

Guidelines for Management of Type 1 Diabetes

9. American Diabetes Association. Peripheral arterial disease in people with diabetes. *Diabetes Care* 2003; 26: 3333-3341.
10. Jonasson JM, Ye W, Sparén P, Apelqvist J, Nyrén O, Brismar K. Risks of nontraumatic lower-extremity amputations in patients with type 1 diabetes: a population-based cohort study in Sweden. *Diabetes Care* 2008;31:1536-1540.
11. The Diabetes Control and Complications Trial Research Group. The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. *N Engl J Med* 1993;329:977-986.
12. Nathan DM, Cleary PA, Backlund JY, Genuth SM, Lachin JM, Orchard TJ, et al. Diabetes Control and Complications Trial/Epidemiology of Diabetes Interventions and Complications (DCCT/EDIC) Study Research Group. Intensive diabetes treatment and cardiovascular disease in patients with type 1 diabetes. *N Engl J Med* 2005;353:2643-2653.
13. Nathan DM, Lachin J, Cleary P, Orchard T, Brillon DJ, Backlund JY, et al. Diabetes Control and Complications Trial; Epidemiology of Diabetes Interventions and Complications Research Group. Intensive diabetes therapy and carotid intima-media thickness in type 1 diabetes mellitus. *N Engl J Med* 2003; 348:2294-2303.
14. Ceriello A. New insights on oxidative stress and diabetic complications may lead to a “causal” antioxidant therapy. *Diabetes Care* 2003; 26:1589-1596.
15. Schnell O, Cappuccio F, Genovese S, Standl E, Valensi P, Ceriello A. Type 1 diabetes and cardiovascular disease. *Cardiovasc Diabetol* 2013;12:156.
16. Shamir R, Kassis H, Kaplan M, Naveh T, Shehadeh N. Glycemic control in adolescents with type 1 diabetes mellitus improves lipid serum levels and oxidative stress. *Pediatr Diabetes* 2008;9:104-109.
17. Petitti DB, Imperatore G, Palla SL, Daniels SR, Dolan LM, Kershner AK, et al. Serum lipids and glucose control: the SEARCH for Diabetes in Youth study. *Arch Pediatr Adolesc Med* 2007;161:159-165.
18. Chen R, Ovbiagele B, Feng W. Diabetes and Stroke: Epidemiology, Pathophysiology, Pharmaceuticals and Outcomes. *Am J Med Sci* 2016;351(4):380-386.
19. Maahs DM, Kinney GL, Wadwa P, Snell-Bergeon JK, Dabelea D, Hokanson J, et al. Hypertension prevalence, awareness, treatment, and control in an adult type 1 diabetes population and a comparable general population. *Diabetes Care* 2005;28:301-306.
20. Rodriguez BL, Dabelea D, Liese AD, Fujimoto W, Waitzfelder B, Liu L, et al. Prevalence and correlates of elevated blood pressure in youth with diabetes mellitus: the SEARCH for Diabetes in Youth Study. *J Pediatr* 2010;157:245-251, e1.
21. de Boer IH, Kestenbaum B, Rue TC, Steffes MW, Cleary PA, Molitch ME, et al; Diabetes Control and Complications Trial (DCCT)/Epidemiology of Diabetes Interventions and Complications (EDIC) Study Research Group. Insulin therapy, hyperglycemia, and hypertension in type 1 diabetes mellitus. *Arch Intern Med* 2008;168:1867-1873.
22. Jensen T, Borch-Johnsen K, Kofoed-Enevoldsen A, Deckert T. Coronary heart disease in young type 1 (insulin-dependent) diabetic patients with and without diabetic nephropathy: incidence and risk factors. *Diabetologia* 1987;30: 144-148.
23. Borch-Johnsen K, Kreiner S. Proteinuria: value as predictor of cardiovascular mortality in insulin dependent diabetes mellitus. *Br Med J (Clin Res Ed)* 1987;294:1651-1654.
24. Newman DJ, Mattock MB, Dawnay AB, Kerry S, McGuire A, Yaqoob M, et al. Systematic review on urine albumin testing for early detection of diabetic complications. *Health Technol Assess* 2005;9:iii-vi, xiii-163.
25. Soedamah-Muthu SS, Chaturvedi N, Witte DR, Stevens LK, Porta M, Fuller JH. EURODIAB Prospective Complications Study Group. Relationship between risk factors and mortality in type 1 diabetic patients in Europe: the EURODIAB Prospective Complications Study (PCS). *Diabetes Care* 2008;31:1360-1366.

Macrovascular Complications

26. de Boer IH, Katz R, Cao JJ, Fried LF, Kestenbaum B, Mukamal K, et al. Cystatin C, albuminuria, and mortality among older adults with diabetes. *Diabetes Care* 2009;32:1833-1838.
27. Chronic Kidney Disease Prognosis Consortium; Matsushita K, van der Velde M, Astor BC, Woodward M, Levey AS, de Jong PE, et al. Association of estimated glomerular filtration rate and albuminuria with all-cause and cardiovascular mortality in general population cohorts: a collaborative meta-analysis. *Lancet* 2010;375:2073-2081.
28. Witte DR, Tesfaye S, Chaturvedi N, Eaton SE, Kempler P, Fuller JH. EURODIAB Prospective Complications Study Group. Risk factors for cardiac autonomic neuropathy in type 1 diabetes mellitus. *Diabetologia* 2005; 48:164-171.
29. Pop-Busui R, Kirkwood I, Schmid H, Marinescu V, Schroeder J, Larkin D, et al. Sympathetic dysfunction in type 1 diabetes: association with impaired myocardial blood flow reserve and diastolic dysfunction. *J Am Coll Cardiol* 2004; 44:2368-2374.
30. Spallone V, Ziegler D, Freeman R, Bernardi L, Frontoni S, Pop-Busui R, et al. Toronto Consensus Panel on Diabetic Neuropathy. Cardiovascular autonomic neuropathy in diabetes: clinical impact, assessment, diagnosis, and management. *Diabetes Metab Res Rev* 2011;27(7):639-253.
31. Astrup AS, Tarnow L, Rossing P, Hansen BV, Hilsted J, Parving HH. Cardiac autonomic neuropathy predicts cardiovascular morbidity and mortality in type 1 diabetic patients with diabetic nephropathy. *Diabetes Care* 2006; 29:334-339.
32. Lipid and lipoprotein levels in patients with IDDM diabetes control and complication. Trial experience. The DCCT Research Group. *Diabetes Care* 1992;15:886-894.
33. Dokken BB. The Pathophysiology of Cardiovascular Disease and Diabetes: Beyond Blood Pressure and Lipids. *Diabetes Spectrum* 2008; 21 (3):160-165.
34. Purnell JQ, Dev RK, Steffes MW, Cleary PA, Palmer JP, Hirsch IB, et al. Relationship of family history of type 2 diabetes, hypoglycemia, and autoantibodies to weight gain and lipids with intensive and conventional therapy in the Diabetes Control and Complications Trial. *Diabetes* 2003;52:2623-2629.
35. Schwab KO, Doerfer J, Hallermann K, Krebs A, Schorb E, Krebs K, et al. Marked smoking-associated increase of cardiovascular risk in childhood type 1 diabetes. *Int J Adolesc Med Health* 2008;20:285-292.
36. Mons U, Müezzinler A, Gellert C, Schöttker B, Abnet CC, Bobak M, et al. CHANCES Consortium. Impact of smoking and smoking cessation on cardiovascular events and mortality among older adults: meta-analysis of individual participant data from prospective cohort studies of the CHANCES consortium. *BMJ* 2015 Apr 20;350:h1551.
37. Rodriguez BL, Fujimoto WY, Mayer-Davis EJ, Imperatore G, Williams DE, Bell RA, et al. Prevalence of cardiovascular disease risk factors in U.S. children and adolescents with diabetes: the SEARCH for Diabetes in Youth Study. *Diabetes Care* 2006;29:1891-1896.
38. Margeirsdottir HD, Larsen JR, Brunborg C, Overby NC, Dahl-Jørgensen K. Norwegian Study Group for Childhood Diabetes. High prevalence of cardiovascular risk factors in children and adolescents with type 1 diabetes: a population-based study. *Diabetologia* 2008; 51:554-561.
39. Schwab KO, Doerfer J, Hecker W, Grulich-Henn J, Wiemann D, Kordonouri O, et al. Spectrum and prevalence of atherogenic risk factors in 27,358 children, adolescents, and young adults with type 1 diabetes: cross-sectional data from the German diabetes documentation and quality management system (DPV). *Diabetes Care* 2006;29:218-225.
40. Van Vliet M, Van der Heyden JC, Diamant M, Von Rosenstiel IA, Schindhelm RK, Aanstoot HJ, et al. Overweight is highly prevalent in children with type 1 diabetes and associates with cardiometabolic risk. *J Pediatr* 2010 Jun;156(6):923-929.
41. Bagga A, Jain R, Vijayakumar M, Kanitkar M, Ali U. Evaluation and management of hypertension. *Indian Pediatr* 2007;44(2):103-121.
42. Flynn JT, Kaelber DC, Baker-Smith CM, Blowey D, Carroll AE, Daniels SR, et al. Subcommittee on Screening and Management of High Blood Pressure in Children. Clinical Practice Guideline

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- for Screening and Management of High Blood Pressure in Children and Adolescents. *Pediatrics* 2017;140(3):e20171904.
43. Centre for Disease Control and Prevention: Defining Childhood Obesity. Available from: <https://www.cdc.gov/obesity/childhood/defining.html>. Accessed August 13, 2020.
 44. World Health Organization: Childhood overweight and obesity. Available from: <https://www.who.int/dietphysicalactivity/childhood/en/>. Accessed August 13, 2020.
 45. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ* 2000;320:1240-1243.
 46. Khadilkar VV, Khadilkar AV. Revised Indian Academy of Pediatrics 2015 growth charts for height, weight and body mass index for 5-18-year-old Indian children. *Indian J Endocrinol Metab* 2015;19(4):470-476.
 47. Donaghue KC, Marcovecchio ML, Wadwa RP, Chew EY, Wong TY, Calliari LE, et al. ISPAD Clinical Practice Consensus Guidelines 2018: Microvascular and macrovascular complications in children and adolescents. *Pediatr Diabetes* 2018;19 Suppl 27:262-274.
 48. Wilson PW, D'Agostino RB, Levy D, Belanger AM, Silbershatz H, Kannel WB. Prediction of coronary heart disease using risk factor categories. *Circulation* 1998;97(18):1837-1847.
 49. Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults. Executive Summary of The Third Report of The National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, And Treatment of High Blood Cholesterol In Adults (Adult Treatment Panel III). *JAMA* 2001;285:2486-2497.
 50. Ridker PM, Buring JE, Rifai N, Cook NR. Development and validation of improved algorithms for the assessment of global cardiovascular risk in women : the Reynolds Risk Score. *JAMA* 2007;297:611-619.
 51. Ridker PM, Paynter NP, Rifai N, Gaziano JM, Cook NR. C-reactive protein and parental history improve global cardiovascular risk prediction: the Reynolds Risk Score for men. *Circulation* 2008;118:2243-2251.
 52. Kanjilal S, Rao VS, Mukherjee M, Natesha BK, Renuka KS, Sibi K, et al. Application of cardiovascular disease risk prediction models and the relevance of novel biomarkers to risk stratification in Asian Indians. *Vasc Health Risk Manag* 2008;4(1):199-211.
 53. Colhoun HM, Rubens MB, Underwood SR, Fuller JH. The effect of type 1 diabetes mellitus on the gender difference in coronary artery calcification. *J Am Coll Cardiol* 2000;36:2160-2167.
 54. Snell-Bergeon JK, Hokanson JE, Jensen L, MacKenzie T, Kinney G, Dabelea D, et al. Progression of coronary artery calcification in type 1 diabetes: the importance of glycemic control. *Diabetes Care* 2003; 26:2923-2928.
 55. Olson JC, Edmundowicz D, Becker DJ, Kuller LH, Orchard TJ. Coronary calcium in adults with type 1 diabetes: a stronger correlate of clinical coronary artery disease in men than in women. *Diabetes* 2000;49:1571-1578.
 56. Rask-Madsen C, King GL. Mechanisms of disease: endothelial dysfunction in insulin resistance and diabetes. *Nat Clin Pract Endocrinol Metab* 2007;3:46-56.
 57. Kim WY, Astrup AS, Stuber M, Tarnow L, Falk E, Botnar RM, et al. Subclinical coronary and aortic atherosclerosis detected by magnetic resonance imaging in type 1 diabetes with and without diabetic nephropathy. *Circulation* 2007;115:228-235.
 58. Muhlestein JB, Lappé DL, Lima JA, Rosen BD, May HT, Knight S, et al. Effect of screening for coronary artery disease using CT angiography on mortality and cardiac events in high-risk patients with diabetes: the FACTOR-64 randomized clinical trial. *JAMA* 2014;312:2234-2243
 59. Young LH, Wackers FJ, Chyun DA, Davey JA, Barrett EJ, Taillefer R, et al. DIAD Investigators. Cardiac outcomes after screening for asymptomatic coronary artery disease in patients with type 2 diabetes: the DIAD study: a randomized controlled trial. *JAMA* 2009;301:1547-1555

Chapter-10

Education

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Introduction

Diabetes with onset in childhood or adolescence needs major lifestyle changes. These include several daily injections, frequent glucose monitoring either by painful finger prick testing or continuous glucose monitoring system (CGMS), periodic visits to a healthcare facility and annual screening for vascular complications. Besides, there remains a constant concern about low and high blood glucose and the background fear of chronic complications. Several skills have to be taught quickly, and then frequently reinforced, with the aim of empowering the child and family to effectively control their diabetes and life. It is therefore not surprising that diabetes education is the backbone of diabetes care, with the American Diabetes Association (ADA) emphasizing that “Medical treatment of diabetes without systematic self-management education can be regarded as substandard and unethical care”.

A large proportion of children present initially with diabetic ketoacidosis (DKA), sometimes severe DKA. Once the child's clinical condition stabilizes, diabetes education has to start. With greater awareness of childhood diabetes, diagnosis is increasingly being made before florid DKA develops. For example, an otherwise well child presents with polyuria or new-onset bedwetting or vaginal/ penile infection, the urine exam shows glycosuria, so the blood glucose is tested and found high. In these and similar situations, management can be done on an outpatient basis.

Initiating education

The initial few days of handling the diagnosis and imparting the basics of education form the bedrock of later diabetes care. Once the diagnosis has been made, it is useful to have a checklist of aspects to be discussed immediately, in the near future, and much later during follow up (see checklist at the end of chapter). Encouraging acceptance of the illness and willingness to carry out an intensive daily regimen is the first step. The family should come for review at frequent intervals for the first few months, so that further aspects of care can be taught. The pace at which these aspects are covered will vary from patient to patient, and the nature of the diabetes care team.

Basic skills

Basic skills have to be taught as soon as the diagnosis is made. This includes self-testing and recording of blood glucose; handling insulin – understanding the action profile of basal and bolus insulins, injection technique, and insulin dose adjustment; and handling hypoglycemia. The initial days are also the most difficult for the family, as the diagnosis

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causes shock, denial, despair, and fear. Parents are unwilling and unable to absorb the information given to them. It is therefore crucial that they start performing hands-on tasks of testing glucose and injecting insulin from the very beginning, this somewhat reduces the panic and restores a sense of control. It may be useful for the parents to practice injections on themselves using normal saline. This convinces them that present-day needles of insulin syringes are indeed almost painless, and bolsters the morale of the child when the parents' fear changes visibly into comfort. It also provides an opportunity to talk about the use of separate insulin syringe for each individual with diabetes and about the safe disposal of sharps.

During this period of turmoil, it may be necessary to teach things repeatedly, as stressed family members may not be able to concentrate. The family should be made to understand the need for good glycemic control, ensured by regular daily self-monitoring of blood glucose (SMBG), basal-bolus insulin regimen, and ongoing self-adjustments. Families from low socioeconomic strata may balk at the high costs of SMBG. They should be explained that management with regular SMBG and multiple dose insulin regimen gives not only much better quality of life but in the long term, is actually less expensive, as it saves the cost of emergency care and hospital admissions for acute complications, absenteeism, and later development of chronic complications and income loss.

Once the family has begun testing and injecting, as discussed above, other aspects need attention. These include insulin dose adjustments, dietary education including introduction to the concept of food exchanges and carbohydrate counting (where appropriate), and handling exercise, and lifestyle in general. History of the family's and child's pre-existing lifestyle is taken, and appropriate advice on required modifications is provided. It is crucial to emphasize from the beginning that some or all lifestyle modifications (LSM) should be made by all family members, for their own good as well as for the child's sake. The shock of the diagnosis can actually help, because the family is initially willing to make drastic changes. The principle that the child is not treated as an exception, since diabetes does not require a special diet -everybody eats healthy and is physically active -is a prerequisite for achieving good glycemic control. This will ensure stable mental health of the child and family members, avoid feelings of exclusion and inferiority, and reduce the burden of extra work that diabetes care entails. Teaching carbohydrate counting and carbohydrate exchanges is laborious but may increase flexibility and improve glycemic control. Occasional dietary indiscretions and eating "unhealthy" foods, especially on special occasions, should be condoned - the discussion should include ways to handle such situations.

Another guiding principle is to encourage the child to be as independent as possible, at age appropriate levels. Thus, children above the age of 5-7 years can be encouraged, under supervision, to test blood glucose and inject insulin on their own. Children should be involved in decision making, whether in deciding doses, play, or food - planning meal menus, helping buy and prepare food, including cooking for the older children. This enhances the feeling of control and confidence, and reduces helplessness and deprivation.

After stabilization

After diagnosis and stabilization over 2-5 days, the next important step is returning to school/college, work place, perhaps hostel. Education must be given to the key staff persons in these institutions: teachers, medical room staff, bus driver, few close friends, etc., explaining key points about diabetes care, and what to do in case of hypoglycemia, ketosis, or other

untoward situations. One or more handouts with clear guidelines, and contact details of the family and care team should be made available. It is a good idea to keep a diabetes identification card (detailing name, address and telephone number of parent/guardian, name of the treating doctor, name and dosage of insulin and other medications, and what should be done in case of hypoglycemia with unconsciousness) with the patient at all times. An emergency kit containing necessary items for management of hypoglycemia such as glucose powder/tablets/powdered sugar (simple carbohydrate source), some biscuits or other snack (complex carbohydrate source), glucagon injection (where possible), blood glucose meter, lancet and glucose strips should be available in patient's bag and school/college medical room at all times.

Safe disposal of sharps should be taught from the beginning. Later, aspects such as dealing with sick days, travel, festivals, should be carefully dealt with, and reinforced from time to time.

Psychosocial aspects

Diabetes is a self-managed condition which involves continuous care and frequent decision making - this can be overwhelming for the child and the caregivers. Given the disruptive and expensive nature of diabetes care, the importance of psychosocial care cannot be overstated. The family goes through challenges on a daily basis - from the time of diagnosis which brings shock, despair, denial, and fear, to day-to-day activities like going to school, playing, social gatherings etc. The initial stress, anxiety and depression give way to acceptance of the condition, and preparedness to carry out daily care activities. Different family members progress through these stages differently. The diabetes care team has to factor this in when dealing with the family and diabetes education.

Understandably, the prevalence of psychological disorders among children with type 1 diabetes (T1DM) and their caregivers is high, with relationships in the family also going through turmoil. In our experience, parents are often distressed by the need for coping with "the new normal" - learning the technical aspects of diabetes care; concern about the stigma of a chronic condition; fear of hypoglycemia, and its attendant complications, especially seizures; fear of future problems with career and matrimony; and conflicts amongst the caregivers. Many have clinical depression but are unwilling to seek professional help for a variety of reasons. Therefore, the presence of a psychologist with expertise in T1DM in the care team can greatly improve outcomes and reduce suffering. Where this is not possible, some training of other team members in dealing with these aspects is desirable. Formal psychiatric pharmacotherapy is needed in a subset of children or caregivers. When these issues are neglected for any reason, diabetes care and control deteriorate, setting up a vicious downward spiral.

From the beginning, restoring self-esteem and self-confidence is important. Cognitive behavioral therapy can help-techniques include learning coping skills, motivational interviewing, family conflict resolution, and stress management. It is useful initially for the diabetes care team to try to make sure responsibilities are divided, so that the entire burden (and often, blame) does not fall on one person, often the mother. As discussed earlier, lifestyle changes should be undertaken by the entire family.

A contentious question is disclosing the child's diabetes. People in contact with the child - immediate family, staff in school, sports and tuition classes, close playmates need

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to know about diabetes and what to do in a crisis like hypoglycemia. However, informing everyone can attract a lot of unwanted attention and sympathy, so discretion is necessary. Body image issues may crop up in the growing child.

Parental supervision and help are needed during childhood and especially during the teenage years. Children and adolescents with T1DM may feel 'different' from their peers, and left out; they may be teased and bullied; or they may get too much sympathy from teachers and other adults. Parents must probe gently if they observe any unusual behavioral change in the child, discussing these issues in a non-threatening manner. Appropriate action (like informing the school, talking to parents of the other children) is needed to control the situation, and reassure the child that they have support. Adolescence needs increased but unobtrusive supervision and care, with increasing freedom and flexibility as needed. Over protectiveness and neglect are both damaging. Parents should be careful about their own mental health, that of the child, and equally, that of the siblings and significant others, to prevent resentments building up.

Red flags include disturbed sleep, disordered eating, lack of interest in social activities, poor interaction with friends/family, too much aggression, poor academic performance, complaints from school, and feelings of hopelessness and self-harm. The family should be encouraged to meet a professional psychologist/ counsellor if such problems persist. Sometimes pharmacotherapy may be needed. Self-help groups, peer support, altruism, and spirituality are other solutions.

The level of education imparted to the child and family varies, depending on the child's age, diabetes duration, and presence of risk factors; the ability and motivation of the family; local and cultural factors; and the resources available – financial, technological, and emotional – of the family and the diabetes care team. At every stage, goal setting and problem-solving should be emphasized. Content may change with time, as the child goes through life stages, and also as newer modalities become available. The timing and intensity of education will also change from time to time, as the care team has to factor in the psychological state of the family at that particular time, and deal with them accordingly. For example, since there is no clear-cut etiology of T1DM, it is common for family members to blame someone – spouse, another family member, physician, vaccination, etc. Disabusing them of fallacies such as this, or that diabetes can be transmitted to others, is an important task for the care team.

Awareness of the family dynamics is useful for the care team to optimally teach and treat, e.g. who are the key decision makers in the family; who are reasonable, who not; who controls the finances; who is available to do the self-care tasks; who would be able to go to school for the initial days to teach.

Adolescence

Adolescence is particularly difficult to deal with, since the physiological poor control due to insulin resistance, is combined with the natural adolescent drives for independence, risk taking and rebellion. This can lead to creative ways to disrupt systems. They may refuse to test or take doses, falsify information, and experiment with diabetes care and risky behaviors. Parents have to be helped

to ensure they supervise without being oppressive, to discuss and share decision-making, and allow some leeway in daily routines. Smoking, alcohol and other addictions should

be discussed with and without the parents' presence, discouraged, and handled in a non-judgmental manner.

Modes of education, digital tools

Education can be done in a variety of settings – in the clinic, in school/other institutions, during picnics, camps and other events, and now increasingly, using social media and other electronic means. It can be one-on-one, or more effectively and inexpensively, in a group setting, which may be physical or virtual. Verbal communication should ideally be accompanied by reliable, age and culture, appropriate material which can be revised repeatedly at leisure (physical and virtual books, booklets, handouts, websites, apps, games, etc.). The internet is an easy way to access information, so patients should be guided where they can find reliable information. It can be imparted by the endocrinologist, diabetes educator, dietician, psychologist, parent-volunteers or older patients in self-help groups. Parent and peer education can be very valuable – again, more effective and inexpensive. However, it is very critical that the messages given by the diabetes care team and group members should be the same. Contradictions between team members can be confusing and distressing for the patient and family. Similarly, group sessions should be monitored by the diabetes care team, to ensure only correct information is available, and myths removed. Digital tools can be used by the team to reach out, and can be personalized or generalized; and one-way or two-way. They can be particularly useful at diagnosis, during sick days, or when changing providers (moving from pediatric to adult clinic, or moving place of residence).

Monitoring

The need for tracking glycemic control using glycosylated hemoglobin (HbA1c) every 3 months or time in range (TIR) if using CGMS should be emphasized from the beginning. In addition, clinical monitoring of growth, development, blood pressure, puberty, and the retina is useful. Tests for co-morbidities and complications are needed periodically – thyroid stimulating hormone (TSH), tissue transglutaminase antibodies (tTG-IgA), lipids, and hemoglobin in the blood, and albumin-creatinine ratio in the urine.

Co-morbidities, complications

Obesity should be avoided by effective dietary and lifestyle management. Regular monitoring enables early detection of problems like hypothyroidism, hypertension, celiac disease, dyslipidemia, or later, retinopathy or nephropathy. The diabetes care team should explain the need for such monitoring, and the benefits of early and adequate management.

Acute complications

A child or adolescent with well controlled diabetes should ideally have acute illnesses at a rate no higher than the normal population. When any illness does occur, management becomes more complicated. Therefore, the family must understand that good quality of life, and good glycemic control, is possible only with regular daily SMBG, multiple dose basal-bolus insulin regimen, and ongoing self-adjustments. This is particularly important for families from low socioeconomic strata, who balk at the high costs of care.

The major acute complications - DKA and hypoglycemia - are largely preventable. Clear instructions must be given to family members, and critical persons in institutions (school, college, workplace) about how to prevent these complications, and what to do if they occur.

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They must also know whom to contact in an emergency. These teaching points need reinforcement at regular intervals.

Sick day guidelines

Sicknesses are often associated with high BG and an increased risk of ketoacidosis. In some conditions like gastroenteritis there is a risk of hypoglycemia. Hence, all patients need to be educated on handling sick days.

The key messages during an illness include:

- (i) Check BG frequently (at least 4 hourly, more frequently if needed)
- (ii) Check ketones if BG are persistently high (>250 mg/dL) or child is having vomiting/ abdominal pain or rapid breathing.
- (iii) Adjust insulin doses according to BG and ketone levels (Box 1 and Table I) giving correction doses for high BG especially with ketosis.
- (iv) In case of low BG (more likely in gastroenteritis), BG can be maintained by regular intake of carbohydrates/sweet liquids or with mini dose glucagon (Box 2). Insulin doses can be reduced but should not be skipped altogether
- (v) Never miss insulin totally, since a common mistake is to miss insulin doses since the child is not eating
- (vi) Ensure adequate hydration,
- (vii) Treat the underlying illness.

The family should know when to bring the child to hospital. The indications are:

- (i) if he/ she is less than 5y of age
- (ii) if he/she looks sick
- (iii) if ketones are moderate-high or if the ketones are rising despite giving corrective insulin doses
- (iv) if there is pain in abdomen, vomiting, severe diarrhea or poor oral intake,
- (v) especially if hypoglycemia is occurring.
- (vi) if he/she is having symptoms of ketoacidosis such as rapid breathing, drowsiness or altered behaviour
- (vii) if temperature is $>101^{\circ}$ F

Table I: Guidelines for extra dose of rapid/short acting insulin in sick days

KETONES		BLOOD GLUCOSE LEVEL (mg/dL)		
URINE	BLOOD (mmol/L)	180- 250	250- 400	>400
Negative	< 0.6	No extra insulin	5%	10%
Small	0.6 - 0.9	5%	5-10%	10%
Small to moderate	1 - 1.4	5-10%	10%	10%
Moderate to large	1.5- 2.9	5-10%	20%	20%
Large	> 3	10%	20%	20%

(Modified from ISPAD 2018 guidelines on sick day management)

Box-1: Guidelines for taking extra insulin for high BG/ketones in sick days

- Calculate total daily dose (TDD) of insulin by adding all the number of units that are given to the child (including long and short-acting insulin).
- Extra insulin to be taken as a percentage of TDD as shown in table I
- Extra dose is administered only as rapid/short acting insulin like regular, lispro, aspart/fast acting aspart or glulisine and can be repeated 3-4 hourly as needed.
- In case sugars running low, give extra carbohydrates/mini dose glucagon, consider reducing insulin dose by 10-20% but do not skip doses altogether. Basal insulin doses may need reduction by 20-50% depending on BG.

Abbreviation: BG: Blood Glucose, TDD: Total daily dose

Box 2: Mini-dose glucagon for prevention of hypoglycemia in sick days

- To be taken if BG low despite taking carbohydrates/not tolerating carbohydrates
- Take with U100 insulin syringe (black markings, orange cap)
- Dose:
 - < 2 years= 2 units
 - 3-15 years= 1 unit per age of the child (example 10 units for 10-year-old),
 - >15 years= 15 units
- Injected under the skin similar to insulin
- Do not take if moderate or large urine ketones/serum ketones> 1 mmol/L

Abbreviation: BG: Blood Glucose

Blood ketone meters are available in India (e.g. Freestyle Optium blood ketone test strips), and their use for monitoring should be encouraged, since they are more reliable than urine ketone monitoring. For children using CGMS, frequent monitoring of BG is not a problem, but they must be taught to be alert to the changes in BG patterns, and provide the correction doses of insulin. Pump users must be reminded that they can develop DKA quickly if there is pump malfunction, since there is no basal insulin. They must not neglect BG monitoring and keep extra supplies of regular or rapid insulin which can be used by syringe/vial or pen device in case the need arises. Families from low socioeconomic status who do limited BG monitoring should be encouraged to make sure frequent testing is done during sick days.

The sick child should be seen at the onset of illness by the endocrinologist, or pediatrician, for appropriate treatment of the underlying illness, and admitted if necessary, or reviewed as often as indicated. Infections may be more common and/ or more severe if the child's diabetes is poorly controlled. However, the tendency of many pediatricians and physicians to overtreat any child with diabetes, e.g. giving antibiotics when not indicated (as in a viral illness), is not justified.

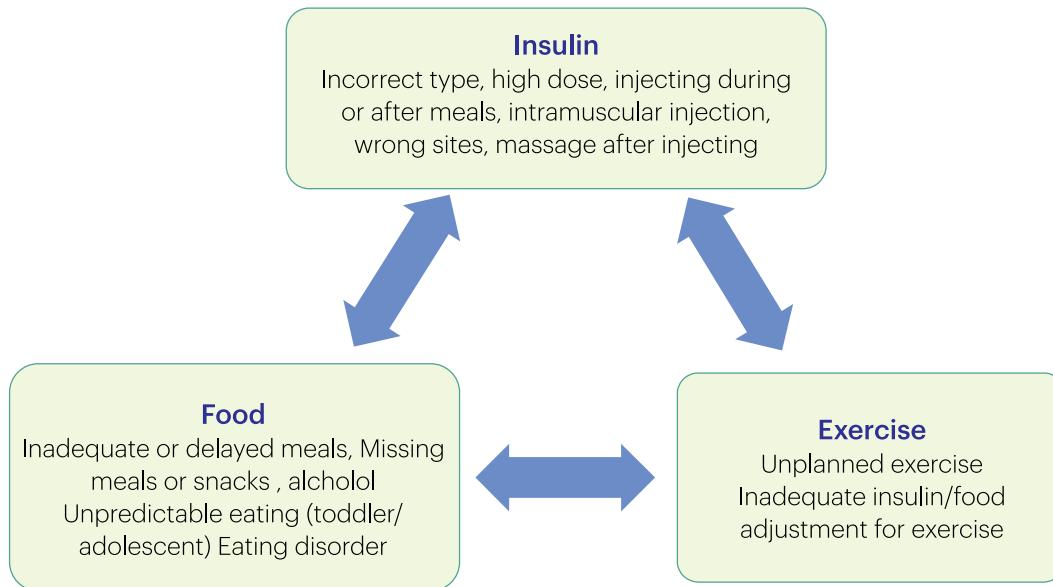
Hypoglycemia

The other major acute complication is hypoglycemia. Severe hypoglycemia, marked by coma or convulsions, is very frightening, and fear of hypoglycemia can be an important barrier to good glycemic control. Therefore, prevention and management are essential survival skills to be taught to the patient and family at the time of diagnosis, and reinforced frequently.

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Patients should be taught to avoid situations which can lead to hypoglycemia (Figure 1) - delaying or missing meals, and/ or exercising without adjusting insulin and calories, or overdose of insulin (accidental or deliberate). Frequent BG testing is important when starting a new exercise regimen or unexpected activity. Having at all times a diabetes I-card stating the symptoms of hypoglycemia and some form of plain sugar (glucose powder or tablets, sugar cubes, powdered sugar, sugar candy, gur, honey, juice) on one's person can be life-saving. This should be followed by a slowly absorbed snack like milk or peanuts. Family and staff who are familiar with the symptoms and signs of hypoglycemia, and know what to do, can usually prevent a severe episode. However, in case a crisis does occur, Injection Glucagon should be given, and the patient rushed to hospital for intravenous glucose infusion if needed. Glucagon must be kept at home or school/work - it is available in India. Glucagon can be administered via intramuscular or subcutaneous route. The dose is 0.5 mg for children <12 years and 1 mg for children and adults >12 years. Recently, the United States Food and Drug Administration (FDA) has approved nasal glucagon (3mg, Baqsimi) for treatment of severe hypoglycemia in patients aged ≥4 years. The approval was based on the results of two randomized trials, that showed non-inferiority of nasal glucagon to injectable glucagon for treatment of insulin-induced hypoglycemia. Patients can be asked to show I-card and hypoglycemia kit during clinic visits to drive home the point.

Figure 1: Common causes of hypoglycemia



Symptoms (Table II) may be different at different ages or circumstances; for example, a change in behavior can be the only symptom of low glucose in toddlers. The occurrence of symptoms depends on the BG level, the rapidity of fall in BG, antecedent glycemic control and frequency of hypoglycemia. Therefore, as far as possible, BG should be checked for confirmation, especially with CGMS, which may show spurious lows. Special emphasis must be given to hypoglycemia occurring at night, as it is a very commonly missed phenomenon. In patients using CGMS, asymptomatic hypoglycemia and night hypoglycemia can be picked up easily. These situations pose a challenge to those on multiple daily tests, so the family should be taught how to distinguish persistent hyperglycemia

from rebound hyperglycemia. Intelligent CGMS users can analyze the glucose trends to prevent hypoglycemia episodes; the alarm feature is invaluable in toddlers and especially at night. Treatment of hypoglycemia is summarized in Figure-2 and has been discussed in the chapter of acute complications in detail. Table -III lists common treatment options for hypoglycemia treatment. It should be emphasized that hypoglycemia should not be used as occasion for treats and sweets. Use of milk or fat containing sweets like milk chocolates, ice cream, milk-based sweets and ghee/oil containing sweets is not appropriate for hypoglycemia treatment.

Table II: Symptoms of hypoglycemia

Symptoms due to body's response to low BG	Symptoms due to reduced glucose delivery to brain
Shakiness or tremors Excess hunger Fast heartbeat Sweating Pale skin, cold extremities Anxiety Feeling of weakness	Headache Confusion Behavioral change Slurred speech, blurred vision Difficulty concentrating Drowsiness Unsteady walking IF NOT TREATED SEVERE SYMPTOMS BELOW CAN BE SEEN Loss of consciousness Fits

Abbreviation: BG:Blood glucose

Table -III: Common sources of glucose used for hypoglycemia treatment

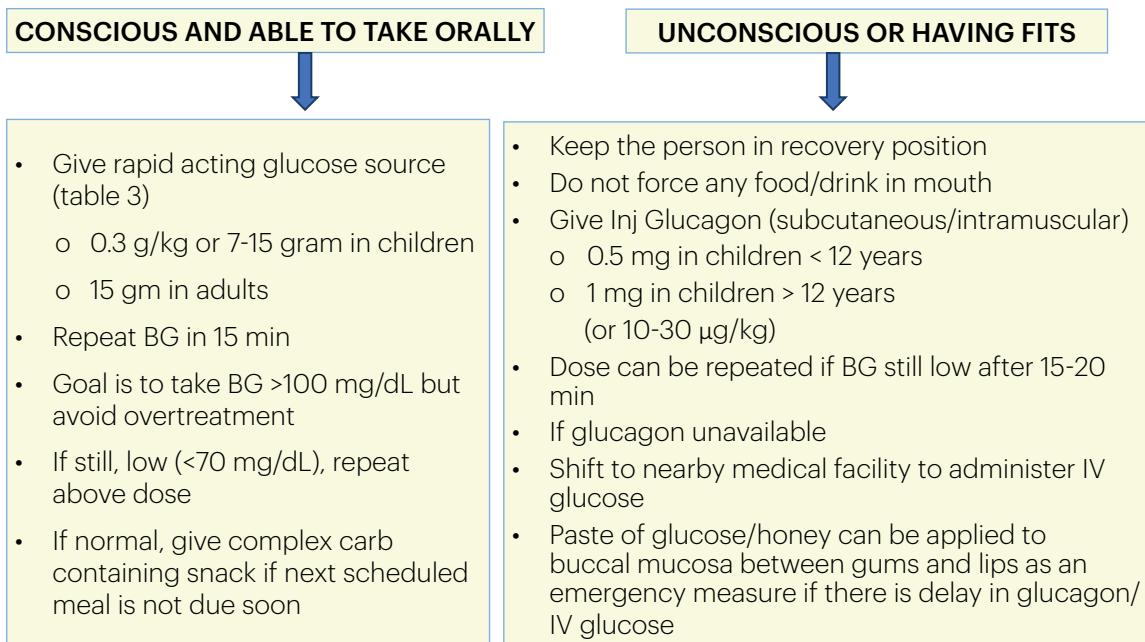
Source	Common brand names	Quantity	Carb content
Glucose tablets	Hypotab Glucovita bolts	1 tablet	4 g (hypotab), 2 g (glucovita)
Glucose powder, sugar & honey	Glucon-D	1 teaspoon	4 g
Hard candies	Poppins Mango bite	1 candy	3-4 g
Cold drink	Coca cola, pepsi etc	100 ml	11 g
Sweetened juices	Tetra pack juices - e.g. Real, Tropicana, Frooti	100 ml	14-15 g

Sports

Exercise has several benefits for diabetes control, and quality of health and life in general, and must always be encouraged for the child and family members. Hypoglycemia and to a lesser extent, hyperglycemia, interfere with games and sports; a severe hypoglycemic episode may cause the family to dissuade the individual with diabetes from all exercise. Therefore, it is important to check BG frequently – before and after, and for prolonged sports, during the activity, when first starting a play regimen, or during unexpected activity. If the activity is planned, insulin doses should be decreased in anticipation. For prolonged sports, a slowly absorbed snack like nuts and seeds, peanut chikki, coconut barfi or chocolate may be taken before starting. If hypoglycemia does occur, then of

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Figure 2: Treatment of hypoglycemia (confirm hypoglycemia with glucometer whenever possible)



course, simple sugars should be taken to correct it, as discussed above. BG responses differ in aerobic and anaerobic activity.

Preconception Care

All women of child-bearing age with T1DM should proactively receive counselling on methods of contraception, planning of pregnancy and the risks associated with an unplanned pregnancy. These include a higher risk of congenital malformations (commonly cardiac and neural tube defects), miscarriage, preterm labor, pre-eclampsia and fetal or neonatal deaths. Pregnancy may also aggravate complications of T1DM.

Contraception should be practised till the desired glycemic control is achieved, and folic acid supplementation started in the preconceptual period. Contraception could be hormonal or non-hormonal (barrier methods or intrauterine device)- the latter may be preferable in women with past or family history of thromboembolic diseases.

Preconception care should be aimed to achieve a HbA1c of < 7% (preferably as close to 6% as possible) without causing significant hypoglycemia. Recommended BG testing frequency is 6-7 times per day or with a CGMS; targets are fasting/ premeal readings of 80-110 mg/dl and 1-hour post-meal readings of 100-155 mg/dl. For this, physiological insulin dosing is needed - basal bolus regimen or continuous subcutaneous insulin infusion (CSII), i.e., insulin pump.

Preconception, all patients should be assessed for complications and co-morbid conditions, relevant changes made in treatment, and folic acid supplementation started (at least 400 µg/day). Issues like obesity, smoking, alcohol or drug consumption, and pre-existing complications like retinopathy (can worsen during pregnancy) should be dealt with before planning the pregnancy. Teratogenic or drugs with unproven safety during pregnancy such as statins, ACEI or ARB should be substituted by safer drugs (such as methyldopa, calcium

channel blockers or labetolol for control of hypertension) (also see chapter on “Special group- Pregnancy, Travel and Surgery”).

Travel

Several aspects of diabetes care need attention during travel, and should be discussed well in advance. Eating, activity, and sleep patterns can be variable, even from day to day, so BG monitoring has to increase, and insulin doses adjusted accordingly. Insulin and glucagon need transport at 2-25°C, in a thermos or other insulated carrycase, never packed in check-in baggage. Depending on the duration of travel, all supplies - insulins, syringes, pen needles, BG strips, blood glucose meter, sensor and other disposables, candies to prevent hypoglycemia and some concentrated calorie sources like dry fruit – and 50% extra as spares – should be carried. On school trips, parents must ensure the accompanying teachers can handle routine care and emergencies, and have emergency contact details. Discarded sharps should be stored safely for later safe disposal (also see chapter on “Special group-Pregnancy, Travel and Surgery”).

Driving

Indian law requires a minimum age of 16y for a learner’s license, 18y for a regular license, and 20y for a commercial license. Indulgent parents who allow underage teens to drive should be vehemently discouraged. Frequent BG testing should be encouraged initially. The patient must make sure BG is not low, or trending low, before beginning to drive, as even mildly low sugars can interfere with cognition. Some non-perishable snacks (e.g. peanuts) and also simple sugar sources (candies) should be available in the vehicle for emergencies. Patients on CGMS should keep an eye on the BG trend, and avoid even mild hypoglycemia.

In addition, vision should be normal. Rapid BG changes can lead to some blurring of vision – driving should be avoided at such times. Of course, as with persons without diabetes, no alcohol or intoxicant should be consumed before or when driving.

Limited resources

The difficulties of managing T1DM are amplified in families with limited resources, including even food insecurity, and availability of insulin and glucose strips. Poverty and illiteracy often go hand in hand – they make the task of education more difficult, but also more rewarding, since diabetes care education can help overcome some of the barriers posed by these conditions. Every aspect of diabetes care should be viewed through the prism of cost-effectiveness and affordability, since parents may be too ashamed to tell the team they ration insulin, BG testing, etc. More expensive insulins and devices are not necessarily superior. Insulin in vials is less costly than in cartridges. Disposable pens are more expensive than reusable ones. Lancets and needles can be reused several times with proper care. Multiple dose insulin regimens can give good metabolic control; insulin pumps are not essential. By forming groups and buying supplies in bulk directly, families can reduce costs. Excellent outcomes can be obtained with careful attention to finding cost-effective solutions, peer support, charitable and subsidized options, and income generation.

Remote Areas

Health care providers with expertise in managing T1DM are few and far between in many developing countries, especially in smaller cities and villages. This frequently results in

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poor management and therefore poor outcomes and needless suffering. In all developing countries, the deep penetration of mobile phones and the low cost of their use has begun to enable those living in remote areas to access experts and better care. In India, the recent decision of the Government to legalize telemedicine, and its extensive use during the COVID crisis, would enable better care to be possible for patients who could earlier not access experts. Use of digital tools is also helpful.

Another difficulty in remote areas is quality of insulin. Any breach of the cold chain would decrease the potency of insulin, leading to variability in glycemic control. This is a neglected area which needs urgent attention.

Fasting and Feasting in T1DM

Multiculturalism and practice of multiple religions means myriad of reasons for which Indians might consider undergoing fast. Hindus can consider nine days fast in Navratras, or day long fasts during Ekadashi or Purnima every month. Muslims observe Ramadan [where they refrain from eating and drinking from dawn to dusk, and consume calorie dense food at suhoor (before sunrise) and iftar (after sunset)] twice a year, Buddhists observe 12 hours fast for three lunar months during Vassa, Jains partake in 8-10 days of Paryushana, Christians keep fast during Lent, and Sikhs during Guru-Purnima. Most of these days of piety are followed by periods of celebration and feasting associated with consumption of high calorie food.

Since persons with diabetes are advised to consume food at regular intervals to maintain blood glucose levels within target ranges, these periods of fasting may lead to increased risk of hypoglycemia, whereas consumption of calorie rich food in post-fast period may lead to hyperglycemia, ketoacidosis or other metabolic abnormalities. Dehydration and electrolyte imbalance occurs due to abstinence from fluid intake, especially during summer festivals, while hyperglycemia worsens it by excessive fluid loss through urination. Dehydration increases the risk of thrombosis in persons with T1DM. To accommodate suhoor there is altered sleep pattern with decreased REM and increased NREM sleep, which decreases insulin sensitivity.

With these risks in mind, both religious and medical organizations allow for exemptions to these religious fast for persons with diabetes. ADA places persons with T1DM in very high-risk group, while the International Diabetes Federation Diabetes and Ramadan (IDF-DAR) guidelines places uncontrolled T1DM and well controlled T1DM in very high-risk group (category 1) and high-risk group (category 2), respectively with the recommendation that these patients must not and should not fast, respectively. These categories are advocated by Islamic Organization for Medical Sciences and the International Islamic Fiqh Academy, thereby exempting patients with type 1 diabetes from fasting without the guilt of not participating in their religious duties. However, many individuals still insist on partaking in these fasts due to the deeply religious connotations associated with them. In such a scenario, physicians should be aware of the risks and challenges associated with these fasts and counsel and educate the patients in ways to mitigate them. Following are the measures prescribed by IDF-DAR which can also be applied for other religious fasts:

1. Receive structured education

- a) All patients should consult their physician 6-8 weeks prior for proper risk stratification and quantification. Patients with T1DM and any of the following conditions should be strongly advised to avoid fasting: