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ISPAD GUIDELINES

ISPAD Clinical Practice Consensus Guidelines 2022: Managing diabetes in preschoolers

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1 | SUMMARY OF WHAT IS NEW OR DIFFERENT

- Preschool children with type 1 diabetes (T1D) who have access to modern diabetes care can safely achieve a HbA1c below 48 mmol/mol (6.5%).
- Continuous glucose monitoring (CGM) is the recommended tool for glycemic monitoring in preschoolers with T1D.
- When using CGM, a reasonable treatment target is 50% time in target (TIT) 3.9–7.8 mmol/L (70–140 mg/dL) or 70% time in range (TIR) 3.9–10 mmol/L (70–180 mg/dL).
- Insulin pump is the preferred method of insulin delivery in this age group whenever available and affordable.
- Hybrid closed loop insulin pump therapy is valuable and needs to be made available to children with T1D in this age group as they generally have a high day-to-day variation in insulin needs.
- Early onset diabetes is associated with a high lifetime risk of diabetes complications, necessitating optimal glycemic control from onset.

2 | EXECUTIVE SUMMARY AND RECOMMENDATIONS

- The ISPAD target hemoglobin A1c (HbA1c) for children is <7% (<53 mmol/mol). As children diagnosed with T1D at preschool age are expected to have a long diabetes duration and thus have a high risk

of diabetes complications **B**. They benefit from a tight glycemic target and maximizing time spent in glycemic target range from the onset. **C**

- A reasonable treatment goal after the initial remission period in insulin treated children younger than 7 years can be >50% of time in target (TIT) 3.9–7.8 mmol/L (70–140 mg/dL) or >70% TIR 3.9–10 mmol/L (70–180 mg/dL). **B** Soon after diagnosis, during the remission period, a higher TIT and TIR is preferable. **E**
- Intensive insulin therapy, that is, as close to physiological insulin replacement as possible, with a combination of basal insulin and pre-prandial insulin boluses should be used, with frequent glucose monitoring and meal-adjusted insulin regimens. **C**
- Insulin pump therapy is the preferred method of insulin administration for young children (aged <7 years) with T1D whenever available and affordable. **E**
- As pump treatment develops further with hybrid closed loop (HCL)/automated insulin delivery (AID) this treatment modality needs to be made available and adapted for children younger than 7 years. **A** The special needs of toddlers and preschoolers should be addressed when developing these devices. **E**
- If pump therapy is not available, multiple daily injections (MDIs) should be used from the time of diagnosis. **E**
- Pre-prandial administration of bolus insulin and insulin given for correction if blood glucose is high is preferable to giving the insulin dose during or after the meal. **B**
- Studies in this age group support introducing carbohydrate counting at onset of diabetes. **C**
- Syringes with ½ unit markings and pens with at least ½ unit dosing increments should be used to facilitate more accurate insulin dosing when injecting small doses of insulin in multiple daily injection therapy. **E**
- Continuous glucose monitoring (CGM) is the recommended method of glucose monitoring. **C**
- If CGM is not available, 7 to 10 blood glucose checks per day with appropriate interpretation and action are usually needed to achieve target glycemia in this age group. **C**
- Lifestyle interventions, such as food choices and physical activity, designed to reduce the risk of subsequent cardiovascular disease in children with T1D, should already start in preschool age children and should be directed toward the entire family and not just the individual child with T1D. **C**
- Family-centered meal routines with restrictions on continuous eating habits (grazing) are important to ensure dietary quality and optimize glycemic control in preschool children. **C**
- Breastfeeding is recommended for all infants in accordance with WHO recommendations. This includes infants with diabetes. **E**
- Insulin dosing in breastfed infants can preferably follow a basal-bolus pattern with bolus dosing based on carbohydrate counting. **E**
- Diabetes education should be provided to staff at preschools and schools where children with T1D are enrolled, to promote equal and safely managed participation in all preschool/school activities. **E**
- Optimal glycemic control, minimizing exposure to both hypoglycemia and hyperglycemia will give the child the best opportunity to concentrate, participate, and learn while at preschool and school. **C**
- Weight, height (or length if <24 months), and Body Mass Index Standard Deviation Score (or percentiles) should be monitored at least every third month on growth charts in preschool children with T1D. **E**

3 | INTRODUCTION

This chapter focuses on components of care unique to toddlers and preschool-aged children with T1D. These guidelines are written for children with T1D aged 6 months to 6 years, but practical aspects might also be useful in younger children with insulin-treated diabetes. Children younger than 6 months of age at diagnosis should be investigated for other types of diabetes including monogenic diabetes, and their management is discussed further in ISPAD 2022 guidelines Chapter 4 on 'The diagnosis and management of monogenic diabetes in children and adolescents'.

Early onset T1D is associated with a high risk of early cardiovascular disease and premature death.[1] The strongest modifiable risk factor associated with diabetes-related mortality due to microvascular and macrovascular complications is HbA1c.[2,3] Glycemic target setting has been shown to positively affect outcomes.[4–6]

Preschool children are dependent on others for all aspects of their care. For the families (primarily parents) of preschool children with T1D, their diabetes teams and other caregivers (including school and daycare staff members and babysitters), treatment is a constant challenge. Despite the challenges, it is important to strive for normoglycemia, as current knowledge about the implications of dysglycemia makes reducing the likelihood of acute and chronic complications imperative from the time of diabetes onset.[7,8] Optimizing glycemic control for children in this age group often requires treatment strategies that differ from those employed for older children and adolescents with T1D. These strategies need to take into consideration the cognitive, motor, and social developmental levels of preschool children as well as their small body size and growth pattern.

In addition to their dependence on others (in this chapter referred to as "caregivers," i.e., parents) for insulin administration and glucose monitoring, preschool children are also dependent on others for aspects of their lifestyle related to healthy eating and physical activity. Lifestyle choices and preferences established during early childhood provide a window of opportunity for ingraining healthy habits that may be perpetuated throughout the child's life. The early establishment of positive behaviors may help to ameliorate the high risk of cardiovascular disease that is associated with diabetes. Providing adequate education and support for lifestyle changes requires that the multidisciplinary diabetes team uses a family-based approach to ensure that the whole family is appropriately supported to promote health.

Early childhood is an important time for establishing salutogenic[9] and adaptive health behaviors and parents and primary caregivers of young children play an important role in this process. Supporting caregivers while they become increasingly comfortable with intensive insulin treatment is vital, including support for the caregiver's own physical and emotional health.[10,11] It is also important to teach caregivers, strategies for helping their young child to become an active

participant in their own care. Young children can help caregivers complete diabetes-related tasks such as helping to select a finger for glucose monitoring, a site for injection/infusion, and selecting healthy foods. It is also recommended that caregivers employ think aloud strategies to begin to teach young children problem-solving skills.

Screening and promotion of optimal health-related quality of life should be regularly undertaken in preschool children with T1D as in any child with T1D.

Children younger than 7 years with T1D constitute a minority of the population of all pediatric patients with T1D. Small centers will have few very young patients and it will take longer to gain experience in the care of this patient group. Close collaboration between centers is necessary to optimize quality of care for preschool children with T1D.

4 | GROWTH AND DEVELOPMENT IN THE FIRST YEARS OF LIFE

For preschool children to experience normal growth and development, it is essential that they maintain near normoglycemia, aiming to maximize glucose time in target range, and are provided with sufficient nutrients. Restrictive diets or lack of food make it difficult to provide essential nutrients for growth and development and must be avoided. This requirement of sufficient nutrition is in part due to the brain's high metabolic requirement in infancy and childhood.

It is essential to monitor weight, height (or length if <24 months in accordance with national health care recommendations), and BMI-SDS (or percentiles) on growth charts in preschool children with T1D at least every third month. When telemedicine is used it is important to have access to valid data measured by health care professionals on height/length and weight at least every third month.

5 | THE BRAIN AND COGNITIVE DEVELOPMENT IN CHILDREN WITH EARLY ONSET T1D

Multiple risk factors have been associated with potential suboptimal cognitive and fine motor development in children and adolescents with T1D. These factors include early onset of disease (typically defined as <5 years of age),[12] disease duration, history of moderate to severe ketoacidosis (including those at diagnosis),[13] severe hypoglycemia (including seizures or unconsciousness)[14] and cumulative exposure to hyperglycemia.[15] A meta-analysis showed that the risk of cognitive disruption is largest for children with early-onset diabetes and the effect is detectable after a mean diabetes duration of 6 years. The mean effect size is moderate but might not be large enough to affect school performance.[8] Clinicians should be concerned about diabetic ketoacidosis (DKA), severe hypoglycemia and hyperglycemia all being detrimental for the health of the preschool child.[7]

During toddler and preschool years, the brain is highly sensitive to metabolic disturbances; potential abnormalities, particularly affecting white matter, have been identified in several neuroimaging studies of young brains exposed to glycemic extremes, as occurs in T1D.[16–18] The mechanisms by which early brain development is affected by T1D are not clearly understood. Long-term exposure to hyperglycemia as well as hypoglycemia (especially with seizures) and oxidative stress caused by glycemic variability are possible contributors. Both the duration and age of onset of diabetes appear to play a key role. For instance, metabolic conditions such as hyperglycemia and ketoacidosis at diagnosis may make the brain more vulnerable to subsequent metabolic insults.[7,8,19]

Existing meta-analyses report decrements in domains of intelligence quotient (IQ and verbal IQ in particular), executive function (attention, working memory, and response inhibition), delayed memory (episodic recall), and processing speed (paper-pencil) among children with T1D compared to age-matched children without diabetes, although these differences are generally not reported until the children are studied later in childhood.[12] It is possible that chronic exposure to different aspects of dysglycemia is additive, and that brain and cognitive changes only become apparent over time or that children need to achieve a threshold of cognitive maturity for differences to become measurable.[7]

Optimal glycemic control will give young children with T1D the best opportunity to concentrate, participate, and learn while at preschool and school. Health care professionals are best able to help children avoid any negative impact of T1D on everyday functioning by mitigating prolonged exposure to hyperglycemia, and by ensuring early identification and providing interventions for academic, cognitive, or motor issues. For further reading, the ISPAD 2022 guidelines Chapter 15 on Psychological care of children and adolescents with T1D comprehensively addresses this subject.

6 | GLYCEMIC TARGETS IN PRESCHOOL CHILDREN WITH TYPE 1 DIABETES

Optimizing glycemic control for preschool children with T1D is crucial for their future, both with respect to acute and long-term complications[2] as well as their neurocognition, brain structure,[7] and health-related quality of life (HRQoL).

ISPAD 2022 Consensus guidelines Chapter 8 on Glycemic Control Targets has recommended glycemic targets for hemoglobin A1c (HbA1c <7.0%, <53 mmol/mol). This target is applicable to all pediatric age groups and the aim is to optimize glycemia for each individual child. Children younger than 7 years with access to high quality diabetes care, including modern technology can achieve HbA1c 6.5% [48 mmol/L] or lower without a high risk of hypoglycemia.[20,21]

Optimizing glycemia is important in preschool age children diagnosed with T1D due to their higher risk of diabetes complications and premature death than persons diagnosed with diabetes later in life.[1] There is also evidence that hyperglycemia during childhood raises the risk of long-term complications even if substantial improvement is achieved later during young adulthood.[22] This evidence underscores the NICE guidelines, which encourage an HbA1c target ≤6.5% (≤48 mmol/mol)[23] and may fuel urgency within all guidelines to strive for HbA1c levels that are as low as safely achievable for preschool age children to reduce the risk of long-term complications of T1D. It is important that the diabetes team and family share the same glycemic targets; hence they should be set and evaluated together with the

child's family. Likewise, the glycemic targets need to be communicated to other caregivers (i.e., at preschool) to guide the child's treatment. From the onset, it is important for the entire diabetes team to communicate that near normoglycemia is achievable through diabetes education and clearly set glycemic targets.[4–6]

A CGM study in healthy children aged 2–8 years showed that glucose is in the range 4–7.8 mmol/L (72–140 mg/dL) 89% of the day.[24] A reasonable treatment goal after the initial remission period in insulin treated children younger than 7 years can be >50% of time in target (TIT) 3.9–7.8 (70–140 mg/dL) or >70% time in range (TIR) 3.9–10 mmol/L (70–180 mg/dL). Soon after diagnosis, during the remission period, a higher TIT or TIR is preferable.

It is important that both the diabetes team and families of young children use a language that tells the child that a glucose value can be high, low or in range, and that the glucose level is never "good" or "bad". The knowledge of a glucose value often calls for action, but never for blame or punishment. Rather than asking a child "*Your glucose is high—what did you do?*" or "*what did you eat?*," which can imply that the child has done something wrong, caregivers can be taught to "think out loud" and involve even young children in problem-solving (i.e., "*The glucose is high. What do we do when the glucose is high? Exercise and insulin can help. This time you will get insulin.*") This process can be started well before the child has an expressive verbal language, since the child's receptive language development starts early. This means that introducing diabetes related problem-solving gets integrated into the child's global development from diagnosis. It is important to be proactive when discussing glucose data and problem-solving in the clinic and to analyze positive examples together with the caregivers versus only reacting to glucose excursions.

7 | INSULIN THERAPY IN PRESCHOOL CHILDREN

Insulin treatment guidelines for preschool children are essentially similar to older children and adolescents, with age-dependent aspects taken into consideration. Insulin treatment always needs to be tailored for the individual child and planned together with their caregivers. Approval of insulin analogs for different age groups is regulated by authorities. See the ISPAD 2022 Consensus Practice Guidelines on Chapter 9 on Insulin treatment for further reading on insulin and insulin analogs in pediatric use. Worldwide, most preschool children with diabetes use insulin injections to manage their diabetes.

Insulin pumps offer both greater flexibility in insulin dosing and a better means to deliver very small, precise doses of insulin than injections and are thus considered the preferred method for insulin delivery in infants, toddlers, and preschoolers. A pump with high precision in delivering very small basal rates should be chosen for a preschool child. If pump therapy is not available or affordable, multiple daily injections (MDIs), with consideration of an injection port to reduce the number of injections, can be used.

When evaluating cost effectiveness and affordability of insulin pumps, psychosocial issues, such as quality of life and diabetes-specific emotional distress (both for the child and the caregivers) as well as metabolic aspects need to be considered.

Although insulin pump use is recommended, injection therapy is used in many centers for preschool children with T1D, especially in the following situations:

- when insulin pump treatment is not available or affordable.
- children who were using pumps have experienced pump failures or "skin reactions" that are difficult to adequately treat
- when the local diabetes team is inexperienced with using pumps in this age group. If so, advice should be sought from a more experienced center to provide the child with pump treatment and to optimize quality of care.

For safety reasons, all primary caregivers of very young children treated with an insulin pump need to be practically skilled in treatment with insulin injections in case of technical pump problems.

Pain and fear associated with insulin delivery can be reduced by behavioral strategies (i.e., distraction, deep breathing).[25] The usage of subcutaneous catheters such as Insuflon (Unomedical, Lejre, Denmark) or I-port (Medtronic MiniMed, Northbridge CA, USA) and changed every third day can be helpful.[26] Topical lidocaine can be administered before insertion of s.c. insulin ports for infusion or injections.

7.1 | Insulin dosing

Preschool children with optimal glycemic control usually need less insulin on a body weight basis than older children. The total insulin dose has been reported to be 0.4 to 0.8 U/kg/d (median 0.6 U/kg/d) in preschool children with well controlled T1D after the remission phase.[27] Preschool children have higher day-to-day variation in insulin needs than older children.[28] Insulin sensitivity varies with both age-appropriate activities and with age-appropriate napping. Preschool children may have higher insulin needs during day-time napping.

7.2 | Basal insulin

When using injections for insulin treatment, the unique diurnal pattern of insulin requirements in preschool children should be taken into consideration in designing an individualized basal dosing scheme.[29–32] The low insulin requirement and tendency toward low glucose levels are often most obvious during the night and especially between 3 and 6 AM. Preschool children often need much more insulin late in the evening between 9 PM and 12 AM and the overnight insulin needs are variable from night to night.[28] This creates typical patterns when designing basal insulin dosing plans. If basal analogs are used one should consider their action profile in relationship to insulin requirements.

The low body weight and thus low total insulin dose demands special consideration when using commercially available insulin pumps

and insulin preparations, especially in children with a body weight below 5–10 kg. Sometimes very small doses necessitate dilution of U-100 insulin, or an intermittent basal rate of 0 U/h for limited periods, i.e. every second hour during the night.[33,34] These approaches may help to meet the needs of the young child's insulin treatment and must be carefully discussed (with advantages and disadvantages) with the primary caregivers so that they are informed of the benefits and risks of the chosen strategy. Insulin should always be prescribed and documented in normal units to avoid hazardous misunderstandings regarding insulin dosing, especially if the child using diluted insulin is admitted to hospital. Any pump containing diluted insulin should be labeled with information regarding the currently contained concentration of insulin.

A glucose and meal-adjusted basal-bolus insulin regimen (delivered by injections or pump) requires that basal insulin delivery be fine-tuned by the caregivers in accordance with the child's current insulin sensitivity. Preschool children have a higher day-to-day variation in insulin needs than older children.[28] Insulin sensitivity can be increased after very active days, such as a days at the beach or in the snow, or after a day playing with friends. The overnight long-acting insulin or basal rate might then be reduced by 10% to 30%. Insulin sensitivity can be markedly reduced (increased insulin resistance), for example, during fever when the long- acting insulin or basal rate might need to be increased by 20% to 100% according to glucose levels. Under these circumstances, glucose levels must be carefully monitored and caregivers need constant (24 hour per day/365 days per year) access to support from the diabetes team.

7.3 | Bolus dosing

A glucose and meal-adjusted basal-bolus insulin regimen (delivered by injections or pump) can be adapted to the preschool child's daily activities and is the preferred type of insulin treatment. Twice daily insulin dosing in this age group does not give the flexibility needed to adapt doses to varying situations in daily life and requires a rigid pattern of eating to match insulin peaks, which is challenging in this age group and is associated with poor glycemic outcomes.[35,36] In settings with limited resources or when struggling with severe socioeconomic deprivation, including problems with insulin availability and administration, sometimes the only option is to give NPH insulin in the morning together with rapid-acting insulin at the time of the first meal of the day to provide some insulin for daytime meals. However, this regimen should be avoided if at all possible.

Preschool children often need proportionally larger bolus doses than older children, often constituting 60% to 80% of the total daily insulin dose (TDD). The often used rule of 500 (500/TDD = how many grams of carbohydrate [CHO] is covered by 1 U of insulin) for bolus calculations, as detailed in the ISPAD 2022 Consensus Guidelines Chapter 9 on Insulin treatment rarely fits the youngest children as it often underestimates the insulin dose.[37] One can use a 330 or 250 rule (gives 50%–100% more insulin) instead of 500. To evaluate and further tailor the child's insulin dosing it is necessary to repeatedly observe and calculate the correct proportion between insulin and CHO from real life meals.

The need for insulin at breakfast is often very high, and one might consider using 150/TDD in the calculation, and then evaluate and calculate from real life meals as above. At breakfast preschool children often have some degree of insulin resistance, and it is common to experience a marked glucose peak after breakfast despite an adequate insulin dose taken before the meal. For further reading, please see the ISPAD 2022 guidelines chapter 10 on Nutritional Management in Children and Adolescents with Diabetes. Increasing the insulin dose (lower insulin-to-CHO ratio) too much can risk hypoglycemia before lunch. In this situation, it may be helpful to give the prandial insulin 10 to 20 min before breakfast, lower the carbohydrate amount if it is high, and switch the carbohydrate type to a lower glycemic index (GI) carbohydrate. The need for a large bolus dose of insulin to cover breakfast might necessitate a very low basal rate during the following 3 hours.

The lower insulin requirement between 3 and 6 AM and higher insulin requirement between 9 PM and 12 midnight can affect the individual insulin sensitivity/correction factor for treating hyperglycemia. The usual 100/ TDD for mmol/l (or 1800 for mg/dL) often needs to be adjusted to give smaller correction doses during late night/early morning and larger doses in the evening.

Prandial bolus timing is important, regardless of mode of insulin delivery (pump or MDI). Pre-prandial bolus insulin given 15 min before the meal is preferable to insulin administered during or after the meal and should be routinely advised for all toddlers and preschoolers, even the most unpredictable eaters and when using formulations of insulin designed for faster uptake (faster aspart).[38] It is also important in hybrid-closed loop systems (see below).

Given the difficulties in anticipating carbohydrate intake in very young children, if needed the dose can be split with an insulin pump: a portion of the insulin dose is delivered before the meal and the remainder during the meal when eating is erratic or new foods are offered. Another possibility with a pump, is that a combination bolus (also called combo or dual wave bolus) can be used; that is, part of the bolus is given before the meal and the remainder over 20–40 min. If the child stops eating before the meal is finished, the remainder of the bolus can be canceled.

Small inaccuracies in calculation of up to 5–7 g CHO will usually not be problematic. Larger inaccuracies may result in hypoglycemia or hyperglycemia 2–3 h after eating, but not immediately. These can be anticipated and treated with additional CHO or a small correction dose of insulin at least 2 h after the meal.

When giving relatively large bolus doses, one must remember that they interact with the need for basal insulin in the following hours. Thus, the total basal rate can be relatively low, around 20%–40% of TDD. In preschool children, it is often estimated that the effect of a subcutaneous bolus of a rapid-acting insulin analog (lispro, aspart, or glulisine) lasts for only 2–3 h (active insulin time in pumps).[37]

When using MDIs with frequent glucose checks and meal-adjusted insulin dosing, one possible strategy is to give a rapid-acting insulin analog for all meals, except for the last meal of the day when

short-acting regular insulin can be used to ameliorate the increase in glucose before midnight. Part of the dose can be given as rapid-acting analog insulin, the insulins can be mixed in a syringe or given as separate injections (if an injection aid is used).

8 | PRACTICAL ASPECTS ON USE OF INSULIN PUMPS WITH AND WITHOUT CGM IN PRESCHOOL CHILDREN

Over the last few years pump size has decreased, pumps can deliver smaller doses, and CGM devices have become more accurate and more widely available making these therapies acceptable for preschool children. The safety of insulin pump and CGM use in this population appears to be similar to that seen in other age groups.

Yet, frequency of insulin pump and CGM use varies between centers.[39] Barriers to the use of these treatment options in pre-school children need to be explored and systems better adapted to this patient group.

For s.c. infusion of insulin in preschool children it is possible to use either flexible catheters or steel catheters. Both have advantages and disadvantages. Considerations include risk of pain, risk of kinking, number of adhesive points, insertion technique and skin reactions. The choice of infusion set needs to be re-evaluated during childhood as the child grows and subcutaneous fat distribution changes.

There are few data on special considerations regarding skin care in preschool children with T1D but CGM-related skin problems seem to be frequent in very young users.[40] In general, recommendations for site use (including site selection, site preparation, and site rotation) are similar as for older children. Many preschool children receive insulin injections and insert infusion sets and CGM sensors in their buttocks, an area often covered by a diaper. The abdomen, upper arm, and upper thigh are also commonly used. For children under the age of 6 years using insulin pumps, rates of scarring and lipohypertrophy are high but not different than in older children.[40]

8.1 | Hybrid closed loop with automated insulin delivery systems in preschool children with T1D

While hybrid closed loop insulin pumps (HCL) with automated insulin delivery (AID) are now relatively widely used in older children with T1D, during the past few years, their use in infants, toddlers and preschool children has largely been restricted to clinical trials.[28] Notably, the evidence from clinical trials suggests that HCL with AID can increase TIR, especially overnight, among very young children.[41] HCL with AID can reduce parental burden for managing diabetes-related care and reduce perceptions of parenting stress.[42,43] Making certified systems with this technology available for children younger than 7 years, tailoring the algorithms to the age-specific needs of this patient group, and further developing clinical and research experience using this treatment modality in preschool children will be important. Age-specific challenges to address in automated systems include the small insulin doses needed, often well below 10 U per day,[44] the large differences in physiological insulin needs during different parts of the day, significant day-to-day variation in insulin needs, and safety concerns to avoid accidental insulin dosing.

When first implementing HCL-systems there may be a need for some "re-learning" among diabetes teams and caregivers of young children. They should avoid late bolus dosing for carbohydrates, which on an automated system results in "basal" increases by the algorithm when the glucose is rising without adequate insulin on board. A subsequent late bolus to cover the carbohydrate intake combined with the "basal" increase may precipitate hypoglycemia. Additionally, if basal insulin is suspended due to impending hypoglycemia, the amount of carbohydrate needed to treat hypoglycemia may be less than is usually required with standard pump therapy. The need to trust the system's capacity to correct glycemic excursions is a new challenge for caregivers.

With some diabetes centers employing advanced technologies for patients from the time of diagnosis, healthcare providers now sometimes encounter families of young children with T1D who have never experienced any other mode of insulin treatment. Nonetheless, for safety reasons, all families need to be equipped, experienced and skilled in insulin injections and capillary glucose monitoring ("finger-prick") in case of technical problems with the devices or algorithms.

9 | PRACTICAL ASPECTS ON USE OF MULTIPLE DAILY INSULIN INJECTIONS IN PRESCHOOL CHILDREN

When an insulin pump is not affordable or available, MDI is a treatment that can be used safely and effectively.

High precision insulin dosing adjusted by carbohydrate counting is difficult when using insulin pens or syringes filled with insulin U-100. Syringes with ½ unit markings and pens with at least ½ unit dosing increments should be used. Diluting insulin to 10 U/ml increases the possibility to dose in small steps and to adjust insulin dosing to anticipated carbohydrate intake and current glucose levels.

Giving insulin pre-meal is also necessary when insulin is administered via injections. Giving all the insulin in one injection necessitates a skilled caregiver estimation of the child's anticipated eating. This can be achieved by encouraging eating practices that make it easier to predict intake (see Nutrition section below).

An individually programmed bolus calculator (i.e., a phone app or a paper-and-pen scheme) can simplify calculation of bolus doses.

It is important to create a calm situation when injecting insulin. Insulin can be injected in the buttocks with the child sitting face-to-face on the lap of a caregiver. Some children need to see what is happening and injecting in the abdominal region can make this possible. Upper arms and legs can also be used for injection but may risk the child moving their limb and require the caregiver to hold the child, creating an unpleasant injection experience.

The major challenge for many caregivers of toddlers and preschoolers on MDI is how to handle the complicated situation of more

or less simultaneously cooking, calculating the insulin dose, injecting the child and then transferring focus to eating together with the family. Cooperation between two caregivers is often a necessity in this complex situation.

10 | GLUCOSE MONITORING

In this chapter, blood glucose (SMBG) values refer to glucose values measured by capillary blood check ("finger prick" and "blood glucose monitoring") although meters generally display plasma glucose concentrations. Since plasma glucose is 11% higher than whole blood glucose, this term is used when exact numbers are mentioned. The term "glucose value" refers to a glucose value from either continuous glucose monitoring (CGM) or a capillary blood check. The use of CGM (rtCGM or isCGM) is recommended in all insulin treated children younger than 7 years.

10.1 | Blood glucose checking

Families should be taught how to measure and interpret capillary blood glucose values (SMBG). The limited capacity of the preschool child to verbally communicate necessary information related to self-care increases the need for high quality and frequency of glucose monitoring. It is important for the preschool child that the caregivers can perform the monitoring in a way that gives the child a sense of security and trust. Accuracy in everyday monitoring situations should be ensured by follow up with the diabetes team. The child should be introduced to glucose monitoring and interpretation according to age appropriate and individual capabilities, as the development of the mathematical understanding of numbers and time is gradual.

While independent self-care can never be expected from any preschool child with T1D, most typically-developing children with diabetes can perform blood glucose checks and perform some basic interpretation by age 7 years. However, this should always be overseen by a caregiver.

General advice on SMBG monitoring is available in the ISPAD guidelines on Glucose monitoring. In children younger than 7 years-old, the recommended checking frequency of 4–6 times per day is rarely sufficient to achieve target glucose and HbA1c levels. A high proportion of time is spent out of glycemic target range.[45] Even with a higher monitoring frequency of 7 or 10 checks per day, undetected hypoglycemia and hyperglycemic events in insulin treated preschool children are common.[46]

Nighttime SMBG is recommended by many diabetes teams and performed by many families with pre-school children with T1D.[47] Preschool children with diabetes can spend a long time in the hypoglycemic range without detection,[36,48] despite nighttime monitoring of SMBG.[46] The normal activities of the child must be interrupted to measure a blood glucose value during daytime.

Thus, relying on SMBG as the only way of monitoring glucose has several limitations but is a necessary tool to master for all caregivers of a preschool child with T1D.

10.2 | Continuous glucose monitoring

CGM provides an effective mode of monitoring for low and high glucose levels. Qualitative reports from caregivers suggest CGM can promote a sense of safety, decreased worry, and greater comfort with other caregivers when used as part of remote monitoring.[49] When available and affordable, CGM should be used as a tool for adjusting insulin doses. With use of newer systems, real-time CGM use is high and sustained in young children with T1D and significantly reduces hypoglycemia.[50] Reduced glycemic variability was observed in real world use of CGM among a multinational cohort of young children.[51] Health care providers should counsel caregivers on how to reduce CGM-related challenges, which can include pain from insertion, disruptive alarms, limited areas to place a sensor, skin and adhesive problems, and data overload. Health care providers fill an important role in educating families of young children about diabetes technologies, including CGM, and need to help families to establish realistic expectations of the benefits and challenges of CGM use.[52]

The ability of some CGM devices to remotely transmit glucose values to a phone can be of benefit for caregivers who rely on others for care of their child, for example, while at day care or preschool.[53]

11 | NUTRITIONAL NEEDS OF THE PRESCHOOL CHILD WITH T1D

Optimal nutrition is required to provide sufficient energy and nutrients to meet the rapidly changing needs of children at this stage of life. Relative to their body weight, children's nutrient and energy requirements are greater up to around 4–5 years of age, after which their growth rate slows and their nutrient needs decrease relative to their body size.[54]

Breastfeeding should be encouraged for all infants,[55] including infants with diabetes. Complementary foods, preferably iron-rich, should be introduced from 4 to around 6 months of age. If breastfeeding is not possible, an iron-fortified infant formula should be given as the main milk drink until 12 months of age.

A routine regarding breast- or formula-feeding is important for infants with diabetes as this enables appropriate interpretation of glucose levels and basal and bolus insulin adjustments. This may involve 3–4 hourly feeds (of approximately 150–240 ml) during the day with complementary solids. Continuous or hourly breastfeeding is discouraged as this makes insulin dosing difficult while bolusing every third to fourth hour during day-time works practically. Breast milk has approximately 7.4 g CHO per 100 ml, so for infants 6 months and older it is possible to bolus before the feed for at least 5–7 g CHO and 15 g CHO in older babies (>9 months).

Dietary recommendations are based on healthy eating principles suitable for all preschool children, with the aim of establishing family-based meal-time routines that promote glycemic control and reduce cardiovascular risk factors. Carbohydrate counting is important to permit the matching of insulin dose to carbohydrate intake on intensive insulin regimens and should be taught to the family at the onset of

diabetes (See nutrition chapter 10). Nutritional advice must be individualized and adapted to cultural and family traditions.

A pediatric diabetes dietitian should provide education, monitoring, and support at regular intervals throughout the preschool years, as caregivers of preschool children with diabetes report meal-times as one of the most difficult components of their child's care.[56] Preschoolers require more frequent dietetic review than older children, with a suggestion for reassessment at least twice annually until the age of 6 years (See ISPAD 2022 Consensus Guidelines Chapter 10 on Nutritional Management in in Children and Adolescents with Diabetes). It is important to provide caregivers guidance for appropriate food quantities for age, including minimum and maximum carbohydrate amounts, particularly as food intake may drop off during the second year of life and following weight regain after a T1D diagnosis.[20]

There is international agreement that carbohydrate should not be restricted in children with T1D as it may result in deleterious effects on growth and brain development.[57,58] Care should be taken when giving dietary education, so that methods of quantifying carbohydrates do not increase saturated or trans-fat intake. Although caregivers may prefer high- fat snacks to avoid affecting glucose levels, this should be discouraged as they will provide unnecessary calories, an unhealthy fat intake, and negatively impact dietary quality. Studies suggest that consistency in children's intake[59] and balanced meals containing protein, fat and carbohydrate[60] may be helpful methods for reducing post-prandial glycemic variation.

Preschool children with T1D should consume a diet that emphasizes vegetables, fruit, whole grain bread and cereals, dairy foods and appropriate types and amounts of fats. Low fat diets are not suitable for children under 2 years of age. Lower glycemic index (GI) choices, can be introduced as substitutes for higher GI food choices. Iron deficiency can be a concern in this age group; adequate consumption of lean meat or alternatives is important and should not be overlooked because of the increased focus on carbohydrate.

A *guide* to the macronutrient distribution of the total daily energy intake in preschool children is shown below. However, this should be based on an individualized assessment and with respect to the family's eating pattern prior to the child's diabetes diagnosis and day-to-day variations in the child's appetite.

Carbohydrates: 40–50 Energy (E) %. Average intakes 110–140 g/d in children aged – 5 years; 200 g/d in children 6 to 10 years.[57]

Protein: 15–20 E % (decreasing with age from approximately 1.5 g/kg body weight/day in 6-month-old infants to 1 g/kg body weight/day in preschoolers).

Fat: 30–35 E % (less than 10 E% saturated fat, less than 10 E% polyunsaturated fat, and more than 10 E% mono-unsaturated fat). Infants less than 12 months may consume up to 40% energy from fat.

Fruit and vegetable intake remain of particular concern and ways to incorporate these into the whole family's diet, including the preschool child's, should be discussed.[59,61] Examples of recommendations from Australia, United States, and the Nordic countries are expressed in different ways but consistent in content: 180 g vegetables (2½ servings) and 150 g fruit (1 serving) daily from 2 years of age; or 1½ serving of fruit and vegetables daily between 1 and 3 years. 400 g of fruits/vegetables are recommended each day from 4 years of age.

The dietary quality of preschool children with diabetes is similar to or poorer than their peers without diabetes.[62] Preschool children with T1D consume less fruit and vegetables and have higher saturated fat intakes than peers[63] and then recommendations would advise.[64,65] This may increase the risk of future cardiovascular disease. Eating habits in young children influence food choices later in life,[66] so early intervention with increased attention to an increase in fruit and vegetable intake and decrease in saturated fat is needed. It is helpful to counsel caregivers that young children with or without diabetes may require up to 10 exposures to a new food before it is accepted[67] and to educate caregivers on how to make appropriate adjustments to pre-prandial insulin dosing or meal planning (e.g., pairing a new food with a familiar food) to avoid dosing during or after the meal. It can also be helpful to remind caregivers that miscalculations of carbohydrate content <5 g rarely affects the postprandial glucose levels.

More children with T1D have an overweight body mass index compared to children in the general population,[21,64,68,69] and this is most pronounced in the youngest children (<6 years).[70,71] It is important to plot the growth chart including assessments of weight for length or height at least at 3-month intervals to identify excessive weight gain, in order to commence interventions that involve the whole family. Diabetes associated risks of extra caloric intake as over-treatment of hypoglycemia or excessive feeding before bed because of parental fear of hypoglycemia need to be explored if the child develops overweight/obesity. Encouraging participation in family meals has been recommended to promote dietary quality and social interaction.

Age-appropriate finger foods should be encouraged for self-feeding, and the reintroduction of a bottle as an easy method of carbohydrate intake discouraged. Bottles can lead to overconsumption of fluids, increasing carbohydrate intake and placing other nutrients at risk.

12 | ESTABLISHING POSITIVE FOOD BEHAVIORS AND MEAL-TIME ROUTINES

Establishing positive food behaviors and meal-time routines are important for preschool children with T1D, as these behaviors impact glycemic control[56,72] and set the stage for life-long appropriate nutrition practices.[66] It is important that caregivers model eating practices and the preschool child is exposed to new foods in the context of family meals. Early childhood developmental traits, including seeking independence, transient food preferences, variable appetite, food refusal, and behavioral resistance often make mealtimes challenging for caregivers of children with diabetes. Caregivers of children with T1D report more disruptive meal behaviors, including longer meal duration and more frequent food refusal compared with controls[69,73,74]; even for children using insulin pumps.[75] Research has

demonstrated positive correlations between suboptimal dietary adherence and higher glucose levels.[56,63,75,76] Caregivers' fear of hypoglycemia associated with food refusal or unpredictable dietary patterns can result in force feeding, grazing continually over the day, and postprandial insulin administration, causing prolonged periods of hyperglycemia.

To assist the reliable intake of carbohydrate at mealtimes and to minimize food refusal, the following strategies should be offered:

- structured mealtimes
- avoidance of continuous eating habits as this has been associated with poorer glycemic outcomes in young children[59]
- small snacks including limits on low carbohydrate foods as these fill the child up
- limits on the time spent at the table; for small children, mealtimes should be limited to approximately 20 minutes per meal.[77]
- avoidance of force feeding
- team members should reassure caregivers that hypoglycemic episodes related to inadequate carbohydrate consumption are usually mild.

Caregivers should be advised that postprandial bolus insulin can become an established habit and reinforce anxiety about the child under-eating. Fear of hypoglycemia can lead to under-bolusing for meals, resulting in inadequate bolus doses given over the day and subsequent hyperglycemia. Continuous eating (grazing) makes interpretation of glucose levels and insulin dose adjustments difficult. A regular meal pattern with one small snacking episode between meals (7–15 g carbohydrate preceded by an appropriate insulin dose) may reduce food refusal as the child may be hungrier at main meals. Unreasonable expectations of a child's intake may result in food refusal and subsequent hypoglycemia. Food refusal should generally be dealt with effectively and similarly to toddlers without diabetes. It is important to emphasize parental patience and to encourage caregivers not to use food bribes.

All diabetes team members should provide the family with clear and consistent messages regarding food and mealtime behaviors.[78] Distractions such as the television and toys should be removed at mealtimes.[65] Research has demonstrated that disruptive child behaviors can be reduced by establishing specific rules and consequences for mealtimes and teaching caregivers behavioral strategies for meals.[79] Stepwise, the child needs to establish an age-appropriate positive connection between insulin, food and health (i.e., "*I get insulin, I eat and thus I can jump this high and feel great*").

13 | LIFESTYLE FACTORS IN PRESCHOOL CHILDREN

The American Heart Association (AHA) has identified that T1D is associated with extremely high risk of cardiovascular disease, calling for treatments to minimize this risk.[80] Lifestyle habits, such as nutritional preferences,[66] physical activity,[81] and time spent sedentary,[82] that are established in childhood often persist into adulthood. Thus, lifestyle factors in early childhood have a dual impact on later cardiovascular risk, observable both as early markers of atherosclerosis during adolescence[83] and as a set of behaviors that influence the child's risk of cardiovascular disease as an adult and even into senescence.

Children tend to follow the lifestyle habits of their caregivers and entire family regarding physical activity,[84] TV watching[85] and food choices[61,86,87] in childhood and then subsequently throughout their adult lives.[66] Lifestyle supporting interventions should thus be directed toward the caregivers and entire family and not the individual child with T1D.

13.1 | Physical activity

Physical activity and sleep confer many health benefits for all children. Physical activity has a strong, graded, inverse cross-sectional relationship to insulin resistance[88,89] and body fat.[90] High-intensity physical activity is the most effective type of activity to reduce cardiovascular risk.[91] Engaging in regular physical activity is also necessary to acquire and improve gross motor skills.[92] Many countries recommend at least 60 min/day of moderate and vigorous physical activity for all children,[93] and WHO recommends this at least from 5 years of age.[94]

Preschool-age children engage in patterns of physical activity that are different from older children and characterized by multiple small bursts of activity.[95] This difference can complicate how to quantify the physical activity of a preschooler. Asking caregivers about how, where, and how often (vs. how long) their preschooler plays may be a way to help quantify their physical activity.

General facilitators of physical activity for preschoolers include access to safe play environments and organized activities, their own preference for being physically active, positive parent modeling of physical activity, spending time outdoor and peer interaction.[96,97]

Data suggest that both having diabetes and being a girl represent risk factors for greater physical inactivity in preschool-age children.[98]

13.2 | Sleep

Sufficient and high-quality sleep plays an important role in overall health and may also be associated with hyperglycemia and glycemic variability in children with T1D.[99,100] The American Academy of Sleep Medicine recommends infants sleep between 12 and 16 h per day, toddlers sleep between 11 and 14 h per day, and preschoolers sleep between 10 and 13 h per day including naps.[101,102] However, recent studies in young children with T1D report much shorter than average sleep durations (8 h per night) based on parent-report and actigraphy.[100,103] Both children and caregivers experience sleep disruptions and restriction because of nighttime caregiving and caregivers commonly report fear of nighttime hypoglycemia.[11,104,105] Infants and toddlers sleeping pattern during the day needs to be taken into consideration when programming the insulin pump. There is emerging evidence suggesting automated insulin delivery systems can reduce

the number of parental awakenings and fear during the night and improve parental perceptions of sleep quality.[42]

14 | KETONE MONITORING

Ketoacidosis is a life-threatening acute complication of diabetes. Six percent of children younger than 6 years in the United States and 4% of children in Germany/Austria (data from the T1D Exchange clinic registry and the Prospective Diabetes Follow-up Registry: DPV) have suffered from ketoacidosis during the past year.[106] Education of families on prevention of ketoacidosis is an essential part of diabetes care, especially as young children are physiologically prone to develop ketosis. See the ISPAD Guidelines on Diabetic Ketoacidosis chapter 13 for further advice.

The high incidence of gastroenteritis with vomiting and risk of misinterpreting vomiting due to insulinopenia makes monitoring of ketones important in this age group. Measuring ketone bodies in blood (betahydroxybutyrate, BOHB) should be the primary method of detecting and monitoring ketosis in preschool children with T1D; see the ISPAD Guidelines chapter 12 on Sick days. Blood ketone checking gives the caregivers and health care professionals timely information regarding ketone levels and their rise or fall to provide advice over the phone or in the emergency room.

Ketones should be monitored when there is a suspicion of lack of insulin raised either by high blood glucose (2 values above 14 mmol/L [252 mg/dL] within 2 h that do not decline with an extra insulin dose) or when the child shows symptoms suggestive of ketosis (vomiting, nausea, abdominal pain or unclear illness). It is important to educate and remind caregivers of young children that insulin always should be given by s.c. injection (with a syringe or a pen) when treating ketonemia (without DKA) even if the child usually is treated with an insulin pump. See the ISPAD Guidelines chapter 12 on Sick days for further advice on treatment.

Measurement of acetoacetate in urine with a dipstick can be used as an alternative to blood ketone measurement but gives different information. As preschool children do not urinate on command, results from blood ketone monitoring will be more easily available for the caregiver parent unless the child uses diapers. Cotton balls can be put in the diaper to absorb urine which can then be applied to the dipstick.

15 | HYPOGLYCEMIA

Hypoglycemia, including caregiver fear of hypoglycemia, is a limitation to striving for normoglycemia in preschool children, see ISPAD guidelines chapter 12 on hypoglycaemia.[47,105,107] Young age has traditionally been regarded as a marker of high risk of severe hypoglycemia during insulin treatment. Inherent in this risk, is the observation that preschoolers are erratic in their daily life (food intake, activity levels, sleep, and sick days) predispoding to hypoglycemia. Many preschool children are also unable to identify and articulate their symptoms, making it very difficult for caregivers to detect these symptoms. There is an additional risk due to prolonged nocturnal hypoglycemia, common in children younger than 7 years with T1D.[46,108–110] HCL studies indicate that preschool children have a high day-to-day variation in insulin need,[28] which may also contribute to risk.

Data suggest the frequency of severe hypoglycemia has decreased over time in all children with T1D and that there is no longer a clear association between lower HbA1c and higher risk of hypoglycemia.[111,112] Moreover, specific to preschoolers, Germany and Austria (DPV), USA (T1DX)[106] and Sweden all report that no more than 3% of children younger than 6 or 7 years with T1D have experienced a severe hypoglycemic event with seizures/unconsciousness during the previous year.[21] These data suggest the use of insulin pumps, hybrid closed loop systems, insulin pumps with a suspend before low algorithm can reduce the time spent in hypoglycemia. Access to CGM and predictive alarms for upcoming hypoglycemia appear to increase the probability of early detection and prevention of hypoglycemia.

These technologies represent an opportunity to turn the corner in reducing the risk of severe hypoglycemia in preschool-age children with T1D. Caregivers who lack the knowledge or confidence to use these technologies effectively in their child's daily management may benefit from advanced diabetes education to understand glucose patterns and how to use alerts on their child's CGM to recognize and treat potentially dangerous glucose trajectories (e.g., rate of glucose decrease shown by arrows pointing downward).

The fear of a hypoglycemic event, rather than the frequency of hypoglycemic events, is associated with higher HbA1c and lower HRQoL,[107,113] suggesting the role of fear cannot be underestimated for caregivers of young children with T1D. Fear of nocturnal hypoglycemia is a particular challenge. Emerging evidence supports that behavioral interventions may reduce caregivers fear and there is evidence that consistent CGM use can reduce time in hypoglycemia in young children.[50,114] Asking in a clinic visit about typical frequency and severity of hypoglycemia is encouraged. It may also be helpful to use validated surveys that ask about thoughts and feelings during and after the hypoglycemic event to identify caregivers who might benefit from treatment.

15.1 | Treatment of mild hypoglycemia in infants and preschool children

Oral glucose as tablets, gel, or a drink is the preferred method of hypoglycemia treatment. The dose of glucose should be easily accepted and quickly ingested by the child. The recommended dose (0.3 g glucose/kg bodyweight) will raise plasma glucose approximately 2.5–3.6 mmol/L (45–64 mg/dL) (guidelines chapter 12 on hypoglycemia).[115] In young children 5–7 g carbohydrate is usually adequate, and it is important not to give too much carbohydrate when treating hypoglycemia to avoid subsequent hyperglycemia. This risk is high in young children with a small body size.

To treat hypoglycemia in breast- or formula-fed infants, carbohydrate gel, diluted juice, or a glucose polymer from a spoon or bottle

can be offered. Honey should not be given to infants younger than 1 year due to risk of botulism.

Giving something that contains fat (i.e., milk and chocolate) will slow gastric emptying and cause a slower rise in plasma glucose.[116] Sucrose sweetened confectionary should not be routinely used to treat hypoglycemia, as it can lead to increased risk of dental caries.

16 | CARE OF THE NEWLY DIAGNOSED INFANT, TODDLER, OR PRESCHOOLER WITH DIABETES

The care of the newly diagnosed child with T1D is a key opportunity for successful diabetes treatment. The diabetes team needs to have clear routines regarding treatment initiation for newly diagnosed infants, toddlers and preschool children with diabetes and be ready to tailor these further to fit the individual child and family.

Preschool children, especially toddlers, have a high risk of rapidly developing ketoacidosis at diabetes onset. Early detection and fast referral to a hospital with competence in management of DKA in very young children is lifesaving. Please see ISPAD 2022 guidelines Chapter 13 on Diabetic Ketoacidosis and Hyperglycemic Hyperosmolar State.

After DKA has resolved, or directly following diagnosis, if DKA is avoided, the immediate treatment goal should be to restore and maintain normoglycemia.

Carbohydrate counting, meal-time routines and nutrition need to be taught and discussed during the first days with insulin treatment. The education needs to be tailored to the individual family's crisis reaction upon diagnosis and preexisting understanding. The education needs to be given in a culturally sensitive manner and with a high respect of parental integrity.

Very young children with T1D may benefit from introduction of an insulin pump and CGM at or soon after diagnosis. Both devices can offer families greater ability to fine-tune insulin delivery when navigating the partial remission period.[117–120]

The professional diabetes team needs to get acquainted with the family's structure, habits and beliefs regarding lifestyle and upbringing of young children to develop individualized diabetes care plans that promote optimal habits and insulin treatment routines or can inform a rationale for habits that need to be changed.

The diabetes team should have programs and resources available to promote caregivers resilience and long-term capacity to provide developmentally appropriate levels of daily diabetes management as the child grows.

17 | LIVING WITH DIABETES IN THE FAMILY

For people living with T1D and their families, the management of the disease is complex and individual. Daily challenges imposed by T1D include cognitive and emotional burdens that can take the form of increased vigilance to dietary intake, symptom monitoring, and frustrations with glucose excursions. For caregivers of preschool children with T1D, additional complexities are encountered, including the necessity to adapt to developmental changes to ensure adequate psychological adjustments for the child and themselves, and to facilitate care in the context of other care providers such as preschool staff. Clinicians need to be aware of the overwhelming sense of responsibility and worry which parents of preschool children with T1D can feel.[121] Caregivers who have access to a supportive network (relatives and/or friends) have lower risk of diabetes-related stress and burnout.[10] It is important to educate secondary caregivers about T1D and insulin treatment. Attention should be given to the needs of the siblings of a young child with T1D.

As children grow up, they understand more about health and illness. When appropriate, it needs to be explained that diabetes is not caused by eating too much sugar, and that you cannot catch diabetes from another person. This needs to be intentionally taught to friends and relatives to avoid common misconceptions about diabetes.

Caregivers are an integral part of the diabetes team and have the most important supportive role to play over the years as their children eventually learn to self-manage their diabetes. Providing this support can be difficult when caregivers have their own stressors to deal with, and struggle with the constant vigilance needed to ensure the safety of their child. During young childhood, caregivers take responsibility for all diabetes-related tasks. It is important that they do this in a way that is neither threatening nor frightening for their child. Involving the child in aspects of diabetes management as soon as possible (e.g., using think aloud strategies when performing diabetes management, incorporating choice options when appropriate "What side of your bottom for your pump site? Pick one or I will") is recommended, so the child can begin to develop a sense of ownership/management of their own health. A supportive and emotionally warm parenting style is important for promoting improved quality of life for children with T1D.

Establishing good habits in the early years may form the basis for optimal life-long diabetes self-management. The way that caregivers model diabetes-related tasks will have a direct impact on the way their children learn. Supporting caregivers toward a positive adjustment to living with diabetes will help them to effectively model those tasks and assignments involved in daily life with diabetes as preschool children learn from examples.

It is important to engage all primary caregivers in diabetes care from the onset, and to keep them involved in everyday diabetes care throughout the childhood years and to avoid that responsibility for diabetes self-care is carried by only one primary caregiver.

18 | SCREENING CHILDREN FOR PSYCHOSOCIAL DISTRESS

Regular screening of children for psychosocial distress is important to ensure that difficulties are identified early, and appropriate support and treatment plans established as soon as possible. Most children are

not able to complete questionnaires or report on their own level of emotional distress in a reliable manner until they are approximately 7–8 years of age. Therefore, both talking with them directly about how they feel, and asking their caregivers to report on their children's psychosocial well-being is recommended. Including the child in the discussion is important and asking the child direct questions is essential. *What do you do for your diabetes that you are proud of? What parts of diabetes are easy for you? What parts of diabetes are annoying for you? Who are your biggest helpers in caring for your diabetes? If you could change something about your diabetes, what would it be?*

Members of diabetes teams need to develop clinical skills in talking directly with the very young child. This is sometimes a time consuming but necessary task.

Repeated meetings together with the child and caregivers are often needed to establish and continue an ongoing dialogue with the very young child. Telemedicine can contribute new challenges in caring for the preschool-age child (e.g., very young children may be shy or become distracted by the telemedicine equipment/setting). Therefore, when using video-based telemedicine with families, it may be necessary for diabetes teams to allot additional time to re-establish rapport with the child. Some strategies to try may include normalizing the telemedicine experience by asking the child to share a treasured item (e.g., toy or game) or to introduce the practitioner to their pet and to encourage interaction between the caregiver and child.

There are several pediatric measures of depressive symptoms that are validated and reliable for use with children as young as 7 years of age, varying in length and depth of detail.

Parental anxiety and fears can have a direct and negative effect on diabetes management and health outcomes. It can be associated with depression; however, these are two separate conditions and should be treated separately. They can have an opposite effect on diabetes management and control, supporting the recommendation to assess them separately.

19 | PRESCHOOL CARE

Legislation protects children with T1D in many countries. Schools must make reasonable adjustments to ensure that children with disabilities are not put at a substantial disadvantage compared with their peers. For diabetes, this means that preschools should have enough staff trained to allow the child with diabetes to take part in all aspects of preschool and school life without loss of quality in insulin treatment. Contingency plans must be in place to quickly train replacement staff.

In addition to ensuring the rights of the child with diabetes, it is important to create trust and cooperation between the preschool, the family, and the diabetes team. An individual diabetes management plan is needed in this collaboration and should include information about and practical training in the use of diabetes-related technologies. The child's young age and limited capacity to verbally discuss aspects of self-care need to be offset by well trained staff, written plans and an ongoing dialogue with the primary caregivers. Both the caregivers and the diabetes team need to share the responsibility for educating the preschool institution, especially when the child is newly diagnosed with diabetes or when an additional diagnosis such as celiac disease occurs. Working with the preschool staff on carbohydrate counting enables the appropriate doses of insulin to be given in relation to the food intake and glucose levels.

In countries where there are no regulations to support the child with diabetes, the diabetes team together with the parent organizations should advocate for improved regulations.

20 | CARE FOR THE PRESCHOOL CHILD WITH T1D IN LIMITED RESOURCES SETTINGS

Whenever possible, the guidelines described in the preceding sections should be followed. Treatment strategies and targets (such as HbA1c) need to be individualized and adapted to local circumstances.

Treatment of preschool children with T1D in contexts with generally high under-5 mortality-rates is an extreme challenge. Adding diabetes to general threats to health and survival such as infectious diseases and accidents puts the child in a hazardous position. Young children have a high risk of life-threatening ketoacidosis, which can be misinterpreted as gastroenteritis unless a high level of awareness and monitoring capabilities are available.

If possible, priority should be given to the youngest patients to get best possible access to monitoring of glucose and ketones. Flexible insulin regimens are preferred as the insulin needs of the young child is variable from day-to-day.

Breast-feeding should be recommended for children with diabetes on the same basis as other children in accordance with local traditions and recommendations. Preschool children with diabetes should follow the same guidelines for vaccination as healthy peers. Monitoring of weight and height/length is essential.

For further advice see the ISPAD Guidelines chapter 25 on limited resources.

21 | FUTURE NEEDS OF PRESCHOOL CHILDREN WITH T1D

"Diabetes during early childhood creates a psychosocial challenge to the families of these children. Successful management of infants and toddlers with diabetes depends on a well-functioning and educated family, the availability of a diabetes health care team experienced in the treatment of these youngsters, and the involvement of the extended family, child care personnel and others who play a role in their daily care."[122]

Children younger than 7 years with T1D constitute only approximately 10% of the population of all children (below 18 years) with T1D, but in many countries the incidence in this subgroup is increasing.[123] Collaboration among centers is thus necessary to conduct pathophysiological, epidemiological and clinical studies regarding

treatment strategies and tools (both technical equipment and pharmacological) and outcomes studies in this age group that are sufficiently powered. Moreover, when the youngest children with T1D are included in these studies, data regarding children with early onset diabetes must be presented separately to enable subgroup analysis.

The addition of new tools should enable families living with T1D to provide increasingly effective therapy and support for preschool children with diabetes. There is a need for effectiveness and implementation trials of the newer diabetes technologies in preschool-age children (e.g., HCL/AID) to expand on the outcomes of current smaller RCT/clinical trials. Access to this kind of equipment must be made available for young children with diabetes and not restricted only to older persons.

Evidence-based family interventions to improve both metabolic and psychosocial outcomes in both the short- and long-term need to be developed. There is also a need for additional research and interventions targeting lifestyle behaviors and diabetes in preschool-age children (e.g., sleep, physical activity, and diet/nutrition).

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All authors contributed to all parts of the writing process and are equally responsible for the text.

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