et al*., 2000) showed conclusively that effective treatment of type 2 diabetes can greatly reduce diabetes complications such as heart attack (by more than 50%), stroke (by 44%) and serious deterioration of vision (by up to 33%). Effective treatment involves close monitoring and control of blood glucose levels, blood pressure and lipids (fats, such as cholesterol). Similarly in type 1 diabetes, improving blood glucose control has been shown to lessen the risks of major complications of diabetes (The Diabetes Control and Complications Trial Research Group, 1993, Nathan *et al*., 2005, DCCT/EDIC Research Group *et al*., 2011), including a reduction in risk for development and progression of retinopathy by 76% and 54% respectively (The Diabetes Control and Complications Trial Research Group, 1993), a reduction of the risk of a first cardiovascular event by 42% (Nathan *et al*., 2005), and a reduction of the risk of the first nonfatal myocardial infarction, stroke or death from cardiovascular disease by 57% (Nathan *et al*., 2005). The Steno-2 Study further demonstrated that by intervening simultaneously on multiple factors (glucose, blood pressure, cholesterol etc), the risks of developing the most severe diabetes-related complications were reduced by about 50% over 13 years (Gæde *et al*., 2008).

It is notable that the beneficial effects of good blood glucose control appear to continue even after blood glucose is no longer under such tight control. This is referred to as "metabolic memory" or a "legacy effect" (Ranjit Unnikrishnan *et al*., 2011). In the Diabetes Control and Complications Trial (DCCT), type 1 diabetes patients were placed on either standard or intensive treatment regimens to control their blood glucose levels for just over six years. Over the subsequent 10-15 years, the levels of blood glucose control were very similar in the two groups, but those who had been in the intensive group for the first six years of the trial continued to show better outcomes – a 42% reduction in cardiovascular events (Nathan *et al*., 2005) and a 50% reduction in developing impaired kidney function (DCCT/EDIC Research Group *et al*., 2011).

Nevertheless, diabetes is a progressive disease. Even with effective management the disease progresses from year to year and treatment regimens need to be altered to maintain good control. While the work to find a cure for diabetes continues, it is possible to reduce the effects and the costs of the disease very significantly.

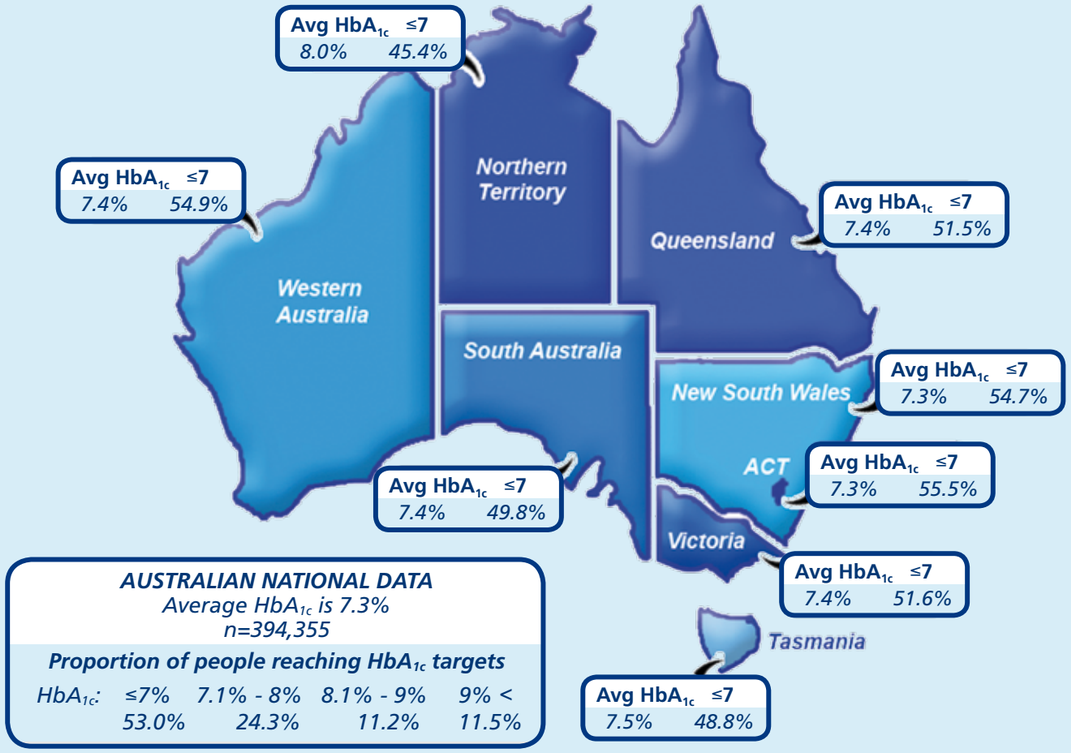
Current diabetes health in Australia

Only around half of the Australian population with diabetes is reaching the glycaemic target of HbA_{1c} <7%. Those individuals not reaching the <7% target would be at higher risk of diabetic complications (Michaelides *et al*., 2008).

In 2008, the Mapping Glycaemic Control Across Australia (MGCAA) project was established to track HbA_{1c} levels across Australia. The HbA_{1c} test is used in the routine care of people with diabetes to assess how well their blood sugar levels are controlled. The project collects HbA_{1c} data directly from community laboratories to assemble a picture of how well diabetes is being controlled across the country. This has become a tool to assist health providers in identifying target areas where interventions and strategies for change need to be implemented.

Data on nearly 400,000 people with diabetes in 2010 show that only around half of the Australian population with diabetes is reaching the glycaemic target of HbA_{1c} <7%. Those individuals not reaching the <7% target are at higher risk of diabetic complications. The percentage of the population that reaches glycaemic targets increases with age. Only around 36% of those aged <40 years meet the target in contrast to 61% of those >80 years (Michaelides *et al*., 2008). There was also some regional variation, with the average HbA_{1c} being highest at 8.0% in the Northern Territory, with the states and the Australian Capital Territory having average levels of 7.3-7.5%.

Changing Diabetes Map (2010)

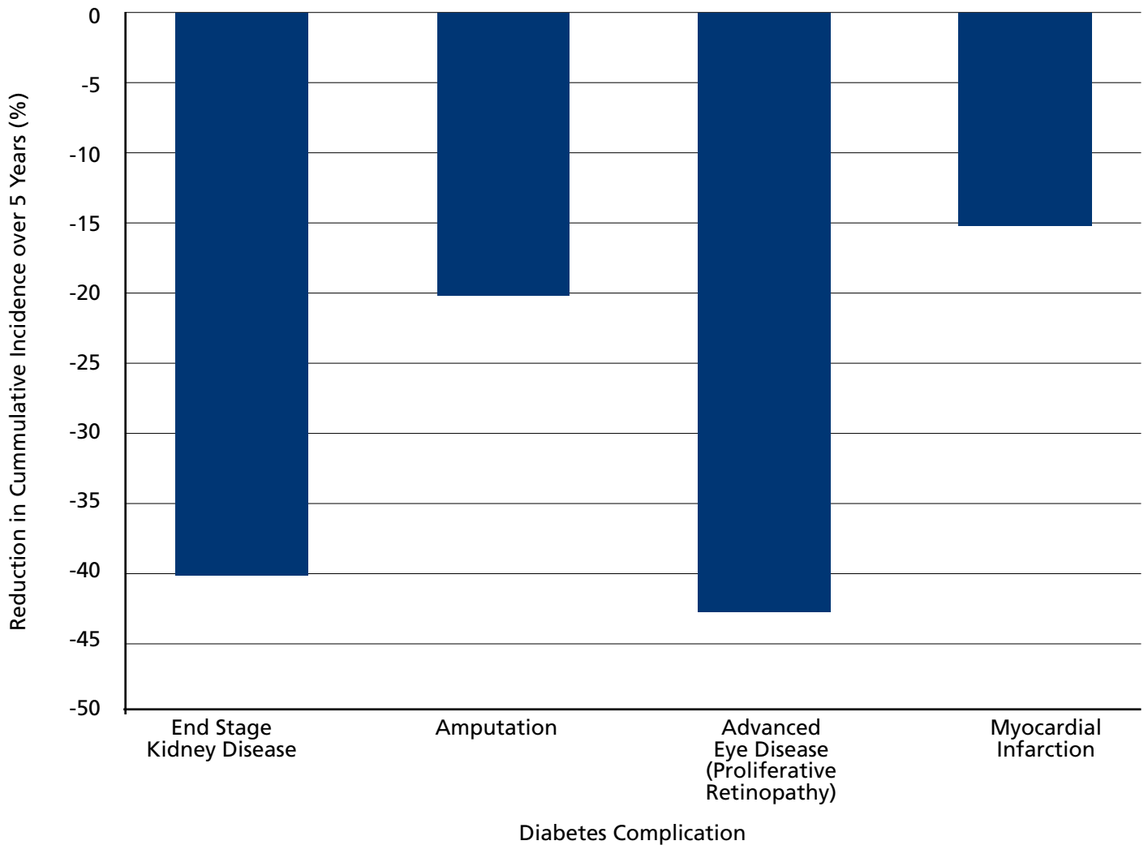


Website: http://www.glycomate.com/changingdiabetes/

The impact of improving just glycaemic control in type 2 diabetes was modelled using the CORE Diabetes Model (Palmer *et al*., 2004a). A reduction in HbA_{1c} from 8% to 7% was modelled over a 5 year period while all other parameters such as weight, blood pressure and lipid profiles were kept constant. The improvement in just glycaemic control resulted in a reduction in the cumulative incidence of End Stage Kidney Disease by 40%, of amputations by 20%, of advanced eye disease by 42% and of myocardial infarction by 15% (Figure 7). It should be noted that over the 5 year time period that was modelled, only a small minority of individuals would develop each of these complications. Nevertheless, improving glycaemic control in the Australian diabetes population has the potential to have a significant impact on the health of people with diabetes but will require the necessary investments in diabetes treatment.

Figure 7. Impact of improving glycaemic control on diabetes complications in type 2 diabetes (CORE Diabetes Model).

Impact on diabetes complications of reducing HbA_{1c} by 1%



What this means for Australia

The consequence of a continued and uncontrolled rise in the numbers of people with diabetes may be that the children of today will be the first for many centuries to have a shorter life expectancy than their parents or grandparents.

Australia, like many other countries, is facing a rising tide of people with diabetes. Within 20 years, there may be more than 3 million Australians with diabetes. Such increases will fuel rises in the complications of diabetes, particularly kidney and cardiovascular disease. The last few decades have seen a steady decline in deaths from cardiovascular disease, due to factors such as reduced smoking and improved treatment of cholesterol and blood pressure, along with better management of heart attacks and strokes. However, the rising prevalence of diabetes and obesity may reverse these trends, because of the increased risk of cardiovascular disease associated with diabetes. The consequence of an unchecked rise in the numbers of people with diabetes may be that the children of today will be the first for many centuries to have a shorter life expectancy than their parents or grandparents.

The outlook for Indigenous Australians is even more challenging. Amongst older adults in many Indigenous communities, diabetes has become the norm, and many families have at least one person on dialysis due to diabetes-related kidney disease. Type 2 diabetes is frequently seen in younger adults, meaning that the development of serious complications of diabetes occurs at a working age with major consequences on employment.

The healthcare costs of diabetes to the Australian economy, at $6 billion annually, are already enormous. Further rises in the numbers of people with diabetes will add substantially to this figure, and argue strongly for investment in prevention, early detection and improved management of diabetes.

Australian Diabetes Policy

Diabetes was declared as a National Health Priority by the Federal government in 1997, and also figured prominently in the National Preventative Health Taskforce recommendations. Governments at state and federal levels have supported a variety of programs to both monitor diabetes and to implement improvements in diabetes prevention, detection and management. Despite this, the numbers of people with diabetes continue to rise, and much more needs to be done.

A new and updated national policy on diabetes needs to incorporate population-wide measures to reduce the risk of developing type 2 diabetes, screening programs to detect undiagnosed type 2 diabetes, and better access to all components of the multi-disciplinary teams and treatments required for the complex challenges of managing type 1 and type 2 diabetes. Likewise, government funding for research to help find a cure and improved treatments for type 1 diabetes is essential as there is no mechanism for the prevention of this disease. New research is also needed to develop new therapies, improve individuals' abilities to manage their own condition, and to identify better ways of translating new research developments into daily practice for all people with diabetes.

Call to action

Prevention – An internationally acknowledged priority

The threat posed by the growing prevalence of diabetes has been acknowledged by the United Nations (UN) and the European Union (EU), which have both highlighted the importance of preventive measures alongside effective management and care. UN Resolution no. 61/225 (20 December 2006) "encourages Member States to develop national policies for the prevention, treatment and care of diabetes in line with the sustainable development of their healthcare systems, taking into account the internationally agreed development goals, including the Millennium Development Goals". The recent UN General Assembly High Level Meeting on prevention and control of non-communicable diseases further committed the UN and its member states to develop coordinated actions to prevent and treat diabetes and other non-communicable diseases. Australia has already begun to develop strategies for implementation of diabetes prevention programs, but much more investment and development is still required to bring these to all of those at risk. Furthermore, as noted above and by the UN, the role of government in developing a multi-sectoral approach to prevention is essential. As a first priority, focussed, timely and integrated action must be taken to ensure national diabetes strategies are reviewed and strengthened, as necessary, to reflect the UN Resolution and enable effective implementation.

The changing diabetes barometer:

An innovative response to an urgent need

Prevention works. Primary prevention means that the growth in type 2 diabetes incidence can be slowed while secondary prevention means that the impact of the disease on individuals with diabetes, healthcare systems and the economy can be reduced. Achieving this requires measurement, information sharing, and improvement based on the wider adoption of best practices from primary prevention and effective treatment regimes.

Launched in November 2007, the Changing Diabetes Barometer initiative is an example of an international approach aiming to improve lives of people with diabetes and reduce costs associated with this progressive chronic disease. The initiative seeks to achieve these aims by inspiring the collection and sharing of important information on the size of the burden of diabetes and the effectiveness of interventions to combat it. At its centre is a message to all involved in meeting the challenge of diabetes, a call to 'measure, share and improve'. The initiative argues that data must be collected to show the impact of varying efforts and approaches to reduce diabetes incidence, diagnose the disease early and treat it effectively, thereby reducing the incidence of diabetes-related complications and premature deaths.

The Changing Diabetes Barometer initiative collects success stories and monitors progress at an international level, inspiring the spread of best practices which will lead to improved patient outcomes. Data is shared with the International Diabetes Federation (IDF) so that the promotion of measuring and sharing works in partnership with further development of the IDF atlas. The Changing Diabetes Barometer facilitates informed communications between stakeholders to enable such an exchange of best practices, based on clear evidence. Other Australian initiatives to facilitate improved access to knowledge about diabetes for both patients and healthcare professionals include the Changing Diabetes Map, the NDSS diabetes map and the Juvenile Diabetes Research Foundation's Path to a Cure newsletter.

Conclusion

Diabetes represents a major and growing challenge to the health and economy of our nation. The size of the current and future impact of diabetes on individuals, families and communities mandates that the substantial work on its management done so far is significantly expanded. New interventions are needed, and established interventions must be made available to all who would benefit from them. Adoption of healthy lifestyles is essential for the prevention of type 2 diabetes, but substantial progress in this area will only occur within a framework of societal and government support for and facilitation of appropriate lifestyle choices. Continued government funding for research to help find a cure and improved treatments for type 1 diabetes is essential as there is no mechanism for the prevention of this disease. Provision of accurate, up to date and detailed information on the disease burden and on successful intervention strategies is another essential plank of improving the outlook for people with diabetes.

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