

Appendices

Limited Care Guidance Appendix

Definition, epidemiology, and classification of diabetes in children and adolescents

Whenever possible, follow the guidance described in the full chapter for recommended care (Pediatr Diabetes 2014; 15 (Suppl. 20): 4–17)

- If blood glucose testing is unavailable, diabetes can be provisionally diagnosed, in the presence of symptoms, by the finding of high levels of glucose and ketones in the urine.
- In geographical areas where the known incidence of type 1 diabetes is low, health care professionals should be aware that there is a higher rate of diabetic ketoacidosis at presentation due to lack of consideration of the diagnosis.
- The possibility of other types of diabetes should be considered in the child who has:
 - an autosomal dominant family history of diabetes
 - associated conditions such as deafness, optic atrophy or syndromic features.
 - marked insulin resistance and acanthosis nigricans
 - long interruption of insulin therapy without the occurrence of ketoacidosis.
 - a history of exposure to drugs known to be toxic to beta cells or cause insulin resistance.
- Molecular genetic testing can help define the diagnosis and treatment of children with suspected monogenic diabetes. Genetic testing should be considered in all children presenting with diabetes before six months of age, as it is available free of charge and the diagnosis may have major effects on treatment.

Phases of type 1 diabetes in children and adolescents

Whenever possible, follow the guidance described in the full chapter for recommended care (Pediatr Diabetes 2014; 15 (Suppl. 20): 18–25)

- The child with newly diagnosed type 1 diabetes needs to be cared for in a center with maximal expertise.

- At diagnosis, insulin treatment may need to be initiated prior to transfer.
- Bedside glucometers can be used when suspecting diabetes, but a high blood glucose reading should be verified by a laboratory analysis when possible.
- Health care professionals should be aware that there are no interventions at present are proven to prevent or delay the onset of type 1 diabetes.
- Parents and children with type 1 diabetes should be counseled that the remission phase of diabetes is transient and does not indicate total remission of diabetes.

Type 2 diabetes in the child and adolescent

Whenever possible, follow the guidance described in the full chapter for recommended care (Pediatr Diabetes 2014; 15 (Suppl. 20): 26–46)

The initial treatment of T2D should be tailored to the symptoms and severity of the clinical presentation, including assessment for DKA and its appropriate care. Home glucose testing should be performed as appropriate to the clinical setting and as resources permit. Healthy diet and lifestyle should be emphasized and metformin is the initial choice for pharmacologic treatment, if insulin is not required. Blood pressure should be measured at each visit and other complications such as albuminuria, retinopathy, dyslipidemia, NAFLD, and PCOS should be screened for at diagnosis and annually, as possible.

Healthy life-style change focusing on healthy diet and increased physical activity are the foundation of treatment for T2D. Care should be taken to implement culturally appropriate therapeutic life style change. Metformin and basal insulin if needed (including NPH) are the pharmacologic treatments of choice; both of these are relatively inexpensive and widely available. General guidelines for care of T2D in youth should also apply for areas in which resources and care may be limited.

The diagnosis and management of monogenic diabetes in children and adolescents

Whenever possible, follow the guidance described in the full chapter for recommended care (Pediatr Diabetes 2014: 15 (Suppl. 20): 47–64)

- Monogenic diabetes is uncommon, accounting for ~1–4% of pediatric diabetes cases. However, the diagnosis should be suspected in cases where:
 - Diabetes presents in the first year of life, especially before age 6 months.
 - Absence of ketosis at diagnosis or subsequently during intercurrent illnesses.
 - Preserved beta cell function, with low insulin requirements 3–5 years after diagnosis.
 - Presence of hearing, visual or renal impairment. In particular, mitochondrial diabetes should be suspected in patients with diabetes and maternally inherited sensorineural hearing loss.
 - Family history of diabetes in one parental side or family history of non-autoimmune diabetes.
- Transient neonatal diabetes is usually diagnosed within the first week of life and resolves around 12 weeks.
- Approximately half of diabetes cases diagnosed during infancy (permanent neonatal diabetes (PNM, or monogenic diabetes of infancy), will require lifelong treatment to control hyperglycemia.
- Genetic testing should be considered in all children presenting with diabetes before six months of age, as it is available free of charge and its diagnosis may have major effects on treatment.
- Molecular genetic testing can help define the diagnosis and treatment of children with suspected monogenic diabetes. As these tests are expensive, genetic testing should be limited to those who on clinical grounds are likely to be positive.
- *HNFI*A-MODY is the first diagnostic possibility to be considered familial autosomal dominant symptomatic diabetes.
- Results of genetic testing should be reported and presented to families in a clear and unambiguous, since results may have a major effect on clinical management (**E**)
- Some forms of monogenic diabetes are sensitive to sulphonylureas, such as *HNFI*A-MODY and HNF-4 α MODY and many cases of permanent neonatal diabetes (Kir6.2 mutations).
- Mild fasting hyperglycemia due to glucose kinase deficiency is not usually progressive during childhood, but may require insulin during pregnancy.

Management of cystic fibrosis-related diabetes in children and adolescents

Whenever possible, follow the guidance described in the full chapter for recommended care (Pediatr Diabetes 2014: 15 (Suppl. 20): 65–76)

When analog insulin is not available, NPH insulin (e.g. Humulin N, Protaphane, Novolin N, Insulatard, Isophane, etc) and regular/soluble insulin can be used to treat CFRD, but care needs to be taken to avoid late post-prandial hypoglycemia. One possible regimen is NPH insulin at bedtime, and regular insulin with breakfast, lunch and supper, in a patient who is eating 3 meals and 3 snacks a day.

Diabetes education in children and adolescents

Whenever possible, follow the guidance described in the full chapter for recommended care (Pediatr Diabetes 2014: 15 (Suppl. 20): 77–85)

Management in resource poor settings

- All children and adolescents with diabetes and their carers have the right to basic education and practical skills training to enable them to survive the onset of diabetes safely and successfully.
- Initial learning, started as soon as possible after diagnosis, should include immediate knowledge-based education and practical survival skills (see Appendix). This should be followed by graduated levels of education reinforced whenever possible by diagrams, drawings, written guidelines, booklets and other visual media appropriate to the child's age, maturity and environmental circumstances.
- Diabetes education must be given by someone with experience and expertise in paediatric diabetes management.
- Appropriately adapted diabetes education at all ages must be centred on the needs and levels of understanding of both the child and parents/carers.
- Diabetes education is most effective when based on self-management and is child and parent centred

The delivery of ambulatory diabetes care to children and adolescents with diabetes

Whenever possible, follow the guidance described in the full chapter for recommended care (Pediatr Diabetes 2014: 15 (Suppl. 20): 86–101)

Great disparities exist in the level of pediatric diabetes care available to children, resulting from a wide range of factors across the world, from huge imbalances of geographic, economic and scientific development to gender discrimination. Limited access to insulin, food and supplies, limited access to care,

financial burdens, psychosocial instability, and detrimental health beliefs can all contribute to suboptimal care of children with diabetes across the world.

Access to health care can be a large challenge for poor children, more so in developing countries.

Shortages of providers with diabetes expertise are widespread. For example, in Ethiopia, which is densely populated, there is only one pediatric endocrinologist for more than 40 million children. Sometimes lack of awareness means death before diagnosis, or soon after diagnosis. Increasing awareness and education among health care personnel can help. Additionally, families can be put in touch with each other and can offer peer support and education. While there may not be in person access to the Diabetes Care Team outlined in the core section, health care providers working with children with diabetes and their families need to provide self-management education and have regular follow up. Communication between visits may rely more heavily on telephone calls. Community health workers may serve as an extension of the specialize Diabetes Care Team, meeting with families and identifying areas that require attention outside of in-person follow up.

For all children with diabetes, the importance of providing 'a good start' with clear, positive messages, support, and advice cannot be overemphasized. Education and proactive discussion around common problems and challenges in diabetes self-management can decrease the risk that such problems will arise later, and can promote open channels of communication around such problems. Diabetes is an expensive condition to manage. The treatment regimen prescribed from the onset should be appropriate for the family's economic and educational status. More than half the world's population is poor or extremely poor. The long-term and expensive therapies are often not affordable even in the cities due to the absence or limitations of basic health insurance policies. Costs of diabetes care may be prohibitive for children and families without external support. For example, in a study of factors associated with DKA in Ethiopia where the median monthly income was \$37, the cost of insulin (\$6/vial), blood glucose testing (\$2/test) and HbA1c measurement (\$13) created a great hardship. Where costs are borne by the family, options to reduce costs should be explored, e.g. conventional rather than analog insulins; syringes rather than pen devices; careful reuse of syringes and lancets; meters with inexpensive strips; obtaining supplies from donor organizations, etc.

Availability of insulin and diabetes supplies, such as glucose meters and glucose and ketone test strips, may be quite limited, particularly in remote areas. If the family does travel to urban centers for consultation,

they can be encouraged to obtain sufficient quantities of insulin and supplies in the city.

It is also important to address practical issues around home diabetes management. A person testing blood glucose and injecting insulin several times a day would inevitably generate huge numbers of "sharps" (needles and lancets) on a regular basis. Families must be taught and frequently reminded to safely dispose of these sharps. This can be done in a variety of ways, appropriate to the local conditions. If nothing else is available, parents can be asked to collect all sharps in a thick walled metal or plastic container (e.g. shampoo bottle) and bring them on each visit to the clinic for safe disposal. Insulin cannot be exposed to extreme temperatures. After purchasing the insulin, the family must be taught how to transport and store it. During travel, it can be carried safely in a cooler or in a thermos flask with a few cubes of ice (too little and it thaws, too much and it freezes, so the right amount can be worked out, depending in the ambient temperatures and the distances involved.) Insulin inadvertently frozen must be discarded. At the other extreme, insulin becomes less potent after exposure to warm temperatures: at temperatures of 32 and 37°C, loss of potency started after 3 weeks, while at 25–26 °C, potency was retained by the end of 4 weeks. In areas where ambient temperatures may be as high as 45–48°C, and where refrigeration is not available, insulin can safely be stored in local cooling devices (see Figure 1) with which temperatures of about 25–26 °C can be achieved (19, 20). Even in very hot climates insulin can be stable for 2–4 weeks immersed in water in mud pots, but this awareness is not widespread. Poor glycemic control may be due to these factors, which are often overlooked.

Food can be in scarce supply, and not all children have food on a daily basis. It is in such situations that multidose modified basal bolus regimens are very useful. The child can take small doses of NPH insulin once or twice a day, and regular insulin only when food is eaten, the dose depending on the amount of food available. Diet in families with low socioeconomic status may be high in fats, trans fats, salt and processed (low fiber) carbohydrates. Parents are encouraged to use whole grains e.g. partly polished rather than white rice, home baked bread rather than bread bought from the market, low fat milk and milk products (usually less expensive than full fat), salads instead of oily cooked vegetables, fresh fruit and roasted rather than deep fried snacks. Such foods are often less attractive than heavily advertised sweetened (or diet) drinks and crisps. Intensive education and innovation may be necessary to address such situations.

International programs such as Life for a Child can alleviate resource shortages to a limited extent, and stability and consistency of providing these resources is

essential. In Bangladesh, it has been shown that public health measures can make a big difference in diabetes care, but low costs options are often ignored by health care providers, corporations and government.

Diabetes education typically uses written materials and numerical insulin dose calculations. When children and their caregiver(s) have limited literacy and numeracy, different approaches are needed. For example, the majority of Ethiopians have little or no education and females are less educated than males. Females are usually the ones who are giving diabetes care, and because females are less educated this will have a negative impact on the care provided. Even relatively simple tasks such as reading and recording BG values and insulin doses may be difficult. Pictorial educational materials and simple instructions are essential for illiterate families. Innovative measures can be used, such as teaching the mother or child to draw the numbers because they cannot write them, providing premarked syringes (wrapped with colored tape to mark the dose), and using color coding to designate doses of insulin based on proximity of glucose reading to target range. Somewhat similar is the problem of multiple languages or dialects: educational and instructional materials may not be available in the local language. In these circumstances, self-help groups can be of great value when available.

Poverty significantly increases vulnerability because it tends to be associated with illiteracy or poor education, social deprivation, little or no job security, and inadequate access to health care or institutional support. In many countries families must assume the cost of health care, and the expenses incurred with a chronic disease can push a family further into poverty. Such families are then also at higher risk for discrimination. These children tend to have poor glycemic control, and therefore higher rates of acute and chronic complications and mortality. This worsens employability, income, cost of care, and quality of life. In extreme cases, insulin may be stopped due to financial stresses or gender discrimination.

On the positive side, many developing countries have robust family structures. Support may come from the extended family or community. Compliance may actually be better because of social conditioning to follow instructions. Availability of “junk foods” may be limited and physical activity levels may be higher. Establishing a trusting relationship with good communication should allow for identification of the child’s and family’s resources and challenges, so that they can be successful in managing their diabetes.

Assessment and monitoring of glycemic control in children and adolescents with diabetes

Whenever possible, follow the guidance described in the full chapter for recommended care (Pediatr Diabetes 2014: 15 (Suppl. 20): 102–114)

- In situations where care is limited by a lack of resources, including insulin and equipment for self-monitored blood glucose and measurement of HbA1c, targets for assessing and monitoring glycemic control in children with diabetes could be adjusted according to locally acceptable standards.
- Every effort should be made to continually adjust these targets to improve the quality of care.
- The cost of BG monitoring is very expensive and in many countries the cost relative to the cost of living may make this technology unavailable.
- All centers caring for young people with diabetes should urge nations, states, and health care providers to ensure that children and adolescents with diabetes have adequate glucose monitoring supplies.
- Testing 3–4 times a day several days a week may provide more information than a single daily measurement.
- The creative use of SMBG’s to provide a profile of glucose over a typical day will help to adjust doses of insulin; e.g. checking before and after a standard meal can help to adjust meal-related insulin dose with only 2 extra tests per day. In this fashion, different meals can be assessed over different weeks
- Urine glucose monitoring is an alternative where there are cost considerations, and it provides useful but different information from SMBG. Urinary glucose reflects glycemic levels over the preceding several hours and is affected by the renal threshold for glucose, which in children is approximately 10–11 mmol/L (180 – 200 mg/dL).

Limitations of urine glucose monitoring include

- uncertain correlation with BG levels;
- inability to detect hypoglycemia or monitor response to treatment of hypoglycemia;
- less valuable as an educational tool to identify glycemic patterns; and unhelpful in hyperglycemic crises because of the lag phase between recovery and changes in urine glucose.

Target

- As many urine tests as possible should show no glycosuria without the occurrence of frequent or severe hypoglycemia.

Equipment

- Glucose oxidase strips that are relatively inexpensive, convenient, and safe.
- Some non-specific reducing agent methods are used such as Clinitest tablets or Benedict's test. These are less convenient to use and are also potentially dangerous if the chemical reagents come into contact with the skin, esophagus, or gastrointestinal tract.
- Frequency of HbA1c measurement will depend on local facilities and availability, but every child should have a minimum of one measurement per year.
- Adolescents with stable type 2 diabetes should have at least one HbA1c measurement per year and symptoms of uncontrolled diabetes reinforced frequently since adolescents may become insulin requiring more rapidly than adults.

Insulin treatment in children and adolescents with diabetes

Whenever possible, follow the guidance described in the full chapter for recommended care (Pediatr Diabetes 2014; 15 (Suppl. 20): 115–134)

- Insulin should be available in sufficient amounts, being consistent in quality and type.
- Use syringes and vials for insulin administration (or pens, if available).
- The principles of insulin use including professional support, are as for Recommended care, but a combination of NPH and Regular insulin may give acceptable blood glucose control.
- Regular and NPH insulin may be mixed in the same syringe, given as pre-mixed insulin or given as separate injections.
- A basal bolus regimen with Regular and NPH is preferred to pre-mixed insulin preparations. NPH insulin should be given twice daily in most cases, in addition, Regular insulin needs to be given 2–4 times daily to match carbohydrate intake.
- Pre-mixed insulins may be convenient (i.e. few injections), but limit the individual tailoring of the insulin regimen, and can be difficult in cases where regular food supply is not available.
- Insulin storage as for Recommended care.
- In hot climates where refrigeration is not available, cooling jars, earthenware pitcher (matka) or a cool wet cloth around the insulin will help to preserve insulin activity.
- In children on small doses of insulin, 3 ml cartridges instead of 10 ml vials should be chosen for use with syringes to avoid wastage of insulin.

Nutritional management in children and adolescents with diabetes

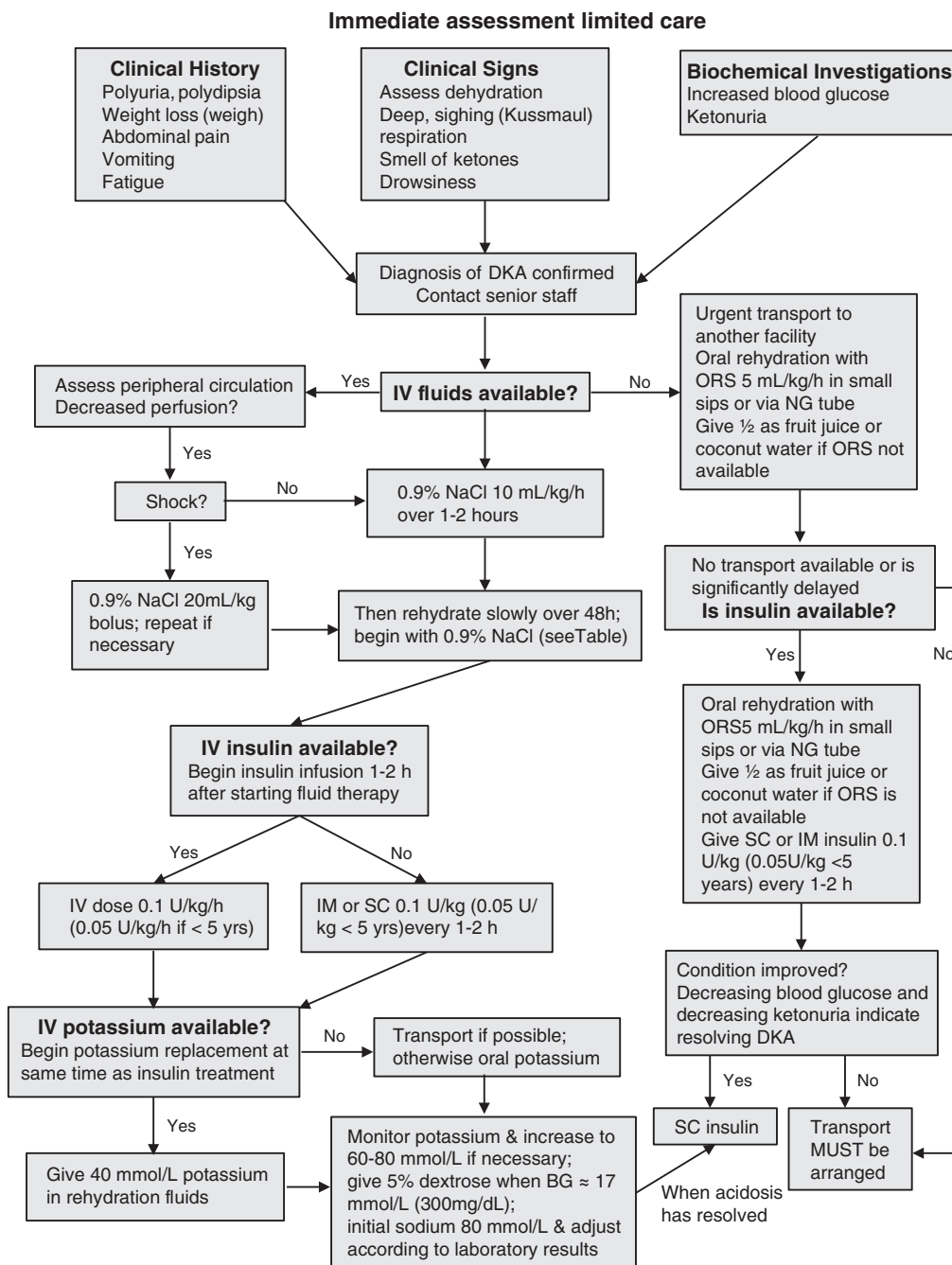
Whenever possible, follow the guidance described in the full chapter for recommended care (Pediatr Diabetes 2014; 15 (Suppl. 20): 135–153)

- Children and adolescents with diabetes should eat a variety of healthy foods in amounts appropriate for age, stage of growth and energy requirements.
- Growth monitoring is an essential part of diabetes management. Unexpected weight loss or failure to gain weight appropriately may be a sign of 1) illness (infections, celiac disease), 2) insulin omission, 3) an eating disorder or 4) issues with food security.
- An experienced pediatric dietitian should be available as part of the diabetes team to provide education at diagnosis and at regular review.
- Nutritional advice should be adapted to cultural, ethnic and family traditions as well as the cognitive and psychosocial needs of the individual child. Where possible all relevant family members should be involved in education.
- Meal-time insulin doses should be matched to the carbohydrate content of foods to be consumed. Insulin should be given before the meal. Alternatively, for those on fixed insulin doses, a consistent day-to-day intake of carbohydrate should be consumed to match the timing and type of insulin injections. This advice should be regularly reviewed to accommodate changes in appetite, food availability and physical activity.
- Restriction of carbohydrate intake < 45% of total energy requirement should be avoided as this may impair growth. (For further reading please refer to Nutrition Chapter ISPAD Guidelines 2014)
- To enable appropriate matching of carbohydrate intake to the insulin profile, carbohydrate may be measured in grams, portions or exchanges. A variety of educational tools are available in many countries to assist health professionals and families quantify carbohydrate.
- Prevention and management of hypoglycemia, particularly during and after exercise should be discussed.
- Drinks high in sugar and foods with high amounts of saturated fat should be generally avoided.
- If financial constraints make food scarce or erratic, this is an added burden that should be discussed openly and potential solutions identified.

Diabetic ketoacidosis and hyperglycemic hyperosmolar state

Whenever possible, follow the guidance described in the full chapter for recommended care (Pediatr Diabetes 2014; 15 (Suppl. 20): 154–179)

- Written guidelines should be available for DKA management in children.
- Weigh the child.
- Immediately infuse 10 mL/kg of 0.9% saline over 1–2 hours in patients who are volume depleted but not in shock. This may be repeated, if necessary, to ensure a stable peripheral circulation. Thereafter, replace the fluid deficit and provide the maintenance fluid requirement according to the Table below. If unable to obtain intravenous access in a severely dehydrated patient consider intraosseous fluid administration.
- Fluids: Rehydrate with 0.9% saline for at least 4–6 hours; thereafter with a solution that has a tonicity equal to or greater than 0.45% saline.
- Sodium: The sodium content of the fluid should be increased if measured serum sodium concentration is low and does not rise appropriately as the plasma glucose concentration falls.
- Potassium: If intravenous (IV) fluids and insulin are available, but potassium is not available, after 1 hour of fluid therapy, give a bolus dose of insulin, 0.1 unit/kg (0.05 unit/kg if child is younger than 5



ORS oral rehydration solution; NG nasogastric

years), and then arrange urgent transport to a facility that can provide potassium. If serum potassium measurements are not immediately available, an ECG may be helpful to determine whether the child has hyperkalemia or hypokalemia. Prolongation of the PR interval, T wave flattening and inversion, ST depression, prominent U waves, apparent long QT interval (due to fusion of the T and U waves) indicate hypokalemia. A tall, peaked and symmetrical T wave is the first sign of hyperkalemia.

- **Insulin:** Do not use IV insulin if blood glucose (BG) levels cannot be measured at least every 2 hours. In circumstances where continuous IV administration of insulin is not possible, give intramuscular (IM) short-acting insulin (regular) or rapid-acting insulin analogue (insulin lispro, aspart or glulisine) 0.1 unit/kg (0.05 unit/kg < 5 years) every 1–2 hours until tissue perfusion has improved. Thereafter, switch to the same dose of SC regular insulin or rapid-acting insulin analogue every 1–2 hours, which may be as effective as infusion of IV regular insulin in patients with uncomplicated DKA.
- **When BG is <14 mmol/L (250 mg/dl),** give glucose-containing fluids orally and consider reducing the dose of SC insulin from 0.1 to 0.05 unit/kg (or from 0.05 to 0.025 unit per kg) at 1–2 hour intervals aiming to maintain BG ~ 11 mmol/l (200 mg/dL) until complete resolution of DKA.
- **Intravenous fluids:** When IV fluids are not available, arrange urgent transport to a facility that can provide IV fluid therapy. Giving insulin before starting intravenous fluid treatment may precipitate shock and increases the risk of hypokalemia and cerebral edema.
- **Give little sips (or small volumes through a syringe) of Oral Rehydrating Solution (ORS)** as frequently as possible without causing the child to vomit. If vomiting does not occur after 1–2 hours, give ORS at a rate of 5 mL per kg body weight per hour.
- **In some cases it may be possible to insert a nasogastric tube and slowly rehydrate with ORS** at 5 mL per kg body weight per hour.
- **If ORS is not available,** fruit juice and coconut water provide some potassium.
- **Transportation:** If the child cannot be transported (e.g. roads are blocked), give oral rehydration as above and SC insulin 0.1-0.05 unit/kg every 1–2 hours. Decreasing urine ketone concentrations indicate resolving acidosis.
- **Laboratory resources:** Hourly BG monitoring may not be available. Try to measure BG level at least every 4 hours. If analysis of acid–base status is not available, a bedside blood β -hydroxybutyrate (ketone) value ≥ 3 mmol/l together with BG >11.1 mmol/L (200 mg/dL) can be used to confirm the

Table.

Body weight kg	Maintenance	DKA: Give maintenance + 5% of body weight/24-h	
	mL/24 h	mL/24 h	mL/h
4	325	530	22
5	405	650	27
6	485	790	33
7	570	920	38
8	640	1040	43
9	710	1160	48
10	780	1280	53
11	840	1390	58
12	890	1490	62
13	940	1590	66
14	990	1690	70
15	1030	1780	74
16	1070	1870	78
17	1120	1970	82
18	1150	2050	85
19	1190	2140	89
20	1230	2230	93
22	1300	2400	100
24	1360	2560	107
26	1430	2730	114
28	1490	2890	120
30	1560	3060	128
32	1620	3220	134
34	1680	3360	140
36	1730	3460	144
38	1790	3580	149
40	1850	3700	154
45	1980	3960	165
50	2100	4200	175
55	2210	4420	184
60	2320	4640	193
65	2410	4820	201
70	2500	5000	208
75	2590	5180	216
80	2690	5380	224

diagnosis of ketoacidosis and monitor the response to treatment.

Table lists volumes for maintenance and rehydration per 24 hours and per hour based on body weight. After initial resuscitation, and assuming 10% dehydration, the total amount of fluid should be given over 48 hours. Fluids given orally (when patient has improved) should be subtracted from the amount in the table. For body weights >32 kg, the volumes have been adjusted so as not to exceed twice the maintenance rate of fluid administration.

Example: A 6-year-old boy weighing 20 kg will receive 10 mL/kg (or 200 mL) in the first 1–2 hours and thereafter 93 mL per hour or a total volume of 2,230 mL per 24 hours for 48 hours.

Assessment and management of hypoglycemia in children and adolescents with diabetes

Whenever possible, follow the guidance described in the full chapter for recommended care (Pediatr Diabetes 2014: 15 (Suppl. 20): 180–192)

In many regions of the world such as Africa there are several issues which make management of hypoglycemia a daunting process in a child with type 1 diabetes. A significant risk factor is the lack of a regular or sufficient supply of food. A child who has received a prescribed dose of insulin may suddenly be faced with either no food or a smaller portion which will not be commensurate with the amount of insulin given. Many children, both with and without diabetes, go to bed hungry, therefore nocturnal hypoglycemia is common. In many cases blood glucose monitoring is performed once or twice a day. As a consequence, blood glucose monitoring is not readily available to the child with diabetes when symptoms suggestive of hypoglycemia arise. For every child with newly diagnosed diabetes it is mandatory that the child and caregiver are trained in recognizing the signs and symptoms of hypoglycemia before leaving the hospital. Severe hypoglycemia is therefore likely to occur at a much higher incidence than that reported in the literature.

Management of hypoglycemia is particularly challenging when there is limited access to medical care. Glucagon is not readily available and the expense may be prohibitive. Glucose in the powdered form in small sachet packs of 75 grams is available in some countries. Honey is a good alternative but may not be readily available. Another option is products derived from cane sugar to which sucrose may be added.

If a child becomes unconscious and needs hospital management then empirical treatment is usually given due to unavailability of glucose meters and strips to confirm hypoglycemia as well as the urgency to treat.

In most cases, 5% glucose in water or in 0.9% NaCl is available and medical personnel are encouraged to use these infusions. Occasionally only 0.9% NaCl and 50% glucose are available and practitioners are encouraged to reconstitute instead of giving multiple repeated boluses. Add 100ml of 50% glucose to 900ml of 0.9% NaCl to make a 5% glucose solution. If these options are not available, oral rehydration therapy has been suggested as an alternative if the child is alert and able to safely swallow.

In many regions of limited care, another cause for hypoglycemia is the use of 70/30 premixed insulin which does not allow for flexibility in diet or exercise. A lack of awareness of diabetes in children makes it difficult for a child with hypoglycemia to obtain immediate help.

There may be a cultural stigma regarding diabetes in children which prevents families advising the school, other family members, or neighbors that their child has diabetes. Therefore, when the parent is not with the child, hypoglycemia can have severe or even fatal consequence.

Sick day management in children and adolescents with diabetes

Whenever possible, follow the guidance described in the full chapter for recommended care (Pediatr Diabetes 2014: 15 (Suppl. 20): 193–202)

- Education about what may occur with any intercurrent illness must be provided to all patients and family members with periodic re-education of these same general principles at least annually.
- Monitoring of home blood glucose at least 4–6 hourly and urine ketones should be available during sick days.
- If home glucose or ketone monitoring is unavailable, systems should be established for contacting health care professionals and/or emergency personnel for evaluation and treatment of potential hyperglycaemic crises, ketoacidosis as well as hypoglycaemic crises.
- Fluid intake should be increased, especially in hot climates.
- Unknown or uncertain alternative medicine co-prescription should be avoided.
- While awaiting emergency treatment or evacuation by health care professionals during sick days, appropriate initial sugar and electrolyte solutions (like the WHO ORS solution) and advice on their administration should be provided.

Comprehensive care

Exercise in children and adolescents with diabetes

Whenever possible, follow the guidance described in the full chapter for recommended care (Pediatr Diabetes 2014: 15 (Suppl. 20): 203–223)

- Exercise is very beneficial and diabetes is no bar to participation.
- Blood glucose control may be helped by exercise.
- Adjustments to food and insulin may be required depending upon the type and duration of exercise.
- If unable to monitor glucose, take a snack before exercise and decrease insulin dose before exercise. Also decrease basal insulin during the following night if not exercising daily.

Management of children and adolescents with diabetes requiring surgery

Whenever possible, follow the guidance described in the full chapter for recommended care (Pediatr Diabetes 2014: 15 (Suppl. 20): 224–231)

- Children with type 1 diabetes requiring major surgery should be referred to a center with sufficient resources to provide safe care.
- Elective surgery should be scheduled as the first case of the day, preferably in the morning.
- If it is possible to delay surgery, diabetic ketoacidosis, ketosis or severe hyperglycaemia should first be corrected.
- Children with type 1 diabetes requiring surgery need insulin, even if fasting, to prevent ketoacidosis. At least half of the usual basal insulin dose should be given before surgery.
- Children undergoing major surgery (expected to last at least 2 hours) or who have received NPH insulin should receive dextrose in their IV infusion to prevent hypoglycemia. Children undergoing minor surgery or procedures (lasting for less than 2 hours) may initially receive an IV infusion without dextrose if treated with basal/bolus insulin regimen or continuous subcutaneous insulin infusion.
- Blood glucose monitoring should be performed before, during and immediately after general anesthesia to detect hypo- and hyperglycemia. Aim for blood glucose in the range 5–10 mmol/l (90–180 mg/dl).
- The usual recommendation is no solid food for at least 6 hours before surgery. Clear fluids and breast milk may be allowed up to 4 hours before surgery (check with the anesthetist).
- Emergency surgery:
 - If ketoacidosis is present, follow an established treatment protocol for diabetic ketoacidosis and delay surgery, if possible, until circulating volume and electrolyte deficits are corrected.
 - If there is no ketoacidosis, start IV fluids and insulin management as for elective surgery.

Psychological care of children and adolescents with type 1 diabetes

Whenever possible, follow the guidance described in the full chapter for recommended care (Pediatr Diabetes 2014: 15 (Suppl. 20): 232–244)

The principles and recommendations in the full chapter are largely generic and therefore should apply to all health-care settings irrespective of the resources available.

- Diabetes care for young people should include the recognition of the potentially serious impact of

diabetes on both psychosocial functioning in the child, adolescent and the family and also the adverse effects on metabolic control.

- Professionals caring for young people with diabetes should be prepared to discuss the psychological difficulties associated with diabetes (including depression, acting out, rebellion) and have access to other professionals with more specialist expertise in this field

Diabetes in adolescence

Whenever possible, follow the guidance described in the full chapter for recommended care (Pediatr Diabetes 2014: 15 (Suppl. 20): 245–256)

The principles and recommendations in the full chapter are generic and therefore should apply to all health-care settings irrespective of the resources available.

Understanding the physiological and psychological changes of adolescence and developing a specific approach to the communication, education and support of the adolescent patient and their family, which is sensitivity to their needs, cultural and religious background, is essential. It is acknowledged that many patients and families with diabetes come from a low income background and are cared for in health-care systems that are significantly resource limited. Nevertheless the approach to managing the adolescent with diabetes in terms of developing trusting and motivating relationships with them, encouraging self-reliance and self-efficacy, and engendering the trust and support from their family are general ones that should be applicable to all settings.

Microvascular and macrovascular complications in children and adolescents

Whenever possible, follow the guidance described in the full chapter for recommended care (Pediatr Diabetes 2014: 15 (Suppl. 20): 257–269)

- Blood pressure should be measured at least annually and antihypertensive medication used if > 95th percentile for age, height and gender or > 130/80.
- Treatment of hypertension: ACE inhibitors are preferred but other antihypertensive agents, such as calcium channel blockers and diuretics can be used.
- Examine eyes and visual acuity annually for retinopathy and cataracts after two years diabetes duration, and annually thereafter.
- Measure urinary protein annually for nephropathy (> 500mg/day) after two years diabetes duration, and annually thereafter.

- Examine feet annually for neuropathy, infections, ulcers after two years duration, and annually thereafter.
- For type 2 diabetes, blood pressure should be measured at each visit. Other complications such as albuminuria, retinopathy, dyslipidemia, and PCOS should be screened for at diagnosis and annually, as possible.

Other complications and diabetes-associated conditions in children and adolescents

Whenever possible, follow the guidance described in the full chapter for recommended care (Pediatr Diabetes 2014: 15 (Suppl. 20): 270–278)

- Monitoring of growth and physical development and the use of growth charts is an essential element in the continuous care of children and adolescents with type 1 diabetes
- Screening of thyroid function by measurement of TSH is recommended at the diagnosis of diabetes and, thereafter, every second year in asymptomatic individuals without goiter. More frequent assessment is indicated otherwise.
- The diagnosis of hypothyroidism is confirmed by demonstrating a low free thyroxine (T4) level (or if not available, total T4) and a raised TSH concentration.
- Screening for celiac disease should be performed at the time of diabetes diagnosis, and every 1–2 years

thereafter. More frequent assessment is indicated if the clinical situation suggests the possibility of celiac disease or the child has a first-degree relative with celiac disease.

- If small bowel biopsy is not possible in a child with positive screening tests, then a trial of a gluten-free diet is recommended if celiac disease is suspected. Response should be determined from improvement in growth, bowel habit and reduction in titre of screening antibodies.

Children with type 1 diabetes with confirmed celiac disease should receive dietetic education and educational materials.

- Diabetes care providers should be alert for the symptoms and signs of Addison's disease (adrenal failure) in children and youth with type 1 diabetes although the occurrence is rare.
- Routine clinical examination should be undertaken for skin and joint changes. Regular screening by laboratory or radiological methods is not recommended.
- Prevention of lipohypertrophy includes rotation of injection sites with each injection, using larger injecting zones and non-reuse of needles.
- Screening for vitamin D deficiency, particularly in high risk groups, should be considered in young people with type 1 diabetes and treated using appropriate guidelines.