ISPAD Clinical Practice Consensus Guidelines 2022:

Management of the child, adolescent, and young adult with diabetes in limited resource settings

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WHAT IS NEW OR DIFFERENT

This chapter provides updated and consolidated guidance on providing best-possible care to children, adolescents, and young adults with type 1 diabetes (T1D) and type 2 diabetes (T2D) in widely varying situations when human and medical resources are acutely or chronically limited for any reason.

Management of T1D should be as physiological as possible even in limited resource settings (LRS), to improve care and decrease morbidity and mortality. These recommendations are not aimed at endorsing suboptimal care, but at improving care by making the best possible use of available resources, while constantly endeavoring to reach the next level.

EXECUTIVE SUMMARY AND RECOMMENDATIONS

The child, adolescent and young adult with diabetes should receive optimal care according to the principles and recommendations described in the ISPAD 2022 Consensus Guidelines (ISPAD 2022 CPG) respective chapters (See Appendix 1) as far as possible.

The following recommendations (and suggestions) give various options and guidance to provide best possible care when resources are limited, with the acknowledgement that conditions may vary from place to place, within the same place depending on finances and facilities, and even from time to time. These recommendations have relied heavily on expert opinion.

Introduction

- Suboptimal care of the young person with diabetes (PwD) remains common, even though outcomes improve significantly with awareness and diabetes education.  
- Diabetes management is recommended to be as physiological as possible, maximizing quality of life (QoL), preventing acute and chronic complications, and allowing proper growth and development. A
- All PwD should have access to basic diabetes care supplies, including insulin and blood glucose level (BGL) monitoring devices, and diabetes education. The increasing availability and decreasing costs of various insulins and glucometers, as well as increasing communication due
to improving technology has lowered the cost of basic diabetes care and made it more accessible. E

• In LRS, co-existing poverty, low rates of literacy, family or community conflict, uncertain safety, discrimination and stigma makes families with PwD more vulnerable. E The T1D Index attempts to quantify the impact in different regions. E

• To confidently provide the maximal level of care possible within the resources available confidently, it is beneficial if all members of the diabetes care team (DCT) share the same goals and approaches to care. A

• In all LRS, it is desirable that health care professionals (HCP) be aware of support available locally, nationally, and internationally; from the government and non-governmental organizations (NGOs). E

• It is suggested that HCP working in LRS be aware of the latest low-cost diabetes technology and therapy available. E

Diagnosis, epidemiology, classification, and stages of type 1 diabetes

• Diagnostic criteria for all types of diabetes are based on symptoms and laboratory measurement of BGL. If BGL testing is unavailable, diabetes can be provisionally diagnosed if classical symptoms are present, and urine has high levels of glucose and ketones. E

• Registries and data in LRS are scarce, hindering adequate policy decisions and action. It is suggested that steps be taken for improving availability of data. B

• Measurement of islet autoantibodies, C-peptide or genetic tests is not routinely recommended for diagnosis of T1D. They may be selectively done if diabetes type is unclear. E

• Diagnosis of monogenic diabetes by genetic testing is becoming more available and affordable. A

• Individuals with a first degree relative with T1D have ~15-fold increased relative risk of developing T1D. A BGL testing in symptomatic relatives may be helpful for early diagnosis. B

• Screening and diagnosing pre-symptomatic diabetes (stages 1 and 2) may not be feasible in LRS, but early diagnosis of symptomatic diabetes (stage 3) is strongly recommended for prevention of DKA, and reducing morbidity and mortality. A

Diabetes education
• Diabetes self-management education (DSME), initial and ongoing, is important for PwD and caregivers, wherever they live in the world. E
• Appropriate DSME improves glycemic, psychosocial as well as medical acute and chronic outcomes. E
• It is suggested that education resources be translated into local languages, be visual and tailored to literacy and age. C
• Training older role models (PwD and parents of PwD) is helpful for children in remote areas, as is group teaching at clinic. E A separate pediatric diabetes clinic is advisable. E
• Organized diabetes meetings and camps during weekends or vacations are helpful for education, reinforcement, reminders, and emotional support for PwD and family members. E

Insulin therapy
• Physiological insulin replacement with basal bolus regimen, delivered by multiple daily injections (MDI), is recommended, along with maximal self-monitoring of blood glucose (SMBG) possible. E
• Reasonable glycemic targets and QoL can be achieved using low-cost conventional insulins (Regular and NPH) and SMBG, though the analog insulins do offer advantages. B
• Pre-mixed insulins and two dose regimens are not physiological. They are associated with increased acute and chronic complications, offsetting financial benefits, if any. Hence, these are not recommended for management of T1D. E

Glucose monitoring
• Though glucose monitoring is expensive, achievement of glycemic targets is not possible without regular SMBG. A
• If the ideal of 6-10 BGL tests per day is not possible, at least pre-meals and bedtime BGL testing is suggested for determining appropriate insulin dosing and reducing nocturnal hypoglycemia. Testing 3-4 times on the same day, several days a week, may provide more information than a single daily measurement at different times. E
• BGL targets should be individualized: an increased lower BGL limit of 80 or 90 mg/dl (4.4 or 5 mmol/L) may be more practical in LRS to reduce the risk of hypoglycemia. E
• Target HbA1c for young people with diabetes should be <7.0% (<53mmol/mol) without frequent hypoglycemia or severe hypoglycemia (SH); A measured every 3 months. E
• Continuous Glucose Monitoring (CGM) should be used as frequently as possible, especially in pre-school children. A
• Intermittent use of CGM, i.e., once in every few weeks, may be done for better understanding of glycemic patterns and special situations, if constant use is not feasible. E

Nutrition
• Nutritional advice needs to be adapted to cultural, ethnic, and family traditions. E
• Pictorial teaching of portion sizes and carbohydrate counting of local foods, available on several websites, is helpful. E
• Food insecurity may worsen glycemia, increase acute and chronic complications, and cause several nutritional deficiencies. C
• Celiac disease (CD), dyslipidemia and hypertension need special attention. C

Exercise
• Exercise is a key part of diabetes management and must be encouraged in every PwD. A
• Adjusting insulin dosing and food intake to exercise safely without hypoglycemia is important. A
• Having food available is mandatory during and after activities, as needed. A Exercise should be avoided or minimized, if food is not available. E
• Where manual labor or sports are part of the daily routine, importance of SMBG and food availability should be emphasized. E
• Predictability and routine are of great value in avoiding exercise-related complications when measuring BGL is irregular. E

Hypoglycemia
• Hypoglycemia is common in LRS and is a major impediment to achieving optimal glycemia. A
• Education about hypoglycemia for family, friends, school staff, and colleagues is as important as for the PwD for timely prevention, recognition and management. E
• Revising hypoglycemia education at regular intervals and during special situations like sports is suggested. E
• Basal bolus MDI insulin regimens are more amenable than premixed or fixed dose insulin regimens to prevent hypoglycemia, especially if food insecurity is present. E
• Glucagon can be lifesaving and is recommended to be a part of WHO’s Essential Medicines List (EML). E
• Glucose paste or gel, honey, or other such sugar source applied sublingually or on the buccal mucosa could be lifesaving. E
• Availability of health care centers and emergency responders where intravenous (IV) glucose can be given for SH is suggested. E

Sick day management
• Brief and easy-to-understand pictorial education material in the local language(s) on how to manage diabetes during intercurrent illnesses is suggested. E
• During an illness, monitoring BGL at least 3-4 hourly, and blood or urine ketones 6-8 hourly is a minimum requirement. Insulin should not be stopped; hydration should be maintained with salty or sweet liquids based on BGL. C
• It is important for PwD in rural and remote areas to have close contact with their DCT during sick day management. E

Diabetic ketoacidosis
• DKA may be more common in LRS, due to inadequate awareness, inadequate diabetes education, misinformation, and barriers to access to care. C
• Mild and moderate uncomplicated DKA can be treated with subcutaneous (SC) Regular insulin or rapid-acting insulin analogs. This can be done at the nearest peripheral health set-up, with virtual consultations with an expert. B
• Written instruction sheets for peripheral health workers regarding the management of DKA may be useful, where families may not have access to expert HCP. E
• Incidence and severity of hypokalemia and hypoglycemia may be higher in malnourished children during DKA management. C

Psychological care
• It is important to recognize psychosocial issues like diabetes distress, eating disorders, depression in PwD and key caregivers. E
• Inflexible treatment regimens, inadequate or inappropriate DSME, frequent complications like hypoglycemia, and financial distress worsen these conditions. E
• Positive tone of the DCT, non-stigmatizing words, diabetes peers’ support and effective DSME help improve psychological status. E
• Telemedicine may improve access to appropriate mental health support for PwD and caregivers. E

Very young (preschool) child
• Diabetes management is more challenging in very young children. C
• Early recognition of symptoms is paramount, as symptoms like increased thirst or urinary output are easily missed. C
• DKA may be mistaken for other common illnesses such as gastroenteritis, respiratory infections, urinary infections, and malaria. C
• MDI regimens with long-acting analogs as basal are suggested, depending on supply and affordability. E
• Multiple BGL testing and even CGM are recommended, based on feasibility. E

School
• Every child with diabetes has the right to receive an education, wherever they live globally. E
• It is desirable that school staff be educated by parents and DCT members, either by outreach visits or virtual meetings; and the child supported, for safety and efficacy. E
• An individualized Diabetes Management Plan (DMP) for each child is encouraged. E
• Testing BGL, taking insulin, taking extra calories when needed, and other diabetes care activities should be permitted and supervised by school staff. E
• It is desirable for school staff to know how to prevent and manage hypoglycemia, hyperglycemia, and other emergencies. E
• Even in places without special laws for PwD, comprehensive legal protection for children incorporating supervision of diabetes management at school is desirable. E

Adolescence
• Adolescence and T1D may be a challenging combination especially in LRS, where social taboos, discrimination, financial constraints and lack of adequate medical facilities further impede the delivery of care. E
Psychosocial support is essential, by the DCT, and by role models and peers, particularly for PwD living in remote areas. E

The greater glycemic variability, need for more frequent SMBG, higher insulin doses, and screening for complications during adolescence, increase costs. It is desirable to proactively discuss these issues with the family. E

DSME at clinic, in group sessions, and at diabetes meetings and camps, along with diabetes role models is recommended to encourage and engage the young PwD directly, reducing isolation. E

It is desirable to proactively and sensitively discuss topics like menstruation, contraception, smoking, driving, alcohol, and other substance abuse. E

**Microvascular, macrovascular, other complications, and monitoring**

- Regular monitoring of growth, physical development, puberty is essential in all settings. C
- General examination, blood pressure, and inspection of injection sites and feet for cracks and calluses is needed at every clinic visit. C
- Thyroid status monitoring with TSH at diagnosis of T1D and then every 1-2 years is needed, along with monitoring for growth, puberty, and goiter. B
- Screening for other comorbid conditions (like CD) is performed as needed, available and affordable. E
- Baseline and regular screening to prevent micro- and macrovascular complications is cost-effective in the long-term. E
- Screening for nephropathy, retinopathy, neuropathy, dyslipidemia need to be done to the extent possible, especially if glycemic management is suboptimal and medical or family history is unfavorable. E

**Fasting**

- PwD in LRS may opt for fasting because of various reasons. E
- Fasting is permissible if glycemic status is optimal, hypoglycemia awareness is present, frequent BGL monitoring is feasible, with willingness to break the fast without penalty when hypoglycemia, ketosis or dehydration occurs. B
- Insulin doses and schedules should be adjusted as per the rules and duration of the fast. B
• In religious fasting, all religious authorities recognize the need for ‘not-fasting’ if fasting would endanger the health of the PwD. This can be emphasized to the PwD and family to remove guilt. E

Surgery
• Insulin must be administered to all persons with T1D during and after surgery, to avoid ketosis/DKA. A
• Surgery is to be preferably done where possibility to administer IV fluids, at least minimal laboratory support, and experienced staff are available. E
• Elective surgery is suggested to be done at a time of optimal glycemia. E

Type 2 diabetes
• T2D is increasing with the obesity pandemic, though some ethnic groups may be non-obese. B
• Socioeconomic status (SES) has large measurable associations with T2D, with the fastest rise of youth-onset T2D in low SES groups in Europe and USA. B
• Cultural, social, geographic, and economic barriers may be present to implementing behavioral change. These social determinants of health impact onset, prognosis and course of T2D. Prescribing lifestyle modification in the life context of the youth and family is desirable. E
• Treatment planning should consider household food security, housing stability and family financial resources. E
• Metformin is the initial therapy of choice. A If HbA1c is >8.5% and ketones are present, long or intermediate acting insulin is needed initially. B If islet antibody testing is not available, evidence of insulin resistance (acanthosis, skin tags) and the course of diabetes may provide clues to the diagnosis and whether long term insulin is needed. E
• Youth with T2D should be screened for hypertension, dyslipidemia, liver dysfunction and sleep apnea as well as psychological co-morbidities including depression, diabetes distress, and disordered eating, at diagnosis and on follow-up. B

Language matters
• It is desirable that the DCT members be careful about educating the family avoiding use of stigmatizing words which promote negativity. These include, but are not limited to, words and phrases such as ‘suffering from diabetes’, ‘sick child’, ‘diabetic child’, ‘other normal children’, ‘poor control’. E

INTRODUCTION

In many parts of the world, especially south-east Asia, Africa and South America, T1D may be undiagnosed and untreated, or sub-optimally managed, with early mortality and frequent acute complications. Most of the available global T1D data is from developed countries, not from LRS. The T1D Index seeks to fill this lacuna by assessing, using mathematical modelling, the decades of healthy life years lost to T1D. Similarly, youth-onset T2D is also increasing, in parallel to the obesity epidemic.

HCP in LRS may feel overwhelmed by best practice recommendations given in the international guidelines, which may not be possible to follow due to limited availability of diabetes care supplies, trained personnel, community awareness and support, and government policy recognition. They can follow these guidelines, without feelings of guilt or inadequacy, to provide best possible care given their circumstances, while trying to improve level of care.

Economic constraints due to the high, recurring costs of diabetes care, and lack of government aid and insurance support puts the onus of care on the family. Indirect costs such as travel to clinic, or taking leave from work, may further reduce families’ ability to access care and supplies. With costs usually paid out of pocket, the individual family’s ability and willingness to spend determine quality of care.

Societal conditions like large families, taboos and discrimination, low literacy and low numeracy add further challenges. If disease, war, terrorism, or natural disasters occur, their impact on an already constrained situation is much more severe.

Resource constraints, poverty, and illiteracy (reading and numeracy) may also be present in many regions of high-income countries (HIC). Therefore, rather than discussing specific countries, these guidelines focus on what can be done in settings where there is variable, suboptimal access to diabetes care supplies (including insulin, monitoring systems, technologies), trained personnel, and/or food insecurity and other constraints.
Depending on the resources available, the helpful concept of ‘minimal, intermediate and comprehensive levels of care’ developed by Ogle et al., has been adapted and used in this Chapter (Table 1). This stratification can assist government policy makers, professional health planners, community advocates, and HCP.

This guideline is, therefore, NOT an endorsement of suboptimal care or commitment. Rather it discusses options and guidance to provide best possible care within whatever limited resources are available, while encouraging all families, HCP, communities, advocates, and governments to strive for the next level of care. The guiding principles are to encourage developmentally appropriate self-reliance and diabetes care, embedded in a relationship of trust and motivation between the HCP and the PwD.

ISPAD strongly advocates and encourages:

- Optimization of diabetes management with the given resources, while striving for improvement in level of care,
- All communities to provide opportunities and avoid discrimination,
- Training of school personnel and other caregivers,
- Governments, medical agencies and insurance providers to facilitate care and prevention,
- Non-profit organizations and support groups to work for the cause of T1D.

In LRS, the PwD may have to seek care from ‘diabetologists’ familiar with adult T2D management, but not with growth and development; or pediatricians unfamiliar with diabetes care; or general physicians, unfamiliar with pediatric diabetes care and pediatric issues. The resultant increased risk of acute and early chronic complications, reduced schooling and socializing opportunities, and reduced ability to work and earn, inflict preventable suffering and costs, and early death.

Fortunately, expertise and awareness among HCP are increasing. In every country and region, more governmental organizations and NGOs are providing supplies and psychological support. ISPAD’s own advocacy and educational efforts include worldwide easy online access to a host of teaching material, including these guidelines, and links to resources from other organizations.

DIAGNOSIS, EPIDEMIOLOGY, MONOGENIC DIABETES

*Whenever possible, follow the guidelines detailed in ISPAD 2022 CPG Chapters 1 and 4 (Appendix 1).*
In geographical areas where the known incidence of T1D is low, the rate of DKA at presentation is higher, due to lack of awareness and delayed or misdiagnosis. HCP should be aware of the need to check BGL and suspect diabetes in any child presenting with weight loss, lethargy, thirst, excessive urination, abdominal pain or persistent/ recurrent infections. In all children with hyperglycemia, initially the diagnosis of T1D should be considered and insulin provided, where symptoms are clear.

The proportion of T1D, T2D and other types of diabetes varies markedly between countries and ethnicities. Measurement of islet antibodies, C-peptide or genetic tests may not be routinely available or affordable in many parts of the world, and need not be done for classical T1D. They may be useful in regions with a higher proportion of T2D, especially in adolescents with obesity, markers of insulin resistance, and/or strong family history. Often the clinical course also helps distinguish T1D from T2D.

Advantages of genetic testing, and scenarios which arouse suspicion of monogenic diabetes, are discussed in ISPAD 2022 Consensus Guidelines Chapter 4 (Monogenic Diabetes). Infants under 6 months with diabetes (Neonatal Diabetes, NDM) may especially benefit. It is useful to know that some academic centers around the world offer these genetic tests free or at a low cost, which can be availed if required.

**STAGES OF TYPE 1 DIABETES**

*Whenever possible, follow the guidelines detailed in ISPAD 2022 CPG Chapter 2 (Appendix 1).*

Detection of Stages 1 and 2 (islet antibodies positive but presymptomatic) using extensive genetic and antibody testing of the PwD and family members may not be feasible in LRS. If the diagnosis of T1D is evident clinically, antibody and C-peptide testing are not routinely indicated, unless opportunities to participate in an ongoing prevention trial are locally available.

However, early diagnosis of Stage 3 diabetes (hyperglycemia) is useful to prevent DKA. Therefore, strategies which increase awareness of diabetes amongst HCP and communities have the chance of earlier diagnosis before DKA develops. This may be easily possible in family members and near relatives. Reduction in incidence and severity of DKA means less hospitalization, reduced cerebral edema and other immediate morbidities of DKA, reduced parental anxiety, reduced long term morbidity, and minimal mortality.
DIABETES EDUCATION

Whenever possible, follow the guidelines detailed in ISPAD 2022 CPG Chapter 6 (Appendix 1).

The several daily tasks of self-management, including BGL testing, taking insulin injections appropriately as well as adjusting doses, managing food and physical activity levels, require proper knowledge of diabetes. This is feasible if DSMS is imparted right from the beginning and reinforced consistently. DSME is needed not only for the family of the PwD but other caregivers (e.g., school teachers, sports coaches, nursery/creche staff, friends’ parents) as well. A person-centered, self-empowering approach should be encouraged.

Local beliefs, myths, and previous experiences (e.g., T2D or T1D in the family) influence the way parents and caregivers accept the diagnosis and management plan. An effective way to handle myths, as well as improve acceptance, is to introduce the newly diagnosed family to peers who understand diabetes well. Meeting others their own age and SES, who have experienced the initial trauma and are facing the same challenges, can markedly improve acceptance and hope. Many families in LRS rely on local/alternative medicines/therapies and it is common for them to explore these options in the search for a cure. Clear explanations at diagnosis are desirable to avoid the catastrophe of missed insulin.

In each center, it is desirable to develop a culture- and age-appropriate basic structured program, with periodic review, using educational material in the language the family is comfortable with. Visual aids such as diagrams, pictures, comics, kids’ diabetes education pamphlets/booklets, and videos, are useful, especially for those who are illiterate.

An multidisciplinary team of pediatric endocrinologist, dietician, diabetes educator and mental health specialist, all familiar with pediatric diabetes is not likely to be available in LRS. The local physician is encouraged to provide all these aspects of care. However, physicians with just a few PwD in their care, often cannot spare the time needed to learn, understand, and then teach pediatric, adolescent, and young adult diabetes care to individual families.

Education can be supplemented, thanks to the widespread availability of mobile phones, by telemedicine. During the Covid pandemic, this became widely accepted globally, making it easier to access care from experts and improve training and education. The primary pediatrician/physician, particularly if living in a remote area with little or no access to quality diabetes care and education, can coordinate care with expert centers.
Interactive web-based resources, apps on smartphones, text messaging for information, are useful for young people, who are naturally attracted to technology. With a sizable number of people searching online for health-related content, such content is created by health professionals, lay persons, not-for-profit and commercial organizations. The treating HCP is encouraged to verify content, ensuring it is culturally sensitive and appropriate to the family’s literacy level.

Contact with self-help groups and/or local or international charitable organizations at diagnosis helps provide emotional, financial and logistical support. Experienced family members of PwD or PwD themselves can help bridge this deficiency of formal diabetes educators. Training them further and using their help to spread DSME can be practical, feasible and very effective.

The level and content of diabetes education is ideally individualized based on:

- Age
- Interest, level of motivation, family support
- Stage of diabetes
- Literacy, numeracy, language, culture
- Maturity, learning pace, degree of independence and self-motivation
- Availability of basic facilities (insulin, refrigeration, BGL monitoring strips, meters and batteries, lab tests)
- Extent to which technology is available.

Teaching also needs to change over time, as the child/young person matures (or for a while, rebels), or if situations change (changes in financial status of family, changes in the medical center, migration, connectivity, war, terrorism, local disasters).

It is important for the DCT to ensure that the family is able to access adequate supplies for sustainability. To fill affordability gaps, low-cost conventional insulins (vs. analogs), delivery systems (e.g., vials and syringes vs. pens), and glucometer strips can be advised. The family may also need guidance on where to buy supplies, and/or which organization to contact for support. Prescribing expensive insulins or glucometers may force the family into rationing or missing insulin doses or BGL testing. Reducing SMBG can be a major problem, especially in the initial months, when the child transits from the initial high insulin needs, to the honeymoon phase (risk of hypoglycemia), and then back again to higher dose needs (risk of DKA).
After the initial survival skills have been taught, the DCT/educator must maintain daily/frequent contact with the family (if required, by tele- or video-calling), to help with the initial diabetes management.

To sum up, appropriate DSME imparted at diagnosis and reinforced regularly, establishes and maintains positive attitudes to diabetes care, while countering and overcoming myths and beliefs.

Regular follow up is best encouraged by making the clinic visit as useful and interesting as possible. It is wise for the DCT to show interest in the young person rather than focusing only on diabetes. It is useful to develop a specific clinic time for T1D families. The waiting area provides a good opportunity to introduce parents/caregivers and PwD to one another, encouraging them to interact. This strengthens the support groups as well. Innovative ways to utilize waiting time with games and quizzes which impart diabetes education can be encouraged. Funds may need to be arranged for families which cannot afford the travel to the clinic.

**INSULIN THERAPY**

*Whenever possible, follow the guidelines detailed in ISPAD 2022 CPG Chapter 9 (Appendix 1).*

The goals of therapy for LRS are no different from well-resourced situations, although it must be acknowledged they are much more difficult to achieve because of the limitations discussed. While many compromises may be needed, some are unacceptable, e.g., using premixed insulins and 2 dose regimens.

*Choice of insulin and insulin regimen*

All children and adolescents with T1D should be started on basal-bolus regimens with MDI, using the much cheaper conventional (Regular and NPH) (or analog insulins if affordable and available). The price of biosimilar glargine is close to that of conventional insulins in many regions, making it a feasible option for governments or donor agencies to procure.44 This is useful in reducing nocturnal hypoglycemia and improving HbA1c.45 Basal needs are provided by NPH or glargine; bolus needs by Regular insulin given before each meal and large snack i.e. 3-4 times a day. This ensures that insulin cover is available whenever carbohydrates are consumed. These regimens lessen postprandial and nocturnal hypoglycemia and hyperglycemia, improve QoL, and enable normal study and work.46
Examples of basal bolus regimens:

1. NPH is given once daily (before dinner or at bedtime), with Regular Insulin given before breakfast, lunch, dinner and any large snack (e.g. the substantial meal with carbohydrates most children eat in school). The child can take the school bolus dose one period before the mealtime break, to ensure the 30-40 min gap needed before eating.

2. NPH is given twice daily: before breakfast and at night, while Regular Insulin is given before each major meal/ large snack, as above. NPH and Regular insulins can be mixed in the same syringe for the morning and night dose, reducing the number of pricks.

3. Glargine is given once daily (either morning or bedtime), with Regular insulin boluses, as above.

Premixed insulins and 2 dose regimens are still used in many LRS and elsewhere, but they are non-physiologic and not recommended in T1D. The use of pre-mixed insulins limits individual tailoring of insulin doses, leading to higher rates of hypoglycemia, SH, hyperglycemia and DKA. This is worsened by the limited ability to test BGL frequently in LRS. In situations of food insecurity, dangerous hypoglycemia can occur. In some parts of the world, donors may provide only premixed insulin. Since the cost per unit of insulin of Regular Insulin, NPH and pre-mixed insulins is similar, donations of Regular and NPH insulins should be insisted upon.

Similarly, the twice-daily split-mix regimen is not appropriate for T1D. The mid-day meal does not get adequate insulin cover, resulting in evening and pre-dinner hyperglycemia. Post-breakfast hypoglycemia can occur, especially in school when the parents are not able to adequately monitor, and impair the child’s ability to study and play. The risk of post-dinner and nocturnal hypoglycemia is high. With food insecurity, hypoglycemia may become dangerous. These glycemic swings occur even with very strict discipline in food amounts, timing and exercise, which is usually impractical. The adverse impact is worsened by the limited capacity for SMBG.

The resultant increased glycemic variability, with symptomatic and asymptomatic glucose disruptions at home, overnight, in school, and during activity, is associated with worse short-term outcomes, and reduced QoL. Ultimately more long-term diabetes complications also occur.

Over the years, the prices of insulin have come down and availability has improved because of increased production, especially of biosimilars. The lower cost of biosimilars has made many insulin regimens
more affordable. The choice of insulin and insulin regimens should be individualized, based on the PwD’s:

- Age, lifestyle and routine
- Affordability, motivation and family support
- Food availability
- General health and presence of other disorders
- Ability for self-management
- Hypoglycemia awareness.

Additional factors in LRS include:

- Consistent availability, cost of insulin
- Refrigeration issues, with uninterrupted supply of electricity
- Access to SMBG/ CGM
- Food insecurity
- Social and financial circumstances
- Access to health insurance or other institutional support.

Whichever insulins and regimen are chosen, support by comprehensive DSME, appropriate for the age, maturity, and individual needs of the PwD and family, is needed. The chosen insulins must always be available in sufficient amounts, with consistent quality and type, and adequate cold chain maintenance. The requirements should be discussed and reviewed periodically with the family.

Since insulin vials and syringes are the cheapest option, they continue to be the most common method of insulin administration. Hence education regarding appropriate syringes (U40 vs. U100, shortest needle length of 6mm) and techniques for mixing Regular and NPH insulins is important. In some countries, conventional insulin vials are available in both concentrations - U40 (40U per ml) and U100 (100U per ml), which can be a source of error in dosing. Though U100 insulin causes less pain on injection, families and donor agencies may prefer U40 insulin for several reasons - if paying out-of-pocket (lesser cost per purchase), if lacking access to regular refrigeration (insulin used up sooner), or if 0.5U increments needed, e.g., for a small child. The U40 syringes have 1U increments so 0.5U can be given, cf. the 1 ml U100 syringes
which have 2U increments. The DCT should teach and reinforce matching the insulin vial with the corresponding insulin syringe. The syringes may be used 3-6 times if proper care and asepsis is maintained.

Dosing errors with pens tend to be fewer than with syringes, and pen needles of 4mm length are available. Needles of 4mm length are especially important in the under-nourished child. Therefore, if available and affordable, insulin pens with 4mm needles should be considered, especially if dosing or numeracy errors persist.

**Insulin Storage**

While insulin manufacturers’ advice for storage of insulin is at 2-8°C, maintenance of cold chains may be challenging in LRS. Daily temperatures could reach as high as 45-48°C, which affects insulin stability. Insulin should be purchased from reliable pharmacies, and insulin in use kept cool, preferably in a refrigerator, especially in the summer months.

Many families may lack access to regular refrigerators or electricity. In these situations, methods such as double-layer clay pots (Fig 7), goat skin, acrylate polymer bead wallets, etc. have been devised to store insulin at temperatures below 25°C. Kept in a shaded, airy place, they work well if humidity is low. Alternatively, insulin can be stored wrapped in plastic, in a thermos flask, along with 3-4 cubes of ice, which are replaced when they melt.

![Figure 7: Clay pot (courtesy Dr Archana Sarda)](image)

Vials and cartridges of insulins are usually advised to be discarded after 4-6 weeks of opening as per the manufacturers’ instructions. This may lead to significant insulin wastage. To avoid this, anecdotally many
centers use insulins for longer than 4-6 weeks, increasing the dosage as needed, and teaching the family the need to reduce the doses each time a new vial or cartridge of insulin is opened.\textsuperscript{53-56}

\textit{Sharps Disposal}

Diabetes care inevitably generates sharps - whether for insulin administration or SMBG. It is important that families are taught safe disposal. The discarded sharps are to be stored in a thick, puncture-proof plastic container with a tight-fitting lid, and carried to the health center or laboratory for safe disposal. It must be emphasized and reinforced that sharps must never be disposed of in the general garbage.\textsuperscript{57}

\textbf{GLUCOSE MONITORING}

\textit{Whenever possible, follow the guidelines detailed in ISPAD 2022 CPG Chapters 8 and 16 (Appendix 1).}

It is crucial that treating physicians as well as families with PwD are aware that SMBG is an integral part of T1D management. Regular glucose monitoring, several times daily, whether using fingerstick capillary blood tests, or CGM (real-time) if available, is essential for management of diabetes.\textsuperscript{58,59}

Unfortunately, test strips are expensive and may be unavailable or unaffordable in LRS. Local and/or international NGOs increasingly assist with this. Lobbying to achieve favorable government policies to make SMBG supplies available to all is important.

If availability of test strips is scarce, so rationing of testing is needed, it may be an option to check BGL a few days every week (maybe, every alternate or third day, or 2-3 consecutive days in a week). Keeping the meal and exercise pattern consistent throughout the week is helpful in these situations. Thus, if only 25-30 strips per month are available to the family, a 7-point BGL profile done once a week on a working/school day, can help discern patterns so the doses/ time/ activity/ diet can be planned accordingly on other days also, with the guidance of the DCT. Monitoring on other days is then done as per individual need, e.g., for unexpected exercise, or when hypoglycemia is suspected. One BGL test a day at different times is less helpful in guiding dose adjustments, though it may help in prevention of hypoglycemia. Doing a 6-8 point profile on the same day, as often as possible in a week, may be more useful.

PwD are advised how crucial it is to maintain a record of the BGL, along with the food eaten and exercise undertaken. Analysis of these logs by the family themselves, discussed during each and every clinic visit,
enables understanding and self-adjustment of insulin doses, food and activity, to improve management of diabetes and QoL.

It is common in all settings, for adolescents in particular, to enter falsified/ fabricated BGL. A non-judgemental, problem-solving approach to such situations may be helpful.

**Continuous Blood Glucose Monitoring Systems (CGMS)**

CGM has transformed diabetes care in recent years. In many LRS, CGMS are unavailable or unaffordable, as constant use may cost 3-10 times more than SMBG. However, when comparing costs, if the savings on multiple BGL test strips, the potential prevention of acute and chronic complications, and the prevention of hospitalizations is factored in, the cost difference is considerably less. Improvement of QoL must also be emphasized by DCT and communities lobbying for governments’ support in this regard. Regular CGMS use was shown to reduce HbA1c by 0.98% even in LRS. The technology is rapidly evolving, including opensource apps which allow for calibration on smartphones, and improved accuracy. Where constant use cannot be afforded, intermittent use of CGMS every few weeks may be considered. It is desirable that the DCT keeps abreast of technology changes and explore options with the PwD and families.

**GLYCEMIC TARGETS**

*Whenever possible, follow the guidelines detailed in ISPAD 2022 CPG Chapter 8 (Appendix 1).*

Glycemic targets set by the DCT, especially the lower limit, depend on many factors, including age of the PwD, family circumstances, frequency of BGL testing, access to technology, hypoglycemia awareness, and level of caregiver involvement. If the number of test strips is limited, advocating the lower BGL target as 80 or 90 mg/dL (4.4 or 5 mmol/L) may be more desirable than 70 mg/dL (4 mmol/L), to reduce hypoglycemic episodes. For example, a rural family with poor literacy, able to only afford a few strips, and with little or no access to medical care in a crisis, or disinterested or both working parents, may be advised to maintain BG above 90 mg/dl (5.5 mmol/L).

The upper BGL target of 180 mg/dl (10 mmol/L) is suitable in LRS as well.

*HbA1c*
HbA1c continues to have a central role in assessing glycemia, and provides useful insights, especially where SMBG is not frequent. Availability of point of care (POC) HbA1c measurements can be especially valuable in clinics in remote areas, as it can be offered in special camps. Limitations of HbA1c and POC testing must be kept in mind. Anemia, common in LRS, and hemoglobinopathies may affect the result. ISPAD continues to recommend a target HbA1c of <7.0% without significant hypoglycemia, in most cases, though this may be difficult to achieve in some LRS. If the risk or incidence of hypoglycemia is high, due to limited availability of supplies, the targets may be modified.

It is important to negotiate acceptable glycemic target ranges with the family, and then be consistent between all HCP looking after the child. These may be renegotiated when circumstances change, e.g., if more test strips are available, or as the child matures and can manage better.

NUTRITION

*Whenever possible, follow the guidelines detailed in ISPAD 2022 CPG Chapter 10 (Appendix 1).*

Availability and affordability of food and the frequency of SMBG vary in LRS. Food insecurity, natural disasters, war, famine, and acute or chronic poverty adversely affect diabetes management. Food insecurity may be compounded by food inconsistency, inadequate SMBG, suboptimal DSME, and local suboptimal understanding, so the PwD may experience more frequent hypoglycemia and hyperglycemia, higher A1c levels, as well as nutritional deficiencies. Regular monitoring and recording of growth (height, weight, BMI), helps to detect obesity and malnutrition.

In LRS, nutrient deficiencies will need to be assessed (e.g., Vitamin D deficiency due to inadequate sun exposure, or B12 deficiency in vegetarians/vegans), necessitating supplements. Iron and folic acid deficiencies causing anemia are common in some regions; if local governments provide iron-folic-acid tablets in school, this is desirable for the PwD as well. Regular deworming may be needed according to the local protocols.

Local traditions, food culture, and food availability have to be assessed. Rather than providing fixed diet charts, practical modifications of pre-existing dietary patterns promote acceptance and psychological well-being. PwD eat the same foods as the rest of the family. Some PwD in LRS live in close proximity with multiple relatives, sometimes sharing a kitchen. Those preparing food may be grandparents or older aunts and uncles; where possible, they are encouraged to receive nutrition education.
Nutrition education starts with the basics of food composition and distribution. The plate method, with use of pictures (as in Figure 8), is an efficient tool to teach preparation of balanced meals as per local availability. The family is taught to include all macronutrients (complex carbohydrates, fiber, protein, fat and fluids) in desirable proportions, with affordable options. Pictures can be sent to mobile phones, and work even for rural families with low SES and/or poor literacy to include missing or inadequate macronutrients (often protein) in the right proportion.

Figure 8: Indian “thali” (plate), with balance of protein, fiber, carbohydrates, micronutrients. Half the plate has vegetables and fruits; quarter has complex carbohydrates, quarter has protein, with a side of low fat dairy, and water as a drink. [courtesy Dr Anju Virmani]

If a dietician familiar with T1D is unavailable, nutrition advice can be supplemented by telemedicine and virtual educational tools. Appropriate apps and educational material are available in many countries and languages, including the websites of LFAC, ISPAD, ChildrenWithDiabetes (CWD) and regional and national Diabetes Association websites, for visual carbohydrate counting.

Junk foods should be discouraged for the entire family, as for adults and children without diabetes. Carbohydrate rich festive foods can be permitted as a treat on special occasions and celebrations, in small portions, with extra insulin and activity. Foods labeled ‘diabetic’, ‘sugar-free’ or ‘fat-free’ do not offer any advantage, are expensive, and should be discouraged.

The diagnosis of CD necessitates dietary counseling to ensure a gluten free diet (GFD). Home cooking becomes more important as ordinary commercial foods are likely to be contaminated with wheat, and gluten free foods are expensive. Fortunately, in most regions, millets and maize are cheaper than wheat and rice, so if the additional effort of eating home cooked food with home ground millets is put in, a GFD is affordable.
Meal plans will need periodic adaptations according to growth progression, pubertal changes, adiposity, activity, and alterations in lifestyle (e.g., moving to college, job or marriage); seasonal events like harvest time; religious or national festivals; or change in the family circumstances or finances (e.g., one parent losing a job or the mother getting pregnant).

**EXERCISE**

_Whenever possible, follow the guidelines detailed in ISPAD 2022 CPG Chapter 14 (Appendix 1)._  

WHO recommends 60 min daily moderate to vigorous intensity physical activity (PA) for all children. Families may discourage PA because the PwD is perceived as being ‘ill’, and/or due to fear of hypoglycemia (FOH). They must be taught to manage PA safely, without hypoglycemia, by adjusting insulin doses and food intake, guided by SMBG. In some LRS, in crowded urban areas, or in unsafe regions, children and adolescents (especially girls) may be forbidden or unable to go out for active play. They can be encouraged to find alternative options indoors. On the other hand, the child/adolescent may need to do manual labor as part of the daily routine. Where manual labor is needed, stopping the PwD’s participation accentuates the feeling of being different and a burden: it can be encouraged with due adjustments.

PwD in any setting must be encouraged to always use footwear, protective if possible, while exercising and playing, especially in poorly maintained streets or grounds. Regular foot self-examination and at clinic visits, and appropriate care of wounds, is encouraged.

**HYPOGLYCEMIA**

_Whenever possible, follow the guidelines detailed in ISPAD 2022 CPG Chapter 11 (Appendix 1)._  

The sharp reduction in incidence of SH seen with greater use of SMBG, MDI, insulin analogs, CGMS, and pumps, has not occurred in LRS. Without optimal SMBG at home, school or work, the incidence and severity of hypoglycemia, especially nocturnal hypoglycemia, rises. SH can lead to cognitive impairment, especially in very young children, accidents and injuries, coma, convulsions, even death, including dead-in-bed syndrome. Nocturnal hypoglycemia becomes more difficult to detect and treat, and far more dangerous.
Therefore, hypoglycemia and FOH continue to be major hurdles in trying to optimize glycemia, especially in LRS. The major contributors to hypoglycemia are suboptimal SMBG, non-physiologic insulin regimens (twice-daily split-mix regimens and premixed insulins\textsuperscript{46}), errors in insulin administration, inadequate knowledge of insulin dose adjustments, food insecurity, excessive PA, non-disclosure of diabetes due to social stigma, and unawareness about the honeymoon phase. Food insecurity (e.g., a fixed, prescribed dose of insulin has been given, but food is insufficient or unavailable; or nocturnal hypoglycemia if the PwD goes to bed hungry) may engender a feeling of shame, and not be mentioned by the family, unless specifically asked for. Such issues need proactive handling with care and sensitivity. Delay in having a meal may occur in many circumstances, not necessarily due to poverty, and should be discussed during clinic visits.

Regular SMBG, including periodic 2-3 am BG checking (or CGMS if affordable and available), with adjustment of insulin doses, is key to prevent and treat hypoglycemia. The BGL diary should be discussed at each clinic visit. If conventional insulins are being used, education about resuspending NPH carefully, need for mid-meal and bedtime snacks, and daily SMBG, is regularly reinforced. If food insecurity is a possibility, education about insulin dose modifications, maintaining safety, and preventing hypoglycemia is reinforced. Checking overnight BG is encouraged, especially after excessive PA and reduced or delayed meals. In moderate hypoglycemia, sublingual application of glucose appears to work better than oral administration.\textsuperscript{25,67,68}

Management of SH can be particularly challenging in LRS, where glucagon is likely to be unavailable and/or unaffordable. When SH occurs, the PwD should be placed in a lateral position (to prevent aspiration), keeping the airway clear, and transferred immediately to the nearest healthcare facility for administration of 10% IV dextrose. Immediate access to health care facilities or trained personnel to detect and treat hypoglycemia may also be difficult, more so in remote areas. Anecdotally, a thick paste of glucose, sugar, honey, or other sugar source applied on the buccal mucosa, keeping the PwD in a lateral position, has been helpful many times. Innovations such as these, or keeping a cotton ball soaked in glucose/ sugar solution in the buccal cavity, have saved many lives in LRS.

HCP in peripheral health set ups may be unwilling to give IV glucose to a PwD. The DCT is encouraged to provide written documents for the family to give such HCP, giving simple, clear instructions for emergency management of hypoglycemia.
**SICK DAY MANAGEMENT**

*Whenever possible, follow the guidelines detailed in ISPAD 2022 CPG Chapter 12 (Appendix 1).*

DSME and simple written instructions for managing sick days at home; as well as for HCP in peripheral health set ups, are important. Families are advised and reminded about the importance of 2-4 hourly SMBG and at least 6 hourly ketone checking, with maintenance of hydration with salty fluids, particularly in remote areas or where local health facilities are inadequate. Blood ketone testing is more reliable and can be encouraged for those in remote areas; if that is not feasible, ketodiastix for urine ketone testing are inexpensive, and should be readily available.

Widespread use of mobile phones has made it possible to send simple instructions in local language(s) to the family, and enable them to contact the DCT quickly. Access to emergency contact numbers of DCT members is important.

**DIABETIC KETOACIDOSIS**

*Whenever possible, follow the guidelines detailed in ISPAD 2022 CPG Chapter 13 (Appendix 1).*

In LRS, DKA is likely to occur more frequently (particularly at diagnosis). With infections predominating in LR scenarios, clinical mimics are gastroenteritis, respiratory infection, urinary tract infection, septicemia or acute malaria. There may be areas with little or no pathology support to make the diagnosis of DKA. In typical cases, the clinical features, hyperglycemia (detected by high urine sugar) and significant ketosis (urine ketones) are sufficient to make the diagnosis of T1D even if it is not possible to measure venous pH or serum bicarbonate. Delays in diagnosis lead to greater severity, more complications such as cerebral edema, and higher mortality of 3.4-13.4% (due to sepsis, shock, renal failure etc.). Further, minimal or no availability of IV fluids, venous access, medications, laboratory access, intensive care units and experienced HCP interfere with optimal treatment. A recent study showed that some of the 12% mortality in adults with DKA was due to preventable causes like hypoglycemia and hypokalemia. Therefore, it is important to increase awareness among primary care HCP to suspect DKA early and diagnose it, provide initial emergency treatment, and know when to transfer to a more experienced health facility.

Unavailability of serum pH testing means classifying the severity is not possible, but this should not lead to delay in treating DKA. Families of PwD are advised to always have urine ketone strips (or better still,
blood ketone meter and strips, if possible) and carry them to the health facility in case of unavailability there.

If IV fluid therapy is not available (no venous access, IV fluids or access to a cannula), small sips of a salty fluid or coconut water (since it is high in sodium) can be given as frequently as possible without causing vomiting. If the PwD is vomiting persistently, or too drowsy to drink, such fluids may be given by a nasogastric tube (at a lower rate than calculated, and increased as tolerated). In the drowsy person, the HCP should consider the balance between the risk of aspiration with the benefit of sustaining circulation.

Clinical assessment of respiration, level of consciousness and cardiovascular status, and observation of fluid intake and output are achievable in almost all health care settings. If the number of BGL strips is limited, checks can be spread out, keeping initial tests further apart (as high BGL are expected), and saving test strips for later, as the BGL approaches 180 mg/dl (10 mmol/l).

**PSYCHOLOGICAL CARE**

*Whenever possible, follow the guidelines detailed in ISPAD 2022 CPG Chapter 15 (Appendix 1).*

The constant stress of managing diabetes, with the added challenges of poverty, scarcity, insecurity, social discrimination and cultural taboos can be overwhelming, leaving many families unable to cope. Diabetes care in LRS is often so focused on survival and access to medical supplies, that psychological well-being takes a back seat. Addressing psychological aspects is necessary to improve glycemia, QoL and outcomes.  

The first step is to sensitize the HCP and the caregivers that the mental health of the PwD and the caregivers matters. Families in LRS often report the PwD is being ‘stubborn’ or ‘devious’ or ‘bad tempered’, usually not recognizing these as psychological issues which need to be addressed. Families may resist seeking professional support, and indeed it may not be available. It is important not to judge a family/caregiver for either being a cause for the problem in the first place, or for being unwilling to prioritize psychological care even if needed and available.

Diabetes may be considered stigmatizing, more so in LRS. In the absence of flexible insulin regimens or resources for adequate SMBG, the reduced flexibility of food choices and timings of meals and activity, and the constant fear of an embarrassing event due to hypoglycemia, often lead to anxiety and
depression. Repeated episodes of hypoglycemia and marked glycemic variability can cause tiredness and mood swings, which are interpreted as “bad behavior”. This situation is worsened if the family considers diabetes burdensome or shameful, and insists on hiding it from outsiders, or sometimes even within the family. The child/adolescent feels guilty and isolated, often cannot test or take insulin or food in time, and so runs the risk of hypoglycemia, hyperglycemia, and long-term complications. Some families may not have access to healthy food choices, or the culture may not be supportive of healthy eating. If not educated about carbohydrate counting, the PwD must manage diabetes with fixed meal plans, further accentuating the feeling of being different and abnormal.

Fortunately, many LR families have strong family bonding and support, which can help cope emotionally and financially. Sometimes, the extended family itself may be a cause of stress, with interference in the management of T1D. Family support may also be absent in specific situations, e.g., migrants, displaced or refugee families, those living in or escaping from conditions of war, terrorism, or other major social upheaval; or simply if both parents in a nuclear family have long working hours. There may be barriers in language or cultural differences from the DCT. These factors, as in well-resourced settings, may lead to or worsen psychopathology, including depression, diabetes denial, eating disorders, in the PwD or key caregiver/s. This can be a major impediment to achieving reasonable glycemic management and QoL. The situation is worsened if psychological health issues are also treated as taboo and stigmatizing.

Often these social and financial problems are much greater for girls and women with diabetes. The burden of caring for the child/adolescent may be disproportionately placed on the mother. The DCT is encouraged to involve other family members in participating and taking ownership of the child’s diabetes care.

Mental health specialists familiar with T1D are likely not available locally, but may be accessed virtually. In addition, contact with older, well-adjusted PwD or with PwD parents can provide support.

**VERY YOUNG (PRESCHOOL) CHILDREN**

*Whenever possible, follow the guidelines detailed in ISPAD 2022 CPG Chapter 23 (Appendix 1).*

Diabetes management, difficult at any age, is much more so in very young children. They have erratic eating, behavior and PA patterns, with little ability to communicate symptoms or understand. Recurrent hypoglycemia has the potential to cause permanent cognitive damage to the developing brain. Apart
from acute complications, the risk of chronic complications, as well as mortality, is higher. LRS pose additional challenges, since availability of insulin analogs, access to CGM or even frequent SMBG, adequate DSME, and trained HCP are likely to be insufficient.

Therefore, providing comprehensive DSME to the family at the onset is important. Telemedicine may help where trained personnel are not available locally. Parents of toddlers are usually younger, and may be financially and/or emotionally insecure. Awareness about support with free or subsidized insulin, glucose strips, possible CGM, pathology support and other needs can be helpful. It is essential that all members of the family are involved in diabetes care.

Most preschoolers in LRS remain on Regular and NPH insulin, administered by insulin syringes, as in the DCCT study. Insulin should be given before meals, not after. Administration of small doses is a practical challenge, as 0.5U pens are expensive and usually unavailable. It is possible to give doses of U40 insulins with 0.5U increments. If analog insulins are being used, 0.5U or 0.3U insulin syringes should be used if available. Insulin analogs cost 3-4 times more, but may be preferred in case of repeated hypoglycemia, and may be affordable as the doses are small. Twice daily and premixed insulin regimens should not be used at all. Insulin syringes with the shortest needle length are needed.

Frequent SMBG (7-10 BGL daily) is crucial in this age group. There should be a high index of suspicion for hypoglycemia, especially nocturnal hypoglycemia. Use of CGM (continuous usage or once in a few weeks) is desirable if feasible (perhaps with charity support).

A meal plan with a relatively consistent carbohydrate intake at meal and snack times, together with carbohydrate counting, is helpful. Tackling half-finished meals, erratic PA, and insulin dose adjustments should be taught and reinforced in a manner which is understood.

**SCHOOL**

*Whenever possible, follow the guidelines detailed in ISPAD 2022 CPG Chapter 22 (Appendix 1).*

Resuming school following the demanding diagnosis of T1D can be challenging anywhere in the world. This may be exacerbated in LRS, where some families react to the diagnosis by taking the child (especially girls) out of school, because ‘the child is sick’, or for financial reasons. Many families or schools ask the child (more likely with girls) to conceal the diagnosis, which increases the psychological pressure as well as the risk of acute complications.
Sometimes, schools may refuse admission or continuation of schooling because of misapprehensions; usually due to lack of awareness of T1D. Relevant diabetes education for caregivers in school and age-appropriate discussion with peers are helpful. 

Schools may not have easy access to an HCP to deal with emergencies, either in-house or nearby, though access to mobile phones has greatly improved this. In LRS, the challenges may be exacerbated in varying degrees by other issues:

- Limited availability of insulin, often none of glucagon
- Limited availability of BG testing supplies
- Inadequate educational resources in local languages
- Geographical distance and transport issues.

In hot weather, the insulin to be taken before the school meal/snack (and glucagon if available) should be stored in a refrigerator, or in a cooling bag in the child’s school bag, or in a double clay pot kept at an airy spot. The child should always carry a “hypo kit”, containing a sugary drink, a snack to be given after correction of hypoglycemia, and a glucometer and strips in case the child does not test BGL daily before taking insulin.

Each child should have an individualized DMP made jointly by the DCT, parents and school staff. Because mobile phones are now universally available, they can be utilized for sending the DMP and other diabetes education material to the school staff, and maintaining contact between the child, staff, parents, and if needed, the DCT. During the Covid pandemic years, mobile phones and Zoom video-calls were extensively and effectively used. Their continued use can help generate confidence in the parents and PwD, so that lost school days are minimized, especially in remote areas.

Parents should be made aware of legal rights as well as insights about the best way to handle diabetes with school staff. Pragmatism is necessary, as facilities may not be available or even feasible in some situations.

**ADOLESCENCE**

*Whenever possible, follow the guidelines detailed in ISPAD 2022 CPG Chapter 21 (Appendix 1).*

Adolescence is a difficult phase of life; the combination of adolescence with diabetes is particularly difficult, since the adolescent wants to fit in and not be different from his/her peers. Psychosocial,
developmental, and sexual issues in adolescents and young adults with diabetes in LRS are similar to those in well-resourced settings. However, trained personnel to handle these issues are usually lacking, and there may be several additional challenges. Psychosocial health becomes difficult to focus upon by a family trying to make ends meet. Many youngsters may have to start working early to supplement family income, while pursuing education/dropping out of studies, adversely impacting diabetes care.

In some cultures, girls face several restrictions, with the family’s priorities being early marriage and pregnancy. It may be difficult or impossible to talk directly to or examine the female adolescent because of social restrictions. In some cultures, taboos and secrecy around menstruation, sex education and substance use/abuse make it difficult to detect or manage these situations. Stigmatization and discrimination may be more obvious. Families may resort to keeping diabetes secret, increasing diabetes distress and complications. In many conservative families, adolescents, especially girls, may be given little freedom to think and act for themselves. If early marriage and pregnancy are a possibility, this should be acknowledged and planned, with pre-conception discussed with the PwD and family. Relevant religious, cultural or societal issues can be asked for and addressed. The myth that women cannot be pregnant because of diabetes must be removed.

Psychological support through group education programs and support sessions are particularly valuable and cost-efficient in LRS. Residential camps or weekend sessions have been successful around the world, whatever the settings, since adolescent needs and challenges are the same globally; more so in LRS lacking formal institutional support.

Risk-taking behavior for adolescents with diabetes are the same globally. Education is vital to keep them safe. Physical or verbal abuse may occur, but referral to a mental health care specialist may not be possible: not available or refused by the family for fear of stigma. In these circumstances, the physician, nurse and/or dietician have to help as best as they can, with help from peers with diabetes, and telemedicine.

It is important that the DCT build a mutually trusting relationship with the PwD and caregivers, to reduce the chances of the young PwD being lost to follow up.

**TRANSITION**

Across the world, transition to adult care is difficult. In many LRS, there may be no transition, as the same general physician or DCT sees children and adults. Where adult and pediatric care is separate, the
pediatric team would have to facilitate the transition as smoothly as possible. Some LRS transition children aged 12 years of age; most transition between 15 - 21 years of age.

**COMPPLICATIONS AND SCREENING**

*Whenever possible, follow the guidelines detailed in ISPAD 2022 CPG Chapter 18 (Appendix 1).*

Regular recording and tracking of height, weight, BP and pubertal status need care with measurement and record keeping, cost nothing, while yielding considerable information. This is especially valuable in LRS, where routine annual testing for comorbidities may not be possible, so testing can be done at least for those with altered growth and development patterns. To be useful, these parameters must be accurately measured (e.g., ensuring proper instruments, correct technique, and for BP readings, appropriate-sized cuffs) and accurately recorded at least 1-2 times a year.

Height and weight should be regularly plotted on local standardized growth charts for boys and girls, with the mid-parental height (MPH) noted on the right y-axis. Children typically consistently follow a centile, which is more or less in consonance with the MPH, so even if local charts are not available, any standardized chart can be used (e.g., the American CDC or other similar standards), as long as the genetic endowment is accounted for by plotting the MPH. Charting growth data makes it easy to interpret and to demonstrate to parents whether velocity is normal, inadequate or excessive. If velocity is abnormal, any explanations and need for more detailed testing should be recorded. Charts of normal BMI and BP at different ages should be available for interpretation.

Decreased growth velocity and delayed puberty can occur with persistent dysglycemia, hypothyroidism, CD, other gastrointestinal causes, Addison’s disease (hypoadrenalism), or chronic infections (such as hepatitis, chronic malaria, parasitic infestations). Dysglycemia can be due to several reasons: non-physiologic treatment plan, or expensive analogs which are unaffordable (hence rationed or omitted), and/or with inadequate or no SMBG. Mauriac syndrome, due to very severe dysglycemia, is characterized by growth failure, hepatomegaly with glycogenic hepatopathy, steatosis, and late pubertal development.

**FASTING DURING RELIGIOUS OBSERVANCES BY PEOPLE WITH DIABETES**
Whenever possible, follow the guidelines detailed in ISPAD 2022 CPG Chapter 24 (Appendix 1).

Almost all religions advise fasting, with variable rules, for healthy adults, as a way of learning self-discipline, developing empathy for the hungry, and gaining spiritual awareness. They also urge that fasting should not cause any harm to the person, and forbid it under certain circumstances. For example, prepubertal children, menstruating, pregnant or breastfeeding women, individuals with acute or chronic illnesses whose health could deteriorate due to the fasting, those with an intellectual disability, or those who are traveling are exempt from Ramadan fasting.

In fasts where water is not forbidden, the risk of dehydration is less, so more physical activity is permissible.

Before SMBG became prevalent, fasting was forbidden in T1D. With frequent SMBG, or better still, CGM, fasting has become possible, but only if undertaken with great care, with intensive professional supervision. The exact pattern of dietary restrictions should be understood by the DCT, and pre-fasting counseling and education about insulin dose adjustments as necessary imparted to the PwD and family. They must understand the need for 6-8 BGL tests daily, and be willing to break the fast without penalty in case hypoglycemia or ketosis occur. Anyone with diabetes not-in-target, unable or unwilling to monitor BGL frequently, or needing to do physical labor, runs the risk of developing complications like hypoglycemia or dehydration, and should be forbidden to fast, since self-harm is considered sinful. The desire to fast and conform with peers can be used as a reason to improve glycemia in the weeks preceding the fasting period, and continued later.

Practicing Christians are expected to abstain from meat on Lent (from Ash Wednesday to Good Friday). A Daniel fast (no meat, dairy, alcohol, or oil allowed till sundown) would involve high carbohydrate intake, managed with carb counting and appropriate doses of pre-meal insulin. A Black fast (no food or water permitted till sunset) would need pre-meal insulin based on the carb count, for the pre-fast and post-sunset meals. Fasting rules for the Baha’is and for the Jews’ Yom Kippur and Tisha B’Av (no food or water from dawn to dusk) being similar to those during Ramadan, the same management can be recommended.

In the “Theravada or Hinayana” sect of Buddhism (mainly in Thailand, Lao, Myanmar, Cambodia, and Sri Lanka), novices, nuns and monks have breakfast and lunch before 1 pm, but can drink juice or other sweet drink in the evening and before bedtime. This diet pattern of “8 precepts practice” is sometimes followed by teenagers or adults, and is easily managed by adjusting the basal-bolus regimen. The
“Mahayana” sects’ (Tibet, Bhutan, China, Taiwan, Korea and Japan) fasting consists of having the usual three meals a day of vegetarian food, milk and egg: meat is forbidden. Regular insulin can be taken before each meal, the dose reduced as needed, based on carb counting.

Hindu fasts are usually for one day, often with milk and/or fruits permitted. Longer (e.g. 9 day fasts called Navaratras) permit use of millets and pseudo-cereals in place of cereals. Jain fasts can be for 8 days (Aathai), 3 days (Tela); or 2 days (Chattha), with no food, only water permitted till sunset: they can be managed as for Ramadan, but dehydration is not a concern. For Ekashana, only one meal is eaten till sunset; Beyashna means two meals only till sunset; in Olee, a specific additive e.g., ghee/ spices/ salt is abstained from for 9 days, thus altering glycemic patterns.

General principles to be followed for fasting are to reduce basal insulin by 30-40% (if glargine, by reducing dose the previous night, or the same morning; if NPH, by skipping the morning dose and taking only at night). The Regular insulin bolus is taken before any major meal, as above. Non-physiological regimens (two dose and/or using premix insulins) cause hypo- and hyperglycemia on an ongoing basis, and can be even more risky during fasting. If the PwD has been resisting the change to a basal bolus MDI regimen earlier, the desire to keep a fast could be used as a motivation to change well before the fast starts.

SURGERY

Whenever possible, follow the guidelines detailed in ISPAD 2022 CPG Chapter 20 (Appendix 1).

Children with T1D requiring major surgery should be referred to a center with sufficient resources to provide safe care, including facilities to measure blood gases, urea, electrolytes, and blood/urine ketones; availability of bedside blood glucose meters; and healthcare staff experienced in pediatric diabetes. Elective surgery should be performed with pre-existing glycemia in range. Basal insulin should be given to prevent DKA, with half the usual dose given before surgery. Rapid acting or Regular insulin can be given IV or SC, based on hourly BGL testing during and after the surgery, till the child can accept food orally.

Emergency surgery
In case of emergency surgery, when transfer to a better equipped center is not possible, some alterations in care are possible.

If blood gases cannot be checked, urine ketones should be checked in freshly voided urine.

If general anesthesia is required, a temporary urinary catheter can be inserted, and removed post-surgery.

If testing urea and electrolytes is not possible, the HCP should carefully observe urine output and clinical signs for hydration status. Potassium is not advised if the individual has oliguria.

If a glucometer is not available, fresh urine samples should be checked for glucose monitoring, keeping in mind that the correlation of BGL and urine glucose is poor, and that hypoglycemia will be missed.

If no facilities are available for administration of IV fluids, then oral rehydration solutions can be used. The usual recommendation that no solid food should be given for at least 6 hours before surgery holds good. Clear fluids and breast milk may be allowed up to 4 hours before surgery (check with the anesthetist).

If DKA is present, the established treatment protocol for DKA should be followed, and surgery delayed if possible, until circulating blood volume and electrolyte deficits are corrected. In the absence of DKA, IV fluids and insulin management should be commenced, as for elective surgery.

**TYPE 2 DIABETES**

*Whenever possible, follow the guidelines detailed in ISPAD 2022 CPG Chapter 3 (Appendix 1).*

The prevalence of T2D in the young is rising in many parts of the developing world, due to the epidemic of obesity, caused by increasing consumption of junk food, and decreasing PA. However, not all youths with T2D are obese, especially in Asia. The risk of T2D rises if there are additional factors like low birth weight, rapid growth in infancy, and strong family history of gestational diabetes and T2D.

Adolescent girls are at particular risk in conservative societies: PA may be more curtailed, meals may contain more carbohydrates and less protein (which is expensive), less medical attention may be given, and the decision-making male members of the family may not be informed about “embarrassing” concerns such as irregular menstrual cycles. Regular PA and reduction of junk food can be advised in all medical encounters; and height, weight and BP monitored regularly.
The rapid β-beta cell failure and the high morbidity seen in adolescent T2D underlines the need for prevention, early diagnosis, and aggressive treatment. The younger the child with T2D, the worse is the cardio-metabolic profile. Therefore, prevention and early identification of obesity, and simple fasting and post-prandial BGL screening every 1-3 years, is especially important in LRS. Delay in diagnosis may result in presentation in DKA, which needs initial insulin treatment.

Distinguishing T1D from T2D is important. Often, parental and physician resistance to starting insulin results in oral medication advised to persons with T1D, resulting in chronic hyperglycemia, and acute and chronic complications. On the other hand, unnecessary insulin given to an adolescent with T2D can result in further weight gain. Testing for GAD and other antibodies to distinguish T1D from T2D or to diagnose “double diabetes” is often unaffordable. However, clinical behavior on follow up may give clues to distinguish the two conditions.
Table 1. Possible solutions to Type 1 Diabetes care in LRS

<table>
<thead>
<tr>
<th>Constraint</th>
<th>Insulin affordability</th>
<th>Insulin access</th>
<th>Glucometer Strip cost</th>
<th>Scarcity of strips</th>
<th>No fridge for insulin</th>
<th>Illiteracy</th>
<th>Lack of educators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Possible solution</td>
<td>Use Regular as bolus and NPH as basal</td>
<td>Connect to nearby NGO/ Support group</td>
<td>Connect with company/ Govt/ NGO for low-cost options</td>
<td>Devise effective monitoring patterns and interpretation to use minimum strips</td>
<td>Use an earthen clay pot in scientific way</td>
<td>Use videos and other visual modes of teaching</td>
<td>Train adults with T1D or caregivers to become coaches</td>
</tr>
<tr>
<td>Topic</td>
<td>Comprehensive Care</td>
<td>Intermediate care</td>
<td>Minimum care</td>
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<tr>
<td>Choice of insulin</td>
<td>Regular/rapid acting analog + basal (glargine)</td>
<td>Regular + NPH</td>
<td>Regular + NPH</td>
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<tr>
<td>No of times</td>
<td>1. Regular /rapid acting analog before each meal + basal once (morning or bedtime)</td>
<td>1. Regular before each meal + NPH at bedtime.</td>
<td>1. Regular before each meal and NPH at bedtime.</td>
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<td></td>
<td>2. Regular before each meal &amp; rapid acting analog in school or for correction</td>
<td>2. Regular &amp; NPH before breakfast and dinner</td>
<td>2. Regular &amp; NPH before breakfast and dinner +</td>
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<td></td>
<td>doses + basal once (morning or bedtime).</td>
<td>+ Regular before lunch/ large snack.</td>
<td>Regular before lunch/ large snack.</td>
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<tr>
<td>Storage of insulin</td>
<td>In refrigerator</td>
<td>In refrigerator</td>
<td>Earthen pot for insulin in regular use/ nearby</td>
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<td>fridge for stored supply.</td>
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<tr>
<td>Insulin syringe reuse</td>
<td>As less reuse as possible.</td>
<td>Change after 3-6 times</td>
<td>Use for up to 10 times.</td>
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<td></td>
<td>Use of pen devices, specially in school and during travel.</td>
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<td>Discard earlier if touched somewhere, blunted or</td>
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<td>painful.</td>
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<tr>
<td>Disposal of syringes etc.</td>
<td>Collect in a puncture-proof bottle: give to hospital on visit.</td>
<td>Collect in puncture-proof bottle: give to</td>
<td>Collect in puncture-proof bottle: give to</td>
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<tr>
<td></td>
<td>Recycle</td>
<td>hospital on visit.</td>
<td>hospital on visit.</td>
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</tr>
</tbody>
</table>

Table 2. Modified levels of T1D care for LRS
<table>
<thead>
<tr>
<th>Glucose monitoring</th>
<th>SMBG: Individualized pattern for 7-10 BGL, including 2-3 am, daily. Additional BGL for unexpected exercise, hypos, sick days. CGMS: use constant use if possible, or intermittently HbA1c lab/ point of care every 3 months Tracking Time In Range</th>
<th>SMBG: Individualized pattern for 4 BGL daily; 7 BGL profile once a week. Additional BGL for unexpected exercise, hypos, sick days. CGMS: once in 3-6 months for identifying hypoglycemia and patterns. HbA1c point of care every 3-4 months.</th>
<th>SMBG: 7 BGL profile once or twice a week. Additional BGL for unexpected exercise, hypos, sick days. HbA1c whenever possible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screening</td>
<td>Height, Weight, growth charts, BP, clinical examination in each visit for visual/ sensory changes.</td>
<td>Height, Weight, growth charts, BP, clinical exam in each visit for visual/ sensory changes</td>
<td>Height [marked on the wall], Weight, BP, clinical exam for visual/ sensory changes annually.</td>
</tr>
<tr>
<td>Diabetes care and education: by whom?</td>
<td>Treatment by specialist. Education by a team of educator, nutritionist, psychologist 24x7 helpline support. Coaches to train in basics T1D Leaders to motivate Periodic camps</td>
<td>Treatment by specialist. Education by a team of educator, nutritionist, psychologist via telemedicine Helpline support. Coaches to train in basics T1D Leaders to motivate</td>
<td>By the local doctor, in touch with specialist By training paramedical staff via short-term courses Using experienced PwD or caregivers as coaches.</td>
</tr>
<tr>
<td>Diabetes Education: how? (tools)</td>
<td>WhatsApp groups, educational videos and material, peer group activities, mobile apps</td>
<td>WhatsApp groups, educational videos, peer group activities, mobile apps</td>
<td>WA groups: audio messages</td>
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<tr>
<td></td>
<td>Online sessions, handbooks &amp; logbooks</td>
<td>Online sessions, handbooks &amp; logbooks</td>
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<tr>
<td></td>
<td>WA groups: audio messages</td>
<td>Peer interaction: casual or structured</td>
<td></td>
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<tr>
<td></td>
<td>Displays in clinic: Audio/video/pictorial posters/leaflets</td>
<td>Indigenous games and tools such as snakes and ladders to teach low literacy groups.</td>
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<tr>
<td></td>
<td>Peer interaction: casual or structured</td>
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<td></td>
<td>Emphasis on self-dose adjustment skills.</td>
<td>Emphasis on self-dose adjustment skills.</td>
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<tr>
<td></td>
<td>Calculating ICF</td>
<td>Dose adjustments as per sliding scale</td>
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<tr>
<td></td>
<td>For all: Insulin care, insulin mixing, hypoglycemia management, sick day management.</td>
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<tr>
<td></td>
<td>SMBG: Understanding implications of the readings with basics of self-dose adjustments.</td>
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</tr>
<tr>
<td>Nutrition</td>
<td>Ability to balance meals, carb counting, Calculating ICR</td>
<td>Balanced meals. Calculating ICR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dose adjustment accordingly.</td>
<td>Recognizing Macronutrients.</td>
<td></td>
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<tr>
<td></td>
<td>Of the available local food:</td>
<td>Approximate carbohydrate counting</td>
<td></td>
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<tr>
<td></td>
<td>Concept of balanced plate and frequency of meals.</td>
<td></td>
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<tr>
<td></td>
<td>Recognizing Carbohydrates, proteins, fats and fiber.</td>
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<tr>
<td></td>
<td>Approximate/Visual Carb Counting can be learnt.</td>
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</tbody>
</table>
| Frequency of visit to hospital | Once in 3 months if no problem.  
In communication with educator team online.  
For new families: Frequent (?daily) visit plan till basics of education taught, motivation given, can adjust doses and practice self-care. | Once in 3 months if no problem.  
In communication with the educator team online.  
For new families: Frequent visit plan till basics of education taught, motivation given, can adjust doses and practice self-care. | Once in 2-3 months and in touch with coach frequently.  
Newly detected: 2-3 times a week for 2 weeks or longer to learn basics. |
| Annual complication screening | Annual screening as per age and duration of diabetes [follow guidelines]  
Govt. or private facility depending on affordability. | Annual screening as per age and duration of diabetes [follow guidelines].  
Refer to nearest government hospital. | Refer to nearest Government facility annually  
Tests during NGO camps whenever possible. |
| Resources | Mostly or wholly out of pocket (may get partly through support).  
Form a group, negotiate for low costs from companies.  
Reach out to various NGOs/Clubs who run support programs. | Partly out of pocket by PwD and partly through support.  
Make a group and negotiate for low cost from companies.  
Reach out to various NGOs/clubs who run support programs. | Reach out to NGOs, local politicians, regional or national Diabetes Associations, rich PwD with T2D/ T1D. |
<table>
<thead>
<tr>
<th>Exercise</th>
<th>Understand and plan different types of exercise. Check BGL to learn to adjust doses before and after exercise.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Understand and plan different types of exercise. Learn to adjust doses before and after exercise.</td>
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<tr>
<td></td>
<td>Local games with education for foot care &amp; hypoglycemia Monitor if hypoglycemia</td>
</tr>
</tbody>
</table>
### Appendix 1: ISPAD 2022 Clinical Practice Consensus Guidelines Chapters list

<table>
<thead>
<tr>
<th>Chapter numbers</th>
<th>Chapter titles</th>
</tr>
</thead>
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<td>1</td>
<td>Definition, epidemiology, and classification of diabetes in children and adolescents</td>
</tr>
<tr>
<td>2</td>
<td>Stages of Type 1 Diabetes in Children and Adolescents</td>
</tr>
<tr>
<td>3</td>
<td>Type 2 diabetes in children and adolescents</td>
</tr>
<tr>
<td>4</td>
<td>The diagnosis and management of monogenic diabetes in children and adolescents</td>
</tr>
<tr>
<td>5</td>
<td>Management of Cystic Fibrosis-Related Diabetes in children and adolescents</td>
</tr>
<tr>
<td>6</td>
<td>Diabetes Education in Children and Adolescents</td>
</tr>
<tr>
<td>7</td>
<td>The Delivery of Ambulatory Diabetes Care to Children and Adolescents with Diabetes</td>
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<tr>
<td>8</td>
<td>Glycemic targets and glucose monitoring for children, adolescents, and young people with diabetes</td>
</tr>
<tr>
<td>9</td>
<td>Insulin treatment in children and adolescents with diabetes</td>
</tr>
<tr>
<td>10</td>
<td>Nutritional Management in Children and Adolescents with Diabetes</td>
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<tr>
<td>11</td>
<td>Assessment and management of hypoglycemia in children and adolescents with diabetes</td>
</tr>
<tr>
<td>12</td>
<td>Sick day management in children and adolescents with diabetes</td>
</tr>
<tr>
<td>13</td>
<td>Diabetic Ketoacidosis and Hyperglycemic Hyperosmolar State</td>
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<td>14</td>
<td>Exercise in Children and Adolescents with Diabetes</td>
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<td>Page</td>
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<td>----------------------------------------------------------------------</td>
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<tr>
<td>15</td>
<td>Psychological Care of children and adolescents with type 1 diabetes</td>
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<td>16</td>
<td>Diabetes technologies: Glucose monitoring</td>
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<tr>
<td>17</td>
<td>Diabetes technologies: Insulin delivery</td>
</tr>
<tr>
<td>18</td>
<td>Microvascular and macrovascular complications in children and adolescents with diabetes</td>
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<tr>
<td>19</td>
<td>Other complications and associated conditions in children and adolescents with type 1 diabetes</td>
</tr>
<tr>
<td>20</td>
<td>Management of children and adolescents with diabetes requiring surgery</td>
</tr>
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<td>21</td>
<td>Diabetes in Adolescence</td>
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<td>22</td>
<td>Management and support of children and adolescents with diabetes in school</td>
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<td>23</td>
<td>Managing diabetes in preschoolers</td>
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<tr>
<td>24</td>
<td>Ramadan and other religious fasting by young people with diabetes</td>
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<tr>
<td>25</td>
<td>Management of the child, adolescent, and young adult with diabetes in limited resource settings</td>
</tr>
</tbody>
</table>


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