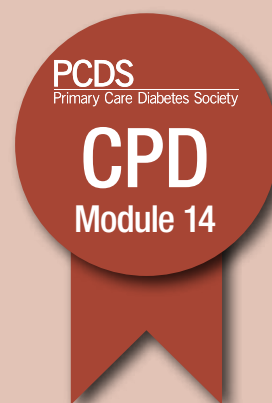


# Children and young people with diabetes: A practical guide for primary care



## New online learning opportunity

Visit the journal website to gain a certificate of continuing professional development for participating in this module. See page 108

## Krystyna Matyka

Diabetes is not uncommon in childhood, affecting 1 in 450 children with the majority (97%) having type 1 diabetes (Royal College of Paediatrics and Child Health, 2009). The incidence of both type 1 and type 2 diabetes is increasing but it is likely that a large UK general practice will only see one newly diagnosed child every 2 years (Ali et al, 2011). Treatment of this complicated condition can be challenging for children, their families and healthcare professionals, and treatment priorities and strategies will need to adapt as the child grows. This article reviews some of the common clinical issues in managing diabetes in children and young people.

Most children and young people (CYP) with type 1 diabetes present with the classic symptoms of polyuria, polydipsia, lethargy and weight loss. However, healthcare professionals do not always consider diabetes in the context of childhood, and many parents may suspect diabetes but, not wanting to believe this could happen to their child, will delay seeking medical help (Lowe et al, 2005). This is problematic, particularly considering the subsequent outcome of diabetic ketoacidosis, and potential death, if diabetes is untreated.

There are particular difficulties in diagnosing young children, particularly those <2 years of

age. Parental concerns may be that the child is fretful, restless or irritable but, on questioning, a story of increased or constant milk feeding and heavy, soaking nappies will be obtained. Older children may present with secondary nocturnal enuresis. Ketoacidosis will cause Kussmaul breathing, leading to a diagnosis of a chest infection, or abdominal pain which may be mistaken for an acute surgical emergency. Urine testing for glucose and ketones is easy in most children (if they have diabetes they will be polyuric). If positive and/or a random capillary blood glucose is greater than 11.1 mmol/L an urgent discussion with the local paediatrician should take place (Alberti et al, 2004).

## Learning objectives

After reading this article, the participant should be able to:

1. Identify and refer a child or young person with type 1 or type 2 diabetes presenting in primary care.
2. Outline the dietary recommendations for children and young people with type 1 or type 2 diabetes.
3. Discuss insulin treatment for children and young people with type 1 diabetes including during puberty.
4. Describe optimal management of diabetes at school and during adolescence.

## Key words

- Adolescence
- Diabetes in school
- Insulin
- Type 1 diabetes
- Type 2 diabetes

Supported by a grant from MSD Diabetes. These modules were conceived and are delivered by the Primary Care Diabetes Society in association with *Diabetes & Primary Care*. MSD had no input into the modules and is not responsible for their content.

Krystyna Matyka is Senior Lecturer in Paediatrics, University of Warwick Medical School, Coventry.

**Page points**

1. There are now more children and young people (CYP) presenting with type 2 diabetes, especially in areas with high proportions of ethnic groups.
2. The clinical presentation of CYP with type 2 diabetes can be similar to that of a child with type 1 diabetes, and cases with ketosis have been described although this is often mild.

However, there are a number of other forms of diabetes that are increasingly being diagnosed (*Table 1*). Diabetes arises as part of cystic fibrosis, for example, and can occur in any child on high-dose steroid replacement – the highest prevalence is likely to be among those undergoing chemotherapy. In addition, other primary forms of diabetes occur, which is important because they may present with an incidental finding of hyperglycaemia or glycosuria in an otherwise well child (Porter and Barrett, 2004). *Table 1* highlights the differential diagnosis of glucose intolerance in childhood and the likely clinical presentation. Of these, an increasing incidence of type 2 diabetes, probably related to the increased prevalence of childhood overweight and obesity,

has caused the greatest concern (Matyka, 2008).

There are now more CYP presenting with type 2 diabetes, especially in areas with high proportions of ethnic groups. The numbers are still relatively small and we do not seem to have the same high prevalence as seen in North America or Japan (Matyka, 2008). The clinical presentation of CYP with type 2 diabetes can be similar to that of a child with type 1 diabetes, and cases with ketosis have been described although this is often mild (Fagot-Campagna et al, 2000; see *Box 1* for a case report to illustrate this) (*Table 1*).

The majority of children with type 2 diabetes in the UK are from south Asian backgrounds and have a strong family history of type 2

**Table 1. The presentation, investigation and treatment to identify different types of diabetes.**

Type of diabetes	Presentation	Investigation	Treatment
Type 1	<ul style="list-style-type: none"> <li>● Polyuria/polydipsia.</li> <li>● Loss of weight.</li> <li>● Usually lean.</li> </ul>	<ul style="list-style-type: none"> <li>● Random blood glucose &gt;11.1 mmol/L.</li> <li>● Ketonuria.</li> <li>● GAD/IA2 antibody positive.</li> </ul>	<ul style="list-style-type: none"> <li>● Insulin.</li> </ul>
Type 2	<ul style="list-style-type: none"> <li>● Obese.</li> <li>● Ethnic minority background.</li> <li>● Strong family history of type 2 diabetes.</li> <li>● Acanthosis nigricans.</li> <li>● Other features of metabolic syndrome (such as polycystic ovary syndrome, high blood pressure, abnormal lipids).</li> <li>● May be incidental finding.</li> </ul>	<ul style="list-style-type: none"> <li>● Random blood glucose &gt;11.1 mmol/L.</li> <li>● May have ketonuria.</li> <li>● GAD/IA2 antibody negative.</li> </ul>	<ul style="list-style-type: none"> <li>● Metformin as first-line treatment.</li> <li>● Insulin may be necessary if diagnostic uncertainty, blood glucose concentration very high or in the presence of ketones.</li> </ul>
MODY	<ul style="list-style-type: none"> <li>● Polyuria/polydipsia.</li> <li>● Loss of weight.</li> <li>● Family history of early onset type 2 diabetes in close relatives (&lt;25 years of age).</li> <li>● Usually lean.</li> </ul>	<ul style="list-style-type: none"> <li>● Random blood glucose &gt;11.1 mmol/L.</li> <li>● May have ketonuria.</li> <li>● GAD/IA2 antibody negative.</li> </ul>	<ul style="list-style-type: none"> <li>● Further investigations to be discussed with local paediatric diabetes team.</li> <li>● Insulin may be necessary if diagnostic uncertainty or blood glucose concentration very high.</li> <li>● Some forms of MODY respond to sulphonylurea treatment.</li> <li>● Seek further advice.</li> </ul>
Disease specific associated diabetes	<ul style="list-style-type: none"> <li>● Cystic fibrosis.</li> <li>● Chemotherapy.</li> <li>● Genetic syndromes such as Bardet Biedl, Prader-Wili, Down's syndrome.</li> </ul>	<ul style="list-style-type: none"> <li>● Further investigations to be discussed with local paediatric diabetes team.</li> </ul>	

GAD=glutamic acid decarboxylase; IA2=insulin antibody; MODY=maturity onset diabetes of the young.  
 Adapted from: Porter and Barrett (2004).

diabetes (Haines et al, 2007). Making a confident diagnosis of type 2 over type 1 diabetes can be a challenge even for an experienced paediatrician. The most pragmatic approach in case of any doubt is to give insulin therapy (Rosenbloom et al, 2009); this is likely to be necessary where blood glucose levels are in double figures or in the presence of significant ketonaemia even in a person with type 2 diabetes. Once the child is safely on treatment and stabilised, the precise diagnosis can then be reviewed regularly in the relative safety of the diabetes clinic.

Cases of delayed or missed diagnoses of diabetes are regularly observed (Ali et al, 2011). About 30% of children with new onset diabetes have had at least one related medical visit prior to being diagnosed (Bui et al, 2010). The National Patient Safety Agency is now requesting that all such cases are reported as clinical adverse events. At best, children can still be relatively well at presentation; at worst, they can die before they reach the hospital. Where there is any concern about the possibility of diabetes in a CYP it is essential to discuss the individual with a senior paediatrician as soon as possible.

### Nutrition and weight management for overweight children with diabetes

Most children with type 1 diabetes do not have a significant weight problem. However, the inability to deliver insulin in a physiological manner means that most will be over-insulinised (Holl et al, 1998; 2003), except perhaps those on insulin pump therapy, and thus will be heavier than their counterparts without diabetes.

There have been a number of changes to the nutritional management of people with type 1 diabetes over the years. Currently the emphasis is on healthy eating, and the International Society for Pediatric and Adolescent Diabetes (ISPAD) has produced guidelines which recommend that the composition of a healthy diet is 50–55% carbohydrate, of which sucrose can be up to 10% of total daily energy intake, 30–35% should be fat, of which less than 10% should come from saturated or trans fatty acid sources, and 10–15% should be protein (Smart et al, 2009). Salt intake should be less than 6 g per day, much of which is already present

in the highly processed food consumed in the developed world.

These dietary recommendations apply across the paediatric age range but a flexible approach will be necessary for younger children, particularly toddlers. Frequent small meals, or “grazing”, are typical of young children and it will be easier to adapt the insulin regimen to fit the child rather than ask the parents to make drastic changes to the diet of their young children who already provide a number of challenges.

Studies have examined the diet of different age groups of CYP (Smart et al, 2009). There are methodological problems with examining dietary patterns in a group of people who have been given a lot of information on how to eat. Food diaries, often used as a gold standard for assessment, are also an effective deterrent to “normal” eating: when being asked to fill in a food diary for 3 days one may well reward oneself with a burger and chips or a large bar of chocolate on day four. However, clinical experience does suggest that people with diabetes are no different to the general population in terms of what may be called

### Page points

1. Where there is any concern about the possibility of diabetes in a child or young person it is essential to discuss the individual with a senior paediatrician as soon as possible.
2. Most children with type 1 diabetes do not have a significant weight problem. However, the inability to deliver insulin in a physiological manner means that most will be over-insulinised, except perhaps those on insulin pump therapy, and will thus be heavier than their counterparts without diabetes.

### Box 1. Case report.

#### Narrative

EG is a 14-year-old girl who has presented to her GP with dysuria and frequency. Urine dipstick shows glucose +++ and ketones ++. Her capillary blood glucose level is 16 mmol/L. On further questioning she has probably had increased thirst and increased urinary frequency for the past 6 months and may have lost some weight. Her family are from Pakistan and her father has type 2 diabetes and mother had gestational diabetes with her last pregnancy 4 years ago. She is overweight with a weight of 70 kg and a height of 162 cm (BMI 26.7 kg/m<sup>2</sup>). She looks well with no evidence of dehydration. She has marked acanthosis nigricans on her back and axillae.

#### Discussion

It is very likely that this young girl has type 2 diabetes. She comes from an ethnic minority at very high risk, has a strong family history, has an insidious onset and has marked acanthosis. However, her blood glucose is high and she has ketones. She needs to be referred to a paediatrician immediately and is likely to have blood taken to check for antibodies (islet cell and glutamic acid decarboxylase). In view of her current high blood glucose levels and ketones she will need insulin: once-daily long-acting insulin may work well. She will also need advice on healthy lifestyle approaches for weight management. Her continued use of insulin can be reviewed by the diabetes team in due course.

### Page points

1. It is likely that most people with type 2 diabetes will be either overweight or obese.
2. Children and their families will need to be motivated and engaged for any weight-loss strategy to be effective.
3. Worryingly, it has been shown that even adolescents with type 2 diabetes and their parents underestimate the severity of the weight problem.
4. The management of the child or young person with diabetes will depend on a number of factors including age, weight, developmental stage, cognitive ability and family support.

dietary “indiscretions”. Ideally these would be infrequent, and although blood glucose levels can be controlled by carbohydrate counting and adjusting insulin dosage, the extra calories can lead to significant weight gain, which can be difficult to lose.

It is likely that most people with type 2 diabetes will be either overweight or obese, however it is beyond the scope of this article to describe in detail the approaches to weight management for childhood obesity. A number of studies have been performed in CYP, varying from lifestyle adjustments to weight loss medication such as orlistat and sibutramine, and have been reviewed within a Cochrane review (Oude Luttikhuis et al, 2009) and NICE (2006) guidance is available. The majority of these studies have included small sample sizes and have been of short duration with many showing little effect on weight change.

There is no doubt that weight loss medications can be effective in sub-groups of people. A study of sibutramine involving just under 500 adolescents showed that at 12 months the estimated mean change in BMI from baseline for sibutramine was  $-3.1 \text{ kg/m}^2$  versus  $-0.3 \text{ kg/m}^2$  for placebo, and this difference was statistically significant at all study visits, even at week 1 of treatment (Berkowitz et al, 2006). Sibutramine never had a license in the UK for those aged under 18 years but has lost its license completely due to concerns over cardiovascular safety so this avenue of management has now been closed.

There do not appear to have been any studies that have specifically assessed weight management strategies in CYP with type 2 diabetes, but there is no reason to suspect that generic weight management approaches would not be appropriate. Children and their families will need to be motivated and engaged for any weight-loss strategy to be effective. Data suggest that this can be very difficult, and studies also show that families struggle to recognise that their child may have a significant weight problem (Etelson et al, 2003; Eckstein et al, 2006). This may be because many parents will compare their child’s physique with other children in the playground; with 20% of children overweight or obese in the UK, some parents may have

false reassurance from playground comparisons (Etelson et al, 2003; Eckstein et al, 2006).

Worryingly, it has been shown that even adolescents with type 2 diabetes and their parents underestimate the severity of the weight problem (Skinner et al, 2008). In one study the mean BMI of 104 adolescents with diabetes was  $36.4 \text{ kg/m}^2$ ; 87% were classed as overweight by North American guidelines (Barlow and Dietz, 1998). Yet 40% of parents whose child had a BMI >95th percentile felt that their child’s weight was “about right” and 55% of adolescents with a BMI >95th percentile were unconcerned by their weight. There was consistency in weight estimation between adolescents and their parents. Those parents and adolescents who underestimated weight problems had poorer dietary and physical activity behaviours than those who were more aware of the weight issues (Skinner et al, 2008). Adequate explanation of the importance of weight management for people with type 2 diabetes is therefore paramount.

### Management of children with type 1 diabetes

The management of the CYP with diabetes will depend on a number of factors, including age, weight, developmental stage, cognitive ability and family support.

#### Insulin requirement

As in most areas of paediatrics, doses of medications, in this case insulin, are initially based on body weight. Doses prescribed at diagnosis are informed “estimates” of likely need. Most centres are likely to start doses at the lower end of the estimated range to avoid provoking hypoglycaemia soon after diagnosis. Most CYP will be quite insulin resistant for the first few weeks (approximately 4–8 weeks) after diagnosis due to the preceding persistent hyperglycaemia causing glucose toxicity just prior to diagnosis, and doses may need to be increased quite rapidly in the early stages. It is suggested that total daily insulin requirements will vary from 0.7–1.0 units/kg/day for pre-pubertal children (Bangstad et al, 2009).

For young people going through puberty the insulin requirements will go as high as 1.5–

2.0 units/kg/day during the rapid growth phase, usually mid to late puberty. The increase in insulin requirements during the pubertal growth spurt is felt to be due to increases in growth hormone released during puberty resulting in insulin resistance (Dunger, 1992).

In addition, the insulin deficiency of type 1 diabetes leads to abnormalities in the growth hormone/insulin-like growth factor-1 (IGF-1) feedback mechanism and pubertal children over-secrete growth hormone making puberty a time of marked insulin resistance for children with type 1 diabetes (Dunger, 1992).

Total daily doses of insulin are likely to be very high during puberty as young people also significantly increase their calorie intake to fuel normal growth (a 60 kg boy could need up to 120 units per day), causing anxiety for these individuals and their carers alike. Despite these large doses of insulin, even adolescents who are very engaged with their diabetes management can struggle to achieve tight glycaemic control.

Data from the DCCT (Diabetes Control and Complications Trial) are quite old now but they do highlight the difficulties for adolescents. A total of 195 adolescents aged between 13 and 17 years participated in the trial (DCCT Research Group, 1994). Although the beneficial effect of improved glycaemic control was still evident, adolescents found it more difficult to achieve lower HbA<sub>1c</sub> levels than their adult counterparts (8.06±0.13% [64±1.4 mmol/mol] versus 7.12±0.03% [54±0.03 mmol/mol]; *P*<0.001), yet they had a greater tendency towards severe hypoglycaemia (85.7 events per 100 person years versus 56.9 events in the adult cohort) (DCCT Research Group, 1994).

### Insulin injections

Young children with diabetes are likely to need shorter needles than adolescents and adults, however this will need to be assessed with each individual – some teenagers can be very slim and the author has used short (4 mm) needles in this group often at diagnosis where there has been significant weight loss. All children are advised to rotate injection sites both throughout the day and from day to day to avoid the development of lipohypertrophy, although it is the author's

experience that there are a small number of people who appear to be particularly prone to this complication even with good site rotation.

### Insulin regimen

There are few studies that have examined the optimum diabetes regimen for children at different ages in a structured experimental fashion (Spinks et al, 2007). As a result the choices of regimen and insulin type are likely to be a negotiation between child, family and their healthcare team.

Many clinical teams are recommending intensive insulin regimens, either multiple daily injections (MDI) or insulin pump therapy, for all CYP with diabetes (Gosden et al, 2010). This will involve carbohydrate counting and dose adjustment of mealtime rapid-acting insulin. These are likely to be the best regimens for very young children (under 5 years of age) who may eat unpredictably both with respect to timing and quantity of food. Rapid-acting insulin can be given after food for these children so the dose can be tailored to the amount of food actually eaten rather than the amount of food offered.

Using MDI is a good way of managing food refusal in any age of child without having to worry about the risk of hypoglycaemia. This is also a very good regimen for adolescents who will have much less structure to their lives and want to go out and socialise with friends at varying times. However, these regimens do involve a high treatment burden and require a great deal of individual and family engagement for them to work well – adolescence can be a very difficult time for this kind of treatment adherence. Many outpatient consultations with adolescents will involve negotiations about how to fit diabetes around the life of someone who would prefer to believe that it was not there.

There will be some families who will struggle with these regimens. Carbohydrate counting and insulin dose adjustment based on ambient glucose, food and physical activity are likely to require a reasonable level of understanding and can be extremely challenging for families with special educational needs (either in the child or supporting family) or problems with literacy or numeracy. Support is available, often

### Page points

1. Total daily doses of insulin are likely to be very high during puberty as young people also significantly increase their calorie intake to fuel normal growth (a 60 kg boy could need up to 120 units per day), causing anxiety for patients and carers alike.
2. Young children with diabetes are likely to need shorter needles than adolescents and adults, however this will need to be assessed with each individual.
3. Many clinical teams are recommending intensive insulin regimens, either multiple daily injections or insulin pump therapy, for all children and young people with diabetes.
4. Carbohydrate counting and insulin dose adjustment based on ambient glucose, food and physical activity are likely to require a reasonable level of understanding and can be extremely challenging for families with special educational needs (either in the child or supporting family) or problems with literacy or numeracy.

### Page points

1. The NICE guideline states that a child under the age of 12 years will qualify for insulin pump therapy if multiple daily injections are considered impractical or inappropriate, which could include all children under the age of 12 years.
2. The STAR 3 (Sensor-Augmented Pump Therapy for A1C Reduction) study examined the use of sensor-augmented insulin pump therapy. The results suggest that this can lead to improvements in HbA<sub>1c</sub> levels in both children and adults without an increased risk of hypoglycaemia.
3. There are some studies that have examined the benefits of self-monitoring of blood glucose. Findings from these suggest that four blood glucose tests or more per day is associated with a 1 percentage point (13 mmol/mol) reduction in HbA<sub>1c</sub>.
4. With an increasing emphasis on intensive insulin regimens, schools are being asked to do more for children with diabetes, especially primary school children who are unable to do their own injections or, at the very least, need some adult supervision.

coming from the local diabetes team from the specialist nurse, but some families are still left with little confidence. In the end, people with diabetes have to make decisions about their diabetes management almost continuously and no diabetes care team will be able to provide this level of input.

Data suggest that families will benefit from much more intensive support but this can prove difficult where diabetes teams are stretched already and alternative means of support do need to be developed (Brink et al, 2002). In the meantime, a conventional insulin regimen of twice-daily mixed insulin or an MDI regimen with long-acting background insulin and predetermined, fixed doses of rapid-acting insulin with meals, rather than carbohydrate counted adjusted doses, may be a suitable compromise for these families.

### Insulin pump therapy

Insulin pump therapy has been approved by NICE for use in childhood (NICE, 2008). The NICE guideline states that a child under the age of 12 years will qualify for insulin pump therapy if MDI is considered impractical or inappropriate, which could include all children under the age of 12 years. Children over the age of 12 would need to fulfil adult criteria (NICE, 2008). In some areas, where insulin pump provision has been unproblematic, some services are starting children on insulin pumps at diagnosis, yet there are many centres where this is not possible for a number of reasons.

Data suggest that there is some benefit for insulin pump therapy in childhood mainly with respect to avoidance of hypoglycaemia (Pickup and Sutton, 2008). There are also emerging data to suggest that a combination of an insulin pump and continuous glucose monitoring (CGM) (worn continuously) can improve glycaemic control. The STAR 3 (Sensor-Augmented Pump Therapy for A1C Reduction) study examined the use of sensor-augmented insulin pump therapy. The results suggest that this can lead to improvements in HbA<sub>1c</sub> levels in both children and adults without an increased risk of hypoglycaemia (Bergenstal et al, 2010). CGM may be particularly useful in hypoglycaemia

avoidance. A study of people with good glycaemic control – an HbA<sub>1c</sub> level of <7.0% (<53 mmol/mol) – showed that control could be improved even in these individuals and without hypoglycaemia (Juvenile Diabetes Research Foundation [JDRF] CGM Study Group, 2009).

In contrast, another study examining continuous rather than focused use of glucose sensors showed a benefit in adults over the age of 25 years but not in CYP, which may have been related to a lower rate of continuous use of the glucose sensor in younger people; CGM use for 6 or more days per week was 83% in those over 25 years of age, 30% in 15–24 year-olds and 50% of 8–14 year-olds (JDRF CGM Study Group et al, 2008).

There are some studies that have examined the benefits of self-monitoring of blood glucose (SMBG). Findings from these suggest that four blood glucose tests or more per day is associated with a 1 percentage point (13 mmol/mol) reduction in HbA<sub>1c</sub> (Levine et al, 2001). Yet in these studies it is difficult to ascertain whether it is those people who are most engaged with their diabetes who benefit the most from frequent blood glucose monitoring; doing six blood tests a day just to document them in a glucose diary is likely to be of limited therapeutic value. However, CYP on MDI regimens will be asked to perform four blood tests per day whereas CYP on pump therapy will be asked to perform a minimum of four to six tests per day.

### Management of diabetes at school

The management of any child with a chronic illness in school can prove challenging. Dealing with blood tests and injections can prove even more so. With an increasing emphasis on intensive insulin regimens, schools are being asked to do more for children with diabetes, especially primary school children who are unable to do their own injections or, at the very least, need some adult supervision.

Although schools have a duty of care towards children with all sorts of medical needs, there is no legislation in the UK – or in many other countries globally – that specifies the supportive role of school staff (Diabetes UK, 2008). Studies of parents and children have shown that negative

experiences are not uncommon in school. A number of children use the school toilets to do injections and blood glucose testing and there are concerns that school staff lack even a basic understanding of diabetes and so children rely on peers and not teaching staff for help (Newbould et al, 2007; Amillategui et al, 2009).

Data from Spain suggest that 44% of parents have had to rearrange their work schedules to support their children at school (Amillategui et al, 2007) and UK data show that if children were unable to administer their own insulin, 70% of schools expected a parent to come and give the injection (Diabetes UK, 2009). However, the difficulties for schools and teaching staff should not be underestimated and expectations for a high level of knowledge and understanding of diverse medical conditions from epilepsy, through congenital heart disease to diabetes, are significant.

### Adolescence

Adolescence defines the period of time of transition from childhood to adulthood. It is a time of great change in biological, social and psychological terms. The impact of puberty on diabetes and the associated increased insulin requirement has already been discussed. If SMBG is performed regularly yet readings are often high due to the insulin resistance of puberty, this will be demoralising for adolescents. If high doses of insulin are given to overcome insulin resistance, frequent hypoglycaemia may ensue, which can be very embarrassing for adolescents, or could lead to unacceptable weight gain (especially in girls). It is not surprising that adolescents find it hard to keep up with the management of their diabetes. *Box 2* highlights such issues.

In addition, having a chronic illness like diabetes at a time when fitting in with peers is of paramount importance is potentially very challenging. It is known that diabetes control deteriorates during this time – insulin doses may be omitted and clinic attendance can be erratic. A number of different approaches have been tried to improve adolescent engagement with diabetes management but there is no easy answer. Family support is crucial at this time and comprises

“behaviours that foster in an individual feelings of comfort and belonging, and that he or she is basically accepted and approved of as a person by the parents and family” (Skinner et al, 2005).

Research shows a bell-shaped response to family support with both those getting too little and too much tending to do less well in terms of diabetes management (Gustafsson et al, 1987). Recurrent diabetic ketoacidosis is a significant risk especially in girls, those from lower socioeconomic backgrounds and those with pre-existing psychosocial issues (Chapman et al, 1988).

Risk taking is part of what may be considered normal adolescent behaviour – testing out the boundaries as a phase of personal development. These risks will have a variable impact on health but are likely to have a greater impact on health in those with an underlying chronic condition and may also be more prevalent in these younger people. In the UK, data suggest that 11% of 13- to 14-year-olds have smoked cigarettes with 4% smoking every day; 17% have been drunk at least once and 11% have tried some type

### Page points

1. The difficulties for schools and teaching staff should not be underestimated and expectations for a high level of knowledge and understanding of diverse medical conditions from epilepsy, through congenital heart disease to diabetes, are significant.
2. It is known that diabetes control deteriorates during adolescence – insulin doses may be omitted and clinic attendance can be erratic.
3. In the UK, data suggest that 11% of 13- to 14-year-olds have smoked cigarettes with 4% smoking every day; 17% have been drunk at least once and 11% have tried some type of recreational drug.

### Box 2. Case report.

#### Narrative

AE is a 13-year-old girl who has had type 1 diabetes for 4 years. At the past two clinic appointments it has been noticed that she has been losing weight – approximately 4 kg in the past 6 months. She has always found it difficult to engage with her diabetes and has long-standing poor glycaemic control. Her most recent HbA<sub>1c</sub> level is 11% (97 mmol/mol). On questioning she has symptoms of abdominal pain and diarrhoea.

#### Discussion

Type 1 diabetes is associated with a number of other autoimmune problems such as thyroiditis, coeliac disease and also inflammatory bowel disease. Omitting insulin to manage weight is also well described in people with diabetes and is more common in girls. It will be essential to exclude a significant medical problem that could be causing weight loss in this girl. She will need a full examination and investigations to screen for thyroid problems, malabsorption and inflammation. A stool sample will need to be sent for culture. Specialist advice may be necessary if any of these are abnormal. If there is no underlying medical problem and the issue is one of poor diabetes control and insulin omission an open discussion with the girl and her family will be necessary to explore the problems in more detail and to examine possible strategies that may alleviate the difficulties. If an eating disorder is suspected psychiatric advice will need to be sought.

### Page points

1. The long-term risks of micro- and macrovascular disease in people with type 1 diabetes are well described and so all adolescents should be informed of the dangers and offered smoking cessation support as and when available.
2. Information and support for young girls and women with diabetes is vital to prevent unplanned pregnancies.
3. Young people over the age of 12 years need to annually have their blood pressure checked, retinal screening, urine screening for microalbuminuria and a blood test for assessment of renal function.

of recreational drug (Office for Standards in Education, Children's Services and Skills, 2008).

A large study from a multicentre collaboration across Germany and Austria showed that the prevalence of smoking in CYP with diabetes increased from 0.1% in under 11-year-olds to 28.4% in 15- to 20-year-olds (Hofer et al, 2009). Smokers had poorer glycaemic control (HbA<sub>1c</sub> 9.1% [76 mmol/mol] versus 8.0% [64 mmol/mol] in smokers versus non-smokers, respectively;  $P < 0.0001$ ) and there were also negative effects on diastolic blood pressure and lipid profile. However, this may reflect a group of individuals struggling to engage with their diabetes management in general. The long-term risks of micro- and macrovascular disease in people with type 1 diabetes are well described and so all adolescents should be informed of the dangers and offered smoking cessation support as and when available.

The UK has the highest rate of teenage pregnancies in Europe, five times the rate in The Netherlands and twice that of France (United Nations Statistics Division, 2010). Teenage pregnancies are associated with poorer health outcomes for both mother and child (Chen et al, 2007) but this may, in part, reflect the poorer socioeconomic status of the young women who become pregnant during adolescence. There do not appear to be any studies examining pregnancy rates and outcomes in adolescents with diabetes, although these do happen.

UK data from studies of adult women with diabetes are quite sobering. A study conducted by the Confidential Enquiry into Maternal and Child Health (CEMACH) found that only 41% of pregnancies were planned, 28% of women smoked (compared with 35% of the general maternity population) and only 27% took folic acid before pregnancy (CEMACH, 2007). The preterm delivery rate was 36% with a Caesarean section rate of 67% compared with 7% and 22%, respectively, in the general population. Women with diabetes also had a five-fold increased risk of stillbirth, a three-fold increased risk of perinatal mortality and a two-fold increased risk of fetal congenital anomaly.

Information and support for young girls and women with diabetes is vital to prevent

unplanned pregnancies. Yet the correct methods and timing of providing such information to young girls remain unclear both for girls with diabetes and those in the general population (CEMACH, 2007). Adolescent girls will have a lot of exposure to healthcare – time that could be used for education with the cooperation and encouragement of parents or carers.

### Diabetes review

NICE guidance recommends that all children over the age of 12 years have an “annual review” with screening for microvascular complications (NICE, 2004). Young people need to have their blood pressure checked, retinal screening, urine screening for microalbuminuria and a blood test for assessment of renal function.

Up to 10% of people with type 1 diabetes will have autoimmune thyroiditis. If this develops during childhood then it can have a significant impact on cognitive development, and so NICE (2004) recommends that pre-pubertal children, <12 years old, have blood taken annually for renal function and thyroid function tests from diagnosis. Coeliac disease is also common in CYP with type 1 diabetes. In the author's experience, this combination is extremely challenging – most of the foods recommended as part of a healthy diet, and which contain long-acting carbohydrate, contain gluten. “Unhealthy”, sugar-loaded food is often gluten-free.

Until recently, NICE (2004) recommended annual screening for coeliac antibodies in all CYP with diabetes regardless of age, and many asymptomatic people have been diagnosed and started on a gluten-free diet. The long-term health benefits of treating asymptomatic coeliac disease in CYP with diabetes are yet to be proven. More recently, NICE (2004) has decided that coeliac disease should be screened for at diagnosis only and individuals only re-tested if they develop symptoms. The psychological impact of being diagnosed with two lifelong, serious medical conditions that are almost incompatible does not appear to have been examined.

### Conclusion

Childhood diabetes is a complex medical condition that requires healthcare professionals



to have a large number of clinical, educational and psychological skills. There is no doubt that joint working with children and their families is as rewarding as it can be challenging. This is an area where joint working with primary care is still underdeveloped but could lead to improved outcomes for children and their families. ■

- Alberti G, Zimmet P, Shaw J et al (2004) Type 2 diabetes in the young: the evolving epidemic. The international diabetes federation consensus workshop. *Diabetes Care* **27**: 1798–811
- Ali K, Harnden A, Edge JA (2011) Type 1 diabetes in children. *BMJ* **342**: d294
- Amillategui B, Calle JR, Alvarez MA et al (2007) Identifying the special needs of children with type 1 diabetes in the school setting. An overview of parents' perceptions. *Diabet Med* **24**: 1073–9
- Amillategui B, Mora E, Calle JR, Giralt P (2009) Special needs of children with type 1 diabetes at primary school: perceptions from parents, children and teachers. *Pediatr Diabetes* **10**: 67–73
- Bangstad HJ, Danne T, Deeb L et al (2009) Insulin treatment in children and adolescents with diabetes. *Pediatr Diabetes* **10**(Suppl 12): 82–99
- Barlow SE, Dietz WH (1998) Obesity evaluation and treatment: Expert Committee recommendations. The Maternal and Child Health Bureau, Health Resources and Services Administration and the Department of Health and Human Services. *Pediatrics* **102**: E29
- Bergental RM, Tamborlane WV, Ahmann A et al (2010) Effectiveness of sensor-augmented insulin-pump therapy in type 1 diabetes. *N Engl J Med* **363**: 311–20
- Berkowitz RI, Fujioka K, Daniels SR et al (2006) Effects of sibutramine treatment in obese adolescents: a randomized trial. *Ann Intern Med* **145**: 81–90
- Brink SJ, Miller M, Moltz KC (2002) Education and multidisciplinary team care concepts for pediatric and adolescent diabetes mellitus. *J Pediatr Endocrinol Metab* **15**: 1113–30
- Bui H, To T, Stein R et al (2010) Is diabetic ketoacidosis at disease onset a result of missed diagnosis? *J Pediatr* **156**: 472–7
- Chapman J, Wright AD, Natrass M, FitzGerald MG (1988) Recurrent diabetic ketoacidosis. *Diabet Med* **5**: 659–61
- Chen XK, Wen SW, Fleming N et al (2007) Teenage pregnancy and adverse birth outcomes: a large population based retrospective cohort study. *Int J Epidemiol* **36**: 368–73
- Confidential Enquiry into Maternal and Child Health (2007) *Diabetes in Pregnancy: Are We Providing the Best Care? Findings of a National Enquiry*. CEMACH, London. Available at: <http://bit.ly/f5A9KU> (accessed 04.04.11)
- DCCT Research Group (1994) Effect of intensive diabetes treatment on the development and progression of long-term complications in adolescents with insulin-dependent diabetes mellitus: Diabetes Control and Complications Trial. *J Pediatr* **125**: 177–88
- Diabetes UK (2008) *Making All Children Matter: Support for Children with Diabetes in School*. Diabetes UK, London. Available at: <http://bit.ly/e1N3bT> (accessed 04.04.11)
- Diabetes UK (2009) *Right From the Start: A Triangulated Analysis of Diabetes Management in Primary Schools in England, Northern Ireland and Scotland*. Diabetes UK, London
- Dunger DB (1992) Diabetes in puberty. *Arch Dis Child* **67**: 569–70
- Eckstein KC, Mikhail LM, Ariza AJ et al (2006) Parents' perceptions of their child's weight and health. *Pediatrics* **117**: 681–90
- Etelson D, Brand DA, Patrick PA, Shirali A (2003) Childhood obesity: do parents recognize this health risk? *Obes Res* **11**: 1362–8
- Fagot-Campagna A, Pettitt DJ, Engelgau MM et al (2000) Type 2 diabetes among North American children and adolescents: an epidemiologic review and a public health perspective. *J Pediatr* **136**: 664–72
- Gosden C, Edge JA, Holt RI et al (2010) The fifth UK paediatric diabetes services survey: meeting guidelines and recommendations? *Arch Dis Child* **95**: 837–40
- Gustafsson PA, Cederblad M, Ludvigsson J, Lundin B (1987) Family interaction and metabolic balance in juvenile diabetes mellitus. A prospective study. *Diabetes Res Clin Pract* **4**: 7–14
- Haines L, Wan KC, Lynn R et al (2007) Rising incidence of type 2 diabetes in children in the U.K. *Diabetes Care* **30**: 1097–101
- Hofer SE, Rosenbauer J, Grulich-Henn J et al (2008) Smoking and metabolic control in adolescents with type 1 diabetes. *J Pediatr* **154**: 20–23
- Holl RW, Grabert M, Sorgo W et al (1998) Contributions of age, gender and insulin administration to weight gain in subjects with IDDM. *Diabetologia* **41**: 542–7
- Holl RW, Swift PG, Mortensen HB et al (2003) Insulin injection regimens and metabolic control in an international survey of adolescents with type 1 diabetes over 3 years: results from the Hvidovre study group. *Eur J Pediatr* **162**: 22–9
- Juvenile Diabetes Research Foundation Continuous Glucose Monitoring Study Group, Tamborlane WV, Beck RW et al (2008) Continuous glucose monitoring and intensive treatment of type 1 diabetes. *N Engl J Med* **359**: 1464–76
- Juvenile Diabetes Research Foundation Continuous Glucose Monitoring Study Group (2009) The effect of continuous glucose monitoring in well-controlled type 1 diabetes. *Diabetes Care* **32**: 1378–83
- Levine BS, Anderson BJ, Butler DA et al (2001) Predictors of glycemic control and short-term adverse outcomes in youth with type 1 diabetes. *J Pediatr* **139**: 197–203
- Lowes L, Gregory JW, Lyne P (2005) Newly diagnosed childhood diabetes: a psychosocial transition for parents? *J Adv Nurs* **50**: 253–61
- Matyka KA (2008) Type 2 diabetes in childhood: epidemiological and clinical aspects. *Br Med Bull* **86**: 59–75
- Newbould J, Francis SA, Smith F (2007) Young people's experiences of managing asthma and diabetes at school. *Arch Dis Child* **92**: 1077–81
- NICE (2004) *Type 1 Diabetes: Diagnosis and Management of Type 1 Diabetes in Children, Young People and Adults*. NICE, London. Available at: <http://bit.ly/bDO1Gs> (accessed 04.04.11)
- NICE (2006) *Obesity Guidance on the Prevention, Identification, Assessment and Management of Overweight and Obesity in Adults and Children*. NICE, London. Available at: <http://bit.ly/he00bt> (accessed 04.04.11)
- NICE (2008) *Continuous Subcutaneous Insulin Infusion for the Treatment of Diabetes Mellitus: Review of Technology Appraisal Guidance 57*. NICE, London. Available at: <http://bit.ly/d46xv1> (accessed 04.04.11)
- Office for Standards in Education, Children's Services and Skills (2008) *TellUs3 National Report*. OFSTED, Manchester
- Oude Luttikhuis H, Baur L, Jansen H et al (2009) Interventions for treating obesity in children. *Cochrane Database Syst Rev* **21**: CD001872
- Pickup JC, Sutton AJ (2008) Severe hypoglycaemia and glycaemic control in type 1 diabetes: meta-analysis of multiple daily insulin injections compared with continuous subcutaneous insulin infusion. *Diabet Med* **25**: 765–74
- Porter JR, Barrett TG (2004) Acquired non-type 1 diabetes in childhood: subtypes, diagnosis, and management. *Arch Dis Child* **89**: 1138–44
- Rosenbloom AL, Silverstein JH, Amemiya S et al (2009) Type 2 diabetes in children and adolescents. *Pediatr Diabetes* **10**(Suppl 12): 17–32
- Royal College of Paediatrics and Child Health (2009) *Growing up with Diabetes: Children and Young People with Diabetes in England. Research Report*. Royal College of Paediatrics and Child Health, London
- Skinner TC, Murphy H, Huws-Thomas M (2005) Diabetes in adolescents. In: Snoek FJ, Skinner TC (eds). *Psychology in Diabetes Care*. Wiley, Chichester
- Skinner AC, Weinberger M, Mulvaney S et al (2008) Accuracy of perceptions of overweight and relation to self-care behaviors among adolescents with type 2 diabetes and their parents. *Diabetes Care* **31**: 227–9
- Smart C, Aslander-van Vliet E, Waldron S (2009) Nutritional management. *Pediatr Diabetes* **10**(suppl 12): 100–17
- Spinks JJ, Edge JA, Matyka K, Malik S (2007) Type 1 diabetes mellitus – management. In: J Allgrove, PGF Swift, Greene S (eds). *Evidence-based Paediatric and Adolescent Diabetes*. Blackwell Publishing, Oxford
- United Nations Statistics Division (2010) Statistics and Indicators in Women and Men. Table 2c. Childbearing. United Nations Statistics Division, New York. Available at: <http://bit.ly/gYNpsC> (accessed 13.04.11)

## Online CPD activity

Visit [www.diabetesandprimarycare.co.uk/cpd](http://www.diabetesandprimarycare.co.uk/cpd) to record your answers and gain a certificate of participation

Participants should read the preceding article before answering the multiple choice questions below. There is ONE correct answer to each question. After submitting your answers online, you will be immediately notified of your score. A pass mark of 70% is required to obtain a certificate of successful participation; however, it is possible to take the test a maximum of three times. Before accessing your certificate, you will be given the opportunity to evaluate the activity and reflect on the module, stating how you will use what you have learned in practice.

- Children with diabetes are recommended to consume a healthy diet. What proportion of daily calorie intake should be fat? Select ONE option only.**
  - 20–25%.
  - 25–30%.
  - 30–35%.
  - 35–40%.
  - 40–45%.
- A basal–bolus regimen would be suitable for which of the following children or young people? Select ONE option only.**
  - A 2-year-old with type 1 diabetes and food refusal.
  - An 8-year-old with type 1 diabetes and coeliac disease.
  - A 14-year-old with type 2 diabetes.
  - A child with type 1 diabetes and an autistic spectrum disorder.
  - All of the above.
- NICE (2008) guidance for insulin pump therapy does not recommend insulin pump therapy for which of the following children or young people? Select ONE option only.**
  - A 13-year-old child with an HbA<sub>1c</sub> level of 8.6% (70 mmol/mol).
  - An 18-month-old with an HbA<sub>1c</sub> level of 8.0% (64 mmol/mol).
  - A 6-year-old on twice-daily mixed insulin with an HbA<sub>1c</sub> level of 6.5% (48 mmol/mol).
  - A 14-year-old with recurrent severe hypoglycaemia.
  - A 13-year-old with type 2 diabetes.
- Which of the following is NOT a presenting symptom of type 1 diabetes? Select ONE option only.**
  - Secondary enuresis.
  - Abdominal pain.
  - Tachypnoea.
  - Weight gain.
  - Irritability.
- Which of the following statements about adolescents is true? Select ONE option only.**
  - Adolescents can require up to 3 units of insulin per kilogram per day at time of maximal growth.
  - Risk-taking behaviour is more common in adolescents with chronic illnesses than the healthy adolescent population.
  - Adolescents should be encouraged to take responsibility for managing their diabetes as early as possible.
- Adolescents benefit from continuous glucose monitoring to the same extent as adults.**
- Adolescents who smoke have improved glycaemic control.**
- NICE (2004) guidance for the management of type 1 diabetes suggests that children should have which of the following? Select ONE option only.**
  - Annual screening for coeliac disease.
  - Annual blood pressure measurement from the age of 10 years.
  - Annual assessment of thyroid function from diagnosis.
  - Annual assessment of microalbuminuria from diagnosis.
  - Annual screening for lipids from the age of 12 years.
- Which of the following statements about type 2 diabetes is NOT true? Select ONE option only.**
  - Type 2 diabetes is more common in children and young people from ethnic minorities than those from white European backgrounds.
  - Weight management is an essential aspect of type 2 diabetes management.
  - Ketosis can be present at first presentation of type 2 diabetes.
  - Insulin treatment is never indicated as it leads to weight gain.
  - Acanthosis nigricans is a cutaneous marker of insulin resistance.
- Tom is an 8-year-old boy who has had type 1 diabetes for 2 years. Tom is experiencing recurrent, frequent episodes of severe hypoglycaemia involving convulsions. His family are worried about nocturnal hypoglycaemia and have trouble sleeping. The clinic have recommended insulin pump therapy but the family are concerned. Tom's most recent HbA<sub>1c</sub> level is 6.5% (48 mmol/mol). Based on NICE (2008) guidance which of the following is the best advice? Select ONE option only.**
  - Advise the family to try insulin pump therapy as research shows that this is a very good form of treatment for hypoglycaemia avoidance.
  - Advise against insulin pump therapy as intensive diabetes control leads to increased hypoglycaemia frequency.
- Advise against insulin pump therapy as his HbA<sub>1c</sub> level is very good and pump therapy is unlikely to lead to any improvements in glycaemic control.**
- Advise against insulin pump therapy as the child is too young.**
- Advise against insulin pump therapy as the child does not fulfil NICE criteria.**
- One of your patients, Fiona, is 15 years of age and has had diabetes for 6 years. You have had letters from the local diabetes clinic expressing concern that they have not seen Fiona in clinic for 12 months and are keen for you to review her diabetes management should the opportunity arise. Fiona has come to you asking for contraceptive advice. Which of the following is the correct course of action? Select ONE option only.**
  - Recommend that she should go back to the diabetes clinic.
  - Have a frank discussion about the difficulties of having a healthy pregnancy with type 1 diabetes.
  - Have a frank discussion about the importance of having a planned pregnancy with type 1 diabetes and go through all the options for contraception.
  - Review Fiona's diabetes management, take blood for HbA<sub>1c</sub>, renal function, thyroid function and a urine sample to check for microalbuminuria but avoid discussing contraception.
  - Refer her to the gynaecologist.
- John is 11 years old and has had type 1 diabetes for 3 years. He is on a basal–bolus regimen but his family are concerned that his blood glucose is regularly high (>12 mmol/L) at the time of the evening meal. They have tried ringing the local diabetes team but they have all gone to a conference. Which of the following is unlikely to be causing these high blood glucose levels? Select ONE option only.**
  - Slightly over-estimating the dose of rapid acting insulin at lunchtime.
  - Injecting into lipohypertrophic injection sites.
  - Recurrent hypoglycaemia during physical education mid-afternoon requiring treatment.
  - Eating sweets on the way home from school.
  - Missing the lunchtime dose of rapid-acting insulin.