

ISPAD Clinical Practice Consensus Guidelines 2022: Diabetes in adolescence

John W. Gregory¹  | Fergus J. Cameron^{2,3,4}  | Kriti Joshi⁵ | Mirjam Eiswirth⁶  | Christopher Garrett⁷ | Katharine Garvey⁸ | Shivani Agarwal⁹ | Ethel Codner¹⁰ 

¹Division of Population Medicine, School of Medicine, Cardiff University, Cardiff, UK

²Royal Children's Hospital, Melbourne, Australia

³Murdoch Children's Research Institute, Melbourne, Australia

⁴Department of Paediatrics, University of Melbourne, Melbourne, Australia

⁵Department of Endocrinology & Diabetes, Queensland Children's Hospital, South Brisbane, Australia

⁶Department of Anglophone Studies, Universität Duisburg Essen, Essen, Germany

⁷Institute of Psychiatry, Psychology and Neuroscience, Bart's Health and East London Foundation Trust, London, UK

⁸Division of Endocrinology, Boston Children's Hospital, Boston, Massachusetts, USA

⁹Department of Medicine (Endocrinology), Albert Einstein College of Medicine, Montefiore Medical Center, Bronx, New York, USA

¹⁰Instituto de Investigaciones Materno Infantil, Facultad de Medicina, University of Chile, Santiago, Chile

Correspondence

John W. Gregory, Division of Population Medicine, School of Medicine, Cardiff University, Heath Park, Cardiff CF14 4XN, Wales, UK.

Email: wchjwg@cardiff.ac.uk

KEYWORDS: adolescence, diabetes, type 1 diabetes

1 | SUMMARY OF WHAT IS NEW/DIFFERENT

- Modern insulin therapy produces normal or minimally delayed puberty.
- Despite recent technological advances in the care of diabetes, achieving optimal glycemic control during adolescence remains challenging.
- Peer support through online social media is an increasingly important source of advice.
- Motivational interviewing by psychologists is effective in optimizing outcomes in teenagers.
- Diabetes distress during adolescence may lead to less consistent use of insulin and other self-care measures with consequent increased glycemic variability.
- Mental health needs during adolescence may supersede other healthcare needs, requiring other specialty team involvement and prioritizing interprofessional communication.

- Mental health assessment is complex in adolescents and screening is recommended particularly for those experiencing recurrent diabetic ketoacidosis (DKA).
- Preconception counseling should begin during early puberty.
- A care ambassador/patient navigator leads to better transition outcomes.
- Screening for social determinants of health should be standard care in adolescents.

2 | EXECUTIVE SUMMARY, RECOMMENDATION & GRADING OF EVIDENCE

Adolescence is the transitional phase of development between childhood and emerging adulthood. Healthcare and emotional needs are distinctly different from younger children and mature adults.

This is an open access article under the terms of the [Creative Commons Attribution-NonCommercial](https://creativecommons.org/licenses/by-nc/4.0/) License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited and is not used for commercial purposes.

© 2022 The Authors. *Pediatric Diabetes* published by John Wiley & Sons Ltd.

Puberty

- Puberty is a period of physiological insulin resistance, exaggerated in adolescents with type 1 diabetes (T1D) (B).
- Pubertal development is normal or minimally delayed in the modern insulin era (B).
- Worsening of glycemic control is commonly reported in puberty and persists throughout adolescence (B).

Diabetes identity and communication

- Consider directing young people toward relevant local peer support groups and make them aware of the diabetes online community at diagnosis (B).
- Include asking in consultations about youth participation in peer support communities online and offline (what they learn and how these communities support them) (B).
- Supporting communication between the young person's family, their healthcare team, and school through individual health plans and school nurse support is advised (B).
- Encourage authoritative, helpful parenting styles with clear and realistic expectations (C).

Mental health

- Diabetes services should recognize the significant mental health burden of young people with T1D and have mental health clinicians trained in diabetes to support them (B).
- Screen to identify early markers of mental health problems requiring treatment (B).
- Episodes of DKA and chronically very high HbA1c are red flags for mental health problems (B).

Sexual health

- In order to increase awareness of the risks of unplanned pregnancy and suboptimal glycemic control, pre-conceptional counseling should begin in puberty in all girls (B).
- Hormonal contraception can be used, provided there are no microvascular complications and less than 20 years of disease duration; morbid obesity, severe hypertension, or the presence of multiple cardiovascular risk factors are contraindications for using combined hormonal contraception (E).
- Despite the absence of studies in teenagers with diabetes, long-acting reversible contraception is the contraceptive of choice in adolescents (B).

Becoming a young adult

- The transition from pediatric to adult care should be a planned, organized process (E).

- Youth mature at different rates and delay of transition based on the developmental needs of the young person may be appropriate to optimize outcomes (B).
- Transition planning, specifically utilizing care coordinators/patient navigators, can enhance post-transition clinic attendance and engagement (A).
- Screening for social needs should occur at least annually for all youth with diabetes and their families (C).
- Diabetes care plans should accommodate unmet social needs, with appropriate referral to community resources when appropriate (C).

3 | INTRODUCTION

Adolescence culminates in peak physical development, followed by psychological and cognitive maturation, autonomy, and social independence. The combination of rapid physical and sexual maturation with subsequent neuro-maturation creates a period of physiologic and behavioral vulnerability. This is especially relevant to the management of chronic illnesses such as diabetes in which the endocrine changes of puberty impact directly upon the physiology of glycemic control.

All adolescents vary in their adaptation and responses to change, and attitudes can be impulsive, questioning, and disruptive, often receiving a negative response from adults. Similarly in pediatric diabetes practice, highlighting the “difficulties” in interactions with adolescents and their behaviors is widespread. The clinical consequences of these behaviors are exemplified in data such as those from the T1D Exchange in the United States (Figure 1),¹ which showed a marked deterioration in glycemic control between the ages of 10 and 20 years. These findings are not isolated to the United States and are common across many other health-care settings, although not universal.^{2,3} These disappointing outcomes have not arisen or persisted due to clinical inertia. On the contrary, there is a plethora of medical literature examining the issues around adolescents and diabetes, including

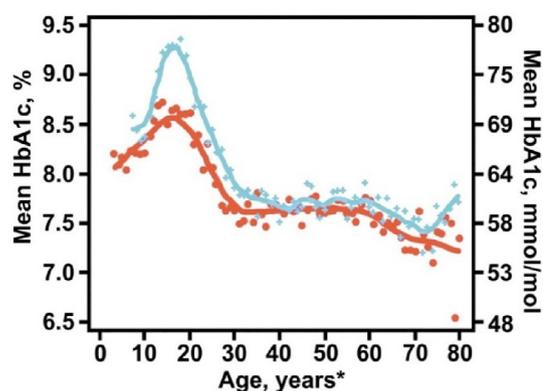


FIGURE 1 Serial data from the T1D exchange¹ highlighting adolescence as a period of deteriorating glycemic control over two time-intervals (2010–2012 in red and 2016–2018 in blue).

textbooks and chapters dedicated to this topic,^{4–6} special guidelines⁷ and over 13,000 papers published since 2000 that can be found under a PubMed search of “type 1 diabetes and adolescence.”

There has also been a concomitant rise in the use of new strategies that promised increased ease of use and the potential for improved adherence. Despite all this clinical activity, we are arguably not making progress in improving diabetes-related outcomes for adolescents. This leads to the question, why suboptimal diabetes outcomes during adolescence are seemingly so unchanged? Adolescence is marked by physiological and behavioral changes, many of which affect blood glucose levels. These include pubertal endocrine changes leading to greater insulin resistance,⁸ evolving neurocognition with lessened impulse control leading to erratic meal and exercise patterns,^{9,10} suboptimal adherence to treatment regimens¹¹ and suboptimal impulse control with hazardous and risk-taking behaviors.^{12,13} All of these changes are occurring in the context of an adolescent's developing autonomy and independence and in the face of chronic disease management, their need for ongoing support and some level of dependence on others. In adolescents with T1D there is robust evidence linking clinical outcomes to ongoing parental engagement.¹⁴

The other apparent phenomenon that militates against improved clinical outcomes during adolescence has been the enormous rise in mental health issues, particularly anxiety, depression, and disordered eating.¹⁵ Self-evidently, a functional psyche is the foundation for the never-ending task of ongoing diabetes self-care. It is hard to maintain the tools of adaptive living such as motivation, cognitive flexibility, and a long-term perspective when one's psyche is injured. Consequently, mental health-care needs during adolescence may be so immediate and of such severity, that they will occasionally override other health-care needs in the short-term. This, in turn, will necessitate the involvement of other specialty health-care teams and a level of multidisciplinary health-care communication that is heightened and uncommon during other periods of diabetes management. The transitory and shifting nature of health-care priorities adds to the increased complexity of chronic disease management at this age.

The quest for optimal behavioral and physiological outcomes, including euglycemia, can be tremendously challenging for young people and their therapists. The purpose of this chapter is to direct the reader to the evidence that there is to help them achieve these outcomes, in a transitory, but nevertheless challenging period of diabetes management.

4 | ENDOCRINOLOGY OF PUBERTY

Puberty may be an accelerator for the onset of T1D and there is a peak in incidence during the peripubertal years.^{16–18} There are gender differences in the age of onset of T1D, with younger age of onset in girls linked to their earlier start of puberty. The role of estrogen in modulating transcription of genes such as the IL-6 promoter, has been proposed to be one of the explanations for this variance.¹⁹

Transient pubertal insulin resistance (IR) occurs in those with and without diabetes and has implications for glycemic control and risk

of complications.²⁰ This dip in insulin sensitivity is exaggerated in adolescents with T1D and is 33%–42% lower when compared to non-diabetic children.⁸ IR is believed to be largely mediated by the pubertal peak in GH and IGF-1 levels which follow the same pattern of rise and fall. GH levels are higher in T1D at all pubertal stages, thereby providing credence to the observation of increased IR in T1D.²¹ Mechanistically, GH affects the insulin signaling pathway at the post-receptor level, leading to a state of IR.²² This pattern of increased GH and IR also leads to exaggerated ketogenesis in adolescents with T1D, which could predispose them to glycemic decompensation and DKA.²³

Adolescence is also a period when glycemic control commonly deteriorates.²⁴ This occurs due to a combination of non-modifiable factors such as physiological IR, the effect of gonadal steroids, a rise in lean body mass leading to increased insulin requirements, and modifiable factors such as psychosocial and behavioral changes which lead to reduced adherence with treatment regimens along with a decline in physical activity.^{22,25}

Puberty also confers an additive risk for the development of diabetic complications independent of the effect of glycemic control. Recent data suggest an increased risk of vascular complications such as proliferative retinopathy and nephropathy in individuals with a pubertal versus a post-pubertal onset of diabetes. This heightened risk is attributed to the effect of IR of puberty, the GH/IGF1 changes, androgens and the greater adiposity seen during adolescence.²⁶

Diabetes can also adversely impact growth and pubertal development. Insulin and leptin are essential for normal GnRH neuronal function and a deficiency can therefore, lead to a state of hypogonadism. Studies from the early era of insulin treatment when suboptimal glycemic control was prevalent, reported a moderate-to-severe delay in the onset of puberty.^{27,28} However, with the advent of modern insulin therapy, pubertal development is normal or minimally delayed and correlates with HbA1c levels.^{29–31} Ovarian hyperandrogenism and menstrual irregularities are other commonly reported problems in adolescent girls with T1D.²⁸

Similarly, severe growth abnormalities such as Mauriac syndrome are now rare. However, subtle impairments of growth have been related to glycemic control.^{32,33} Blunting of the pubertal growth spurt with reduced peak height velocity have been described, though adult height is usually normal.^{33–38} This growth impairment is attributed to changes in the GH/IGF1 axis with lower IGF-1, IGFBP-3 and increased IGFBP-1 levels reported in adolescents with T1D, due to hepatic GH resistance caused by decreased portal insulin concentrations.^{32,34,35,37}

Body composition changes with increasing weight are also evident during puberty, with girls in particular showing increased fat mass as a side effect of the intensified insulin regimen and a subsequent state of relative leptin resistance.^{26,33,35,39} This in turn makes them prone to a PCOS phenotype and may contribute to increased cardiovascular risk.^{28,40} Body habitus changes may also impact negatively on body image and provoke the development of eating disorders and insulin omission for weight loss, leading to worsening glycemia and increased complications.^{41,42}

5 | DIABETES IDENTITY AND COMMUNICATION IN ADOLESCENCE

5.1 | Communicating within the diabetes community

People (or parents of children) with diabetes spend most of their time managing diabetes alone.

- Peer support through online social media is an increasingly important source of advice.
- While interactions with the health-care team are important, peer support plays a crucial role in day-to-day management and improves self-management and physiological outcomes.⁴³
- Understanding how communication within the diabetes community facilitates peer support and better self-management, can inform communication with the health-care team, and aid development of effective interventions.

There are three main sites of communication: the diabetes online community (DOC),^{44,45} structured settings like peer support groups or peer mentoring programs,^{46–49} and everyday conversations and interactions with family, friends or peers.⁵⁰

Most communication within the DOC takes place on various social media channels like Facebook, Youtube, Twitter, or Instagram,^{44,51} whereas peer support groups, mentoring, and communication with peers and family or friends happen to a large extent face-to-face or via text messages.⁵² Young people with diabetes and their families turn to peer support, particularly for social and emotional support and sharing of personal experiences, but also for information about treatment options and reviews or discussion of new technology.^{44,53–56} The DOC has effective ways of policing knowledge and making sure no misinformation is spread; overall the quality of information shared was rated as high and reliable in a scoping review of the literature.^{44,57}

In communicating with each other, especially online, young people with diabetes draw on creative and humorous modes including visual⁵⁸ and textual materials. They emphasize that they are persons first and that diabetes is only one part of who they are.^{59,60}

Analyzing communication within the diabetes community thus highlights the importance of social and emotional support, as well as the holistic, person-centered perspective that treats the individual in his/her own context.

- Youth should be directed toward relevant local peer support groups and made aware of the diabetes online community at diagnosis.
- Include asking in consultations about youth participation in peer support communities online and offline (what they learn & how these communities support them).
- Supporting communication between the young person's family, their healthcare team, and school through individual health plans and school nurse support is advised.

5.2 | School

Young people with diabetes experience greater absenteeism and exclusion from school, some poorer educational attainment and higher risk of unemployment.⁶¹ Contributory factors include: lack of full-time school nurses, teacher knowledge of diabetes, access to diabetes tools, freedom to perform diabetes self-care, nutritional information in cafeterias, and communication between parents and school personnel.⁶² Improved communication between the young person's family, their health-care team and the school through individual health plans and school nurse support seems effective and telemedicine in school may support individual case management.⁶³

Students with T1D are concerned about 'being different' from their peers, which may inhibit self-care activities and lead to bullying.⁶³ They reported relying for support on a small number of trusted close friends⁶⁴ who could help at times of need while keeping their diabetes a secret from others. This peer support improves quality of life in school⁶⁵ and is associated with better glycemic control.⁶⁶ However, there is little evidence about how best to support young people to improve their resilience and coping in school or further education.⁶⁷ For detailed review refer to Chapter 22 ISPAD 2022 guidelines on "Management and support of children and adolescents with type 1 diabetes in school."

5.3 | Family

Several non-modifiable family demographic factors are associated with worse glycemic control, including ethnic minority status, public health insurance, families with a single parent or large numbers of children, reduced income and parental literacy.⁶⁸ Warm and supportive family interactions are linked with better outcomes, particularly in adolescent girls.⁶⁹ Authoritative, empathic parenting styles with clear and realistic expectations are correlated with better glycemic control and paternal involvement is important.⁷⁰ Adolescent perception of negative parental tones in discussions about diabetes was associated with worse glycemic control,⁷¹ whereas autonomy-supportive communication is related to improved adherence.⁷²

Diabetes-specific family conflict is associated with poorer glycemic control and reduced quality of life in teenagers,⁷⁰ suggesting that interventions focused on promoting family teamwork and communication or referral for family therapy may prove useful. Most studies have been US-based and cross-sectional and do not prove causality. However, a group intervention aiming to train families in teamwork around diabetes in the UK-proved disappointing, mostly due to poor attendance, suggesting more individualized approaches is required.⁷³

5.4 | Interaction with health-care services

Many young people with T1D and their families report significant communication problems with health-care providers, with a mismatch in perceived priorities^{74,75} and difficulties obtaining the information they required to effectively manage their diabetes.¹¹ A review of

psychoeducational interventions, mostly delivered by non-psychologists, reports a modest benefit on self-efficacy of adolescents with T1D though little impact on glycemic control.⁷⁶ Only a few studies utilized interventions delivered by members of the pediatric diabetes health-care team as part of routine care. Communication designed to facilitate behavior change known as motivational interviewing, which could be incorporated into routine clinic consultations, has shown promise when delivered by trained psychologists⁷⁷ but not when incorporated by trained pediatric diabetes health-care staff into routine consultations.⁷⁸ Nonetheless, there is good evidence that pediatric staff deemed to be “good communicators” are more effective in promoting adherence in the children they take care of⁷⁹ and that training in communication skills is worth investing in.

- Motivational interviewing by psychologists is effective in optimizing outcomes in teenagers.

6 | MENTAL HEALTH DISORDERS (ALSO REFER TO CHAPTER 15 ISPAD 2022 CONSENSUS GUIDELINES ON ‘PSYCHOLOGICAL CARE OF CHILDREN AND ADOLESCENTS WITH TYPE 1 DIABETES’)

T1D seems an etiological factor in de novo psychiatric presentations or causes pre-existing subclinical mental health problems to tip into psychiatric diagnoses.⁸⁰

Mental health assessment is complex in the context of adolescence and screening is recommended.⁸¹ However, in clinical practice, indicators such as DKA admissions, very high HbA1c levels and insulin omission or overdose evident on continuous glucose monitoring (CGM), should be regarded as indirect evidence of possible mental health problems and assessed accordingly.⁸²⁻⁸⁴

Mental health problems in people with T1D can potentially lead to early complications and significantly early mortality,⁸⁵⁻⁸⁷ usually through the interaction of mental health symptoms with insulin misuse. Mental health treatment should ideally be undertaken by clinicians with experience in diabetes.

- Mental health needs during adolescence may supersede other health-care needs, requiring other specialty team involvement and prioritizing interprofessional communication.
- Screening to identify early markers of mental health problems requiring treatment is advised
- Mental health assessment is complex in adolescents, and screening is recommended in those with diabetes, particularly those experiencing recurrent diabetic DKA or chronically very high HbA1c levels.

6.1 | Diabetes distress

Diabetes distress is the negative emotion or affect experienced by approximately 30% of adolescents with T1D.⁸⁸ Although not listed as a mental health disorder in the World Health Organization's

International Classification of Diseases and Related Health Problems, diabetes distress has a complex relationship with the common mental health conditions, depression and anxiety disorders. The presence of diabetes distress can lead to over-diagnosis of depression and therefore clinical assessment is important to discern the cause.^{89,90} It is the presence of diabetes distress long-term rather than depression per se that is more strongly associated with chronic hyperglycemia.⁹¹

- Diabetes distress during adolescence may lead to less consistent use of insulin and other self-care measures with consequent increased glycemic variability.

6.2 | Depression

Adolescents with depression present with a tendency to more somatic symptoms. Core features include low mood, no enjoyment and negative cognitions, although coexistent irritability or oppositional behavior may lead to missed diagnosis. Somatic symptoms such as fatigue and brain-fog may overlap with T1D symptoms from hypo- or hyperglycemia.⁹² Questionnaire studies suggest 30% of youth with T1D have depression.⁹³ Care must be taken to ensure that diabetes distress regarding the burden of T1D is not misconstrued for depression and detailed assessment is necessary to ensure appropriate diagnosis and treatment. There is a high prevalence of depression symptoms in the early stages of diagnosis which usually resolve during adaptation.⁹⁴ Regular screening for depression and co-occurring anxiety and diabetes distress will help identify those most in need of intervention.⁸¹

- Depression may be confused with diabetes distress.
- Careful evaluation and screening for depression or diabetes distress.
- First line treatment for depression where available is cognitive behavioral therapy (CBT).⁹⁵
- In the absence of access to talking therapies or in more severe cases that do not respond to CBT, use of antidepressant medication is indicated. Serotonin reuptake inhibitors (SSRIs) have the best evidence base for depression outcomes and improvements in glycemic control.⁹⁶

6.3 | Anxiety disorders

Anxiety disorders in young people are characterized by intense anxiety in either specific or all areas of life and consequent avoidance of precipitating factors. Like depression, anxiety in adolescents can be masked by what appears to be irritability or stubbornness. In a population of adolescents with T1D, approximately 30% have significant anxiety symptoms and there is significant overlap with diabetes distress.⁹³

Generalized anxiety is described as “free floating” with continual symptoms and no specific focus. There is substantial comorbidity with depression. As a counter to chronic uncomfortable feelings of anxiety, a person will compensate by avoiding as many stressful experiences as possible. In the context of diabetes, this could include not attending appointments, testing blood glucose or taking insulin.

Panic disorder is intense bursts of anxiety in which the person becomes overwhelmed by fear, often with prominent somatic symptoms such as sweating and tachycardia, as well as intense feelings of impending doom. Panic can occur out of the blue or be related to specific experiences, such as, for example, using public transport. Panic episodes can also be superimposed on a background of generalized anxiety. Panic disorder is particularly complicated in T1D, given the extensive overlap of panic symptoms and those of hypoglycemia.

First line treatment for anxiety disorders where available is CBT.⁹⁵ In the absence of access to talking therapies or in more severe cases, the use of antidepressant medication is indicated. Like depression, SSRIs have the best evidence base for effectiveness.⁹⁷

6.4 | Drug and alcohol use

Studies indicate that adolescents with T1D are not more likely to experiment with alcohol or other substances, than their non-T1D peers.^{98,99} However, young adult males with T1D are more likely to have a substance disorder diagnosis, suggesting that such problematic behavior may start earlier in life, during adolescence.^{80,100} Clinicians should be aware that cigarettes, alcohol or drugs may be used by adolescents to manage diabetes distress. However, adolescents' knowledge of the risks regarding alcohol use for someone experiencing diabetes does not necessarily result in affected individuals following guidance on how to drink alcohol safely.⁹⁹

6.5 | Eating disorders and body image

Eating disorders are seen more frequently in the T1D adolescent population,¹⁰¹ with a varying prevalence of 1.6% using psychiatric criteria to 21% using specific tools designed for T1D.¹⁰¹ Key from a diabetes clinicians' point of view, is the degree of overeating and insulin omission. Some people will have a binge eating picture with no under use of insulin and likely tending to develop obesity, whereas others will have a normal eating pattern, but have weight or shape concerns leading to insulin omission, usually with not very low BMI and high HbA1c. Most important to recognize is the degree of clinical risk associated with acute and chronic complications.⁸⁶ Screening tools are useful where services have varying experience in assessment for disordered eating.¹⁰²

Treatment should maintain a shared focus between diabetes management and disordered eating, involving a specialist service or liaison between an Eating Disorder Service and diabetes clinicians.¹⁰³

6.6 | Recurrent diabetic ketoacidosis

There is growing evidence for the association of recurrent DKA episodes and underlying mental health problems, including self-harm and personality function.¹⁰⁴ Although standard practice after DKA is re-education regarding sick day rules, mental health assessment prior to discharge is also advised. Services should use DKA recurrence as an indicator to suggest that an individual, their parent, or other key caregiver is struggling

with their mental health or a frank psychiatric disorder. They should provide appropriate mental health intervention, thereby reducing risk of further DKA and risk of morbidity, poor quality of life and even early mortality from acute and chronic complications.¹⁰⁴

7 | SEXUAL HEALTH

7.1 | Preconception counseling

Preconception counseling aims to promote self-care behaviors leading to healthy babies and mothers with diabetes. Frequently, medical care providers lack the knowledge to address reproductive issues in teenagers,^{105,106} yet adolescents with T1D have inadequate knowledge about the risks of hyperglycemia during pregnancy.^{107,108}

Preconception counseling should begin during early puberty,^{7,109} as unprotected sexual activity in young women with significant hyperglycemia has substantially increased risks for the individual and their offspring.¹⁰⁷ The first phase of preconception care is "awareness counseling", provided well before the need for contraception or pregnancy care. Advice to young people regarding sexual health should consider religious, cultural and familial perspectives,^{28,110} and a non-judgmental approach to sexual activity or sexual orientation is important.¹¹¹ The following should be discussed during medical visits¹¹²:

- the importance of optimal glycemic control before pregnancy to avoid risks to the developing embryo and fetus
- that ovulation is preserved and pregnancy may occur despite hyperglycemia or menstrual irregularities¹¹³
- family planning and contraception.

READY-girls is the only preconception counseling program that has been developed for young adolescents living with diabetes. This program has shown long-lasting benefits.^{106,114} READY-girls is available free of charge in English (www.diabetes.org/ReadyGirls).

7.2 | Contraception

7.2.1 | Barrier methods

Male condoms offer the best protection against sexually transmitted disease (STD) and substantial protection against pregnancy.^{115,116} Diaphragms, female condoms and coitus interruptus, a common practice among teenagers, are not recommended because they are associated with high pregnancy rates.

7.2.2 | Long-acting reversible contraception (LARC)

LARC, which includes intrauterine devices (IUDs) and the subdermal progestin implant, have become a first-line contraceptive choice for adolescents, even if they are nulliparous.¹¹⁷⁻¹²⁰ LARC offers better

protection against unintended pregnancy than oral contraceptives.¹¹⁸ The effect of LARC on glycemic control in very young women with diabetes has not been evaluated though it is the contraceptive with the lowest risk of thromboembolism in women with diabetes.¹²¹ Non-hormonal IUDs may be considered in young people in whom hormonal methods are contraindicated.¹¹⁸ LARC does not protect against STDs nor are they associated with more episodes.

7.2.3 | Combined hormonal oral contraceptives (OCs)

Young people with diabetes without micro- or macro-vascular complications may use any hormonal method,¹²⁰ whereas those with complications should avoid using OCs, but may use IUDs or barrier methods.^{118,120} Newer OCs with a lower estrogen dose ($\leq 35 \mu\text{g}$ ethinyl estradiol) and newer progestogens are not associated with detrimental effects on glycemic control or weight,¹²² though a recent epidemiological study suggested that OCs in young women with diabetes may be associated with a poorer cardiovascular risk profile.¹²³

Young people with diabetes on OCs, should be monitored regularly for side effects. Diabetes per se is not a risk factor for venous thromboembolism,¹²⁰ but the association with other risk factors should be considered. Very obese individuals should be aware that hormonal contraception may have a decreased efficacy and higher risk of venous thromboembolism.¹²⁴ Hormonal patches have shown the highest risk of thromboembolism in adult women with diabetes.¹²¹ Women should be educated about the signs of thromboembolism (abdominal pain, chest pain, headaches, blurred vision (eye), severe leg pain (ACHES)). Those with a history of thrombotic disease should not use combined hormonal contraception.¹²⁰

Polycystic ovarian syndrome, menstrual abnormalities and hyperandrogenism are prevalent in young women with diabetes.^{31,125} The use of an OC may be helpful.^{28,126,127}

Progesterone-only OCs provide insufficient contraception for teenagers who are likely to forget the OCs. Sexually active young people should also be advised about the availability of the “morning after” hormone pill.¹²⁸

7.2.4 | Hormonal injections

Medroxyprogesterone injections have been associated with decreased bone mass gain, which may be especially detrimental for adolescents with T1D. Combined hormonal monthly injection could be considered for youth with T1D with an erratic lifestyle who cannot have LARC but no safety study has been performed in youth with T1D.

7.2.5 | Adverse pregnancy outcomes in adolescents and young women with diabetes

Suboptimal glycemic control around conception increases the risks of congenital malformations, spontaneous abortion, and fetal

death.^{28,127,129–137} A planned pregnancy in a person with diabetes in optimal glycemic control and good health carries only slightly higher risks than those in the general population but not as elevated as previously reported in those with suboptimal glycemic control. However, most pregnancies in young women with diabetes are unplanned and associated with suboptimal glycemic control.^{131,132,138,139} A fifth of live-born infants of unplanned pregnancies in adolescents with Type 2 diabetes had major congenital malformations, despite recommendations about early counseling on contraception and pre-pregnancy counseling.¹⁴⁰ Recent studies show worse outcomes in pregnancies in adolescents with diabetes and higher healthcare utilization during pregnancy,¹³⁷ including a higher risk of preeclampsia and larger babies than adult women with pregestational diabetes.¹⁴¹ However, a nationwide Welsh study showed the similar outcomes of pregnancies in both teenage and older mothers with T1D though hospital admissions during the first year of life were five times more common in the babies of younger mothers.¹³⁵

Access to expert pregnancy management should include:

- pre-pregnancy care in order to plan a healthy pregnancy;
- joint management by an obstetrician and physician with expertise in diabetes and pregnancy; and
- delivery in a hospital with expert maternal, fetal, perinatal, and neonatal care.

8 | BECOMING A YOUNG ADULT

8.1 | Study and examinations

Most adolescents and young adults will be required to complete major academic examinations. Providers should discuss the cognitive effects of hypoglycemia^{142,143} and hyperglycemia.¹⁴⁴ Reasonable accommodations for formal or standardized testing should be provided to students with diabetes.¹⁴⁵ Accommodations should include free access to food (for treatment of hypoglycemia), drink, and lavatory, as well as diabetes equipment including blood glucose meter, CGM, and insulin delivery devices. Adjustments to insulin regimens and/or diet should be made according to maintain euglycemia during exams.

8.2 | Driving

Hypoglycemia is the main factor increasing driving risk in people with diabetes.^{146–148} However, this risk is mitigated with glycemia awareness, stable glycemic control and no visual disability, to the extent that in most settings, youth with diabetes are able to drive non-commercial vehicles. Regulations vary in different countries.¹⁴⁷ Severe hypoglycemia in the preceding months may cause authorities in some areas to delay granting a license or result in suspension. Counseling should include information on relevant regulations and hypoglycemia prevention by blood glucose monitoring before driving, use of CGM and appropriate food intake.

8.3 | Employment

There should be no discrimination or stigma against people with diabetes in the workplace¹⁴⁹ Advice on employment and diabetes should include the following:

- recommendation to inform potential employers about diabetes;
- discussion of those careers that may be unavailable to persons with diabetes, e.g. police officer, firefighter, armed forces and certain public services, driving large goods vehicles or piloting airplanes (regulations vary among countries); and
- preparing for the workplace with responsible diabetes self-care.

8.4 | Young adulthood and leaving home

The developmental stage from the late teens through the twenties has been defined as “emerging adulthood,” a period of significant competing educational, social, work, and financial priorities.¹⁵⁰⁻¹⁵² As young adults with diabetes experience competing life priorities and receive decreased parental support, adherence and glycemic control may decline. Young adults with T1D are at risk for acute complications as well as chronic microvascular complications and early mortality.¹⁵³⁻¹⁵⁵ Young adults need specialized diabetes care and education, including counseling on diabetes self-management, health-care navigation (e.g., maintaining supplies and appointments), and sick-day management.^{151,152} In addition,¹⁵⁶ providing information about T1D for peers and colleagues – including risks, symptoms and treatment of hypoglycemia – is important as the young adult develops independence.

8.5 | Transition from pediatric to adult care

In addition to assuming increased self-care responsibility, young adults will eventually need to transfer from pediatric to adult diabetes providers. The transition from pediatric to adult care should be a planned, organized process rather than a sudden and unanticipated transfer.¹⁵¹ Suboptimal transition and coordination may lead to fragmentation of care delivery and increased risk for adverse outcomes. Transition care challenges documented in the literature include inadequate transition preparation,¹⁵⁷⁻¹⁶⁰ prolonged gaps between pediatric and adult care,^{158,159,161,162} and increased post-transition diabetes hospitalizations.¹⁶³

Age at transition varies according to the individual factors, the availability of appropriate adult diabetes services, and health system regulations. In some countries, youth must transition from pediatric to adult diabetes care at aged 18 years, whereas ongoing care until mid-20s is usual in other countries. Two observational studies from the U.S. suggest worse deterioration of glycemic control in young adults receiving adult care, compared to those still receiving pediatric care.^{69,164} While further research is needed to delineate optimal transition age and predictors of success, delay of transition based on the developmental needs of the young person may be appropriate. Young

adults with diabetes should continue to be seen by a diabetes team (whether pediatric or adult) every 3 months at minimum.

Some diabetes transition interventions have shown promising results, including dedicated young adult clinics,¹⁶⁵⁻¹⁶⁷ intensive transition coordination efforts¹⁶⁸⁻¹⁷⁰ and use of a care ambassador/patient navigator to support the transition process.^{165,171-174} Recent randomized trials have shown increased clinic attendance and lower disengagement rates in young adults with appointment navigation/coordination support.^{171,172,174} Based on the current body of literature, specific transition recommendations include the following:

- development and sharing of a clinic-specific transition care policy;
- transition preparation, education (including counseling on diabetes self-management, diabetes control and complications, differences between pediatric and adult systems, and health-care navigation) and readiness assessment by pediatric providers, ideally starting in the early adolescent years and at least 1 year prior to transition;
- discussion with the young person and their family as to the best time for transfer, based on preference and readiness, as well as regulations and availability of adult services;
- delay of transition until the early twenties may be appropriate for many, ideally with flexibility about transition age as the psychosocial maturity and circumstances of young adults vary widely;
- identification of an adult service able to provide for the needs of young adults with diabetes;
- documentation of a written clinical diabetes summary and transition plan;
- utilization of transition care coordinators/patient navigators to assist with appointment scheduling and attendance, records transfer, and tracking to avoid loss to follow-up; and
- direct communication and handover between pediatric and adult diabetes care teams.

9 | GROUPS NEEDING SPECIAL ATTENTION

For socially vulnerable groups, added biological, behavioral, and socio-environmental factors can contribute to inequity in medical and psychological outcomes. The Social Determinants of Health are a set of factors beyond the personal choices and behaviors of individuals, related to the one's socioeconomic status, environment, and social relationships that greatly influence the one's overall health status.^{175,176} Social determinant domains include economic stability, neighborhood and built environment, education, social and community contexts, and healthcare. Social determinants of health are directly tied to social vulnerabilities including economic status or social class, and can be further exacerbated by racial/ethnic status, gender, or geographic location, among others.¹⁷⁷ Globally, it is estimated that social determinants of health account for 45%–60% of the variation in health status and can result in large inequities in myriad health outcomes, including in diabetes, life expectancy, across continents, countries, states, and regional areas.¹⁷⁵

Socially vulnerable adolescents with diabetes, disproportionately experience negative effects of social determinants, which act as competing priorities to diabetes self-management and major contributors to adverse health outcomes. Adolescents are in a vulnerable period of their lives where they are starting to become independent from the family unit and when economic, social, educational, and behavioral gaps may become more pronounced, especially in the context of social vulnerabilities.¹⁷⁸ Social vulnerability increases the risk of developing diabetes by 2-fold in youth^{179–181} and furthermore contributes to double the risk of suboptimal glycemic control, 1.5 times higher complications, and 2 times higher premature mortality.^{154,182,183} Moreover, low access to high-quality medical care and decreased care engagement compounds these health outcome risks, leading to delays in diagnosis and management and increased utilization of emergency care.^{184–186} In countries and regions that systematically marginalize certain vulnerable groups such as women or racial/ethnic minorities, the unequal distribution of material resources and social advantages has grave effects on health and diabetes.^{187–189}

- Consider screening for social needs at least annually for all youth with diabetes and their families (C).
- Diabetes care plans should accommodate unmet social needs, with appropriate referral to community resources when appropriate (C).

Special attention is needed for socially vulnerable adolescents with diabetes, to prevent progression to adverse outcomes. Ultimately, while cooperation of housing, food, governmental, and health sectors may be necessary, to impact diabetes outcomes at the population level,^{179,190} interventions in the delivery of diabetes care may have significant impact. First and foremost, screening for social determinants of health and vulnerabilities should become a standard of care. The World Health Organization and numerous other international and national organizations have pushed for standardized screening measures to identify social determinants at the point of care.¹⁹⁰ Knowledge of the social determinant of health barriers such as underemployment, housing and utility insecurity, food scarcity, interpersonal issues or social isolation, and the lack of access to necessary medications could greatly impact diabetes care plans and mitigation strategies.^{176,179} In addition, multiple local community-based resources are now available to aid material and mental health needs, which can be leveraged to enhance diabetes self-management for adolescents with diabetes.¹⁷⁹ Group diabetes care formats should be encouraged for socially vulnerable adolescents with diabetes, as peer networking has demonstrated improvement in care engagement and outcomes at this developmental stage and for marginalized youth who may not have strong social support networks for diabetes care.¹⁹¹

Overall, health-care providers, health-care clinics, and larger clinical systems need to create policies that promote and prioritize equitable care to all adolescents with diabetes. Programs that evaluate and treat diabetes in the social context are urgently needed. Several studies addressing housing, food security, and linkage to high-quality healthcare have shown promising improvements in diabetes outcomes among adults,¹⁷⁹ but few research studies and clinical interventions have focused on highly vulnerable adolescents who have unique

developmental needs and require additionally tailored care.^{178,192} In addition, the powerful force of unconscious or implicit bias and its effect on health-care delivery and care engagement, needs to be more fully realized in the care of socially vulnerable adolescents with diabetes, who are often already marginalized by health-care providers.¹⁹³ Ultimately, increased awareness and tailored care for socially vulnerable adolescents with diabetes, will improve generations of health outcomes into adulthood. For details, refer to ISPAD 2022 guidelines Chapter 25 on “Management of Diabetes in children and adolescents with Limited Resources.”

PEER REVIEW

The peer review history for this article is available at <https://publons.com/publon/10.1111/pedi.13408>.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

ORCID

John W. Gregory  <https://orcid.org/0000-0001-5189-3812>

Fergus J. Cameron  <https://orcid.org/0000-0002-1566-7436>

Mirjam Eiswirth  <https://orcid.org/0000-0002-9663-0511>

Ethel Codner  <https://orcid.org/0000-0002-2899-2705>

REFERENCES

1. Foster NC, Beck RW, Miller KM, et al. State of type 1 diabetes management and outcomes from the T1D exchange in 2016–2018. *Diabetes Technol Ther.* 2019;21(2):66–72. doi:10.1089/dia.2018.0384
2. James S, Perry L, Lowe J, Harris M, Craig ME. Group as. Suboptimal glycemic control in adolescents and young adults with type 1 diabetes from 2011 to 2020 across Australia and New Zealand: data from the Australasian diabetes data network registry. *Pediatr Diabetes.* 2022;23:736–741. doi:10.1111/pedi.13364
3. Boettcher C, Tittel SR, Meissner T, et al. Sex differences over time for glycemic control, pump use and insulin dose in patients aged 10–40 years with type 1 diabetes: a diabetes registry study. *BMJ Open Diabetes Res Care.* 2021;9(2):8. doi:10.1136/bmjdr-2021-002494
4. Skinner TC, Channon S, Howells L, Mcevilley A. Diabetes during adolescence. In: Snoek FJ, Skinner, TC, eds. *Psychology in Diabetes Care.* John Wiley & Sons; 2000.
5. Seiffge-Krenka I. *Diabetic Adolescents and their Families: Stress, Coping, and Adaptation.* Cambridge University Press; 2001.
6. Werther GA, Court JM, Eds *Diabetes and the Adolescent.* Miranova Publishers; 1998.
7. American Diabetes Association. 13. Children and adolescents: standards of medical care in Diabetes-2021. *Diabetes Care.* 2021;44(Suppl 1):S180–S199. doi:10.2337/dc21-S013
8. Amiel SA, Sherwin RS, Simonson DC, Lauritano AA, Tamborlane WV. Impaired insulin action in puberty. A contributing factor to poor glycemic control in adolescents with diabetes. *N Engl J Med.* 1986; 315(4):215–219. doi:10.1056/nejm198607243150402
9. Webb KL, Dobson AJ, O’Connell DL, et al. Dietary compliance among insulin-dependent diabetics. *J Chronic Dis.* 1984;37(8):633–643. doi:10.1016/0021-9681(84)90113-9
10. Loman DG, Galgani CA. Physical activity in adolescents with diabetes. *Diabetes Educ.* 1996;22(2):121–125. doi:10.1177/014572179602200204

11. Datye KA, Moore DJ, Russell WE, Jaser SS. A review of adolescent adherence in type 1 diabetes and the untapped potential of diabetes providers to improve outcomes. *Curr Diab Rep*. 2015;15(8):51. doi:[10.1007/s11892-015-0621-6](https://doi.org/10.1007/s11892-015-0621-6)
12. Bryden KS, Neil A, Mayou RA, Peveler RC, Fairburn CG, Dunger DB. Eating habits, body weight, and insulin misuse. A longitudinal study of teenagers and young adults with type 1 diabetes. *Diabetes Care*. 1999;22(12):1956-1960. doi:[10.2337/diacare.22.12.1956](https://doi.org/10.2337/diacare.22.12.1956)
13. Sawyer SM, Drew S, Yeo MS, Britto MT. Adolescents with a chronic condition: challenges living, challenges treating. *Lancet*. 2007;369(9571):1481-1489. doi:[10.1016/s0140-6736\(07\)60370-5](https://doi.org/10.1016/s0140-6736(07)60370-5)
14. Cameron FJ, Skinner TC, de Beaufort CE, et al. Are family factors universally related to metabolic outcomes in adolescents with type 1 diabetes? *Diabet Med*. 2008;25(4):463-468. doi:[10.1111/j.1464-5491.2008.02399.x](https://doi.org/10.1111/j.1464-5491.2008.02399.x)
15. Cameron FJ, Northam EA, Ambler GR, Daneman D. Routine psychological screening in youth with type 1 diabetes and their parents: a notion whose time has come? *Diabetes Care*. 2007;30(10):2716-2724. doi:[10.2337/dc07-0603](https://doi.org/10.2337/dc07-0603)
16. Rogers MAM, Kim C, Banerjee T, Lee JM. Fluctuations in the incidence of type 1 diabetes in the United States from 2001 to 2015: a longitudinal study. *BMC Med*. 2017;15(1):199. doi:[10.1186/s12916-017-0958-6](https://doi.org/10.1186/s12916-017-0958-6)
17. Atkinson MA, Eisenbarth GS, Michels AW. Type 1 diabetes. *Lancet*. 2014;383(9911):69-82. doi:[10.1016/s0140-6736\(13\)60591-7](https://doi.org/10.1016/s0140-6736(13)60591-7)
18. Dabelea D, Bell RA, D'Agostino RB Jr, et al. Incidence of diabetes in youth in the United States. *JAMA*. 2007;297(24):2716-2724. doi:[10.1001/jama.297.24.2716](https://doi.org/10.1001/jama.297.24.2716)
19. Gillespie KM, Nolsoe R, Betin VM, et al. Is puberty an accelerator of type 1 diabetes in IL6-174CC females? *Diabetes*. 2005;54(4):1245-1248.
20. Moran A, Jacobs DR Jr, Steinberger J, et al. Insulin resistance during puberty: results from clamp studies in 357 children. *Diabetes*. 1999;48(10):2039-2044. doi:[10.2337/diabetes.48.10.2039](https://doi.org/10.2337/diabetes.48.10.2039)
21. Edge JA, Dunger DB, Matthews DR, Gilbert JP, Smith CP. Increased overnight growth hormone concentrations in diabetic compared with normal adolescents. *J Clin Endocrinol Metab*. 1990;71(5):1356-1362. doi:[10.1210/jcem-71-5-1356](https://doi.org/10.1210/jcem-71-5-1356)
22. Kelsey MM, Zeitler PS. Insulin resistance of puberty. *Curr Diab Rep*. 2016;16(7):64. doi:[10.1007/s11892-016-0751-5](https://doi.org/10.1007/s11892-016-0751-5)
23. Edge JA, Harris DA, Phillips PE, Pal BR, Matthews DR, Dunger DB. Evidence for a role for insulin and growth hormone in overnight regulation of 3-hydroxybutyrate in normal and diabetic adolescents. *Diabetes Care*. 1993;16(7):1011-1018. doi:[10.2337/diacare.16.7.1011](https://doi.org/10.2337/diacare.16.7.1011)
24. Clements MA, Foster NC, Maahs DM, et al. Hemoglobin A1c (HbA1c) changes over time among adolescent and young adult participants in the T1D exchange clinic registry. *Pediatr Diabetes*. 2016;17(5):327-336. doi:[10.1111/pedi.12295](https://doi.org/10.1111/pedi.12295)
25. Rausch JR, Hood KK, Delamater A, et al. Changes in treatment adherence and glycemic control during the transition to adolescence in type 1 diabetes. *Diabetes Care*. 2012;35(6):1219-1224. doi:[10.2337/dc11-2163](https://doi.org/10.2337/dc11-2163)
26. Fröhlich-Reiterer EE, Rosenbauer J, Bechtold-Dalla Pozza S, Hofer SE, Schober E, Holl RW. Predictors of increasing BMI during the course of diabetes in children and adolescents with type 1 diabetes: data from the German/Austrian DPV multicentre survey. *Arch Dis Child*. 2014;99(8):738-743. doi:[10.1136/archdischild-2013-304237](https://doi.org/10.1136/archdischild-2013-304237)
27. Bergqvist N. The gonadal function in female diabetics. *Acta Endocrinol Suppl*. 1954;19:1-20.
28. Codner E, Soto N, Merino PM. Contraception, and pregnancy in adolescents with type 1 diabetes: a review. *Pediatr Diabetes*. 2012;13(1):108-123. doi:[10.1111/j.1399-5448.2011.00825.x](https://doi.org/10.1111/j.1399-5448.2011.00825.x)
29. Rohrer T, Stierkorb E, Heger S, et al. Delayed pubertal onset and development in German children and adolescents with type 1 diabetes: cross-sectional analysis of recent data from the DPV diabetes documentation and quality management system. *Eur J Endocrinol*. 2007;157(5):647-653. doi:[10.1530/eje-07-0150](https://doi.org/10.1530/eje-07-0150)
30. Gaete X, Vivanco M, Lopez P, Rocha A, Sepúlveda C, Codner E. Earlier puberty in boys with type 1 diabetes mellitus compared to a simultaneously recruited group of control adolescents. *Pediatr Diabetes*. 2019;20(2):197-201. doi:[10.1111/pedi.12811](https://doi.org/10.1111/pedi.12811)
31. Codner E, Cerda T, Gaete X. Puberty in type 1 diabetes mellitus: advances in care are associated with changes in pubertal milestones and hormone profiles. *Current opinion in endocrine and metabolic Research*. 2020;14:85-91. doi:[10.1016/j.coemr.2020.06.002](https://doi.org/10.1016/j.coemr.2020.06.002)
32. Chiarelli F, Giannini C, Mohn A. Growth, growth factors and diabetes. *Eur J Endocrinol*. 2004;151(Suppl 3):U109-U117. doi:[10.1530/eje.0.151u109](https://doi.org/10.1530/eje.0.151u109)
33. Plamper M, Gohlke B, Woelfle J, et al. Interaction of pubertal development and metabolic control in adolescents with type 1 diabetes mellitus. *J Diabetes Res*. 2017;2017:8. doi:[10.1155/2017/8615769](https://doi.org/10.1155/2017/8615769)
34. Ahmed ML, Connors MH, Drayer NM, Jones JS, Dunger DB. Pubertal growth in IDDM is determined by HbA1c levels, sex, and bone age. *Diabetes Care*. 1998;21(5):831-835. doi:[10.2337/diacare.21.5.831](https://doi.org/10.2337/diacare.21.5.831)
35. Dunger D, Ahmed L, Ong K. Growth and body composition in type 1 diabetes mellitus. *Horm Res*. 2002;58(Suppl 1):66-71. doi:[10.1159/000064762](https://doi.org/10.1159/000064762)
36. Bonfig W, Kapellen T, Dost A, et al. Growth in children and adolescents with type 1 diabetes. *J Pediatr*. 2012;160(6):900-903. doi:[10.1016/j.jpeds.2011.12.007](https://doi.org/10.1016/j.jpeds.2011.12.007)
37. Mitchell DM. Growth in patients with type 1 diabetes. *Curr Opin Endocrinol Diabetes Obes*. 2017;24(1):67-72. doi:[10.1097/med.0000000000000310](https://doi.org/10.1097/med.0000000000000310)
38. Bizzarri C, Timpanaro TA, Matteoli MC, Patera IP, Cappa M, Cianfarani S. Growth trajectory in children with type 1 diabetes mellitus: the impact of insulin treatment and metabolic control. *Horm Res Paediatr*. 2018;89(3):172-177. doi:[10.1159/000486698](https://doi.org/10.1159/000486698)
39. Ingberg CM, Särnblad S, Palmér M, Schvarcz E, Berne C, Aman J. Body composition in adolescent girls with type 1 diabetes. *Diabet Med*. 2003;20(12):1005-1011. doi:[10.1046/j.1464-5491.2003.01055.x](https://doi.org/10.1046/j.1464-5491.2003.01055.x)
40. Escobar-Morreale HF, Roldán-Martín MB. Type 1 diabetes and polycystic ovary syndrome: systematic review and meta-analysis. *Diabetes Care*. 2016;39(4):639-648. doi:[10.2337/dc15-2577](https://doi.org/10.2337/dc15-2577)
41. Cameron FJ, Garvey K, Hood KK, Acerini CL, Codner E. ISPAD clinical practice Consensus guidelines 2018: diabetes in adolescence. *Pediatr Diabetes*. 2018;19(Suppl 27):250-261. doi:[10.1111/pedi.12702](https://doi.org/10.1111/pedi.12702)
42. Cecilia-Costa R, Volkening LK, Laffel LM. Factors associated with disordered eating behaviours in adolescents with type 1 diabetes. *Diabet Med*. 2019;36(8):1020-1027. doi:[10.1111/dme.13890](https://doi.org/10.1111/dme.13890)
43. Saylor J, Lee S, Ness M, et al. Positive health benefits of peer support and connections for college students with type 1 diabetes mellitus. *Diabetes Educ*. 2018;44(4):340-347. doi:[10.1177/0145721718765947](https://doi.org/10.1177/0145721718765947)
44. Litchman ML, Walker HR, Ng AH, et al. State of the science: a scoping review and gap analysis of diabetes online communities. *J Diabetes Sci Technol*. 2019;13(3):466-492. doi:[10.1177/1932296819831042](https://doi.org/10.1177/1932296819831042)
45. Troncone A, Cascella C, Chianese A, Iafusco D. Using computerized text analysis to assess communication within an Italian type 1 diabetes Facebook group. *Health Psychol Open*. 2015;2(2):2055102915615338. doi:[10.1177/2055102915615338](https://doi.org/10.1177/2055102915615338)
46. Barnetz Z, Feigin R. "we didn't have to talk": adolescent perception of mentor-mentee relationships in an evaluation study of a mentoring program for adolescents with juvenile diabetes. *Child Adolesc Soc Work J*. 2012;29(6):463-483. doi:[10.1007/s10560-012-0273-1](https://doi.org/10.1007/s10560-012-0273-1)

47. Lu Y, Pyatak EA, Peters AL, et al. Patient perspectives on peer mentoring: type 1 diabetes management in adolescents and young adults. *Diabetes Educ.* 2015;41(1):59-68. doi:10.1177/0145721714559133
48. Raymaekers K, Oris L, Prikken S, et al. The role of peers for diabetes Management in Adolescents and Emerging Adults with Type 1 diabetes: a longitudinal study. *Diabetes Care.* 2017;40(12):1678-1684. doi:10.2337/dc17-0643
49. Suh S, Jean C, Koo M, et al. A randomized controlled trial of an internet-based mentoring program for type 1 diabetes patients with inadequate glycemic control. *Diabetes Metab J.* 2014;38(2):134-142. doi:10.4093/dmj.2014.38.2.134
50. Troncione A, Cascella C, Chianese A, et al. Psychological support for adolescents with type 1 diabetes provided by adolescents with type 1 diabetes: the chat line experience. *Pediatr Diabetes.* 2019;20(6):800-810. doi:10.1111/peidi.12873
51. Greene JA, Choudhry NK, Kilabuk E, Shrank WH. Online social networking by patients with diabetes: a qualitative evaluation of communication with Facebook. *J Gen Intern Med.* 2011;26(3):287-292. doi:10.1007/s11606-010-1526-3
52. Vaala SE, Hood KK, Laffel L, Kumah-Crystal YA, Lybarger CK, Mulvaney SA. Use of commonly available Technologies for Diabetes Information and Self-Management among Adolescents with Type 1 diabetes and their parents: a web-based survey study. *Interact J Med Res.* 2015;4(4):e24. doi:10.2196/ijmr.4504
53. Gavriila V, Garrity A, Hirschfeld E, Edwards B, Lee JM. Peer support through a diabetes social media community. *J Diabetes Sci Technol.* 2019;13(3):493-497. doi:10.1177/1932296818818828
54. Gilbert K, Dodson S, Gill M, McKenzie R. Online communities are valued by people with type 1 diabetes for peer support: how well do health professionals understand this? *Diabetes Spectrum.* 2012;25(3):180-191. doi:10.2337/diaspect.25.3.180
55. Ravert RD, Hancock MD, Ingersoll GM. Online forum messages posted by adolescents with type 1 diabetes. *Diabetes Educ.* 2004;30(5):827-834. doi:10.1177/014572170403000518
56. White K, Gebremariam A, Lewis D, et al. Motivations for participation in an online social Media Community for Diabetes. *J Diabetes Sci Technol.* 2018;12(3):712-718. doi:10.1177/1932296817749611
57. Koteyko N, Hunt D, Gunter B. Expectations in the field of the internet and health: an analysis of claims about social networking sites in clinical literature. *Soc Health Illn.* 2015;37(3):468-484. doi:10.1111/1467-9566.12203
58. Eiswirth ME. Making the invisible visible: sociolinguistics meets medical communication in a travelling exhibition. *J Socioling.* 2021;1-18. doi:10.1111/josl.12516
59. Dickinson JK. The experience of diabetes-related language in diabetes care. *Diabetes Spectr.* 2018;31(1):58-64. doi:10.2337/ds16-0082
60. Koteyko N, Hunt D. Performing health identities on social media: an online observation of Facebook profiles. *Discourse, Context Media.* 2016;12:59-67. doi:10.1016/j.dcm.2015.11.003
61. Fleming M, Fitton CA, Steiner MFC, McLay JS, Clark D, King A, Lindsay RS, Mackay DF, Pell JP Educational and health outcomes of children treated for type 1 diabetes: Scotland-wide record linkage study of 766,047 children. *Diabetes Care Sep* 2019;42(9):1700-1707. doi:10.2337/dc18-2423
62. Kise SS, Hopkins A, Burke S. Improving school experiences for adolescents with type 1 diabetes. *J Sch Health.* 2017;87(5):363-375. doi:10.1111/josh.12507
63. Edwards D, Noyes J, Lowes L, Haf Spencer L, Gregory JW. An ongoing struggle: a mixed-method systematic review of interventions, barriers and facilitators to achieving optimal self-care by children and young people with type 1 diabetes in educational settings. *BMC Pediatr.* 2014;14:228. doi:10.1186/1471-2431-14-228
64. Newbould J, Francis SA, Smith F. Young people's experiences of managing asthma and diabetes at school. *Arch Dis Child.* 2007;92(12):1077-1081. doi:10.1136/adc.2006.110536
65. Wagner J, Heapy A, James A, Abbott G. Brief report: glycemic control, quality of life, and school experiences among students with diabetes. *J Pediatr Psychol.* 2006;31(8):764-769. doi:10.1093/jpepsy/jsj082
66. Eriksen TM, Gaulke A, Thingholm PR, Svensson J, Skipper N. Association of type 1 diabetes and school wellbeing: a population-based cohort study of 436,439 Danish schoolchildren. *Diabetologia.* 2020;63(11):2339-2348. doi:10.1007/s00125-020-05251-z
67. Pansier B, Schulz PJ. School-based diabetes interventions and their outcomes: a systematic literature review. *J Public Health Res.* 2015;4(1):467. doi:10.4081/jphr.2015.467
68. Butler AM, Georges T, Anderson BJ. Family influences. In: Delamater AM, Marrero DG, eds. *Behavioral Diabetes.* Springer Nature Switzerland AG; 2020:105-120.
69. Helgeson VS, Reynolds KA, Snyder PR, et al. Characterizing the transition from paediatric to adult care among emerging adults with type 1 diabetes. *Diabet Med.* 2013;30(5):610-615. doi:10.1111/dme.12067
70. Shorer M, David R, Schoenberg-Taz M, Levavi-Lavi I, Phillip M, Meyerovitch J. Role of parenting style in achieving metabolic control in adolescents with type 1 diabetes. *Diabetes Care.* 2011;34(8):1735-1737. doi:10.2337/dc10-1602
71. DeBoer MD, Valdez R, Chernavsky DR, et al. The impact of frequency and tone of parent-youth communication on type 1 diabetes management. *Diabetes Ther.* 2017;8(3):625-636. doi:10.1007/s13300-017-0259-2
72. Goethals ER, Jaser SS, Verhaak C, et al. Communication matters: the role of autonomy-supportive communication by health care providers and parents in adolescents with type 1 diabetes. *Diabetes Res Clin Pract.* 2020;163:15. doi:10.1016/j.diabres.2020.108153
73. Murphy HR, Wadham C, Hassler-Hurst J, Rayman G, Skinner TC. Randomized trial of a diabetes self-management education and family teamwork intervention in adolescents with type 1 diabetes. *Diabet Med.* 2012;29(8):e249-e254. doi:10.1111/j.1464-5491.2012.03683.x
74. Howe CJ, Ayala J, Dumser S, Buzby M, Murphy K. Parental expectations in the care of their children and adolescents with diabetes. *J Pediatr Nurs.* 2012;27(2):119-126. doi:10.1016/j.pedn.2010.10.006
75. Richards G, Morris M, Booker S, Johnson A. What do people with type 1 diabetes find helpful in health professionals? Results from a focus group study. *Pract Diabetes Int.* 2006;23:249-252.
76. Charalampopoulos D, Hesketh KR, Amin R, Paes VM, Viner RM, Stephenson T. Psycho-educational interventions for children and young people with type 1 diabetes in the UK: how effective are they? A systematic review and meta-analysis. *PLoS One.* 2017;12(6):18. doi:10.1371/journal.pone.0179685
77. Channon SJ, Huws-Thomas MV, Rollnick S, et al. A multicenter randomized controlled trial of motivational interviewing in teenagers with diabetes. *Diabetes Care.* 2007;30(6):1390-1395. doi:10.2337/dc06-2260
78. Robling M, McNamara R, Bennert K, et al. The effect of the talking diabetes consulting skills intervention on glycaemic control and quality of life in children with type 1 diabetes: cluster randomised controlled trial (DEPICTED study). *BMJ.* 2012;344:17. doi:10.1136/bmj.e2359
79. Zolnierok KB, Dimatteo MR. Physician communication and patient adherence to treatment: a meta-analysis. *Med Care.* 2009;47(8):826-834. doi:10.1097/MLR.0b013e31819a5acc
80. Dybdal D, Tolstrup JS, Sildorf SM, et al. Increasing risk of psychiatric morbidity after childhood onset type 1 diabetes: a population-based cohort study. *Diabetologia.* 2018;61(4):831-838. doi:10.1007/s00125-017-4517-7
81. Hilliard ME, De Wit M, Wasserman RM, et al. Screening and support for emotional burdens of youth with type 1 diabetes: strategies for

- diabetes care providers. *Pediatr Diabetes*. 2018;19(3):534-543. doi:[10.1111/pedi.12575](https://doi.org/10.1111/pedi.12575)
82. Berger G, Waldhoer T, Barrientos I, et al. Association of insulin-manipulation and psychiatric disorders: a systematic epidemiological evaluation of adolescents with type 1 diabetes in Austria. *Pediatr Diabetes*. 2019;20(1):127-136. doi:[10.1111/pedi.12784](https://doi.org/10.1111/pedi.12784)
 83. Garrett CJ, Moulton CD, Choudhary P, Amiel SA, Fonagy P, Ismail K. The psychopathology of recurrent diabetic ketoacidosis: a case-control study. *Diabet Med*. 2021;38(7):8. doi:[10.1111/dme.14505](https://doi.org/10.1111/dme.14505)
 84. Petit JM, Goueslard K, Chauvet-Gelinier JC, et al. Association between hospital admission for ketoacidosis and subsequent suicide attempt in young adults with type 1 diabetes. *Diabetologia*. 2020; 63(9):1745-1752. doi:[10.1007/s00125-020-05206-4](https://doi.org/10.1007/s00125-020-05206-4)
 85. Evans-Cheung TC, Bodansky HJ, Parslow RC, Feltbower RG. Mortality and acute complications in children and young adults diagnosed with type 1 diabetes in Yorkshire, UK: a cohort study. *Diabet Med*. 2018;35(1):112-120. doi:[10.1111/dme.13544](https://doi.org/10.1111/dme.13544)
 86. Gibbings NK, Kurdyak PA, Colton PA, Shah BR. Diabetic ketoacidosis and mortality in people with type 1 diabetes and eating disorders. *Diabetes Care*. 2021;44(8):1783-1787. doi:[10.2337/dc21-0517](https://doi.org/10.2337/dc21-0517)
 87. Shulman R, Luo J, Shah BR. Mental health visits and low socioeconomic status in adolescence are associated with complications of type 1 diabetes in early adulthood: a population-based cohort study. *Diabet Med*. 2018;35(7):920-928. doi:[10.1111/dme.13633](https://doi.org/10.1111/dme.13633)
 88. Hagger V, Hendrieckx C, Sturt J, Skinner TC, Speight J. Diabetes distress among adolescents with type 1 diabetes: a systematic review. *Curr Diab Rep*. 2016;16(1):9. doi:[10.1007/s11892-015-0694-2](https://doi.org/10.1007/s11892-015-0694-2)
 89. Merikangas KR, He JP, Burstein M, et al. Lifetime prevalence of mental disorders in U.S. adolescents: results from the National Comorbidity Survey Replication--Adolescent Supplement (NCS-A). *J Am Acad Child Adolesc Psychiatry*. 2010;49(10):980-989. doi:[10.1016/j.jaac.2010.05.017](https://doi.org/10.1016/j.jaac.2010.05.017)
 90. Joint British Diabetes Societies for Inpatient Care. The management of diabetes in adults and children with psychiatric disorders in inpatient settings. *Royal Coll Psych*. 2017;40. https://abcd.care/sites/abcd.care/files/resources/JBDS_MentalHealth_%2031082017.pdf
 91. Skinner TC, Joensen L, Parkin T. Twenty-five years of diabetes distress research. *Diabet Med*. 2020;37(3):393-400. doi:[10.1111/dme.14157](https://doi.org/10.1111/dme.14157)
 92. Carroll NC, Vittrup B. Type 1 diabetes in adolescence: considerations for mental health professionals. *J Child Adolesc Counsel*. 2020; 6(2):137-148. doi:[10.1080/23727810.2020.1729010](https://doi.org/10.1080/23727810.2020.1729010)
 93. Buchberger B, Huppertz H, Krabbe L, Lux B, Mattivi JT, Siafarikas A. Symptoms of depression and anxiety in youth with type 1 diabetes: a systematic review and meta-analysis. *Psychoneuroendocrinology*. 2016;70:70-84. doi:[10.1016/j.psyneuen.2016.04.019](https://doi.org/10.1016/j.psyneuen.2016.04.019)
 94. DeCosta P, Grabowski D, Skinner TC. The psychosocial experience and needs of children newly diagnosed with type 1 diabetes from their own perspective: a systematic and narrative review. *Diabet Med*. 2020;37(10):1640-1652. doi:[10.1111/dme.14354](https://doi.org/10.1111/dme.14354)
 95. Young-Hyman D, de Groot M, Hill-Briggs F, Gonzalez JS, Hood K, Peyrot M. Psychosocial Care for People with Diabetes: a position statement of the American Diabetes Association. *Diabetes Care*. 2016;39(12):2126-2140. doi:[10.2337/dc16-2053](https://doi.org/10.2337/dc16-2053)
 96. Baumeister H, Hutter N, Bengel J. Psychological and pharmacological interventions for depression in patients with diabetes mellitus: an abridged Cochrane review. *Diabet Med*. 2014;31(7):773-786. doi:[10.1111/dme.12452](https://doi.org/10.1111/dme.12452)
 97. Wehry AM, Beesdo-Baum K, Hennelly MM, Connolly SD, Strawn JR. Assessment and treatment of anxiety disorders in children and adolescents. *Curr Psychiatry Rep*. 2015;17(7):52. doi:[10.1007/s11920-015-0591-z](https://doi.org/10.1007/s11920-015-0591-z)
 98. Martínez-Aguayo A, Araneda JC, Fernandez D, Gleisner A, Perez V, Codner E. Tobacco, alcohol, and illicit drug use in adolescents with diabetes mellitus. *Pediatr Diabetes*. 2007;8(5):265-271. doi:[10.1111/j.1399-5448.2007.00307.x](https://doi.org/10.1111/j.1399-5448.2007.00307.x)
 99. Potter K, Luca P, Pacaud D, et al. Prevalence of alcohol, tobacco, cannabis and other illicit substance use in a population of Canadian adolescents with type 1 diabetes compared to a general adolescent population. *Paediatr Child Health*. 2018;23(3):185-190. doi:[10.1093/pch/pxx157](https://doi.org/10.1093/pch/pxx157)
 100. Creo A, Sriram S, Vaughan LE, Weaver AL, Lteif A, Kumar S. Risk of substance use disorders among adolescents and emerging adults with type 1 diabetes: a population-based cohort study. *Pediatr Diabetes*. 2021;22(8):1143-1149. doi:[10.1111/pedi.13266](https://doi.org/10.1111/pedi.13266)
 101. Wagner G, Karwautz A. Eating disorders in adolescents with type 1 diabetes mellitus. *Curr Opin Psychiatry*. 2020;33(6):602-610. doi:[10.1097/ycp.0000000000000650](https://doi.org/10.1097/ycp.0000000000000650)
 102. Pursey KM, Hart M, Jenkins L, McEvoy M, Smart CE. Screening and identification of disordered eating in people with type 1 diabetes: a systematic review. *J Diabetes Complications*. 2020;34(4):24. doi:[10.1016/j.jdiacomp.2020.107522](https://doi.org/10.1016/j.jdiacomp.2020.107522)
 103. Clery P, Stahl D, Ismail K, Treasure J, Kan C. Systematic review and meta-analysis of the efficacy of interventions for people with type 1 diabetes mellitus and disordered eating. *Diabet Med*. 2017;34(12): 1667-1675. doi:[10.1111/dme.13509](https://doi.org/10.1111/dme.13509)
 104. Ehrmann D, Kulzer B, Roos T, Haak T, Al-Khatib M, Hermanns N. Risk factors and prevention strategies for diabetic ketoacidosis in people with established type 1 diabetes. *Lancet Diabetes Endocrinol*. 2020;8(5):436-446. doi:[10.1016/s2213-8587\(20\)30042-5](https://doi.org/10.1016/s2213-8587(20)30042-5)
 105. Kohn JR, Hilliard ME, Lyons SK, Fox KA, Kushner JA. Identifying and addressing gaps in reproductive health education for adolescent girls with type 1 diabetes. *PLoS One*. 2018;13(11):15. doi:[10.1371/journal.pone.0206102](https://doi.org/10.1371/journal.pone.0206102)
 106. Sina M, MacMillan F, Dune T, et al. Development of an integrated, district-wide approach to pre-pregnancy management for women with pre-existing diabetes in a multi-ethnic population. *BMC Pregnancy Childbirth*. 2018;18(1):402. doi:[10.1186/s12884-018-2028-2](https://doi.org/10.1186/s12884-018-2028-2)
 107. Giraudo F, Lalanne I, Valdés I, Gajardo A, Charron-Prochownik D, Codner E. Risky sexual behaviors in adolescents and young adult women with type 1 diabetes: an overlooked problem. *Pediatr Diabetes*. 2021;22(7):1092-1098. doi:[10.1111/pedi.13245](https://doi.org/10.1111/pedi.13245)
 108. Wotoszyn-Durkiewicz A, Żalińska M, Brandt A, Myśliwiec M, Ściesińska M, Kuhn J. Assessing the knowledge of the consequences of uncontrolled diabetes in pregnancy and its effects on fetal development, among female adolescents with type 1 diabetes. *Pediatr Endocrinol Diabetes Metab*. 2017;23(4):188-196. doi:[10.18544/pedm-23.04.0092](https://doi.org/10.18544/pedm-23.04.0092)
 109. Chiang JL, Maahs DM, Garvey KC, et al. Type 1 diabetes in children and adolescents: a position statement by the American Diabetes Association. *Diabetes Care*. 2018;41(9):2026-2044. doi:[10.2337/dci18-0023](https://doi.org/10.2337/dci18-0023)
 110. Abujaradeh H, Olshansky E, Peterson-Burch F, et al. Adolescent Latinas' with diabetes and their Mothers' understanding of diabetes and reproductive health: converging themes to inform a culturally sensitive preconception counseling program. *J Pediatr Health Care*. 2021;35(2):205-215. doi:[10.1016/j.pedhc.2020.10.004](https://doi.org/10.1016/j.pedhc.2020.10.004)
 111. American Diabetes Association. 12. Children and adolescents. *Diabetes Care*. 2017;40(Suppl 1):S105-S113. doi:[10.2337/dc17-S015](https://doi.org/10.2337/dc17-S015)
 112. Peterson-Burch F, Abujaradeh H, Charache N, Fischl A, Charron-Prochownik D. Preconception counseling for adolescents and Young adults with diabetes: a literature review of the past 10 years. *Curr Diab Rep*. 2018;18(3):11. doi:[10.1007/s11892-018-0983-7](https://doi.org/10.1007/s11892-018-0983-7)
 113. Codner E, Eyzaguirre FC, Iñiguez G, et al. Ovulation rate in adolescents with type 1 diabetes mellitus. *Fertil Steril*. 2011;95(1):197-202. doi:[10.1016/j.fertnstert.2010.10.041](https://doi.org/10.1016/j.fertnstert.2010.10.041)
 114. Charron-Prochownik D, Sereika SM, Becker D, et al. Long-term effects of the booster-enhanced READY-girls preconception counseling program on intentions and behaviors for family planning

- in teens with diabetes. *Diabetes Care*. 2013;36(12):3870-3874. doi:[10.2337/dc13-0355](https://doi.org/10.2337/dc13-0355)
115. Committee On Adolescence. Condom use by adolescents. *Pediatrics*. 2013;132(5):973-981. doi:[10.1542/peds.2013-2821](https://doi.org/10.1542/peds.2013-2821)
 116. Thurheimer J, Sereika SM, Founds S, Downs J, Charron-Prochownik D. Efficacy of the READY-girls program on general risk-taking behaviors, condom use, and sexually transmitted infections among Young adolescent females with type 1 diabetes. *Diabetes Educ*. 2016;42(6):712-720. doi:[10.1177/0145721716668651](https://doi.org/10.1177/0145721716668651)
 117. Jatlaoui TC, Riley HEM, Curtis KM. The safety of intrauterine devices among young women: a systematic review. *Contraception*. 2017;95(1):17-39. doi:[10.1016/j.contraception.2016.10.006](https://doi.org/10.1016/j.contraception.2016.10.006)
 118. Salinas A, Merino PM, Giraudo F, Codner E. Long-acting contraception in adolescents and young women with type 1 and type 2 diabetes. *Pediatr Diabetes*. 2020;21(7):1074-1082. doi:[10.1111/pedi.13069](https://doi.org/10.1111/pedi.13069)
 119. Secura GM, Madden T, McNicholas C, et al. Provision of no-cost, long-acting contraception and teenage pregnancy. *N Engl J Med*. 2014;371(14):1316-1323. doi:[10.1056/NEJMoa1400506](https://doi.org/10.1056/NEJMoa1400506)
 120. Department of Reproductive Health WHO. *Medical Eligibility Criteria for Contraceptive Use*. 5th ed. World Health Organization; 2015.
 121. O'Brien SH, Koch T, Vesely SK, Schwarz EB. Hormonal contraception and risk of thromboembolism in women with diabetes. *Diabetes Care*. 2017;40(2):233-238. doi:[10.2337/dc16-1534](https://doi.org/10.2337/dc16-1534)
 122. Visser J, Snel M, Van Vliet HA. Hormonal versus non-hormonal contraceptives in women with diabetes mellitus type 1 and 2. *Cochrane Database Syst Rev*. 2013;2013(3):24. doi:[10.1002/14651858.CD003990.pub4](https://doi.org/10.1002/14651858.CD003990.pub4)
 123. Bohn B, Mönkemöller K, Hilgard D, et al. Oral contraception in adolescents with type 1 diabetes and its association with cardiovascular risk factors. A multicenter DPV study on 24 011 patients from Germany, Austria or Luxembourg. *Pediatr Diabetes*. 2018;19(5):937-944. doi:[10.1111/pedi.12656](https://doi.org/10.1111/pedi.12656)
 124. Carmine L. Contraception for adolescents with medically complex conditions. *Curr Probl Pediatr Adolesc Health Care*. 2018;48(12):345-357. doi:[10.1016/j.cppeds.2018.11.004](https://doi.org/10.1016/j.cppeds.2018.11.004)
 125. Thong EP, Codner E, Laven JSE, Teede H. Diabetes: a metabolic and reproductive disorder in women. *Lancet Diabetes Endocrinol*. 2020;8(2):134-149. doi:[10.1016/s2213-8587\(19\)30345-6](https://doi.org/10.1016/s2213-8587(19)30345-6)
 126. Ibáñez L, Oberfield SE, Witchel S, et al. An international consortium update: pathophysiology, diagnosis, and treatment of polycystic ovarian syndrome in adolescence. *Horm Res Paediatr*. 2017;88(6):371-395. doi:[10.1159/000479371](https://doi.org/10.1159/000479371)
 127. Codner E, Merino PM, Tena-Sempere M. Female reproduction and type 1 diabetes: from mechanisms to clinical findings. *Hum Reprod Update*. 2012;18(5):568-585. doi:[10.1093/humupd/dms024](https://doi.org/10.1093/humupd/dms024)
 128. Verhaeghe J. Clinical practice: contraception in adolescents. *Eur J Pediatr*. 2012;171(6):895-899. doi:[10.1007/s00431-012-1676-x](https://doi.org/10.1007/s00431-012-1676-x)
 129. Zheng X, Yang D, Luo S, et al. Association of Implementation of a comprehensive preconception-to-pregnancy management plan with pregnancy outcomes among Chinese pregnant women with type 1 diabetes: the CARNATION study. *Diabetes Care*. 2021;44(4):883-892. doi:[10.2337/dc20-2692](https://doi.org/10.2337/dc20-2692)
 130. Forde R, Collin J, Brackenridge A, Chamley M, Hunt K, Forbes A. A qualitative study exploring the factors that influence the uptake of pre-pregnancy care among women with type 2 diabetes. *Diabet Med*. 2020;37(6):1038-1048. doi:[10.1111/dme.14040](https://doi.org/10.1111/dme.14040)
 131. Gaudio M, Dozio N, Feher M, et al. Trends in factors affecting pregnancy outcomes among women with type 1 or type 2 diabetes of childbearing age (2004-2017). *Front Endocrinol (Lausanne)*. 2020;11:9. doi:[10.3389/fendo.2020.596633](https://doi.org/10.3389/fendo.2020.596633)
 132. Murphy HR, Howgate C, O'Keefe J, et al. Characteristics and outcomes of pregnant women with type 1 or type 2 diabetes: a 5-year national population-based cohort study. *Lancet Diabetes Endocrinol*. 2021;9(3):153-164. doi:[10.1016/s2213-8587\(20\)30406-x](https://doi.org/10.1016/s2213-8587(20)30406-x)
 133. Page JM, Allshouse AA, Cassimatis I, et al. Characteristics of stillbirths associated with diabetes in a diverse U.S. cohort. *Obstet Gynecol*. 2020;136(6):1095-1102. doi:[10.1097/aog.0000000000004117](https://doi.org/10.1097/aog.0000000000004117)
 134. Vélez MP, Slater M, Griffiths R, et al. Diabetes during pregnancy and perinatal outcomes among first nations women in Ontario, 2002/03-2014/15: a population-based cohort study. *CMAJ Open*. 2020;8(1):E214-E225. doi:[10.9778/cmajo.20190195](https://doi.org/10.9778/cmajo.20190195)
 135. Allen LA, Cannings-John RL, Evans A, et al. Pregnancy in teenagers diagnosed with type 1 diabetes mellitus in childhood: a national population-based e-cohort study. *Diabetologia*. 2020;63(4):799-810. doi:[10.1007/s00125-019-05063-w](https://doi.org/10.1007/s00125-019-05063-w)
 136. Davidson AJF, Park AL, Berger H, et al. Risk of severe maternal morbidity or death in relation to elevated hemoglobin A1c preconception, and in early pregnancy: a population-based cohort study. *PLoS Med*. 2020;17(5):18. doi:[10.1371/journal.pmed.1003104](https://doi.org/10.1371/journal.pmed.1003104)
 137. Kohn JR, Rajan SS, Kushner JA, Fox KA. Outcomes, care utilization, and expenditures in adolescent pregnancy complicated by diabetes. *Pediatr Diabetes*. 2019;20(6):769-777. doi:[10.1111/pedi.12871](https://doi.org/10.1111/pedi.12871)
 138. Murphy HR, Bell R, Dornhorst A, Forde R, Lewis-Barned N. Pregnancy in diabetes: challenges and opportunities for improving pregnancy outcomes. *Diabet Med*. 2018;35(3):292-299. doi:[10.1111/dme.13579](https://doi.org/10.1111/dme.13579)
 139. Stone RG, Scully P, Troy E, et al. Pregnancy outcomes in women with onset of type 1 diabetes mellitus less than 18 years of age. *BMJ Open Diabetes Res Care*. 2020;8(1):5. doi:[10.1136/bmjdr-2019-001080](https://doi.org/10.1136/bmjdr-2019-001080)
 140. Klingensmith GJ, Pyle L, Nadeau KJ, et al. Pregnancy outcomes in youth with type 2 diabetes: the TODAY study experience. *Diabetes Care*. 2016;39(1):122-129. doi:[10.2337/dc15-1206](https://doi.org/10.2337/dc15-1206)
 141. Walker AR, Waites BT, Caughey AB. The impact of extremes of maternal age on maternal and neonatal pregnancy outcomes in women with pregestational diabetes mellitus. *J Matern Fetal Neonatal Med* Feb 2020;33(3):437-441. doi:[10.1080/14767058.2018.1494713](https://doi.org/10.1080/14767058.2018.1494713)
 142. McCrimmon RJ, Ryan CM, Frier BM. Diabetes and cognitive dysfunction. *Lancet*. 2012;379(9833):2291-2299. doi:[10.1016/s0140-6736\(12\)60360-2](https://doi.org/10.1016/s0140-6736(12)60360-2)
 143. Ryan CM, Atchison J, Puczynski S, Puczynski M, Arslanian S, Becker D. Mild hypoglycemia associated with deterioration of mental efficiency in children with insulin-dependent diabetes mellitus. *J Pediatr*. 1990;117(1 Pt 1):32-38. doi:[10.1016/s0022-3476\(05\)82440-0](https://doi.org/10.1016/s0022-3476(05)82440-0)
 144. Gonder-Frederick LA, Zrebiec JF, Bauchowitz AU, et al. Cognitive function is disrupted by both hypo- and hyperglycemia in school-aged children with type 1 diabetes: a field study. *Diabetes Care*. 2009;32(6):1001-1006. doi:[10.2337/dc08-1722](https://doi.org/10.2337/dc08-1722)
 145. Jackson CC, Albanese-O'Neill A, Butler KL, et al. Diabetes care in the school setting: a position statement of the American Diabetes Association. *Diabetes Care*. 2015;38(10):1958-1963. doi:[10.2337/dc15-1418](https://doi.org/10.2337/dc15-1418)
 146. Inkster B, Frier BM. Diabetes and driving. *Diabetes Obes Metab*. 2013;15(9):775-783. doi:[10.1111/dom.12071](https://doi.org/10.1111/dom.12071)
 147. Graveling AJ, Frier BM. Driving and diabetes: problems, licensing restrictions and recommendations for safe driving. *Clin Diabetes Endocrinol*. 2015;1:8. doi:[10.1186/s40842-015-0007-3](https://doi.org/10.1186/s40842-015-0007-3)
 148. Cox DJ, Singh H, Lorber D, Hermayer K. Diabetes and driving safety: science, ethics, legality and practice. *Am J Med Sci*. 2013;345(4):263-265. doi:[10.1097/MAJ.0b013e31828bf8d7](https://doi.org/10.1097/MAJ.0b013e31828bf8d7)
 149. Anderson JE, Greene MA, Griffin JW Jr, et al. Diabetes and employment. *Diabetes Care*. 2014;37(Suppl 1):S112-S117. doi:[10.2337/dc14-S112](https://doi.org/10.2337/dc14-S112)
 150. Arnett JJ. Emerging adulthood. A theory of development from the late teens through the twenties. *Am Psychol*. 2000;55(5):469-480.
 151. Peters A, Laffel L. Diabetes care for emerging adults: recommendations for transition from pediatric to adult diabetes care systems: a

- position statement of the American Diabetes Association, with representation by the American College of Osteopathic Family Physicians, the American Academy of Pediatrics, the American Association of Clinical Endocrinologists, the American Osteopathic Association, the Centers for Disease Control and Prevention, children with diabetes, the Endocrine Society, the International Society for Pediatric and Adolescent Diabetes, Juvenile Diabetes Research Foundation International, the National Diabetes Education Program, and the pediatric Endocrine Society (formerly Lawson Wilkins pediatric Endocrine Society). *Diabetes Care*. 2011;34(11):2477-2485. doi:10.2337/dc11-1723
152. Weissberg-Benchell J, Wolpert H, Anderson BJ. Transitioning from pediatric to adult care: a new approach to the post-adolescent young person with type 1 diabetes. *Diabetes Care*. 2007;30(10):2441-2446. doi:10.2337/dc07-1249
 153. Bryden KS, Dunger DB, Mayou RA, Peveler RC, Neil HA. Poor prognosis of young adults with type 1 diabetes: a longitudinal study. *Diabetes Care*. 2003;26(4):1052-1057. doi:10.2337/diacare.26.4.1052
 154. Dabelea D, Stafford JM, Mayer-Davis EJ, et al. Association of Type 1 diabetes vs type 2 diabetes diagnosed during childhood and adolescence with complications during teenage years and Young adulthood. *JAMA*. 2017;317(8):825-835. doi:10.1001/jama.2017.0686
 155. Laing SP, Jones ME, Swerdlow AJ, Burden AC, Gatling W. Psychosocial and socioeconomic risk factors for premature death in young people with type 1 diabetes. *Diabetes Care*. 2005;28(7):1618-1623. doi:10.2337/diacare.28.7.1618
 156. Skinner TC, Murphy H, Hews-Thomas H-T. Diabetes in Adolescents. In: Snoek FJ, Skinner TC, eds. *Psychology in Diabetes Care*; Wiley; 2000:27-51.
 157. Busse FP, Hiermann P, Galler A, et al. Evaluation of patients' opinion and metabolic control after transfer of young adults with type 1 diabetes from a pediatric diabetes clinic to adult care. *Horm Res*. 2007;67(3):132-138. doi:10.1159/000096583
 158. Garvey KC, Foster NC, Agarwal S, et al. Health care transition preparation and experiences in a U.S. National Sample of Young adults with type 1 diabetes. *Diabetes Care*. 2017;40(3):317-324. doi:10.2337/dc16-1729
 159. Garvey KC, Wolpert HA, Rhodes ET, et al. Health care transition in patients with type 1 diabetes: young adult experiences and relationship to glycemic control. *Diabetes Care*. 2012;35(8):1716-1722. doi:10.2337/dc11-2434
 160. White M, O'Connell M, Cameron FJ. Transition in type 1 diabetes mellitus from a tertiary pediatric center: what are we doing before they walk out the door? *Diabetes Manag*. 2012;2:379-384.
 161. Kipps S, Bahu T, Ong K, et al. Current methods of transfer of young people with type 1 diabetes to adult services. *Diabet Med*. 2002;19(8):649-654. doi:10.1046/j.1464-5491.2002.00757.x
 162. Pacaud D, Yale JF, Stephure D, Trussell R, Davies HD. Problems in transition from pediatric care to adult care for individuals with diabetes. *Can J Diabetes*. 2005;29(1):13-18.
 163. Nakhla M, Daneman D, To T, Paradis G, Guttman A. Transition to adult care for youths with diabetes mellitus: findings from a universal health care system. *Pediatrics*. 2009;124(6):e1134-e1141. doi:10.1542/peds.2009-0041
 164. Lotstein DS, Seid M, Klingensmith G, et al. Transition from pediatric to adult care for youth diagnosed with type 1 diabetes in adolescence. *Pediatrics*. 2013;131(4):e1062-e1070. doi:10.1542/peds.2012-1450
 165. Holmes-Walker DJ, Llewellyn AC, Farrell K. A transition care programme which improves diabetes control and reduces hospital admission rates in young adults with type 1 diabetes aged 15-25 years. *Diabet Med*. 2007;24(7):764-769. doi:10.1111/j.1464-5491.2007.02152.x
 166. Lane JT, Ferguson A, Hall J, et al. Glycemic control over 3 years in a young adult clinic for patients with type 1 diabetes. *Diabetes Res Clin Pract*. 2007;78(3):385-391. doi:10.1016/j.diabres.2007.04.014
 167. Logan J, Peralta E, Brown K, Moffett M, Advani A, Leech N. Smoothing the transition from paediatric to adult services in type 1 diabetes. *J Diabetes Nurs*. 2008;12(9):328-338.
 168. Sequeira PA, Pyatak EA, Weigensberg MJ, et al. Let's empower and prepare (LEAP): evaluation of a structured transition program for Young adults with type 1 diabetes. *Diabetes Care*. 2015;38(8):1412-1419. doi:10.2337/dc14-2577
 169. Vidal M, Jansa M, Anguita C, et al. Impact of a special therapeutic education programme in patients transferred from a paediatric to an adult diabetes unit. *Eur Diab Nurs*. 2004;1(1):23-27. doi:10.1002/edn.5
 170. Cadario F, Prodram F, Bellone S, et al. Transition process of patients with type 1 diabetes (T1DM) from paediatric to the adult health care service: a hospital-based approach. *Clin Endocrinol (Oxf)*. 2009;71(3):346-350. doi:10.1111/j.1365-2265.2008.03467.x
 171. Butalia S, Crawford SG, McGuire KA, Dyjur DK, Mercer JR, Pacaud D. Improved transition to adult care in youth with type 1 diabetes: a pragmatic clinical trial. *Diabetologia*. 2021;64(4):758-766. doi:10.1007/s00125-020-05368-1
 172. Spaic T, Robinson T, Goldbloom E, et al. Closing the gap: results of the multicenter Canadian randomized controlled trial of structured transition in Young adults with type 1 diabetes. *Diabetes Care*. 2019;42(6):1018-1026. doi:10.2337/dc18-2187
 173. Van Wallegem N, Macdonald CA, Dean HJ. Evaluation of a systems navigator model for transition from pediatric to adult care for young adults with type 1 diabetes. *Diabetes Care*. 2008;31(8):1529-1530. doi:10.2337/dc07-2247
 174. White M, O'Connell MA, Cameron FJ. Clinic attendance and disengagement of young adults with type 1 diabetes after transition of care from paediatric to adult services (TrACeD): a randomised, open-label, controlled trial. *Lancet Child Adolesc Health*. 2017;1(4):274-283. doi:10.1016/s2352-4642(17)30089-5
 175. Commission on Social Determinants of Health. *Closing the Gap in a Generation: Health Equity through Action on the Social Determinants of Health: Final Report of the Commission on Social Determinants of Health*. World Health Organization; 2008.
 176. World Health Organization. *Healthy People 2020: Social Determinants of Health*. Federal Government Website, managed by the US Department of Health & Human Services; 2020. cited Apr 1 2018, <https://www.healthypeople.gov/2020/topics-objectives/topic/social-determinants-of-health>
 177. ATSDR: Agency for Toxic Substances and Disease Registry. CDC/ATSDR social vulnerability index. Centers for disease prevention and control: Place and Health. 2021. Accessed July 6, 2021. <https://www.atsdr.cdc.gov/placeandhealth/svi/index.html>
 178. Agarwal S, Hilliard M, Butler A. Disparities in care delivery and outcomes in Young adults with diabetes. *Curr Diab Rep*. 2018;18(9):65. doi:10.1007/s11892-018-1037-x
 179. Hill-Briggs F, Adler NE, Berkowitz SA, et al. Social determinants of health and diabetes: a scientific review. *Diabetes Care*. 2020;44(1):258-279. doi:10.2337/dci20-0053
 180. Pettitt DJ, Talton J, Dabelea D, et al. Prevalence of diabetes in U.S. youth in 2009: the SEARCH for diabetes in youth study. *Diabetes Care*. 2014;37(2):402-408. doi:10.2337/dc13-1838
 181. Zeitler P, Hirst K, Pyle L, et al. A clinical trial to maintain glycemic control in youth with type 2 diabetes. *New Engl J Med*. 2012;366(24):2247-2256. doi:10.1056/NEJMoa1109333
 182. Agarwal S, Kanapka LG, Raymond JK, et al. Racial-ethnic inequity in Young adults with type 1 diabetes. *J Clin Endocrinol Metab*. 2020;105(8):e2960-e2969. doi:10.1210/clinem/dgaa236
 183. Livingstone SJ, Levin D, Looker HC, et al. Estimated life expectancy in a Scottish cohort with type 1 diabetes, 2008-2010. *JAMA*. 2015;313(1):37-44. doi:10.1001/jama.2014.16425
 184. Crossen SS, Wilson DM, Saynina O, Sanders LM. Outpatient care preceding hospitalization for diabetic ketoacidosis. *Pediatrics*. 2016;137(6):8. doi:10.1542/peds.2015-3497

185. Ke C, Lau E, Shah BR, et al. Excess Burden of mental illness and hospitalization in Young-onset type 2 diabetes: a population-based cohort study. *Ann Intern Med.* 2019;170(3):145-154. doi:[10.7326/m18-1900](https://doi.org/10.7326/m18-1900)
186. Valenzuela JM, Seid M, Waitzfelder B, et al. Prevalence of and disparities in barriers to care experienced by youth with type 1 diabetes. *J Pediatr.* 2014;164(6):1369-1375. doi:[10.1016/j.jpeds.2014.01.035](https://doi.org/10.1016/j.jpeds.2014.01.035)
187. Fagot-Campagna A, Pettitt DJ, Engelgau MM, et al. Type 2 diabetes among north American children and adolescents: an epidemiologic review and a public health perspective. *J Pediatr.* 2000;136(5):664-672. doi:[10.1067/mpd.2000.105141](https://doi.org/10.1067/mpd.2000.105141)
188. Glezeva N, Chisale M, McDonald K, Ledwidge M, Gallagher J, Watson CJ. Diabetes and complications of the heart in sub-Saharan Africa: an urgent need for improved awareness, diagnostics and management. *Diabetes Res Clin Pract.* 2018;137:910-919. doi:[10.1016/j.diabres.2017.12.019](https://doi.org/10.1016/j.diabres.2017.12.019)
189. Vilms RJ, McDougal L, Atmavilas Y, et al. Gender inequities in curative and preventive health care use among infants in Bihar, India. *J Glob Health.* 2017;7(2):10. doi:[10.7189/jogh.07.020402](https://doi.org/10.7189/jogh.07.020402)
190. World Health Organization social determinants of health. Rio political declaration on social determinants of Health 2011. <https://www.who.int/publications/m/item/rio-political-declaration-on-social-determinants-of-health>
191. Raymond JK, Shea JJ, Berget C, et al. A novel approach to adolescents with type 1 diabetes: the team clinic model. *Diabetes Spectr.* 2015;28(1):68-71. doi:[10.2337/diaspect.28.1.68](https://doi.org/10.2337/diaspect.28.1.68)
192. Harris MA, Wagner DV, Heywood M, Hoehn D, Bahia H, Spiro K. Youth repeatedly hospitalized for DKA: proof of concept for novel interventions in children's healthcare (NICH). *Diabetes Care.* 2014;37(6):e125-e126. doi:[10.2337/dc13-2232](https://doi.org/10.2337/dc13-2232)
193. Hall WJ, Chapman MV, Lee KM, et al. Implicit racial/ethnic bias among health care professionals and its influence on health care outcomes: a systematic review. *Am J Public Health.* 2015;105(12):e60-e76. doi:[10.2105/ajph.2015.302903](https://doi.org/10.2105/ajph.2015.302903)

How to cite this article: Gregory JW, Cameron FJ, Joshi K, et al. ISPAD Clinical Practice Consensus Guidelines 2022: Diabetes in adolescence. *Pediatr Diabetes.* 2022;23(7): 857-871. doi:[10.1111/pedi.13408](https://doi.org/10.1111/pedi.13408)