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Review of diabetes among Aboriginal and Torres Strait Islander people

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Review of diabetes among Aboriginal and Torres Strait Islander people

Abstract

Diabetes is the fastest growing chronic disease condition globally. Type 2 diabetes in particular, has reached epidemic proportions, with the greatest burden falling on socially disadvantaged groups and Indigenous peoples.

This review focuses primarily on type 2 diabetes among Aboriginal and Torres Strait Islander people, which is responsible for the majority of cases of diabetes in this population. It provides general information on the social and cultural context of diabetes, and the behavioural and biomedical factors that contribute to diabetes among Aboriginal and Torres Strait Islander people.

This review provides detailed information on:

- the extent of diabetes among Aboriginal and Torres Strait Islander people, including incidence and prevalence data; hospitalisations; mortality and burden of disease
- the prevention and management of diabetes
- relevant programs, services, policies and strategies that address the health issue of diabetes among Aboriginal and Torres Strait Islander people
- two special population groups
 - adolescents
 - pregnant and post-partum women.

This review concludes by suggesting possible future directions for combatting the growing epidemic of diabetes among Aboriginal and Torres Strait Islander people.

This review is part of a suite of knowledge exchange products that includes a [summary](#), a video, and a fact sheet.

Acknowledgements

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Keywords

endocrinology, endocrine system diseases, type 2 diabetes, diabetes in pregnancy, gestational diabetes, diabetes, chronic disease, Aboriginal and Torres Strait Islander people, Aboriginal and Torres Strait Islander culture, Aboriginal and Torres Strait Islander health, Aboriginal and Torres Strait Islander Health Workers, Aboriginal and Torres Strait Islander Health Practitioners, primary health care, health promotion, health professionals, public health, population health, community health, policies and strategies

About this review

The purpose of this review is to provide a comprehensive synthesis of key information on diabetes among Aboriginal and Torres Strait Islander people in Australia to: (1) inform those involved or interested in Aboriginal and Torres Strait Islander health; and (2) provide the evidence for those involved in policy, strategy and program development and delivery. The review focuses primarily on type 2 diabetes among Aboriginal and Torres Strait Islander people- which is responsible for the majority of cases of diabetes in this population - but also refers to type 1 diabetes and gestational diabetes where relevant. It provides general information on the social and cultural context of diabetes, and the behavioural and biomedical factors that contribute to diabetes among Aboriginal and Torres Strait Islander people. This review provides detailed information on the extent of diabetes among Aboriginal and Torres Strait Islander people, including: incidence and prevalence data; hospitalisations; mortality and burden of disease. This review discusses the prevention and management of diabetes, and provides information on relevant programs, services, policies and strategies that address the health issue of diabetes among Aboriginal and Torres Strait Islander people. It discusses the diabetes situation in two special population groups – (i) adolescents and (ii) pregnant and post-partum women. This review concludes by suggesting possible future directions for combatting the growing epidemic of diabetes among Aboriginal and Torres Strait Islander people.

This review uses information taken from journal articles, research reports, government reports, national data collections and national surveys that are available and can be accessed through the Australian Indigenous Health *InfoNet*'s publication database <https://healthinonet.ecu.edu.au/key-resources/publications/>.

The Health *InfoNet*, consistent with its nomenclature guide, prefers the term 'Aboriginal and Torres Strait Islander' rather than 'Indigenous Australian' for its publications. Also, some sources may only use the terms 'Aboriginal only' or 'Torres Strait Islander only'. However, when referencing information from other sources, authors may use the terms from the original source. As a result, readers may see these terms used interchangeably in some instances. If they have any concerns, they are advised to contact the Health *InfoNet* for further information.

Introduction

Diabetes is the fastest growing chronic disease condition globally (Diabetes Australia, 2015a) (Zimmet, 2017). Type 2 diabetes in particular, has reached epidemic proportions. It is estimated that in 2019, 463 million people had diabetes (International Diabetes Federation, 2019). This number is projected to reach 578 million by 2030, and 700 million by 2045, although these are probably underestimates (Zimmet, 2017). Diabetes prevention poses a challenge for public health systems everywhere (Diabetes Australia, 2015a; Shaw & Tanamas, 2012; Zimmet et al., 2014). The greatest burden tends to fall on socially disadvantaged groups and indigenous peoples (Zimmet et al., 2014). Aboriginal and Torres Strait Islander Australians experience disproportionately high levels of diabetes. They are almost three times more likely to have diabetes than non-Indigenous Australians (Australian Bureau of Statistics, 2019). Although Aboriginal and Torres Strait Islander women are no more likely to develop gestational diabetes (Australian Institute of Health and Welfare, 2020c), they are more likely to have pre-existing diabetes than non-Indigenous women (Australian Institute of Health and Welfare, 2021c). There is also evidence that Aboriginal and Torres Strait Islander children younger than 17 years of age are between 6 and 20 times more likely to develop type 2 diabetes (Craig et al., 2007; Haynes et al., 2016) (traditionally considered an adult condition) than non-Indigenous children. Mortality rates are correspondingly high, and Aboriginal and Torres Strait Islander people are four times more likely to die from diabetes than non-Indigenous Australians (Australian Institute of Health and Welfare, 2020c).

The high level of diabetes among Aboriginal and Torres Strait Islander people reflects a broad range of contributing factors (Australian Government Department of Health, 2021b; Australian Institute of Health and Welfare, 2015b; Diabetes Australia, 2013a). These include education, employment, income, housing, access to services, connection with land, racism and incarceration (Carson et al., 2007; Marmot, 2004). Addressing these factors should reduce the impact of diabetes on Aboriginal and Torres Strait Islander people; but this will require a range of tailored, culturally appropriate prevention and management programs, and broader action beyond the health service sector (Australian Government Department of Health, 2021b; Closing the Gap Clearinghouse, 2012; Diabetes Australia, 2013a; O'Dea et al., 2007).

Prevention, early detection and management are critical for reducing the impact of diabetes on Aboriginal and Torres Strait Islander people. It is important that programs for Aboriginal and Torres Strait Islander people are delivered sensitively, tailored to community needs, and not perceived as being forced upon communities (Diabetes Australia, 2013a). In addition, the involvement of Aboriginal and Torres Strait Islander community members and Aboriginal Health Practitioners in the design of any programs will help to ensure that the proposed intervention is culturally acceptable to the wider community (Nguyen et al., 2016).

Box 1: Diabetes

Diabetes (diabetes mellitus) is a condition marked by high levels of glucose in the blood due to the body's inability to produce and/or use insulin effectively (Australian Institute of Health and Welfare, 2014c). It is a complex, chronic condition that can lead to morbidity, disability, reduced quality of life and premature death (Australian Institute of Health and Welfare, 2014c; Diabetes Australia, 2011; Shaw & Tanamas, 2012). Diabetes can affect the entire body and typically requires lifelong management (Diabetes Australia, 2011; Shaw & Tanamas, 2012). New research has shown it is possible for some people with type 2 diabetes to reduce their average glucose level to that which is considered 'normal' (achieve an HbA1c of under 6.5% or 48 mmol/mol) and sustain it at that level for a prolonged period of time (at least three months) - without the need for glucose lowering medication. This is referred to as type 2 diabetes 'remission' (Diabetes Australia, 2021d; Diabetes UK, 2021; Riddle et al., 2021).

If undiagnosed or suboptimally managed, diabetes can lead to a range of complications and death (Australian Bureau of Statistics, 2014a). Complications include diseases of the large blood vessels (macrovascular disease), such as heart disease and stroke, and diseases of the small blood vessels (microvascular disease), such as kidney disease, eye disease and nerve disease (Diabetes Australia, 2015b). Type 2 diabetes is the most common form of diabetes, traditionally affecting older people but increasingly occurring in young people and children (Kao & Sabin 2016)(Shaw & Tanamas, 2012; Zimmet et al., 2014). Type 1 diabetes and gestational diabetes are the other main types of diabetes (Australian Institute of Health and Welfare, 2020a). Other types of diabetes are relatively uncommon, and are most typically related to certain conditions or syndromes that result in defects in insulin secretion, insulin action, or both, such as diabetes after pancreatitis.

The context of Aboriginal and Torres Strait Islander health and diabetes

The risk of developing type 2 diabetes is influenced not only by an individual's behaviour, but primarily by historical, social, cultural, geographical, economic and community factors, and government health policies and services (Closing the Gap Clearinghouse, 2012; Zimmet, 2017). Health disparities experienced by indigenous peoples worldwide are influenced by the continuing impact of colonialism which has had lasting effects on health determinants and access to health services (Tremblay et al., 2020). In particular health service programs and health-care practices are generally based on dominant group values, principles and beliefs, often leading to stigmatisation and racism within these systems. Emerging evidence suggests that epigenetic factors, the intrauterine environment and other early life factors may also influence the development of diabetes (McEwen et al., 2019; Zimmet et al., 2014).

Several behavioural and biomedical factors are known to increase the risk of developing type 2 diabetes, (Australian Institute of Health and Welfare, 2015c); conversely, improvements in these factors can reduce the risk of type 2 diabetes and become protective in nature. The main health risk factors are discussed below.

Factors contributing to diabetes among Aboriginal and Torres Strait Islander people

Protective factors

There are no known protective factors against type 1 diabetes but beneficial changes in lifestyle, such as a reduction in obesity, increases in physical activity and improvements in diet, are critical to reducing the risk of type 2 diabetes and have been well documented (Australian Institute of Health and Welfare, 2015c, 2020c; Closing the Gap Clearinghouse, 2012).

Breastfeeding can be protective against the development of type 2 diabetes for both the mother and offspring. Numerous studies have shown that breastfeeding can reduce the risk of maternal type 2 diabetes in later life (Horta & de Lima, 2019), and reduce the rate of progression from gestational diabetes to type 2 diabetes (Chamberlain et al., 2016). Breastfeeding may also reduce the risk of babies becoming overweight (Diabetes Australia, 2013a).

Risk factors

Behavioural and biomedical risk factors known to increase the risk of developing type 2 diabetes include high blood pressure, tobacco smoking, low levels of physical activity, poor diet (high in sodium, sugar and saturated fats), and having overweight or obesity (Australian Institute of Health and Welfare, 2015c, 2020c) (See Box 2). Aboriginal and Torres Strait Islander people are more likely to have these risk factors for diabetes than non-Indigenous Australians (Australian Bureau of Statistics, 2014e), and many who already have diabetes have multiple risk factors and other related health conditions (Australian Bureau of Statistics, 2014c, 2014d; Australian Institute of Health and Welfare, 2014b).

In contemporary society, economic opportunity, physical infrastructure and social conditions influence the health of individuals and communities (Carson et al., 2007; Marmot, 2004; Wilkinson & Marmot, 2003). These factors are apparent in measures of education, employment, income, housing, access to services, connection with land, racism and incarceration. On all these measures, Aboriginal and Torres Strait Islander people experience substantial disadvantage in comparison with non-Indigenous Australians.

The high prevalence of many risk factors among Aboriginal and Torres Strait Islander people is well documented, and is likely to contribute to the high prevalence of diabetes in this population compared with the non-Indigenous population (Closing the Gap Clearinghouse, 2012).

Box 2: Health risk factors for diabetes

Health risk factors refer to the behaviours, characteristics, or exposures that increase the likelihood of a person developing a disease (Australian Institute of Health and Welfare, 2015c, 2020c). When people have multiple risk factors, the likelihood of developing the disease is heightened. Risk factors can also increase the severity of the disease and the likelihood of developing complications or other diseases, and can compromise efforts to provide optimal care to people who already have the disease.

The conventional risk factors for diabetes can be divided into two main categories: non-modifiable and modifiable (Australian Institute of Health and Welfare, 2008, 2015c). Non-modifiable risk factors include family history and age. Modifiable risk factors can be categorised as behavioural or biomedical and can be modified by changes in behaviour and lifestyle, or the use of medical interventions. Behavioural risk factors are health-related behaviours and include tobacco smoking, low levels of physical activity and inadequate nutrition. Biomedical risk factors are often influenced by behavioural risk factors, but refer to factors that are present in the body and include impaired glucose regulation, high blood pressure (hypertension), high blood cholesterol (dyslipidaemia) and obesity. When these risk factors occur together, known collectively as the metabolic syndrome, they greatly increase the risk of type 2 diabetes.

Having more than one risk factor increases the risk of diabetes and having diabetes increases the risk of some other diseases including cardiovascular disease, kidney disease and diabetic retinopathy (Australian Institute of Health and Welfare, 2012, 2015c). Cardiovascular disease is itself a risk factor for diabetes.

Epigenetics and the intrauterine environment

Evidence is now emerging as to the influence of epigenetics and the intrauterine environment on diabetes incidence. We know that mothers with pre-existing type 2 diabetes and mothers with gestational diabetes (GDM) are more likely to have offspring who develop diabetes later in life and this is believed to be due to changes in the offspring's gene expression (Zimmet, 2017).

Epigenetics, or changes in gene expression, due to stressors in the intrauterine environment during critical periods of fetal development, may be the mechanism by which the development of diabetes occurs (Ling & Rönn, 2019; McEwen et al., 2019; Zimmet, 2017). The developmental origins of health and disease (DOHaD) hypothesis proposes that babies who face intrauterine stressors such as diabetes risk factors (maternal malnutrition, maternal psychological stress, smoking and alcohol use) and hyperglycemia during pregnancy, experience epigenetic changes that predispose them to poor physical and neurocognitive health (McEwen et al., 2019).

Both low birth weight (<2500 grams) and high birth weight (> 4000 grams) are risk factors for the development of type 2 diabetes and obesity later in life (Hare et al., 2020). In 2019, 12% of Aboriginal and Torres Strait Islander births were low birth weight compared with an Australian average of 6.6% (Australian Institute of Health and Welfare, 2019a). The mean birth weight for Aboriginal and Torres Strait Islander babies was 3,211 grams, compared with an Australian average of 3,321 grams. These results are likely to be explained by the high prevalence of risk factors in Aboriginal and Torres Strait Islander mothers such as poverty, racism and malnutrition (McEwen et al., 2019). A recent study by Hare and colleagues (Hare et al., 2020) identified that rates of high birthweight and large-for-gestational-age among births to Aboriginal mothers more than doubled between 1987 and 2016. They suggest that this trend is primarily driven by increasing rates of hyperglycemia in pregnancy in this population. These figures may partly explain the higher prevalence of type 2 diabetes among Aboriginal and Torres Strait Islander people.

Diabetes risk through epigenetic changes can be transmitted inter-generationally thus creating a vicious cycle that will continue to reinforce the type 2 diabetes epidemic (Zimmet, 2017).

Box 3: Types of diabetes

Pre-diabetes describes a condition in which blood glucose levels are higher than normal, although not high enough to be diagnosed as type 2 diabetes (fasting blood glucose levels between 5.5 and 6.9 mmol/l) (Diabetes Australia, 2016). Pre-diabetes has no signs or symptoms. People with pre-diabetes have a higher risk of developing type 2 diabetes and cardiovascular disease. Pre-diabetes can often be prevented from progressing to diabetes through lifestyle changes and weight loss.

There are two pre-diabetes conditions: impaired glucose tolerance (IGT) and impaired fasting glucose (IFG) (Diabetes Australia, 2016).

Type 1 diabetes is most frequently diagnosed in childhood and adolescence (Australian Institute of Health and Welfare, 2010, 2014b; World Health Organization, 2012). It is an autoimmune condition that is characterised by hyperglycaemia (high blood sugar levels) resulting from the body's inability to produce insulin.

Type 2 diabetes traditionally develops in adulthood, although the incidence is increasingly reported in child and adolescent populations (Kao & Sabin, 2016). As with pre-diabetes, there are often no symptoms for type 2 diabetes. It is characterised by hyperglycaemia due to insulin resistance and/or a deficiency in insulin production. Type 2 diabetes is managed with lifestyle modifications, and may require medications and insulin treatment.

Gestational diabetes (GDM) is a form of diabetes that develops during pregnancy in some women (Australian Institute of Health and Welfare, 2010, 2014b; World Health Organization, 2012). This type of diabetes is short-term and usually develops in the second or third trimester of pregnancy, with potentially adverse outcomes for both mother and baby (Australian Institute of Health and Welfare, 2010, 2014b). GDM usually disappears after the baby is born, although it puts the mother and child at increased risk of developing type 2 diabetes later in life (Whitbread et al., 2017). GDM can recur in later pregnancies.

Diabetes in pregnancy (DIP) (or *Overt diabetes*) is pre-existing type 2 diabetes that is not diagnosed before pregnancy (International Association of Diabetes and Pregnancy Study Groups Consensus Panel, 2010). It is important to detect DIP as early as possible to restore normal glycemia to enable the best possible pregnancy outcome. Evidence suggests that Aboriginal and Torres Strait Islander women with DIP are at high risk of progression to type 2 diabetes within a short timeframe after birth (Wood et al., 2021).

Extent of diabetes among Aboriginal and Torres Strait Islander people

There are several types of diabetes, of which the most frequently occurring are type 1, type 2 and GDM (see Box 3) (Diabetes Australia, 2013b, 2015a; Lalor et al., 2014).

There are various ways to measure the extent of diabetes in a given population, including prevalence, incidence, health service utilisation, mortality and burden of disease. This review focuses primarily on national data that provide an aggregate picture of the impact of diabetes on Aboriginal and Torres Strait Islander people. Much of the published data pertains to type 2 diabetes, given type 2 diabetes is responsible for the vast majority of the burden of diabetes, but figures for type 1 diabetes and GDM are

reported where relevant. If the type of diabetes is not specified it can be assumed to be type 2 diabetes. Separate data for Torres Strait Islander people is limited, but is also provided where available.

The various measurements used in this review are defined in Box 4. It should be noted however, that:

- the availability and quality of data varies
- there are data limitations associated with each of the measures of diabetes
- statistics about diabetes for Aboriginal and Torres Strait Islander people are often underestimated (Appendix 1 provides a brief discussion of limitations associated with data sources used in this review).

Box 4: Measuring diabetes

Incidence is the number of new cases of diabetes that occur during a given period (Lee-Koo et al., 2014).

Prevalence is the number or proportion of cases of diabetes in a population at a given time (Lee-Koo et al., 2014).

Age-standardised rates enable comparisons of rates of diabetes between populations that have different age structures (Steering Committee for the Review of Government Service Provision, 2014a). Age standardisation is often used when comparing Aboriginal and Torres Strait Islander people and non-Indigenous people because the Aboriginal and Torres Strait Islander population has a younger age structure than the non-Indigenous population.

Rate ratio is the rate of Aboriginal and Torres Strait Islander people affected by diabetes divided by the rate of non-Indigenous people affected by diabetes (Steering Committee for the Review of Government Service Provision, 2014a).

Ratio is the proportion of Aboriginal and Torres Strait Islander people affected by diabetes divided by the proportion of non-Indigenous people affected by diabetes.

Potentially preventable hospitalisations are hospital admissions for conditions (including diabetes) that may have been avoided through appropriate preventive measures and early disease management, usually delivered in primary care and community based care settings (Steering Committee for the Review of Government Service Provision, 2014a).

Potentially avoidable deaths are deaths among people aged less than 75 years from conditions (including diabetes) considered potentially preventable and treatable (Steering Committee for the Review of Government Service Provision, 2014a). Potentially avoidable deaths can be reduced through lifestyle improvements and appropriate primary prevention, early intervention and medical treatment.

Burden of disease is measured in disability-adjusted life years (DALYs). It provides a combined estimate of years of life lost due to premature mortality caused by diabetes, and years of life lost due to disability or ill health caused by diabetes (Australian Institute of Health and Welfare, 2015a).

Prevalence

In 2018, there were 208 cases of type 1 diabetes per 100,000 population among Aboriginal and Torres Strait Islander children and young adults aged 0–24 years. After adjusting for age, Aboriginal and Torres Strait Islander children and young adults were less likely to have type 1 diabetes than non-Indigenous children and young adults (197 per 100,000 and 232 per 100,000 respectively) (Australian Institute of Health and Welfare, 2020c).

According to self-reported data from the ABS 2018-19 National Aboriginal and Torres Strait Islander Health Survey¹ (NATSIHS), around 7.9% of Torres Strait Islander people and 7.8% of Aboriginal people had diabetes² (combined total proportion 7.9% or 64,100 people) (Australian Bureau of Statistics, 2019). After controlling for differences in the age structures between the populations, based on self-reported and measured results, Aboriginal and Torres Strait Islander people were 2.9 times as likely to have diabetes as non-Indigenous Australians (13% compared with 4.3%) (Australian Bureau of Statistics, 2019). The proportion was similar in males and females after age-standardisation (13% and 12% respectively).

The prevalence of diabetes increased with age, (Australian Bureau of Statistics, 2019) ranging from 2.5% for Aboriginal and Torres Strait Islander people aged 25-35 years to 11% for those aged 35-44 years, 19% for those aged 45-54 years and 35% for those aged 55 years and over. While rates among Aboriginal and Torres Strait Islander people are higher than non-Indigenous people in almost all age groups, this is particularly true for the younger age groups (25-54 years) (see Table 1).

The rate of diabetes/high sugar levels was higher for both Aboriginal and Torres Strait Islander males and females than non-Indigenous males and females (2.5 and 3.2 times higher respectively), but lower among Aboriginal and Torres Strait Islander people living in non-remote areas (15 per 100 persons) than among those living in remote areas (24 per 100 persons) (see Table 1). Rates of diabetes/high sugar levels varied between states and territories (Australian Institute of Health and Welfare & National Indigenous Australians Agency, 2020); they were highest in Western Australia (WA) at 24 per 100 persons, followed by the Northern Territory (NT) at 22 per 100 persons. Tasmania (Tas) had the lowest rate at 8.5 per 100 persons, with 11 per 100 persons in the Australian Capital Territory (ACT), 12 per 100 persons in Victoria (Vic), 13 per 100 persons in New South Wales (NSW), and 20 per 100 persons in both Queensland (Qld) and South Australia (SA).

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- 1 The National Aboriginal and Torres Strait Islander Health Survey (NATSIHS), run by the ABS, collects information from Aboriginal and Torres Strait Islander people on health measures. These measures include statistics about long-term health conditions, disability, lifestyle factors, physical harm and use of health services Australian Bureau of Statistics. (2019). *National Aboriginal and Torres Strait Islander Health Survey, 2018-19*.
 - 2 Self-reported data from the ABS 2018–19 National Aboriginal and Torres Strait Islander Health Survey does not distinguish between type 1 and type 2 diabetes.

Table 1. Rates¹ of people reporting diabetes/high sugar levels as a long-term health condition, by Indigenous status, and Indigenous:non-Indigenous rate ratios, Australia, 2017-2018 and 2018-2019

| | Aboriginal and Torres Strait Islander people ² (Rate) | Non-Indigenous ³ (Rate) | Rate Ratio ⁴ |
|---------------------|---|---------------------------------------|-------------------------|
| Age (years) | | | |
| 18-24 | 0.8 | 0.9 | 0.9 |
| 25-34 | 3.0 | 1.2 | 2.5 |
| 35-44 | 11 | 2.5 | 4.4 |
| 45-54 | 21 | 5.2 | 4.0 |
| 55+ | 36 | 15 | 2.4 |
| Gender | | | |
| Male | 18 | 7.0 | 2.5 |
| Female | 17 | 5.3 | 3.2 |
| Remoteness | | | |
| Non-remote | 15 | 6.1 | 2.5 |
| Remote ⁵ | 24 | 8.6 | 2.8 |

Notes:

1. Rates are expressed as number per 100 persons.
2. Data for Aboriginal and Torres Strait Islander people is from NATSIHS 2018-19.
3. Data for non-Indigenous Australians is from the National Health Survey 2017-18.
4. Rate ratio is calculated by dividing the Indigenous rate by the non-Indigenous rate.
5. The NHS 2017-18 excludes *Very Remote* areas of Australia and discrete Aboriginal communities.

Source: Australian Institute of Health and Welfare, 2020 (derived from Table D1.09.2) (Australian Institute of Health and Welfare & National Indigenous Australians Agency, 2020)

Biomedical data

Biomedical data was not collected in the NATSIHS 2018-19, and therefore cannot be used to compare or corroborate self-reported results. However, biomedical results from the 2011-12 AATSIHS broadly confirmed the self-reported results obtained in that survey. Biomedical data was obtained for a subset of Aboriginal and Torres Strait Islander adults (18 years and over) who provided blood and urine samples (Australian Bureau of Statistics, 2014a). Results for fasting plasma glucose levels identified that 1.5% of Aboriginal and Torres Strait Islander adults had diabetes (fasting blood glucose levels ≥ 7 mmol/L) but were undiagnosed, and a further 4.7% were at high risk of diabetes due to high fasting blood glucose levels (5.6-6.9 mmol/L) (Australian Bureau of Statistics, 2014b).

Pre-diabetes

In 2012-13, based on fasting plasma glucose results:

- 4.7% of Aboriginal and Torres Strait Islander adults had pre-diabetes
- the proportion of Aboriginal and Torres Strait Islander adults with pre-diabetes did not differ significantly by sex or between remote and non-remote areas
- Aboriginal and Torres Strait Islander adults were 1.8 times as likely to have pre-diabetes than non-Indigenous adults (based on age-standardised rates) (Australian Institute of Health and Welfare, 2015d).

Incidence

Type 1 diabetes

National incidence data for diabetes is based on estimates for insulin-treated diabetes and obtained from the *National (insulin-treated) diabetes register* (NDR). This data is limited to type 1 diabetes incidence for Aboriginal and Torres Strait Islander people (Australian Institute of Health and Welfare, 2020b).

In 2019, there were 130 new cases of type 1 diabetes among Aboriginal and Torres Strait Islander people, accounting for 4% of all new cases (Australian Institute of Health and Welfare, 2020b). Of these, the age-standardised rate per 100,000 population was 16 for males and 9.8 for females. The incidence rate for Aboriginal and Torres Strait Islander people was similar to that for non-Indigenous people (13 per 100,000 population compared with 12 per 100,000 population respectively).

A prospective population-based incidence study conducted in NSW between 2001-2006 (Craig et al., 2007) found that incidence rates of type 1 diabetes were similar in the Aboriginal and Torres Strait Islander and non-Indigenous youth aged 19 years or younger (16 per 100,000 and 21 per 100 000 respectively).

Gestational diabetes

In 2017-18, over 1,700 (13%) Aboriginal and Torres Strait Islander mothers who gave birth were diagnosed with GDM. After adjusting for differences in the age structure of the populations, the incidence rate among Aboriginal and Torres Strait Islander mothers was similar to the rate for non-Indigenous mothers (17% and 16% respectively) (Australian Institute of Health and Welfare, 2020c). By contrast, just over 2% of Aboriginal and Torres Strait Islander mothers and less than 1% of non-Indigenous mothers who had a baby in 2016-2018 reported that they had pre-existing diabetes (Australian Institute of Health and Welfare, 2021c).

In 2016-17 (Australian Institute of Health and Welfare, 2019c):

- there were over 1,600 new cases of GDM among Aboriginal and Torres Strait Islander women, equating to 12% of Aboriginal and Torres Strait Islander women aged 15–49 years who gave birth
- incidence of GDM increased with age, peaking in the 40 years and over age group at 32%. Aboriginal and Torres Strait Islander women in this age group were four times as likely to be diagnosed with GDM as Aboriginal and Torres Strait Islander women aged 15–19 years and 20–24 years (incidence of 6.6% and 8.8% respectively).

Morbidity

Health service utilisation

Measures of health service utilisation cannot provide information about whether the health system is meeting the needs of Aboriginal and Torres Strait Islander people, but they give some indication of the demand for, and access to, health services (Australian Institute of Health and Welfare, 2014a). Included among these measures are figures for attendance at general practices and hospitals.

General practice attendances

General practitioners (GPs) are usually the initial point of contact for people with diabetes and often play a key role in coordinating the other specialised services and health professionals who are needed to manage the condition (Australian Institute of Health and Welfare, 2008). The *Bettering the evaluation and care of health* (BEACH) survey is a continuous, national, cross-sectional survey of the clinical activity of GPs (Britt & Miller, 2013). The survey provides some evidence of the frequency with which GPs manage diabetes for Aboriginal and Torres Strait Islander patients.

Data from the Bettering the Evaluation and Care of Health (BEACH) study indicate that, in the period from April 2010 to March 2015, 5.5% of problems managed by GPs among Aboriginal and Torres Strait Islander people, were diabetes related. The majority of diabetes-related problems managed were for non-insulin dependent type 2 diabetes (92%). The rate of diabetes problems managed by GPs was three times as high among Aboriginal and Torres Strait Islander people as among other Australians. The disparity was greater for non-insulin dependent type 2 diabetes than insulin dependent type 1 diabetes (3 and 2.3 times respectively) (Australian Institute of Health and Welfare, 2020c).

As at June 2019, over half (56%) of Aboriginal and Torres Strait Islander regular clients with type 2 diabetes had claimed a GP Management Plan in the previous 2 years, while 53% had claimed a Team Care Arrangement (Australian Institute of Health and Welfare, 2020c). The proportion of Aboriginal and Torres Strait Islander regular clients claiming either a GP Management Plan or Team Care Arrangement in the previous 2 years increased slightly from June 2017 to June 2018 (54% to 56% for GP Management Plans and 51% to 53% for Team Care Arrangements) though remained unchanged from June 2018 to June 2019 .

Hospitalisation

Hospital services are typically required to treat the advanced stages of complications of diabetes or acute episodes of hyper- or hypoglycaemia (Australian Institute of Health and Welfare, 2014b). The higher levels of diabetes observed among Aboriginal and Torres Strait Islander people are clearly reflected in hospitalisation figures.

Type 1

In 2017-18, national hospitalisation data showed (Australian Institute of Health and Welfare, 2020c):

- there were around 3,000 hospitalisations with a principal and/or additional diagnosis of type 1 diabetes among Aboriginal and Torres Strait Islander people, equating to 361 per 100,000 population
- the age-standardised rate of hospitalisations for type 1 diabetes in this cohort increased from 362 to 446 hospitalisations per 100,000 population between 2015-16 and 2017-18
- after adjusting for age, the hospitalisation rate was almost twice as high among Aboriginal and Torres Strait Islander people compared with non-Indigenous people (446 per 100,000 and 233 per 100,000 respectively)
- the age-standardised hospitalisation rate was higher among Indigenous males than females (525 hospitalisations per 100,000 and 381 hospitalisations per 100,000 population respectively)
- age-specific hospitalisation rates peaked in those aged 55–64 years (905 hospitalisations per 100,000 population)
- hospitalisation rates for type 1 diabetes as a principal and/or additional diagnosis were around three times as high among Aboriginal and Torres Strait Islander people living in major cities and regional areas as those living in remote and very remote areas (482, 528 and 175 hospitalisations per 100,000 population respectively)
- among the states and territories, hospitalisation rates were highest in Vic (575 per 100,000 population) and lowest in the NT (147 per 100,000 population). Other states had rates ranging from 322 to 562 per 100,000 population.

Type 2

In 2017-18, national hospitalisation data showed (Australian Institute of Health and Welfare, 2020c):

- there were around 69,000 hospitalisations with a principal and/or additional diagnosis of type 2 diabetes among Aboriginal and Torres Strait Islander adults
- the age-standardised hospitalisation rate was almost five times as high among Aboriginal and Torres Strait Islander adults as non-Indigenous adults (19,000 per 100,000 and 4,500 per 100,000 population respectively)
- the age-standardised rate of hospitalisations increased from 12,100 hospitalisations per 100,000 population to 14,300 hospitalisations per 100,000 population between 2015-16 and 2017-18
- after adjusting for age, the hospitalisation rate was higher among Aboriginal and Torres Strait Islander females (all ages) compared to Aboriginal and Torres Strait Islander males (15,500 per 100,000 and 13,100 per 100,000 population respectively) (Table 2)
- type 2 diabetes hospitalisation rates increased with age, peaking in those aged 65 years of age and over (45,800 hospitalisations per 100,000 population)
- hospitalisations for type 2 diabetes were 3.3 times as high among Aboriginal and Torres Strait Islander people living in remote and very remote areas as those living in major cities (30,800 compared with 9,200 per 100,000 population)
- hospitalisation rates were highest in WA (35,000 per 100,000 population) and lowest in Tas (4,100 per 100,000 population). Other states and territories had rates ranging from 6,200 to 21,800 per 100,000 population.

Table 2: Rate ratio of hospital separations for diabetes¹ for Aboriginal and Torres Strait Islander people and non-Indigenous people (as a principal diagnosis), by age group and sex, 2017-18

| Age group (years) | Males | Females | Persons |
|-------------------|---------------------------|---------|---------|
| | Rate Ratio ^{2,3} | | |
| 0-4 | 0.8 | 1.8 | 1.3 |
| 5-14 | 1.3 | 1.5 | 1.4 |
| 15-24 | 1.7 | 3.6 | 2.9 |
| 25-34 | 3.5 | 5.1 | 4.5 |
| 35-44 | 5.4 | 7.5 | 6.6 |
| 45-54 | 4.6 | 6.5 | 5.3 |
| 55-64 | 3.6 | 5.3 | 4.2 |
| 65+ | 2.6 | 4.0 | 3.1 |
| Total | 1.8 | 3.4 | 2.5 |

Notes:

1. Based on the ICD-10-AM 10th edition codes E10, E11, E13, E14, O24.
2. Rates age standardised to the 2001 Australian population.
3. Rate ratio is the Indigenous rate (number per 100,000 population) divided by the non-Indigenous rate.

Source: AIHW analysis of National Hospital Morbidity Database (Australian Institute of Health and Welfare, 2020c)

Mortality

In 2020, the rate of deaths from diabetes for Aboriginal and Torres Strait Islander people was 75 per 100,000 population. This rate was 4.9 times higher than for non-Indigenous people (Australian Bureau of Statistics, 2021). The death rate was higher for Aboriginal and Torres Strait Islander males than females (82 per 100,000 and 71 per 100,000 respectively). Diabetes was the fourth leading cause of death for Aboriginal and Torres Strait Islander males and the second leading cause of death for females.

Between 2011-2015 and 2016-2020, the number of Aboriginal and Torres Strait Islander people dying from diabetes decreased from 81 deaths per 100,000 population to 75 per 100,000 population (Australian Bureau of Statistics, 2021).

The greatest disparity in Aboriginal and Torres Strait Islander: non-Indigenous age-specific death rates in 2020 occurred in the 45-54 years age group (Australian Bureau of Statistics, 2021). In this age group Aboriginal and Torres Strait Islander people were 10.7 times more likely to die from diabetes than non-Indigenous people (rate ratios were 16.6 for females and 8.1 for males).

In the period 2014-2018, the age-standardised rate of avoidable and preventable deaths³ from diabetes was 44 per 100,000 population among Aboriginal and Torres Strait Islander people (Australian Institute of Health and Welfare, 2020c). After adjusting for age, the rate was similar among males and females (46 per 100,000 population and 42 per 100,000 population respectively). The rate of avoidable and preventable deaths from diabetes increased with age for both Aboriginal and Torres Strait Islander males and females (Table 3). There was variation in the rate of avoidable and preventable deaths from diabetes by state and territory. The NT had the highest rate (108 per 100,000 population), followed by WA (66 per 100,000 population), Qld and SA (43 per 100,000 population) and NSW (21 per 100,000 population).

3 Avoidable and preventable mortality refers to deaths from conditions that are considered avoidable given timely and effective health care (including disease prevention and population health initiatives) Australian Institute of Health and Welfare, & National Indigenous Australians Agency. (2020, 9/12/2020). *Aboriginal and Torres Strait Islander Health Performance Framework report*. Australian Institute of Health and Welfare. <https://www.indigenoushpf.gov.au/>.

Table 3. Avoidable and preventable deaths from diabetes¹, Aboriginal and Torres Strait Islander Australians, 2014-2018

| Age group (years) | Number per 100,000 population | | |
|--------------------|-------------------------------|---------|---------|
| | Males | Females | Persons |
| 0-44 | 3 | 3 | 3 |
| 45-49 | 39 | 27 | 33 |
| 50-54 | 71 | 63 | 66 |
| 55-59 | 92 | 105 | 99 |
| 60-64 | 155 | 168 | 162 |
| 65-74 | 281 | 253 | 266 |
| Total ² | 46 | 42 | 44 |

Notes:

1. ICD Codes E10,E11,E13, E14.
2. Rates age-standardised to the 2001 Australian Standard Population.
3. Includes data from NSW, Qld, WA, SA and the NT only.
4. Rates were calculated using ABS 2016 Census-based population estimates and projections.

Source: AIHW analysis of National Mortality Database (Australian Institute of Health and Welfare, 2020c)

Burden of disease

Every year in Australia, many years of healthy life are lost because of injury, illness or premature deaths in the population. This loss of healthy life is called the 'burden of disease' (Australian Institute of Health and Welfare, 2021b).

The *Australian burden of disease study* (ABDS) measures the impact of living with illness and injury and dying prematurely. The summary measure 'disability-adjusted life years' (or DALY) measures the years of healthy life lost from death and illness.

In 2018, type 2 diabetes was the fourth-leading specific cause of total burden of disease among Aboriginal and Torres Strait Islander people, with an age-standardised rate of 15 DALY per 1,000 people (Australian Institute of Health and Welfare, 2021b).

Special populations

Children and adolescents

There is growing concern regarding the emergence of type 2 diabetes in Aboriginal and Torres Strait Islander children and adolescents (Zimmet et al., 2014). Data are limited, but type 2 diabetes accounts for the majority of new cases of youth-onset diabetes⁴ in this population; between 2006 and 2011, 55% of new cases in Aboriginal and Torres Strait Islander youth aged 10-19 years were type 2 and 43% were type 1 diabetes (Australian Institute of Health and Welfare, 2014d). Type 2 diabetes occurs more frequently among Aboriginal and Torres Strait Islander adolescents than among their non-Indigenous counterparts (Craig et al., 2007; Haynes et al., 2016; Stone et al., 2013; Titmuss et al., 2019), with studies from different Australian states, namely WA, NSW and the NT reporting similar findings.

A retrospective, cross-sectional study of Aboriginal and Torres Strait Islander youth in the Top End of Australia in 2016-2017 used primary health care data to estimate the prevalence of type 2 diabetes. The crude prevalence was 6.7 per 1000 population, with the youngest reported age at diagnosis being 4.4 years of age. Prevalence was higher for

4 Youth-onset diabetes is defined as that diagnosed before the age of 25 years

those aged 15-24 years (14 per 1000 population) than those 15 years or younger (1.4 per 1000 population) and higher for females than males (9.4 per 1000 population and 4.2 per 1000 population respectively) (Titmuss et al., 2022).

A retrospective population-based cohort study was undertaken in children aged less than 17 years who were diagnosed with type 2 diabetes in WA between 1990 and 2012 (Haynes et al., 2016). A 20-fold higher mean incidence was observed in Aboriginal and Torres Strait Islander children compared with non-Indigenous children, (13 per 100,000 person-years compared with 0.6 per 100,000 person-years) although both groups had similarly high annual rates of increase. The mean age at diagnosis was 13.3 years, with 12% of children being classified as overweight and 61% obese.

Studies conducted in NSW found similar results (Craig et al., 2007; Tran et al., 2014). Incidence rates were over six times higher in the Aboriginal and Torres Strait Islander youth with a median age at diagnosis of 13.5 years (Tran et al., 2014) to 14.5 years (Craig et al., 2007). Ninety percent of the youth were classified as overweight or obese.

Early onset of type 2 diabetes places these children and adolescents at heightened risk of comorbidities, diabetes complications and associated premature mortality (Maple-Brown et al., 2010; Peña et al., 2020; Titmuss et al., 2019; Viner et al., 2017). Renal disease, hypertension, dyslipidaemia and depressive symptoms are among the most common comorbidities and complications (Viner, White & Christie 2017). Glycaemic control in type 2 diabetes during adolescence deteriorates faster than in adults due to greater insulin resistance and β -cell dysfunction (Peña et al., 2020).

In 2020, the Australian Paediatric Endocrine Group published guidelines on paediatric type 2 diabetes (Peña et al., 2020). It provides recommendations on screening, diagnosis, diabetes education, monitoring including targets, multicomponent healthy lifestyle, pharmacotherapy, assessment and management of complications and comorbidities, and transition. There is also a dedicated section on considerations of care for children and adolescents from indigenous backgrounds in Australia and New Zealand. Previous to this, health professionals had to refer to adult guidelines, or international guidelines that did not address care for people from indigenous backgrounds.

Pregnant women (Diabetes in pregnancy)

Data from the National Perinatal Data Collection (NPDC) relating to Aboriginal and Torres Strait Islander mothers who gave birth in Australia during 2019 showed that: 12,272 (86%) did not have diabetes, 1,657 (12%) had GDM, and 312 (2.2%) had pre-existing diabetes⁵ (Australian Institute of Health and Welfare, 2021a).

Hospitalisations for diabetes in pregnancy

In 2017-18, around 3,800 Aboriginal and Torres Strait Islander females were admitted to hospital with a principal and/or additional diagnosis of diabetes during pregnancy, a rate of 24,700 per 100,000 females aged 10-54 years with a pregnancy outcome. Age-standardised rates were 1.8 times as high among Aboriginal and Torres Strait Islander females in this cohort as non-Indigenous females (36,300 per 100,000 and 19,800 per 100,000 respectively) (Australian Institute of Health and Welfare, 2020c).

Between 2015-16 and 2016-17, hospitalisation rates increased substantially along with the level of remoteness. The rate was over two times as high among those living in remote and very remote areas (44,100 per 100,000 females) as those living in major cities (20,600 per 100,000 females). Rates were highest in the NT (42,300 per 100,000 population) and lowest in Tas (15,500 per 100,000 population). Other states had rates ranging from 16,100 to 31,300 per 100,000 population (Australian Institute of Health and Welfare, 2020c).

⁵ The National Perinatal Data Collection (NPDC) does not distinguish between type 1 and type 2 diabetes.

Diabetes in pregnancy can lead to a range of complications for the mother and child (see Box 5) (Australian Institute of Health and Welfare, 2019b)

Box 5: Risks associated with diabetes in pregnancy

Risks for the child include: pre-term birth, stillbirth, low and high birthweight, longer stay in hospital, low Apgar score, admission to neonatal intensive care units and resuscitation (Australian Institute of Health and Welfare, 2010, 2019b). There is also increased risk of obesity, impaired glucose tolerance (IGT) and type 2 diabetes in early adulthood. Babies of mothers with pre-existing diabetes are at higher risk of complications than those with GDM.

Risks for the mother include: pre-existing and gestational hypertension, pre-eclampsia, induced labour, pre-term birth, caesarean section, and longer antenatal and postnatal stays in hospital; first appearance or progression of complications including those associated with kidney, eye and cardiovascular diseases. (Australian Institute of Health and Welfare, 2010, 2019b). Mothers with GDM experience complications at a lower rate than mothers with pre-existing diabetes. However, for mothers with GDM there is a risk of recurrent GDM in subsequent pregnancies and progression type 2 diabetes.

Complications for diabetes in pregnancy

Among Australian women who have diabetes during pregnancy, Aboriginal and Torres Strait Islander mothers and babies are more likely to experience adverse effects during pregnancy, labour and delivery than non-Indigenous mothers and babies (Australian Institute of Health and Welfare, 2019b; Duong et al., 2015). Living in a remote region appears to increase the risk of an adverse outcome (Duong et al., 2015).

Babies of Aboriginal and Torres Strait Islander mothers with pre-existing diabetes had higher rates of pre-term birth, stillbirth, low and high birthweight, low Apgar score, resuscitation, and special care nursery/ neonatal intensive care unit admission, and stayed longer in hospital, compared with mothers with no diabetes (Australian Institute of Health and Welfare, 2019b).

Mothers with pre-existing diabetes had higher rates of caesarean section, induced labour, pre-existing and gestational hypertension, and pre-eclampsia, compared with mothers with no diabetes. They also had longer antenatal and postnatal stays in hospital (5 or more days) (Australian Institute of Health and Welfare, 2019b).

In 2016-2018 (Australian Institute of Health and Welfare, 2021c):

- Aboriginal and Torres Strait Islander mothers who had pre-existing diabetes were 2.3 times more likely to have a stillborn baby, and 1.9 times more likely to experience a perinatal death than those without diabetes.
- Aboriginal and Torres Strait Islander women who had pre-existing diabetes prior to the onset of pregnancy were about 3.3 times as likely to have a pre-term birth as Aboriginal and Torres Strait Islander women who did not have pre-existing diabetes before the onset of pregnancy.
- Aboriginal and Torres Strait Islander women who had GDM were about 1.2 times as likely to have a pre-term birth as Aboriginal and Torres Strait Islander women who did not have GDM.
- Pre-existing diabetes and GDM both increased the risk of Aboriginal and Torres Strait Islander women having a low birthweight baby (0.8 and 0.5 respectively) compared with Aboriginal and Torres Strait Islander women who did not have diabetes.

National figures regarding complications of diabetes in pregnancy for Aboriginal and Torres Strait Islander mothers and babies for the period 2014-2015 are presented in Table 4.

Table 4. Selected maternal and infant complications of diabetes among Aboriginal and Torres Strait Islander women who gave birth, by diabetes in pregnancy status, Australia, 2014-2015 (age-standardised percent and ratio)

| Complication | Pre-existing diabetes | | GDM | | No diabetes |
|--|-----------------------|--------------------|----------------|--------------------|----------------|
| | % ¹ | Ratio ² | % ¹ | Ratio ² | % ¹ |
| <i>Maternal</i> | | | | | |
| Pre-existing (chronic) hypertension ³ | 9.1 | 7.1 | 2.9 | 2.2 | 1.3 |
| Gestational hypertension ³ | 7.1 | 1.9 | 5.7 | 1.5 | 3.8 |
| Pre-eclampsia ³ | 8.2 | 3.4 | 4.1 | 1.7 | 2.4 |
| Pre-term induction ⁴ | 40 | 1.5 | 42 | 1.6 | 27 |
| Antenatal hospital stay 5 or more days ⁵ | 13 | 7.8 | 4.7 | 2.8 | 1.7 |
| Postnatal hospital stay 5 or more days ⁶ | 31 | 3.0 | 13 | 1.3 | 10 |
| | | | | | |
| <i>Infant</i> | % ¹ | Ratio ² | % ¹ | Ratio ² | % ¹ |
| Pre-term birth ⁷ | 36 | 2.5 | 16 | 1.1 | 14 |
| Caesarean section | 62 | 2.2 | 43 | 1.5 | 29 |
| Low birthweight ⁸ | 17 | 1.3 | 9.5 | 0.7 | 14 |
| High birthweight ⁹ | 5.1 | 4.1 | 2.4 | 2 | 1.2 |
| Low Apgar score ¹⁰ | 5.6 | 1.9 | 2.9 | 1.0 | 2.9 |
| Resuscitation ¹¹ | 37 | 1.8 | 22 | 1.1 | 20 |
| Special Care Nursery (SCN)/Neonatal Intensive Care Unit (NICU) admission | 67 | 3.0 | 33 | 1.5 | 23 |
| Hospital stay 7-13 days ¹² | 16 | 2.9 | 7.8 | 1.4 | 5.6 |
| Hospital stay 14 days or more ¹² | 14 | 2.8 | 4.6 | 1.0 | 4.8 |

Notes:

1. Data are directly age-standardised to the Australian female population aged 15–44 as at 30 June 2001.
2. Ratio is calculated by dividing the percent of women with pre-existing or gestational diabetes by the percent of women with no diabetes for each group.
3. Due to differences in definitions and methods used for data collections between jurisdictions, care should be taken when interpreting this data.
4. Labour induced at less than 37 weeks.
5. Women who gave birth in hospital only. Excludes women who gave birth in centres attached to hospitals.
6. Only includes women who were discharged home. Women who gave birth in hospital only. Excludes women who gave birth in centres attached to hospitals.
7. Gestational age of live born babies from 20-36 weeks (4 babies of less than 20 weeks gestational age were also included).
8. Less than 2,500 grams.
9. 4,500 grams and over.
10. Apgar score (at five minutes) of 0-6.
11. Only includes where active resuscitation was undertaken.
12. Only babies who were discharged home are included. Excludes babies who were born in birth centres attached to hospitals.

Source: Derived from (Australian Institute of Health and Welfare, 2019a)

COVID-19 and diabetes

The emergence of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) virus and the resulting COVID-19 pandemic (Gujral et al., 2020) has highlighted the vulnerability of those people with diabetes and other non-communicable chronic diseases (Australian Government Department of Health, 2021b). Among those hospitalised with COVID-19, patients with diabetes are reportedly among the most severely affected. According to national data (COVID-19 National Incident Room Surveillance Team, 2020) people with diabetes experience higher rates of intensive care unit stays and deaths due to COVID-19. There is also emerging evidence that long-term health consequences and complications of diabetes are exacerbated by COVID-19, and that COVID-19 may induce the onset of diabetes (Khunti et al., 2021).

Aboriginal and Torres Strait Islander people and people living in remote communities are at greater risk of contracting COVID-19 than the general population for several reasons (Communicable Disease Network Australia, 2020):

- there are often higher rates of other health issues in these communities
- it can be harder to access health care
- people in the community may be very mobile and travel often
- people often rely more on outreach services in remote places.

Other risk factors for Aboriginal and Torres Strait Islander people include: living in large households, crowded or insecure housing and/or intergenerational families.

The Australian Government advises that Aboriginal and Torres Strait Islander people may be at a greater risk of severe illness from COVID-19 (Australian Government Department of Health, 2021c) than the general population. This is because, at a population level, Aboriginal and Torres Strait Islander people have a greater burden of chronic disease than non-Indigenous Australians (Communicable Disease Network Australia, 2020) and reduced access to the social determinants of health (Thurber et al., 2021). This places them at higher risk of severe outcomes from a COVID-19 infection as has been observed in indigenous populations in the USA (Gujral et al., 2020).

During the 'first wave' of the pandemic in early 2020, the Australian Government, following advice from the National Aboriginal Community Controlled Health Organisation (NACCHO), ordered the closure of remote communities to prevent visitors entering and bringing the virus to vulnerable community members (Power, 2020). Telehealth was utilised for checkups and to ensure the Aboriginal and Torres Strait Islander community members were adhering to their medical plans. In regional and urban areas, Aboriginal medical services continued to visit their Elders.

In July 2020, the Australian Government released an emergency response plan for COVID-19, specifically for Aboriginal and Torres Strait Islander people (Australian Government Department of Health, 2020). The aim was to reduce the likelihood of a case in an Aboriginal or Torres Strait Islander community and facilitate community preparedness. The proposed strategies included:

- maintaining health service provision in the local health facility
- monitoring vulnerable people with moderate to severe chronic disease and working with them to identify potential courses of action in the case of infection
- ensuring care plans are up to date to manage existing conditions such as hypertension, renal disease, diabetes and cancer
- ensuring where possible scripts are filled in advance
- consideration of maximal safe dispensing of medications to minimise traffic through clinics.

Particular challenges for primary health care services in remote and very remote communities in managing a COVID-19 outbreak include the risk of an increase in

mortality from existing chronic diseases, including diabetes, due to staffing reductions, and the difficulty in maintaining essential services such as chronic disease programs.

Continuation of health care to at-risk individuals is crucial throughout the pandemic (Scott et al., 2020). Telehealth is the key for the delivery of care for patients in rural and remote areas, or during lockdowns. It is important that people with diabetes are educated regarding self-management of their condition during acute illness, including medication changes. It is also critical that there is no deterioration in the medical management of glycaemia and other complications of diabetes, which, if neglected, may result in increased morbidity and mortality independent of COVID-19.

In the healthcare system in the United States of America (USA), the need to maintain glycemic control while reducing patient contact has led to urgent implementation of improvised protocols for treatment of people with diabetes (Gujral et al., 2020). A lack of personal protective equipment (PPE), lockdowns, supply disruptions and social distancing requirements have led to the development of risk-minimisation strategies that promote more self-management procedures.

Prevention and management of diabetes

The prevention and management of type 2 diabetes is vital to the current and future health of Aboriginal and Torres Strait Islander people (O'Dea et al., 2007). It is generally accepted that for type 2 diabetes prevention and management programs to be effective they require evidence based health promotion measures, public health interventions and clinical services. It is important that programs for Aboriginal and Torres Strait Islander people are delivered sensitively, tailored to community needs, and not perceived as being forced upon communities (Diabetes Australia, 2013a). In addition, the involvement of Aboriginal and Torres Strait Islander community members and Aboriginal Health Practitioners in the design of any programs will help to ensure that the proposed intervention is culturally acceptable to the wider community (Nguyen et al., 2016). Furthermore, interventions that improve cultural safety for Indigenous people living with diabetes can also have positive effects on clinical outcomes (Tremblay et al., 2020).

Most primary health care services in Australia play a critical role in the early detection of diabetes (Stoneman et al., 2014). Improvements in the early detection of undiagnosed diabetes in the primary health care setting are recommended to facilitate early intervention and management for Aboriginal and Torres Strait Islander people (Diabetes Australia, 2013a).

Multifactorial interventions for diabetes management are more successful in achieving positive health outcomes for patients (Gibson & Segal, 2015). Interventions need to occur within and beyond the health system (including policy action, education, employment and nutrition), through government and non-government agencies, and need to commence as early as possible in the life course (Frier et al., 2021; Nguyen et al., 2016; O'Dea et al., 2007; Seear et al., 2020).

Formal evaluations of long-term diabetes prevention and management programs for Aboriginal and Torres Strait Islander communities are limited, but the Australian experience suggests that the current high levels of diabetes among Aboriginal and Torres Strait Islander people are potentially preventable (O'Dea, 2005).

Prevention

There is currently no known way to prevent type 1 diabetes (Diabetes Australia, 2015c) or GDM (Mayo Clinic, 2015), but the prevention of type 2 diabetes in high risk individuals is a critical component of diabetes care (Royal Australian College of General Practitioners, 2014). Type 2 diabetes and social disadvantage are related (Frier et al., 2021) which means that broader action that extends beyond the health service sector and addresses the social determinants of Aboriginal and Torres Strait Islander health such as poverty, culture, racism, employment and education is required (Diabetes Australia, 2013a; Frier et al., 2021; O'Dea et al., 2007).

Conventional best practice primary prevention can prevent or delay the onset of type 2 diabetes in high risk individuals by:

- identifying those at high risk through the use of risk assessment tools
- delivering education programs
- promoting lifestyle modifications that focus on increased physical activity, dietary change and weight loss.

(Australian Government Department of Health, 2021b).

Furthermore, Aboriginal and Torres Strait Islander people can benefit from diabetes support, education and services (e.g. Aboriginal and Torres Strait Islander Community Controlled Health Services, where they exist, or culturally competent mainstream services) as an integral part of their primary health care services (Australian Department of Health, 2015a). Food security, access to affordable healthier choices and appropriate facilities to exercise need to be encouraged and facilitated; and family and child health needs to be improved through pregnancy and early years programs.

Risk assessment and screening

To deliver evidence based prevention programs to high risk Aboriginal and Torres Strait Islander people they must first be identified through culturally appropriate risk assessment (Diabetes Australia, 2013a).

The *Australian type 2 diabetes risk assessment tool* (AUSDRISK) is a non-invasive assessment that has been developed to facilitate identification of high risk individuals. However, with the high background prevalence of type 2 diabetes in Aboriginal and Torres Strait Islander adults, the Royal Australian College of General Practitioners (RACGP) recommend that blood testing for pre-diabetes or diabetes in conjunction with other opportunistic screening (such as a cardiovascular risk assessment) should be the preferred procedure (National Aboriginal Community Controlled Health Organisation & Royal Australian College of General Practitioners, 2018). Proceeding to direct screening for pre-diabetes or diabetes has the potential to identify diabetes earlier and reduce the risk of associated complications.

Marley and colleagues (Marley et al., 2015) suggest that a combination of point-of-care (POC) and laboratory glycated haemoglobin A (HbA1C) testing is more effective than IGT and/or IFG testing for diabetes in everyday practice in remote Aboriginal primary health care. This method may simplify diabetes testing in remote areas, provide more timely diagnoses, and increase case detection. Screening for type 2 diabetes with an HbA1C or oral glucose tolerance test (OGTT) should be considered in Aboriginal and Torres Strait Islander children aged 10 or older according to the presence of risk factors (Peña et al., 2020).

A diabetes prediction model and tool published in 2015 (Adegbiya et al., 2015) claims to predict the 10-year absolute risk of type 2 diabetes for Aboriginal people based on waist circumference (WC) and age. To date this work has not been replicated to assess whether the findings can be generalised to Aboriginal and Torres Strait Islander communities outside the Kimberley region of WA.

Education

It is recommended that education in diabetes prevention is tailored for Aboriginal and Torres Strait Islander communities, families and individuals (Diabetes Australia, 2013a). It needs to be delivered in a culturally appropriate manner and in the patient's native language, with an interpreter where required (Nguyen et al., 2016). Awareness programs and education programs (including school education programs) need to be community-wide, and culturally relevant, and communicate the fact that the onset of type 2 diabetes can be delayed or possibly prevented (Australian Government Department of Health, 2021). Education should be provided in a culturally and linguistically appropriate manner, which includes translating materials and services. They should also challenge the perception that diabetes is 'normal' in Aboriginal and Torres Strait Islander communities (Nguyen et al., 2016).

Deadly Choices is a social marketing initiative that was started in 2010 in South East Qld by the Institute for Urban Indigenous Health (IUIH). The Deadly Choices program conducts school-based chronic disease education initiatives for young Aboriginal and Torres Strait Islander students (years 7 to 12) in Brisbane, Qld (Institute for Urban Indigenous Health, 2021; Malseed et al., 2014a).

It aims to empower Aboriginal and Torres Strait Islander peoples to make healthy choices for themselves and their families, such as quitting smoking, eating good food, and exercising daily. It also encourages people to access their local health service and complete a 715 Health Check every 9-12 months - normalising the idea of seeing a doctor not just when sick, but to remain healthy, access support, and prevent or better manage chronic disease. An evaluation of the program found that participants demonstrated significant improvements over time in knowledge, attitudes and self-efficacy associated with types of chronic disease, chronic disease risk factors, prevention and health checks (Malseed et al., 2014b). The students who took part in the program showed a significant improvement in their knowledge of chronic disease and associated risk factors, and a significant increase in their breakfast frequency compared with a control group.

Lifestyle modifications

Excess weight, suboptimal nutrition and physical inactivity are risk factors that contribute to the disproportionately high levels of type 2 diabetes seen in Aboriginal and Torres Strait Islander communities (Diabetes Australia, 2013a). Internationally, intensive lifestyle programs have reduced the incidence of diabetes among people who are overweight with pre-diabetes to an extent that is comparable to the use of medication (Closing the Gap Clearinghouse, 2012). Whether similar programs would be effective for Aboriginal and Torres Strait Islander people has yet to be established.

A review of healthy lifestyle programs addressing physical activity and nutrition among Aboriginal and Torres Strait Islander people found that programs can have positive health effects for up to two years, and are more likely to be effective if they are initiated by the community (Closing the Gap Clearinghouse, 2012). However, without adequate long-term funding, sustaining healthy lifestyle programs in communities where multiple social and economic problems exist is particularly challenging, and very few healthy lifestyle programs have to date continued to operate beyond five years (Closing the Gap Clearinghouse, 2012; Diabetes Australia, 2013a; Seear et al., 2019).

In 2015, a lifestyle modification program designed to help people reduce their risk of developing diabetes and cardiovascular disease, was funded by the Victorian Government. Managed by Diabetes Australia - Victoria (Diabetes Victoria, 2021; Life!, 2015), the Life! program offers a course specifically for Aboriginal people and their families called the Road to Good Health (The Life! Program, 2021). Run by Aboriginal Health Workers and other health professionals, this course supports participants to make long-term, sustainable lifestyle changes, such as adopting a healthier diet and becoming more physically active. Anecdotal evidence suggests the course is culturally relevant, valuable to users and popular, but published evaluations are not available.

Various programs have used sport to promote healthy lifestyles among Aboriginal and Torres Strait Islander children and adults, but further studies are required to establish their long-term impact (Closing the Gap Clearinghouse, 2012). Evaluation of short-term programs have demonstrated some positive results, such as those reported in 12-week exercise programs for Aboriginal and Torres Strait Islander males (Mendham et al., 2015) and females (Canuto et al., 2012). The 10-week Too Deadly for Diabetes program conducted in an urban Aboriginal community used diet and exercise to assist participants to achieve positive health outcomes (Power et al., 2021). Much of the value of the program was found in it being run by an Aboriginal person, for Aboriginal people and in an Aboriginal organisation.

In the regional location of Derby, WA, the Derby Aboriginal Health Service ran a lifestyle intervention program for young people aged 15-25 years with the aim of preventing type 2 diabetes in high risk community members (Seear et al., 2019). An education component was supported by gender-specific physical activity sessions. They

concluded that programs involving community direction, a committed local person, supportive facilitators and relevant and enjoyable content are likely to be useful but that substantial, dedicated prevention funding over a long period of time is required.

Broader initiatives that extend beyond the immediate scope of the health sector have also been proposed to help reduce the incidence of type 2 diabetes in the Aboriginal and Torres Strait Islander population. They include (Diabetes Australia, 2013a; Pan et al., 2021):

- increasing availability, affordability and accessibility of healthy food and drinks (e.g. in stores and through community gardens and traditional food projects)
- limiting advertising of unhealthy food and drinks
- providing clearer food labelling and education regarding the nutritional value of foods
- the provision of clean community water supply and water bubblers
- use of taxation levers to reduce intake of sugary drinks (e.g. soft drinks)
- encouraging physical activity through partnerships with local councils
- improving housing.

Management

Providing appropriate, effective type 2 diabetes management for Aboriginal and Torres Strait Islander people depends on: access to a broad range of health services in a broad range of settings (Diabetes Australia, 2013a); and coordinated interaction between people with diabetes and their families, communities, healthcare providers and the healthcare system (Royal Australian College of General Practitioners, 2014). Recommendations for improving type 2 diabetes management for Aboriginal and Torres Strait Islander people include:

- earlier detection of undiagnosed diabetes
- good quality primary health care
- access to medications
- self-management education
- tertiary specialist treatment when diabetes is complicated or complications develop.

The following sections refer mainly to the management of type 2 diabetes for Aboriginal and Torres Strait Islander people. Some information about managing diabetes in pregnancy is also provided.

Managing diabetes in the primary health care setting

Improved diabetes management for Aboriginal and Torres Strait Islander people requires access to a range of different models of culturally appropriate care (Diabetes Australia, 2013a) and involvement of an Aboriginal and Torres Strait Islander Health Worker, liaison officer, outreach worker or care coordinator (Royal Australian College of General Practitioners, 2014). A culturally safe, community level health-worker led model of diabetes care for high risk patients can be effective in improving diabetes control in remote Indigenous Australian communities (McDermott et al., 2015). It is also important, however, to engage, educate and partner with patients to empower and enable them to take the lead in their chronic condition management (Nguyen et al., 2016).

Up-skilling GPs to help them manage more complex patients, and providing access to local services that offer specialised treatment (such as renal dialysis for those with diabetes-related complications) would also contribute to improved diabetes management (Diabetes Australia, 2013a). Timely diagnosis and an appropriate management plan, optimal clinical treatment, and motivated self-care have been identified as key steps to improved diabetes management and improved quality of life for the NT Aboriginal

population (Li et al., 2019). Whyatt and colleagues (2017) suggest that timely management in primary care for diabetes would improve preventive care, regular monitoring, crisis intervention, and continuity of care, and reduce emergency department presentations (Whyatt et al., 2017).

Previous research indicates that Aboriginal and Torres Strait Islander people with diabetes in remote communities in the NT were presenting to hospitals in greater numbers for diabetes care than at primary care establishments (Thomas et al., 2014). However, a recent study found that initiation of a timely diabetes care plan was associated with better short-term blood glucose control and fewer diabetes-related admissions (Li et al., 2019).

Newer technology-based strategies have been shown to help facilitate diabetes management in the primary care setting. For example:

- shared electronic health records can reduce the risk of hospital admission for diabetes because an Aboriginal patient's medical history including current medications and results of recent pathology are available at any health centre (Li et al., 2019)
- telemedicine addresses the distance barrier faced by remote Aboriginal and Torres Strait Islander people with diabetes and mitigates the difficulties and costs associated with coordinating a regular specialist visit to remote communities (Nguyen et al., 2016).

Access to medicines

Australians living in areas of greater social disadvantage and in remote areas have reduced initial access to newer diabetes medications (Morton 2021). Differential prescribing of medications by remoteness and socioeconomic disadvantage has been observed in Australia and may contribute to socioeconomic disparities in disease outcomes (Hamrosi et al., 2006). Other potential barriers to access and use of medicines by Aboriginal and Torres Strait Islander people include:

- lack of transport and access to services
- inability to afford medication and services
- difficulty with storing medications, such as insulin, that require refrigeration
- difficulty interpreting labelling and consumer medicine information
- client beliefs and behaviour about filling scripts, taking medication, sharing medication and side effects
- lack of interpreters or culturally appropriate explanation of medications.

Self-management

Self-management and support for self-management is essential to managing diabetes (Australian Government Department of Health, 2021b; Royal Australian College of General Practitioners, 2014; Stoneman et al., 2014). The primary health system can support Aboriginal and Torres Strait Islander people with diabetes through improved self-management education, but the success of such programs is dependent on long-term funding (Diabetes Australia, 2013a). There is evidence that culturally appropriate self-management support for Aboriginal and Torres Strait Islander people is most effective when led by Aboriginal and Torres Strait Islander Health Workers (Parmenter et al., 2020; Stoneman et al., 2014). Other factors that contribute to the success of chronic disease self-management programs for Aboriginal and Torres Strait Islander people include (Parmenter et al., 2020):

- a flexible manner that prioritises relationships
- a social view of health that sees individual health as embedded in socio-cultural contexts

- recognition of and a value for the cultural knowledge and connections of many participants
- provides empowerment and support for self-management and ownership of ones own health.

Examples of culturally appropriate self-management support programs include the Aunty Jean's Good Health Team program (Illawarra Health, 2004), the Wurli-Wurlinjang Diabetes Day program (Entwistle et al., 2011) and the Work It Out program (Parmenter et al., 2020).

Tertiary care

Tertiary specialist services are required to treat complex type 2 diabetes and the complications of diabetes, but many Aboriginal and Torres Strait Islander people access generalised diabetes care in hospitals (Diabetes Australia, 2013a; Whyatt et al., 2017). Whyatt and colleagues observed that Aboriginal people with chronic disease use health services in a different manner to non-Aboriginal people. High hospital use may be related to primary care accessibility and poor continuity of care for chronic conditions. Admission avoidance schemes such as, chronic disease management teams, outreach to local primary health services and ambulatory telehealth services may help to re-direct or address these disparities (Whyatt et al., 2017).

Although effective diabetes management requires high quality primary and secondary care, affordable and timely access to tertiary specialist services is also required to treat and manage complex diabetes and complications (Diabetes Australia, 2013a; Whyatt et al., 2017). The Diabetes Australia *Aboriginal and Torres Strait Islanders and diabetes action plan* (Diabetes Australia, 2013a) suggests that appropriate access to tertiary and specialist services may be facilitated through investment in telehealth, and recommends models of care that promote integration between the primary and tertiary care settings.

Managing diabetes in pregnancy and postpartum

The early detection and management of diabetes during pregnancy⁶ is important to reduce complications for both mothers and babies (Diabetes Australia, 2013a). The increasing number of women developing GDM is putting great pressure on health services, particularly the maternity hospitals where most women receive antenatal and pregnancy care (Diabetes Australia, 2020). The increasing demand is leading to delays in commencing management of GDM in some services, and care being delivered by clinicians who lack appropriate training and expertise in GDM.

GDM detection and management in pregnancy and the postpartum period are also important strategies for preventing or delaying the development of type 2 diabetes (Campbell et al., 2017). However, barriers to screening that have been identified by Aboriginal and Torres Strait Islander women include lack of awareness and forgetting about the need for a test, test inconvenience (a two-hour test that requires the subject to be in a fasted state), the unpleasant nature of the test and the fear of results, poor communication, time pressures and costs. Additional psychological and motivational barriers may also be present, such as denial, fear, tiredness, shame, stress, worry, feelings that diabetes is inevitable and that women lack control over choices, lack of belief in themselves and putting their own health last.

The Northern Territory Diabetes in Pregnancy Partnership Project, which commenced in 2012, (Diabetes Australia, 2013a; Maple-Brown et al., 2013; Menzies School of Health Research, 2015) has three key elements (Menzies School of Health Research, 2015):

- a review of current models of care in the NT to improve health service delivery for women with diabetes in pregnancy
- development of a NT clinical register of referred patients for use by health professionals

⁶ Diabetes in pregnancy refers to pre-existing diabetes and GDM.

- a detailed research project to assess rates and outcomes of diabetes in pregnancy in the NT (Pregnancy and Adverse Neonatal Outcomes in Remote Australia, PANDORA).

The project aims to contribute to the development of policy and planning for the management of diabetes in pregnancy, and the follow-up of mother and baby, in urban, rural and remote regions throughout Australia (Maple-Brown et al., 2013; Menzies School of Health Research, 2015).

Programs and services

A range of mainstream and Aboriginal and Torres Strait Islander-specific Australian Government Department of Health programs contribute to the prevention and management of diabetes and other chronic conditions among Aboriginal and Torres Strait Islander people at a national level (Department of Health, 2015b, 2015d). These programs include:

- the Medicare Benefits Schedule (MBS) - The Medicare health assessment for Aboriginal and Torres Strait Islander people (more commonly known as the health check) must be performed by a medical practitioner and includes risk assessments, diagnosis and intervention for common and treatable conditions such as diabetes (Australian Government Department of Health, 2021a)
- the Practice Incentives Program - Indigenous Health Incentive (PIP IHI) was reviewed and updated as part of the 2021-22 Federal Budget. It provides incentive payments for general practices that register for the IHI and agree to undertake specified activities to improve the provision of care to their Aboriginal and/or Torres Strait Islander patients with a chronic disease (Services Australia, 2021)
- the Pharmaceutical Benefits Scheme (PBS) - provides subsidies for medicines used in the treatment of diabetes (PBS medicine co-payments)
- the National Diabetes Services Scheme (NDSS) - provides subsidised diabetes products and services to persons with diagnosed diabetes who are registered with the scheme
- healthy lifestyle promotion programs including those that tackle smoking
- GP, specialist and allied health outreach services including the Indigenous Australians' Health Programme and Medical Outreach Indigenous Chronic Disease Program
- funding for research into diabetes prevention among Aboriginal and Torres Strait Islander people including: \$3.87 million over three years from 2019-20 and 2021-22 for the Indigenous Youth Diabetes Models of Care project, which will develop, pilot, evaluate and implement culturally appropriate models of care for Aboriginal and Torres Strait Islander youth with type 2 diabetes; and \$6 million over two years from 2019-20 and 2020-21 for the Aboriginal and Torres Strait Islander Diabetic Foot Complication Project, which aims to reduce diabetes foot-related complications and amputations for Indigenous people (Australian Institute of Health and Welfare, 2020c)
- the establishment of Primary Health Networks which work directly with GPs, other primary care providers (including Aboriginal Community Controlled Health Organisations), secondary care providers and hospitals to better coordinate care across the local health system (Australian Institute of Health and Welfare, 2020c)
- the Insulin Pump Program which provides fully subsidised insulin pumps to eligible, low income families who have children (up to 18 years of age) with type 1 diabetes and do not have access to other means of reimbursement, such as private health insurance (Diabetes Australia, 2021c)

- funding for the Australian Institute of Health and Welfare (AIHW) to support national surveillance and monitoring of vascular diseases including diabetes.

Back on Track is a collaboration between Diabetes Australia and the NDSS targeted to Aboriginal and Torres Strait Islander people to encourage them to get 'back on track' with their diabetes self-care (Diabetes Australia, 2021a). The campaign has been developed on the back of research which shows that during 2020, many Aboriginal and Torres Strait Islander people disengaged from their routine diabetes and health care management plans. The primary reasons for this were due to social distancing, fear of exposure to COVID-19, and a focus on other priorities. The campaign encourages patients to undergo routine, regular checkups with their doctor, health worker or nurse.

Primary health care services

At a local level, most mainstream and community controlled primary health care services in Australia play a critical role in the delivery of diabetes care (Stoneman et al., 2014). To meet the needs of Aboriginal and Torres Strait Islander people, primary health care services need to deliver both competent and culturally appropriate chronic disease care (Liaw et al., 2011). The involvement of Aboriginal and Torres Strait Islander Health Workers has been identified by health professionals and patients as an important factor in the delivery of good diabetes care to Aboriginal and Torres Strait Islander people (McDermott et al., 2015; Stoneman et al., 2014). Aboriginal and Torres Strait Islander Health Workers have been shown to help patients feel comfortable, help break down communication and cultural barriers that may exist between patients and non-Indigenous health staff (Stoneman et al., 2014), and provide culturally appropriate self-management support (McDermott et al., 2015).

Aboriginal and Torres Strait Islander community controlled primary health care services play a major role in delivering essential primary health care services to Aboriginal and Torres Strait Islander people in a culturally secure manner (Australian Institute of Health and Welfare, 2013).

Box 6: Aboriginal and Torres Strait Islander community controlled primary health care services

Aboriginal and Torres Strait Islander community controlled primary health care services are located in all jurisdictions and funded by the federal, state and territory governments and other sources (Steering Committee for the Review of Government Service Provision, 2014b). They are planned and governed by local Aboriginal and Torres Strait Islander communities and aim to deliver holistic and culturally appropriate health and healthrelated services.

Aboriginal and Torres Strait Islander community controlled primary health care services vary in the primary health care activities they offer. Possible activities include: diagnosis and treatment of illness or disease; management of chronic illness; transportation to medical appointments; outreach clinic services; immunisations; dental services; and dialysis services.

Policies and strategies

The Australian Government has recently released the *Australian national diabetes strategy 2021-2030* (Australian Government Department of Health, 2021b). An update on the *National Diabetes Strategy 2016-2020*, the *Strategy* is based on contemporary evidence and emerging priorities such as public health issues including COVID-19, aged and disability care, mental health and Aboriginal and Torres Strait Islander health. Development of the *Strategy* has been guided by an Expert Advisory Group and a Jurisdictional Advisory Group and endorsed by Australian Health Ministers.

As with the previous version, the *Strategy* includes seven high-level goals with areas for action and measures of progress. The goals cover the important issues of prevention, awareness, early detection and management of diabetes, as well as highlighting specific vulnerable populations and the research agenda. Goal 5 is specific for reducing the impact of diabetes among Aboriginal and Torres Strait Islander people, however actions relating to all the goals will impact positively on this population (see Table 5).

Table 5. Components of the *Australian national diabetes strategy 2021-2030*

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| Vision |
| Strengthen, integrate and coordinate all sectors to improve health outcomes and reduce the social and economic impact of diabetes in Australia |
| Principles |
| 1. Facilitation of person-centred care and self-management throughout life |
| 2. Reduction in health inequities |
| 3. Collaboration and cooperation to improve health outcomes |
| 4. Coordination and integration of diabetes care across services, settings, technology and sectors |
| 5. Measurement of health behaviours and outcomes |
| Goals |
| 1. Prevent people developing type 2 diabetes |
| 2. Promote awareness and earlier detection of type 1 and type 2 diabetes |
| 3. Reduce the burden of diabetes and its complications and improve quality of life |
| 4. Reduce the impact of pre-existing diabetes and gestational diabetes in pregnancy |
| 5. Reduce the impact of diabetes among Aboriginal and Torres Strait Islander peoples |
| 6. Reduce the impact of diabetes among other priority groups |
| 7. Strengthen prevention and care through research, evidence and data |

Selected national policy developments relevant to addressing diabetes among Aboriginal and Torres Strait Islander people

| | |
|------|--|
| 1987 | <ul style="list-style-type: none"> National Diabetes Service Scheme (NDSS) is established |
| 1996 | <ul style="list-style-type: none"> Diabetes becomes a National Health Priority Area (NHPA) Ministerial Advisory Committee on Diabetes is established |
| 1998 | <ul style="list-style-type: none"> <i>National diabetes strategy and implementation plan</i> report is published |
| 1999 | <ul style="list-style-type: none"> <i>National (insulin-treated) Diabetes Register (NDR)</i> is established |
| 2000 | <ul style="list-style-type: none"> <i>National diabetes strategy 2000-2004</i> is signed |
| 2002 | <ul style="list-style-type: none"> Australian Health Ministers' Advisory Council (AHMAC) agreed to the development of a national policy approach to chronic disease prevention and care |
| 2006 | <ul style="list-style-type: none"> <i>National Service Improvement Framework for Diabetes</i> is released <i>National chronic disease strategy</i> is released Australian Better Health Initiative is announced |
| 2007 | <ul style="list-style-type: none"> Diabetes is included in the <i>National reform agenda</i> A national package to prevent type 2 diabetes is announced |
| 2008 | <ul style="list-style-type: none"> <i>Australian type 2 diabetes risk assessment tool (AUSDRISK)</i> is introduced New Medicare item introduced to develop a <i>Diabetes risk plan</i> for high risk individuals |

| | |
|------|---|
| | <ul style="list-style-type: none"> • <i>Close the gap statement of intent</i> is signed • <i>National partnership agreement on closing the gap in Indigenous health outcomes</i> is established • Indigenous Chronic Disease Package is announced |
| 2010 | <ul style="list-style-type: none"> • Practice Incentives Program-Indigenous Health Incentive (PIP-IHI) receives funding |
| 2011 | <ul style="list-style-type: none"> • NDSS introduces National Development Programs that include initiatives for Aboriginal and Torres Strait Islander people |
| 2013 | <ul style="list-style-type: none"> • <i>Aboriginal and Torres Strait Islanders and diabetes action plan</i> is released • <i>National Aboriginal and Torres Strait Islander Health Plan 2013-2023</i> is released • Medical Outreach Indigenous Chronic Disease Program is established |
| 2014 | <ul style="list-style-type: none"> • Indigenous Australians' Health Programme is established |
| 2015 | <ul style="list-style-type: none"> • <i>National Diabetes Strategy 2016-2020</i> is released |
| 2017 | <ul style="list-style-type: none"> • <i>Diabetes in Australia: focus on the future</i> is published |
| 2019 | <ul style="list-style-type: none"> • <i>National Agreement on Closing the Gap</i> is developed |
| 2021 | <ul style="list-style-type: none"> • <i>National diabetes strategy 2021-2030</i> is released |

Selected national policy developments relevant to addressing diabetes among Aboriginal and Torres Strait Islander people are described briefly below:

- The NDSS was established in 1987 (National Diabetes Services Scheme, 2022). The NDSS is an initiative of the Federal Government administered by Diabetes Australia. It provides diabetes-related products at subsidised prices and offers information and support services to people with diabetes.
- Diabetes first became a National Health Priority Area (NHPA) in 1996 (Australian Institute of Health and Welfare & Commonwealth Department of Health and Family Services, 1997) in recognition of the impact that diabetes has on the Australian community, and in order to give it a higher profile in the health system.
- In the same year the Federal Minister for Health and Family Services announced the establishment of the Ministerial Advisory Committee on Diabetes to provide the Government with independent advice on the management of diabetes in Australia (Colagiuri et al., 1998). The *National diabetes strategy and implementation plan*, published in 1998, included recognition that Aboriginal and Torres Strait Islander people would require special consideration in the planning, delivery and coordination of diabetes prevention and care services.
- In 1999, the NDR was established. The NDR is a database that aims to monitor the incidence of Australians who use insulin to treat diabetes. It includes people with type 1, insulin-treated type 2, gestational and other types of diabetes. Data for the NDR are sourced from the NDSS Registrant data, the NDSS Sales data, the Australasian Paediatric Endocrine Group's (APEG) state-based registers and the National Death Index (NDI) (Australian Institute of Health and Welfare, 2020d).
- In the year 2000, all Australian health ministers signed the *National diabetes strategy 2000-2004* (Diabetes Australia, 2013c). It aimed to help reduce the personal and public burden of diabetes in Australia (Commonwealth Department of Health and Aged Care, 1999). The *Strategy* identified five goals and a framework for action. Aboriginal and Torres Strait Islander people were identified as a high-risk population who would require specific attention.
- In 2002, AHMAC agreed to the development of a national policy approach to chronic disease prevention and care (National Health Priority Action Council, 2006). This led to the development of the *National Service Improvement Frameworks* (one of which is for diabetes) (National Health Priority Action

Council, 2005), followed by the *National chronic disease strategy* in 2006 (National Health Priority Action Council, 2006) and a blueprint for a national surveillance system (Department of Health, 2015c). There was an emphasis on improving access to services for Aboriginal and Torres Strait Islander people in each of these initiatives.

- In 2007, diabetes was included in the 'human capital' stream of the *National reform agenda*. The Federal Government provided funding over four years for a national package to prevent type 2 diabetes (National Partnership Agreement on Preventive Health Implementation Working Group, 2009).
- A diabetes risk assessment tool (the AUSDRISK tool) was developed in 2008, that predicts the five year risk of type 2 diabetes (Department of Health, 2015a). The AUSDRISK is suitable for use in high risk populations, including Aboriginal and Torres Strait Islander populations (Department of Health, 2015a).
- In 2008, the Government and Opposition signed the *Close the gap statement of intent* (Human Rights and Equal Opportunity Commission, 2008), committing to closing the health and life expectancy gap between Aboriginal and Torres Strait Islander people and other Australians by 2030. By the end of 2010, most state and territory governments and oppositions had also signed the *Statement* (Holland, 2015).
- In 2009:
 - all Australian governments committed to achieving the Closing The Gap targets in the *National Indigenous reform agreement (Closing the gap)* (Council of Australian Governments, 2009a)
 - COAG also agreed to the *National partnership agreement on closing the gap in Indigenous health outcomes* (Council of Australian Governments, 2009b)
 - the Federal Government committed funding to the Indigenous Chronic Disease Package (ICDP) (Department of Health, 2012)
 - the Federal Government's *Implementation plan* (Commonwealth of Australia, 2009) was endorsed by the Australian Health Ministers' Conference (Macklin, 2010).
- The Practice Incentives Program-Indigenous Health Incentive (PIP-IHI) commenced in 2010 (Couzos & Thiele, 2010). Funding was allocated over four years to support primary health care services to provide better health care for Aboriginal and Torres Strait Islander people, including best practice management of chronic disease (Couzos & Thiele, 2010; Department of Health and Ageing, 2013).
- In 2013, Diabetes Australia released the *Aboriginal and Torres Strait Islanders and diabetes action plan* (Diabetes Australia, 2013a) - the first national policy document specific to diabetes in the Aboriginal and Torres Strait Islander population.
- The *National Aboriginal and Torres Strait Islander Health Plan 2013-2023* (the *Health plan*) was also released in 2013 (Holland, 2015). This evidence-based policy framework was developed to guide policies and programs to improve Aboriginal and Torres Strait Islander health (Australian Department of Health, 2015b). The *Health plan* (Australian Department of Health and Ageing, 2013) makes specific reference to the impact of chronic diseases, including diabetes, on the health of Aboriginal and Torres Strait Islander adults.
- In 2013, the Medical Outreach Indigenous Chronic Disease Program was established by the Australian Government through the consolidation of two existing Indigenous chronic disease outreach programs.
- The Indigenous Australians' Health Programme (IAHP) was established in 2014, consolidating four existing Aboriginal and Torres Strait Islander health funding streams including the Aboriginal and Torres Strait Islander chronic disease fund

(which replaced the ICDP) (Australian Government Department of Health, 2021d). The IAHP provides some funding for chronic disease management, including the Medical Outreach Indigenous Chronic Disease Program.

- The *Australian National Diabetes Strategy 2016-2020* was released at the end of 2015 (Australian Department of Health, 2015a). It outlined a national response to diabetes, incorporating seven high-level goals with potential areas for action and measures of progress. Goal 5 aimed to reduce the impact of diabetes among Aboriginal and Torres Strait Islander people (Australian Health Ministers' Advisory Council, 2017).
- *Diabetes in Australia: focus on the future* is the implementation plan (the Plan) developed to operationalise each of the Strategy's seven goals. Developed in partnership between the Australian Government and all state and territory governments, the Plan was published in 2017 (Australian Health Ministers' Advisory Council, 2017). The Plan identified nine areas where national priority action is required. Updated data was published in 2020 (Australian Institute of Health and Welfare, 2020c).
- The *National Agreement on Closing the Gap* was developed in 2019-2020 in partnership between Australian Governments and Aboriginal and Torres Strait Islander peak organisations. It sets out new targets and Priority Reforms to improve life outcomes experienced by Indigenous Australians (Coalition of Peaks, 2020).
- The *Australian national diabetes strategy 2021-2030* was released at the end of 2021 (Australian Government Department of Health, 2021b). It supercedes the 2016-2020 Strategy and will be followed by an Implementation Plan. It is anticipated that a mid-term review will be undertaken in 2025.

Future directions

The health care needs of Aboriginal and Torres Strait Islander people with chronic conditions are often complex and managed in a cross-cultural context (Schmidt et al., 2016). Aboriginal and Torres Strait Islander Health Workers and Practitioners are important members of multidisciplinary primary health care teams in Aboriginal and Torres Strait Islander communities in Australia, due to their knowledge of community and culture and, when trained in diabetes care and management, are able to provide regular health checks and education about health risks and self-management. Increased support and training opportunities for Indigenous Health Workers, and the workforce working with and within Aboriginal and Torres Strait Islander primary care settings is essential. But placing skilled and dedicated IHWs to improve care coordination is insufficient to improve chronic disease outcomes without a supportive and systematic service delivery system.

The *Australian national diabetes strategy 2021-2030* highlights key issues that require special attention including diabetes in aged care, prevention of type 2 diabetes, and diabetes in vulnerable communities including Aboriginal and Torres Strait Islander communities. However, the gap between Aboriginal and Torres Strait Islander people and non-Indigenous people is not closing. Experts are calling for a National Type 2 Diabetes Prevention Program with collaboration from all levels of government (Diabetes Australia, 2021b).

Concluding comments

The high levels of type 2 diabetes in many Aboriginal and Torres Strait Islander communities reflect a broad range of historical, social and cultural determinants, and the contribution of lifestyle and other health risk factors (Closing the Gap Clearinghouse, 2012; Diabetes Australia, 2013a; O'Dea et al., 2007). Emerging evidence suggests that epigenetic factors, the intrauterine environment and other early life factors may also influence the development of diabetes (McEwen et al., 2019; Zimmet et al., 2014).

There is growing concern regarding the emergence of type 2 diabetes in Aboriginal and Torres Strait Islander children and adolescents (Zimmet et al., 2014). Early onset of type 2 diabetes places these adolescents at heightened risk of comorbidities, diabetes complications and associated premature mortality (Maple-Brown et al., 2010; Peña et al., 2020; Titmuss et al., 2019; Viner et al., 2017).

The emergence of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) virus and the resulting COVID-19 pandemic (Gujral et al., 2020) has highlighted the vulnerability of people with diabetes and other non-communicable chronic diseases (Australian Government Department of Health, 2021b). The Australian Government advises that Aboriginal and Torres Strait Islander people may be at a greater risk of severe illness from COVID-19 (Australian Government Department of Health, 2021c) than the general population.

The Australian Government has recently released the *Australian national diabetes strategy 2021-2030* (Australian Government Department of Health, 2021b). The Strategy is based on contemporary evidence and emerging priorities such as public health issues including COVID-19, aged and disability care, mental health and Aboriginal and Torres Strait Islander health. It is hoped that the Strategy will provide a bi-partisan long-term commitment to culturally appropriate prevention and management of type 2 diabetes across the lifespan for Aboriginal and Torres Strait Islander people.

Appendix 1: data sources, limitations and methods

The statistical information provided in this review draws on data from a number of sources. The various limitations associated with the data are discussed briefly below:

Defining diabetes

Reported statistics on diabetes prevalence, incidence, health service utilisation, mortality and burden of disease may not clearly define which type (or combination of types) of diabetes is being analysed. Care should be taken to avoid assumptions and generalisations.

Prevalence

People who develop diabetes are often unaware they have the condition, and surveys that do not medically verify self-reported data may underestimate the true prevalence of diabetes (Australian Institute of Health and Welfare, 2011).

Incidence

The *National (insulin-treated) diabetes register* (NDR) collects information on new cases of insulin-treated diabetes. The NDR may underestimate the number of Aboriginal and Torres Strait Islander people with insulin-treated diabetes resulting from non-identification of people of Aboriginal or Torres Strait Islander origin. Underestimates may also be due to low levels of registration with the NDSS, as Aboriginal and Torres Strait Islander people can access diabetes services and products through other programs (this is particularly true in rural and remote areas) (Australian Institute of Health and Welfare, 2014c).

The incidence of type 2 diabetes not requiring insulin treatment cannot be estimated with accuracy due to gaps in currently available data (Australian Institute of Health and Welfare, 2015e).

Hospitalisations

Hospitalisation figures are for 'separations', and as there can be multiple separations for the same individual, hospital records do not necessarily reflect the prevalence of a disease in the population (Steering Committee for the Review of Government Service Provision, 2014a).

Mortality

Indigenous status may be under-identified in death data. Death data for Aboriginal and Torres Strait Islander people is typically only available for NSW, Qld, WA, SA and the NT, as these jurisdictions have sufficient levels of identification and sufficient numbers of deaths to support analysis (Australian Bureau of Statistics, 2015; Steering Committee for the Review of Government Service Provision, 2014a).

Death data probably underestimates deaths due to diabetes as the condition is frequently under-reported on death certificates or not recorded as the underlying cause of death (International Diabetes Federation, 2013).

Burden of disease

The *Australian burden of disease study* uses the underlying cause of death to calculate estimates of fatal burden (Australian Institute of Health and Welfare, 2015a). Use of the underlying cause of death alone (without consideration of associated causes) cannot reflect more complex situations where more than one disease contributes to death. Diabetes is often associated with other diseases and listed as an associated cause of death; therefore burden of disease estimates may not reflect the total fatal burden of diabetes.

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