# Management of type 2 diabetes in young adults aged 18–30 years: ADS/ADEA/APEG consensus statement

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Type 2 diabetes, traditionally a condition of older age, is becoming more prevalent in younger age groups in Australia and worldwide.[1-3] Type 2 diabetes with onset in young adulthood (nominally, 18–30 years of age) is a more aggressive condition than that seen in older age, with greater risks of major morbidity and early mortality.[4,5] It is estimated that onset in young adulthood comprises 16% of the adult type 2 diabetes population globally.[1,6] In the context of a limited evidence base, the objective of this consensus statement is to consider issues for young adults with type 2 diabetes and to outline the specifics of type 2 diabetes management that may differ from later onset type 2 diabetes. Guidelines specifically for the management of type 2 diabetes in children and adolescents (< 18 years of age) are available elsewhere;[7] where relevant, recommendations in this consensus statement are harmonised with current national and international guidance for those < 18 years of age.[2,7] Special considerations for Aboriginal and Torres Strait Islander Australians are highlighted separately. The full statement is available at https://www.diabetessociety.com.au, https://www.adea.com.au and https://www.apeg.org.au.

## Methods

The scope and topics were determined by an Australian Diabetes Society Expert Consensus Development Group, from which a working group of experts in the field was formed. English literature searches were performed using search phrases including "type 2 diabetes" and "youth", "young adult", "young onset", combined with "complications", "depression", "distress", "education", and "pregnancy". These were complemented by reference lists compiled from identified articles, reviews, and suggestions from the working group members.

Through a collaborative drafting process, the body of evidence specifically pertaining to the management of type 2 diabetes in young adults was determined to be too limited to support clinical guideline recommendations, but it was viable as an expert consensus statement. The main studies available specific to type 2 diabetes in young adults were cross-sectional observational studies, some relevant to the Australian context. The lack of high quality evidence pertaining to management specific to young adult type 2 diabetes has been acknowledged.[8] Thus, consensus statement recommendations graded according to the Grading of Recommendations Assessment, Development and Evaluation (GRADE) system[9] have a low certainty of evidence.

The Australasian Paediatric Endocrine Group (APEG) and Australian Diabetes Educators Association (ADEA) have reviewed and endorsed the consensus statement.

## Abstract

**Introduction:** Type 2 diabetes in young adults (nominally, 18–30 years of age) is a more aggressive condition than that seen in older age, with a greater risk of major morbidity and early mortality. This first Australian consensus statement on the management of type 2 diabetes in young adults considers areas where existing type 2 diabetes guidance, directed mainly towards older adults, may not be appropriate or relevant for the young adult population. Where applicable, recommendations are harmonised with current national guidance for type 2 diabetes in children and adolescents (aged < 18 years). The full statement is available at https://www.diabetessociety.com.au, https://www.adea.com.au and https://www.apeg.org.au.

**Main recommendations:** Advice is provided on important aspects of care including screening, diabetes type, psychological care, lifestyle, glycaemic targets, pharmacological agents, cardiovascular disease risk management, comorbidity assessment, contraception and pregnancy planning, and patient-centred education. Special considerations for Aboriginal and Torres Strait Islander Australians are highlighted separately.

**Changes in management as a result of this statement:** Management recommendations for young adults, which differ from those for adults, include:

- screening for diabetes in young adults with overweight or obesity and additional risk factors, including in utero exposure to type 2 diabetes or gestational diabetes mellitus;
- more stringent glucose targets (glycated haemoglobin ≤ 6.5% [≤ 48 mmol/mol]);
- in the context of obesity or higher cardio-renal risk, glucagon-like peptide 1 receptor agonists and sodium–glucose cotransporter 2 inhibitors are preferred second line agents;
- β-cell decline is more rapid, so frequent review, early treatment intensification and avoidance of therapeutic inertia are indicated;
- a blood pressure target of < 130/80 mmHg, as the adult target of ≤ 140/90 mmHg is too high;
- absolute cardiovascular disease risk calculators are not likely to be accurate in this age group; early statin use should therefore be considered; and
- a multidisciplinary model of care including an endocrinologist and a certified diabetes educator.

## Recommendations

Recommendations are summarised in Box 1 and discussed in more detail below.

### Risk screening and diagnosis

Risk factors for type 2 diabetes in young adults are similar to those for older onset type 2 diabetes, with a particular emphasis

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**1 Key management recommendations for young adults with type 2 diabetes, which differ from recommendations for adults**

- Screening for diabetes is recommended in young adults with overweight or obesity and additional risk factors, including in utero exposure to type 2 diabetes or gestational diabetes mellitus.
- If $HbA_{1c}$ levels are 5.7–6.4% (39–46 mmol/mol) or fasting glucose is impaired on initial screen, proceed to an oral glucose tolerance test to identify post-load hyperglycaemia defining impaired glucose tolerance or diabetes.
- Given the high risk of complications, the $HbA_{1c}$ target should be ≤ 6.5 % (≤ 48 mmol/mol) if it can be achieved without undue hypoglycaemia risk and self-management burden.
- β-cell decline is more rapid; frequent review, early treatment intensification and avoidance of therapeutic inertia is indicated.
- In the context of diabetes in the young adult age group, the possibility of maturity onset diabetes of the young is increased and should be considered.
- Young adults with type 2 diabetes experience a psychological burden comparable to young adults with type 1 diabetes, and adverse social determinants of health factors are relatively common among young adults with type 2 diabetes; these may affect care decisions and need to be considered.
- Given the high cardio-renal risk in young adults with type 2 diabetes and the need to avoid iatrogenic weight gain and hypoglycaemia, GLP1 receptor agonists and SGLT2 inhibitors are the likely best second line agents.
- Blood pressure of < 130/80 mmHg, regardless of the presence of albuminuria, is the recommended minimum target. Recent recommendations for targets of ≤ 140/90 mmHg are too high in this age group and particularly so for women.
- Absolute cardiovascular risk calculators are not likely to be accurate in this age group; early statin use should be considered.
- Paediatric guidelines recommend lipid lowering for low density lipoprotein levels > 3.4 mmol/L with a target of < 2.6 mmol/L, and this could be continued or newly considered in young adults with type 2 diabetes.
- Delivery of education should be in forums specific for young people alone, rather than in group settings with older adults.
- Exercise recommendations are as for young adults without type 2 diabetes, that is, a minimum of 300 minutes per week of moderate intensity exercise.
- Wherever possible, care should be provided by specialist teams that include an endocrinologist, credentialled diabetes educator, dietitian, psychologist, and exercise physiologist.

GLP1 = glucagon-like peptide 1; $HbA_{1c}$ = glycated haemoglobin; SGLT2 = sodium–glucose cotransporter 2. ◆

**2 Screening for type 2 diabetes and pre-diabetes is recommended in asymptomatic young adults with overweight or obesity* with one or more of the following risk factors**

- Maternal history of type 2 diabetes or gestational diabetes mellitus during an individual's gestation
- Family history of type 2 diabetes in a first degree relative
- High risk ethnicity: Aboriginal and Torres Strait Islander,† South Asian, South East Asian, North African, Latin American, Middle Eastern, Māori or Pacific Islander people (includes individuals of mixed ethnicity)
- Clinical evidence of insulin resistance (polycystic ovary syndrome, acanthosis nigricans, dyslipidaemia, hypertension) or existing macrovascular disease, impaired fasting glucose, impaired glucose tolerance or history of gestational diabetes mellitus
- Use of antipsychotic medications

* Body mass index (BMI) ≥ 25 $kg/m^2$; specific cut-points recommended for South Asian and South East Asian people: overweight, BMI > 23 $kg/m^2$; obese, BMI > 27.5 $kg/m^2$.[12] † See main text for screening and testing recommendations for Aboriginal and Torres Strait Islander Australians. ◆

on obesity, a strong family history of type 2 diabetes and in utero exposure to gestational hyperglycaemia.[10,11] Young adult type 2 diabetes is most prevalent in races/ethnicities with a high risk of type 2 diabetes overall. Population screening is unlikely to be cost-effective, but risk-based screening criteria are recommended, with risk factors chosen based on their association with type 2 diabetes (Box 2). This extends current general Australian guidance to screening young adults with obesity or who are overweight, in the presence of additional risk factors, including a maternal history of type 2 diabetes or gestational diabetes mellitus during an individual's gestation. These recommendations do not preclude standard recommendations for diabetes testing in adults, although it is likely that the Australian type 2 diabetes risk assessment tool (AUSDRISK) score would lack accuracy for this age group.[13]

In asymptomatic individuals, standard adult diagnostic criteria for diabetes apply (fasting glucose, 2-hour post-load glucose, or glycated haemoglobin [$HbA_{1c}$]), and diagnosis requires two abnormal test results. If the fasting glucose level is in the impaired range (5.6–6.9 mmol/L) or the $HbA_{1c}$ level is 5.7–6.4% (39–46 mmol/mol), it is recommended to proceed to an oral glucose tolerance test, to identify post-load hyperglycaemia defining impaired glucose tolerance or diabetes. Thereafter, screening intervals are as for older adults:[13] if impaired fasting glucose or impaired glucose tolerance is found, then screening for diabetes should be performed annually; if initial tests are within the normal range, screening should continue at a minimum of 3-yearly intervals or earlier if body mass index is increasing. These recommendations are aligned with current guidance for paediatric and adolescent age groups (< 18 years).[2,7] Specific guidance for Australian and Torres Strait Islander Australians is given below.

## Type 2 diabetes in young Aboriginal and Torres Strait Islander Australians

Aboriginal and Torres Strait Islander youth are disproportionately affected by type 2 diabetes. Compared with non-Indigenous Australian youth, Aboriginal and Torres Strait Islander youth experience 20-fold higher rates of type 2 diabetes and 10–20-fold higher hospitalisation rates.[14,15] They have an earlier age of onset of type 2 diabetes than the general Australian population, with the condition reported in children as young as 5 years of age.[16,17] Aboriginal and Torres Strait Islander youth with type 2 diabetes experience very high rates of diabetes complications from a young age.[12,13]

Because of the high risk of type 2 diabetes among Aboriginal and Torres Strait Islander people, case-finding recommendations differ from those for the general population, such that annual screening is recommended from 15 years of age as part of the Medicare Benefits Schedule-funded well person's health check. Screening from 10 years of age in children with a risk factor is recommended in the Central Australian rural practitioner guidelines for remote primary health care, and this recommendation extends to the young adult onset population.[18] Such risk factors include overweight, family history of diabetes, a mother with pre-existing or gestational diabetes mellitus, polycystic ovarian syndrome, and acanthosis nigricans. An $HbA_{1c}$ test is recommended for case-finding, with a confirmation test of $HbA_{1c}$, fasting glucose and/or 2-hour post-load glucose on an oral glucose tolerance test, with standard diagnostic criteria for diabetes applied. If the $HbA_{1c}$ level is 5.7–6.4 % (39–46 mmol/mol), an oral glucose tolerance test is recommended in order to diagnose impaired glucose tolerance,[7] which is an important diagnosis to make, as dietary changes, physical activity changes, weight loss and/or metformin can then reduce the risk of progression to type 2 diabetes.

Key management principles when working with Aboriginal and Torres Strait Islander youth with type 2 diabetes include:

culturally relevant and culturally safe care; involvement of an Aboriginal health practitioner as a key member of the multidisciplinary team; assessment and management of social and emotional wellbeing; and shared care between primary care and multidisciplinary diabetes teams.[19] Development of strong patient–clinician relationships is particularly important, and minimising change in the health care team is therefore a priority. Pregnancy planning and contraception are important considerations among young Aboriginal and Torres Strait Islander women with type 2 diabetes, as rates of type 2 diabetes in pregnancy are 10-fold higher than in non-Indigenous Australian women, and type 2 diabetes is a key contributor to higher rates of adverse perinatal outcomes among Aboriginal women.[20]

## Determining diabetes type

Diabetes type in young adults can be difficult to determine as clinical overlap features are common (eg, obesity may be present in individuals with type 1 diabetes[21] and young adult type 2 diabetes can present with ketosis or ketoacidosis[22]). The main decision in young adults is to distinguish type 1 diabetes from type 2 diabetes and/or to recognise rarer monogenic forms of diabetes. Recommendations for determining diabetes type, based on guidelines for children and adolescents,[2,23] are shown in Box 3. The presence of islet cell autoantibodies likely represents slowly evolving type 1 diabetes.[24,25]

A detailed family history, particularly of early onset diabetes, should be taken, and the possibility of rarer monogenic diabetes should be considered, given therapy implications after a positive diagnosis.[23] A maturity onset diabetes of the young probability calculator is available (https://www.diabetesgenes.org/exeter-diabetes-app/), but is not yet validated for Australian multi-ethnic populations. Genetic testing is available via clinical genetic services. Lack of family history does not exclude the possibility of monogenic diabetes, as de novo mutations can occur.

## Dietary management and physical activity as first line therapy

Box 4 provides summary recommendations for nutrition management, noting that there is little evidence for one specific macronutrient approach in young adult type 2 diabetes. Of interest, the very low energy diet approach has shown benefit among adolescents with obesity and newly diagnosed type 2 diabetes, but evidence for long term effects is lacking at present.[26,27] Similarly, in adults using a weight management program incorporating a low energy formula diet, the DiRECT trial achieved remission of diabetes in almost half of the patients randomised to this intervention.[28] Although young adults with type 2 diabetes were not well represented in this trial and evidence for durability of effect is still limited, the approach merits further consideration given the potential pre-conceptual, occupational and other benefits of inducing remission in this age group. Further research is needed to identify the most effective nutritional approach for young adult type 2 diabetes.

Recommendations for exercise and reducing sedentary time, including screen time limits, are given in Box 4.

## Psychosocial factors

In Australia, young adults with type 2 diabetes often come from ethnic minority groups or from socially disadvantaged groups with multiple stressors including insecurities in employment and housing. As a group, young adults with type 2 diabetes experience a psychological burden comparable to young adults

### 3 Determining diabetes type

- Consider testing for islet cell autoantibodies to exclude autoimmune type 1 diabetes; glutamic acid decarboxylase and insulinoma antigen-2 are the most commonly available tests
- Consider monogenic forms of diabetes and take a detailed family history. Clinical features suggestive of monogenic diabetes include:
  - in young adults who lack the characteristics of type 1 diabetes (no islet autoantibodies, low or no insulin requirement more than 5 years after diagnosis), a family history of diabetes may be present in one parent and first degree relatives of that affected parent
  - stable isolated fasting hyperglycaemia in the range of 5.5–8.5 mmol/L and a 2-hour glucose rise of < 3.5 mmol/L on oral glucose tolerance test (*GCK* MODY)
  - extreme sensitivity to sulfonylurea medications with a large post-load glucose rise > 5 mmol/L on oral glucose tolerance test (*HNF1A* or *HNF4A* MODY)
  - lack of marked obesity and other metabolic syndrome features (eg, acanthosis nigricans)
  - specific features such as genitourinary tract abnormalities or renal cysts, pancreatic atrophy, hyperuricaemia or gout (*HNF1B* MODY)
  - history of neonatal hyperglycaemia
  - maternal line inheritance and associated hearing loss (mitochondrial diabetes)

MODY = maturity onset diabetes of the young. ◆

### 4 Recommendations for dietary and physical activity interventions in young adults with type 2 diabetes

- Obesity is a key modifiable risk factor. A sustained weight loss of 7–10% in individuals with excess weight is expected to provide benefits for blood glucose and cardiovascular risk factors in young adults (Box 7).
- Culturally appropriate programs promoting healthy diet and increased physical activity need to be provided, and family involvement needs to be individualised as developmentally appropriate.
- Current evidence suggests only a modest effect of dietary and physical activity interventions on weight loss and glycaemia, which may in part have a physiological basis. Lack of efficacy should not be considered a failure of personal action. Intensifying pharmacological interventions to improve glycaemia needs to be timely.
- Specific recommendations will need to be sensitive to individual resources, with consideration of the possibility of food insecurity, socio-economic disadvantage and other social stressors, which are all often of specific relevance to this age group.
- In this age group, disordered eating may already exist. Maintaining a healthy relationship with food is paramount.
- Nutrition advice:
  - No long term data are available on the optimal eating pattern or in favour of a particular macronutrient approach; emphasis is on nutrient-dense high quality foods.
  - Reduce total energy intake, intake of low nutrient energy-dense foods, and manage snack frequency and portion control.
  - Eliminate sugar-sweetened beverages (eg, soft drinks and fruit drinks).
  - Ensure intake of adequate fruit (two serves daily) and vegetables (five serves daily).
  - Reduce saturated fat intake and include mono-unsaturated and omega 3 polyunsaturated fats.
  - Ensure adequate knowledge of carbohydrates, including the appropriate intake of lower glycaemic index and high fibre foods.
  - Given the lifelong necessity for healthy eating, offer education on shopping, healthy meal preparation and food labels. Aim to promote healthy food choices, regular mealtimes and reduce reliance on processed, pre-prepared and takeaway foods, and encourage mindful eating behaviours.
  - Individualised advice for weight management and glucose control through the involvement of an accredited practising dietitian is recommended.
- Physical activity and exercise:
  - Recommendations are as for healthy young populations, that is, a minimum of 300 min/week of moderate intensity exercise. An additional emphasis is on reducing sedentary time, limiting recreational screen time to < 2 hours/day, and achieving adequate sleep in a sustainable way.

with type 1 diabetes, and lower engagement and follow-up than older adults with type 2 diabetes.[29] Clinical care needs to be individualised to address these challenges and facilitate access, engagement and improved outcomes.[30] Summary recommendations regarding psychological care for young adults with type 2 diabetes are provided in Box 5.

### Glucose management and pharmacotherapy

The pathophysiological mechanisms underpinning type 2 diabetes in young adults are thought to be similar to those of later onset type 2 diabetes. However, type 2 diabetes in young adults is believed to be a more aggressive phenotype than later onset type 2 diabetes. The faster decline in β-cell function (up to 20–35% per year[31]) may result in an early failure of metformin monotherapy and a more rapid requirement for additional therapy.[31,32]

There have been too few young participants in the large cardio-renal outcome trials to draw conclusions regarding the non-glycaemia-mediated cardiac and renoprotective effects of pharmacotherapy using glucagon-like peptide 1 receptor agonists and sodium–glucose cotransporter 2 inhibitors in the young adult age group.[8] Nevertheless, given the high cardio-renal risk in young adults with type 2 diabetes and the need to avoid iatrogenic weight gain and hypoglycaemia, glucagon-like peptide-1 receptor agonists and sodium–glucose cotransporter 2 inhibitors are the likely best second line agents (https://diabetessociety.com.au/living-guidelines.asp). See Box 6 for further recommendations. The need for effective contraception is a requirement in women, given the unknown teratogenic effects of these newer agents.

### Obesity management for the treatment of young adults with type 2 diabetes

Obesity is an important, modifiable risk factor for young adults with type 2 diabetes. Early intervention is warranted; weight loss can improve glucose control and obesity-related conditions, although the evidence for diabetes remission in young adults with type 2 diabetes is still limited.[33] See Box 7 for additional recommendations.

### Diabetes complications and comorbidities

Clinicians need to be aware that some diabetes complications are more prevalent in young adults with type 2 diabetes than in those with type 1 diabetes, with evidence for more rapid progression and a higher mortality.[34-38] Further, compared with later onset type 2 diabetes, complications occur at a much earlier age, with a higher impact on mortality.[39-41] Some evidence

**5 Recommendations regarding psychosocial care in young adults with type 2 diabetes**

- Emotional health problems (eg, diabetes distress, depression, disordered eating and psychiatric symptoms) are relatively common among young adults with type 2 diabetes. In addition, clinicians need to be mindful that young adults may be susceptible to, and internalise, the social stigma surrounding type 2 diabetes.
- Clinicians need to be aware of, and ask about, depressive symptoms and diabetes distress to enable appropriate intervention where needed.
- Screening tools such as the Patient Health Questionnaire-9 (https://www.racgp.org.au/FSDEDEV/media/documents/Clinical%20Resources/Guidelines/Mental%20health/Work-related-mental-health-conditions-in-general-practice.pdf) and Problem Areas in Diabetes questionnaire (https://www.racgp.org.au/FSDEDEV/media/documents/Clinical%20Resources/Guidelines/Diabetes/Appendix-C.pdf) can be used to identify those who may need additional support and intervention.
- Individualised strategies to assist engagement and follow-up are necessary for this group. These may include flexible appointment times, and strong continuity of care with a single point of contact.
- Clinicians need to be vigilant for alcohol and substance misuse.
- Early referral to social work and mental health professionals with expertise in dealing with young adults is recommended.

**6 Recommendations regarding glucose management and pharmacotherapy in young adults with type 2 diabetes**

- Given the high risk of complications, the glycated haemoglobin target should be ≤ 6.5 % (≤ 48 mmol/mol) if it can be achieved without undue hypoglycaemia risk and self-management burden.
- Insulin may be beneficial at the time of diagnosis to achieve rapid metabolic improvements in the context of symptomatic hyperglycaemia, with a proportion likely to be able to subsequently cease insulin.
- Metformin remains first line therapy, but durability of achieving glucose targets may be less than for older adults.
- There is limited but emerging evidence for the use of newer agents (GLP1 receptor agonists, SGLT2 inhibitors and dipeptidyl peptidase 4 inhibitors) in young adults with type 2 diabetes. Given low hypoglycaemic risk and neutral or beneficial effects on weight, these should be considered early in the treatment algorithm. Consideration of effective contraception in women is essential as there is limited safety evidence for the use of these newer agents in pregnancy.
- Cardio-renal benefits are not yet proven for type 2 diabetes in young adults; however, GLP1 receptor agonists or SGLT2 inhibitors could be considered preferentially in the context of persistent albuminuria or chronic kidney disease, or known cardiovascular disease (Box 8).
- Caution is recommended when using SGLT2 inhibitors in young adults with type 2 diabetes who have ever presented with ketoacidosis (ketosis-prone type 2 diabetes).
- Regular 3-monthly glycated haemoglobin monitoring is warranted given risk of therapy failure and progressive β-cell decline.

GLP1 = glucagon-like peptide 1; SGLT2 = sodium–glucose cotransporter 2. ◆

**7 Recommendations for obesity management for the treatment of type 2 diabetes in young adults**

- As for all people with diabetes, it is recommended to use non-judgmental people-first language (ie, "person with obesity" rather than "obese person"), to avoid defining people by their condition.
- People with obesity or overweight face weight-based stigma and prejudice (weight bias) in many aspects of their lives, which may affect the quality of health care received. Clinicians are encouraged to examine their own potential for weight bias and to refrain from narratives that support negative weight-based stereotypes.
- As weight gain is common in this age range, annual weight/body mass index assessment is recommended, or more frequently (if required), to assess weight trajectory. The need for privacy while weighing and any reluctance to be weighed should be respected and accommodated.
- Relevant weight loss targets, dietary and physical activity recommendations, and the potential for the co-occurrence of depression and presence of disordered eating are outlined in Box 4 and Box 5.
- Interventions for reducing energy intake include the use of very low calorie diets and meal replacements under medical supervision.
- Pharmacotherapies for obesity, beyond those recommended for glycaemic management, are available in Australia. These currently include phentermine, liraglutide, orlistat and naltrexone–bupropion (precaution/warning in individuals younger than 25 years of age with depression). Please refer to expert guidance for further information on their use.*
- Bariatric or metabolic surgery is effective for obesity and improving metabolic indices, although long term data in adolescents and young adults with type 2 diabetes are lacking. In experienced units, metabolic surgery may be considered as an option for young adults with obesity and persistent hyperglycaemia despite non-surgical therapy. Please refer to expert guidance for further information.*
- Assessment for obesity-related complications including those that would benefit from weight loss is recommended (eg, non-alcoholic steatohepatitis, obstructive sleep apnoea, polycystic ovary syndrome, fertility implications and hypertension) (Box 8).

*Australian Obesity Management Algorithm (https://diabetessociety.com.au/documents/ObesityManagementAlgorithm18.10.2016FINAL.pdf). ◆

suggests that a younger age of onset is an independent risk factor for retinopathy in type 2 diabetes, even accounting for diabetes duration;[42] a younger age of onset is also associated with a higher long term risk of end-stage renal disease.[5] In general, guidance for complication management in younger adults is the same as for older adults; however, caveats for usual care of young adults with type 2 diabetes are set out in Box 8.

## Pregnancy and pre-conceptual care

Pregnancies associated with pre-gestational diabetes have higher rates of adverse outcomes than pregnancies without diabetes, especially congenital anomalies, pre-eclampsia, pre-term birth, large-for-gestational-age babies, and pregnancy loss.[43] Further, diabetes in pregnancy is a likely contributor to

### 8 Recommendations for the prevention and management of complications and comorbid conditions in young adults with type 2 diabetes

| Complication or comorbidity | Recommendation |
|---|---|
| Nephropathy and hypertension | The prevalence of albuminuria in young adult type 2 diabetes is high at diagnosis; estimated glomerular filtration rate and urine ACR should be obtained at diagnosis and annually thereafter, with albuminuria confirmed on repeat specimens (preferably three early morning ACR tests). |
| | Blood pressure < 130/80 mmHg, regardless of the presence of albuminuria, should be a minimum target. Recent recommendations for targets of ≤ 140/90 are too high in this age group and particularly so for women. |
| | Angiotensin-converting enzyme inhibitors or angiotensin receptor blockers are first line therapeutic options for hypertension, especially in the context of an elevated ACR; calcium channel blockers are an alternative or may be added in combination. |
| | In the context of persistent albuminuria or chronic kidney disease, consider angiotensin-converting enzyme inhibitors or angiotensin receptor blockers, and glucose lowering with SGLT2 inhibitor therapy. A GLP1 receptor agonist is an alternative if SGLT2 inhibitors are not tolerated or are contraindicated. |
| | Early referral to a nephrology specialist is recommended where there is concern regarding aetiology, or ACR worsens or estimated glomerular filtration rate declines. |
| | Consider non-diabetes aetiology, particularly in the presence of ACR > 30 mg/mmol (300 mg/g). |
| | Potential teratogenic effects of angiotensin-converting enzyme inhibitors or angiotensin receptor blockers, SGLT2 inhibitors and GLP1 receptor agonists should be noted and effective contraception offered where appropriate. |
| Retinopathy | Screening should begin at diagnosis. |
| | Given propensity for rapid progression, even if baseline examinations are normal, screening should be annual as opposed to 2-yearly. |
| | Glycaemic control should be optimised for prevention and to slow progression. |
| | If fenofibrate or anti-vascular endothelial growth factor therapy is considered in the management of diabetic retinopathy, effective contraception should be offered, given potential teratogenicity and adverse pregnancy outcomes. |
| Peripheral neuropathy | Screen for the presence of neuropathy and foot problems at diagnosis and annually thereafter. |
| | Primary management should focus on attaining glucose goals. |
| | Foot care should be emphasised early. |
| CVD and dyslipidaemia | Absolute CVD risk calculators are not likely to be accurate for young adult type 2 diabetes. The following groups are considered as having particularly high lifetime risk, and statin treatment should be considered with the aim of lowering global CVD risk: Aboriginal and Torres Strait Islander Australians; young adults with type 2 diabetes with established elevated ACR; diabetes duration > 10 years; and young adults with type 2 diabetes with established CVD. |
| | Lipid levels should be checked, ideally once initial glucose levels have been as optimised as possible (as lipid levels may improve following improvement in hyperglycaemia) and annually thereafter. |
| | Statins should be considered in the context of a person aged < 30 years and with a total cholesterol level > 7.5 mmol/L. The possibility of familial hypercholesterolemia should be considered. |
| | Paediatric guidelines recommend lipid lowering for low density lipoprotein levels > 3.4 mmol/L, with a target of < 2.6 mmol/L.[2,7] This could be continued or newly considered in young adults with type 2 diabetes, noting that this specific approach is currently supported by the Pharmaceutical Benefits Scheme for total cholesterol levels > 5.5 mmol/L. |
| | Fibrate therapy should be reserved for severe hypertriglyceridaemia (triglycerdide levels > 4 mmol/L) to reduce pancreatitis risk. |
| | Smoking habits should be ascertained regularly and information provided for cessation programs. |
| | Aspirin is not recommended for primary prevention in young adult type 2 diabetes. |
| | Screening for CVD in asymptomatic youth is not warranted. |
| Polycystic ovary syndrome | Assessment for hyperandrogenism should be undertaken for all young adult women with type 2 diabetes. |
| | Weight loss and metformin may improve menstrual disorder. If hormonal contraception is commenced, lipid and insulin effects should be considered in agent selection. |
| Non-alcoholic fatty liver disease | Young adult type 2 diabetes should be assessed for the potential for non-alcoholic fatty liver disease, with aspartate transaminase and alanine aminotransferase tests at diagnosis and then annually. Gastroenterology review is recommended if there is persistent abnormality or lack of response to weight loss. |
| Obstructive sleep apnoea | Sleep disturbance and symptoms should be assessed at diagnosis. |
| Psychological comorbidity | See Box 5. |

ACR = albumin-to-creatinine ratio; CVD = cardiovascular disease; GLP1 = glucagon-like peptide 1; SGLT2 = sodium–glucose cotransporter 2. ◆

intergenerational cycles of early onset type 2 diabetes.[44] Optimal peri-conceptual and antenatal glucose levels, and avoidance of excessive gestational weight gain, may attenuate at least some of the risks mentioned above. Practical recommendations for pregnancy planning and management are provided in Box 9.[45] Breastfeeding is encouraged, as it may offer some protection against the development of early onset type 2 diabetes in the next generation.[46]

Effective contraception should be offered as necessary, and it should be recognised that young women may face unseen barriers to accessing contraception based on age, marital or financial status, and occasionally a health professional with a lack of willingness to acknowledge sexual health needs in youth. Long-acting reversible contraceptives, which include hormonal and non-hormonal intra-uterine contraceptive devices and subcutaneous progestogen implants, have been recommended as first line contraceptive options for adolescents and young women with diabetes.[47,48] A proactive approach to contraception is recommended.

## Education

Diabetes self-management and diabetes education are cornerstones of diabetes care.[49] There is little evidence to inform effective educational approaches, nor are there many educational resources specific to young adults with type 2 diabetes. Structured education programs designed for older adults are unlikely to meet the needs of young adults with type 2 diabetes, and it is not appropriate to mix the age groups. Key barriers to self-management for young adults with type 2 diabetes include being time poor, lack of motivation to undertake the rigours of diabetes self-management, and not understanding the serious nature of their condition resulting in a loss to follow-up.[50] Bespoke structured education programs that are person-focused, not disease-focused, need to be developed and evaluated. Suggested key principles for education are outlined in Box 10.

Structured education, an assessment of the individual's learning needs, and follow-up education need to be integrated into every clinical consultation. The availability of ongoing learning and support, vital in this high risk group who often struggle to understand the complexities of the health and hospital system, is required. Box 11 outlines several topic areas that could be addressed in structured discussion to assist young adults with type 2 diabetes to become proactive in their diabetes management.

### 9 Recommendations regarding pregnancy in young adults with type 2 diabetes[43]

- Pre-pregnancy counselling and contraception advice for young women with diabetes of childbearing potential should be incorporated into routine clinic visits from puberty onwards.
- High dose periconceptual folate (2.5–5 mg daily inclusive of folate in other pregnancy supplements) should be commenced 3 months before pregnancy.
- Ideally, the pre-conceptual and pregnancy glycated haemoglobin concentration should be ≤ 6.5% (48 mmol/mol) while minimising the risk of hypoglycaemia.
- All glucose lowering pharmacotherapy other than insulin and metformin should be stopped before conception, and glycaemic control optimised before conception.
- When pregnancy occurs outside an optimal pre-conceptual setting, sudden withdrawal of metformin and/or sulfonylureas in early pregnancy may lead to rapid deterioration in glucose levels. It is recommended that metformin and/or sulfonylureas be continued initially until specialist review.
- GLP1 receptor agonists, SGLT2 inhibitors and other oral agents (other than metformin or sulfonylurea) should be discontinued immediately, as there is limited safety evidence for their use in pregnancy.

GLP1 = glucagon-like peptide 1; SGLT2 = sodium–glucose cotransporter 2. ◆

### 10 Key principles for the delivery of diabetes education to young adults with type 2 diabetes

- Multidisciplinary health professionals delivering diabetes education to young adults with type 2 diabetes require specialised training in the principles of effective approaches to education and behaviour change.
- A multidisciplinary health care team that provides a consistent message and is empathic is critical to improving clinical outcomes. Ideally, the team will have skills in engaging young people.
- As loss to follow-up is a major concern, strategies involving expert consultation, communication skills, and technology including telehealth and text communication are recommended, to ensure ongoing engagement in the health care system.
- A shared family experience of diabetes should be explored as it may have a negative impact on disease perception and may help identify areas for specific education.
- Delivery of education should be in forums specific for young people alone, rather than in group settings with older adults.
- Structured education, an assessment of the individual's learning needs, and follow-up education should be integrated into every clinical consultation.
- Education formats with interactive tools, including conversation maps, mobile apps, competition and gamification, may be of specific benefit to assist in engagement of young adults with type 2 diabetes.
- Peer–peer interactions should be encouraged. Peer support groups and apps that combine social interaction, entertainment and education could offer significant benefits toward engagement and mastery of self-care practices for young adults with type 2 diabetes.
- The impact of co-existent depression and feelings of anxiety and shame should be considered.

## Transition from paediatric services and models of care

The relatively recent recognition of the occurrence of type 2 diabetes in children and adolescents, together with the rapid

### 11 Topic guidance for structured discussion within the consultation with young adults with type 2 diabetes

- Dealing with the diagnosis of diabetes, its seriousness and impact on their health and wellbeing
- Importance of nutrition and weight loss, adopting healthy choices, and an exploration of attitudes to food and eating behaviours
- Recommendations for exercise, physical activity and limits on recreational screen time and how they may be achieved
- Understanding that traditional lifestyle interventions, while important, may be less effective for youth, so as not promote feelings of failure or shame
- Importance of early and intensive management with combination therapies to achieve tight glycaemic targets, which may be stricter than for older patients
- Strategies to improve medication adherence, such as using a Webster-pak or smartphone type reminders
- Practical skills, such as how Medicare functions, how to fill a prescription, and the need for a referral if seeing a specialist
- Discuss early the potential use of insulin therapy and identify cultural, recreational and employment concerns or other barriers to insulin therapy
- Discuss the higher complication risk and importance of screening for micro- and macrovascular complications from diagnosis and aggressive treatment of cardiovascular risk factors, despite a young age
- Contraceptive advice and pregnancy planning
- The changing needs of the person (eg, leaving home, contraception, planning a pregnancy, recreational drugs, alcohol, smoking, transitioning from school to university or work, etc)
- Assessment and management of anxiety and depression
- How to use technology supports such as apps to record and monitor food, exercise, medication and blood glucose levels

increase in rates, means that models of care for children and adolescents and young adults are not yet well established. Although clinical care for most adults with type 2 diabetes is managed by general practitioners, we propose that support, in addition to that provided by primary care, is required for young adults with type 2 diabetes. Current guidelines for children and adolescents with type 2 diabetes recommend that care be provided by a specialist team.[7] Given all the challenges outlined, it is recommended that young adults with type 2 diabetes also be referred to age-appropriate specialist care. Wherever possible, care should be provided by specialist endocrine teams that include an endocrinologist and a credentialled diabetes educator, who can coordinate multidisciplinary and interdisciplinary care to include dietetic, podiatric, psychological and other specialist services as needed. GPs continue to play an important role, particularly by providing additional support and education, providing continuity of care during the transition, and facilitating continued care.

Transition is a period of vulnerability, as the health system does not engage well with young adults with type 2 diabetes, and there is a high risk of being lost to follow-up for prolonged periods of time. Young adulthood is a time when long term complications become evident and regular screening and timely treatment is critical. In transitioning from paediatric services, there is a need for planning well before the actual transition care occurs, with progressive familiarisation with adult services introduced over months. Although there is little empirical evidence of benefit to young adults with type 2 diabetes, favourable outcomes using this approach can largely be extrapolated from those seen in young adults with type 1 diabetes.[51]

## Conclusion

In response to the growing number of young adults with type 2 diabetes, this first Australian consensus statement on its management provides advice for health care professionals in areas where current guidance, focused largely on older adults, may not be appropriate or relevant. Where applicable, recommendations are harmonised with current national guidance for individuals younger than 18 years of age.[7] Despite a growing understanding of the excess risks and the more aggressive phenotype of type 2 diabetes in young adults compared with older adults, there is still a great need to develop a rigorous evidence base for young adults with type 2 diabetes. This will further inform management recommendations and models of care for this high risk group, from which more definitive guidelines can be developed.

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