

ISPAD Clinical Practice Consensus Guidelines 2022: Management of the child, adolescent, and young adult with diabetes in limited resource settings

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1 | WHAT IS NEW OR DIFFERENT

This guideline provides updated and consolidated guidance on 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.

The 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.

2 | 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 respective chapters of the ISPAD 2022 Clinical Practice Consensus Guidelines (ISPAD 2022 CPG) as far as possible. (See Appendix A for the list of chapters).

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 between centers, within the same center depending on finances and facilities, and even from time to time. The recommendations use the American Diabetes Association Evidence Grades, and rely heavily on expert opinion.

2.1 | Introduction

- Suboptimal care of the young person with diabetes (PwD) remains common, even though outcomes improve significantly with awareness and diabetes education. **E**
- Diabetes management in LRS should be as physiological as possible, maximizing quality of life (QoL), preventing acute and chronic complications, and allowing adequate 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, have 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 make families with PwD more vulnerable. The T1D Index attempts to quantify the impact in different regions. **E**
- It is desirable that health care professionals (HCP) provide the level of care according to available resources, while aiming to attain more comprehensive care when local circumstances and facilities improve (Tables 1 & 2). **E**
- All members of the diabetes care team (DCT) should share the same goals and approaches. **A**
- It is desirable that HCP are aware of support available locally, nationally, and internationally; from Governments and non-governmental organizations (NGOs). **E**
- It is suggested that HCP be aware of the latest low-cost diabetes technology and therapy available. **E**

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

- The 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 glucose is elevated (and urine ketones are present, if testing is available). **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 the diagnosis of T1D. They may be selectively done if diabetes type is unclear. **E**
- The 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**

2.3 | 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, acute and chronic medical 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 (experienced PwD and parents of PwD) is helpful in remote areas, as is group teaching at clinics. **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**

2.4 | Insulin therapy

- Physiological insulin replacement using multiple daily injections (MDI) is desirable, in addition to the greatest frequency of self-monitoring of blood glucose (SMBG) available. **E**
- Optimal glycemic targets and QoL can be achieved using low-cost conventional insulins (Regular and NPH) and SMBG, though analog insulins offer some 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 desirable for management of T1D and should only be used until other alternatives can be obtained. **E**

TABLE 1 Possible solutions to T1D care in LRS

Constraint	Insulin affordability	Insulin access	Glucometer strip cost	Scarcity of strips	No fridge for insulin	Illiteracy	Lack of educators
Possible solution	Use regular as bolus and NPH as basal	Connect to nearby NGO/Support group	Connect with company/ Govt/ NGO for low-cost options	Devise effective monitoring patterns and interpretation using available strips	Use options like earthen clay pot in scientific way	Use videos and other visual modes of teaching	Train adults with T1D or caregivers to become coaches

2.5 | Glucose monitoring

- Though glucose monitoring is expensive, achievement of glycemic targets is not possible without regular SMBG. **A**
- If the ideal of 6–10 SMBG 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 PwD should be <7.0% (<53 mmol/mol) without frequent hypoglycemia and/or severe hypoglycemia (SH), although targets may need to be individualized based on circumstances. **A**
- HbA1c should be measured every 3 months, if available and affordable. **E**
- Although infrequently available in LRS, continuous glucose monitoring (CGM) should be used whenever possible, especially in pre-school children. **A**
- If constant use of CGM is not feasible, intermittent use of CGM (i.e., once every few weeks), may provide better understanding of glycemic patterns. **E**

2.6 | Nutrition

- Nutritional advice needs to be adapted to cultural, ethnic, and family traditions. **E**
- Visual 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 nutritional deficiencies. **C**
- PwD with celiac disease (CD), obesity, dyslipidemia, and hypertension need special attention. **C**

2.7 | Exercise

- Exercise is a key aspect of diabetes management and must be encouraged in every PwD. **A**

- Insulin dosing and/or food intake should be adjusted to safely exercise without hypoglycemia. **A**
- Food should be available during and after physical 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, it is desirable that the importance of SMBG and food availability are emphasized. **E**
- Predictability and routine are of great value in avoiding exercise-related complications when SMBG is irregular. **E**

2.8 | 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**
- Reinforcing hypoglycemia education at regular intervals and during sports is suggested. **E**
- MDI insulin regimens are more likely than premixed or fixed dose insulin regimens to prevent hypoglycemia, especially if food insecurity is present. **E**
- Glucagon can be lifesaving and is listed in the WHO's Essential Medicines List (EML). Local advocacy is advised to increase availability of this medication. **E**
- Newer injectable glucagon and nasal spray glucagon are now available – they are easier to use, and may become more widely available with time. **E** They can be suggested, if available and affordable. **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**

2.9 | Sick day management

- Brief and easy-to-understand visual education materials in the local language(s) on how to manage diabetes during intercurrent illnesses is suggested. **E**

TABLE 2 Modified levels of T1D care for LRS

Topic	Comprehensive care	Intermediate care	Minimum care
Choice of insulin	Regular insulin/rapid acting analog (bolus) + glargine (basaline)	Regular + NPH insulins	Regular + NPH insulins
No of times	1. Regular insulin/rapid acting analog before each meal + basal once or twice (morning and/or bedtime) 2. Regular insulin before each meal & rapid acting analog in school or for correction doses + basal once or twice (morning and/or bedtime).	1. Regular insulin before each meal + NPH at bedtime. 2. Regular insulin & NPH before breakfast and dinner + Regular insulin before lunch/ large snack	1. Regular insulin before each meal and NPH at bedtime. 2. Regular insulin & NPH before breakfast and dinner + Regular insulin before lunch/ large snack
Storage of insulin	In refrigerator	In refrigerator Earthen pot in case of power cuts	Earthen pot for insulin in regular use/ nearby fridge for stored supply.
Insulin syringe reuse	As little reuse as possible. Use of pen devices, specially in school and during travel.	Change after 3–6 times	Use for up to 10 times. Discard earlier if touched somewhere, blunted or painful.
Disposal of syringes, and other sharps	Collect in a puncture-proof bottle: give to hospital on visit. Recycle rest of plastic	Collect in puncture-proof bottle: give to hospital on visit. Recycle rest of plastic	Collect in puncture-proof bottle: give to hospital on visit. Recycle rest of plastic
Glucose monitoring	SMBG: Individualized pattern for 7–10 BGL, including 2–3 am, daily. Additional BGL for unexpected exercise, hypos, sick days. CGMS: constant use if possible, or intermittently HbA1c lab/ point of care every 3 months Tracking Time In Range	SMBG: Individualized pattern for 4 BGL daily; 7 BGL profile once or twice a week. Additional BGL for unexpected exercise, hypos, sick days. CGMS: once in 3–6 months for identifying hypoglycemia and understanding patterns. HbA1c point of care every 3–4 months.	SMBG: 7 BGL profile once or twice a week. Additional BGL for unexpected exercise, hypos, sick days. HbA1c whenever possible, preferably at least every 6 months
Screening	Height, Weight, growth charts, pubertal stage (>10y age), BP, injection sites, clinical examination in each visit for visual/ sensory changes.	Height, Weight, growth charts, pubertal stage (>10y age), BP, clinical exam in each visit for visual/ sensory changes	Height [marked on the wall], Weight, pubertal stage (>10y age), BP, clinical exam for visual/ sensory changes annually.
Diabetes care and education: by whom?	Treatment by specialist. Education by a team of educator, nutritionist, psychologist, can be by telemedicine if not available locally 24 × 7 helpline support. Coaches to train in basics T1D Leaders to motivate Periodic camps	Treatment by specialist. Education by a team of educator, nutritionist, psychologist via telemedicine Helpline support. Coaches to train in basics T1D Leaders to motivate	By the local doctor, in touch with specialist by telemedicine By training paramedical staff via short-term courses Using experienced PwD or caregivers as coaches.
Diabetes Education: how? (tools)	WhatsApp groups, educational videos and material, peer group activities, mobile apps Online sessions, handbooks & logbooks Displays in clinic: Audio/ video/ pictorial posters/ leaflets	WhatsApp groups, educational videos, peer group activities, mobile apps Online sessions, handbooks & logbooks Displays in clinic: Audio/ video/ pictorial posters/ leaflets	WA groups: audio messages and videos if phone (own or neighbour's) available Displays in clinic: Audio/ video/ pictorial posters/ leaflets Peer interaction: casual or structured Indigenous games and tools such as snakes and ladders to teach low literacy groups.
Diabetes Education: what?	Structured age- appropriate diabetes education. Emphasis on self-dose adjustment skills. Calculating insulin correction factor (ICF)	Structured age- appropriate diabetes education. Emphasis on self-dose adjustment skills. Dose adjustments as per sliding scale	For all: Insulin care, insulin mixing, hypoglycemia management, sick day management. SMBG: Understanding implications of the readings with basics of self-dose adjustments.
Nutrition	Ability to balance meals, carb counting, Calculating insulin carbohydrate ratio (ICR) Dose adjustment accordingly.	Balanced meals. Recognizing macronutrients. Food exchanges (with pictures) Approximate carbohydrate counting	Of the available local food: Concept of balanced plate and frequency of meals. Recognizing carbohydrates, proteins, fats and fiber. Approximate/ Visual Carb Counting can be learnt.
Frequency of visit to hospital	Once in 3 months if no problem. In communication with educator team online.	Once in 3 months if no problem. In communication with the educator team online.	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.

TABLE 2 (Continued)

Topic	Comprehensive care	Intermediate care	Minimum care
	For new families: Frequent (?daily) visit plan till basics of education taught, motivation given, can adjust doses and practice self-care.	For new families: Frequent visit plan till basics of education taught, motivation given, can adjust doses and practice self-care.	
Annual complication screening	Annual screening as per age and duration of diabetes [follow guidelines] Government or private facility depending on affordability.	Annual screening as per age and duration of diabetes [follow guidelines]. Refer to nearest government hospital or NGO.	Refer to nearest Government facility or NGO for annual screening Tests during NGO camps whenever possible.
Resources	Mostly or wholly out of pocket by PwD (may get partly through support). Form a group, negotiate for lower prices from companies. Reach out to various NGOs/ Clubs who run support programs.	Partly out of pocket by PwD and partly through support. Form a group, negotiate for lower prices 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.
Exercise	Understand and plan different types of exercise. Check BGL to learn to adjust doses before, during and after exercise.	Understand and plan different types of exercise. Learn to adjust doses before, during and after exercise.	Local games with education for foot care & hypoglycemia Emphasize no exercise if food insecurity. Monitor if hypoglycemia.

- During an illness, frequent SMBG monitoring (3–4 hourly if possible), and, if available, blood or urine ketones 6–8 hourly is recommended. **A**
- When ketone testing is unavailable, medical care should be sought early. Insulin should not be stopped; hydration should be maintained with salty or sweet liquids based on BGL. **C**
- If glucometer/BGL strips or urine/blood ketone testing is not possible during sick days, urine glucose should be monitored to approximately assess the severity of hyperglycemia. **E**
- It is desirable for PwD in rural and remote areas to have close contact with their DCT during sick day management. **E**

2.10 | Diabetic ketoacidosis

- DKA may be more common in LRS, due to inadequate awareness, misinformation, and barriers to accessing care. **C**
- Mild and moderate uncomplicated DKA can be treated with subcutaneous (SC) Regular insulin (or rapid-acting insulin analogs, if available and affordable). This can be done at the nearest peripheral health set-up, with virtual consultations with an expert. **B**
- It is useful to provide written instruction sheets to families regarding the prevention and management of DKA, for health workers in rural and remote areas, where access to expert HCP is not available. **E**
- The incidence and severity of hypokalemia and hypoglycemia may be higher in malnourished PwD during DKA management. **C**

2.11 | Psychological care

- It is important to recognize psychosocial issues such as stigma, diabetes distress, eating disorders, anxiety and depression, family issues, attention deficit disorders, fear of hypoglycemia, alcohol and other substance abuse in PwD and their caregivers. **E**
- Inflexible treatment regimens, inadequate or inappropriate DSME, frequent complications such as recurrent DKA or excessive/ severe episodes of hypoglycemia, and financial distress worsen these conditions. **E**
- Psychological status is improved if all members of the DCT consistently use a positive tone and non-stigmatizing words, diabetes peer support, effective DSME, motivational interviewing and empowerment techniques. **E**
- Telemedicine may improve access to appropriate mental health support for PwD and caregivers. **E**

2.12 | Very young (preschool) child

- Diabetes management is more challenging in very young children and increases the parenting burden. **C**
- Early recognition of symptoms is paramount, as symptoms such as increased thirst or urinary output are easily missed. **C**
- DKA may be mistaken for other common illnesses such as gastroenteritis, respiratory infections, urinary infections, malaria, and parasitic infections. **C**
- MDI regimens with long-acting analogs for basal needs are suggested, depending on supply and affordability. **E**

- Frequent SMBG and CGM are desirable, based on availability and affordability. **E** Donors may be approached to provide supplies. **E**

2.13 | School

- Every PwD has the right to receive an education, wherever they live globally. **E**
- It is desirable that school staff are educated by parents and DCT members, either by outreach visits or virtual meetings; and the PwD supported, for safety and efficacy. **E**
- It is advisable for each PwD to have an individualized annually updated written Diabetes Management Plan (DMP). **E**
- It is strongly encouraged that school staff permit and supervise BGL testing, insulin administration, taking extra calories when needed, and other diabetes care activities. **E**
- It is desirable for school staff to know how to prevent and manage hypoglycemia, hyperglycemia, and other emergencies. **E**
- It is desirable that comprehensive legal protection for PwD is available, incorporating supervision of diabetes management at school, even in places without special laws. **E**

2.14 | Adolescence

- Adolescence and T1D may be a challenging combination especially in LRS, where social taboos, discrimination, financial constraints, lack of adequate medical facilities, and lack of expertise in managing adolescents 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**
- It is desirable to proactively discuss the following issues related to adolescence with the PwD and their family: greater glycemic variability, need for more frequent SMBG, higher insulin requirements, screening for complications and associated increased costs. **E**
- It is desirable for DSME to be used at clinic, in group sessions, at diabetes meetings camps, together with peer support, to encourage and engage the PwD directly, and reduce isolation. **E**
- It is desirable to proactively and sensitively discuss topics such as menstruation, contraception, driving, smoking, alcohol, other substance abuse, and psychosocial co-morbidities such as illiteracy, attention deficit disorders, anxiety and depression in the PwD and their close family members. **E**

2.15 | Microvascular, macrovascular, other complications, and monitoring

- Baseline and regular screening for complications (as below) are essential and must be documented in the medical records annually, with interpretation, and reasons for omissions. **A** Screening can be facilitated with governments or NGOs to decrease or remove

financial barriers. This allows prevention and early identification of micro- and macrovascular complications and is cost-effective in the long-term. **E**

- It is essential in all settings that growth is monitored and charted, as well as physical development and puberty. Height and weight should be plotted on standardized growth charts at every visit. **C**
- It is essential at every clinic visit that every PwD has a general physical examination, blood pressure (BP) measured using an appropriate sized cuff if possible, injection sites inspected and feet examined (for cracks and calluses). **C**
- Thyroid status should be monitored with TSH at diagnosis, then every 1–2 years, along with monitoring of growth, puberty, and goiter. In the absence of annual TSH screening, physical examination and specific thyroid related review become more important, with TSH testing essential for those with slow height velocity, delayed puberty, unexplained weight gain, constipation, or fatigue. **B**
- It is desirable that screening is performed for other comorbid conditions (such as CD) as needed, including specific documentation of possible symptoms, and laboratory investigations where available and affordable. **E**
- It is essential to screen for nephropathy, retinopathy, neuropathy, and dyslipidemia, especially if glycemic status is suboptimal, or if there is medical or family history of diabetes or other complications. **A** The frequency and extent of screening will depend on available resources and affordability.

2.16 | Fasting

- PwD in LRS may opt for fasting because of various reasons. **E**
- Fasting is permissible only 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**

2.17 | Surgery

- Insulin must be administered to all persons with T1D during and after surgery, to avoid ketosis/DKA. **A**
- It is preferable to perform surgery in a facility that can accommodate administration of IV fluids, has at least minimal laboratory support, and has experienced staff available on site or with virtual consultations by HCP. **E**
- It is desirable to perform elective surgery when glycemia is optimal, but emergency surgery should not be delayed. **E**

2.18 | Type 2 diabetes

- T2D is increasing with the global obesity pandemic (LRS as well as middle and high resource settings), although some pre-disposed ethnic groups may be non-obese. **B**
- Socioeconomic status (SES) has large measurable associations with T2D. **B**
- Cultural, social, geographic, and economic barriers may prevent the implementation of behavioral change. These social determinants of health impact onset, prognosis and course of T2D, as well as obesity and the metabolic syndrome. It is desirable to prescribe life-style modification in the life context of the youth and family. **E**
- Treatment planning should consider household food security, household 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 should be prescribed initially. **B**
- If islet autoantibody testing is not available, then family history, 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, thyroid and liver dysfunction sleep apnea, and psychological comorbidities including learning difficulties, depression, anxiety, diabetes distress, and disordered eating, at diagnosis and on follow-up. **B**

2.19 | Language matters

- It is desirable that the DCT members educate the family to avoid use of stigmatizing words, which may 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'. Motivational interviewing techniques should be encouraged for all HCPs. **E**

3 | INTRODUCTION

In many parts of the world, especially south-east Asia, Africa and South America, T1D numbers seem low as many persons may be undiagnosed and untreated, or sub-optimally managed, with early mortality and frequent acute complications.¹⁻¹⁰ This situation seems to be improving, with better survival, but most of the available global T1D data is from developed countries, not from LRS. The T1D Index seeks to fill this void by assessing, using mathematical modeling, the probable numbers of persons with T1D and the decades of healthy life years lost to T1D.¹¹ Similarly, youth-onset T2D is also increasing, in parallel to the obesity epidemic.¹²⁻¹⁶

HCP in LRS may feel overwhelmed by best practice recommendations given in the international guidelines, which may not be possible to follow due to costs, limited availability of diabetes care supplies,

trained personnel, community awareness and support, social stigma, and government policy recognition. However, it is desirable for them to follow these LRS guidelines, to provide best possible care given their local circumstances, while striving to improve the level of care (Table 2) when situations improve.

Economic constraints due to the high, recurring costs of diabetes care, and/or lack of government aid and/or insurance support put 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.¹⁷ With costs usually paid out of pocket, the individual family's ability and willingness to spend determine quality of care.¹⁸⁻²⁰

Societal conditions such as 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 regions of high-income countries (HIC), or resource constraints (war, natural disasters, etc.) may develop suddenly. 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) and 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' has been adapted and used in this Chapter (Table 2).²¹ This stratification can assist government policy makers, professional health planners, community advocates, and HCP.²²

This guideline is 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 and family.²³⁻²⁶

ISPAD strongly advocates and encourages:

- Optimization of diabetes management and ongoing, documented education, 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.²⁷ 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 individual and societal costs, as well as early death.²⁸

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 materials, including these ISPAD 2022 CPG, and links to resources from international organizations such as Life for a Child (LFAC), Changing Diabetes in Children (CDiC), Children with Diabetes (CWD), and several national bodies and NGOs.

4 | DIAGNOSIS, EPIDEMIOLOGY, MONOGENIC DIABETES

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.²⁹ HCP, especially in the emergency rooms, should be aware of the need to test the BGL with a glucometer, and suspect diabetes in any unwell young person, especially if there is a history of weight loss, lethargy, thirst, excessive urination, ants at site of urination, abdominal pain, or persistent/ recurrent infections. If symptoms are suggestive of diabetes and blood glucose testing is not available, urine glucose testing should be performed where possible. In all youth with hyperglycemia and clear symptoms, the diagnosis of T1D should be strongly considered and insulin administered. Death from missed or delayed diagnosis may drastically decrease if this is done.

The proportion of T1D, T2D and other types of diabetes varies markedly between countries and ethnicities.^{30–35} Measurement of islet autoantibodies, 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 CPG Chapter 4 on 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.

5 | STAGES OF TYPE 1 DIABETES

Detection of Stages 1 and 2 (positive islet autoantibodies but pre-symptomatic) using extensive genetic and antibody testing of the PwD's family members or the general population, 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 T1D (hyperglycemia) is useful to prevent DKA. Therefore, strategies which increase awareness of diabetes among HCP and communities improve the chances of earlier diagnosis, before DKA develops.^{36,37} 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.³⁸

6 | DIABETES EDUCATION

The many (more than 100) 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 DSME 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; it is common for them to explore these options in the search for a cure, and omit insulin. Clear explanations and peer support at diagnosis are desirable to avoid this catastrophe.

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. Many diabetes associations now have freely available/ downloadable tools. The Pink Panther Diabetes manual as well as Hanas' Diabetes Manual are also available in multiple language translations.^{24,39,40}

A multidisciplinary DCT of pediatric endocrinologist, dietician, diabetes educator and mental health specialist, all familiar with pediatric diabetes, is not likely to be available in most LRS. The local physician is encouraged to provide all these aspects of care.^{24,39,40} However, physicians with 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. Therefore, 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.⁴¹ With a sizable number of people searching online for health-related content,⁴² such content is created by health professionals, lay persons, not-for-profit and commercial organizations.⁴³ 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 may help provide emotional, financial, and logistical support.⁴⁴ Support by experienced family members of PwD, or senior PwD peers can be helpful in the absence of a multidisciplinary DCT.^{45,46} Training them further and using their help to spread DSME can be practical, feasible and effective.⁴⁴

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 to optimize care. To fill affordability gaps, low-cost or donated Regular and NPH insulins (vs. analogs), delivery systems (e.g., vials and syringes vs. pens), and inexpensive glucometer/strips can be advised. The family may need guidance on where to buy supplies, and/or which organization to contact for support. When HCP prescribe expensive insulins or glucometers/BGL strips, this may force families to ration or miss insulin doses or BGL testing. Less frequent SMBG testing can be detrimental, particularly in the initial months when the PwD transitions from initial high insulin requirements to the honeymoon phase (with associated risk of hypoglycemia), and then to higher insulin requirements (leading to 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 education and management.

To sum up, appropriate DSME imparted at diagnosis and reinforced regularly, establishes and maintains positive self-empowering 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.

7 | INSULIN THERAPY

The goals of therapy for LRS are no different from well-resourced situations, although they are much more difficult to achieve because of the limitations discussed. While many compromises may be needed, some are unacceptable, for example, using premixed insulins and twice-daily dose regimens, because these older regimens are known to be associated with worse time in range (TIR), more DKA, and more frequent as well as more severe episodes of hypoglycemia.⁴⁷

7.1 | Choice of insulin and insulin regimen

All children and adolescents with T1D should be started on MDI regimens, using the cheaper conventional (Regular and NPH) insulins (or analog insulins if affordable and available). Basal needs are usually approximately 40% of the total daily dose (TDD), and can be met by either NPH or glargine. The price of biosimilar glargine has become close to that of conventional insulins in recent years in many regions, making it a feasible alternative to NPH for governments or donor agencies to procure.⁴⁸ It is useful in reducing nocturnal hypoglycemia and improving HbA1c.⁴⁹ Bolus needs are the remainder of the TDD, and are met by Regular insulin in divided doses, given before each meal and large snack, that is, 3–4 times a day. This ensures that insulin cover is available whenever carbohydrates are consumed, and doses can be adjusted according to the pre-meal BGL, the amount of food available, the exercise planned or anticipated, and given when the food is available. MDI regimens enable flexibility in dosing and timing, reducing the adverse impact of variable meal timings, food insecurity, and variable physical activity. They lessen postprandial and nocturnal hypoglycemia and hyperglycemia, improve QoL and school activities, as well as enabling better study and work.⁴⁷ MDI regimens are practical because currently available needles are very fine, lessening pain and needle phobia.

7.2 | Examples of MDI regimens

1. NPH is given once daily (before dinner or at bedtime), with Regular Insulin given before breakfast, lunch, dinner and any large snack (such as a meal with substantial carbohydrates which most children eat at school). The PwD 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. Sometimes, glargine may have to be split into morning and bedtime doses, with mealtime Regular insulin boluses, based on BGL pattern review as well as history of hypoglycemia.

Premixed insulins and twice-daily dose regimens are still used in many LRS, but they are non-physiologic and are not recommended for T1D. When pre-mixed insulin is the only available insulin, it may be given briefly until Regular and NPH insulins are available. The TDD can be divided into before breakfast, before mid-day meal and before dinner doses. The use of pre-mixed insulins is associated with more frequent and severe hypoglycemia, more hyperglycemia and DKA, and general inflexibility with dietary as well as exercise or sick day needs.⁴⁷ This is further exacerbated by the limited ability for frequent BGL testing in LRS. In situations of food insecurity, severe 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 older twice-daily split-mix regimen is also not appropriate for T1D as the mid-day meal does not get adequate insulin cover, resulting in afternoon and evening hyperglycemia. Post-breakfast hypoglycemia can occur, especially in school when the parents are not able to adequately monitor, and then this impairs the PwD's ability to study as well as play. The risk of post-dinner and nocturnal hypoglycemia is often high. With food insecurity, hypoglycemia may become dangerous as well as more frequent and produce possible insulin omission in an effort to reduce such episodes, rather than adjusting the dose or timing of insulin. 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 in such situations.

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

Whichever insulins and regimens are chosen, support by comprehensive DSME, appropriate for the age, maturity, and individual needs of the PwD and family, is needed.⁵⁰ 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.⁵¹ Hence education regarding appropriate syringes (U40 vs. U100, shortest needle length of 6 mm) and techniques for mixing Regular and NPH insulins is important. In some countries, conventional insulin vials are available in both concentrations - U40 (40 U per ml) and U100 (100 U 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 0.5 U increments needed, for example, for a small child. The U40 syringes have 1 U increments so 0.5 U can be given, cf. the 1 ml U100 syringes which have 2 U 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 are maintained.

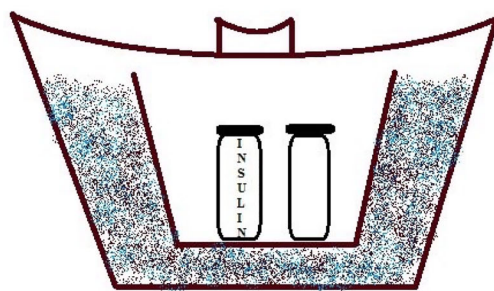
Dosing errors with pens tend to be fewer than with syringes, and pen needles of 4 mm length are available. Needles of 4 mm length are especially important in the very young and the under-nourished child.⁵² Therefore, if available and affordable, insulin pens with 4 mm needles should be considered, especially if dosing or numeracy errors persist.

7.3 | 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 carried home with a cooling arrangement. Insulin in use must be 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 (Figure 1), goatskin, acrylate polymer bead wallets, and so forth, have

FIGURE 1 Clay pot (courtesy Dr Archana Sarda)



been devised to store insulin at temperatures below 25°C.⁵³ Kept in a shaded, airy place; they work well if humidity is low.^{54,55} Alternatively, insulin can be transported and stored wrapped in plastic, in a thermos flask, along with 3–4 cubes of ice, which are replaced when they melt. Too much ice should be avoided.

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 successfully for longer than 4–6 weeks. 'Older' insulin may sometimes have less potency and hence the insulin doses may need to be increased, as guided by SMBG. Subsequently, when a new insulin vial or cartridge is opened, doses can be reduced as necessary.^{56–59}

7.4 | 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.⁶⁰

8 | GLUCOSE MONITORING

8.1 SMBG It is crucial that treating physicians as well as families of PwD are aware that SMBG is an integral component of T1D management. Regular glucose monitoring, several times daily, whether using SMBG or CGM if available, is essential for effective management.^{61,62}

Unfortunately, test strips and batteries are expensive and may be unavailable or unaffordable in LRS. Local and/or international NGOs increasingly assist with this. Lobbying to achieve favorable government, NGO, and insurance policies to make adequate (several times, every day) 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 (for example 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 that the doses/time/activity/diet can be planned accordingly on other days as well, with the guidance of the DCT. Monitoring on other days is then done as per individual need, for example, 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. Performing a 6–8 point profile on the same day, as often as possible in a week, may be more useful.

PwD and their families 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 and documented in the health care records 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 but awareness by HCP is key to such considerations. Motivational interviewing and empowerment skills frequently produce positive results and are helpful.

8.1 | 8.2 Continuous glucose monitoring

CGM has transformed diabetes care in recent years.^{63,64} In many LRS, CGM is unavailable or simply unaffordable, as constant use may cost 3–10 times more than SMBG. However, availability may rapidly change. When comparing costs, while teaching the family or lobbying with policy makers, the savings on multiple BGL test strips, the reduction of acute and chronic complications, and the prevention of hospitalizations should be factored in, as it considerably reduces the cost

difference, while also reducing the pain of multiple daily pricks. The lifetime improvement of QoL, with fewer acute and chronic complications, must be emphasized by the DCT and communities lobbying for governments' (and NGOs') support in this regard. Regular CGM use reduced HbA1c by 0.98% even in LRS.⁶⁵ 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 CGM every few weeks may be considered. This can help the family understand the impact of different foods and activities on BGL. In addition, families may wish to use CGM during special situations such as travel, illness, exams, or pregnancy. Donors may be requested to help for special situations. It is desirable that the DCT keeps abreast of these and other technology changes and explore options with the PwD and families, open up discussions with NGOs and other potential donors as well as with health policy administrators.

9 | GLYCEMIC TARGETS

9.1 BLOOD GLUCOSE TARGETS Glycemic targets set by the DCT, especially the lower limit, will 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), in order to reduce hypoglycemia. For example, a rural family with poor literacy, able to afford only a few strips, and with little or no access to medical care in a crisis, or both working parents, may be advised to maintain BG above 90 mg/dl (5.5 mmol/L).

9.1 | The upper BGL target of 180 mg/dl (10 mmol/L) is suitable for most PwD in LRS.

9.1.1 | 9.2 HbA1c

HbA1c continues to have a central role in assessing overall 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 PwD. These targets may be renegotiated when circumstances change, for example, if more test strips are available, or as the PwD matures and can become more autonomous.

HbA1c testing should be performed every 3 months, if available and affordable, with results discussed with the PwD and caregivers, and documented in the medical records.

10 | NUTRITION

Availability and affordability of food and the frequency of SMBG vary in LRS. Food insecurity adversely affects diabetes management,⁶⁶ and 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 HbA1c levels, as well as nutritional deficiencies, including iron, calcium, protein and vitamin D. Regular monitoring and recording of growth (height, weight, BMI), plotted on standardized growth charts (and discussed with the PwD and family) enable detection of deceleration patterns, or growth rates inconsistent with mid-parental height, and perhaps help consider co-morbidities such as thyroid or celiac disease.^{24,39,40}

Nutrient deficiencies will need to be assessed (e.g., Vitamin D deficiency due to several factors including inadequate sun exposure, or B12 deficiency in vegetarians/vegans), and may necessitate 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.⁶⁷ The meals of a PwD are essentially healthy meals and the entire family should eat the same food. 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 also encouraged to receive ongoing nutrition education either in clinic or with local group support formats.

Nutrition education starts with the basics of food composition and distribution. The plate method, with use of pictures (as in Figure 2), 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, and fat) and fluids in desirable proportions, with affordable options. Pictures can be sent to mobile phones, and are useful even for rural families with low SES and/or poor literacy, to teach inclusion of missing or inadequate macronutrients (often protein) in the right proportion and without excess carbohydrates (e.g., too much rice or potatoes).

If a dietician familiar with T1D is locally unavailable, nutrition advice can be supplemented by telemedicine and virtual educational tools. This must be added to the specific tasks of the physician or nurse and documented at least every 3–6 months in the medical records. Appropriate apps and educational material are available in many countries and languages, including the websites of LFAC, ISPAD, CWD and regional and national Diabetes Association websites, for visual carbohydrate counting.



FIGURE 2 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]

Junk foods⁶⁸ should be discouraged for the entire family (not just the PwD). Carbohydrate rich festive foods can be permitted as a treat on special occasions and celebrations, in small portions, with extra insulin and activity considered accordingly. 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 often more 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 such as 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).

11 | EXERCISE

The WHO recommends 60 min of 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.⁶⁹ 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, youth (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 PwD may need to perform 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: PA can be encouraged with appropriate diabetes education and 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.

12 | HYPOGLYCEMIA

The sharp reduction in incidence of SH seen with greater use of SMBG, MDI, insulin analogs, CGMS, and pumps, has not occurred in LRS.⁷⁰ Without optimal SMBG at home, school or work, the incidence and severity of hypoglycemia, especially nocturnal hypoglycemia, rise. Regular insulins are less physiologic vis-à-vis food and activity, and so increase such risks. 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 is more difficult to detect and treat, and far more dangerous.

Therefore, hypoglycemia and fear of hypoglycemia 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 insulins⁴⁷), errors in insulin administration, inadequate knowledge of insulin dose adjustments, food insecurity, unbalanced and/ or 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 be associated with 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 with specific documentation in the medical record.

Regular SMBG, including periodic 2–3 am BGL checking (or CGM if affordable and available), with adjustment of insulin doses, is key to preventing and treating hypoglycemia. The BGL diary should be discussed at each clinic visit and discussion documented. If conventional insulins are being used, education about resuspending NPH carefully, need for mid-meal and bedtime snacks, daily SMBG, and site rotation for insulin injections (avoiding lipohypertrophy) is regularly reinforced. If food insecurity is likely, education about insulin dose modifications, maintaining safety, and preventing hypoglycemia needs review and reinforcement. Checking overnight BG must be especially encouraged after excessive PA and reduced or delayed meals. In moderate

hypoglycemia, sublingual application of glucose or sugar appears to work better than oral administration.^{25,71,72}

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 settings may not be familiar with IV glucose administration. The DCT is encouraged to provide written documents for the family to give such HCP, giving simple, clear instructions for emergency management of hypoglycemia.

Availability of injectable glucagon should be strongly considered for donations by NGOs in addition to blood glucose meters, testing supplies and insulin. Newer injectable forms of glucagon no longer require refrigeration or premixing so that dosing is easier and less likely to be problematic or erroneous. Fear of using the older, glucagon “spear” needles is also avoided with these new formats. The newer nasal spray glucagon is easier to use, has more consistent BGL responses, minimal side effects and gives more confidence to the user for administration.⁷³ Consideration should be given for donations of nasal spray glucagon kits for home and school use if costs can be controlled, or covered by donations.

Whatever type of treatment for hypoglycemic emergencies is decided upon, initial education of the PwD and family members should be documented and routinely reinforced at least annually, as the PwD matures, assuming more self-care with less adult supervision as an adolescent and young adult.

13 | SICK DAY MANAGEMENT

DSME and simple written instructions for managing sick days at home; as well as for HCP in peripheral health settings; are important. Families are advised and reminded about the importance of 2–4 hourly SMBG and at least 6 hourly ketone checking if available and affordable, 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 when available for those in remote areas. If not feasible, urine ketone sticks should be made readily available, as they are inexpensive.

More widespread use of mobile phones has made it possible to send simple instructions in local language(s) or recorded message to caregivers, and enable them to contact the DCT quickly. Access to emergency contact numbers of DCT members is important, especially for families with low literacy. Education and reinforcement at least

annually, with proper medical chart documentation by the DCT is important.

14 | DIABETIC KETOACIDOSIS

In LRS, DKA is likely to occur more frequently, particularly at diagnosis.²⁹ With infections predominating in LR scenarios, clinical mimics are gastroenteritis, respiratory infection, urinary tract infection, septicemia, acute malaria and other local infections. There may be areas with little or no emergency room or pathology support to make the diagnosis of DKA. In typical cases, the clinical features and presence of hyperglycemia (detected by high blood or urine glucose) and ketosis (urine or blood ketones) are sufficient to make the diagnosis of T1D in DKA, even if it is not possible to measure venous pH or serum bicarbonate. All HCP should know the key questions to ask relatives of extremely ill children, adolescents, or young adults, including any enuresis, nocturia, ants at the site of urination or unexplained weight loss. If the answers to such simple questions by HCP is yes, then there is an obvious need for an immediate finger stick BGL and/or urinalysis for glucose and ketone determination, where possible.⁷⁴ Delays in diagnosis lead to risk of and greater severity of DKA, more complications such as cerebral edema, and higher mortality of 3.4%–13.4% (due to sepsis, shock, renal failure etc.).⁷⁵ Further, minimal or no availability of IV fluids, venous access, medications, laboratory access, intensive care units and experienced HCP interfere with optimal treatment. Posters for increasing awareness of the general public (provided by youth with diabetes as volunteer distributors to schools, nursing offices, locker rooms, pharmacies and emergency facilities) can be adapted with local pictures and local language sources.^{36,37,76} It is also important to increase awareness among primary care HCP to suspect and diagnose DKA early, provide initial emergency treatment, and know when to transfer to a more experienced health facility. Appropriate emergency telephone consultations should also be established, not only for specific medical questions that may arise, but also to facilitate possible transfers if necessary.

If serum pH or bicarbonate testing are unavailable, so that classifying the severity of DKA is not possible, this should not lead to delay in treatment. If available, 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, if unavailable.

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 about 30% 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.

If IV infusion pumps are not available and/or intensive monitoring is not possible, SC or IM insulin (Regular or rapid-acting insulin) injected every 4 or 2 h respectively may be advisable regardless of

DKA severity.^{25,77} This is preferable to using an IV insulin infusion, which is difficult to precisely titrate. If IV fluid therapy is available but laboratory testing including electrolyte monitoring is not, standard rehydration fluids should be used, and potassium should be empirically added at 40 mEq/L once the PwD has voided. Dextrose 5%–10% should be added once the BGL approaches 300 mg/dl (17 mmol/L).

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).

15 | PSYCHOLOGICAL CARE

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.⁷⁸

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 as 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. Motivational style interviewing and empowerment techniques used consistently by all members of the DCT have been shown to be extremely helpful in not only identifying such problems, but also in initiating discussions regarding medical as well as family and psychosocial issues with the PwD and family members.^{40,50}

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 and can escalate to (secret) fear of hypoglycemia and omitting insulin and episodes of recurrent DKA. 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 PwD may feel guilty and isolated, often cannot test or take insulin or food in time, and so runs the risk of more hypoglycemia, more hyperglycemia, and multiple 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 families in LR settings 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, for example, 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 and so are unable to appropriately supervise the PwD. 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, fear of hypoglycemia, or recurrent DKA in the PwD. Family psychosocial problems may be aggravated by having to deal with a demanding chronic illness along with fears about the future health of the PwD. 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; or if they are self-treated with alcohol, marijuana or other substance abuse.

Often these social and financial problems are much greater for girls and women with diabetes. The burden of caring for the PwD may be disproportionately placed on the mother. The DCT is encouraged to involve other family members in participating and taking ownership of the PwD's diabetes care and specifically consider inviting fathers to clinic sessions or education sessions, not just mothers; as well as considering invitations for older siblings of the PwD, friends and grandparents or other relatives who may be available and appropriate to receive not only education but also support from the DCT.

Mental health specialists familiar with T1D are often not available locally, but may be accessed virtually. In addition, contact with older, well-adjusted PwD or with PwD parents can provide support. For example, CWD has an on-line support system that offers the PwD an age-appropriate “friend” who also has T1D, and similarly can offer support for moms and dads as well as grandparents, as can local or national diabetes organizations and weekend or holiday or summer diabetes camping programs. Adolescents and young adults enrolled in colleges and universities also have such support programs available on-line.

16 | VERY YOUNG (PRESCHOOL) CHILDREN

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, with specific attention paid to inviting fathers and not only mothers to be fully educated and available for ongoing supervision and education. Other relatives, including grandparents and older siblings, who may be full or partial caregivers, should also be included at the time of initial diagnosis and in follow up sessions.

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 0.5 U pens are expensive and usually unavailable. It is possible to give doses of U40 insulins with 0.5 U increments. If analog insulins are being used, 0.5 or 0.3 U 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. Additional support from donors may be needed to help in such instances. 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 every 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, but often challenging. Tackling half-finished meals, erratic PA, and insulin dose adjustments should be taught and reinforced in a manner, which is understood. Sometimes giving preschoolers part of their mealtime insulin before and the remaining dose immediately after, can help to allow insulin adjustments for erratic eating, thus avoiding later hypoglycemia problems.

17 | SCHOOL

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 PwD (especially girls) out of school, because ‘the child is sick’, or for financial reasons. Many families or schools ask the PwD (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 or how it can be managed. Relevant diabetes education for caregivers in school and age-appropriate discussion with peers are helpful.^{79–81} 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 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 BGL is not tested daily before taking insulin.

Each PwD should have an individualized DMP made jointly by the DCT, parents, and school staff. When mobile phones are available, they can be utilized for sending the DMP and other diabetes education material to the school staff, and maintaining contact between the PwD, staff, parents, and if needed, the DCT. During the COVID pandemic years, mobile phones and video-calls were extensively and effectively used.⁸² 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. Posters about diabetes symptoms available with local pictures and local languages can be freely provided to school administrators and nursing staff to help with local community awareness and decreasing stigma.⁴⁰

18 | ADOLESCENCE

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.⁸³ Many youth may have to start working early to supplement family income, while pursuing education/dropping out of studies, adversely impacting diabetes care.

In many 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 even 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 very 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.⁸⁴ The myth that women cannot be pregnant because of diabetes must be removed⁸⁵ but the added risks of diabetes and pregnancy must be explained in an honest, compassionate manner, to help improve quality of life and also the health of the potential mother and fetus/baby.

Psychological support through group education programs and support sessions once again are particularly valuable and cost-efficient in LRS. Residential camps or weekend sessions have been successful around the world, whatever the settings,^{25,44} since adolescent needs and challenges are the same globally; more so in LRS lacking formal institutional support.

Risk-taking behavior by adolescents with diabetes also are the same globally. Education is vital to keep them safe. Physical or verbal abuse may occur, and 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. Here, too, employing a motivational educational and empowerment approach and more frequent contact, visual or in person, according to availability of staff, can be extraordinarily helpful.

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.

19 | 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, adolescents, and adults. Where adult and pediatric care are separate, the pediatric team has to facilitate the transition as smoothly as possible. Some clinics in LRS transition at age 12 years while most transition between ages 15 and 21 years. There are numerous reports from around the world in high, middle and low resource settings that document the deterioration of glycemic control associated with increased acute and chronic morbidities in the PwD in the adolescent and young adult years,⁸⁶ and efforts to address these problems continue. Being aware of these difficulties, having honest discussions with the PwD and family and having joint programs for a few years between pediatricians and adult physicians has been helpful in raising awareness and addressing these issues.

20 | COMPLICATIONS AND SCREENING

Regular recording and tracking of height, weight, BP, and pubertal status just need care with measurement and record keeping: they cost nothing, while yielding considerable information. 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, properly measured and plotted on standardized growth charts, with the mid-parental height (MPH) plotted on the right y-axis, are helpful, since children typically follow a centile more or less in consonance with the genetic endowment (accounted for by the MPH). Abnormal growth velocity can help recognition of abnormalities, can be shown to the parents also, and evaluated, so early treatment and correction can be provided. 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, and parasitic infestations).⁸⁷ Dysglycemia can be due to several reasons: non-physiologic treatment plan, unaffordable insulin or expensive insulin analogs which are unaffordable (hence rationed or omitted), and/or with inadequate or no SMBG. Mauriac syndrome,⁸⁸ due to very severe longstanding dysglycemia, is characterized by growth failure, hepatomegaly with glycogenic hepatopathy, steatosis, and late pubertal development. Most examples of Mauriac Syndrome also have frequent significant psychosocial ramifications, family conflicts, and major problems with insulin and monitoring.

Similarly, BP and Tanner staging should be documented and commented upon at each visit. Physical examinations should be thorough, including simple tuning fork assessment of neuropathy. An in-clinic ophthalmoscope helps look for cataracts and early retinopathic changes, especially in those with longstanding high HbA1c levels, recurrent DKA, coexisting nephropathy, or neuropathy. Limited joint mobility (LJM) costs nothing to assess, and may allow the PwD to see an obvious change in their own body, which if present, is directly associated with increased neurologic, nephropathic and ophthalmic risks.^{39,89} All this is especially valuable in LRS, where routine annual screening and testing for comorbidities may not be possible, so testing can be done at least for those with altered growth and development patterns as well as those with abnormal limited joint mobility.

Many NGOs e.g. LFAC and CDiC include not only HbA1c testing systems and supplies, but also on-site microalbuminuria testing systems so that at least these can demonstrate potential abnormalities on annual checkups. If abnormal, and certainly if progressively worsening, associated with higher HbA1c results, positive LJM findings and/or neuropathy or retinopathy by history or exam, warrant further specific renal function testing.

21 | FASTING DURING RELIGIOUS OBSERVANCES BY PEOPLE WITH DIABETES

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 medical 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 as well as Yom Kippur 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 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. PwD whose glycemia is not-in-target, who are unable or unwilling to monitor BGL frequently, or who need to perform physical labor, are at risk of severe hypoglycemia and/or dehydration, and should be advised not 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 increased 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 for 24 h) 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 noon, 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 as well as attention paid to no meat protein since that may also change the insulin dose required for that meal.

Hindu fasts are usually for 1 day, often with milk and/or fruits permitted. Longer fasts (e.g., 9 day fasts called *Navaratri*) 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, for example, 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 or reducing the morning dose and taking NPH only at night and again perhaps some reduction in dosage). The Regular insulin bolus is taken before any major meal, as above, with potential dose reductions and ongoing BG monitoring for safety reasons. Non-physiological regimens (two dose and/ or using premixed 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.

22 | SURGERY

Youth 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/adolescent/young adult diabetes. Elective surgery should be performed with pre-existing glycemia optimized as much as possible. 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, until the PwD can accept food orally. Increased day and overnight blood glucose monitoring should serve as a guide to what IV fluids, foods and insulin doses are needed.

22.1 | 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 likely will be missed unless overtly symptomatic.

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 h before surgery holds good. Clear fluids and breast milk may be allowed up to 4 h 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.

23 | TYPE 2 DIABETES

The prevalence of T2D in the young is rising in many parts of the developing world,⁹⁰ 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.⁹¹ The risk of T2D rises if there are additional factors including 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.⁹¹ Regular PA and reduction of junk food can be advised in all medical encounters with motivational interviewing and empowerment support as previously mentioned; and height, weight plotting 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.⁹² 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 autoantibodies 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.

24 | SUMMARY

Diabetes care for LRS should be optimized by following general guidelines as much as possible. If optimized nutrition and activity cannot be arranged, educational efforts should address these issues adapted according to whatever possibilities exist. Advising near-physiological insulin regimens, optimizing SMBG, home analysis of BG results, adaptations for school (in school and after school activities), and sports participation as well as special celebrations involving food can all be done with appropriate education and at least annual updated reviews. The

DCT should be consistent with advice, and document very specifically in the medical record, to avoid confusion. Education efforts should also be reviewed for changes with growth and development and any individual circumstances for the PWD and family. Monitoring growth, BP, sites, LJM, HbA1c, urine albumin excretion, and ophthalmologic, lipid, thyroid and any other examinations warranted by individual needs (e.g., testing for CD) to the extent possible and affordable, should be a priority. Preventing hypoglycemia and DKA, and handling mental well being, with motivational interviewing and empowerment efforts is needed on an ongoing basis. All these efforts, locally and via telemedicine, would help the PwD optimize health and QoL.

AUTHOR CONTRIBUTIONS

All authors contributed to writing of the Guidelines, and critically read and revised the manuscript.

CONFLICT OF INTEREST

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**APPENDIX A: ISPAD 2022 CLINICAL PRACTICE CONSENSUS
GUIDELINES CHAPTERS LIST**

Chapter numbers	Chapter titles
1	Definition, epidemiology, and classification of diabetes in children and adolescents
2	Stages of type 1 diabetes in children and adolescents
3	Type 2 diabetes in children and adolescents
4	The diagnosis and management of monogenic diabetes in children and adolescents
5	Management of cystic fibrosis-related diabetes in children and adolescents
6	Diabetes education in children and adolescents
7	The delivery of ambulatory diabetes care to children and adolescents with diabetes
8	Glycemic targets and glucose monitoring for children, adolescents, and young people with diabetes
9	Insulin treatment in children and adolescents with diabetes
10	Nutritional management in children and adolescents with diabetes
11	Assessment and management of hypoglycemia in children and adolescents with diabetes
12	Sick day management in children and adolescents with diabetes
13	Diabetic ketoacidosis and hyperglycemic hyperosmolar state
14	Exercise in children and adolescents with diabetes
15	Psychological care of children and adolescents with type 1 diabetes
16	Diabetes technologies: Glucose monitoring
17	Diabetes technologies: Insulin delivery
18	Microvascular and macrovascular complications in children and adolescents with diabetes
19	Other complications and associated conditions in children and adolescents with type 1 diabetes
20	Management of children and adolescents with diabetes requiring surgery
21	Diabetes in adolescence
22	Management and support of children and adolescents with diabetes in school
23	Managing diabetes in preschoolers
24	Ramadan and other religious fasting by young people with diabetes
25	Management of the child, adolescent, and young adult with diabetes in limited resource settings <i>This chapter.</i>