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POCKETBOOK FOR MANAGEMENT OF DIABETES IN CHILDHOOD AND ADOLESCENCE IN UNDER-RESOURCED COUNTRIES

ISPAD
International Society for Pediatric and Adolescent Diabetes

LIFE FOR A CHILD
an International Diabetes Federation Programme

International Diabetes Federation

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For information on the IDF Life for a Child Program see Chapter 14 and also www.lifeforachild.org

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PREFACE

These guidelines have been developed taking into account resource- and cost-related issues affecting care for children and youth with diabetes in developing countries. Healthcare funding and available expertise vary from country to country and often also within a particular country, and therefore it is challenging to write a broad document to meet all needs.

The information in these guidelines is aimed to assist health care professionals in developing countries to optimise the clinical practice they are able to give in their particular centre. In many cases, subsequent referral to a centre with greater expertise is appropriate.

It is estimated that there are approximately 490,000 children under the age of 15 years with type 1 diabetes worldwide. 70,000 new cases are diagnosed each year and numbers are rising between 3-5% per year (IDF Atlas, Brussels 2010).

In the developed world, children and youth with diabetes have full access to insulin and other components of diabetes care, so that they can lead normal healthy lives. However for many children in some countries there is limited access to insulin, blood glucose monitoring, expert medical care and diabetes education. This may be due to unaffordability, or the expert care may simply not be available in the area. The consequences of this are profound. Some children will die undiagnosed or soon after diagnosis. All are prone to life-threatening episodes of low or high blood sugar levels. Over time, inadequate blood glucose control frequently leads to serious complications, including blindness and renal failure. Many have to drop out of school, and struggle to gain employment or find a marriage partner.

The International Society for Pediatric and Adolescent Diabetes (ISPAD) has released comprehensive guidelines in 1995, 2000 and 2009, "Clinical Practice Consensus Guidelines". Using these guidelines, the International Diabetes Federation (IDF) and ISPAD published "Global Guideline for Diabetes in Childhood and Adolescence" in 2011. The Changing Diabetes in Children Program (CDiC) and ISPAD also released "Diabetes in Children and Adolescence - Basic Training Manual for Healthcare Professionals in Developing Countries" in 2011.

The IDF Life for a Child Program and ISPAD decided it was appropriate to develop a shortened version of these guidelines aimed to be of practical use in emergency situations and in clinics that are developing expertise in managing diabetes in children. This Pocketbook provides basic background on diabetes in children,

and clear advice for initial management of diabetic ketoacidosis, initiation of maintenance insulin therapy, complications screening, and other key components of care – see contents.

The Pocketbook will be available in printed form, on the web, and as an app for smartphones (as Android and Apple versions).

The three more detailed guidelines mentioned above were all extensively used as source material. Some information was also drawn from "Caring for Diabetes in Children and Adolescents" (Children's Diabetes Services, Australia 2010).

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1. Clinical Practice Consensus Guidelines, ISPAD 2009

2. Global Guidelines for Diabetes in Childhood and Adolescence, IDF 2011

3. Diabetes in Children and Adolescence - Basic Training Manual for Healthcare Professionals in Developing Countries, Novo Nordisk 2011

4. Caring for Diabetes in Children and Adolescents, Children's Diabetes Services (Australia) 2010

Pocketbook for Management of Diabetes in Childhood and Adolescence in Under-Resourced Countries

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01 DEFINITION AND DIAGNOSIS

Diabetes is a group of disorders characterised by a sustained elevation of blood glucose levels (BGL).

Glucose is the main source of energy for the body. Insulin, a hormone made by the beta cells in the pancreas, facilitates the movement of glucose from the blood to the cells so it can be used. Diabetes occurs either because the body does not produce enough insulin, or because cells do not respond to the insulin that is produced (insulin resistance).

Symptoms and Signs

More Common	Less Common	Severe (Diabetic ketoacidosis)	
Weight loss	Excessive hunger	Frequent vomiting and acute abdominal pain	
Polyuria – in younger children bedwetting is common	Blurred vision	Flushed cheeks	Acetone smell on breath
Excessive thirst	Mood changes	Dehydration with continuing polyuria	
Tiredness - not wanting to work or play	Skin infections	Decreased level of consciousness	
	Oral or vaginal thrush	Kussmaul respiration (deep, rapid, sighing)	
	Abdominal pain	Coma	Shock

In diabetes the body is unable to fully use glucose, and starts to break down fat and muscle, resulting in weight loss. The kidneys are unable to reabsorb all the filtered glucose. The glucose is excreted in the urine (glycosuria), dragging water with it resulting in polyuria (excessive urination) and polydipsia (excessive drinking). Younger children often resume bedwetting.

Breakdown of fat causes ketones to accumulate in the blood (acidosis). If the diagnosis is not made, glucose and ketone levels become very high, resulting in severe dehydration and loss of electrolytes from the body. This is called diabetic ketoacidosis (DKA). The presence of ketones and the accompanying acidosis may cause an acetone/sweet smell on the breath, vomiting, abdominal pain, decreased level of consciousness and rapid deep breathing called Kussmaul respiration. If untreated, shock, cerebral oedema, coma and death may occur.

In babies and young infants, signs and symptoms may be less easily detected.

Diabetes in children is often misdiagnosed as some other condition – e.g. as pneumonia or asthma (laboured breathing), as appendicitis or gastroenteritis (abdominal pain, vomiting), as a serious infection such as malaria, typhoid, HIV/AIDS, tuberculosis, or meningitis (coma etc.), as a urinary tract infection (urinary frequency), or as malnutrition (weight loss, tiredness).

Diagnosis of diabetes is made when:

Symptoms + random BGL
⩾ 11.1 mmol/L (⩾200 mg/dl)

(or)

Fasting BGL ⩾ 7mmol/L (⩾ 126 mg/dl)

(or)

2 hour post load glucose
⩾ 11.1 mmol/l (⩾ 200 mg/dl) during an oral glucose tolerance test
75 gm glucose is given as a sweet drink after fasting

In the absence of clear symptoms, diagnostic testing should be repeated on a separate day.

If resources are limited and blood glucose testing is unavailable, diagnosis can be made by testing urine for high levels of glucose and ketones.

Types of Diabetes

Most diabetes in children is type 1 diabetes, resulting in life-long insulin dependency. Type 2 diabetes can also occur in children (mainly in adolescents). Other rarer types can also occur, even in neonates.

In more detail:

Type 1 Diabetes

Type 1 diabetes is the most common autoimmune disorder in childhood and adolescence. Both genetic and environmental factors are important in determining an individual's risk, however the mechanisms are not fully understood. Incidence varies widely between different countries, within countries and between different ethnic populations. Finland has an incidence of 64 per 100,000 children <15 years per year, with some others <1 per 100,000 children <15 years per year. Type 1 diabetes is increasing by 3-5% per year.

Onset can be at any age after the neonatal period, but it is most common in childhood and adolescence.

Clinical presentation can vary from non-urgent presentation (see more common symptoms in the table on page 6) to severe presentation with dehydration, shock and DKA (see table on page 6).

Newly diagnosed children should be transferred to a centre that has expertise in paediatric diabetes, if this is possible.

Treatment of diabetes consists of

- lifelong insulin dependency with multiple injections per day
- a healthy eating plan
- regular physical activity.

Maintaining this balance in children and adolescents can be difficult due to their variable growth, activity and eating patterns.

Antibody testing should be performed at diagnosis where possible.

For further reading please refer to Chapter 1 *ISPAD Guidelines* 2009.

Type 2 Diabetes

Type 2 diabetes usually affects people over the age of 40, may run in families and is often associated with being overweight. It is increasingly being seen in older children, particularly adolescents who are overweight and inactive, have a family history of type 2 diabetes or in those who are of particular ethnic backgrounds where type 2 diabetes in adults is more prevalent.

People with type 2 diabetes produce insulin but the insulin produced does not work effectively ("insulin resistance"). Type 2 diabetes often responds initially to a healthy eating plan, appropriate exercise and weight reduction. However, metformin is frequently needed (+/- an insulin sensitiser), and later insulin may be required.

For further reading please refer to Chapter 3, *ISPAD Guidelines* 2009

Other Types of Diabetes

Other rarer types of diabetes occur, including:

- The imperfectly understood entities of malnutrition related diabetes and fibrocalculous pancreatopathy also occur in some countries in the developing world. Fibrocalculous pancreatopathy usually presents with abdominal pain and calcification of the pancreas is evident on X-ray or ultrasound
- Some forms of diabetes do not neatly fit type 1 or type 2 - "atypical diabetes"
- Neonatal Diabetes (presenting in the first six months of life) results from the inheritance of a mutation or mutations in a single gene (monogenic diabetes). If this is suspected, genetic testing should be undertaken because it may influence management. This testing can be done free-of-charge through centres in the U.K. and elsewhere. For further reading please refer to Diabetes Genes and Chapter 4, *ISPAD Guidelines*
- Monogenic diabetes outside the neonatal period. This was previously known as MODY – Maturity Onset Diabetes in the Young. These cases generally have a strong family history of diabetes.
- Diabetes associated with syndromes such as Down Syndrome, Prader-Willi Syndrome
- Gestational diabetes can also occur in pregnancy in younger women

For further reading please refer to Chapter 1, *ISPAD Guidelines*, 2009

02 MANAGEMENT OF DIABETIC KETOACIDOSIS

Diabetic Ketoacidosis (DKA) occurs when there is profound insulin deficiency. It frequently occurs at diagnosis and also in children and youth with diabetes if insulin is omitted, or if insufficient insulin is given at times of acute illness.

The biochemical criteria for DKA are:

- **Hyperglycaemia (blood glucose >11mmol/l (~200 mg/dl))**
- **Venous pH <7.3 or bicarbonate <15 mmol/l**
- **Ketonaemia and ketonuria**

DKA results in vomiting, abdominal pain, flushed cheeks, acetone (sweet) smell on breath and dehydration with continued polyuria. Breathing at first is rapid and shallow and later deep sighing respirations (Kussmaul breathing). The level of consciousness decreases and coma can ensue.

DKA is a medical emergency and correction of the clinical and chemical changes must occur gradually to prevent the complications associated with DKA, particularly cerebral oedema. Fluid replacement is initially more important than insulin therapy, as early mortality is due to dehydration and shock rather than hyperglycaemia. Insulin therapy is needed to correct the acidosis and hyperglycaemia. Treatment should be initiated at the healthcare site of first contact, and the child should be transferred as soon as possible to the best available site of care with diabetes experience. If insulin is not available at the healthcare site, transfer is urgent, however fluid treatment must be initiated immediately.

Managing DKA includes the following components:

- Initial assessment and monitoring
- Correction of shock
- Correction of fluid replacement
- Insulin treatment
- Potassium replacement
- Role of bicarbonate
- Treatment of infection (if present)
- Management of cerebral oedema
- Monitoring of the child
- Transitioning to subcutaneous insulin

Page 19 gives a summary flowchart for recommended care settings and Page 20 a summary flowchart for resource-limited care settings.

TREATMENT OF DKA

2.1. Initial Assessment and Monitoring

- Carry out a clinical assessment including history and examination. Be careful to include:
  a. Severity of dehydration. If uncertain about this, assume 10% dehydration in significant DKA
  b. Level of consciousness
  c. Evidence of infection
- Weigh the child
- Measure blood glucose (both blood glucose meter and laboratory measurement if possible)
- Measure ketones by urine dipstick (and blood ketone measurement if possible)
- If a laboratory is available on site, carry out the following tests: blood glucose, electrolytes, HbA1c, urea and creatinine, bicarbonate, haemoglobin and white cell count. Venous or arterial pH should also be measured if available. Take appropriate microbiological samples if infection is suspected. If no laboratory is available, take the appropriate samples and send to the next level of care.

During management of DKA, the child needs to be carefully monitored as follows:

- Record hourly: heart rate, blood pressure, respiratory rate, level of consciousness, glucose meter reading
- Monitor urine ketones in every sample of urine passed
- Record fluid intake, insulin therapy and urine output
- Repeat blood urea and electrolytes every 2-4 hours

2.2. Correction of Shock

- Ensure appropriate life support (Airway, Breathing, Circulation)
- Give oxygen to patients with severe circulatory impairment or shock.
- Set up a large IV cannula. If this is not possible set up intra-osseous access – if this is not possible insert a nasogastric tube (transfer child to a site with IV facilities as soon as possible)
- Treat decreased peripheral perfusion with fluid (IV or intra-osseous) at 10ml/kg of Normal Saline (0.9%) Saline or Ringer's Lactate over 1-2 hours. Repeat boluses of 10ml/kg up to three times until perfusion improves.
- In the rare cases of shock or severe circulatory collapse, rapidly restore circulatory volume with Normal Saline (0.9%) in a 20mL/kg bolus infused as quickly as possible. Additional boluses of 10ml/kg may need to be administered cautiously once or twice.
- If the only access is by nasogastric tube, give the same volume of fluid over 60 minutes (Normal (0.9%) Saline, half strength Darrow's Solution with Dextrose or Oral Rehydration Solution (ORS)) until perfusion improves.

Important:

Shock must be adequately treated before proceeding. There should be good peripheral perfusion and adequate blood pressure.

Important:

Fluid replacement, insulin therapy and potassium replacement will slowly correct the acidosis, deficits in electrolytes, and the hyperglycaemia over 24 hours. Dehydration should be slowly corrected over 48 hours.

2.3. Fluid replacement

- Rehydrate the child with Normal (0.9%) Saline. Aim to provide maintenance and to replace any deficit (up to 10%) over 48 hours. This volume should be distributed evenly over the 48 hours.
- Do not add the urine output to the replacement volume
- Reassess clinical hydration regularly
- Once the blood glucose level is <15 mmol/l (<270 mg/dl), add glucose (also known as dextrose) to the saline (add 100ml of 50% glucose/dextrose to every litre of saline, or use 5% glucose/dextrose saline)
- If intravenous/osseous access is not available, rehydrate orally with Oral Rehydration Solution (ORS). This can be done by nasogastric tube at a constant rate over 48 hours. If a nasogastric tube is not available, give ORS by oral sips at a rate of 5 ml/kg per hour
- When oral fluid is tolerated, IV fluid should be reduced accordingly, so that the total amount of fluid given to the patient per hour does not exceed the calculated hourly rehydration volume

Important:

The more ill the child, the slower the rehydration should be because of the risk of developing cerebral oedema.

Example of volumes needed to replace fluid and provide maintenance for a 10% deficit to be given evenly over 48 hours (if deficit is estimated at <10%, then the infusion rate needs to be appropriately reduced).

Weight (kg)	Infusion rate for maintenance and a 10% deficit (ml/kg/h)
4 – 9	6
10 – 19	5
20 – 39	4
40 - 59	3.5
60 - 80	3

Example: If 10% dehydrated, a 6 year old boy weighing 20 kg will be given 80 ml per hour or a total volume of 1920 ml per 24 hours for two days.

2.4 Insulin Treatment

- Insulin treatment can be started once shock has been corrected and fluid replacement has been commenced. It should be started 1-2 hours after initiating fluid therapy as earlier onset of insulin treatment has been associated with cerebral oedema.
- Insulin is best given intravenously by an infusion.

1. **Intravenous infusion of 0.1 unit/kg/hour. This can be given in two ways:**

   a. Using a syringe pump - dilute 50 units short-acting (regular, "soluble") insulin in 50 ml Normal (0.9%) Saline, 1 unit = 1 ml).

or

   b. Use a side drip (if a syringe pump is unavailable) - put 50 Units of short-acting (regular) insulin in 500 ml of Normal (0.9%) Saline – the concentration of this solution is 1 Unit = 10ml.

For example:

a 25 kg child should receive 2.5 Units per hour:

2.5 ml per hour of the syringe pump solution ⇨ a. above

25 ml per hour of the side drip solution ⇨ b. above

- An IV bolus is unnecessary and should not be used at the start of therapy.
- In children under 5 years of age, and also patients with a hyperglycaemic hyperosmolar state (HHS) consider using a lower rate of insulin delivery, e.g. 0.05 unit/kg/hour, provided that the acidosis continues to resolve.

2. If insulin cannot be given intravenously by a side drip or infusion pump, use deep subcutaneous or intramuscular insulin:

Give 0.1 unit/kg of short-acting (regular, soluble) or rapid-acting insulin SC or IM into the upper arm, and repeat this dose every 1-2 hours. (Arrange transfer to a facility with greater resources as soon as possible). Once the blood glucose is less than 15 mmol/l (270 mg/dl), add glucose/dextrose to the saline (add 100ml of 50% glucose/dextrose to every litre of saline, or use 5% glucose/dextrose

saline). Sometimes higher concentrations of glucose/dextrose are needed to maintain the blood glucose between 5-15 mmol/l (90-270mg/dl) while the metabolic acidosis (as shown in the continued presence of ketones) is still being cleared.

Important:
Continue to give 0.05-0.1 U/kg/hour insulin until ketones have been cleared. Do not correct glucose too rapidly. During initial volume expansion the blood glucose concentration falls rapidly. Aim for a glucose reduction of about 5 mmol/l (90 mg/dl) per hour. A more rapid decline may contribute to the development of cerebral oedema (see 2.9). If glucose declines very rapidly, decrease the rate of insulin delivery, but not lower than 0.05 U/kg/hour – in this case increase glucose concentrations in the fluid instead.

2.5 Potassium replacement

Potassium replacement is needed for every child in DKA.

- Measure blood potassium level as part of the initial assessment
- If this measurement cannot be done immediately, hypo- and hyperkalaemia may be observed on an ECG. Flattening of the T wave, widening of the QT interval and the appearance of U waves indicate hypokalaemia. Tall, peaked, symmetrical T waves and shortening of the QT interval are signs of hyperkalaemia.
- Ideally start replacing potassium once the serum potassium value is known or urine output has been documented. If this value cannot be obtained within 4 hours of staring insulin therapy, start potassium replacement anyway.
- Replace potassium by adding potassium chloride to the IV fluids at a concentration of 40mmol/L. Increase according to measured potassium levels. The maximum recommended rate of intravenous potassium replacement is usually 0.5 mmol/kg/hour
- If potassium is given with the initial rapid volume expansion, a concentration of 20 mmol/l should be used
- If hypokalaemia persists despite a maximum rate of potassium replacement, then the rate of insulin infusion can be reduced.

- For a child being rehydrated with Oral Rehydration Solution (ORS), no added potassium is needed as ORS contains potassium
- Serum potassium should be monitored every six hours or more frequently if indicated
- If intravenous potassium is not available, potassium could be replaced by giving fruit juice, bananas or coconut water orally.

2.6. Role of bicarbonate

Bicarbonate should not be routinely given, but in very rare cases, if the child is in shock with severe acidaemia, it may be appropriate to use bicarbonate

If bicarbonate is considered necessary, cautiously give 1-2 mmol/kg IV over 60 minutes. Watch out for sudden hypokalaemia when administering bicarbonate.

2.7 Treatment of infection

Infection can precipitate the development of DKA. It is often difficult to exclude infection in DKA as the white cell count is often elevated due to stress and acidosis. Fever is a more reliable sign of infection.

If infection is suspected, treat with broad spectrum antibiotics.

2.8 Cerebral oedema

Cerebral oedema is a rare but often fatal complication of DKA.

It can be idiosyncratic, but its occurrence may be related to various factors including the degree of hyperglycaemia, acidosis, dehydration and electrolyte disturbance at presentation, as well as over-rapid correction of acidosis, dehydration or hyperglycaemia.

The rapidly rising intracranial pressure may present as:

- Headache, vomiting or slowing of heart rate, in combination with an increase in blood pressure
- Change in neurological status (restlessness, irritability, increased drowsiness, incontinence, seizures, coma)
- Specific neurological signs (e.g. unreactive pupils, cranial nerve palsies), abnormal respiratory pattern, decorticate posture
- Decreased oxygen saturation (cyanosis)

If cerebral oedema is suspected **TREAT URGENTLY**:

- Exclude hypoglycaemia as a cause of the change in neurological state.
- Reduce the rate of fluid administration by one third
- Give mannitol 0.5-1 g/kg IV over 20 minutes, and repeat if there is no initial response in 30 minutes to 2 hours.
- Hypertonic saline (3%) 5ml/kg over 30 minutes may be an alternative to mannitol, especially if there is no initial response to mannitol
- Elevate the head of the bed
- Intubation may be necessary for a patient with impending respiratory failure
- After treatment has been started, if available, a cranial CT scan should be done to rule out other possible intracerebral causes of neurological deterioration, especially thrombosis or haemorrhage which may benefit from specific therapy.

Cerebral oedema is an unpredictable complication of DKA. Survivors are often left with significant neurological deficits. Meticulous management of the DKA can decrease the risk of developing cerebral oedema. DKA should therefore be managed at the best available facility.

For further reading please refer to Chapter 10, *ISPAD Guidelines*, 2009

2.9 Monitoring the Child

If biochemical parameters of DKA (pH, anion gap*, urine ketones) do not improve, reassess patient, review insulin therapy, and consider other possible causes of impaired response to insulin, e.g. infection or errors in insulin preparation. Also consider that the primary illness may be a serious infection (such as malaria) with stress hyperglycaemia rather than diabetes.

* For further reading please refer to Chapter 10, ISPAD Guidelines 2009

If replacing fluid orally, ensure that the child has ORS or fruit juice once the glucose is below 15 mmol/l (270 mg/dl).

Once the urine ketones are absent, consider making the transition to subcutaneous (SC) insulin.

Where available, measurement of blood ß-hydroxybutyrate concentration (blood ketones) is useful to confirm keto-acidosis (usually 3 mmol/L or above) and monitor the response to treatment.

2.10. Transitioning to subcutaneous insulin

Once the DKA has been adequately treated (hydration corrected, glucose controlled, ketones cleared) the child can be transitioned to subcutaneous insulin.
The first SC dose of short-acting insulin should be given 1-2 hours before stopping the insulin infusion.
(If the child has been receiving SC or IM insulin, stop the additional fluids).

Important: It is often easier to transition to subcutaneous insulin at the next mealtime. If the child is newly diagnosed, refer to Chapter 3, otherwise determine insulin dose from consideration of the dose before admission.

Page 19 gives a summary flowchart for recommended care settings and Page 20 a summary flowchart for resource-limited care settings.

Figure 1
DKA Management – Recommended Care

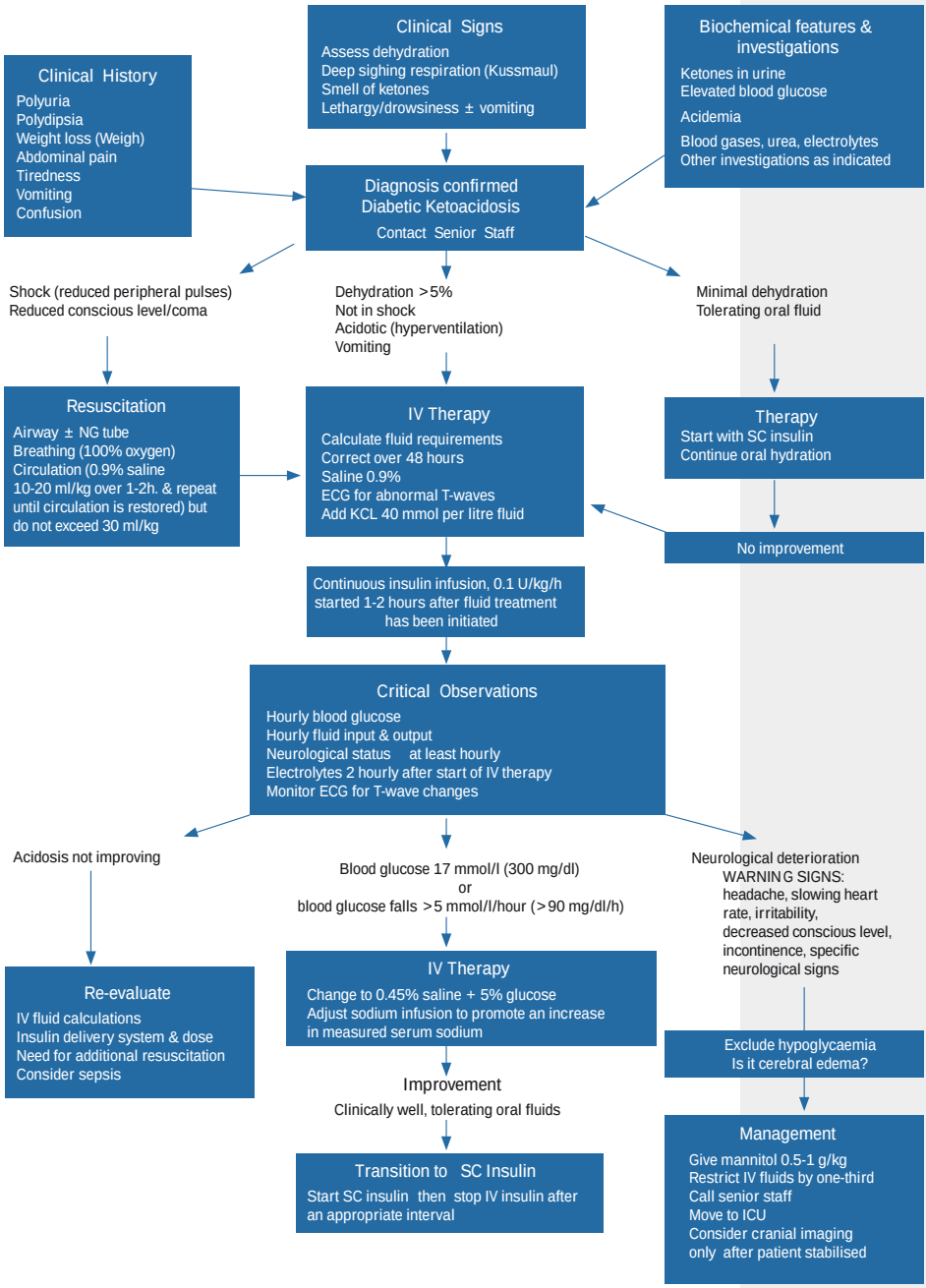
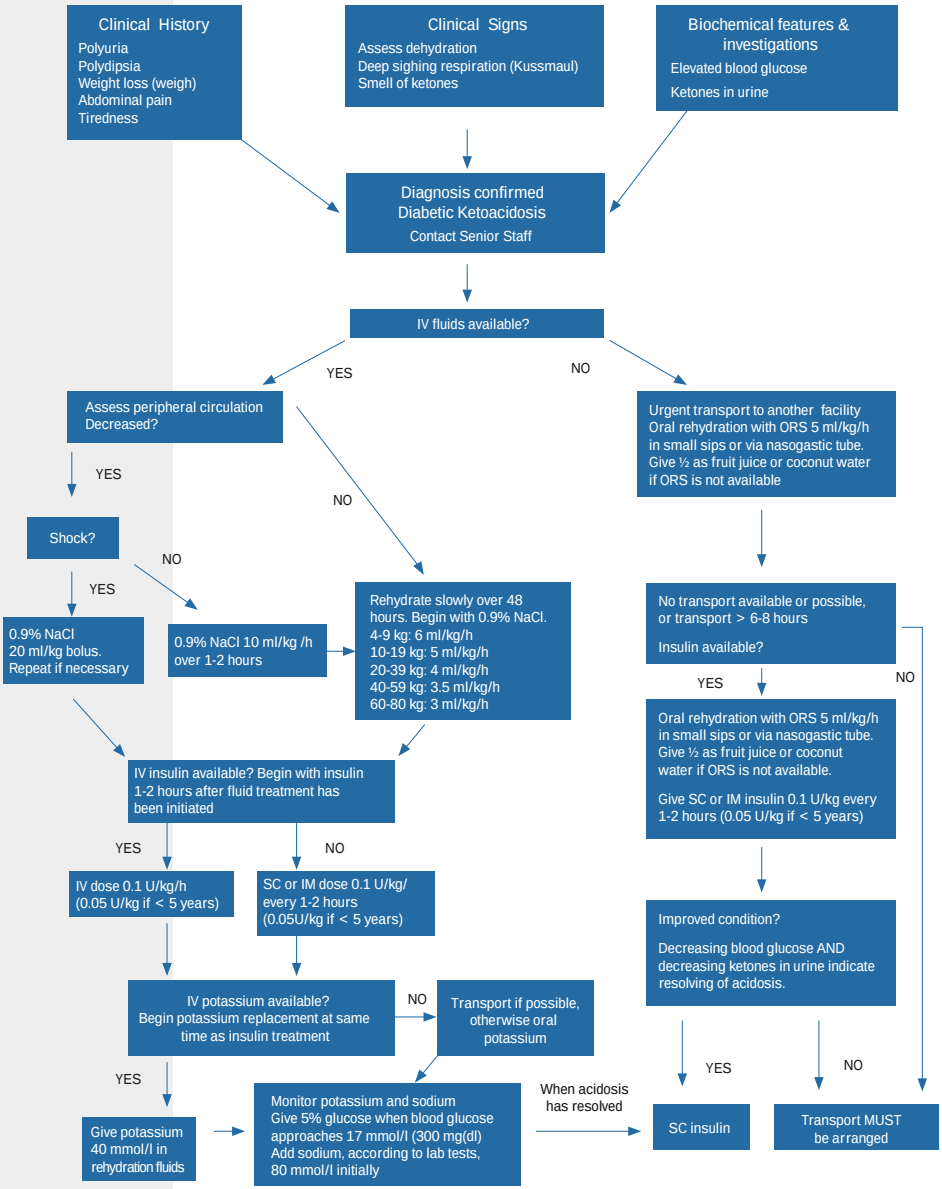


Figure 2
DKA Management – Limited Care



INSULIN TREATMENT

03

All children with type 1 diabetes and some children with other forms of diabetes require insulin. The aim is to replace insulin as physiologically as possible so that blood glucose levels are within the target range avoiding hypoglycaemia and sustained hyperglycaemia. Prolonged under-insulinisation results in chronic hyperglycaemia which increases the risk of stunted growth, diabetes complications, including diabetic ketoacidosis.

Comprehensive diabetes management includes insulin treatment, blood glucose monitoring, nutritional management, physical activity, education, rules for sick days, and psychosocial support (see subsequent sections).

Partial Remission or Honeymoon Phase in Type 1 Diabetes

- Insulin requirements can decrease transiently following initiation of insulin treatment.
- This has been defined as insulin requirements of less than 0.5 units per kg of body weight per day with an HbA1c < 7%.
- Ketoacidosis at presentation and at a young age reduce the likelihood of a remission phase.
- It is important to advise the family of the transient nature of the honeymoon phase to avoid the false hope that the diabetes is spontaneously disappearing.

Insulin requirements

- Pre-pubertal children (outside the partial remission phase) usually require 0.7-1.0 IU/kg/day.
- During puberty, requirements may rise substantially above 1 and even up to 2 U/kg/day.
- The ''correct'' dose of insulin is that which achieves the best attainable glycaemic control for an individual child or adolescent, without causing obvious hypoglycaemia, and resulting in normal growth and development.

Types of Insulin

In most developing countries, human insulin is available. This comes in three forms:

- Short-acting (regular/soluble) - e.g. Actrapid, Humulin R, Insuman Rapid
- Intermediate-acting - NPH insulin – e.g. Humulin NPH, Protaphane, Insulatard
- Pre-mixed short-acting (regular) and intermediate-acting (NPH) insulins – usually in the combination 30/70 or 25/75

Analogue insulins are also available in some countries but are substantially more expensive.

Examples are:
Rapid-acting - e.g. Aspart, Glulisine, Lispro
Long-acting – e.g. Glargine, Detemir

Insulin Action

Insulin type	Prepara-tions	Onset of Action	Peak of action	Duration of action	When to give
Rapid-acting	Aspart, Glulisine, Lispro	15-30 minutes	1-2 hours	3-5 hours	imme-diately prior to meal
Short-acting (regular)	Actrapid, Humulin R, Insuman Rapid	30-60 minutes	2-4 hours	5-8 hours	30 min-utes prior to meal
Interme-diate-acting	Humulin NPH, Pro-taphane, Insulatard,	2-4 hours	4-10 hours	12-24 hours	30 min-utes prior to meal
Long-acting	Detemir	1-2 hours	6-12 hours	20-24 hours	once or twice daily
	Glargine	2-4 hours	relatively peakless	24 hours or less	once or twice daily
Mixed	Rapid/long-acting mix or Short/long-acting mix 30/70 or 25/75	30 min-utes	4-12 hours	8-24 hours	30 min-utes prior to meal

The two most common regimens used are:

- **Twice-daily insulin** using both short-acting and also intermediate-acting insulin. (If these insulins are not always available, pre-mixed insulin can be used as an alternative regimen).
- **Basal bolus regimen (the preferred option)** - with short-acting insulin given with main meals (usually three times per day) and intermediate-acting insulin given once or twice daily (evening, or morning and evening).

Insulin can also be given by an insulin pump but this is very expensive and requires expert education to initiate and monitor therapy.

A note on the use of pre-mixed insulins in children:

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.

Notes on analogue insulins in children:

1. Where available, rapid-acting analogues can be given immediately before meals because of their shorter duration of action. Also there is evidence that the rapid action reduces postprandial hyperglycaemia and also possibly nocturnal hypoglycaemia. They offer the useful option of being given immediately after food when needed (e.g. infants and toddlers who are reluctant to eat). The benefit of the rapid-acting insulin analogues in children is related to the reported reduction of hypoglycaemia. At the present time there is no evidence to show improvements in HbA1c using analogues compared with human insulin.
2. Where available, basal (long-acting) analogues given 1-2 times daily show a more predictable insulin effect with less day to day variation compared to NPH insulin.
3. While the effect of basal analogues on HbA1c improvement is controversial, there is evidence for a reduced rate of hypoglycaemia and a greater treatment satisfaction.

Guidelines on insulin dosage

Initiating therapy in a child not in DKA

Day 1
Give short-acting (regular) insulin (0.1 U/kg) every second hour until blood glucose is < 11 mmol/l, then every 4-6 hours. If hourly monitoring of blood glucose cannot be provided, begin with half the above dose.

Day 2 (from morning/breakfast):
Total daily dose 0.5-0.75U/kg/day.

A. TWO INJECTIONS PER DAY

- A starting point is to give two-thirds of the total daily insulin in the morning before breakfast and one-third before the evening meal

- On this regimen, at the start, approximately one-third of the insulin dose may be short-acting (regular) insulin and approximately two-thirds may be intermediate-acting insulin, although these ratios change with greater age and maturity of the young person.

For example:
For a 36 kg child who is started on 0.5 U/kg/day, the total daily dose is 18 Units. Two-thirds of this is given in the morning (before breakfast) – (12 Units), and one-third before the evening meal – 6 Units. At each injection, 1/3 is short-acting and 2/3 is intermediate-acting.

Therefore the doses, for this 36 kg child, would be:

	Short-acting	Intermediate-acting
Before breakfast	4 Units	8 Units
Before evening meal	2 Units	4 Units

For mixed insulin, always think of the components separately (i.e. 10 units of mix 70/30 equals 3 units of short-acting (regular) and 7 units of intermediate-acting (NPH)), and adjust doses as above.

b. BASAL BOLUS REGIMEN

A starting point is:

- If short-acting (regular) and intermediate-acting insulin is used, give:
  - 70% of the total daily dose as short-acting (regular) insulin (divided up between 3-4 pre-meal boluses)
  - 30% of the total daily dose as a single evening injection of intermediate-acting insulin

- If short-acting (regular) and long-acting analogue insulins are used, give:
  - 50% of the total daily dose as short-acting (regular) insulin (divided up between 3-4 pre-meal boluses)
  - 50% of the total daily dose as a single evening injection of long-acting analogue insulin. (Sometimes this dose does not last for 24 hours and then can be split into two doses morning and evening).

Subsequently, doses can be adjusted daily according to blood glucose levels (see Chapter 6).

It is important to note that:

1. The level of blood glucose can rise in the early morning ("dawn phenomenon") and so care should taken if increasing the evening intermediate/long-acting dose as hypoglycaemia can occur in the middle of the night and this can be dangerous.
2. As mentioned on page 18, insulin requirements can decrease for a time during the "honeymoon period" before rising again.
3. The total daily dose required will generally increase as the child grows, and once puberty ensues a higher dose per kg per day is often needed.

During periods of regular change in consumption of food (e.g. Ramadan) the total amount of insulin should not be reduced but redistributed according to the amount and timing of carbohydrate intake. However, if the total calorie intake is reduced during Ramadan, the daily amount of bolus insulin for meals usually needs to be reduced, for example to two-thirds or three-quarters of the usual dose.

For further reading please refer to Chapter 8, *ISPAD Guidelines* 2009

Mixing Insulins in the same syringe

It is very common to combine intermediate-acting and short-acting/rapid-acting insulins, in order to cover both basal needs plus the extra need from eating.

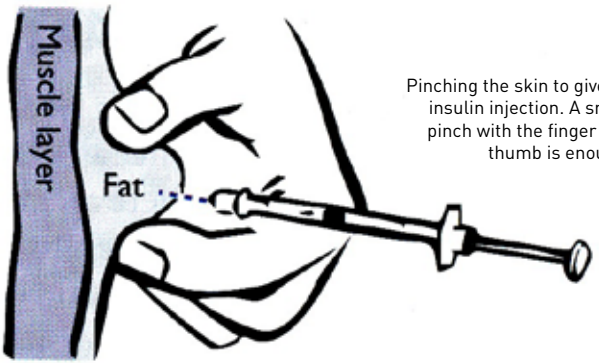
Short-acting insulin or rapid-acting analogues can be combined with intermediate-acting insulins (e.g. NPH) in the same syringe. Begin by injecting air into both bottles. The short-acting insulin is generally drawn into the syringe first. If the intermediate-acting insulin is a "cloudy" insulin, mix by tipping the vial/bottle up and down 10 – 20 times. Do not shake the insulin as this damages the insulin. The doses can be adapted every day according to food intake, physical activity, and blood glucose readings.

For further reading please refer to Page 31, Chapter 5, Insulin Treatment, *Caring for Diabetes in Children and Adolescents*

Giving an injection with a syringe

see: www.diabeteskidsandteens.com.au: Living with Diabetes/Insulin/Giving Insulin and YouTube video How to give an insulin injection dLife.com

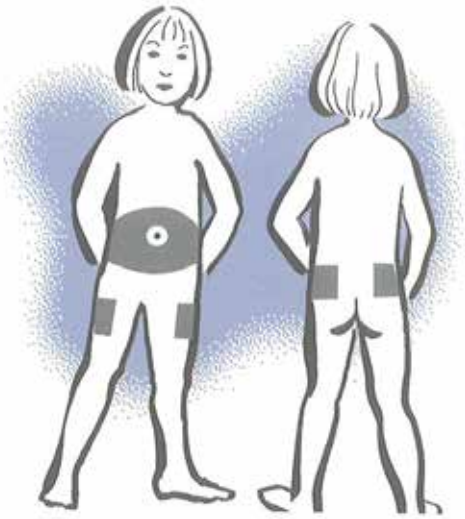
1. Use insulin syringes if possible (preferably with a needle no longer than 8mm). Ensure that the syringes are made for the correct strength of insulin (U-100 or U-40). Ensure that the syringes have adequate gradations and that the dose is correctly understood.
2. Before injecting, check the expiry date, and the name (correct amount of the correct insulin)
3. Pull the plunger down to let air in the syringe, equalling the amount of insulin to be given. Inject this air into the vial.
4. Draw up the insulin
5. Take a small pinch of skin with the index finger and thumb. The pinch needs to be at least to the depth of the needle. This is especially important in lean people, otherwise the injection may go too deep into the muscle layer, hurt more, and absorption will be affected.
6. Insert the needle at a 45 degree angle into the pinched-up skin to a distance of 4-6 mm. Give the injection.
7. Leave the needle in for about 5-10 seconds, then gradually let go of the skin and pull out the needle.
8. Dispose of the syringe appropriately depending on local advice – e.g. sharps container, tin, or strong plastic bottle.



Pinching the skin to give an insulin injection. A small pinch with the finger and thumb is enough.

For further reading please refer to Chapter 5, Insulin Treatments, *Caring for Diabetes in Children and Adolescents*
Image: Caring for diabetes in children and adolescents (3rd edition)

Injection sites



Recommended sites for injection

1. Good technical skill concerning syringes/ pens is important.
2. Injections in the abdominal area are preferred with insulin absorbed more evenly and less affected by exercise than other sites. If insulin is injected into an area that is going to be exercising significantly, it will be absorbed quicker.
3. Children and adolescents should be encouraged to inject consistently within the same area (abdomen, thing, buttocks) at a particular time of day, but must avoid injecting repeatedly into the same spot to avoid lipohypertrophy.

For further reading please refer to Chapter 5, Insulin Treatment, *Caring for Diabetes in Children and Adolescents*
Image: Caring for diabetes in children and adolescents (3rd edition)

Insulin storage

1. Unused insulin should be stored at 4-8°C in a refrigerator where available or in some other method of cooler. In hot climates where refrigeration is not available, cooling jars, zeer pot, earthenware pitcher (matka) or a cool wet cloth around the insulin will help to preserve insulin activity.
2. Insulin must never be frozen.
3. Direct sunlight or extreme heat (in hot climates or in a vehicle) damages insulin.
4. Patients should not use insulins that have changed in appearance (clumping, frosting, precipitation, or discolouration).
5. After first usage, an insulin vial should be discarded after 3 months if kept at 2-8°C or 4 weeks if kept at room temperature.

04 HYPOGLYCAEMIA

The aim of diabetes treatment should be to achieve the best possible glycaemic control without the occurrence of hypoglycaemia. Hypoglycaemia can be fatal, or result in permanent long-term sequelae.

Hypoglycaemia unawareness can occur.

For further reading please refer to Chapter 11, *ISPAD Guidelines* 2009

Definition

Hypoglycaemia occurs when the blood glucose level is ⩽3.9 mmol/L (70 mg/dl) or where there are symptoms of a hypo at a level close to this.

Causes

The main causes of hypoglycaemia are:

- Delayed or missed meals (review reasons for this)
- Physical activity (where possible BGL should be checked prior to exercise, and extra carbohydrates should be eaten based on the BGL and the expected intensity and duration of the exercise).
- Not eating enough carbohydrate (assess timing, amount and peak glucose effect of food eaten)
- Too much insulin (assess insulin profile, time of administration, peak and intensity of action)

Symptoms

Clinical Symptoms	Symptoms of Neuroglycopenia
Trembling/shaking	Inability to concentrate
Rapid heart rate	Blurred or double vision
Palpitations	Slurred speech
Sweating	Confusion/vagueness
Pallor	Dizziness/unsteady gait
Hunger	Loss of consciousness
Nausea	Seizures

Mild Hypoglycaemia occurs when the patient can recognise hypoglycaemia and is able to self-treat without assistance of others. BGL is ⩽ 3.7mmol/L or ⩽ 70mg/dl.

For further reading, refer to Chapter 3.2 Page 59, *Diabetes in Children and Adolescents 2011.*

Severe Hypoglycaemia is when the patient either loses consciousness or has a seizure associated with low blood glucose, or is unable to help him/herself.

Treatment of Hypoglycaemia

Always stay with the person with hypoglycaemia

STEP 1
Give fast acting glucose immediately – 0.3g/kg. An example for a 50kg child – giving 15 gm carbohydrate, is:

- 150-200 ml (1/2 a cup) of a sweet drink e.g. cola or fruit juice **OR**
- 3-4 teaspoons of sugar or honey **OR**
- 6 large or 12 small jelly beans

STEP 2
Follow with one exchange or serve of slow acting carbohydrate (10-15 gm = one slice of bread/2 plain biscuits **OR** one apple **OR** one banana **OR** 250ml or one cup of milk) to maintain the BGL **OR** if a meal or snack is due within 30 minutes, give that meal or snack earlier.

Where BG testing equipment is available, re-test blood glucose 10-15 minutes after treatment, to confirm the BGL is within normal limits. If the BGL remains low, repeat Step 1.

If the patient is unconscious or convulsing and unable to take anything by mouth, lie them on their side and keep their airway clear – i.e. the ABC of resuscitation – airway, breathing, circulation.

Severe hypoglycaemia with loss of consciousness ± convulsions (or if the child is vomiting)

a. If glucagon is available:

Hypoglycaemia is most safely and rapidly reversed by an intramuscular or subcutaneous injection of glucagon 0.5 mg for age < 12 years, 1.0 mg for ages > 12 years, or 10-30 mcg/kg body weight.

b. If glucagon is unavailable

Give intravenous glucose carefully and slowly over several minutes, using 10% or 25% glucose/dextrose solution (or 50% if these are unavailable). Total dose over a several minutes is 0.2-0.5 gm / kg of glucose/dextrose. 50% Dextrose is very hypertonic, and so if it is given it should be administered slowly into a large vein.

SICK DAY MANAGEMENT

05

Many illnesses, especially those associated with fever, raise blood glucose levels because of the effect of stress hormones. The increased resistance to insulin can increase ketone production.

Illnesses with gastrointestinal symptoms (e.g. diarrhoea and vomiting) may lead to lower blood glucose levels and hypoglycaemia due to decreased food intake, poor absorption and changes in intestinal motility.

Sick day management should be an integral part of the initial education of the child and family, and then reinforced at regular intervals.

Management

1. Do not stop insulin during sick days, even though the child or adolescent is ill and not eating normally. The insulin dose may frequently need to be increased or decreased, based on the blood glucose level and food intake, but insulin should not be stopped. If there are no facilities for home monitoring of glucose and ketones, the child or adolescent should be taken to a healthcare facility for regular testing.
2. Evaluate and treat the acute illness.
3. Increase monitoring of blood glucose levels to 3–4 hourly (and more frequently if the glucose level fluctuates widely or changes rapidly).
    - Monitor ketones 1-2 times per day if possible.
    - Check weight if scales are available as a measure of dehydration.
    - If blood glucose is high with ketones, more insulin is needed.
    - If blood glucose is low with ketones, (i.e. "starvation ketosis") more sugary drink is needed before extra insulin can be given.
    - If home glucose and/or ketone monitoring is unavailable, frequent contact with a health professional or clinic review is advisable.

4. Supportive care includes:
   - Adequate fluid intake. Fever and hyperglycaemia can cause increased fluid losses. Oral rehydration fluid provides a source of both fluid and energy.
   - Easily-digested foods when there is loss of appetite.
   - Treating fever with anti-pyretics and treating or prevent vomiting by frequently offering small volumes of fluid to drink.
   - Admitting the child or adolescent to a healthcare facility if these supportive measures cannot be ensured as an out-patient.
5. Additional insulin is usually necessary to control blood glucose (unless the illness causes hypoglycaemia)
   a. Elevated blood glucose results, with absence or small amount of ketones:

   Give: 5-10% of total daily dose of insulin (or 0.05-0.1 U/kg) as short or rapid-acting insulin repeated every 2-4 hours. Total Daily Dose is the sum in units of all insulin injections on a normal day.

   b. Elevated blood glucose results with moderate or large amount of ketones.

   Give: 10-20% of total daily dose of insulin (or 0.1 U/kg) as short or rapid-acting insulin (if available) repeated every 2-4 hours.
6. When vomiting occurs in a child with diabetes, it should always be considered a sign of insulin deficiency (impending ketoacidosis) until proven otherwise.
7. Strenuous exercise should be avoided
8. Consider admission under the following circumstances:
   - Very young children with diabetes, who may become dehydrated more rapidly than older children or adolescents.
   - Parent's inability to check blood glucose at home
   - If supportive care cannot be ensured at home
   - If the acute illness is severe
   - If there is persistent ketonuria

For further reading please refer to Chapter 12, *ISPAD Guidelines* 2009

BLOOD GLUCOSE MONITORING

06

- Blood glucose monitoring is essential in the safe management of childhood and adolescent diabetes to help prevent acute and chronic complications, and also educate and empower the child and family.
- When possible, blood glucose monitoring should be available for all children with diabetes.
- Blood glucose monitoring should ideally be carried out 4-6 times a day, however, this is dependent on the availability of testing strips. Even a couple of tests a week can assist management, and two tests per day gives much useful information.
- Blood glucose testing delivers a picture of what blood glucose levels are like over a period of 24 hours and helps to identify problems early.
- Urine glucose testing may be used as an alternative to blood glucose testing, but provides less information.
- Ideally a record should be kept of blood glucose tests.

Recommended target blood glucose levels:

Before meals	4-7 mmol/l (72-126 mg/dl)
After meals	5-10 mmol/l (90-180 mg/dl)
At bed time	6-10 mmol/l (108–180 mg/dl)
At 3am	5-8 mmol/l (90-144 mg/dl)

Reference: *Caring for Diabetes in Children and Adolescents*

When to Test Blood Glucose Levels (BGLs)

Patterns of BGLs are generally more useful than single blood glucose readings, however, two tests per week is better than no tests at all. Should test strips be scarce, it is best to test at different times of the day a few days a week rather than the same time each day.

For instance, if possible, it is advisable to test before and two hours after breakfast, and before and two hours after other meals, and overnight at 3am (checking for hypoglycaemia) periodically. If strips are readily available, a blood glucose test should be done prior to and following exercise. Exercise, physical activity or play may result in low BGLs during or immediately after exercise, or a delayed hypoglycaemic effect many hours later (up to16 hours).

Designing a Blood Glucose Strategy

There are two basic strategies that can be used to achieve glycaemic control:

1. Prescribe a meal plan with a set amount of carbohydrate (either in grams or exchanges) for each of the major meals and snacks, and a pre-determined dose of short- and longer-acting insulin.
2. Match the pre-meal short-acting insulin dose to the amount of carbohydrate about to be eaten. This works best with a basal-bolus regimen.

Patterns of BGLs are more important than a single BGL.

- If a pre-meal BGL is always high, the preceding dose of intermediate or long-acting insulin is insufficient.
- If the pre-meal BGL is always low, the previous dose of intermediate or long-acting insulin is too high.
- If a pre-meal BGL is sometimes very high and at other times very low, either insulin, food or exercise are not consistent and should be reviewed.
- If the BGL 2 hours after the meal is too high, the meal dose of short-acting (regular) insulin was too low.

- If the BGL 2 hours post-meal is too low, the previous meal dose of short-acting (regular) insulin was too high.

It is important to note that the level of blood glucose can rise in the early morning and so care should be taken if increasing the evening intermediate/long-acting dose as hypoglycaemia can occur in the middle of the night and this can be dangerous.

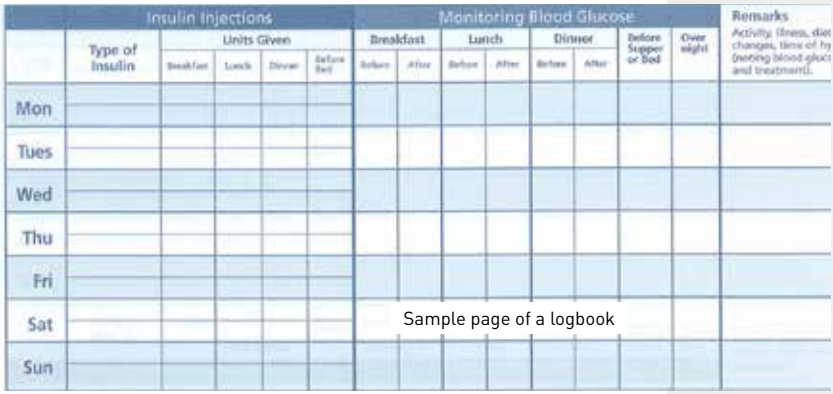
Carrying out a Blood Glucose Test

Before using a meter for the first time ensure that:

- Batteries are not flat
- Required units are set: mg/dl or mmol/l
- Correct strips are available, correct coding has been entered, expiry date has not passed (in more recent meters, coding may not be required)

A log book is useful for recording information such as:

- Time of test
- BGL
- How much and type of insulin given
- Comments e.g. amount and type of food eaten prior to test, type of activity before test e.g. rest, work, exercise.



Sample page of a logbook

HbA1c

- HbA1c (glycated haemoglobin) provides information about average blood glucose levels over the last 2-3 months. This test measures the amount of glucose that attaches to haemoglobin – this depends on how much glucose is in the bloodstream.
- Ideally HbA1c is measured four times per year. If resources are limited, less frequent measurements are still helpful
- The target HbA1c for all age-groups is a value less than 7.5% (58 mmol/mol).
- The table below shows the relationship between HbA1c and average blood glucose (from Nathan et al. Diabetes Care 2008;31:1473-1478)

Table of HbA1c versus mean blood glucose

HbA1c (DCCT) (%)	Estimated Average Blood Glucose (mmol/l)	Estimated Average Blood Glucose(mg/dl)	HbA1c in IFCC Units (mmol/mol)
5	5.4	97	31
6	7.0	126	42
7	8.6	154	53
8	10.2	183	64
9	11.8	212	75
10	13.4	240	86
11	14.9	269	97
12	16.5	298	108

Ketone testing

Ketone testing with either urine strips, or blood when available, should be performed:

- During illness with fever and/or vomiting.
- When blood glucose is above 15 mmol/l (270 mg/dl) in an unwell child or when persistent blood glucose levels above 15 mmol/l (270 mg/dl) are present.
- When there is persistent polyuria with elevated blood glucose, especially if abdominal pain or rapid breathing are present.

For further reading please refer to Chapter 7, *ISPAD Guidelines* 2009

NUTRITIONAL MANAGEMENT

07

- Children with diabetes need a healthy diet with food in amounts and proportions appropriate to the age and stage of growth.
- Nutritional advice should be adapted to cultural, ethnic and family traditions as well as the cognitive and psychosocial needs of the individual child.
- Encourage the child to take the right dose of insulin for the right type and amount of food, and to eat the right amounts for that dose of insulin, at the right time.
- Insulin doses must be matched to the carbohydrate content of the food consumed, or alternatively the carbohydrate content of food consumed must be matched to the timing and the type of insulin injections.
- Nutritional advice should address food availability, diet, food intake and physical activity patterns.
- Excessive restriction of carbohydrate intake to lower blood glucose levels should be avoided.
- Sugary soft drinks or foods with high levels of saturated fat should be avoided.
- There are various approaches used to measure carbohydrate intake - such as exchange or portion control, and carbohydrate counting. For further reading please refer to Chapter 9, ISPAD Guidelines 2009
- Prevention and management of hypoglycaemia, particularly before, during and after exercise should be addressed.
- Education should include preventing hypoglycaemia.
- Ideally there should be an experienced paediatric dietitian in the diabetes team.
- Unexpected weight loss may be a sign of 1) illness (infections, coeliac disease etc.), 2) insulin omission, or 3) an eating disorder.

For further reading please refer to Chapter 9, *ISPAD Guidelines* 2009

08 PHYSICAL ACTIVITY

- Any physical activity including exercise is very beneficial and should be encouraged. Diabetes should not be a barrier to participating in exercise.
- Preparations are needed as exercise may result in hypoglycaemia. Where possible, patients and families should be given tailored advice about what and how much carbohydrate to take before, during, and after exercise, as well as advice about insulin adjustment. Some children and adolescents should snack before activities while others may do better snacking mid-activity or even afterwards. For short, high-intensity activity, the snack should preferably be a fluid-based high energy drink. For a long duration of low-intensity activity, it should be food that is digested more slowly – e.g. fruit.
- Where monitoring is available, blood glucose needs to be measured before exercise, during and following exercise.
- Approximately 1-1.5 g carbohydrate/kg body weight/hour should be consumed during strenuous exercise the child is unable to monitor and reduce their insulin dosage.
- Hypoglycaemia is more likely to occur with prolonged or intense physical activity. It often occurs during or shortly after exercise but is possible up to 24 hours afterwards (increased insulin sensitivity). Risk of post-exercise nocturnal hypoglycaemia is high. The evening dose of intermediate- or long-acting insulin often needs to be decreased after exercise in the afternoon or evening, especially if not exercising on a regular basis. Particular care should be taken that the bedtime blood glucose level is > 7.0 mmol/L (125 mg/dl).
- Sugar-free fluids should be consumed to avoid dehydration.
- Where unaccustomed exercise is being taken, e.g. at a diabetes camp, reduction in total daily dose of insulin (20-50%) is advised to avoid hypoglycaemia.
- Insulin is absorbed quicker when it is injected near to

muscles that are being exercised – e.g. legs in soccer. Hypoglycaemia is then more likely to occur.

- If blood glucose levels are high (>15mmol/l, 270 mg/dl) with ketonuria/ketonaemia, exercise could be dangerous and should be avoided. Give approximately 0.05 U/kg, or 5% of total daily insulin dose as short-acting (regular) (or rapid-acting analogue) insulin and postpone exercise until ketones have cleared (see Sick Day Management – Chapter 5). If ketones cannot be measured, a child who is feeling nauseous should not participate in exercise.
- Children and young people engaged in competitive or more serious sport will require additional support. This should include detailed discussion about the activity and tailored advice on insulin and food adjustments.

For further reading please refer to Chapter 13, *ISPAD Guidelines* 2009

09 DIABETES EDUCATION

- All children and adolescents with diabetes and their carers have the right to 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 simple, knowledge-based education and practical survival skills. For further reading please refer to Life for a Child Health Professional Education Materials
- Myths and false beliefs surrounding diabetes (e.g. "catching" diabetes) should be dispelled at diagnosis.
- Diabetes education is most effective when based on self-management, and is child and parent-centred.
- Ongoing education should be learner-centred, and reinforced by visual aids such as diagrams, drawings, puppet/toy use, written guidelines, booklets, video, DVDs appropriate to the child's age, maturity and environment.
- Parents and children require ongoing patience and reassurance, with some parts of the education needing to be repeated for them to manage effectively.
- Where possible, diabetes education should be delivered by a multidisciplinary paediatric diabetes team (ideally a doctor, nurse, dietitian, psychologist, social worker), with a clear understanding of the special and changing needs of young people and their families. Many countries now have trained paediatric diabetes educators as members of the diabetes team.
- 24 hour telephone support is extremely helpful to families to reduce their isolation, helping to develop confidence in their ability to manage their child's diabetes and cope with emergencies.
- The International Diabetes Federation Life for a Child Programme has a dedicated Education website with pages of downloadable resources in different languages. Life for a Child Education Resources
- Other useful websites are www.childrenwithdiabetes.com and www.diabeteskidsandteens.com.au

For further reading please refer to Chapter 5, *ISPAD Guidelines* 2009

ONGOING CARE, MANAGEMENT OF COMPLICATIONS

10

Diabetes complications can lead to severe morbidity and mortality. ***The most important principle in prevention of complications is to achieve as near normal glycaemic control as possible by intensive education and treatment from diagnosis.***

Complications may include:

- Underinsulinisation leading to growth failure and pubertal delay
- Retinopathy resulting in visual loss and blindness
- Diabetic nephropathy causing hypertension and renal failure
- Neuropathy causing pain, paraesthesia, muscle weakness and autonomic dysfunction,
- Macrovascular disease causing cardiac disease, stroke and peripheral vascular disease with limb loss.

Screening for subclinical complications, with early treatment can delay progression to clinical complications. Other known risk factors are high blood pressure, smoking and hyperlipidaemia.

Standard screening regimen:

- **Weight** should be measured at each visit, and **Height** annually. Pubertal status should be noted at relevant ages.
- **HbA1c** is ideally measured every three months. Target level is <7.5% (58 mmol/mol)
- **Blood pressure** should be measured at least annually
  - > Antihypertensive medication should be introduced if blood pressure is consistently > 95th centile (see table at end of this chapter) or > 130/80 mmHg.

  - Angiotensin converting enzyme (ACE) inhibitors (such as enalapril, captopril) or Angiotensin II receptor blockers (ARB) are recommended treatment and have been effective and safe in children in short-term studies, but **are not safe during pregnancy.**
  - Other antihypertensive agents, such as calcium channel blockers and diuretics can be used if ACE inhibitors are unavailable.

- **Eyes and visual acuity** should be checked for retinopathy and cataracts after two years diabetes duration, and annually thereafter.
  - Minimum assessment for retinopathy should be by visual acuity assessment and where at all possible ophthalmoscopy through dilated pupils by an experienced observer.
  - Where available, assessment for retinopathy should be by fundal photography as well.
  - Abnormalities should be managed by an ophthalmologist.
- **Peripheral and autonomic neuropathy** should be assessed by history, physical examination and sensory tests for vibration, thermal sensation or light touch.
  - Tools include cotton wool, low-frequency tuning forks and monofilaments.
  - Feet should be examined for neuropathy, infections, ulcers etc after two years diabetes duration, and annually thereafter.
- **Urinary protein** should be measured after two years diabetes duration, and annually thereafter. (Persistent microalbuminuria has been shown to predict the progression to end stage renal failure and is associated with an increased risk of macrovascular disease).

  If possible, microalbuminuria should be measured annually by:

  - Timed overnight or 24 hour urine collections (AER).
  - First morning urine albumin/creatinine ratio (ACR).

If assessment of microalbuminuria is not available, dipstick urine protein measurement can be done. This only shows macroalbuminuria (>500mg/day)

Persistent micro- or macroalbuminuria should be treated with ACE inhibitors (or ARB blockers if there are side-effects from ACE inhibitors (e.g. persistent cough)). Other causes of proteinuria (such as urinary tract infection or schistosomiasis) should be excluded.

For further reading please refer to Chapter 17, *ISPAD Guidelines*, 2009

- **Fasting blood lipids** should be performed when diabetes is stabilised in children aged over 12 years. If there is a family history of hypercholesterolaemia, early cardiovascular disease, or if the family history is unknown, screening should start at age 2 years.
  - > If normal results are obtained, screening should be repeated every 5 years.
  - > Target for LDL-C should be lower than 2.6 mmol/l (100 mg/dl). If interventions to improve metabolic control and dietary changes cannot lower LDL-C to target levels, statins should be considered although long-term safety is not established in children.
- Other conditions may occur with diabetes including **hypothyroidism** or hyperthyroidism, **coeliac disease**, and Addison's disease (rare) – screening for these may be appropriate depending on available resources. For further reading refer to Chapter 18, ISPAD Guidelines 2009.
- Smoking is totally contraindicated in diabetes as it increases complications rates.

Blood Pressure Values Requiring Further Evaluation

Age, y	Blood Pressure, mmHg			
	Male		Female	
	Systolic	Diastolic	Systolic	Diastolic
3	100	59	100	61
4	102	62	101	64
5	104	65	103	66
6	105	68	104	68
7	106	70	106	69
8	107	71	108	71
9	109	72	110	72
10	111	73	112	73
11	113	74	114	74
12	115	74	116	75
13	117	75	117	76
14	120	75	119	77
15	120	76	120	78
16	120	78	120	78
17	120	80	120	78
18	120	80	120	80

These values represent the lower limits for abnormal blood pressure ranges, according to age and gender. Any blood pressure readings equal to or greater than these values represent blood pressures in the prehypertensive, stage 1 hypertensive, or stage 2 hypertensive range and should be further evaluated by a physician.

Source: Kaelber DC, Pickett F. Simple Table to identify children and adolescents needing further evaluation of blood pressure. Pediatrics 2009:123:e972-974 Blood Pressure Values according to Age & Gender.

More detailed information on normal BP levels for age, sex, and height is available at: www.nhlbi.nih.gov/health/prof/heart/hbp/hbp_ped.pdf

The International Diabetes Federation Life for a Child Program has an annual clinical data sheet which is very useful in ongoing care. This is available as a paper form or web-based database. ISPAD also has a web-based database.

For further reading please refer to Chapter 17, *ISPAD Guidelines* 2009

PSYCHOLOGICAL CARE

11

The period following the diagnosis of diabetes is a very difficult time for families and they may experience varied feelings including shock, denial, anger, sadness, depression, fear and guilt. Children may also feel that having diabetes is a punishment for them doing something wrong. Adjusting to diabetes takes time, and dealing with it is a daily challenge. It is important to remember that every family is different and manages in different ways. The diabetes team should routinely assess how the child and family are coping.

Strategies to help the child and their family cope with diabetes:

- Encourage the family to learn about diabetes.
- Encourage the family to share their diabetes knowledge with family and friends to engage support.
- Depending on their age and capability, encourage the child to become involved in some of their care.
- Encourage the child to talk to others with diabetes – children often benefit from participating in a support group or camps for children or teens with diabetes.
- Encourage the child to talk about their feelings.
- Encourage the parents to be positive.
- Once settled into a routine, encourage parents to try to re-focus on their child as a whole person - not just on the diabetes.

For further reading please refer to Chapter 15, *ISPAD Guidelines* 2009

12 DIABETES AND ADOLESCENCE

- Adolescence is a challenging period that brings many changes to the young person's life - physically, psychologically and socially.
- Adolescence and diabetes can be an uneasy mix, with diabetes seen as an interference. The required routine interrupts freedom and spontaneity. Young people may worry about what the future with diabetes holds for them and very often require additional support and advice. Difficulties may manifest in various ways, including acting out, rebellion, risk-taking behaviour, and burn-out, and there is an increased risk of depression and eating disorders.
- As adolescents assume increasing self-care and responsibility for their diabetes management, it is important for parents to take less of the initiative and assume a more secondary supporting role. Giving too much responsibility to children too early is a common mistake, however, not giving appropriate responsibility as young people become more independent can also cause problems. When the young person's self-care is inadequate, parents and family members may need to step in and supervise diabetes care once more.
- Diabetes camps and other group work targeting coping skills have been shown to have positive effects on regimen adherence, quality of life and glycaemic control.
- Young people may also receive, and rely on, considerable support from their friends. Having a friend attend re-education sessions and clinic visits with the young person with diabetes may encourage acceptance, and adherence to diabetes management.
- Alcohol consumption can increase the risk of, and make it difficult to recognise the symptoms of hypoglycaemia. It can also cause vomiting and dehydration which may lead to DKA.
- Transition to adult care - All over the world, many youth with diabetes are lost to care for a period when transitioning from a paediatric to an adult clinic. It is crucial that every diabetes service finds effective local solutions for this problem.

For further reading please refer to Chapter 16, *ISPAD Guidelines* 2009

DIABETES AND SCHOOL

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- It is normal for parents to feel anxious about sending their child to school following the diagnosis of diabetes. The child is also likely to feel anxious about returning to school and about feeling different. With appropriate planning and support, the child can participate safely in all school activities and have a productive and fun time at school.
- Parents/guardians have a responsibility to advise the school of their child's medical condition and particular requirements for the management of their child's diabetes. Most schools are very supportive. However, communicating clearly with the school and the child's teachers is vital. Parents should be advised to keep information concise.
- A simple individualised management plan should be developed as a guide to the school staff for managing the child at school. Education may be given by the parent or a diabetes educator.
- Younger children require additional assistance and supervision in the school setting as they face a range of tasks and problems that are beyond their level of cognitive development.
- It is important that school staff be aware of the risk of hypoglycaemia - symptoms, immediate treatment and possible re-treatment - and that appropriate hypo treatment is with the child at all times. Teachers need to be aware that school performance is affected by low glucose levels.
- Children may need to test their blood glucose prior to, during and after physical activity and be alert for signs of hypoglycaemia and receive immediate treatment. Children also may need to take insulin at school and are entitled to appropriate help in doing this.
- Should a high blood glucose level (>15mmol/l) occur, the child should be encouraged to drink water and may need to pass urine more frequently. Parents should be contacted by phone.
- Preparation for exams may be required such as taking the meter and strips into the room, carrying a hypo kit, and water being readily available.

14 DIABETES AND PREGNANCY

Counselling from mid-puberty should include culturally sensitive discussion on contraception and the effects of diabetes on a pregnant mother and her baby.

- Girls with diabetes should be made aware that poor diabetes control around the time of conception markedly increases the risk of serious complications during pregnancy, both for the mother and the child.
- Unplanned pregnancies should be avoided as tight blood glucose control is ideally needed from before conception to after delivery.
- For planned pregnancies, diabetes should ideally be monitored by an experienced team from pre-conception throughout the pregnancy. Establishing good blood glucose control from as early in the pregnancy as possible will reduce risks of complications during delivery and following the birth.
- For patients with type 2 diabetes, metformin and sulphonylureas may be continued during pregnancy, but for many youth, insulin will be required to maintain optimal glycaemia and decrease risk for early congenital malformations and foetal macrosomia. Other oral agents should not be used during pregnancy.

For further reading please refer to IDF Global Guideline on Pregnancy and Diabetes

OTHER TYPES OF DIABETES IN CHILDREN, INCLUDING TYPE 2

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Type 2 Diabetes

- Type 2 diabetes is characterised by insulin resistance (the insulin produced works less effectively) and often also insufficient insulin production. It is increasingly being seen in children, particularly older children who are overweight and inactive, who have a family history of type 2 diabetes or in those who are of particular ethnic backgrounds where type 2 in adults is very prevalent.
- Children with type 2 diabetes usually lack the antibodies seen in type 1 (although there can be overlap between the two conditions). They commonly have acanthosis nigricans (thickened and darkened skin at the base of the neck and in the axillae). Other features of the metabolic syndrome may also be present.
- Even with the onset of type 2 diabetes, many people do not have the dramatic symptoms compared to those with type 1 diabetes. However, type 2 diabetes can sometimes present with severe symptoms and signs including dehydration and ketoacidosis – like type 1 diabetes. This has been reported in up to 25% of type 2 presentations in young people and requires management as in type 1 – see Chapter 2.
- Type 2 diabetes often responds initially to a healthy eating plan, appropriate exercise and weight reduction, but frequently oral hypoglycaemic medicines such as metformin are needed, and then later, insulin may be required.

For further reading on diagnosis and management please refer to Chapter 3, *ISPAD Guidelines* 2009

Other rarer types of diabetes occur, including

- The imperfectly understood entities of **malnutrition related diabetes and fibrocalculous pancreatopathy** also occur in some countries in the developing world. Fibrocalculous pancreatopathy usually presents with abdominal pain and calcification of the pancreas is evident on X-ray or ultrasound
- Some forms of diabetes do not neatly fit type 1 or type 2 - **"atypical diabetes"**
- Neonatal Diabetes (presenting in the first six months of life) results from the inheritance of a mutation or mutations in a single gene (monogenic diabetes). If this is suspected, genetic testing should be undertaken because it may influence management. This testing can be done free of charge (except for shipping costs) through centres in the U.K. and elsewhere.

For further reading please refer to Diabetes Genes and Chapter 4, *ISPAD guidelines*

- **Monogenic diabetes outside the neonatal period** (previously called Maturity Onset Diabetes of the Young (MODY)). There is often a strong family history of diabetes.
- **Gestational diabetes** can also occur in pregnancy in younger women

IDF LIFE FOR A CHILD PROGRAM

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The International Diabetes Federation "Life for a Child" (LFAC) Program was established in 2001. Program partners include Australian Diabetes Council and ISPAD. The program supports diabetes centres in the under-resourced world that care for children and youth (up until the age of 26 years). The type of support provided varies according to expressed needs and the program's resources. Centres are welcome to contact the program to discuss whether help could be provided – for further reading refer to: www.lifeforachild.org

The LFAC website has a section displaying diabetes resources in various languages used in the developing world. Information is available for children, youth, parents, health professionals, and teachers – for further reading refer to: Life for a Child Education Resources.

Disclaimer

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ISPAD
International Society for Pediatric and Adolescent Diabetes

LIFE FOR A CHILD
an International Diabetes Federation Programme

International Diabetes Federation