

Diabetes (type 1 and type 2) in children and young people: diagnosis and management

NICE guideline

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Your responsibility

The recommendations in this guideline represent the view of NICE, arrived at after careful consideration of the evidence available. When exercising their judgement, professionals and practitioners are expected to take this guideline fully into account, alongside the individual needs, preferences and values of their patients or the people using their service. It is not mandatory to apply the recommendations, and the guideline does not override the responsibility to make decisions appropriate to the circumstances of the individual, in consultation with them and their families and carers or guardian.

Local commissioners and providers of healthcare have a responsibility to enable the guideline to be applied when individual professionals and people using services wish to use it. They should do so in the context of local and national priorities for funding and developing services, and in light of their duties to have due regard to the need to eliminate unlawful discrimination, to advance equality of opportunity and to reduce health inequalities. Nothing in this guideline should be interpreted in a way that would be inconsistent with complying with those duties.

Commissioners and providers have a responsibility to promote an environmentally sustainable health and care system and should assess and reduce the environmental impact of implementing NICE recommendations wherever possible.

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This guideline partially replaces CG15.

This guideline is the basis of QS125.

Overview

This guideline covers the diagnosis and management of type 1 and type 2 diabetes in children and young people aged under 18. The guideline recommends how to support children and young people and their families and carers to maintain tight control of blood glucose to reduce the long-term risks associated with diabetes.

In December 2020, we reviewed the evidence and updated the recommendations on [fluid therapy for children and young people with diabetic ketoacidosis](#).

Who is it for?

- Healthcare professionals who care for children and young people with diabetes
- Commissioners and providers of diabetes services
- Children and young people with type 1 or type 2 diabetes, and their families and carers

Recommendations

People have the right to be involved in discussions and make informed decisions about their care, as described in [making decisions about your care](#).

[Making decisions using NICE guidelines](#) explains how we use words to show the strength (or certainty) of our recommendations, and has information about prescribing medicines (including off-label use), professional guidelines, standards and laws (including on consent and mental capacity), and safeguarding.

Blood glucose and plasma glucose

'Blood glucose' is the more commonly used term. However, a lot of the evidence this guideline is based on uses 'plasma' rather than 'blood' glucose, and patient-held glucose meters and monitoring systems are calibrated to plasma glucose equivalents. Because of this, in this guideline we use the term 'blood glucose', except when referring to specific concentration values.

1.1 Diagnosis

1.1.1 Be aware that signs of type 1 diabetes in children and young people include:

- hyperglycaemia (random plasma glucose more than 11 mmol/litre)
- polyuria
- polydipsia
- weight loss
- excessive tiredness. [2004, amended 2015]

1.1.2 Refer children and young people with suspected type 1 diabetes immediately (on the same day) to a multidisciplinary paediatric diabetes team with the competencies needed to confirm diagnosis and provide immediate care. [2004, amended 2015]

1.1.3 Confirm type 1 diabetes in children and young people using the [plasma glucose](#)

criteria in the World Health Organization's 2006 report on the diagnosis and classification of diabetes mellitus. [2004, amended 2015]

- 1.1.4 When diagnosing diabetes in a child or young person, assume type 1 diabetes unless there are strong indications of type 2 diabetes, monogenic or mitochondrial diabetes. [2015]
- 1.1.5 Think about the possibility of type 2 diabetes in children and young people with suspected diabetes who:
- have a strong family history of type 2 diabetes
 - are obese
 - are of black or Asian family origin
 - do not need insulin, or need less than 0.5 units/kg body weight/day after the partial remission phase
 - show evidence of insulin resistance (for example, acanthosis nigricans). [2004, amended 2015]
- 1.1.6 Think about the possibility of other types of diabetes (not type 1 or 2), such as other insulin resistance syndromes, or monogenic or mitochondrial diabetes, in children and young people with suspected diabetes who have any of the following:
- diabetes in the first year of life
 - rarely or never develop ketones in the blood (ketonaemia) during episodes of hyperglycaemia
 - associated features, such as optic atrophy, retinitis pigmentosa, deafness, or another systemic illness or syndrome. [2004, amended 2015]
- 1.1.7 Do not measure C-peptide or diabetes-specific autoantibody titres at initial presentation to distinguish type 1 diabetes from type 2 diabetes. [2015]
- 1.1.8 Consider measuring C-peptide after initial presentation if needed to distinguish between type 1 diabetes and other types of diabetes. Be aware that C-peptide concentrations have better discriminative value the longer the interval between

initial presentation and the test. [2015]

- 1.1.9 Perform genetic testing if atypical disease behaviour, clinical characteristics or family history suggest monogenic diabetes. [2015]

1.2 Type 1 diabetes

Education and information

- 1.2.1 Offer children and young people with type 1 diabetes and their families or carers a continuing programme of education from diagnosis. Include the following core topics:

- insulin therapy (including its aims and how it works), insulin delivery (including rotating injection sites within the same body region) and dosage adjustment
- blood glucose monitoring, including blood glucose and HbA1c targets
- how diet, physical activity and intercurrent illness effect blood glucose levels
- managing intercurrent illness ('sick-day rules', including monitoring of blood ketones [beta-hydroxybutyrate])
- detecting and managing hypoglycaemia, hyperglycaemia and ketosis. [2015, amended 2020]

- 1.2.2 Tailor the education programme to each child or young person with type 1 diabetes and their families or carers, taking account of issues such as:

- personal preferences
- emotional wellbeing
- age and maturity
- cultural considerations
- existing knowledge
- current and future social circumstances
- life goals. [2015]

- 1.2.3 Encourage young people with type 1 diabetes to attend clinic 4 times a year, and explain that regular contact with the diabetes team will help them maintain optimal blood glucose levels. [2004, amended 2015]
- 1.2.4 Explain to children and young people with type 1 diabetes and their families or carers that, like people without diabetes, they should have:
- regular dental examinations (see the [NICE guideline on dental recall](#))
 - an eye examination by an optician at least every 2 years. [2004, amended 2015]
- 1.2.5 Encourage children and young people with type 1 diabetes and their families or carers to discuss any concerns and raise any questions they have with their diabetes team. [2015]
- 1.2.6 Give children and young people with type 1 diabetes and their families or carers information about diabetes support groups and organisations, and the potential benefits of membership. Give this information after diagnosis and regularly afterwards. [2004, amended 2015]
- 1.2.7 Encourage children and young people with type 1 diabetes to wear or carry something that tells people they have type 1 diabetes (for example, a bracelet). [2004]
- 1.2.8 Explain to children and young people with type 1 diabetes and their families or carers how to find out about government disability benefits. [2004, amended 2015]
- 1.2.9 Take particular care when communicating with children and young people with type 1 diabetes if they or their families or carers have physical or sensory disabilities, or difficulties speaking or reading English. [2004]
- 1.2.10 Diabetes teams should offer comprehensive advice to children and young people with type 1 diabetes who want to play sports that have particular risks for people with diabetes. Support groups and organisations (including sports organisations) may be able to provide more information. [2004, amended 2015]
- 1.2.11 Offer education for children and young people with type 1 diabetes and their families or carers on the practical issues around long-distance travel, such as

when best to eat and inject insulin when travelling across time zones. [2004]

Smoking and substance misuse

1.2.12 Encourage children and young people with type 1 diabetes not to start smoking. Explain the general health problems smoking causes, in particular the risks of vascular complications. [2004, amended 2015]

1.2.13 For more guidance on preventing smoking, see also the [NICE guidelines on preventing the uptake of smoking by children and young people and school-based interventions to prevent smoking](#). [2004, amended 2015]

1.2.14 Offer smoking cessation programmes to children and young people with type 1 diabetes who smoke. See also the [NICE guidelines on stop smoking interventions and services, harm reduction approaches to smoking, and smoking cessation in secondary care](#). [2004, amended 2015]

1.2.15 Explain to children and young people with type 1 diabetes and their families or carers about the general dangers of substance misuse and the possible effects on blood glucose levels. [2004]

Immunisation

1.2.16 Explain to children and young people with type 1 diabetes and their families or carers that the [Public Health England Green Book](#) recommends they have:

- annual immunisation against influenza, starting when they are 6 months old.
- immunisation against pneumococcal infection, if they are taking insulin or oral hypoglycaemic medicines. [2004, amended 2015]

Insulin therapy

1.2.17 Discuss the choice of insulin regimen with the child or young person and their family:

- explain the advantages and disadvantages of the different options
- discuss their personal circumstances and preferences

- help them to make an informed decision between the options that are available to them. [2015]
- 1.2.18 Offer children and young people with type 1 diabetes a multiple daily injection basal-bolus insulin regimen from diagnosis. [2015]
- 1.2.19 If a multiple daily insulin injections are not appropriate for a particular child or young person, consider an insulin pump as recommended in the NICE technology appraisal guidance on continuous subcutaneous insulin infusion for the treatment of diabetes mellitus. [2015]
- 1.2.20 Encourage children and young people with type 1 diabetes who are having multiple daily insulin injections to adjust the insulin dose if appropriate after each blood glucose measurement. [2004, amended 2015]
- 1.2.21 Tell children and young people with type 1 diabetes who are having multiple daily insulin injections to inject rapid-acting insulin analogues before eating. Explain that this reduces blood glucose levels after meals and will help them to optimise their blood glucose levels. [2004, amended 2015]
- 1.2.22 When children and young people start on an insulin pump, train them and their families and carers how to use it. A specialist team should provide ongoing support. [2004, amended 2015]
- 1.2.23 Specialist teams should agree a common core of advice to give insulin pump users. [2004, amended 2015]
- 1.2.24 For children and young people with type 1 diabetes who are using twice-daily injection regimens, encourage them to adjust the insulin dose according to the general trend in their pre-meal, bedtime and occasional night-time blood glucose. [2004, amended 2015]
- 1.2.25 Explain to children and young people with newly diagnosed type 1 diabetes and their families or carers that:
- they may have a partial remission phase (a 'honeymoon period') when they start using insulin

- during this time they may only need a low dosage of insulin (0.5 units/kg body weight/day) to maintain an HbA1c level of less than 48 mmol/mol (6.5%). [2004, amended 2015]

1.2.26 Offer children and young people with type 1 diabetes a choice of insulin delivery systems. [2004]

1.2.27 Provide children and young people with type 1 diabetes with insulin injection needles that are the right length for their body fat. [2004, amended 2015]

1.2.28 Provide children and young people with type 1 diabetes and their families or carers with:

- suitable containers for collecting used needles and other sharps
- a way to safely get rid of these containers.

See also the [section on safe use and disposal of sharps in the NICE guideline on infection control](#). [2015]

1.2.29 Offer children and young people with type 1 diabetes a review of injection sites at each clinic visit. [2004, amended 2015]

1.2.30 Provide children and young people with type 1 diabetes with rapid-acting insulin analogues to use during intercurrent illness or episodes of hyperglycaemia. [2015]

1.2.31 If a child or young person with type 1 diabetes does not have optimal blood glucose levels (see [recommendations 1.2.55](#) and [1.2.68](#)):

- offer additional support, such as more contact with their diabetes team, and
- if necessary, offer an alternative insulin regimen (multiple daily injections, an insulin pump, or [once-, twice- or three-times daily mixed insulin injections](#)). [2015]

Oral medicines

1.2.32 Only use metformin in combination with insulin within research studies, because it is uncertain whether this combination improves blood glucose management. [2004]

1.2.33 Do not offer children and young people with type 1 diabetes acarbose or sulphonylureas (glibenclamide, gliclazide, glipizide, tobutamide) in combination with insulin, because they may increase the risk of hypoglycaemia without improving blood glucose management. [2004, amended 2015]

Dietary management

1.2.34 Support children and young people with type 1 diabetes and their families or carers to develop a good working knowledge of nutrition and how it affects their diabetes. [2015]

1.2.35 Discuss healthy eating regularly with children and young people with type 1 diabetes and their families or carers.

- Explain that this means eating foods with a low glycaemic index, fruit and vegetables, and appropriate types and amounts of fats.
- Explain that healthy eating can reduce their risk of cardiovascular disease.
- Support them to adjust their food choices accordingly. [2015]

1.2.36 Take into account social and cultural considerations when providing advice on diet to children and young people with type 1 diabetes. [2015]

1.2.37 Explain that children and young people with type 1 diabetes have the same basic nutritional requirements as other children and young people. Their food should provide enough energy and nutrients for their growth and development. [2004, amended 2015]

1.2.38 For children and young people who are using a multiple daily insulin injection regimen or an insulin pump, offer [level 3 carbohydrate-counting](#) education from diagnosis to them and their families or carers. Repeat this offer regularly. [2015]

1.2.39 When children and young people with type 1 diabetes change their insulin regimen, offer them and their families or carers dietary advice tailored to the new treatment. [2015]

1.2.40 Offer children and young people with type 1 diabetes and their families or carers education about the practical problems associated with fasting and

feasting. [2004, amended 2015]

- 1.2.41 Encourage children and young people with type 1 diabetes and their families or carers to discuss the nutritional composition and timing of snacks with their diabetes team. [2015]
- 1.2.42 Encourage children and young people with type 1 diabetes to eat at least 5 portions of fruit and vegetables each day. [2015]
- 1.2.43 Explain to children and young people with type 1 diabetes and their families or carers that a low glycaemic index diet may help to improve blood glucose management and reduce the risk of hyperglycaemic episodes. [2015]
- 1.2.44 Offer children and young people with type 1 diabetes and their families or carers advice and education to help them follow a low glycaemic index diet. [2015]
- 1.2.45 Offer children and young people with type 1 diabetes dietetic support to help optimise body weight and blood glucose levels. [2004]
- 1.2.46 At each clinic visit for children and young people with type 1 diabetes, measure their height and weight and plot on an appropriate growth chart. Check for normal growth or significant changes in weight, because these may reflect changes in blood glucose levels. [2004, amended 2015]
- 1.2.47 Provide arrangements for weighing children and young people with type 1 diabetes that respect their privacy. [2004]

Exercise

- 1.2.48 Encourage children and young people with type 1 diabetes to exercise on a regular basis, and explain that this reduces their long-term risk of developing cardiovascular disease. [2004, amended 2015]
- 1.2.49 Explain to children and young people with type 1 diabetes and their families or carers that they can take part in all forms of exercise, provided that appropriate attention is given to changes in insulin and dietary management. [2004]

- 1.2.50 Explain to children and young people with type 1 diabetes and their families or carers about:
- the effects of exercise on blood glucose levels and
 - how to avoid hypo- or hyperglycaemia during or after physical activity. [2004, amended 2015]
- 1.2.51 Encourage children and young people with type 1 diabetes and their families or carers to monitor blood glucose levels before and after exercise so that they can:
- identify when changes in insulin or food intake are needed
 - learn how their blood glucose responds to different levels of exercise
 - watch out for exercise-induced hypoglycaemia
 - see how hypoglycaemia can occur several hours after prolonged exercise. [2004, amended 2015]
- 1.2.52 Explain to children and young people with type 1 diabetes and their families or carers that:
- they should have extra carbohydrates as needed to avoid hypoglycaemia and
 - they should have carbohydrate-based foods available during and after exercise. [2004]
- 1.2.53 Explain to children and young people with type 1 diabetes and their families or carers that they should have extra carbohydrates if their plasma glucose levels are less than 7 mmol/litre before they exercise. [2004, amended 2015]
- 1.2.54 Explain to children and young people with type 1 diabetes and their families or carers that they may need to alter their insulin dose or carbohydrate intake if they change their daily exercise patterns. [2004]

Blood glucose and HbA1c targets and monitoring

Blood glucose targets

- 1.2.55 Explain to children and young people with type 1 diabetes and their families or

carers that the optimal target ranges for short-term plasma glucose management are:

- fasting plasma glucose level of 4–7 mmol/litre on waking
- a plasma glucose level of 4–7 mmol/litre before meals at other times of the day
- a plasma glucose level of 5–9 mmol/litre after meals
- a plasma glucose level of at least 5 mmol/litre when driving (see the [DVLA guidance for people with diabetes](#) for further details about driving). [2015]

1.2.56 Explain to children and young people with type 1 diabetes and their families or carers that maintaining blood glucose levels at the lower end of the target ranges will help them achieve the lowest possible HbA1c. [2015]

1.2.57 If children and young people with type 1 diabetes experience problematic hypoglycaemia or undue emotional distress while attempting to achieve blood glucose and HbA1c targets, discuss changing the targets with them and their families and carers.. [2015]

1.2.58 Be aware that blood glucose and HbA1c targets can cause conflict between children and young people with type 1 diabetes and their families or carers, and they may need to agree a compromise. [2015]

Blood glucose monitoring

1.2.59 Advise children and young people with type 1 diabetes and their families or carers to routinely perform at least 5 capillary blood glucose tests per day. [2015]

1.2.60 Advise children and young people with type 1 diabetes and their families or carers that more frequent testing is often needed (for example with physical activity and during intercurrent illness). Ensure they have enough test strips for this. [2015]

1.2.61 Offer children and young people with type 1 diabetes and their families or carers a choice of equipment for monitoring capillary blood glucose, so they can optimise their blood glucose management in response to changes in their insulin, diet and exercise. [2004]

- 1.2.62 Explain to children and young people with type 1 diabetes and their families or carers that blood glucose levels should be interpreted in the 'whole child' context, which includes the social, emotional and physical environment. [2004]
- 1.2.63 Offer ongoing real-time continuous glucose monitoring with alarms to children and young people with type 1 diabetes who:
- have frequent severe hypoglycaemia or
 - have impaired hypoglycaemia awareness that is associated with adverse consequences (for example, seizures or anxiety) or
 - cannot recognise or communicate about symptoms of hypoglycaemia (for example, because of cognitive or neurological disabilities). [2015]
- 1.2.64 Consider ongoing real-time continuous glucose monitoring for:
- babies, infants and pre-school children
 - children and young people with high levels of physical activity (for example national-level sport)
 - children and young people who have comorbidities (for example anorexia nervosa), or who are having treatments (for example corticosteroids) that can make blood glucose management difficult. [2015]
- 1.2.65 Consider intermittent (real-time or retrospective) continuous glucose monitoring to help improve blood glucose management for children and young people who continue to have hyperglycaemia despite insulin adjustment and additional support. [2015]

HbA1c targets and monitoring

- 1.2.66 Measure HbA1c using methods that have been calibrated according to International Federation of Clinical Chemistry (IFCC) standardisation. [2015]
- 1.2.67 Explain the benefits of safely achieving and maintaining the lowest attainable HbA1c to children and young people with type 1 diabetes and their families or carers. [2015]
- 1.2.68 Explain to children and young people with type 1 diabetes and their families or

carers that an HbA1c target level of 48 mmol/mol (6.5%) or lower will minimise their risk of long-term complications. [2015]

- 1.2.69 Explain to children and young people with type 1 diabetes who have an HbA1c level above 48 mmol/mol (6.5%) that any reduction in HbA1c level reduces their risk of long-term complications. [2015]
- 1.2.70 Agree an individualised lowest achievable HbA1c target with each child or young person with type 1 diabetes and their families or carers. Take into account factors such as their daily activities, individual life goals, complications, comorbidities and the risk of hypoglycaemia. [2015]
- 1.2.71 Support children and young people with type 1 diabetes and their families or carers to safely achieve and maintain their individual agreed HbA1c target level. [2015]
- 1.2.72 Measure HbA1c level 4 times a year in children and young people with type 1 diabetes. Think about more frequent testing if they are having difficulty with blood glucose management. [2004, amended 2015]
- 1.2.73 Diabetes services should document the proportion of children and young people with type 1 diabetes who achieve an HbA1c level of 53 mmol/mol (7%) or lower. [2015]

Hyperglycaemia, blood ketone monitoring and intercurrent illness

- 1.2.74 Provide children and young people with type 1 diabetes and their families or carers with individualised oral and written advice ('sick-day rules') about managing type 1 diabetes during intercurrent illness or episodes of hyperglycaemia, including:
- monitoring blood glucose
 - monitoring and interpreting blood ketones (beta-hydroxybutyrate)
 - adjusting their insulin regimen
 - food and fluid intake

- when and where to get further advice or help.

Revisit the advice at least annually. [2015]

- 1.2.75 Offer children and young people with type 1 diabetes blood ketone testing strips and a meter. Advise them and their families or carers to test for ketonaemia if they are ill or have hyperglycaemia. [2015]
- 1.2.76 Explain to children and young people with type 1 diabetes and their families or carers that they should not use blood ketone testing strips after the use-by date. [2015]

Hypoglycaemia

- 1.2.77 Explain to children and young people with type 1 diabetes and their families or carers how they can avoid and manage hypoglycaemia. [2004]
- 1.2.78 Offer education for children and young people with type 1 diabetes and their families, carers, and teachers about recognising and managing hypoglycaemia. [2004]
- 1.2.79 Explain to children and young people with type 1 diabetes and their families or carers that they should always have access to an immediate source of fast-acting glucose and blood glucose monitoring equipment, so that they can check for hypoglycaemia and manage it safely. [2004, amended 2015]
- 1.2.80 Train and equip families, carers, and (if appropriate) school nurses and other carers to give intramuscular glucagon for severe hypoglycaemia in an emergency. [2004, amended 2015]
- 1.2.81 Immediately treat mild to moderate hypoglycaemia in children and young people with type 1 diabetes as follows.
- Give oral fast-acting glucose (for example, 10–20 g) (liquid carbohydrate may be easier to swallow than solid).
 - Be aware that fast-acting glucose may need to be given in frequent small amounts, because hypoglycaemia can cause vomiting.

- Recheck blood glucose levels within 15 minutes (fast-acting glucose should raise blood glucose levels within 5–15 minutes), and give more fast-acting glucose if they still have hypoglycaemia.
- As symptoms improve or blood glucose levels return to normal, give oral complex long-acting carbohydrate to maintain blood glucose levels, unless the child or young person is:
 - about to have a snack or meal
 - having a continuous subcutaneous insulin infusion. [2004, amended 2015]

1.2.82 For children and young people with type 1 diabetes who are in hospital, treat severe hypoglycaemia with 10% intravenous glucose if rapid intravenous access is possible. Give a maximum dose of 500 mg/kg body weight (equivalent to a maximum of 5 ml/kg). [2004, amended 2015]

1.2.83 For children and young people with type 1 diabetes who are not in hospital, or if rapid intravenous access is not possible, treat severe hypoglycaemia as follows.

- Use intramuscular glucagon or a concentrated oral glucose solution (for example Glucogel). Do not use oral glucose solution if they have reduced consciousness, because this could be dangerous.
- If using intramuscular glucagon:
 - give 1 mg glucagon to children and young people who are over 8 years old, or who weigh 25 kg or more.
 - give 500 micrograms of glucagon to children who are under 8 years old, or who weigh less than 25 kg.
- Seek medical assistance if blood glucose levels do not respond or symptoms continue for more than 10 minutes.
- As symptoms improve or blood glucose levels return to normal, and once the child or young person is sufficiently awake, give oral complex long-acting carbohydrate to maintain normal blood glucose levels.
- Recheck blood glucose repeatedly in children and young people who have persistently reduced consciousness after a severe hypoglycaemic episode, to determine whether further glucose is needed. [2004, amended 2015]

- 1.2.84 Explain to young people with type 1 diabetes how alcohol affects blood glucose levels, and in particular the increased risk of hypoglycaemia (including hypoglycaemia while sleeping). [2004, amended 2015]
- 1.2.85 Explain to young people with type 1 diabetes who drink alcohol that they should:
- eat food containing carbohydrate before and after drinking
 - monitor their blood glucose levels regularly, and aim to keep the levels within the recommended range by eating food containing carbohydrate. [2004]
- 1.2.86 Explain to children and young people with type 1 diabetes and their families or carers that when alcohol causes or contributes to hypoglycaemia, glucagon may be ineffective and they may need intravenous glucose. [2004]
- 1.2.87 Diabetes teams should consider referring children and young people with type 1 diabetes for assessment of cognitive function if they have frequent hypoglycaemia or recurrent seizures, particularly if these occur at a young age. [2004]

Difficulties with maintaining optimal blood glucose levels

- 1.2.88 Think about the possibility of non-adherence to therapy in children and young people with type 1 diabetes who have difficulty with blood glucose management, especially in adolescence. [2004, amended 2015]
- 1.2.89 Be aware that young people with type 1 diabetes can have difficulty with blood glucose management during adolescence, and this may in part be due to non-adherence to therapy. [2004]
- 1.2.90 Raise the issue of non-adherence to therapy with children and young people with type 1 diabetes and their families or carers in a sensitive manner. [2004]
- 1.2.91 Be aware of the possible negative psychological impact of setting targets that may be difficult for a child or young person with type 1 diabetes to achieve and maintain. [2015]

Surgery

- 1.2.92 Only offer surgery in centres that have dedicated paediatric facilities for children and young people with diabetes. [2004]
- 1.2.93 All centres caring for children and young people with type 1 diabetes should have written protocols on safe surgery for children and young people. The protocols should be agreed between surgical and anaesthetic staff and the diabetes team. [2004]
- 1.2.94 Surgical, anaesthetic and diabetes teams should discuss care for children and young people with type 1 diabetes before they are admitted to hospital for elective surgery, and as soon as possible after they are admitted for emergency surgery. [2004, amended 2015]

Psychological and social issues

- 1.2.95 Be aware that children and young people with type 1 diabetes have a greater risk of emotional and behavioural difficulties. [2004, amended 2015]
- 1.2.96 Offer children and young people with type 1 diabetes and their families or carers emotional support after diagnosis, and tailor this to their emotional, social, cultural and age-dependent needs. [2004]
- 1.2.97 Assess the emotional and psychological wellbeing of young people with type 1 diabetes who have frequent episodes of diabetic ketoacidosis (DKA). [2004, amended 2015]
- 1.2.98 Be aware that a lack of adequate psychosocial support for children and young people with type 1 diabetes has a negative effect on various outcomes (including blood glucose management), and can also reduce their self-esteem. [2004, amended 2015]
- 1.2.99 Offer children and young people with type 1 diabetes and their families or carers timely and ongoing access to mental health professionals with an understanding of diabetes. This is because they may experience psychological problems (such as anxiety, depression, behavioural and conduct disorders, and family conflict) or psychosocial difficulties that can impact on the management of diabetes and wellbeing. [2004, amended 2015]

- 1.2.100 See the [NICE guidelines on depression in children and young people and antisocial behaviour and conduct disorders in children and young people](#) for guidance on managing these conditions. [2015]
- 1.2.101 Diabetes teams should have access to mental health professionals to support them in psychological assessment and providing psychosocial support. [2004]
- 1.2.102 Offer children and young people with type 1 diabetes who have behavioural or conduct disorders, and their families or carers, access to mental health professionals. [2004]
- 1.2.103 Offer specific family-based behavioural interventions, such as behavioural family systems therapy, if there are difficulties with diabetes-related family conflict. [2015]
- 1.2.104 Consider a programme of behavioural intervention therapy or behavioural techniques for children and young people with type 1 diabetes, if there are concerns about their psychological wellbeing. Choose a type of therapy based on what the child or young person needs help with:
- health-related quality of life – for example, counselling or cognitive behavioural therapy (CBT), including CBT focused on quality of life
 - adherence to diabetes treatment – for example, motivational interviewing or multisystemic therapy
 - blood glucose management if they have high HbA1c levels (above 69 mmol/mol [8.5%]) – for example, multisystemic therapy. [2015]
- 1.2.105 Offer screening for anxiety and depression to children and young people with type 1 diabetes who have persistent difficulty with blood glucose management. [2004]
- 1.2.106 Be aware that children and young people with type 1 diabetes may develop anxiety or depression, particularly when they have difficulty with self-management when they have had diabetes for a long time. [2004]
- 1.2.107 Refer children and young people with type 1 diabetes and suspected anxiety or depression promptly to child mental health professionals. [2004]

- 1.2.108 Be aware that children and young people with type 1 diabetes (in particular young women) have an increased risk of eating disorders. For more guidance on assessing and managing eating disorders, see the [NICE guideline on eating disorders](#). [2004, amended 2015]
- 1.2.109 Be aware that children and young people with type 1 diabetes and an eating disorder may have associated difficulties with:
- blood glucose management (both hyperglycaemia and hypoglycaemia)
 - symptoms of gastroparesis. [2004, amended 2015]
- 1.2.110 For children and young people with type 1 diabetes and an eating disorder, offer joint management involving their diabetes team and child mental health professionals. [2004, amended 2015]

Monitoring for complications and associated conditions of type 1 diabetes

- 1.2.111 Offer children and young people with type 1 diabetes monitoring for:
- thyroid disease, at diagnosis and then annually until transfer to adult services
 - moderately increased albuminuria (albumin:creatinine ratio [ACR] 3–30 mg/mmol) to detect diabetic kidney disease, annually from 12 years
 - hypertension, annually from 12 years. [2015]
- 1.2.112 Refer children and young people with type 1 diabetes for diabetic retinopathy screening from 12 years, in line with [Public Health England's Diabetic eye screening programme](#). [2015]
- 1.2.113 For guidance on monitoring for coeliac disease in children and young people with type 1 diabetes, see the [NICE guideline on coeliac disease](#). [2015]
- 1.2.114 For guidance on managing foot problems in children and young people with type 1 diabetes, see the [NICE guideline on diabetic foot problems](#). [2015]
- 1.2.115 Be aware of the following rare complications and associated conditions when children and young people with type 1 diabetes attend clinic visits:

- juvenile cataracts
- necrobiosis lipoidica
- Addison's disease. [2004, amended 2015]

1.2.116 Explain to children and young people with type 1 diabetes and their families or carers the importance of annual monitoring from 12 years for diabetic kidney disease. [2015]

Diabetic retinopathy

1.2.117 For children and young people with type 1 diabetes who are having eye screening, explain to them and their families or carers that:

- monitoring for diabetic retinopathy begins at 12 years (see recommendation 1.2.112) because diabetic retinopathy that needs treatment is extremely rare in children and young people under 12
- annual monitoring from age 12 is important because, if significant diabetic retinopathy is found, early treatment will improve the outcome (for more information see [Public Health England's Diabetic eye screening programme](#))
- it will help them to keep their eyes healthy and help to prevent problems with their vision
- the screening service is effective at identifying problems so that they can be treated early. [2015, amended 2020]

Diabetic kidney disease

1.2.118 Explain to children and young people with type 1 diabetes and their families or carers that:

- monitoring for moderately increased albuminuria (ACR 3–30 mg/mmol) to detect diabetic kidney disease begins at 12 years because diabetic kidney disease in children and young people under 12 is extremely rare
- using the first urine sample of the day ('early morning urine') to screen for moderately increased albuminuria is important, as this reduces the risk of false positive results

- if moderately increased albuminuria is detected, improving blood glucose management will reduce the risk of this progressing to significant diabetic kidney disease
- annual monitoring from 12 years is important because, if they have diabetic kidney disease, early treatment will improve the outcome. [2015]

1.2.119 Use the first urine sample of the day ('early morning urine') to measure the albumin:creatinine ratio. If the first urine sample of the day is not available, use a random sample, but be aware that this is associated with an increased risk of false positive results. [2015]

1.2.120 If the initial albumin:creatinine ratio is above 3 mg/mmol but below 30 mg/mmol, confirm the result by repeating the test on 2 further occasions using first urine samples of the day ('early morning urine') before starting further investigation and therapy. [2015]

1.2.121 Investigate further if the initial albumin:creatinine ratio is 30 mg/mmol or more (proteinuria). [2015]

1.3 Type 2 diabetes

Education and information

1.3.1 Offer children and young people with type 2 diabetes and their families or carers a continuing programme of education from diagnosis. Include the following core topics:

- HbA1c monitoring and targets
- how diet, physical activity, body weight and intercurrent illness effect blood glucose levels
- how metformin can help, and possible adverse effects
- the complications of type 2 diabetes and how to prevent them. [2015]

1.3.2 Tailor the education programme to each child or young person with type 2 diabetes and their families or carers, taking account of issues such as:

- personal preferences

- emotional wellbeing
- age and maturity
- cultural considerations
- existing knowledge
- current and future social circumstances
- life goals. [2015]

1.3.3 Explain to children and young people with type 2 diabetes and their families or carers that, like people without diabetes, they should have:

- regular dental examinations (see the [NICE guideline on dental recall](#))
- an eye examination by an optician every 2 years. [2004, amended 2015]

1.3.4 Encourage children and young people with type 2 diabetes and their families or carers to discuss any concerns and raise any questions they have with their diabetes team. [2015]

1.3.5 Give children and young people with type 2 diabetes and their families or carers information about diabetes support groups and organisations, and the potential benefits of membership. Give this information after diagnosis and regularly afterwards. [2004, amended 2015]

1.3.6 Explain to children and young people with type 2 diabetes and their families or carers how to find out about possible government disability benefits. [2004, amended 2015]

1.3.7 Take particular care when communicating with children and young people with type 2 diabetes if they or their families or carers have physical and sensory disabilities, or difficulties speaking or reading English. [2004, amended 2015]

Smoking and substance misuse

1.3.8 Encourage children and young people with type 2 diabetes not to start smoking. Explain the general health problems smoking causes, in particular the risks of vascular complications. [2004, amended 2015]

- 1.3.9 For more guidance on preventing smoking, see also the [NICE guidelines on preventing the uptake of smoking by children and young people and school-based interventions to prevent smoking](#). [2004, amended 2015]
- 1.3.10 Offer smoking cessation programmes to children and young people with type 2 diabetes who smoke. See also the [NICE guidelines on stop smoking interventions and services, harm reduction approaches to smoking, and smoking cessation in secondary care](#). [2004, amended 2015]
- 1.3.11 Explain to children and young people with type 2 diabetes and their families or carers about the general dangers of substance misuse and the possible effects on blood glucose levels. [2004, amended 2015]

Immunisation

- 1.3.12 Explain to children and young people with type 2 diabetes and their families or carers that the [Public Health England Green Book](#) recommends they have:
- annual immunisation against influenza
 - immunisation against pneumococcal infection, if they are taking insulin or oral hypoglycaemic medicines. [2004, amended 2015]

Dietary management

- 1.3.13 At each contact with a child or young person with type 2 diabetes who is overweight or obese, advise them and their families or carers about the benefits of exercise and weight loss, and provide support towards achieving this. See also the [NICE guidelines on maintaining a healthy weight and managing obesity](#). [2015]
- 1.3.14 Offer children and young people with type 2 diabetes dietetic support to help optimise body weight and blood glucose levels. [2004, amended 2015]
- 1.3.15 At each contact with a child or young person with type 2 diabetes, explain to them and their families or carers how healthy eating can help to:
- reduce hyperglycaemia
 - reduce cardiovascular risk

- promote weight loss (see recommendation 1.3.13). [2015]
- 1.3.16 Provide dietary advice to children and young people with type 2 diabetes and their families or carers in a sensitive manner. Take into account the difficulties that many people have with losing weight, and how healthy eating can also help with blood glucose levels and avoiding complications. [2015]
- 1.3.17 Take into account social and cultural considerations when providing dietary advice to children and young people with type 2 diabetes. [2015]
- 1.3.18 Encourage children and young people with type 2 diabetes to eat at least 5 portions of fruit and vegetables each day. [2015]
- 1.3.19 At each clinic visit for children and young people with type 2 diabetes:
- measure height and weight and plot on an appropriate growth chart
 - calculate BMI.
- Check for normal growth or significant changes in weight, because these may reflect changes in blood glucose levels. [2004, amended 2015]
- 1.3.20 Provide arrangements for weighing children and young people with type 2 diabetes that respect their privacy. [2004, amended 2015]

Metformin

- 1.3.21 Offer standard-release metformin from diagnosis to children and young people with type 2 diabetes. [2015]

HbA1c targets and monitoring

- 1.3.22 Measure HbA1c using methods that have been calibrated according to International Federation of Clinical Chemistry (IFCC) standardisation. [2015]
- 1.3.23 Explain to children and young people with type 2 diabetes and their families or carers that an HbA1c target level of 48 mmol/mol (6.5%) or lower will minimise their risk of long-term complications. [2015]
- 1.3.24 Explain to children and young people with type 2 diabetes who have an HbA1c

level above 48 mmol/mol (6.5%) that any reduction in HbA1c level reduces their risk of long-term complications. [2015]

- 1.3.25 Explain the benefits of safely achieving and maintaining the lowest attainable HbA1c to children and young people with type 2 diabetes and their families or carers. [2015]
- 1.3.26 Agree an individualised lowest achievable HbA1c target with each child or young person with type 2 diabetes and their families or carers. Take into account factors such as their daily activities, individual life goals, complications and comorbidities. [2015]
- 1.3.27 Measure HbA1c levels every 3 months in children and young people with type 2 diabetes. [2015]
- 1.3.28 Support children and young people with type 2 diabetes and their families or carers to safely achieve and maintain their individual agreed HbA1c target level. [2015]
- 1.3.29 Diabetes services should document the proportion of children and young people with type 2 diabetes who achieve an HbA1c level of 53 mmol/mol (7%) or lower. [2015]

Surgery

- 1.3.30 Only offer surgery in centres that have dedicated paediatric facilities for children and young people with diabetes. [2004, amended 2015]
- 1.3.31 All centres caring for children and young people with type 2 diabetes should have written protocols on safe surgery for children and young people. The protocols should be agreed between surgical and anaesthetic staff and the diabetes team. [2004, amended 2015]

Psychological and social issues

- 1.3.32 Be aware that children and young people with type 2 diabetes have a greater risk of emotional and behavioural difficulties. [2004, amended 2015]
- 1.3.33 Offer children and young people with type 2 diabetes and their families or

carers emotional support after diagnosis, and tailor this to their emotional, social, cultural and age-dependent needs. [2004, amended 2015]

- 1.3.34 Be aware that children and young people with type 2 diabetes have an increased risk of psychological conditions (for example anxiety, depression, behavioural and conduct disorders) and complex social factors (for example family conflict), and these can affect their wellbeing and diabetes management. [2015]
- 1.3.35 Be aware that a lack of adequate psychosocial support for children and young people with type 2 diabetes has a negative effect on various outcomes (including blood glucose management) and can also reduce their self-esteem. [2004, amended 2015]
- 1.3.36 Offer children and young people with type 2 diabetes and their families or carers timely and ongoing access to mental health professionals with an understanding of diabetes. This is because they may experience psychological problems (such as anxiety, depression, behavioural and conduct disorders and family conflict) or psychosocial difficulties that can impact on the management of diabetes and wellbeing. [2004, amended 2015]
- 1.3.37 See the [NICE guidelines on depression in children and young people and antisocial behaviour and conduct disorders in children and young people](#) for guidance on managing these conditions. [2015]
- 1.3.38 Diabetes teams should have access to mental health professionals to support them in psychological assessment and providing psychosocial support. [2004, amended 2015]
- 1.3.39 Offer assessment for anxiety and depression to children and young people with type 2 diabetes who have persistent difficulty with blood glucose management. [2004, amended 2015]
- 1.3.40 Refer children and young people with type 2 diabetes and suspected anxiety or depression promptly to child mental health professionals. [2004, amended 2015]
- 1.3.41 Ensure that children and young people with type 2 diabetes and their families or carers have timely and ongoing access to mental health services when needed.

[2015]

Monitoring for complications and associated conditions of type 2 diabetes

- 1.3.42 Offer children and young people with type 2 diabetes annual monitoring for:
- hypertension starting at diagnosis
 - dyslipidaemia starting at diagnosis
 - moderately increased albuminuria (albumin:creatinine ratio [ACR] 3–30 mg/mmol) to detect diabetic kidney disease, starting at diagnosis. [2015]
- 1.3.43 Explain to children and young people with type 2 diabetes and their families or carers the importance of annual monitoring for hypertension, dyslipidaemia and diabetic kidney disease. [2015]
- 1.3.44 Refer children and young people with type 2 diabetes for diabetic retinopathy screening from 12 years, in line with [Public Health England's Diabetic eye screening programme](#). [2015]
- 1.3.45 For guidance on managing foot problems in children and young people with type 2 diabetes, see the [NICE guideline on diabetic foot problems](#). [2015]

Hypertension

- 1.3.46 Explain to children and young people with type 2 diabetes and their families or carers that monitoring (see recommendation 1.3.42) is important because if they have hypertension, early treatment will reduce their risk of complications. [2015]
- 1.3.47 Use a cuff large enough for the child or young person with type 2 diabetes when measuring blood pressure. [2015]
- 1.3.48 If repeated resting measurements are greater than the 95th percentile for age and sex, confirm hypertension using 24-hour ambulatory blood pressure monitoring before starting antihypertensive therapy. [2015]

Dyslipidaemia

- 1.3.49 Explain to children and young people with type 2 diabetes and their families or carers that monitoring (see recommendation 1.3.42) is important because if they have dyslipidaemia, early treatment will reduce their risk of complications. [2015]
- 1.3.50 When monitoring for dyslipidaemia in children and young people with type 2 diabetes, measure total cholesterol, high-density lipoprotein (HDL) cholesterol, non-HDL cholesterol and triglyceride concentrations. [2015]
- 1.3.51 Confirm dyslipidaemia using a repeat sample (fasting or non-fasting) before deciding on further management. [2015]

Diabetic retinopathy

- 1.3.52 For children and young people with type 2 diabetes who are having eye screening, explain to them and their families or carers that:
- background retinopathy is often found through screening (see recommendation 1.3.43), and improved blood glucose management will reduce the risk of this progressing to significant diabetic retinopathy
 - it will help them to keep their eyes healthy and prevent problems with their vision
 - the screening service is effective at identifying problems so that they can be treated early
 - at least annual monitoring from 12 years is important because, if significant diabetic retinopathy is found, early treatment will improve the outcome. [2015, amended 2020]
- 1.3.53 Consider referring children and young people with type 2 diabetes who are younger than 12 years to an ophthalmologist for retinal examination if they have difficulty with blood glucose management. [2015]

Diabetic kidney disease

- 1.3.54 Explain to children and young people with type 2 diabetes and their families or carers that:

- using the first urine sample of the day ('early morning urine') to screen for moderately increased albuminuria (ACR 3–30 mg/mmol) is important, as this reduces the risk of false positive results
- if moderately increased albuminuria is detected, improving blood glucose management will reduce the risk of this progressing to significant diabetic kidney disease
- annual monitoring (see recommendation 1.3.42) is important because, if they have diabetic kidney disease, early treatment will improve the outcome. [2015]

1.3.55 Use the first urine sample of the day ('early morning urine') to measure the albumin:creatinine ratio. If the first urine sample of the day is not available, use a random sample, but be aware that this is associated with an increased risk of false positive results. [2015]

1.3.56 If the initial albumin:creatinine ratio is above 3 mg/mmol but below 30 mg/mmol, confirm the result by repeating the test on 2 further occasions using first urine samples of the day ('early morning urine') before starting further investigation and therapy. [2015]

1.3.57 Investigate further if the initial albumin:creatinine ratio is 30 mg/mmol or more (proteinuria). [2015]

1.4 Diabetic ketoacidosis

Recognition, referral and diagnosis

1.4.1 Measure capillary blood glucose at presentation in children and young people without known diabetes who have:

- increased thirst, polyuria, recent unexplained weight loss or excessive tiredness and any of
- nausea, vomiting, abdominal pain, hyperventilation, dehydration or reduced level of consciousness. [2015]

1.4.2 For children or young people without known diabetes who have a plasma glucose level above 11 mmol/litre and symptoms that suggest diabetic ketoacidosis (DKA) (see recommendation 1.4.1), suspect DKA and immediately send them to a hospital with acute paediatric facilities. [2015]

- 1.4.3 Be aware that children and young people taking insulin for diabetes may develop DKA with normal blood glucose levels. [2015]
- 1.4.4 Suspect DKA even if the blood glucose is normal in a child or young person with known diabetes and any of the following:
- nausea or vomiting
 - abdominal pain
 - hyperventilation
 - dehydration
 - reduced level of consciousness. [2015]
- 1.4.5 When DKA is suspected in a child or young person with known diabetes, measure their blood ketones (beta-hydroxybutyrate), using a near-patient method if available. Immediately send them to a hospital with acute paediatric facilities if:
- their blood ketones are elevated
 - a near-patient method for measuring their blood ketones is not available. [2015]
- 1.4.6 If DKA is suspected or confirmed in a child or young person, explain to them and to their families or carers that DKA is serious and that they need urgent hospital assessment. [2015]
- 1.4.7 When a child or young person with suspected or known DKA arrives at hospital, measure their:
- capillary blood glucose
 - capillary blood ketones (beta-hydroxybutyrate) if near-patient testing is available, or urine ketones if it is not
 - capillary or venous pH and bicarbonate. [2015]
- 1.4.8 Diagnose DKA in children and young people with diabetes who have:
- hyperglycaemia (plasma glucose more than 11 mmol/litre) and

- acidosis (indicated by blood pH below 7.3 or plasma bicarbonate below 15 mmol/litre) and
- ketonaemia (indicated by blood beta-hydroxybutyrate above 3 mmol/litre) or ketonuria (++ and above on the standard strip marking scale). [2015]

1.4.9 Diagnose DKA severity as follows:

- mild DKA if blood pH is below 7.3 or plasma bicarbonate is below 15 mmol/litre
- moderate DKA if blood pH is below 7.2 or plasma bicarbonate is below 10 mmol/litre
- severe DKA if blood pH is below 7.1 or plasma bicarbonate is below 5 mmol/litre. [2015]

Initial management of diabetic ketoacidosis

1.4.10 Inform the responsible senior clinician when a child or young person is diagnosed with DKA. [2015]

1.4.11 Explain to the child or young person and their families or carers what DKA is, and what care that they may need. [2015]

1.4.12 When DKA is diagnosed in a child or young person in hospital, record their:

- level of consciousness
- heart rate, blood pressure, temperature, respiratory rate (look for Kussmaul breathing)
- history of nausea or vomiting
- clinical evidence of dehydration
- body weight. [2015]

1.4.13 When DKA is diagnosed in a child or young person in hospital, measure and record the capillary or venous:

- pH and pCO₂
- plasma sodium, potassium, urea and creatinine

- plasma bicarbonate. [2015]
- 1.4.14 Consider a near-patient blood ketone (beta-hydroxybutyrate) testing method for rapid diagnosis and monitoring of DKA in children and young people in hospital. [2015]
- 1.4.15 Children and young people with DKA should be cared for in a facility that can provide the level of monitoring and care for DKA specified in section 1.4 of this guideline. [2015]
- 1.4.16 Children and young people with DKA should be cared for with one-to-one nursing either on a high-dependency unit (preferably a paediatric unit), or on a general paediatric ward, if:
- they are younger than 2 years or
 - they have severe DKA (blood pH below 7.1). [2015]
- 1.4.17 Think about inserting a nasogastric tube if a child or young person with DKA has a reduced level of consciousness and is vomiting. [2015]
- 1.4.18 Seek urgent anaesthetic review and discuss with a paediatric critical care specialist if a child or young person with DKA cannot protect their airway because they have a reduced level of consciousness. [2015]
- 1.4.19 Discuss the use of inotropes with a paediatric critical care specialist if a child or young person with DKA is in hypotensive shock. [2015]
- 1.4.20 Think about sepsis in a child or young person with DKA who has any of the following:
- fever or hypothermia
 - hypotension
 - refractory acidosis
 - lactic acidosis. [2015]

Fluid and insulin therapy

- 1.4.21 Treat DKA with intravenous fluids and intravenous insulin if the child or young person is not alert, is nauseated or vomiting, or is clinically dehydrated. [2020]
- 1.4.22 Do not give oral fluids to a child or young person who is receiving intravenous fluids for DKA unless ketosis is resolving, they are alert, and they are not nauseated or vomiting. [2020]
- 1.4.23 For children and young people with DKA who are clinically dehydrated but not in shock:
- give an initial intravenous bolus of 10 ml/kg 0.9% sodium chloride over 30 minutes
 - discuss with the responsible senior paediatrician before giving more than one intravenous bolus of 10 ml/kg 0.9% sodium chloride
 - only consider giving a second 10ml/kg 0.9% sodium chloride intravenous bolus if needed to improve tissue perfusion, and only after reassessing their clinical status
 - when calculating the total fluid requirement, subtract these initial bolus volumes from the total fluid deficit. [2020]
- 1.4.24 For children and young people who have signs of shock, that is weak, thready (low-volume) pulse and hypotension, give an initial intravenous bolus of 20 ml/kg 0.9% sodium chloride as soon as possible. When calculating the total fluid requirement, **do not** subtract this fluid bolus from the total fluid deficit. [2020]
- 1.4.25 Be aware that:
- shock is rare in children and young people with DKA
 - prolonged capillary refill, tachycardia and tachypnoea are common in children with moderate to severe DKA, but this does not mean the child or young person is in shock (these are signs of vasoconstriction caused by metabolic acidosis and hypocapnia). [2020]
- 1.4.26 Calculate the total fluid requirement for the first 48 hours in children and young people with DKA by adding the estimated fluid deficit to the fluid maintenance requirement:

- For the fluid deficit:
 - in mild to moderate DKA (blood pH 7.1 or above), assume 5% dehydration (so a 10 kg child needs 500 ml)
 - in severe DKA (blood pH below 7.1), assume 10% dehydration
 - aim to replace the deficit evenly over the first 48 hours, but in critically ill children and young people, discuss the fluid regimen early with the senior paediatrician or paediatric intensivist (or both), because the risk of cerebral oedema is higher.
- For the fluid maintenance requirement, use the Holliday-Segar formula:
 - give 100 ml/kg for the first 10 kg of weight
 - give 50 ml/kg for the second 10 kg of weight
 - give 20 ml/kg for every kg after this
 - use a maximum weight of 75 kg in the calculation.

When calculating the total fluid requirement, subtract any initial bolus volumes from the total fluid deficit (unless the child or young person is in shock). [2020]

- 1.4.27 Use 0.9% sodium chloride without added glucose for both rehydration and maintenance fluid in children and young people with DKA, until the plasma glucose concentration is below 14 mmol/litre. [2020]
- 1.4.28 Be aware that some children and young people with DKA may develop hyperchloremic acidosis, but this resolves on its own over time and specific management is not needed. [2020]
- 1.4.29 Include 40 mmol/litre (or 20 mmol/500 ml) potassium chloride in all fluids (except the initial intravenous boluses) given to children and young people with DKA, unless they have anuria or their potassium level is above the normal range. Do not delay potassium replacement, because hypokalaemia can occur once the insulin infusion starts. [2020]
- 1.4.30 For children and young people with potassium levels above the normal range, only add 40 mmol/litre (or 20 mmol/500 ml) potassium chloride to their intravenous fluids if:

- their potassium is less than 5.5 mmol/litre **or**
 - they have a history of passing urine. [2020]
- 1.4.31 For children and young people with DKA who have hypokalaemia at presentation, include potassium chloride in intravenous fluids before starting the insulin infusion.
- 1.4.32 Monitor sodium levels throughout DKA treatment, and calculate the corrected sodium initially to identify if the child or young person has hyponatraemia.
- 1.4.33 When monitoring serum sodium levels in children and young people with DKA, be aware that:
- serum sodium should rise as DKA is treated as blood glucose falls
 - falling serum sodium is a sign of possible cerebral oedema
 - a rapid and ongoing rise in serum sodium concentration may also be a sign of cerebral oedema, caused by the loss of free water in the urine. [2020]
- 1.4.34 Do not give intravenous sodium bicarbonate to children and young people with DKA unless:
- they have compromised cardiac contractility, caused by life-threatening hyperkalaemia or severe acidosis **and**
 - you have discussed with the paediatric intensivist. [2020]
- 1.4.35 Do not give children and young people with DKA additional intravenous fluid to replace urinary losses. [2015]
- 1.4.36 Start an intravenous insulin infusion 1–2 hours after beginning intravenous fluid therapy in children and young people with DKA. If a child or young person with DKA is using an insulin pump, disconnect the pump when starting intravenous insulin therapy. [2015]
- 1.4.37 When treating DKA with intravenous insulin in children and young people, use a soluble insulin infusion at a dosage between 0.05 and 0.1 units/kg/hour. Do not give bolus doses of intravenous insulin. [2015]

- 1.4.38 In discussion with a diabetes specialist, think about continuing subcutaneous basal insulin in a child or young person who was using a basal insulin before DKA started. [2015]
- 1.4.39 When the plasma glucose concentration falls below 14 mmol/litre in children and young people with DKA, change fluids to 0.9% sodium chloride with 5% glucose and 40 mmol/litre (or 20 mmol/500 ml) potassium chloride. [2020]
- 1.4.40 If a child or young person's plasma glucose falls below 6 mmol/litre during DKA treatment:
- increase the glucose concentration of the intravenous fluid infusion and
 - if they have persisting ketosis, continue to give insulin at a dosage of least 0.05 units/kg/hour. [2020]
- 1.4.41 If the blood beta-hydroxybutyrate level is not falling within 6–8 hours in a child or young person with DKA, think about increasing the insulin dosage to 0.1 units/kg/hour or more. [2015]
- 1.4.42 Think about stopping intravenous fluid therapy for DKA in a child or young person if:
- ketosis is resolving and their blood pH has reached 7.3 and
 - they are alert and
 - they can take oral fluids without nausea or vomiting.
- Discuss with the responsible senior paediatrician before stopping intravenous fluid therapy and changing to oral fluids for DKA in a child or young person if they still have mild acidosis or ketosis. [2020]
- 1.4.43 Do not change from intravenous insulin to subcutaneous insulin in a child or young person with DKA until ketosis is resolving, they are alert, and they can take oral fluids without nausea or vomiting. [2015]
- 1.4.44 Start subcutaneous insulin in a child or young person with DKA at least 30 minutes before stopping intravenous insulin. [2015]

- 1.4.45 For a child or young person with DKA who is using an insulin pump, restart the pump at least 60 minutes before stopping intravenous insulin. Change the insulin cartridge and infusion set, and insert the cannula into a new subcutaneous site. [2015]

For a short explanation of why the committee made the 2020 recommendations and how they might affect practice, see the [rationale and impact section on fluid therapy](#).

Full details of the evidence and the committee's discussion are in [evidence review A: fluid therapy for the management of diabetic ketoacidosis](#).

Monitoring during therapy

- 1.4.46 Monitor and record the following at least hourly in children and young people with DKA:
- capillary blood glucose
 - heart rate, blood pressure, temperature, respiratory rate (look for Kussmaul breathing)
 - fluid balance, with fluid input and output charts
 - level of consciousness (using the modified Glasgow coma scale). [2015]
- 1.4.47 Monitor and record the level of consciousness (using the modified Glasgow coma scale) and heart rate (to detect bradycardia) every 30 minutes in:
- children under 2 years with DKA
 - children and young people with severe DKA (blood pH below 7.1).
- This is because these children and young people are at increased risk of cerebral oedema. [2015]
- 1.4.48 Monitor children and young people having intravenous therapy for DKA using continuous electrocardiogram (ECG), to detect signs of hypokalaemia (including ST-segment depression and prominent U-waves). [2015]
- 1.4.49 Ensure that healthcare professionals performing the monitoring described in

recommendations 1.4.46, 1.4.47 and 1.4.48 know what to look for and when to seek advice. [2015]

1.4.50 At 2 hours after starting treatment, and then at least every 4 hours, carry out and record the results of the following blood tests in children and young people with DKA:

- glucose (laboratory measurement)
- blood pH and pCO₂
- plasma sodium, potassium and urea
- beta-hydroxybutyrate. [2015]

1.4.51 A doctor involved in the care of the child or young person with DKA should review them face-to-face at diagnosis and then at least every 4 hours, and more frequently if:

- they are aged under 2 years
- they have severe DKA (blood pH below 7.1)
- there are any other reasons for special concern. [2015]

1.4.52 At each face-to-face review of children and young people with DKA, assess the following:

- clinical status, including vital signs and neurological status
- results of blood investigations
- ECG trace
- cumulative fluid balance record. [2015]

1.4.53 Update the child and young person with DKA and their families or carers regularly about their progress. [2015]

Complications of diabetic ketoacidosis

Cerebral oedema

1.4.54 Immediately assess children and young people with DKA for suspected cerebral oedema if they have any of these early manifestations:

- headache
- agitation or irritability
- unexpected fall in heart rate
- increased blood pressure. [2015]

1.4.55 If cerebral oedema is suspected in a child or young person with DKA, start treatment immediately.

1.4.56 Start treatment for cerebral oedema immediately in children and young people with DKA and any of these signs:

- deterioration in level of consciousness
- abnormalities of breathing pattern, for example respiratory pauses
- oculomotor palsies
- pupillary inequality or dilatation. [2015]

1.4.57 When treating cerebral oedema in children and young people with DKA, use the most readily available of:

- mannitol (20%, 0.5–1 g/kg over 10–15 minutes) or
- hypertonic sodium chloride (2.7% or 3%, 2.5–5 ml/kg over 10–15 minutes). [2015]

1.4.58 After starting treatment for cerebral oedema with mannitol or hypertonic sodium chloride in a child or young person with DKA, immediately seek specialist advice on further management, including which care setting would be best. [2015]

Hypokalaemia

- 1.4.59 If a child or young person with DKA develops hypokalaemia (potassium below 3 mmol/litre):
- think about temporarily suspending the insulin infusion
 - discuss hypokalaemia management urgently with a paediatric critical care specialist, because a central venous catheter is needed to give intravenous potassium solutions above 40 mmol/litre. [2015]

Venous thromboembolic disease

- 1.4.60 Be aware of the increased risk of venous thromboembolism in children and young people with DKA, especially if they have a central venous catheter. [2015]

Avoiding future episodes of diabetic ketoacidosis

- 1.4.61 After a child or young person with known diabetes has recovered from an episode of DKA, discuss what may have led to the episode with them and their families or carers. [2015]
- 1.4.62 Think about the possibility of non-adherence to therapy in children and young people with established type 1 diabetes who present with DKA, especially if they have had multiple episodes of DKA. [2004, amended 2015]
- 1.4.63 Advise children and young people who have had DKA and their families or carers how to reduce the risk of future episodes. In particular, explain the importance of managing intercurrent illnesses. [2015]

1.5 Service provision

- 1.5.1 Offer children and young people with diabetes an ongoing integrated package of care, provided by a multidisciplinary paediatric diabetes team.
- 1.5.2 The diabetes team should include members with training in clinical, educational, dietetic, lifestyle, mental health and foot care aspects of diabetes for children and young people. [2004, amended 2015]
- 1.5.3 Offer children and young people with diabetes and their families or carers

24-hour access to advice from their diabetes team. [2004, amended 2015]

- 1.5.4 Involve children and young people with diabetes and their families or carers in making decisions about the package of care provided by their diabetes team. [2004, amended 2015]
- 1.5.5 At diagnosis, offer children and young people with diabetes either home-based or inpatient management, depending on their clinical need, family circumstances and preferences. Explain that home-based care with support from the local paediatric diabetes team (including 24-hour telephone access) is safe, and is as effective as initial inpatient management. [2004, amended 2015]
- 1.5.6 Offer initial inpatient management to children with diabetes who are under 2 years old. [2004, amended 2015]
- 1.5.7 Think about initial inpatient management for children and young people with diabetes if there are social or emotional factors that would make home-based management inappropriate, or if they live a long way from the hospital. [2004, amended 2015]
- 1.5.8 Diabetes teams should speak regularly with school staff who look after children and young people with type 1 diabetes, to provide diabetes education and practical information. [2004, amended 2015]
- 1.5.9 Record the details of children and young people with diabetes on a population-based, practice-based or clinic-based diabetes register. [2004, amended 2015]

Transition from paediatric to adult care

- 1.5.10 Give young people with diabetes enough time to understand how transition from paediatric to adult services will work, because this improves clinic attendance. [2004, amended 2015]
- 1.5.11 Agree specific local protocols for transferring young people with diabetes from paediatric to adult services. [2004, amended 2015]
- 1.5.12 Base the decision on when a young person should transfer to the adult service

on their physical development and emotional maturity, and on local circumstances. [2004, amended 2015]

1.5.13 Ensure that transition from the paediatric service occurs at a time of relative stability in the young person's health, and that it is coordinated with other life transitions. [2004, amended 2015]

1.5.14 Explain to young people with type 1 diabetes who are preparing for transition to adult services that some aspects of diabetes care will change. [2004, amended 2015]

Terms used in this guideline

Hyperchloremic acidosis

A persisting base deficit or low bicarbonate concentration, despite evidence of resolving ketosis and clinical improvement.

Insulin pump

Continuous subcutaneous insulin infusion. A programmable pump and insulin storage device that gives a regular or continuous amount of insulin (usually a rapid-acting insulin analogue or short-acting insulin) through a subcutaneous needle or cannula.

Level 3 carbohydrate counting

Carbohydrate counting with adjustment of insulin dosage according to an insulin:carbohydrate ratio.

Multiple daily injection basal-bolus regimen

Injections of short-acting insulin or rapid-acting insulin analogue before meals, together with 1 or more separate daily injections of intermediate-acting insulin or long-acting insulin analogue.

Once, twice, or three-times daily mixed insulin injections

These are usually injections of short-acting insulin or rapid-acting insulin analogue mixed with intermediate-acting insulin.

Research recommendations

The Guideline Development Group has made the following recommendations for research, based on its review of evidence, to improve NICE guidance and patient care in the future. The Guideline Development Group's full set of research recommendations is detailed in the [full guideline](#).

1 Peer-led education programmes for young people with type 1 diabetes

What is the effectiveness of education programmes in which young people with type 1 diabetes provide training for their peers?

Why this is important

Training delivered by peers is effective both in healthcare and in other settings. This research should evaluate the engagement of the child or young person with type 1 diabetes and their family members or carers (as appropriate), and outcomes for the child or young person. Outcomes could include their success in achieving their target HbA1c level, engagement with diabetes care and management (for example, attendance at clinic), satisfaction with the education programme, and quality of life. The impact on the young person delivering the training should also be evaluated (this could cover the impact on their diabetes care and the psychosocial impact of providing training for their peers). The research should be conducted using quantitative, qualitative and mixed methods.

2 Optimal upper limit and timing for blood glucose measurements after meals for children and young people with type 1 diabetes

What is the optimal upper limit and timing for blood glucose measurements after meals for children and young people with type 1 diabetes to reach an HbA1c level of 48 mmol/mol (6.5%) without unacceptable hypoglycaemia?

Why this is important

Setting an upper limit for plasma glucose measurements 1–2 hours after meals of less than 8 mmol/litre (rather than the 9 mmol/litre recommended in this guideline) could potentially lead to an improvement in blood glucose management without an unacceptable risk of hypoglycaemia. The

evidence reviewed for the guideline did not allow a precise evaluation of the upper limit for the target range, or the timing of blood glucose testing relative to meals. Future research should investigate the HbA1c levels of children and young people with type 1 diabetes who aim for blood glucose measurements after meals slightly lower (to ensure their safety) than 9 mmol/litre, to help decide whether lowering the upper limit is effective in improving long-term blood glucose management. Outcomes include the child or young person's satisfaction with treatment, their HbA1c levels, rates of hypoglycaemia, the views of their family members or carers (as appropriate), and quality of life.

3 Metformin preparations for children and young people with type 2 diabetes

What is the long-term comparative clinical and cost effectiveness of different metformin preparations for treating type 2 diabetes in children and young people?

Why this is important

There is high-quality evidence for the clinical and cost effectiveness of metformin as a treatment for type 2 diabetes from diagnosis in children and young people. However, all of the relevant evidence relates to administration in tablet form and using a standard dosage, despite alternative oral preparations (including solutions and extended-release tablets) being available and having potential advantages to the standard preparation. Gastrointestinal disorders (for example, nausea, vomiting, diarrhoea, abdominal pain and loss of appetite) are very common with metformin, especially at the start of treatment, and may be reduced or avoided with alternative preparations. Extended-release tablets and oral solutions may also be easier to swallow, as standard formulation metformin consists of large tablets. Further research would preferably consist of randomised controlled trials. Outcomes should include blood glucose management (preferably using measurement of HbA1c levels) and the child or young person's satisfaction with and adherence to treatment.

4 Dietary advice based on glycaemic index for children and young people with type 1 diabetes from diagnosis

What is the impact of educating children and young people with type 1 diabetes and their family members or carers (as appropriate) about their glycaemic index from diagnosis?

Why this is important

Very little evidence on the effectiveness of dietary advice based on glycaemic index was identified for inclusion in the guideline review, and the evidence that was identified related mostly to twice-daily insulin regimens. Research is needed to evaluate the effectiveness of teaching children and young people with type 1 diabetes and their family members or carers (as appropriate) about glycaemic index in the context of modern, intensive insulin treatment regimens (insulin pump therapy or multiple daily injections). Important outcomes include success in achieving the target HbA1c level, blood glucose levels after meals, frequency of hypoglycaemia, quality of life, food choices, and the frequency and timing of insulin administration to lower blood glucose levels after meals.

5 Optimal dosage of intravenous insulin for managing diabetic ketoacidosis in children and young people

What is the optimal dosage of intravenous insulin for managing diabetic ketoacidosis (DKA) in children and young people?

Why this is important

The evidence reviewed for the guideline did not allow evaluation of the comparative effectiveness and safety of specific dosages of intravenous insulin, such as 0.025, 0.05 and 0.1 units/kg/hour. The only relevant studies conducted to date have been small retrospective cohort studies with fewer than 100 participants. A large, multi-centre randomised controlled trial is needed to undertake a comparative study of different dosages. This is because DKA is relatively uncommon and cerebral oedema (a potential adverse consequence of DKA) is rare, and there is a concern that larger dosages are associated with an increased risk of cerebral oedema. Important outcomes include rate of DKA resolution, incidence of hypoglycaemia and incidence of cerebral oedema.

6 Effective resuscitation fluid for managing DKA

In children and young people with diabetic ketoacidosis, what is the most effective resuscitation fluid (0.9% sodium chloride vs PlasmaLyte 148) for managing DKA?

Why this is important

There was a lack of evidence for the use of PlasmaLyte 148 for DKA. Based on the evidence available, the committee recommended 0.9% sodium chloride as the resuscitation fluid. However,

some paediatric units are using PlasmaLyte 148 for initial resuscitation. An adequately powered study is needed to explore the effectiveness of PlasmaLyte 148 as a resuscitation fluid. Important outcomes include incidence of cerebral oedema and mortality.

Rationale and impact

These sections briefly explain why the committee made the recommendations and how they might affect practice.

Fluid therapy

Recommendations 1.4.21 to 1.4.34, 1.4.39, 1.4.40 and 1.4.42.

Why the committee made the recommendations

Route of fluid administration

The 2015 recommendations caused some confusion around when to use oral or intravenous fluids. To address this, the committee looked for research evidence that would help them to make clearer recommendations. There was no evidence that compared different routes of administration or different oral fluids for hydration, so the committee updated the recommendations based on their experience and expertise.

Rate of fluid administration

In the 2015 guideline, the rate of fluid administration in diabetic ketoacidosis (DKA) was restricted because rapid fluid administration was believed to cause cerebral oedema. However, for the 2020 update there was some randomised controlled trial evidence (particularly the [PECARN FLUID trial](#)) comparing the effect of different DKA protocols on outcomes such as mortality or clinically apparent brain injury. This evidence showed no significant difference between the 2 protocols, and it demonstrated that the restrictions on the rate of fluid administration were not needed.

In response to this evidence, and applying their clinical expertise, the committee updated the recommendations to use more rapid fluid administration (including fluid boluses). They also made a separate recommendation for children and young people who are in shock, as this group need a higher volume of fluids, and they need these fluids to be given more rapidly.

Total fluid requirement

When the 2015 recommendations were made, rapid fluid administration was believed to cause cerebral oedema. However, more recent randomised controlled trial evidence (particularly the [PECARN FLUID trial](#)) has shown that brain injury in this group may be caused by DKA itself,

because of the resulting cerebral hypoperfusion, reperfusion and neuro-inflammation. If DKA is the cause of brain injury, children and young people would benefit from receiving more fluids in the first 48 hours than was recommended in the 2015 guideline. To address this, the committee updated the recommendation on calculating the fluid maintenance requirement, based on their clinical knowledge and on evidence from the PECARN FLUID trial. The Holliday-Segar formula that they recommended is commonly used in practice and has not been shown to cause any adverse events.

Potassium

No evidence was identified on the use of potassium. The committee used their expertise and their understanding of the evidence on the pathophysiology of DKA to update the recommendation. They added more detail about how to care for children and young people with anuria or potassium levels above the normal range. It is essential to not delay adding potassium to fluids, because insulin can cause hypokalaemia in this population, which can lead to cardiac arrhythmias and death.

Hyperchloremic acidosis

The committee also used their expertise to make recommendations highlighting complications such as [hyperchloremic acidosis](#).

Hyponatraemia

The committee used their expertise to make recommendations on monitoring serum sodium levels and identifying children and young people with hyponatraemia.

How the recommendations might affect practice

There is variation in practice due to the different beliefs on the causes of cerebral oedema. The new recommendations will be a change in practice in some areas, but they are in line with randomised trial evidence and with other clinical guidance (such as the [International Society for Paediatric and Adolescent Diabetes DKA guideline](#)).

[Return to recommendations](#)

Context

Diabetes is a long-term condition that can have a major impact on the life of a child or young person, as well as their family or carers. In addition to insulin therapy, diabetes management should include education, support and access to psychological services, as detailed in this guideline. Preparations should also be made for the transition from paediatric to adult services, which have a somewhat different model of care and evidence base.

Type 1 diabetes is becoming more common in the UK, and since 2004 type 2 diabetes is also being diagnosed with increasing frequency. The 2013–14 National Diabetes Audit identified 26,500 children and young people with type 1 diabetes and 500 with type 2 ([National Paediatric Diabetes Audit report 2013–14](#)). Much of the general care for type 2 diabetes is the same as for type 1 diabetes, although the initial management is different. In addition, the overweight and obesity associated with type 2 diabetes also bring an increased risk of renal complications in particular, and of problems such as hypertension and dyslipidaemia. These differences in management and complications need guidance specific to type 2 diabetes, which is included here for the first time. A variety of genetic conditions (such as maturity-onset diabetes in the young) and other conditions (such as cystic fibrosis-related diabetes) may also lead to diabetes in children and young people, but the care of these diverse conditions is beyond the scope of this guideline.

This guideline recommends attempting to reach a glycated haemoglobin (HbA1c) level near the normal range and near normoglycaemia. This is to further reduce the long-term risks associated with diabetes. Tight management may be achieved by intensive insulin management (multiple daily injections or insulin pump therapy) from diagnosis, accompanied by carbohydrate counting. Newer technology such as continuous subcutaneous glucose monitoring may also help children and young people to have better blood glucose management, although this is not currently recommended for all children and young people with type 1 diabetes.

By implementing the strict blood glucose management recommended in this guideline, improvements can be made to diabetes care that reduce the impact of the condition on the future health of children and young people.

Finding more information and committee details

You can see everything NICE says on this topic in the [NICE Pathway on diabetes in children and young people](#).

To find NICE guidance on related topics, including guidance in development, see the [NICE webpage on diabetes](#).

For full details of the evidence and the guideline committee's discussions, see the [evidence reviews](#). You can also find information about [how the guideline was developed](#), including [details of the committee](#).

NICE has produced [tools and resources to help you put this guideline into practice](#). For general help and advice on putting our guidelines into practice, see [resources to help you put NICE guidance into practice](#).

Update information

December 2020: We have reviewed the evidence and made new recommendations on fluid therapy for children and young people with diabetic ketoacidosis. These recommendations are marked [2020].

We have also amended recommendations 1.2.4, 1.2.117 and 1.3.52 without an evidence review. This is to provide clarity about eye examinations and to bring them in line with the diabetic eye screening programme. These recommendations are marked [2015, amended 2020].

Recommendations marked [2004], [2015] or [2004, amended 2015] last had an evidence review in that year. In some cases minor changes have been made to the wording to bring the language and style up to date, without changing the meaning.

We have also amended recommendation 1.2.1 to highlight an MHRA safety update reminding patients to rotate insulin injection sites within the same body region to avoid cutaneous amyloidosis.

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Accreditation

