3 Prevention, early detection and management

This chapter provides an overview of the current status of prevention, early detection and management of diabetes and its complications. For each of these areas, information is provided on the size of the problem, current practice, and the cost-effectiveness of interventions.

3.1 Primary prevention of diabetes

Possible primary prevention strategies differ for the two types of diabetes because of their different pathophysiologies. Type 1 diabetes is typically an autoimmune process with no clearly established environmental risk factors, whereas Type 2 diabetes is a chronic disease related to lifestyle.

By looking for genetic markers and auto-antibodies, it is now possible to identify children at high risk of Type 1 diabetes. It may be possible in the future to prevent or delay the onset of Type 1 diabetes in such children, but the studies that address this question have not yet been completed. The rest of this section therefore deals with Type 2 diabetes.

Lifestyle factors such as obesity and physical inactivity have a known association with the development of Type 2 diabetes. Primary prevention, namely strategies to reduce the onset of illness in the whole population, population groups or individuals, can be used to reduce levels of these risk factors and prevent or delay the onset of Type 2 diabetes. The same strategies also have a role in the secondary prevention of diabetes, by raising awareness of the lifestyle changes necessary to manage the condition and delay the onset of complications, and providing the means by which those changes can be made.

As diabetes shares many of its risk factors with conditions such as cardiovascular disease and some cancers, prevention strategies that reduce levels of these risk factors are likely to have widespread health benefits.

Approaches to primary prevention of Type 2 diabetes

Broadly speaking, prevention can be aimed at the whole population, an approach which seeks to alter or eliminate lifestyle and environmental risk factors (the 'population' approach). The focus can also be narrowed to particular individuals or groups, especially those at high risk of developing diabetes. This is termed the 'high-risk' approach.

The first approach aims to improve risk factor levels and wider factors in the population as a whole. It is based on the knowledge that by far the greatest number of disease cases arises from that majority of the population who are not seen as 'at risk'; and that small changes in many healthy people can produce much greater community benefit than large changes in a few.

The high-risk approach aims to detect individuals and populations at higher risk and then to reduce that risk. Those with impaired glucose tolerance are at high risk of developing Type 2 diabetes, and form the primary group for this type of approach. Other individuals at higher risk are those with risk factors for diabetes such as a family history of diabetes, age over 40 years, a history of hypertension,

obesity, dyslipidaemia, or physical inactivity. Certain groups are also at higher risk of developing diabetes, either due to clinical reasons, such as pregnant women, or for social or cultural reasons, such as Indigenous Australians and people from various migrant groups (see Chapter 5).

The population approach

While the population approach is expected to have a greater impact than the high-risk approach in reducing the burden of Type 2 diabetes, simply because of the size of the target group, there are limited data to demonstrate the effectiveness of population-based interventions (Colagiuri et al 1998). To some extent, the results from studies of coronary heart disease prevention can be extrapolated to diabetes, because the risk factors are similar. However, it should be noted that there have been unfavourable trends in the prevalence of the most important risk factors for diabetes, obesity and physical inactivity, and less is known about how to change long-term behaviour in these areas than smoking and high blood pressure.

The combined effect of risk factor reduction has been examined in community-wide studies of risk factors, especially in the United States, but also in Wales and in Finland (Tudor-Smith et al 1998; Puska 1995). Effects typically demonstrate significant changes in both intervention and control communities, especially for cholesterol, blood pressure and smoking (Luepker et al 1996; Winkelby et al 1997). The North Karelia project in Finland showed that community-based programs can reduce risk factor levels and coronary heart disease risk in the general population and among higher-risk groups (Jousilahti et al 1995).

The population impact of interventions may be more significant in the long term. For instance, a recent randomised controlled trial of coronary heart disease risk factors in over 12,000 males in the United Kingdom realised small changes in those risks relevant to diabetes (eg weight loss of 1 kg and 5 per cent smoking cessation) (Family Heart Study Group 1994). However, the maintenance of these small changes over the long term has been estimated to result in a 12 per cent reduction in coronary events.

Recent Australian estimates of the potential for existing prevention and treatment interventions to further reduce coronary heart disease in people aged 35–79 years suggest a possible reduction in coronary events of 38 per cent and in coronary deaths of 41 per cent (AIHW & HEALTH, in press). This indicates the potential for diabetes, as the overall benefits would go beyond coronary heart disease to a range of diseases with common risk factors.

The great challenge for diabetes prevention is to turn this theoretical scope into practice, and assess whether risk factors can be avoided or reduced in virtually all people, how Australians can become more physically active, and how the worsening trends in overweight can be reversed.

Macro-environmental factors such as healthy public policy on food supply or supportive environments providing opportunities for physical activity are now recognised as fundamental to the achievement of these goals, as outlined in the Ottawa Charter for Health Promotion (WHO 1986) and the Jakarta Declaration for Health Promotion (WHO 1997).

A further part of the challenge is to attend to the social, economic and environmental conditions behind people's daily lives. The actions of government, businesses and industry can have a large effect on people's opportunities, attitudes and skills.

Factors such as education, taxation, housing, urban design and conditions in the workplace can influence the level of risk factors as well as other social and psychological aspects that affect health. This is especially relevant to the inequalities seen in health, such as the higher rates of diabetes and its risk factors among Indigenous Australians (AIHW 1998a).

The need to address both macro and micro-environmental issues and social and economic conditions has been identified as a principle in the National Public Health Partnership (NPHP; see page 68), and is reflected in national strategies on physical inactivity and overweight and obesity. The NPHP will build on this existing work, based on a commitment to collaboration by the Commonwealth Government and the State and Territory Governments. A National Primary Prevention Strategy is also under development, to provide an integrated platform for risk factor initiatives, in the context of a national approach to non-communicable disease prevention and control.

On an individual level, GPs and other health professionals have an important role in providing all their patients with evidence-based primary prevention advice. The need for incentives to make it easier for health professionals to perform this service is discussed in Chapter 4.

The high-risk approach

Only a few studies have tested interventions for the prevention of Type 2 diabetes, all focusing on impaired glucose tolerance. Two Swedish studies showed similar results, using diet (Sartor et al 1980) and diet plus exercise (Eriksson & Lindgarde 1991) to halt the progression of impaired glucose tolerance to diabetes. The proportion of those who progressed to diabetes was about 30 per cent in the control groups in comparison to just over 10 per cent in the intervention groups. In a recent randomised controlled trial of impaired glucose tolerance in China, progression to diabetes over six years was reduced by 31 per cent through dietary interventions and by 46 per cent through exercise (Pan et al 1997). Whether these interventions prevent or just delay onset requires long-term follow-up. However, even a six-year delay in the onset of diabetes is a substantial health gain. The pharmacological interventions so far have been less than successful. A large-scale trial in the United States, the Diabetes Prevention Program, is currently evaluating the role of diet, physical activity and the drug metformin in preventing progression of impaired glucose tolerance to diabetes.

Cost-effectiveness of interventions

Cost-effectiveness analyses for the primary prevention of diabetes are scarce, and those that exist are based on a range of assumptions. A recent Australian analysis of selected weight reduction and physical activity interventions (Segal et al 1996) made numerous assumptions about the reach and effectiveness of prevention interventions in related fields. Within these parameters, the authors concluded that primary prevention programs for Type 2 risk factors would be a highly efficient use of public resources. It was estimated that these programs could achieve a substantial improvement in health status at little cost, or with a potential net saving in health care resources. For instance, direct program costs for a media campaign (with community support) were estimated to be less than the

costs to the health system of managing cases of Type 2 diabetes that had not been prevented. In addition, while a GP lifestyle advice program was not found to result in net savings, this type of program was still found to be highly cost-effective.

When considering the cost-effectiveness of programs for the prevention of diabetes, the potential for cost saving through common strategies for each NHPA area should be considered.

Key points — Primary prevention

- Dietary and exercise interventions have been shown to at least delay the onset of Type 2 diabetes in high-risk individuals with impaired glucose tolerance.
- There are limited data demonstrating the effectiveness of population-based interventions in the prevention of Type 2 diabetes. However, evidence from populations with coronary heart disease (which shares common risk factors with diabetes) indicates the potential for this approach over the long term.
- Prevention of lifestyle-related risk factors should include environmental-based strategies that address major societal influences on levels of obesity and physical inactivity.
- There is great scope for coordination of primary prevention activities, through collaboration between governments, and the involvement of non-government organisations, general practitioners and other health professionals. This coordination should also include long-term partnerships and alliances with agencies outside the health sector.

3.2 Screening and early detection of diabetes and its complications

Early detection of diabetes is important because control of hyperglycaemia early in the course of the disease may prevent or delay chronic complications. Type 2 diabetes, for example, can remain asymptomatic for many years; up to 20 per cent of people are known to have symptoms of diabetes-related complications (eg retinopathy) at the time of diagnosis (McCarty et al 1996). The earlier a person with diabetes can be diagnosed, the sooner treatment can be given to control blood glucose levels and delay onset and progression of many diabetes-related complications. Screening for early detection of Type 1 diabetes is not recommended because the onset of hyperglycaemia is soon followed by the onset of symptoms. However, early diagnosis and aggressive treatment of gestational diabetes may be needed to reduce foetal morbidity and mortality. The case for early detection is supported by the following findings:

- intensive management of blood glucose and blood pressure reduces the risk of developing complications of diabetes (UKPDS Group 1998a; 1998b; 1998c);
- laser therapy for early diabetic retinopathy reduces progression of retinopathy (Davis et al 1997);
- drug treatment with angiotensin-converting enzyme inhibitors slows progression of nephropathy (Rodby et al 1996);

- control of high blood pressure reduces risk of renal failure (Niskanen et al 1996);
- lipid lowering reduces risk of further coronary events (Pyorala et al 1997; Sacks et al 1996); and
- foot care education reduces risk of ulceration and amputation (Malone et al 1989).

Early detection of diabetes is hampered by its asymptomatic nature in most cases, and the lack of information on cost-effectiveness of different detection approaches. Currently, there is no nationally organised approach to early detection of diabetes. Most cases are diagnosed through opportunistic screening by GPs and other health professionals, although a number of non-government organisations such as Diabetes Australia (see page 62) and Lions Clubs carry out community screening programs.

There is broad agreement that opportunistic assessment through general practice remains the most feasible method of detecting diabetes and its preclinical states at earlier stages as:

- 80–85 per cent of the population visit a GP each year (ABS 1997a);
- GPs can assess, test and provide follow-up care and referral;
- large-scale testing by GPs is feasible (Welborn et al 1997); and
- national screening and management guidelines for GPs can be disseminated through the Royal Australian College of General Practitioners (RACGP) and the National Divisions Diabetes Program (NDDP).

Successful early detection programs require systems to ensure follow-up for diagnosis and continuing management (Overland et al 1997).

Target group

Population-based screening for diabetes is not cost-effective, even though Type 2 diabetes remains undiagnosed in a large proportion of cases. Screening, if any, therefore should be targeted at high-risk groups.

The Australian Diabetes Society (see page 62) identifies the target group for early detection as those who have two or more of the following risk factors:

- positive family history in a first degree relative;
- previous history of gestational diabetes;
- ethnicity (Indigenous Australian, Pacific Islander, South European, Asian Indian, Chinese);
- age over 40; and
- other high-risk characteristics (obesity, high blood pressure, dyslipidaemia).

Diagnostic tests

The oral glucose tolerance test is considered to be the definitive test for the diagnosis of Type 2 diabetes. However, recent recommendations for changes to the diagnostic criteria mean that a fasting blood glucose test with a lower cut-off point could be used for the detection of diabetes (American Diabetes Association 1997; Alberti & Zimmet 1998). The impact of these proposed changes to the diagnostic criteria on the early detection of diabetes has not been fully determined. The

evidence so far would tend to suggest that application of the new criteria as opposed to the oral glucose tolerance test will reduce the number of people with diabetes that will be diagnosed (Davies 1998).

The testing methods and diagnostic criteria used for pregnant women are more sensitive than those for men and non-pregnant women.

In its 1997 position statement, the Australian Diabetes Society identified the laboratory procedures for establishing diabetes. These guidelines have not yet been endorsed nationally, but are consistent with international recommendations.

Costs and cost-effectiveness

Comprehensive cost-benefit analyses are limited by a lack of data on the prevalence of undiagnosed diabetes. Estimates of testing people with two or more risk factors range from $353 for each newly diagnosed case (Colagiuri et al 1998) to $183 (Easton & Segal 1998).

Key points — Early detection

- There is a need to improve community awareness of the importance of early detection of Type 2 diabetes.
- Opportunistic assessment through general practice is likely to remain the most feasible method of detecting diabetes at earlier stages. Early detection rates among general practitioners could be improved through the implementation of guidelines on screening and detection, and the development of incentives for GPs to spend more time assessing and referring patients who are at risk of diabetes.
- The overall cost and cost-effectiveness of increasing early detection should be examined.

3.3 Management of diabetes

For people with diabetes, an array of health services is required on account of the complexity of the disease, and its potential to affect all systems of the body. Effective care should be provided by a health care team that includes a GP, a diabetes educator, a dietitian, and other health care professionals as indicated by specific problems, at the time of diagnosis.

Following initial evaluation, professionals can help people with diabetes establish treatment goals, develop a management plan, care for complications and reduce risk factors. Patient education and continuing support are also central to diabetes management. Nonetheless, diabetes management is mostly about self care and management of the disease on a daily basis. Self monitoring of blood glucose levels using home glucometry has become an essential part of diabetes management.

Providers of long-term care for people with diabetes include GPs; specialists in the fields of diabetology, obstetrics, cardiology, renal medicine and vascular surgery; diabetes nurses; diabetes educators; other allied health professionals (dietitians, podiatrists, optometrists, psychologists, social workers, Aboriginal health workers); pharmacists; and non-government organisations (eg Diabetes Australia).

Approaches to treatment

The argument for strict control of blood glucose levels in Type 1 diabetes, noted over a decade ago (Gifford & Zimmet 1986), has been confirmed by recently completed randomised controlled trials (DCCT Research Group 1993; Reichard et al 1996). A meta-analysis of previously conducted randomised controlled trials has also validated these observations (Wang et al 1993). These studies have shown that strict blood glucose control prevents or delays the progression of diabetes-related complications such as nephropathy, retinopathy and neuropathy in Type 1 diabetes. According to the Diabetes Complications and Control Trial (DCCT), intensive glucose control reduces the risk of all microvascular complications by between 40 and 70 per cent (DCCT Research Group 1993).

The UKPDS has made a similar observation for Type 2 diabetes. This randomised controlled trial has also shown that in comparison to conventional treatment, intensive blood glucose management reduces microvascular complications (mainly the need for retinal laser treatment) by 25 per cent (UKPDS Group 1998a). Intensive glucose control also reduces the number of heart attacks, although the difference was not statistically significant, and there was no influence on mortality.

Another aspect of the UKPDS, intensive blood pressure control, revealed a 32 per cent reduction in deaths related to diabetes, a 37 per cent reduction in microvascular disease, and a 47 per cent reduction in the risk of significant deterioration of vision. In addition, strokes were reduced by 44 per cent (UKPDS Group 1998c).

There is consensus that the best practice in the management of diabetes is to achieve glycosylated haemoglobin (HbA_{1c}) levels within 1–2 per cent of the upper limit of normal (Colagiuri et al 1998). This level of control is feasible for the majority of people with diabetes, but only through a collaborative effort involving the person with diabetes, carers and health service providers (Colagiuri et al 1998).

Treatment modalities for people with diabetes

The treatment goals for people with diabetes vary, and are largely guided by the type of diabetes. People with Type 1 diabetes need insulin therapy for survival, and all other aspects of treatment are secondary to this. Those with Type 2 diabetes, on the other hand, can achieve glucose control in the early course of their disease through dietary management, weight reduction and regular, sustained exercise. Treatment modalities may also vary depending upon the presence of other risk factors and complications.

Type 1 diabetes

The options to treat this form of diabetes are limited. The biggest limitation is that there are no injectable insulin products that can maintain glucose levels over a long period. Multiple daily injections or use of an infusion pump are the predominant strategies. Diet is another essential factor in avoiding hyperglycaemia or hypoglycaemia, requiring the development of a diet program to synchronise with insulin action and physical activity patterns (Bishop et al 1993).

Type 2 diabetes

People with Type 2 diabetes have many more treatment and disease management options available to them. Reductions in risk factors, such as overweight/obesity and physical inactivity, alone can often help achieve acceptable glucose levels.

Controlling nutrition and caloric intake is another option. Use of oral hypoglycaemic agents, in combination with reductions in risk factors, is an option for those who are still capable of some endogenous insulin secretion. Insulin injection therapy can also be used for controlling hyperglycaemia, although occasionally very high doses of insulin are required.

Gestational diabetes

Aggressive management of gestational diabetes can reduce foetal morbidity and mortality. The goal should therefore be to achieve maternal and child outcomes for women with gestational diabetes equivalent to those of non-diabetic pregnancies. However, some concern has been expressed about following this approach, in particular for women with a glucose level in the lower diagnostic range (Colagiuri et al 1998). There is also some concern that overly aggressive management of gestational diabetes may result in a small-for-gestational age baby (Langer et al 1989). However, providing women with advice about modifiable risk factors before discharge from hospital should be standard practice.

Management of pregnancy in women with pre-existing diabetes should also aim at achieving best outcomes for the mother as well as the infant.

Diabetes-related complications

As indicated by DCCT and UKPDS studies, glycaemic control among people with diabetes helps reduce diabetes-related complications. Nonetheless, monitoring for these complications should be an integral part of any management program. Conducting annual eye examinations for diabetic retinopathy, foot examinations and regular checking for albuminuria are essential to diabetes management.

Cost-effectiveness of interventions

A cost-effectiveness analysis of the DCCT data (DCCT Research Group 1996a) has found that the discounted cost of therapy aiming to achieve HbA_{1c} levels within 1–2 per cent of normal (intensive therapy) was cost-effective at an estimated cost of A$31,000 per quality-adjusted life year. Using DCCT treatment costs, the use of intensive therapy among people with newly diagnosed Type 2 diabetes (rather than among people who have had the disease for some time) has been predicted to be even more cost-effective (Eastman et al 1997).

The UKPDS performed a cost-effectiveness analysis for blood pressure control in Type 2 diabetes (UKPDS Group 1998d). Intensive blood pressure control has higher therapy costs than conventional treatment, but the cost of complications is reduced. For example, the mean drug cost per patient was £740 more in the tight control group, but since there were fewer complications in this group, the mean cost of treating complications was £949 less per patient.

However, the true cost of a national program to implement control of diabetes from diagnosis onwards is unknown, because the number of people with diabetes and their current level of glycaemic control are not known. Estimates of population glycaemic control suggest that over one-third of non-Indigenous Australians, over one-half of Indigenous Australians and over two-thirds of children with Type 1 diabetes could benefit from intensive diabetes control.

Secondary prevention of established complications is also important. For example, laser treatment in diabetic retinopathy reduces the risk of developing visual impairment by 50 per cent (Davis et al 1997). Using angiotensin converting enzyme (ACE) inhibitors in people with Type 1 diabetes and micro-albuminuria reduces the number of people who progress to renal failure or die by 50 per cent (Lewis et al 1993). If education about foot care is provided to people at high risk of foot ulceration, the amputation and ulceration rates can be cut by up to two-thirds (Malone et al 1989). Since these interventions generally achieve the best results if started in the early asymptomatic stages, and complications can progress to an advanced stage before symptoms develop, regular medical screening for diabetes-related complications is essential to identify those people who require the treatment.

Key points — Management and treatment

- Providing integrated care to people with diabetes is a major challenge and crosses a range of issues, including information systems and role delineation, and collaboration at both health professional and organisational levels.
- The best practice in diabetes management is to achieve strict control of blood glucose levels. This should be feasible for the majority of people with diabetes, but only through a combined effort involving the person with diabetes, carers and health service providers.
- Evidence suggests that existing treatment interventions are both effective and cost efficient. Treatment levels could be increased through a national approach to diabetes control. However, the true cost of such a program for diabetes control is hard to estimate, because the number of people with diabetes and levels of glycaemic control are not currently known.
- There are effective treatments available to prevent the progression of diabetes-related complications. Since these interventions generally achieve the best results if started in the early asymptomatic stages, and complications can progress to an advanced stage before symptoms develop, regular medical screening is essential to identify people who require treatment for their complications.