Child India

November 2022

Monthly e-Newsletter of Indian Academy of Pediatrics

IAP EXECUTIVE COMMITTEE - 2022

PRESIDENT	DR REMESH KUMAR R
PRESIDENT-ELECT	DR UPENDRA S KINJAWADEKAR
IMM. PAST PRESIDENT	DR PIYUSH GUPTA
VICE-PRESIDENT (CENTRAL ZONE)	DR K RADHAKRISHNA
VICE-PRESIDENT (EAST ZONE)	DR SUDHIR MISHRA
VICE-PRESIDENT (NORTH ZONE)	DR HARINDER SINGH
VICE-PRESIDENT (SOUTH ZONE)	DR SUBRAMANYA NK
VICE-PRESIDENT (WEST ZONE)	DR CHETAN B SHAH
SECRETARY GENERAL	DR VINEET K SAXENA
TREASURER	DR SAMIR HASAN DALWAI
EDITOR-IN-CHIEF, IP	DR DEVENDRA MISHRA
EDITOR-IN-CHIEF, IJPP	DR S THANGAVELU
JT. SECRETARY - LIAISON	DR ALOK BHANDARI
JT. SECRETARY - ADMIN	DR PURNA A KURKURE

Executive Members

DR ANTHATI S KIREETI
DR P ANIL KUMAR
DR R RAMAKRISHNA PARAMAHAMSA
DR MRITUNJAY PAO
DR CHANDRA MOHAN KUMAR
DR SHEO BACHAN SINGH
DR ARUN PRASAD
DR SUSHIL KUMAR
DR AJAY KUMAR GUPTA
DR LALAN K BHARTI
DR MANISH GUPTA
DR VIRENDRA SADANAND GAOKAR
DR KANAKSINH U SURMA
DR RAMESH M BAJANIA
DR SAMIR R SHAH
DR AVS RAVI
DR MAHAVEER PRASAD JAIN
DR RAVINDER K GUPTA
DR JOY BHADURI
DR GEETA PATIL
DR MADHU S PUJAR
DR SN PRASHANTH
DR SHIVA PRAKASH SOSALE C
DR JOSE OUSEPH
DR M NARAYANAN
DR MK NANDAKUMAR
DR RIAZ I
DR KEWAL KISHORE ARORA
DR MAHESH MAHESHWARI
DR NARENDRA R NANIVADEKAR
DR PRAMOD M KULKARNI
DR RAMAKANT D PATIL
DR SANJAY B DESHMUKH
DR BELA VERMA
DR SHYAMKUMAR LAISHRAM
DR SANTANU DEB
DR PRASANT KUMAR SABOTH
DR SUSRUTA DAS
DR GURDEEP SINGH
DR HARPREET SINGH
DR ANURAG TOMAR
DR RAMESHWAR L SUMAN
DR A CHENTHIL
DR A SOMASUNDARAM
DR J BALAJI
DR R SOMASEKAR
DR G VIJAYA KUMAR
DR KOTTOORU SRISAILAM
DR S SRIKRISHNA
DR DHIRAJ M GUPTA
DR OM SHANKAR CHAURASIYA
DR RAJEEV KRASHAK
DR UTKARSH SHARMA
DR ASOK KUMAR DATTA
DR KAUSTAV NAYEK
DR SUTAPA GANGULY
DR SHEILA S MATHAI (SERVICES)

CONTENT

Editor's Note

Dear colleagues,

The November 2022 issue of Child India is at hand.

November is an important month for IAP as we pediatricians celebrate Children's Day (also known as Bal Divas) to increase the awareness of people towards the rights, care and education of children. It was in 1957 that the14th of November was officially declared Children's Day in India by a special government edict to celebrate the birth anniversary of Pandit Jawaharlal Nehru.

The World Diabetes Day is also observed on November 14th since 1991 by the declaration of the International Diabetes Federation (IDF) and the World Health Organisation. November 14 was decided upon as World Diabetes Day because it was the birth anniversary of Frederick Banting, who, along with Charles Best, discovered insulin. This year's theme, 'access to diabetes education', underpins the larger multi-year theme of 'access to care'. In the lead-up to and on 14 November, WHO will highlight not only the challenges, but more importantly the solutions, to scaling-up access to diabetes medicines and care.

Major IAP week and day celebrations were slated for this month.

You all would have had many programs between Nov 7th and 14th for the Child and Adolescent Health Care Week (CAHCW) and were busy guiding the adolescent. Theme for this year was 'Great adolescence by child nurturance'.

The IAP Teenage day, observed on the 1st day of the Child and Adolescent Health Care Week, had its theme as 'Addiction-free teens'. Nearly 4.6 lakh children fall in the badly addicted category, according to the AIIMS report. Another drug category, hallucinogens, is used in limited circles. According to the AIIMS report, India has nearly 12.6 lakh users in this category, of which one-third are in the harmful or dependent category.

Daughter's day was celebrated on Nov 13th, the Sunday during the Child and Adolescent Health Care Week with the theme 'Give them wings' and The healthy lifestyle Day would have been observed on any day of that week with the theme 'Say no to JUNCS and Yes to exercise'.

World Pneumonia Day (Nov 11th) & Week (Nov 12th to 18th) themed on 'Heathy lung for all' and IAP Newborn Week (Nov 15th to 22nd) on 'Home care of newborn in urban area' will also have kept us IAPians on our toes this month.

We hope that all reports for the IAP Awards of these Day and Week Celebrations were submitted in pen drive in the prescribed format before Nov 30th.

Child India takes this opportunity to congratulate all the winners of the recently conducted IAP elections and wish and thank all our friends who stood for elections so that they could serve the Academy.

Wishing you all had a great November,

Jai Children of our country, Jai IAP!

Dr Jeeson C Unni
Editor-in-Chief

President's Address

Dear friends,

Greeting from Child India

Firstly I would like to to congratulate all the winners of the recently conducted IAP elections and thank all contestants who together made this exercise a resounding success. I take this opportunity to express our deep gratitude to our IAP Election Commissioners lead ably by CEC Dr Durga Prasad

As we celebrate World Diabetes Day, the November and December issues of Child India will focus on various topics related to Diabetes Mellitus in children in response to growing concerns about the health and economic threat posed by diabetes,

Children with type 1 diabetes continue to fight for attention to their needs. Most epidemiologic studies and reviews of diabetes in India or South Asia focus on adults, while neglecting the significant burden of childhood diabetes.

Data from India reveals a significant prevalence of type 1 diabetes (over 10/100,000 population, with certain urban pockets reporting over 30/100,000 population). At the same time, the burden of glucose intolerance (associated with abdominal obesity) and type 2 diabetes is increasing in children.

Shobana et al, (Diabetes Res Clin Pract. 2002;55:45–8) submitted that the median annual expenditure on diabetes was Re. 13,980. The median percentage of income spend on diabetes was 59% in low socioeconomic families, 32% in the middle socioeconomic stratum, and 12% in the high income group.

We thank Dr PSN Menon for coordinating these 2 issues and all the esteemed contributors for the articles.

Warm regards,

Dr Remesh Kumar
National President, IAP 2022

Secretary's Message

Dear Friends,

"If everyone is moving forward together, then success takes care of itself."

We are happy to inform you that month of November 2022 is also an academic feast for all our colleagues. Various IAP Subspecialty Chapters, Groups and IAP State Branches have successfully organised their annual conferences in the month of November 2022.

We are happy to share that IAP East Zone successfully conducted Zonal Conference at Silchar. around 6 IAP Subspecialty Chapters and Groups, ie. Asian Congress on Adolescent Health (AHA), National Conference of IAP PEM Chapter (NAPEM) 2022, NCPID Conference, National Conference PHOCON, National Conference IAP Medical Education Chapter, Conference of ICANCL Group has successfully organised their conferences in the month of November 2022. Also, around 5 states, i.e., UP Pedicon, MP Pedicon, ODISHA STATE Pedicon 2022, PUNE Pedicon 2022, MAHAPEDICON 2022 CALPEDICON 2022 have successfully organised their annual conferences. I Congratulate all committee members of these Mega Events and Conferences for their extraordinary efforts and teamwork to push IAP to greater heights in academics and child welfare.

On 7th November 2022, we successfully conducted our 5th Executive Board meeting at Srinagar, Jammu and Kashmir. and Office Bearers meeting on 21st November 2022 via video conferencing. On behalf of CIAP, I thank to all Office bearers and Executive Board members for their active participation and fruitful discussion and decisions in the best interest of child health of the Country.

Along with this, Indian Academy of Paediatrics conducted workshops on the following modules under the Presidential Action Plan 2022. 1 Workshop of Pediatric Emergency Care & Resuscitation Training Module (PECART), 5 of Demystifying Allergic Disorders (DAD), 2 of Pyrexia of Infection & Non-Infection (POINT), 4 of Ped Gastro, 3 of Growth & Puberty- A Challenging Journey-Pediatric Endocrinology Module, 3 of Perinatology - Caring both ends of the Cord & 5 of Poor Scholastic Performance 2.0 (PSPP 2.0).

Regarding the NTEP and ECD, A total of 190 workshops of NTEP have been successfully conducted. In November alone, we conducted a total of 2 workshops. A total of 106 workshops of ECD have been done to date and 8 workshops of ECD in November 2022. This month total of 84 Basic NRP and 20 Advanced NRP provider courses have been successfully conducted.

Also, I would like to inform you that one of our CIAP office Staff members Mr Kiran Mahadik retired on 30th November 2022. I wish him a happy retirement.

On behalf of IAP, I urge you to organize various activities in the best interest of the health and welfare of the country's children.

Long Live IAP, Jai IAP

In service of Academy,

Dr Vineet Saxena
Hon. Secretary General 2022 & 23

IAP Election 2022 Result

PRESIDENT ELECT (No. of Vacancies-1)			
01	DR ABHAY KANTILAL SHAH	GUJARAT	NOT ELELCTED
02	DR GV BASAVARAJA	KARNATAKA	ELECTED
03	DR T HIMABINDU SINGH	TELANGANA	NOT ELELCTED
VICE PRESIDENT - EAST ZONE (No. of Vacancies-1)			
01	DR ASUTOSH MAHAPATRA	ODISHA	NOT ELECTED
02	DR BISHWAJIT MISHRA	ODISHA	ELECTED
03	DR SWAPAN KUMAR RAY	WEST BENGAL	NOT ELECTED
VICE PRESIDENT - WEST ZONE (No. of Vacancies-1)			
01	DR JAYANT G JOSHI	MAHARASHTRA	NOT ELECTED
02	DR KAMLESH K SHRIVASTAVA	MAHARASHTRA	NOT ELECTED
03	DR YOGESH N PARIKH	GUJARAT	ELECTED
VICE PRESIDENT - NORTH ZONE (No. of Vacancies-1)			
01	DR ASHWANI K SOOD	HARYANA	NOT ELECTED
02	DR HARISH KUMAR PEMDE	DELHI	NOT ELECTED
03	DR RAJEEV SETH	DELHI	ELECTED
VICE PRESIDENT - SOUTH ZONE (No. of Vacancies-1)			
01	DR JEESON C UNNI	KERALA	ELECTED UNOPPOSED
VICE PRESIDENT - CENTRAL ZONE (No. of Vacancies-1)			
01	DR A YASHOWANTH RAO	TELANGANA	NOT ELECTED
02	DR PIYALI BHATTACHARYA	UTTAR PRADESH	ELECTED

President's Engagements

At UP Pedicon at Jhansi October 29th, 30th

President's Engagements

Shri Kailash Satyarthi, the Nobel laureate (who shared the Nobel Prize in 2014 with Malala Yusuph) @ the inauguration of 53rd Madhya Pradesh (MPIAP) Pedicon at Vidisha on 11th Nov 2022. The social reformer who is a world renowned fighter against Child Labour was awe inspiring in his inaugural address. Conference also blessed by the presence of Shri Viswas Sarang ji, the Minister for Medical Education, Govt of Madhya Pradesh. Congratulations to Team Madhya Pradesh & Vidisha for organising a large scale conference at the newest and smallest branch of Madhya Pradesh. Kudos to Dr Neeti Agarwal, Dr. Rajesh Tikkas, Dr Mahesh Maheswari, Dr M K Jain, Dr Surendra Sonkar & Team. For me, it was quite exciting to deliver a lecture on "The Yummy Allergens" as well to catch up with Respected Seniors Prof. Dr. S Bhambal & Dr. C H Sharma with few of my best friends like Dr Rashmi Dwivedi, Dr Zafar Meenai, Dr Sunita Lakhwani, Dr Kawaljith Multani, Dr K K Arora, Dr VP Goswami, Dr M L Agnihotri and Dr. Ashwani Syal.

President's Engagements

Action plan released to curb child abuse to mark Children's Day

A TWO-DAY LONG CANCELCON 2022 CONCLUDES AT PGI

PUNJAB EXPRESS BUREAU
Chandigarh, November 13

CANCELCON 2022, a two-day conference on child abuse and rights being organized at PGI, concluded on Sunday with massive participation of representatives from the country and overseas.

This was the first time that the stakeholders along with doctors fraternity on such a sensitive issue, deliberate upon to curb the child abuse. Organizing Secretaries

This was the first time that the stakeholders along with doctors fraternity on such a sensitive issue, deliberate upon to curb the child abuse.

Dr Jatinder Sharma informed that CCPCR, Association of Pediatricians, Sahibzada Academy of Pediatrics, Mohali, Indian Academy of Pediatrics, Child Welfare Committee, Juvenile Police Units, UNICEF, local NGOs and other stakeholders have prepared a road map to deal the situation. Intensifying their efforts, participants affirmed to build a violence-free society for the children.

On the last day of the conference, all the stakeholders, reinforcing their pledge, issued action plans and SOPs in this regard with establishing a coordination between doctors, police, educationists and voluntary

More than 200 Police Officers, Teachers, Child Welfare officers and other stake holders from Civil Society made the ICANCL (Indian Child Abuse, Neglect & Child Labor) National Conference at Chandigarh quite unique. The conference at PGI Pediatrics Advanced Center Auditorium on 11th & 12 th Nov 2022, addressed by a good number of Government functionaries including Mr Kultar Singh, Punjab Legislatve Assembly Speaker, Mrs Gurpreet Deo, DGP Punjab & Mrs Satinder Kaur, Chairperson Child Welfare Commitee, was much inspiring to the multi sectional participants. Many senior IAP stalwarts including Dr BNS Walia, Dr ON Bhakoo & Dr R N Srivastava (Past National President) and current national Vice President NZ Dr Harinder Singh and myself made it to the inaugural function. Congratulations to the ICNCL Team of Dr Sandhya Khadse, Dr Uma Nayak, Dr Ashok Kumar, Dr Rajeev Seth, Dr Beka Sachdev & Dr Jagdeesh. No amount of appreciation will be sufficient to the brilliant Chandigarh and Mohali IAP Team of Dr Kanya.

President's Engagements

"IAP SUPERHERO KIT" Distribution as part of IAP U5MR Project launched at Barabanki in Uttar Pradesh on 14th Nov. Children's Day. Around 150 children identified as underprivileged by IAP Barabanki District U5MR Champion Dr Utkarsh Bansal and Team with the help of District Health authorities were provided the kits. The items included in the kit focus on determinants of anemia and undernutrition and send a strong message. We plan to have 2000 children from high priority aspirational districts as direct beneficiaries from Central IAP in the 1st phase which will be completed in the next 2 weeks. Congratulations to Team UP IAP under the stewardship of Dr Sanjay Niranjan, Pres UP IAP & Dr Alka Agarwal, IPP with whole hearted guidance from Dr NC Prajapathi (DME, UP) and Dr Piyali Bhattacharya , VP Elect CZ . The strong support from HIMS Medical College management especially Dr Sachan & Dr Richa Misra was instrumental to the success of the launching program. Sincere gratitude to Dr Utkarsh Bansal, Dr Sanjay Niranjan and Dr Prajapathi who made it happen with the targeted number of deserving children and their parents thronging the venue and giving it a festive atmosphere on the Children's Day.

President's Engagements

Children Hospital, Kashmir at Srinagar (attached to Govt Medical College), the 500 bed dedicated hospital catering to the needy children of the valley is certain to be a mammoth center of excellence in Pediatric care in our country. Indian Academy of Pediatrics was fortunate to have the "2022 Adolescent Health Care Week" inaugurated at this new hospital on 8th Nov.

Sincere gratitude to Dr Muzaffar Jan, Dr Khurshid Wani, Dr Mubashish and all the Team at Kashmir branch for facilitating the activities at Srinagar. Dr Ravinder Gupta, our EB member J& K was most instrumental in translating the new IAP initiatives at Kashmir into a resounding success.

President's Engagements

Ludhiana IAP hosted the 2022 Annual State Conference of Sutluj Academy of Pediatrics (IAP Punjab) on 13th of Nov 2022, Sunday. Dr Ritesh Chabra & Team made it a most memorable day of Academics and Socialisation. The ever charming Punjabi zeal and vibrancy never went wanting all through the event.

Congratulations dear Dr Vineet Arora & Dr Vibhu Narad, the Org Chairpersons & Dr Ritesh Chabra & Dr Vikas Bansal, the Org Secretaries for the successful conduct of the conference. The guidance from our ever enthusiastic Vice President North Zone Dr Harinder Singh, Central EB Members from Punjab Dr Harpreet Singh & Dr Gurpreet Singh & the Patrons Dr AS Chawla, Dr Dalijit Singh, Dr SS Bedi, Dr Harmesh Bairns & Dr Surinder Likhi was most supportive to the conference proceedings. Quite exciting to catch up with my Punjabi buddies Dr Tarlochan Randhawa, Dr Naresh Grover, Dr Manmeet Sodhi and most importantly the ever smiling cheerful Secretary Dr Ritesh Chabra. Thanks again dears for a great day out there in.

President's Engagements

A totally plastic free, environment friendly conference was awaiting to happen - NCPID, the showpiece event of the Infectious Diseases Chapter of Indian Academy of Pediatrics in its 2022 edition at VIT Campus, Vellore took the bold challenge of going "Green" all the way. The all round skills of Dr Narmada Ashok coupled with her passion and enthusiasm for IAP made the conference unique on its own. Dr S Balasubramanian, the ID Chapter Chairperson and the stalwart ID specialist from Chennai and his Secretary Dr Bhaskar Shenoy left no stone unturned to provide mesmerising scientific sessions from D1. The academic giants right from world renowned immunisation expert Dr Jacob John were there to enrich the scientific deliberations. The new Team of 2023 led by Dr Vasanth Khalatkar was installed at the inaugural function. Congratulations to the Organising Team of Dr Janani Sankar & Dr Arulalan, Organising Chairpersons, Dr Narmada Ashok, Org Secretary, Dr Suresh Babu, Treasurer & Dr Sathish Kumar, for carving.

Basic Aspects of Type 1 Diabetes in Children

LEENA PRIYAMBADA
Consultant Pediatric Endocrinologist
Rainbow Children's Hospital, Hyderabad, Telangana

INTRODUCTION

Childhood diabetes is one of the common chronic health conditions in children characterized by chronic hyperglycemia and its consequences. Diabetes in children can be mostly grouped into type 1 diabetes (T1D), type 2 diabetes (T2D) and other specific types including monogenic diabetes etc. The incidence of both T1D and T2D is rising.

DIAGNOSIS OF DIABETES

The characteristic symptoms of diabetes include polyuria, polydipsia, nocturia and weight loss despite a good appetite. But the onset of diabetes is usually months before appearance of symptoms and hence many diagnosed children may be asymptomatic.

A marked elevation of the plasma glucose concentration confirms the diagnosis of diabetes, including a random plasma glucose ≥200 mg/dL or fasting plasma glucose ≥126 mg/dL in the presence of overt symptoms or glycosylated hemoglobin (HbA1c) ≥6.5%. An oral glucose tolerance test (OGTT) is usually not required and should not be performed if diabetes can be diagnosed using the above criteria [1].

In the absence of overt symptoms, the diagnosis of diabetes requires two abnormal test results from the same sample, or in two separate test samples. In the absence of unequivocal hyperglycemia, continued observation with fasting and/or 2-hour postprandial plasma glucose and/or OGTT should be done. If OGTT is not feasible, the child should be followed up with self-monitoring of blood glucose (SMBG), HbA1c, and continuous glucose monitoring (CGM).

CLASSIFICATION OF DIABETES

T1D is the commonest form of childhood diabetes, though the incidence of T2D is increasing. Some of the more common types of diabetes are listed in Table 1 [1].

Table 1: Some common types of childhood diabetes

Type 1: β-cell destruction, immune mediated or idiopathic
Type 2: Insulin resistance with relative insulin deficiency
Other specific types: • *Monogenic:* MODY, neonatal diabetes • *Diseases of exocrine pancreas:* Pancreatitis, trauma/pancreatectomy, cystic fibrosis-related diabetes, hemochromatosis • *Endocrinopathies*: Cushing's syndrome, hyperthyroidism, pheochromocytoma • *Drug- or chemical- induced:* Steroids, atypical anti-psychotics, L-asparaginase, cyclosporine, tacrolimus • *Genetic defects in insulin action:* INSR, congenital generalized lipodystrophy • *Genetic syndromes sometimes associated with diabetes:* Down, Turner, Klinefelter, Prader Willi syndromes, Friedreich's ataxia

An autosomal dominant family history of diabetes in three generations with onset before the age of 35 years, diabetes in the first 12 months of life (especially first 6 months), mild fasting

hyperglycemia (100–150 mg/dL), associated conditions such as deafness, optic atrophy, or syndromic features and history of exposure to relevant drugs should indicate the possibility of other specific types of diabetes especially if islet autoantibodies are negative.

TYPE 1 DIABETES

Epidemiology

Even in the absence of a nationwide registry, India has the second highest prevalence of type 1 diabetes (T1D) in the world [2]. Currently India has approximately 8.6 lakh people with T1D. If a 10-year-old child gets T1D in India, the remaining life expectancy is only about 24 years, while in a developed country like Australia, a similar child will survive for 64 more years. One in six children with diabetes die of diabetic ketoacidosis (DKA) due to non-diagnosis in limited resource settings [2]. This tells us that diabetes can be very successfully managed and consequences probably depend on how well it is managed. It is of extreme importance that spreading awareness regarding T1D is increased. Though it commonly presents in childhood, it also presents in adulthood in many cases.

Pathogenesis

T1D results from a deficiency of insulin due to autoimmune destruction of ß-cells. The main targets of islet cell autoantibodies are glutamic acid decarboxylase 65 (GAD), tyrosine phosphatase-like insulinoma antigen 2 (IA2), insulin autoantibodies (IAA), and B-cell specific zinc transporter 8 autoantibodies (Znt8). Negative antibodies do not exclude T1D. Nearly 85% of newly diagnosed and prediabetic subjects have positive antibodies. The etiology of this destruction is multifactorial, and the exact nature of genetic susceptibility, environmental factors and the immune destruction are unclear.

The overall risk of T1D in the general population is 0.4%. Individuals with a first degree relative with T1D have ~15-fold increased relative risk of developing T1D. The HLA region on chromosome 6p21 accounts for approximately 30 to 50% of the familial aggregation of T1D. The highest non-HLA genetic contribution arises from the insulin gene (INS), PTPN22, CTLA-4 and IL2RA genes. The environmental triggers (infectious, nutritional, obesity, changes in the microbiome, chemicals) which are thought to be associated to T1D and pancreatic β-cell destruction remain largely unknown, but the process of β-cell destruction usually begins months to years before the manifestation of clinical symptoms. Once multiple islet autoantibodies are present, T1D progression rates are similar between individuals with or without a family history of T1D.

Stages and Screening of T1D

There are 4 stages of T1D as detailed below [3].

Stage 1: Multiple islet autoantibodies, normal blood glucose, pre-symptomatic

Stage 2: Multiple islet autoantibodies, abnormal glucose tolerance, usually pre-symptomatic

Stage 3: Blood glucose above ADA diagnostic thresholds (e.g. “newly diagnosed T1D”)

Stage 4: Long standing T1D

About 80–90% of children with multiple islet autoantibodies progress to stage 3 within 15 years compared to ~15% who have a single islet autoantibody; and nearly 100% of children with multiple autoantibodies will ultimately progress to stage 3 T1D in the lifetime. Autoantibody screening at ages 2 and 6 years may provide for optimal sensitivity and positive predictive value in public health settings. If feasible targeted screening along with careful monitoring identifies pre-symptomatic stage 3 diabetes. This reduces the incidence of diabetic ketoacidosis (DKA), rates of hospitalization, and directs individuals towards studies seeking to delay or prevent ongoing beta cell loss. In limited resource settings, at the very least SMBG for 1st degree relatives who show symptoms should

be done. An anti-CD3 antibody, Teplizumab, has been recently approved by FDA to delay the onset of stage 3 type 1 diabetes. However, the practicalities of this therapy will need to be worked out.

Management of T1D

Diabetes care is best provided with a person-centered care model, where the persons with diabetes and their family are the central members of the care team. Once diagnosed, there are four main pillars of management of T1D: insulin, nutrition, physical activity and monitoring.

Insulin therapy

Insulin therapy using long-acting basal insulin and short acting bolus insulin is the mainstay of treatment. Basal bolus regimen with multiple daily injections or continuous subcutaneous insulin infusion using insulin pumps are recommended (Figure 1) [4,5]. Premixed insulins contain a fixed ratio of a mixture of premeal and basal insulins and are not physiological. Higher rates of DKA and severe hypoglycemic risk have been reported in children, adolescents, and young adults with TID using premixed insulin as compared to a basal-bolus insulin regimen [6]. Similarly, twice-daily insulin dosing regimens are also unphysiological. Both premixed and twice daily insulin regimen are not recommended for management in T1D [7].

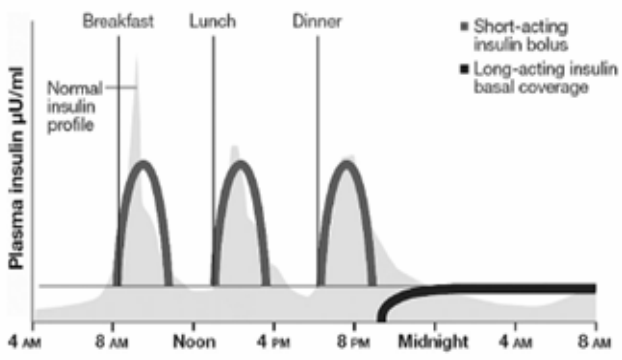


Figure 1: Basal bolus regimen using multiple daily injections [8]

Self-monitoring

Effective management also involves use of self-monitoring of blood glucose (SMBG), and continuous glucose monitoring (CGM) devices either real-time or intermittently scanned, either stand alone or integrated with sensor augmented insulin pumps. SMBG at least 6 times a day is recommended by International Society for Pediatric and Adolescent Diabetes (ISPAD) to adjust insulin doses appropriately. In limited resource settings, the maximum possible use aiming to do at least the pre-insulin, premeal blood glucose (BG) and the bedtime BGs every day. If regular use of CGM is not feasible, intermittent use of CGM every few weeks should be encouraged to understand glycemic patterns better. Blood ketone monitoring should be preferred over urine ketone monitoring where feasible. The target BG levels have been revised to 70–180 mg/dL throughout with a tighter fasting control of 70–140 mg/dL [9].

Nutrition

Growing children need adequate nutrition and a variety of food for their physical and mental and emotional growth. A healthy balanced individualized meal plan with attention to good quality carbohydrates, proteins and vegetables is appropriate. The entire family should be encouraged to have the same meal as the person with T1D. Carbohydrate should approximate 40–50% of energy, fat <35% of energy (saturated fat <10%), and protein 15–25% of energy. Matching of insulin dose to carbohydrate using insulin carbohydrate ratio (ICR) on intensive insulin regimens allows greater flexibility in carbohydrate intake and mealtimes, with improvements in glycemia and quality of life [10]. The use of the glycemic index provides additional benefit to glycemic management over that observed when total carbohydrate is considered alone. Impact of meals and carbohydrate counting should be introduced right at the beginning of therapy. There are several methods of quantifying carbohydrate intake (gram

increments, 10–12 g carbohydrate portions and 15 g carbohydrate exchanges). There is no strong evidence to suggest that one method is superior to another. Even in young children insulin should be administered before the meals and not during or after the meals. If the amount of food to be eaten cannot be confirmed, a smaller pre-prandial dose and if needed, a correction dose can be given. Dietary fat and protein affect early and delayed postprandial glycemia. Changes to both the insulin dose and pattern of delivery are needed for meals higher in protein and fat. Eating disorders are not uncommon in children with T1D and must be looked for [10].

Physical activity and exercise

Regular physical activity is one of the cornerstones of diabetes management and the recommended 60 minutes of moderate to vigorous intensity PA every day should be encouraged. There may be an increased risk of hypoglycemia during, shortly after, and up to 24 hours after exercise based on the type and severity of exercise. A history of severe hypoglycemia in the preceding 24 hours is generally a contraindication to exercise. SMBG or CGM is essential for managing optimal glycemia during exercise. Aerobic activities such as running, walking, cycling, and swimming result in lowering of BG levels whereas anaerobic activities like sprinting and weightlifting increase BG levels. A target BG range of 90–270 mg/dL during exercise is recommended [11].

Diabetes education

A structured diabetes education from the initial start of therapy and repeated on a regular basis is the key to T1D management. The rationale behind multiple daily injections, SMBG frequency, sick day rules, nutritional management should be conveyed to the families. Diabetes youth leaders and peer support groups, online and offline are great sources of support for persons with diabetes and their families. Sick day rules and hypoglycemia management must be revised frequently and visual charts should be given to the families for reference.

Outpatient follow-up

Outpatient follow-up is recommended as at least 3-monthly visits with growth, physical examination, and HbA1c assessments and adjustment of insulin, diet and exercise as needed. HbA1c target is recommended to be <7%. Even HbA1c <6.5% can be targeted if advanced technology is being used appropriately under proper medical supervision and hypoglycemia is not a concern. CGM metrics, recorded over a 14-day period, should have >70% time spent between 70–180 mg/dL (time in range, TIR).

Recommendation on routine vaccinations to be provided for children with diabetes according to age-related and regional recommendations. Advice on annual vaccination against influenza is given for all individuals with diabetes above 6 months of age. Pneumococcal and meningococcal vaccines are also recommended. Guidance on other age and developmentally appropriate goals and life events (including contraception, driving safety, use of alcohol, tobacco and other substances, and other risk-taking behaviors) need to be addressed.

Psychosocial screening for symptoms of diabetes distress, depression and disordered eating in children aged 12 and above should begin shortly after diagnosis and reviewed regularly.

Co-morbidities screening: Person with T1D should be screened for hypothyroidism with TSH measurements at diagnosis and every 2 years thereafter. If thyroid antibodies are positive, then TSH should be repeated annually. Celiac disease screening is recommended during the initial year of diabetes diagnosis and at 2–5 years intervals using tissue transglutaminase (tTg-IgA). A biopsy sparing approach may be considered on a case-by-case basis in symptomatic children. Other autoimmune conditions are screened based on the presence of symptoms. Calcium and vitamin D intake as well as regular weight bearing exercise should be optimized and smoking avoided for optimal bone health [12].

Vascular complications screening should begin at puberty or from age 11 years, whichever is earlier, after 2–5 years diabetes duration; and repeated annually for kidney disease and neuropathy; and every 2–3 years for retinopathy. Lipid screening should begin > 11 years and if normal results are obtained, it should be repeated every 3 years. Blood pressure should be checked at every visit and at least annually [13].

Language matters!

Optimal communication increases motivation as well as health and well-being of people with diabetes. Furthermore, careless or negative language can be de-motivating, is often inaccurate and can be harmful. Avoid 'diabetic' 'patient' 'sufferer'; instead use person with diabetes. Avoid 'disease'; instead use 'condition'. Avoid 'obese'; instead use 'unhealthy weight' etc. [14].

REFERENCES

1. American Diabetes Association Professional Practice Committee. 2. Classification and Diagnosis of Diabetes: Standards of Medical Care in Diabetes—2022. Diabetes Care. 2021;45(Supplement_1):S17-S38.
2. Gregory GA, Robinson TIG, Linklater SE, Wang F, Colagiuri S, de Beaufort C, et al. Global incidence, prevalence, and mortality of type 1 diabetes in 2021 with projection to 2040: a modelling study. Lancet Diabetes Endocrinol. 2022;10(10):741-60.
3. Besser REJ, Bell KJ, Couper JJ, Ziegler AG, Wherrett DK, Knip M, et al. ISPAD clinical practice consensus guidelines 2022: Stages of type 1 diabetes in children and adolescents. Pediatric diabetes. 2022 Sep 30. doi: 10.1111/ped.13410.
4. Nathan DM, Genuth S, Lachin J, Cleary P, Crofford O, Davis M, et al. The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. N Eng J Med. 1993;329(14):977-86.
5. Cengiz E, Danne T, Ahmad T, Ayyavoo A, Beran D, Ehtisham S, et al. ISPAD Clinical Practice Consensus Guidelines 2022: Insulin treatment in children and adolescents with diabetes. Pediatr Diabetes. 2022; In press.
6. Mortensen HB, Robertson KJ, Aanstoot HJ, Danne T, Holl RW, Hougaard P, et al. Insulin management and metabolic control of type 1 diabetes mellitus in childhood and adolescence in 18 countries. Hvidøre Study Group on Childhood Diabetes. Diabet Med. 1998;15(9):752-9.
7. Virmani A, Brink SJ, Middlehurst A, Mohsin F, Giraudo F, Sarda A, et al. ISPAD Clinical Practice Consensus Guidelines 2022: Management of the child, adolescent, and young adult with diabetes in limited resource settings. Pediatr Diabetes. 2022; In press.
8. Badlani S, Ford WT, Yu DJ, Brogan GX, Pollack CV, Volturo GA. Evidence for Basal–Bolus Insulin Versus Slide Scale Insulin. Curr Emerg Hosp Med Rep. 2014;2(1):26-34.
9. de Bock M, Codner E, Craig ME, Huynh T, Maahs DM, Mahmud FH, et al. ISPAD Clinical Practice Consensus Guidelines 2022: Glycemic targets and glucose monitoring for children, adolescents, aand young people with diabetes. Pediatr Diabetes. 2022; In press.
10. Annan F, Higgins LA, Jelleryd E, Hannon T, Rose S, Salis S, et al. ISPAD Clinical Practice Consensus Guidelines 2022: Nutritional management in children and adolescents with diabetes. Pediatr Diabetes. 2022; In press.
11. Adolfsson P, Taplin CE, Zaharieva DP, Pemberton J, Davis EA, Riddell MC, et al. ISPAD Clinical Practice Consensus Guidelines 2022: Exercise in children and adolescents with diabetes. Pediatr Diabetes. 2022; In press.
12. Fröhlich-Reiterer E, Elbarbary NS, Simmons K, Buckingham B, Humayun KN, Johannsen J, et al. ISPAD Clinical Practice Consensus Guidelines 2022: Other complications and associated conditions in children and adolescents with type 1 diabetes. Pediatric diabetes. 2022; In Press.
13. Bjornstad P, Dart A, Donaghue KC, Dost A, Feldman EL, Tan GS, et al. ISPAD Clinical Practice Consensus Guidelines 2022: Microvascular and macrovascular complications in children and adolescents with diabetes. Pediatr Diabetes. 2022;In press.
14. Speight J, Conn J, Dunning T, Skinner TC. Diabetes Australia position statement. A new language for diabetes: improving communications with and about people with diabetes. Diabetes Res Clin Pract. 2012;97(3):425-31.

Day-to-Day Management of Type 1 Diabetes in Children

DR BHANU K BHAKHRI
Addl Professor, Department of Pediatrics & Pediatric Endocrinologist,
Post Graduate Institute of Child Health (PGICH),
Super Speciality Paediatric Hospital and Post Graduate Teaching Institute (SSPHPGTI)
Noida, Uttar Pradesh

INTRODUCTION

Type 1 diabetes (T1D) is a unique condition. Unlike most of the common illnesses in which the patient has to passively follow the clinician's advice for few days till the illness resolves, in T1D the condition stays with the affected person for life and the family members have to get actively involved in monitoring, delivery of therapy and clinical decision making, several time a day. Since a majority of children with T1D are diagnosed during childhood, usually the parents of the child have to learn the management of the condition which has round-the-clock effects over the child's metabolic state, requiring constant attention. Gradually the family members (and later the child him/herself) have to play the role of a clinician while the clinician plays the modified role of a guide during this transformation of care.

Yearly, 3 children are freshly diagnosed with T1D among every 1,00,000 Indian children aged up to 14 years. This incidence is also noticed to be rising at an alarming rate of 3-5 percent per year [1]. With this increasing burden of T1D among Indian children it is important that pediatricians should have a clear understanding about the basics of disease, management components and most importantly their unconventional role in this situation. It is important to consider all these facts while planning the day-to-day care of T1D among children. Certain updated international guidelines also throw some light over optimal management planning relevant to regional situations [2].

GOALS OF MANAGEMENT

The goals of management are to provide care that results in

- "On target" glycemic profiles
- Optimal quality of life
- Growth and development which is appropriate for age
- Minimum possible risk of acute and long-term diabetes-related complications
- Early detection of co-morbidities
- Identification of barriers to care and their addressal by a multidisciplinary team

KEY ELEMENTS OF MANAGEMENT

The key elements can be classified as given below.

- **Structure:** It is the flow of information between the two groups. The first group comprise of the people who are a part of daily routine of the child (family members, school, day care personals etc.) while the members of multidisciplinary diabetes care group (pediatric diabetologist, diabetes nurse, dietician, clinical psychologist etc.) form the second group. The role of the diabetes care group members is to sensitize people involved in daily care about the specific needs of the child, to teach them various diabetes care skills and prepare them to identify and manage the usual issues arising during the course of T1D.
- **Process:** Usually it is in the form of regular outpatient visits and annual reviews. Intermittent group meetings, camps, teleconsultations etc. are additional modalities of interaction. In addition, there should be provision of access to anytime on call and inpatient care whenever there is emergency situation requiring clinical attention. Table 1 describes the suggested plan for continuum of T1D care over the course following the diagnosis.
- **Content:** The flow of information is in the form of structured diabetes education and self-management training with updated information tailor made for each family.
- **Outcomes:** The desired outcome is gradually improving understanding of the family (and later of the child) about optimal diabetes care using appropriate tools and troubleshooting for emergent problems and potential barriers of care.

SPECIFIC COMPONENTS OF MANAGEMENT

The various components of day-to-day T1D management are depicted in Figure 1.

Insulin therapy

The current recommendations support providing intensive insulin therapy either in the form of multiple daily injections (MDI) or continuous subcutaneous insulin infusion (CSII) [3]. With the availability of a spectrum of newer synthetic insulins, various combinations of long

Figure 1: Components of day-to-day management of type 1 diabetes in children

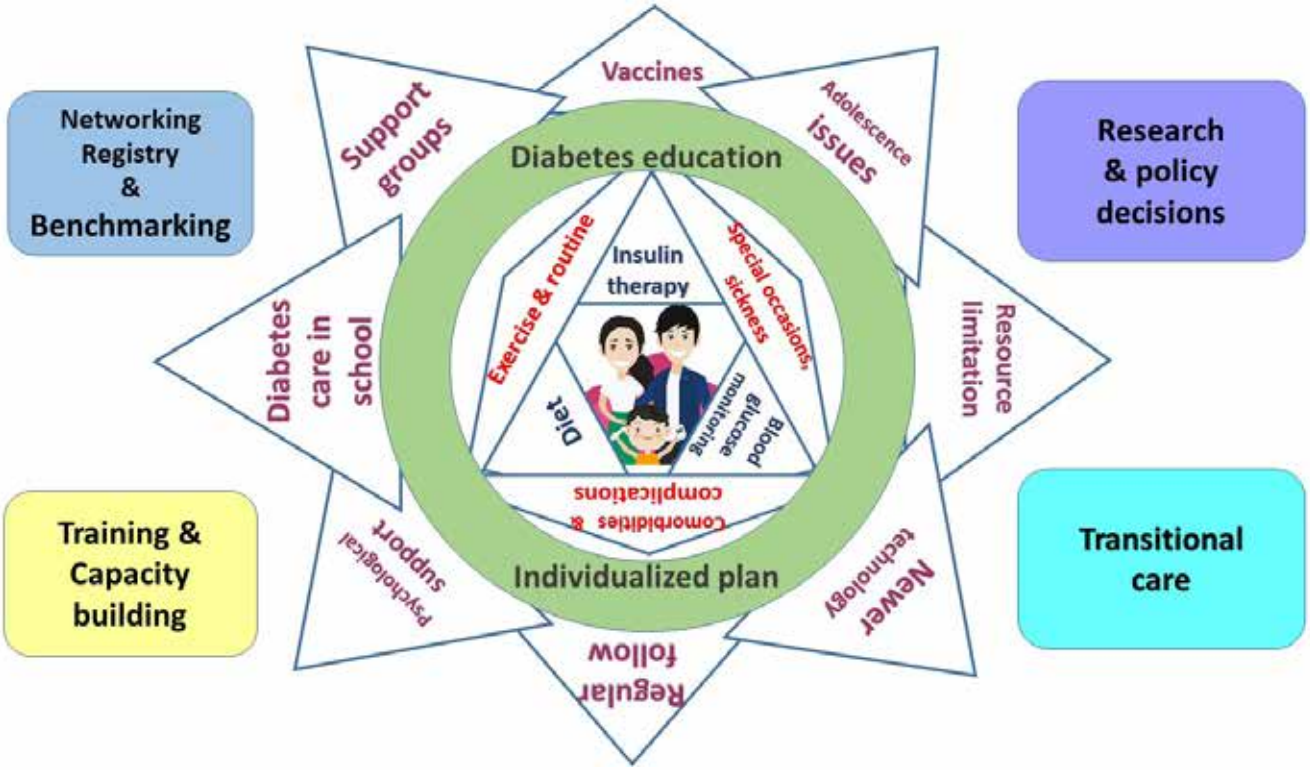


Table 1:
Continuum of type 1 diabetes care over the course following the diagnosis

Phase	Period & duration	Focus & remarks
Inpatient care (Induction)	Soon after the diagnosis or resolution of emergency issue, usually for 3–5 days.	• Opportunity for optimal discussion about the condition, addressal of families concerns and supervised training of the caregivers for basic skills required for insulin administration and blood glucose monitoring. • Investigations to establish the diagnosis and identify the comorbidities may be offered.
Initial frequent clinical visits (Extensive)	Weekly or fortnightly visits for next 2–3 months	• Assessing the adjustment of the family to the new requirements, identifying the potential barriers to care. • Evaluating the clarity of the caregivers regarding the basic principles of care and addressing to their queries. Introducing further refinements in the diabetes care concepts discussed earlier. • Suggesting resource material (books, videos etc.) for diabetes self-care and formulating an individualized diabetes care plan.
Routine clinical visits (Continuation)	One to three monthly visits for subsequent months and years	• Assessment of growth, development and puberty and immunization coverage (routine and special). • Detailed discussion on blood glucose trends, options of dose titration nutritional aspects, newer advances. Reinforcing basic principles like injection site rotation, food portions, hypoglycemia management, sick day rules, active lifestyle. • Addressing to barriers in care in school, home etc.
Annual clinical reviews (Continuation-strengthening)	Annual structured group meetings with multidisciplinary team members	• Active follow up with reminders. Mutual networking among the families. • Group education, activities of common interest like demonstration of newer technologies, introduction to support groups, provision of financial support etc. • Conducting group activities like retinopathy, neuropathy screening etc. Updating individual records and addressal of the lacunas identified in routine care.
Transitional care (Handing over)	Overlapping clinical visits with adult diabetologist starting from late adolescence	• To help the family in adjusting with the adult-centered diabetes in order to seamlessly continue the uniform diabetes care during the transition from pediatric to adult care systems.

acting (basal – detrimir, glargine, degludec etc.) and short acting (bolus – aspart, fiasp, regular, lispro etc.) insulins are possible which may suit the specific routine and circumstances of the child. Being relatively inexpensive, the MDIs are usually affordable for majority of users while CSII provide freedom from multiple daily pricks and wide fluctuations in insulin actions often associated with use of MDIs.

A practical approach is to introduce both the options early in the course of management allowing the family to make informed choices. It is the ethical and medicolegal obligation of the clinical team to introduce the entire spectrum of available options of treatment modalities. At the time of diagnosis, majority of children in the region are started on MDIs with insulin glargine or detrimir as basal and insulin regular or aspart as bolus component. The basal-bolus components are initially started at an empirical ratio (approximately 40:60) in total daily dose (TDD) 0.7–1 unit/kg body weight and titrated further as guided by blood glucose trends. The concepts of additional doses should be discussed in the context of insulin carbohydrate ratio (ICR) and insulin sensitivity factor (ISF) simultaneously while discussing the detailed concepts of diet. For those opting for CSII, it is prudent to ensure the caregiver's clear understanding about the proper use of the device which might require several detailed sessions with members of diabetes care team and device service provider.

Blood glucose monitoring

There should be a clear understanding about the need of constant watch over blood glucose (BG) levels. Majority of Indian families use conventional glucometers for testing, which usually requires testing 4–8 times a day in order to get meaningful BG trends. Emphasis should be made on checking BGs during night, travel, school time, sickness and special occasions. Continuous blood glucose monitoring (CGM) systems are recommended but are often beyond the affordability of most of the families. In the last few years, several newer modalities such as flash BG readers, options of using devices intermittently or for groups of people and integration with smart phone devices have helped in bringing such technologies closer to the reach of considerable set of users. Recently a closed loop system with integrated CGM system providing feedback to automatically titrate insulin delivery rate has also been introduced in India.

Nutrition in T1D

It is primarily based on healthy eating principles suitable for all. It should be targeted towards the maintenance of ideal body weight, optimal growth and development of the child. As a rough guide of the components, the carbohydrates, fats and protein should be around 40–50%, <35% (saturated <10%) and 15–25% of total energy intake respectively [4]. The diet should be adapted to meet the cultural, ethnic and family traditions and sociodemographic circumstances around the child. The concepts of glycemic index, carbohydrate counting and food portions should be introduced early especially in reference to the commonly used locally available food items. It is advisable to have a specialist pediatric dietician with experience in pediatric diabetes as a part of multidisciplinary diabetes care team.

Exercise in T1D

Child should be encouraged to follow an active lifestyle with regular exercise in daily routine. It not only helps in the maintenance of body parameters and composition but also improves the glycemic response of the given insulin dose. The anticipated BG fluctuations, need of monitoring and additional snack during exercise should be informed [5].

Complications and comorbidities

The caregivers should be able to anticipate, prevent, identify and manage the acute complication such as hypoglycemia and hyperglycemia. Their management should be clearly specified in the individual diabetes care of the child. Other issues, e.g. injection site complications and contact dermatitis should be discussed. The spectrum and schedule of testing for all long-term complications (neuropathy, nephropathy, retinopathy, dyslipidemia etc.) as well comorbidities (thyroiditis, celiac disease etc.) should be emphasized and specified in the care plan. Comorbidities are not only more commonly seen among children with T1D but also affect glycemic control if not addressed properly.

Care during sickness and special occasions

Sick days are often gateways to the development of serious complications like diabetic ketoacidosis (DKA) and hypoglycemia. The basic principles of adequate hydration, frequent testing for BG, ketones, top up doses etc. should be emphasized. Similarly, the caretaker should be able to anticipate, prevent, detect and manage the BG fluctuations during feasting (festivals, celebrations etc.) and fasting (sickness, religious etc.).

Care in school

In the absence of any legislative guidelines for responsibilities of school administration towards the care of a child with T1D, the approach of clear communication, mutual coordination and realistic expectations are likely to provide best outcomes. Providing an identification tag with the child with clear instructions in case of emergencies is recommended [6]. Parents are expected to keep back-up diabetes supplies in school storage if needed. Remote real time CGM systems may provide better insight to the parents of a young child about the status during schooltime. School personnel (school nurse, class teacher, transport assistance etc.) are expected to provide supervision and assistance in routine care and steps of emergency care associated with common conditions. School authorities should provide relaxation/allowance to the child in terms of specific needs, clinical visits, examinations etc. and encourage the child to participate in various students' activities without discrimination. Diabetes care team is responsible for training of school personals and providing individualized diabetes care plan.

Care in resource limited settings

An effective diabetes self-care education remains the backbone of care. The care plan should be as physiological as possible making the best possible use of available resources. Diabetes care workers should be aware of using low-cost supplies (e.g. urine ketone strips etc.) and avoid getting non-mandatory investigations. The focus should remain at uninterrupted access to basic diabetes care supplies exploring support from options like state hospitals supplies, government schemes, non-governmental organizations (NGOs), support groups, donations etc. [7].

Adolescent issues

Secondary to the ongoing physiological, social and behavioral transformation, often adolescents manifest rebel, autonomy and disinterest towards diabetes care. Individualized sensitive approach taking care of their autonomy often helps in getting best outcomes, sometimes with support of a clinical psychologist [8]. It is also important to plan proper transition of pediatric to adult care in order to ensure continuum of optimal care.

Psychological support

Since T1D is a condition requiring constant lifelong efforts and resources, it is often associated with psychological stress among caregivers in form of denial, guilt, pity or burn out etc. in the different phases of the disease. Support from clinical psychologists is often required to address to such issues [9].

NEWER TECHNOLOGIES

With fast evolving scenario of the various advancements in diabetes care technology, first of all it is important for the diabetes care team members to get regularly updated themselves. Introduction to families provides them opportunity to achieve better control with ongoing improved understanding of the condition. Various newer options and advancements in insulin types, delivery system, BG monitoring and associated issues like remote transfer of data, dosing algorithms etc. should be introduced. Demonstration of products may provide better insight to the users about the utilities [10].

Development of system to support effective regional diabetes care

In view of the involvement of number of stakeholders and lifelong resource-intensive care it is also important to align the regional systems to make them conducive for the care delivery for the optimal outcomes. Few such interventions are networking, registry and benchmarking which provide convenience to the beneficiary and improve the quality of services. Similarly, it is also important to apply regular efforts towards manpower training of relevant diabetes care. It is also important to draw the policy makers' attention towards the specific needs of children living with T1D. The role of research in search of better answers to existing and emerging problems relevant to our region cannot be ignored.

SUMMARY

Effective diabetes care education to make the family/person self-sufficient in comprehensive care remains the focus of long-term care. Identification and optimal addressal of the potential barriers of care is important to achieve the desired goals in individual care. Benchmarking, training, policy making and relevant research activities are crucial for development of an effective system of diabetes care in the region.

REFERENCES

1. Das AK. Type 1 diabetes in India: Overall insights. Indian J Endocrinol Metab. 2015 Apr;19 (Suppl 1):S31-3.
2. Limbert C, Tinti D, Malik F, Kosteria I, Messer L, Jalaludin YM, et al. ISPAD Clinical Practice Consensus Guidelines 2022: The delivery of ambulatory diabetes care to children and adolescents with diabetes. Pediatr Diabetes. 2022; In press.
3. Cengiz E, Danne T, Ahmad T, Ayyavoo A, Beran D, Ehtisham S, et al. ISPAD Clinical Practice Consensus Guidelines 2022: Insulin treatment in children and adolescents with diabetes. Pediatr Diabetes. 2022; In press.
4. Annan F, Higgins LA, Jelleryd E, Hannon T, Rose S, Salis S, et al. ISPAD Clinical Practice Consensus Guidelines 2018: Nutritional management in children and adolescents with diabetes. Pediatr Diabetes. 2022; In press.
5. Adolfsson P, Taplin CE, Zaharieva DP, Pemberton J, Davis EA, Riddell MC, et al. ISPAD Clinical Practice Consensus Guidelines 2022: Exercise in children and adolescents with diabetes. Pediatr Diabetes. 2022; In press.
6. Goss PW, Middlehurst A, Acerini CL, Anderson BJ, Bratina N, Brink S, et al. ISPAD Position Statement on Type 1 Diabetes in Schools. Pediatr Diabetes. 2018 Nov;19(7):1338-1341.
7. Priyambada L, Wolfsdorf JI, Brink SJ, Fritsch M, Codner E, Donaghue KC, et al. ISPAD Clinical Practice Consensus Guideline: Diabetic ketoacidosis in the time of COVID-19 and resource-limited settings-role of subcutaneous insulin. Pediatr Diabetes. 2020 Dec;21(8):1394-1402.
8. Gregory JW, Cameron FJ, Joshi K, Eiswirth M, Garrett C, Garvey K, et al. ISPAD Clinical Practice Consensus Guidelines 2022: Diabetes in adolescence. Pediatr Diabetes. 2022 Nov;23(7):857-871.
9. de Wit M, Gajewska KA, McDarby V, Zhao X, Hapunda G, Goethals ER, et al. ISPAD Clinical Practice Consensus Guidelines 2022: Psychological care of children and adolescents with type 1 diabetes. Pediatr Diabetes. 2022; In press.
10. Codner E, Acerini CL, Craig ME, Hofer SE, Maahs DM. ISPAD Clinical Practice Consensus Guidelines 2018: What is new in diabetes care? Pediatr Diabetes. 2018 Oct;19 Suppl 27:5-6.

New Diabetes Technologies – Simplified for the Pediatricians

DR NIKHIL LOHIYA
Consultant Pediatric Endocrinologist,
Silver Lining Pediatric Super Specialty Center, Nagpur, Maharashtra

INTRODUCTION

Modern time, has witnessed a technology revolution especially in the field of medicine and the management of type 1 diabetes (T1D) is no exception. Youth, especially in western countries, are using technologies in day-to-day management of T1D. The task of self-care management of diabetes has become more meticulous and calculated. The International Society for Pediatric and Adolescent Diabetes (ISPAD) and the American Diabetes Association (ADA) hence have recognized the importance of patient education and awareness on these aspects and have published guidelines on the same [1, 2, 3].

In this write-up we attempt to provide an overview of diabetes technologies which a pediatrician should know. This will help a pediatrician to address day-to-day issues of children with T1D and their families. There are many deficiencies in achieving the recommended glycemic control in a child with T1D, which can be addressed to a certain extent with the use of these technologies. In this write-up we will discuss continuous glucose monitoring (CGM) devices, advanced insulin delivery systems, and insulin pumps; in addition we will also brief on smart insulin pens and automated delivery systems. CGM reduces the number of finger-pricks for glucose testing and insulin pumps reduce the need for multiple daily injections (MDI). Hence, both these devices are boons and extremely helpful in the daily management of children with T1D.

CONTINUOUS GLUCOSE MONITORING (CGM)

Why go for CGM when we have glucometers?

All children with T1D are advised to do self-monitoring of blood glucose (SMBG) which patients usually perform at home as a part of the day-to-day management. The blood glucose (BG) reading gives a fair idea of what is happening at that particular time of event. However, it provides only a single snapshot of blood glucose reading. Since the change in blood glucose is a dynamic phenomenon in T1D, we are not aware of the whole scenario by one or two readings of blood glucose by SMBG. It is practically not justified to ask patient to do finger-prick test every hour or so as to understand the complete scenario regarding how the blood glucose levels are varying during a period of 12 or 24 hours.

The use of the technology of CGM has shown improvement in blood glucose control with fewer diabetes-related emergency visits to the healthcare facilities, especially with early initiation of CGM during the new-onset period and at a younger age. It also helps in titrating insulin dosing and the prevention of hypoglycemia. The mean glycosylated hemoglobin (HbA1c) is also better among patients who are using CGM devices.

What is the principle of CGM?

CGM measures interstitial blood glucose is every 1–15 minutes. The method used to assess interstitial glucose is by enzyme-tipped electrodes or fluorescence technology [4]. The last decade has seen a significant improvement in the technology of CGM including the accuracy, reliability, availability, small size, user friendliness, remote monitoring and personal acceptance [5].

What are the parts of a CGM device?

A CGM device includes sensor which is inserted under the skin, a transmitter which transmits the glucose signal, a receiver which receives the signal and displays the glucose value (Fig 1). A receiver can be a dedicated device or a mobile application where signal is transmitted via Bluetooth. Medtronic and Dexcom CGMs are real-time CGMs, whereas Abbott Freestyle Libre functions by intermittent scanning. CGM sensors needs to be replaced every 7, 10 or 14 days. These sensors are usually inserted on arms, abdomen, buttocks/hips, or anterior thighs.

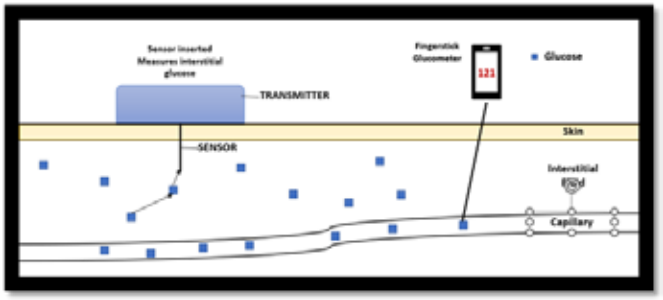


Fig 1. Working of CGM & Glucometer. Note that glucometer measures capillary blood glucose whereas CGM measures interstitial blood glucose.

The commonly available CGM sensors and their characteristics are listed in Table 1.

In whom should CGM be used?

It should be used ideally by every individual but there is no such thumb rule. In fact, in a country like India where cost is a major barrier, it should be used when there is a discrepancy in the blood glucose readings and HbA1c. Also, when there is a suspicion of nocturnal hypoglycemia, CGM is an excellent tool. In situation where child is afraid of pricks, CGM can be offered.

Recommendations of CGM 'Time-in-Range'

"Time-in-Range" (TIR) is the percentage of time a person spends their blood glucose levels in a target range (70–180 mg/dL) [5, 6]. A better way to understand this is as "hours per day" spent in-range. For example, 30% time-in-range means 7.2 hours per day spent in range. The International Consensus Statement on Time in Range (TIR) defined the concept of the time spent in the target range between 70 and 180 mg/dL while reducing time in hypoglycemia, for patients using CGM (Fig 2) [6, 7].

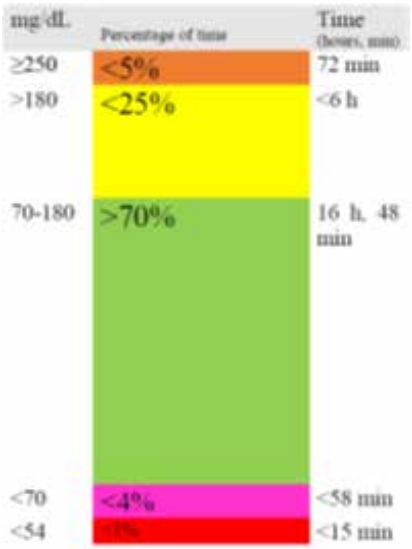


Fig 2 Target time in range recommended over 24 hours with glucose range

CONTINUOUS SUBCUTANEOUS INSULIN INFUSION

Insulin pump, or continuous subcutaneous insulin infusion (CSII) is an important part of management of T1D since many years. In western countries insulin pumps are the most common modality of insulin delivery especially among youth with T1D [3].

Table 1. Types of CGM sensors

Type	Blinded or Professional CGM	Real-time CGM	Intermittently scanned CGM (isCGM) or Flash CGM
Characteristic	Obtains glucose data over a short period of time providing healthcare professionals to look at the data obtained as glucose level display as excursions and patterns in a masked fashion	Automatically display glucose readings at regular interval. They can use programmable alarms helping in identifying hypo- or hyperglycemia as well as the rate-of-change alarms for rapid glycemic excursions	They do not automatically display glucose readings at regular intervals, but report only when the user scans the sensor by holding a reader, or a near field communication protocol (NFC)-enabled smartphone, close to the sensor.
Data access	Only to healthcare provider	Real-time access even to patient and can be obtained on reader and even smartphones	Data can be transferred from a smartphone to a webserver for remote glucose monitoring
Available In India	FreeStyle Libre Pro (Abbott)	Guardian (Medtronic) Dexcom	FreeStyle Libre (Abbott)
Display	Only on scanning by a healthcare professional	Continuous display on reader	Only on scanning of receiver
FDA approved	Yes	Yes	Yes
Cost	*FreeStyle Libre Pro (Abbott)* - Rs. 2500/-	*Guardian Connect* iPoD - Rs 60000/- Transmitter - Rs 52000/- Sensor - Rs 3250/- *Dexcom* Receiver- Rs 45000/- Sensor-Rs 8500/-	*FreeStyle Libre (Abbott)* Reader - 5000/- Sensor - 4500/-

Why use insulin pumps when we have MDI therapy?

The use of insulin pumps has shown improved glycemic control, reduced hypoglycemia, and improved quality of life. The basal rates can be adjusted. The chances of missing a dose is also reduced. The flexibility of insulin delivery is also high. Higher rates of satisfaction have been reported by families using pumps. There is a better perception of health of a child with T1D as compared with injections users. The diabetes-specific quality of life is reported higher along with a reduction in care burden reported by caregivers using pump.

What is insulin pump?

It is a device used for insulin delivery. It has three parts the pump itself, infusion set and sensor-transmitter in sensor-augmented insulin pumps. It is depicted in the image below (Fig 3). Newer insulin pumps do come with an integrated sensor which transmits the signal to insulin pump and insulin pump then adjust the insulin infusion with smart automated algorithms.

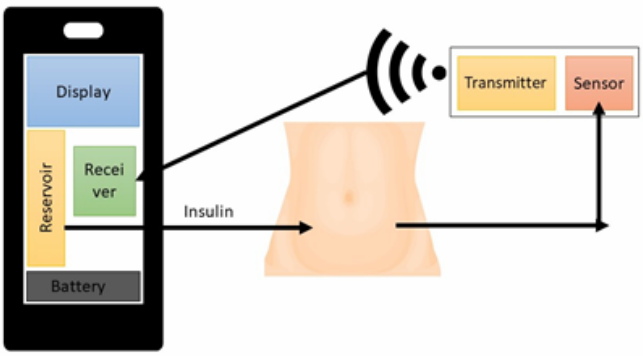


Fig 3. Parts of insulin pump

The common insulin pump brands available include Medtronic (MiniMed™), Omnipod and Tandem. The insulin pump is carried by the user as a device attached to a strap under his/her clothes, in a pocket, on belt or with an adhesive patch on the stomach or arm.

How do you select a candidate for insulin pump therapy?

The family should be aware of the fundamentals of insulin therapy; they should be aware about correction of insulin doses and calculation of the same. It should be understood by the caretakers that though pump reduces their burden in many ways, the input for treatment with pump should be provided by the caregivers. The child and caregiver should be responsible enough to be aware of dislodgement of pump. The commitment, education and readiness of the patient and caregiver are of paramount importance for initiating insulin pump. They should have an understanding of insulin action, carbohydrate counting, correction doses, and sick day management for safe pump use.

What are the challenges with the use of insulin pumps?

Frequent glucose monitoring is recommended as pump failure may lead to diabetic ketoacidosis (DKA). The cost of the device is another challenge faced by the families. A structured education with proper understanding is also recommended.

When can insulin pump be initiated?

It varies with the choice of the physician and also the understanding and commitment of the family and the child. The decision whether to start an insulin pump immediately after the diagnosis or or after the honeymoon phase settles with the onset of overt diabetes, varies from physician to physician. The ISPAD recommends pump therapy for youth with diabetes regardless of age.

NEXT GENERATION INSULIN PENS

Smart pens are a forthcoming advancement in management of T1D. It is still in pipeline to be implemented in clinical practice. It features dose calculators which takes into account active

insulin (insulin on board), record of insulin doses and times of administration, and downloadable report generation [3]. This will help in calculation of daily dose of insulin, missed doses of insulin and potential of observing the glycemic pattern of a child.

SUMMARY

Technology has moved really fast in the past decade or so as far as T1D management is concerned. It has provided us with valuable tools, which are really useful in improving the glycemic control and general care of a child with diabetes. Caregivers can make use of them with appropriate education and good knowledge of their uses for the benefit of a child with T1D.

REFERENCES

1. American Diabetes Association. 13. Children and adolescents: standards of medical care in diabetes—2019. Diabetes Care. 2019;42(Supplement 1):S148-64.
2. Tauschman M, Forlenza G, Hood K, Cardona-Hernandez R, Giani E, Hendrieckx C, et al. ISPAD Clinical Practice Consensus Guidelines 2022: Diabetes technologies: Glucose monitoring. Pediatr Diabetes. 2022; In press.
3. Sherr JL, Schoelwer M, Dos santos TJ, Reddy L, Biester T, Galderisis A, et al. IS{PAD Clinical Practice Consensus Guidelines 2022: Diabetes Technologies: Insulin Delivery. Pediatr Diabetes. 2022; In press.
4. Rodbard D. Continuous glucose monitoring: a review of successes, challenges, and opportunities. Diabetes Technol Ther. 2016;18(Suppl 2):S3-S13.
5. Klonoff DC, Buckingham B, Christiansen JS, Montori VM, Tamborlane WV, Vigersky RA, Wolpert H. Continuous glucose monitoring: an Endocrine Society clinical practice guideline. J Clin Endocrinol Metab. 2011;96(10):2968-79.
6. Bailey TS, Grunberger G, Bode BW, Handelsman Y, Hirsch IB, Jovanovič L, et al. American Association of Clinical Endocrinologists and American College of Endocrinology 2016 Outpatient glucose monitoring consensus statement. Endocr Pract. 2016;22(2):231-61.
7. Battelino T, Danne T, Bergenstal RM, Amiel SA, Beck R, Biester T, et al. Clinical targets for continuous glucose monitoring data interpretation: recommendations from the international consensus on time in range. Diabetes Care. 2019;42(8):1593–1603

Nutritional Management of Childhood Diabetes

DR PARVATHY L
Consultant Pediatric Endocrinologist, Aster Medcity
Kochi, Kerala

INTRODUCTION

Type 1 diabetes mellitus (T1D) over the years is emerging as a major health issue in children and adolescents. As per the IDF atlas 2021, India harbours the maximum number of persons with T1D in the age group 0–19 years [1]. Lifestyle management and medical nutrition therapy are essential components in treating T1D. Understanding the medical nutrition therapy (MNT) for children with T1D forms one of the four important pillars in the optimal management of T1D. A dietician with special experience in pediatric diabetes and carbohydrate counting should be an integral part of the multidisciplinary team caring for children with diabetes.

Why is diet an important aspect in the management of T1DM ?

- To provide adequate nutrition to facilitate growth and development in children and adolescents.
- To maintain blood glucose (BG) in the near normal range with less events of hypoglycemia.
- To match the carbohydrate intake with the dosage and action profile of insulin.
- To prevent and treat acute complications of diabetes such as hypoglycemia, hyperglycemia, diabetic ketoacidosis (DKA) and address illness and exercise-related glycemic excursions.
- To develop a healthy, consistent eating habit by involving the child and family to ensure consistency and avoid development of erratic dietary habits which are very common and hinder appropriate glycemic control in the long run.
- Undue restrictions cause micronutrient deficiencies, growth impairment as well as poor adherence to meal plans.

CONCEPTS OF ENERGY AND PROXIMATE PRINCIPLES OF DIET

It is important to individualize the diet plan for each child considering her/his socio-cultural, economic backgrounds and should be finalized in consultation with the child and parents. The energy requirement for children and adolescents with T1D is similar to the general population. The requirements are higher than normal soon after diagnosis and after recovery from DKA and also in puberty [3, 4].

It is imperative to plot growth parameters on appropriate growth charts once in six months. Inadequate weight gain on serial growth plotting would point to the possibility of insufficient caloric intake. Other comorbidities, poor control of diabetes and chronic illnesses such as tuberculosis have to be ruled out. Excessive weight gain could be due to overeating with over-insulinization, and it is important to rule out co-existing hypothyroidism and frequent hypoglycemia with over-correction.

Table 1 lists the recommendations by International Society for Pediatric and Adolescent Diabetes (ISPAD) for children [2].

Table 1 – ISPAD 2022 guidelines recommendation of macronutrient consumption (ref 2)

Macro-nutri-ent		Recommendations
Car-bohy-drates	40 to 50%	**Focus on high quality carbohydrate sources** Inclusion of fiber rich foods, low GI, low GL Up to 10% of total energy may be sucrose
Fats	30 to 40%	**Limit saturated fats (<10%) and trans fats** Focus on including omega 3 fats
Pro-teins	15 to 25%	**50% from good quality protein** Protein intake lowers GI & reduces post-meal BG excursions

CARBOHYDRATES

Carbohydrates are the main proximate principles/macronutrients in food that affect blood glucose levels most. Insulin needs to be matched to the carbohydrate content of each meal [3]. Protein and fat do not have an immediate effect on blood glucose, but they do contribute to blood glucose after hours of intake. Too much carbohydrate restriction may affect growth in children and adolescents and should be avoided. The Indian diets are typically rich in simple carbohydrates [4, 5]. The intake of complex carbohydrates should be encouraged to include at least 70% of the total carbohydrates. Healthy sources of carbohydrate foods include wholegrain cereals and bread/millets, legumes, fruits, vegetables and low-fat dairy products.

The intensive insulin regimen, basal-bolus regimen and the continuous subcutaneous insulin infusion (CSII) allow a greater flexibility in meals. The carbohydrate intake at meals can be varied from day to day. The family needs to calculate the pre-meal insulin dose to match the anticipated carbohydrate intake at that meal. The carbohydrate contents of common foods and snacks need to be educated to the family and individualized insulin-to-carbohydrate ratio (ICR) must be established. If the child is on split-mix regimen (rarely used now) where a fixed insulin dose is given daily, the carbohydrate content in meals also should be fixed. Here there should be three main meals, two mid-meal snacks to cover peak action of insulin plus a bedtime snack to prevent nocturnal hypoglycemia.

Foods that produce slower blood glucose rise over first 2-3 hours after intake are preferred, i.e. those with low glycemic index (GI). Low GI foods include whole wheat chappatis and bread, oats (rolled/steel cut), barley, soya beans, peas, lentils, Bengal gram and gram flour, temperate fruits (like apple and pears), full cream milk and yoghurt. Foods with high GI include white rice, white bread, jowar, ragi, maize, semolina, tapioca, cornflakes, potato, tropical fruits (pineapple, papaya and mango) and honey [6].

Fiber

Fiber refers to the indigestible carbohydrates present in food and is adequate in traditional Indian diet. It is present in whole fruits with skin, vegetables, oats(rolled/steel cut), legumes, beans and whole grain cereals. A fiber intake equal to the child's age in years plus 5 g is known to be beneficial.

PROTEIN

In general, the protein requirement is 2 g/kg at 1 year, 1 g/kg at 10 years and 0.8–0.9 g/kg in adolescence. Animal source proteins (e.g. fish, milk, egg white, poultry and meat) are of better quality than those from vegetarian sources (e.g. soya, beans and lentils), as they are rich in

essential amino acids. It is to be noted that animal protein intake is associated with higher salt and saturated fat content.

FAT

Saturated fat consumption should not exceed 10% of the total calories. They are seen in animal sources like egg yolk, flesh foods, poultry skin, butter, ghee, cream, coconut oil, palm oil etc. Fish, lean meat and poultry without skin and fat are low in saturated fat content.

Unsaturated fats, both polyunsaturated (PUFA) and monounsaturated (MUFA) help to reduce the risk of cardiovascular disease. PUFA should make up not more than 10% of the calories. They are cardio-protective, Omega-6 PUFAs reduce LDL cholesterol and they are present in sunflower oil, safflower oil, sesame oil etc. Omega-3 PUFAs reduce serum triglycerides and they are found in cold water fatty fish like mackerel, salmon, sardine and tuna, and also in flaxseeds, walnuts, soyabean, broccoli, spinach and cauliflower.

MUFA are the healthiest fats and should make up 10–20% of the total calories. They are found in olive oil, sesame oil, rice-bran oil, mustard oil, almonds and avocados.

VITAMINS AND MINERALS

Vitamin and mineral requirements in children with diabetes are similar to that of healthy children. Appropriate choice of macronutrients ensures RDA of all vitamins and minerals.

Salt intake should be similar to that of healthy children. Daily salt intake should be limited to 1000 mg in children 1–3 years old, 1200 mg in 4–8 years old, 1500 mg in children more than 9 years and adolescents. Processed food should be reduced as they are rich in salt.

Sweeteners, commonly used are non-nutritive hypocaloric ones such as saccharin, neotame, aspartame, acesulfame K, Stevia, alitame and sucralose. They can be used in acceptable daily limits. But their role in better glycemic control, weight control or reducing cardiometabolic risk factors is limited.

CARBOHYDRATE COUNTING

Carbohydrate counting is essential for patients on basal-bolus regime and CSII. The most appropriate method is using Insulin to Carbohydrate Ratio (ICR) which may vary from child to child based on age, sex, pubertal status, duration of diagnosis and activity. ICR represents the g of carbohydrate that would be covered by 1 unit of rapid acting insulin. ICR can be calculated using the formula 500 divided by total daily dose (TDD) of insulin (450 divided by TDD for regular insulin) .The ratio can be fine-tuned by checking BG before and 2 hours after meals to maintain a BG increase of less than 60 mg/dL. Divide the daily caloric intake in 3 major meals and 2 snacks if needed in basal bolus regime and CSII. The families must be taught to weigh and measure the foods that they commonly eat. They should use standardized measures (cups, spoons, and bowls) and should be provided with written material on carbohydrate counting for Indian foods and snacks.

LOW CARBOHYDRATE SNACKS

Low carbohydrate snacks are recommended when it is inconvenient to administer a pre-snack insulin bolus. In prescribed amounts, they do not have a significant impact on BG levels [7]. These snacks should be good sources of protein, healthy fats and fiber like egg, grilled chicken and fish (100 g each), cottage cheese (50 g), curd (100 g), non-starchy vegetables, salads, nuts and seeds, mushroom and buttermilk (Fig 1).

Figure 1. Low carbohydrate snacks – Salad, nuts and egg

NUTRITIONAL MANAGEMENT OF EXERCISE AND PHYSICAL ACTIVITY

Children with T1D should receive some carbohydrate snacks before physical activity. If pre-exercise insulin doses are appropriately reduced, a carbohydrate intake of 0.3–0.5 g/kg/hour of moderate physical activity is to be supplemented. If the blood glucose levels before exercise is lower and insulin doses are not adjusted, then 1–1.5 g/kg/hour carbohydrates need to supplied to prevent hypoglycemia. It is important to maintain adequate hydration before, during and after exercise.

SUMMARY

- Medical nutrition therapy (MNT) has an essential role in the optimal management of T1D in children and adolescents.
- A dietician trained in pediatric diabetes management is an integral part of the multidisciplinary team managing T1D.
- Caloric requirement are calculated as for any non-diabetic child.
- It is imperative to monitor for adequate growth which is an indicator of caloric sufficiency.
- Children using basal-bolus regimen and CSII may have flexibility in meal timings and content; they need to use carbohydrate counting and ICR wisely for optimal glycemic control.
- Continuous glucose monitoring (CGM) system provides better tuning of blood glucose levels based on carbohydrate intake.
- Complex carbohydrates and foods with low GI give better postprandial control.
- Options of low carbohydrate snacks should be provided to prevent glycemic excursions.

REFERENCES

1. International Diabetes Federation. Diabetes Atlas 2021,10th edition.
2. Smart CE, Annan F, Higgins LA, Jelleryd E, Lopez M, Acerini CL. ISPAD Clinical Practice Consensus Guidelines 2022: Nutritional management in children and adolescents with diabetes. Pediatr Diabetes. 2022;19 Suppl 27:136-54.
3. Indian Society for Pediatric and Adolescent Endocrinology (ISPA). ISPAE type 1Diabetes Mellitus Clinical Practice Guidelines 2017.
4. National Institute of Nutrition (NIN). Nutrient requirements for Indians, ICMR 2020 Guidelines.
5. Longvah T, Ananthan R, Bhaskarachary K, Venkaia K. Indian Food Composition Tables. The new Indian Food Composition Tables (IFCT). 2017.
6. Henry CJ, Quek RYC, Kaur B, et al. A glycaemic index compendium of non-western foods. Nutr Diabetes 2021;11, 2 (2021).doi https://doi.org/10.1038/s41387-020-00145-w
7. Tascini G, Berioli MG, Cerquiglini, L, Santi E, Mancini G, Rogari F, Toni G, Esposito S. (2018). Carbohydrate Counting in Children and Adolescents with Type 1 Diabetes. Nutrients. 2018;10(1), 109. doi.org/10.3390/nu10010109

Acknowledgements –

Ms Sheryl Salis, Nurture Health Solutions, Mumbai
Ms Ancy, Clinical Nutritionist, Aster Medcity, Kochi

Hypoglycemia in Children with Type 1 Diabetes

DR REETHA G
Professor, Department of Pediatrics
Government Medical College, Kannur, Kerala

INTRODUCTION

Hypoglycemia is one of the acute complications of type 1 diabetes (T1D) in children. It is usually due to an imbalance amongst food intake, insulin dose and physical activity. Most children can recognize the symptoms of hypoglycemia early itself and corrective measures can be taken at the right time. Neuroglycopenic symptoms of hypoglycemia can be unpleasant and sometimes life-threatening. In children with severe and recurrent hypoglycemia, there is a constant fear which has great psychological impact on both the child as well as parents [1]. It prevents them from maintaining a strict glycemic control. In the day-to-day management of diabetes it is imperative that blood glucose (BG) in maintained in the target range without any hypoglycemic episodes. Since the risk of long-term complications with poor BG control is much more than the risks of hypoglycemia with good BG control, patients should be encouraged to aim for BG concentrations in the target range as far as possible.

DEFINITION

The commonly used definitions for hypoglycemia in clinical practice include the following [2]:

- Clinical hypoglycemia alert – a BG value <70 mg/dL is considered as a threshold value for identifying and treating hypoglycemia.
- Clinically important or serious hypoglycemia – a BG value of <54 mg/dL, a value below which children can develop neuroglycopenic symptoms.
- Severe hypoglycemia – Severe hypoglycemia is defined as an event associated with severe cognitive impairment (including coma and convulsions) requiring external assistance by another person to actively administer carbohydrates or glucagon. No specific glucose value is defined in this category.

HOW FREQUENT IS HYPOGLYCEMIA IN DIABETIC CHILDREN?

Mild hypoglycemic episodes are common in diabetic children, which may be asymptomatic and sometimes go unrecognized. There is an increased risk of severe hypoglycemia in children who are on intensive glucose control regime [3]. Younger age and low glycosylated hemoglobin (HbA1c) were recognized as strong risk factors for severe hypoglycemia earlier, but not so now. With improvement in the quality of care over the years, glycemic control has improved with a reduced HbA1c without an increase in the incidence of severe hypoglycemic episodes [4].

PROBLEMS CAUSED BY HYPOGLYCEMIA

Transient cognitive dysfunction is the most commonly observed abnormality with complete recovery in about an hour after correction, although severe episodes can take longer time to recover. There were no significant long-term cognitive abnormalities observed even after 18

years of follow up in a study [5]. Hypoglycemia has been implicated to play a role in 'death in bed syndrome', the incidence of which is more common in persons with diabetes (PwD) compared to general population. This remains a constant fear in the minds of children and their families [1]. There is an increased risk of epilepsy later in life associated with recurrent severe hypoglycemia, especially if these episodes occur in children less than 6 years of age. The psychological impact of fear of hypoglycemia is a well-recognized entity which greatly impairs the quality of life.

FACTORS THAT CAN CAUSE RECURRENT HYPOGLYCEMIA

The factors that can cause recurrent hypoglycemia include:

- Excess insulin (sometimes intentional)
- Reduced food intake or missing meals
- Antecedent strenuous exercise
- Hypothyroidism
- Celiac disease
- Addison disease

SIGNS AND SYMPTOMS

Symptoms of hypoglycemia are due to the release of counter-regulatory hormone to the falling BG levels in the initial phase. If the event gets prolonged then neuroglycopenic symptoms manifest.

- The adrenergic response incudes shakiness, sweating, pallor and palpitation.
- The neuroglycopenic symptoms include headache, difficulty in concentrating, blurred vision, difficulty in hearing, slurring of speech, confusion, loss of consciousness, and seizure.

Behavioral changes such as irritability, agitation, quietness, stubbornness and tantrums may be predominant symptoms for young children who may not be able to convey the warning signs properly.

Impaired awareness of hypoglycemia occurs in some children. In this situation the release of counter-regulatory hormones occurs only at a lower glucose value and children fail to recognize hypoglycemia clinically. This may lead to prolonged hypoglycemia and sometimes seizures. This complication usually occurs in children with longstanding diabetes.

Nocturnal hypoglycemia is another entity that is of concern. The counter-regulatory hormone responses to hypoglycemia are attenuated during sleep. Individuals with diabetes are much less likely to be awakened by hypoglycemia than individuals without diabetes [6]. Always suspect nocturnal hypoglycemia if pre-breakfast BG is low. Similarly if children reports confusional states, nightmares, seizures etc. during night and lethargy, altered mood, or headaches on waking up it is mandatory to check the overnight BG levels. Younger children and those with lower HbA1c levels are at increased risk. Exercise is another risk factor. A bedtime snack has been shown to reduce incidence of nocturnal hypoglycemia in those on intermediate acting insulins. However insulin analogs such as glargine and detemir have less peak effect and so has less of hypoglycemic episodes. Hence extra snacks may not be needed. Incidence of nocturnal hypoglycemia is lower on pump therapy and with ultra-long-acting basal insulin, degludec.

TREATMENT

Hypoglycemia can be detected using self-monitoring of blood glucose (SMBG) or continuous glucose monitoring (CGM). If BG is less than 70 mg/dL, remedial measures should be taken to prevent further fall in BG. Give 0.3 g/kg of glucose in children (which would be approximately 9 g of glucose for a child with a weight of 30 kg and 15 g for a child with weight of 50 kg) in the form of a rapidly acting carbohydrate preparation such as glucose tablets or orange juice [7]. This causes a rise in BG by 18–20 mg/dL in 10 minutes

without rebound hyperglycemia. In children on insulin pump therapy, basal insulin delivery should be suspended if glucose is <54 mg/dL. When glucose tablets are not available, dietary sugars like hard candy, table sugar, jelly beans, fruit juice, honey etc. may be used. Glucose-based treatment should be the first choice.

Retest blood glucose after 15 minutes. If there is suboptimal response, the same treatment can be repeated. Once hypoglycemia is reversed, the child should have a snack of slower-acting carbohydrate, such as bread, milk, biscuits or fruit . The recommended quantity for glucose is 15 g; the quantity needed may be slightly higher for other sugars. Food items like chocolate which contain fat should be avoided as the initial treatment of hypoglycemia, as the intestinal absorption is delayed due to presence of fat and this results in slower rise of BG.

If the hypoglycemia is severe and the child is unable to swallow or is unconscious, the best treatment option would be an injection of glucagon. Different glucagon preparations are available, which can be given via intravenous, intranasal, intramuscular (IM) or subcutaneous (SC) route [8]. The dose of SC/IM glucagon is 1 mg in children weighing >25 kg and 0.5 mg in children weighing < 25 kg. If glucagon is not available, the child should be put in a lateral position to prevent aspiration and a thick paste of glucose (glucose powder with a few drops of water or table sugar crushed into powdered sugar with consistency of thick cake icing) should be slowly smeared onto the dependent cheek pad. Do not try to forcibly make an unconscious child drink glucose solutions [2].

In the hospital setting 10% dextrose 2 mL/kg intravenously, maximum of 5 mL/kg should be used. If there is recurrent hypoglycemia, the child should be given oral carbohydrates as soon as the child is able to take orally and/or intravenous infusion of 10% dextrose at a glucose infusion rate of 2–5 mg/kg/min.

With advances in technology and availability of newer insulin pumps the incidence of hypoglycemia has reduced in pump users. Sensor-augmented pump therapy with 'low glucose suspension' option reduces time spend in hypoglycemia by suspending insulin delivery in the event of hypoglycemia and pumps with 'predictive low glucose management (PLGM)' can predict fall in glucose over time and suspend insulin delivery.

Children with severe hypoglycemia are at risk of further similar episodes. Efforts should be made to identify the cause and parents counseled regarding preventive measures.

SUMMARY

Hypoglycemia is a known acute complication of T1D and causes significant distress to children and their families. Information about symptoms, treatment and prevention of hypoglycemia should be a part of regular diabetic education. Parents as well as caregivers including teachers should be empowered with the required skill to manage hypoglycemia in a child with diabetes so as to ensure that they receive timely help, thereby improving their quality of life.

REFERENCES

1. Driscoll KA, Raymond J, Naranjo D, Patton SR. Fear of Hypoglycemia in Children and Adolescents and Their Parents with Type 1 Diabetes. Curr Diab Rep. 2016;16(8):77.
2. Abraham MB, Karges B, Dove K, Naranjo D, Arbelaez AM, Mbogo J, et al. ISPAD Clinical Practice Consensus Guidelines 2022: Assessment and management of hypoglycemia in children and adolescents with diabetes. Pediatr Diabetes. 2022; In press.
3. Hypoglycemia in the Diabetes Control and Complications Trial. The Diabetes Control and Complications Trial Research Group. Diabetes.1997;46(2):271-286.
4. Haynes A, Hermann JM, Clapin H, Hofer SE, Karges B, Jones TW, et al. Decreasing Trends in Mean HbA1c Are Not Associated With Increasing Rates of Severe Hypoglycemia in Children: A Longitudinal Analysis of Two Contemporary Population-Based Pediatric Type 1 Diabetes Registries From Australia and Germany/Austria Between 1995 and 2016. Diabetes Care. 2019;42(9):1630-1636.
5. Diabetes Control and Complications Trial/Epidemiology of Diabetes Interventions and Complications Study Research Group; Jacobson AM, Musen G, Ryan CM, Silvers N, Cleary P, Waberski B, et al. Long-term effect of diabetes and its treatment on cognitive function. N Eng J Med. 2007;356(18):1842-1852.
6. Jones TW, Porter P, Sherwin RS, Davis EA, O'Leary P, Frazer F, et al. Decreased epinephrine responses to hypoglycemia during sleep. N Engl J Med. 1998;338(23):1657-1662.
7. McTavish L, Wiltshire E. Effective treatment of hypoglycemia in children with type 1 diabetes: a randomized controlled clinical trial. Pediatr Diabetes. 2011;12(4 Pt 2):381-387
8. Chung ST, Haymond MW. Minimizing morbidity of hypoglycemia in diabetes: a review of mini-dose glucagon. J Diabetes Sci Technol. 2015;9(1):44-51.

Management of diabetic ketoacidosis – Changing paradigms due to limited resources

AHILA AYYAVOO PhD
Pediatric Endocrinologist
GKNM Hospital & Parvathy Clinic, Coimbatore, Tamilnadu

INTRODUCTION

The incidence of type 1 diabetes mellitus (T1D) among children has been increasing around the world over the recent past. The most dreaded complication of T1D among children is diabetic ketoacidosis (DKA) [1, 2]. The factors influencing the risk for development of DKA include age (children younger than 2 years of age), delay in diagnosis, lower socio-economic strata with difficulty in access to healthcare facilities, missed insulin doses, poor control of pre-existing T1D, associated infections, adolescence, previous episodes of DKA, and insulin pump dysfunction [3, 4].

DIAGNOSIS AND MISDIAGNOSIS

The diagnosis maybe missed in the community and local clinics because of the mode of presentation. Children with DKA could be misdiagnosed as

- acute severe wheeze or pneumonia due to breathlessness,
- acute gastroenteritis due to vomiting and dehydration,
- acute abdomen due to severe abdominal pain or
- acute encephalopathy due to altered consciousness and drop in Glasgow Coma Scale [3].

The International Society for Pediatric and Adolescent Diabetes (ISPAD) guidelines have proposed several ways of diagnosing and classifying DKA based on either blood gas pH or serum bicarbonate [4]. While mild DKA is defined as a pH of 7.21 to 7.3 or a serum bicarbonate of 10 to 15 mEq/L, moderate DKA is defined as a pH of 7.11 to 7.2 or a serum bicarbonate of 5 to 10 mEq/L and severe DKA as a pH of <7.1 or a bicarbonate of < 15 mEq/L [4].

MANAGEMENT IN RESOURCE -POOR SETTINGS

The standard of treatment around the world is the administration of the appropriate fluid at the proper infusion rate along with intravenous insulin (IVI) infusion under close supervision in intensive care units (ICU) or high dependency units (HDU) [4]. These facilities require huge amount of resources in terms of personnel, infrastructure, laboratory backup and investment and may not be available in all parts of the world. So, an easier and cheaper alternative method of administering insulin in resource poor settings would be useful for children with DKA. A few centers around the world administered insulin subcutaneously in both adult and pediatric patients with a pH of more than 7 [5, 6]. Insulin analogs including insulin aspart and insulin lispro have been used successfully in these studies through the subcutaneous route and found to be equally efficient in comparison to the IVI infusion of 'regular' insulin.

A recent study in Coimbatore had noted that

subcutaneous insulin (SCI) of 'regular' insulin could be successfully used in the management of DKA. The cost of treatment with SCI for DKA was almost four times cheaper than IVI. The time taken to recovery with SCI therapy was much shorter than IVI in the treatment of DKA [7]. The type of fluid, rate of infusion and electrolyte content of the fluid used in the treatment of pediatric DKA remains the same between both modes of administration of insulin. The goal of therapy is gradual correction of dehydration status and appropriate doses of insulin administration while avoiding the onset of cerebral edema.

Point of care glucometer have been used to measure blood glucose every hour. Blood ketones have been measured with the same meter initially and 2 to 4 hours later to reassess the improvement in DKA. The above study highlights the use of clinical evaluation to assess the severity of DKA. Assessment of consciousness with the use of mother's voice instead of Glasgow Coma Scale (GCS), capillary refill time (CRT) along with pulse rate and blood pressure, have been used to assess the severity of DKA in these patients. Evaluation of neurological status is an important part of clinical assessment and follow-up to assess recovery status. Minimal appropriate investigations have been performed based on the clinical condition of the child [7]. These include pH or bicarbonate to assess severity, other electrolytes to design the type of fluid for infusion and serum creatinine to assess renal status.

ASSESSMENT AND MANAGEMENT OF DKA

Assessment of clinical status and management protocol have been explained Figure 1 below [7]. Hourly assessment of pulse rate, blood pressure and respiratory rate serve as excellent guides in the designing the treatment and helping in faster recovery. 'Regular' insulin is given subcutaneously at a dose of 0.05 units/kg/3 hourly in children aged younger than 5 years and 0.1 units/kg/3 hourly in children older than 5 years with DKA. The management is initiated based on capillary refill time (CRT) as given below:

- Normal CRT – Stable child; fluids administered only if there is evidence of dehydration and usual regimen of BG monitoring and insulin administration are undertaken.
- Prolonged CRT – Assessment of pulse and BP can help in the assignment to the treatment protocol based on whether these children have compensated or uncompensated shock [7].

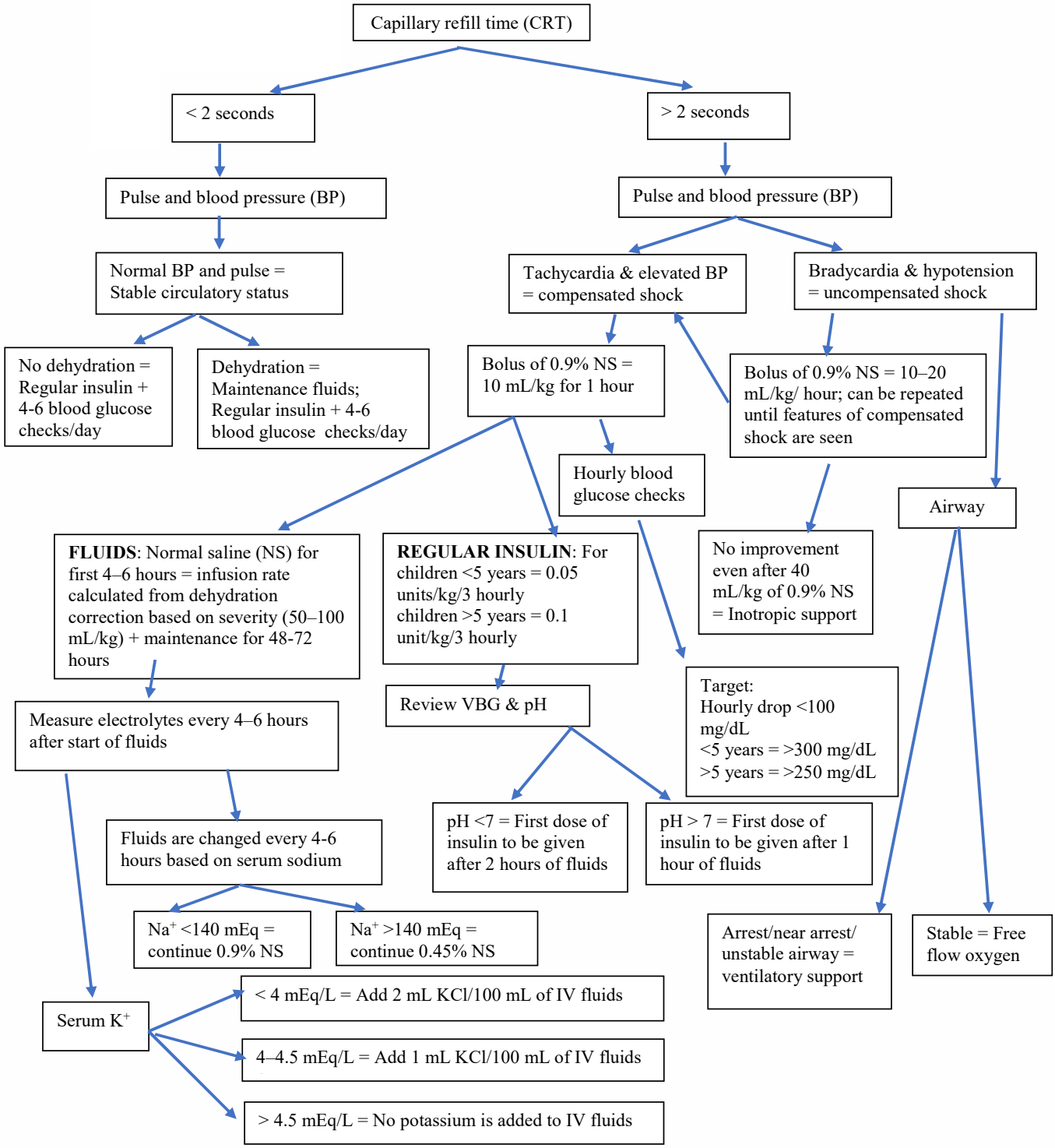
Fluids are calculated for dehydration at the rate of 50–100 mL/kg (based on the severity of dehydration) + maintenance fluids (calculated using Holliday–Segar formula = 100 mL/kg for the first 10kg + 50 mL/kg for the next 10 kg + 20 mL/kg for every kg weight thereafter). The maintenance fluids are calculated for 72 hours for children younger than 5 years and for 48 hours for children older than 5 years. For heavier children, maintenance fluids are calculated based on 1500 mL/ square meter body surface area [4].

The mainstay of treatment for DKA is the correction of dehydration and correcting hyperglycemia with a slow insulin infusion. Other aspects of management include maintenance of electrolytes, acid-base balance and other co-morbidities. Intravenous (IV) insulin is preferred over subcutaneous (SC) or intramuscular (IM) insulin as its onset is rapid and the dose can be titrated easily based on the patient's varying BG levels. However, IV insulin is associated with higher cost of hospitalisations and resource requirements.

SUMMARY

SCI has been used in the treatment of children with severe DKA and a pH of less than 7 in the study by Ayyavoo et al. [7]. in summary, SCI in the management of DKA is a useful and viable alternative in children. This can prove extremely useful in resource-poor settings such as developing and underdeveloped countries and during pandemics.

Figure 1: Subcutaneous insulin for the treatment of pediatric diabetic ketoacidosis (ref 7)



Reproduced under Open Access charter from: Ayyavoo A, Ravikulan A, Palany R. Treatment of diabetic ketoacidosis with subcutaneous regular insulin in a non-ICU setting is effective and economical. J Pediatr Endocrinol Diabetes 2022;2(2):50-5 available at doi: 10.25259/JPED_32_2022

REFERENCES

1. DIAMOND Project Group. Incidence and trends of childhood type 1 diabetes worldwide 1990–1999. Diabet Med. 2006;23(8):857-66.
2. Kalra S, Kalra B, Sharma A. Prevalence of type 1 diabetes mellitus in Karnal district, Haryana state, India. Diabetol Metab Syndr. 2010;2:14.
3. Raghupathy P. Diabetic ketoacidosis in children and adolescents. Indian Journal of Endocrinology and Metabolism. 2015;19(Suppl 1):S55-7.
4. Glaser N, Fritsch M, Priyambada L, Rewers A, Cherubini V, Estrada S, et al. ISPAD Clinical Practice Consensus Guidelines 2022: Diabetic ketoacidosis and the hyperglycemic hyperosmolar state. Pediatr Diabetes. 2022; In press.
5. Manna TD, Steinmetz L, Campos PR, Farhat SCL, Schvartsman C, Kuperman H, et al. Subcutaneous use of a fast-acting insulin analog: an alternative treatment for pediatric patients with diabetic ketoacidosis. Diabetes Care. 2005;28(8):1856-61.
6. Ersöz H, Ukinc K, Köse M, Erem C, Gunduz A, Hacihasanoglu A, et al. Subcutaneous lispro and intravenous regular insulin treatments are equally effective and safe for the treatment of mild and moderate diabetic ketoacidosis in adult patients. Int J Clin Pract. 2006;60(4):429-33.
7. Ayyavoo A, Ravikulan A, Palany R. Treatment of diabetic ketoacidosis with subcutaneous regular insulin in a non-ICU setting is effective and economical: A single-center experience. J Pediatr Endocrinol Diabetes 2022;2(2):50-5.

Microvascular and Macrovascular complications of Childhood Diabetes Mellitus

DR ANJANA CHARI S N.
DNB Pediatrics trainee,
Mehta Multispeciality Hospitals India Pvt Ltd, Chennai, Tamilnadu
DR HEMCHAND KRISHNA PRASAD
Consultant, Department of Pediatric Endocrinology
Chennai, Tamilnadu

INTRODUCTION

Diabetes mellitus (DM) is a chronic lifelong disease which results in the development of a multitude of microvascular and macrovascular complications (Table 1) [1]. Children and adolescents with type 1 diabetes mellitus (T1D) and type 2 diabetes mellitus (T2D) should be screened periodically for microvascular and macrovascular complications [1]. The International Society for Pediatric and Adolescent Diabetes (ISPAD) and American Diabetes Association (ADA) have come up with recent guidelines for identification and management of complications of DM in children (2, 3). This manuscript aims to guide pediatricians managing childhood DM to identify and manage these complications in a rational manner to optimize the long-term health of the child.

Table 1. Microvascular and Macrovascular complications of childhood diabetes mellitus

Microvascular complications	Macrovascular complications
Diabetic retinopathy	Dyslipidemia
Diabetic neuropathy	Hypertension
Diabetic nephropathy	

MICROVASCULAR COMPLICATIONS

Diabetic Neuropathy (DN)

Prevalence. A recent Indian study reported a prevalence of DN in 56% of children screened using nerve conduction study [4]. Authors reported that poor glycemic control with glycosylated hemoglobin (HbA1c) above 9% and duration of diabetes above 5 years as risk factors for development of DN.

When to screen? The ISPAD 2022 guidelines and ADA 2020 guidelines recommend periodic screening for diabetic neuropathy by a proper history and physical examination. ISPAD recommends that screening for DN should be performed at puberty or at 11 years of age with duration of diabetes of 2–5 years and at diagnosis in T2D [2]. ADA recommends screening with puberty or beyond the age of 10 years with diabetic duration of 5 years [3].

Classification. DN includes both distal sensory peripheral neuropathy and autonomic neuropathy. Small fiber involvement (C-fibers) results in hyperalgesia (increased pain), reduced sweating (dryness); whereas involvement of large fiber (A delta fibers) results in deep-seated pain, numbness, tingling, pins and needle sensation [5, 6]. The peripheral neuropathy that occurs in childhood DM with poor control is

Box 1. Clinical assessment of diabetic neuropathy

Signs and symptoms

- Increased pain, reduced sweating
- Deep seated pain, numbness, tingling, pins and needle sensation
- Alternating diarrhea and constipation
- Giddiness
- Hypoglycemia unawareness

Clinical evaluation

- A proper foot examination is pivotal
- Assess for absent heart rate variability
- Palpate for dorsalis pedis pulse and posterior tibial artery pulse
- Assess for pin prick sensation, temperature sensation and pain sensation
- Assess for vibration sense (using a 128 Hz tuning fork)
- Check for proprioception
- Look for ankle jerk
- Postural hypotension

typically a distal and symmetric polyneuropathy occurring in long-standing DM with sub-optimal control. When the onset of neuropathy is proximal, asymmetric, predominantly motor and occurs with short duration of DM, immune-medicated neuropathies should be considered. Autonomic neuropathy may manifest with systemic involvement—cardiovascular symptoms (postural hypotension and loss of heart rate variability), gastrointestinal symptoms (alternating constipation and diarrhea) and hypoglycemia unawareness [7, 8].

Diagnosis. The diagnosis is predominantly clinical (Box 1). The presence of atypical features warrants nerve conduction study. One should remember that:

- Early autonomic neuropathy, especially bladder involvement with relatively good glycemic control should make a clinician consider DIDMOAD (Diabetes Insipidus Diabetes Mellitus Optic Atrophy Deafness) syndrome
- Presence of atypical features such as asymmetric proximal involvement and predominant motor involvement may warrant nerve conduction study
- Measurement of vitamin B12 levels may be considered if there are appropriate clinical pointers with neuropathy
- Treatment-induced neuropathy may be considered with neurological symptoms with early aggressive glycemic control [9].

Treatment. Treatment of DN focuses on the improvement of glycemic control. Proper foot care should be emphasized in all follow-up visits. Special footwear may be considered in specific situations. Pregabalin, gabapentin and amitriptyline are some pharmacological agents that can be used with expert guidance. Autonomic symptoms can be treated with oral metoclopramide and erythromycin.

Diabetic Retinopathy (DR)

Prevalence. DR is an important preventable cause for blindness in our country. An incidence of 3.6% of proliferative DR in 512 individuals with T1D from a centre in northern India has been reported [10]. The prevalence of DR is determined by the age group, glycemic control, setting of screening and tool used for screening [11, 12].

Classification. Clinically, DR is divided into two stages—non-proliferative (NPDR) and proliferative (PDR). NPDR is the earliest clinically apparent manifestation of DR. It is characterized by microaneurysms, retinal hemorrhages both pre- and intraretinal, cotton wool spots related to ischemia and microinfarction, hard exudates due to protein and lipid leakage, intraretinal microvascular abnormalities (IRMAs), and venular dilatation and tortuosity. There is a severe form of NPDR (previously known as pre-proliferative) characterized by vascular obstruction, an increase in the number of retinal hemorrhages and microaneurysms, IRMAs, marked venous abnormalities, ischemia and infarction of the retinal nerve fibers causing cotton wool spots [1, 2]. PDR is characterized by neovascularization in the retina and/or vitreous posterior surface. Diabetic macular edema/ maculopathy is characterized by swelling or thickening of the macula due to sub- and intra-retinal accumulation of fluid in the macula triggered by the breakdown of the blood-retinal barrier [13].

Screening. Screening for DR in T1D should begin from the onset of puberty or at the age of 11 years with 2–5 years diabetes duration and at diagnosis in T2D, whereas, in children and adolescents with T2D it should start at the time of diagnosis [1, 2]. Screening for DR can be performed usually by retinal examination with dilation of pupils using indirect ophthalmoscopy. Other useful tools include slit lamp examination and fundus photography to visualize the retina.

On ophthalmological screening, if the fundus is normal, 2–3 yearly follow-up is considered [1]. Earlier follow-up should be done if there is worsening of glycemic control. Presence of mild NPDR should be closely monitored every 6 months. More advanced stages of DR should be closely monitored by a pediatric ophthalmologist.

A close interaction between pediatric ophthalmologist and treating diabetic team is essential. Presence of optic atrophy during fundus assessment may be a pointer to DIDMOAD syndrome. Children who have longstanding poor glycemic control when initiated on intensive insulin therapy can worsen. Hence, a fundus assessment may be helpful in such cases before the intensification of diabetes control [2].

Treatment. Treatment options for DR include pan-retinal laser photocoagulation and vitreo retinal surgery. Newer agents like anti-VEGF medications such as ranibizumab and bevacizumab are useful with severe NPDR and macular edema.

Diabetic Nephropathy

Diabetic nephropathy is an important treatable microvascular complication of childhood DM.

Staging. Diabetic nephropathy is classically described in literature to be a progressive disease in five stages. Identification of albuminuria identifies the adolescent at stage 3 of nephropathy. There are no established ways to identify children and adolescents at the hyperfiltration stage or stage of subtle morphological alterations. Recently, neutrophil gelatinase–associated lipocalin (NGAL), tumor necrosis factor (TNF) receptor-1 and serum bradykinin are emerging as biomarkers for early identification and disease progression in adult studies.

Screening for DN is commenced during puberty or at 11 years of age with 2–5 years of diabetic duration in T1D and at diagnosis in T2D. The ADA guidelines recommend screening by puberty, or 10 years of age with a duration of DM of 5 years [3]. A recent Indian study has described the prevalence of 13.4% in a screening of 319 subjects with T1D. Authors also report that 11.3% subjects with nephropathy had age below 10 years [14]. Hence, screening for nephropathy may be performed earlier, if, there is poor glycemic control.

The ideal screening modality is described to be assessment of urinary albumin excretion

on a random spot specimen and urine albumin creatinine ratio (ACR). Estimation of eGFR based on serum creatinine, height, age and sex can complement urine albumin excretion measurement. Previously, sex-based interpretation of 30 and 42 mg/g creatinine in males and females, respectively, were advocated for urine ACR. However, the recent guidelines recommend uniform use of urine ACR cut off of 30 mg/g of creatinine (3 mg/mmol). Timed urine collections (urine albumin excretion of above 30 mg/24 hours or 20 µg/min) may be more accurate than spot urine assessment but are more cumbersome and laborious.

Numerous confounding factors are described in literature for a false positive screen. Hence, one should remember that:

a) A random positive urine ACR positivity should be reconfirmed on an early morning first-voided urine sample (to avoid influence of confounders like exercise and upright position)

b) There is marked day-to-day variability in urine albumin excretion. Hence a positive screen should be reconfirmed by repeating on 2–3 samples in a 3–6 months period. Positive urine ACR in one sample is considered as intermittent albuminuria and warrants aggressive glycemic control and close follow-up. Positive urine ACR in 2 or 3 samples warrant further intervention as described in Figure 1.

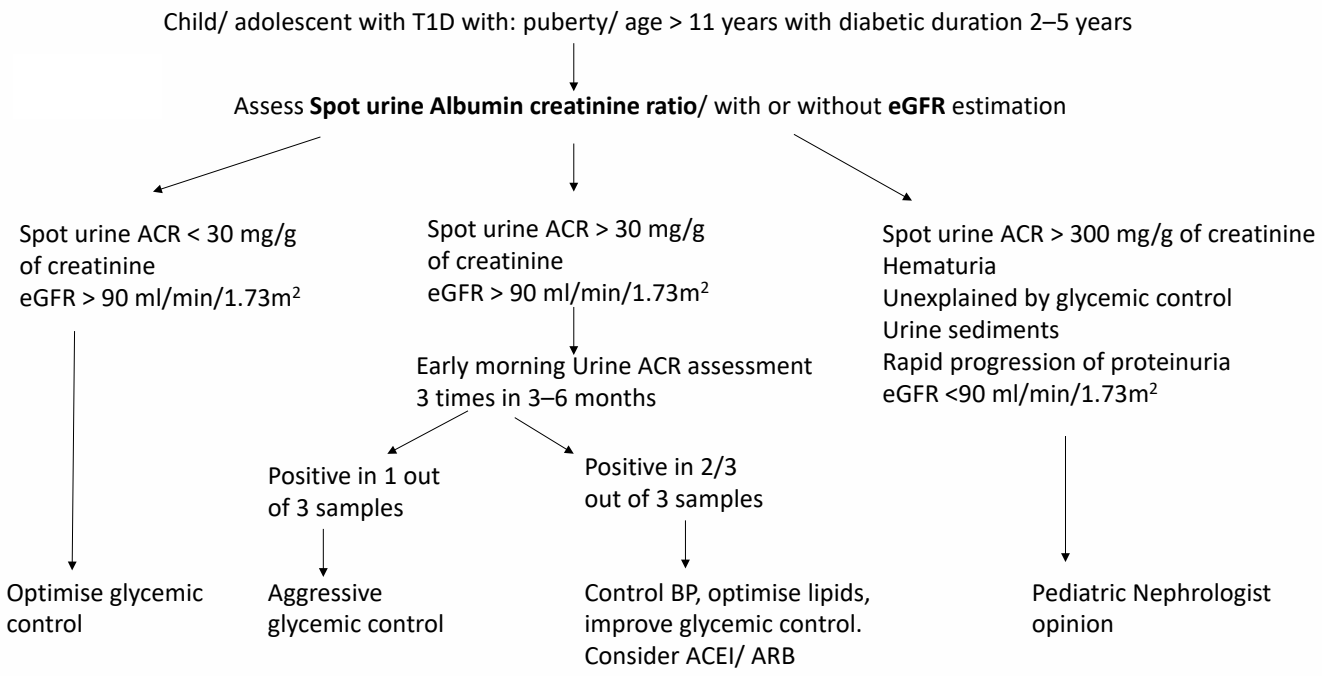
c) Important causes for a false positive screen such as severe hyperglycemia, febrile illness, urinary tract infection and menstruation should be borne in mind while collecting the urine sample.

d) An element of acute kidney injury may be encountered in significant proportion of childhood DKA. Hence, sample collection should be deferred after immediate recovery from DKA.

e) Rarely, monogenic diabetes with significant kidney involvement can present with significant proteinuria, unrelated to diabetes control [15].

Clinicians who encounter atypical features including hematuria, active urine sediments,

Figure 1. Approach to a positive albumin screen in a child with diabetes mellitus



rapid reduction in eGFR, macroalbuminuria (above 300 mg/g of creatinine or 30 mg/mmol of creatinine) should consider early pediatric nephrology consultation. A practical approach to urine albumin screen in summarized in Figure 1.

Management. Management includes strict glycemic control, maintenance of blood pressure (BP) in target range and maintenance of lipid parameters in target range. Restriction of sodium to <2300 mg/day can be considered in those with persistent albuminuria. Persistent microalbuminuria with or without hypertension should be treated with oral ACE inhibitors enalapril (2.5–5 mg/day) or angiotensin receptor blockers such as telmisartan 20–40 mg/day. Serum creatinine, electrolytes (for hyperkalemia) and BP should be checked 2 weeks after initiation of medications.

MACROVASCULAR COMPLICATIONS

Hypertension

All children with DM (both T1D and T2D) should have their BP measured in every clinic visit.

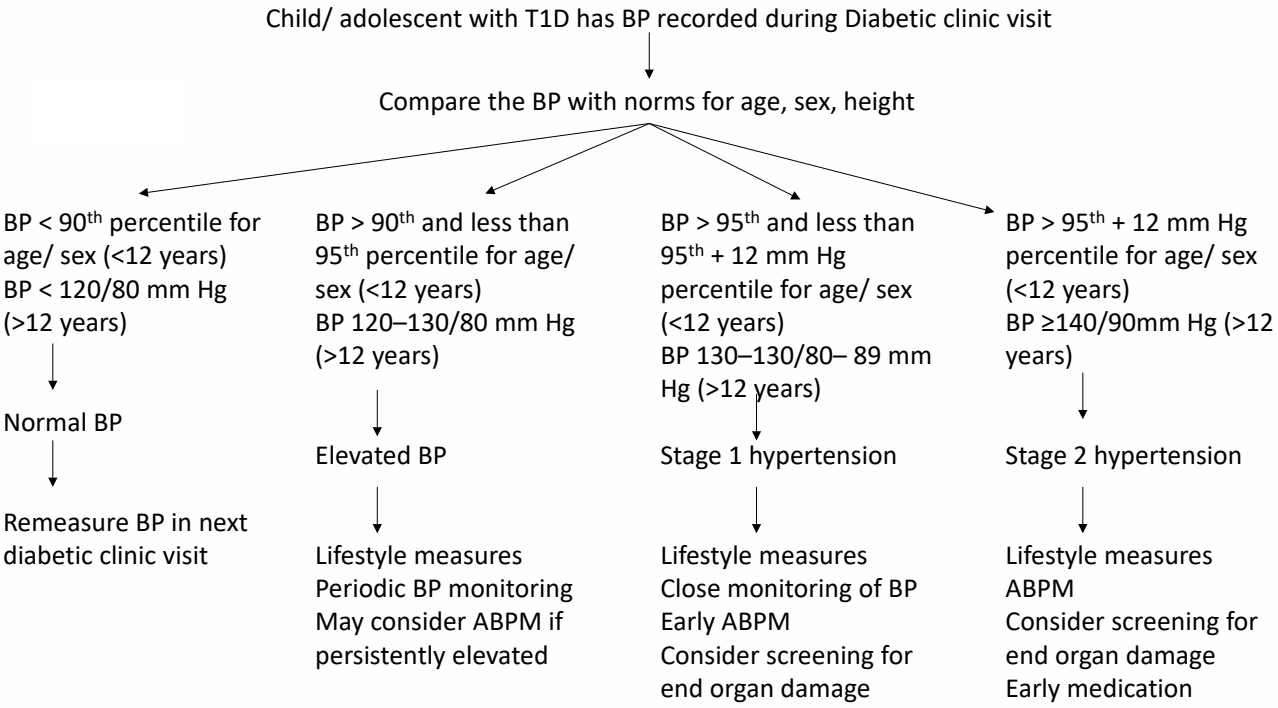
Technique of BP measurement. BP can be measured by three techniques—oscillometric method, auscultatory method and ambulatory blood pressure monitoring (ABPM). Auscultatory method of BP measurement using a mercury sphygmomanometer is the gold standard to confirm pediatric hypertension [16]. The child or adolescent should be seated for 3–5 minutes with uncrossed legs in a quiet room with the right arm at heart level, with back supported, feet on floor or child in the parents' lap seated comfortably. With the upper arm in neutral position and arms flexed at 90 degrees, the bladder of the cuff should encircle the arm 2–3 cm above the ante-cubital fossa. Stethoscope should be placed over the brachial artery pulse proximal and medial to the cubital fossa. The bulb is deflated at the rate of 2–3 mm/sec. The onset of tapping Korotkoff sound 1 is taken as systolic BP of the child and disappearance of Korotkoff's sound 5 is taken as diastolic BP. One should measure the mid-arm circumference and bladder should have length 80–100% and width 45–55% of arm circumference. Recommended bladder lengths are 8, 12, 18, 24 and 30 cm and width 4, 6, 9, 10 and 13 cm in neonates, infants, children, adolescents and adults, respectively [16].

Diagnosis. Elevated BP in diabetic clinic setting should be confirmed by repeated measurement in other settings. BP should be above 90th percentile on three different occasions to consider as elevated BP. The percentile tables devised by AAP based on 50,000 normal weight children which give BP percentile for various heights should be used for classification [17].

Children with T1D are classified to have normal BP, elevated BP, stage 1 hypertension, stage 2 hypertension and appropriate action is taken (Figure 2). ABPM is an important tool in the hands of the pediatrician to distinguish children with persistent hypertension and white coat hypertension [18]. Practical challenges are often encountered while subjecting morbidly obese adolescents to ABPM. Quality of reading should be checked (at least one reading per hour and 40–50 per day) and BP load should be ascertained (percentage of readings above target). Centers without access to ABPM can use home monitoring of BP as an alternative [19]. A quick history for family history of hypertension, medications, examination of BMI, waist circumference, presence of xanthelasma, arcus juvenilis and presence of features of insulin resistance (acanthosis and skin tags) should be done. Clinicians should never forget conditions which present with diabetes and hypertension in children—Turner syndrome, William syndrome and Cushing syndrome. Specific evaluation may be considered in the presence of clinical pointers.

Management. The goal of treatment of hypertension in children is to achieve a BP level which would reduce the risk of organ damage. The treatment goal with nonpharmacologic and pharmacologic therapy should be a reduction in SBP and DBP to <90th percentile in young

Figure 2. Approach to elevated BP in a child with diabetes mellitus



children and <120/80 mm Hg in adolescents ≥ 13 years old. Moderate to vigorous physical activity and adherence to diet which is rich in fruits, vegetables, fish, poultry, lean meat and low sugar and salt diet (DASH diet) is recommended in children with hypertension. Persistent elevation of BP above 95th percentile or presence of end organ damage warrants medication. Drugs that can be considered include oral enalapril, ramipril, losartan and telmisartan.

Dyslipidemia

Dyslipidemia is an important macrovascular complication of long-standing childhood DM [20,21].

Prevalence. A recent Indian study from the authors' unit on prevalence of dyslipidemia in T1D has reported a prevalence of 67.3% in 171 subjects [22]. Another study from western India has reported a prevalence of 47.2% in 235 children and adolescents with T1D [23]. In this study, 11.9% of subjects were aged below 10 years and had dyslipidemia. HbA1c remains the most important determining factors for occurrence of dyslipidemia in both the studies. Also, a recent Indian study has reported a significant increase in waist circumference, lipid parameters and body fat percentage in subjects with T1D post COVID lock down [24]. Hence, it is recommended that all children above 11 years with diabetes age of 2–5 years should be screened by a lipid profile after glycemic control is achieved. Also, children aged above 2 years should be screened with a lipid profile in the presence of risk factors such as family history of hypercholesterolemia, elevated BMI or early cardiac events in the family.

Screening: Screening can be performed by a non-fasting sample. Confirmation is done by assessing a repeat fasting sample. Low density lipoprotein (LDL) above 100 mg/dL, HDL below 40 mg/dL, triglyceride level above 130 mg/dL (above 10 years) and 100 mg/dL (below 10 years) is considered abnormal. A practical approach to lipid screening is summarized in Figure 3.

Evaluation. Children with raised lipid parameters should have a meticulous assessment of BMI on the IAP 2015 charts and maintained below the 23rd adult equivalent

[25]. Waist circumference should be measured and maintained below the 70th percentile [26]. A quick physical examination for arcus and xanthomas should be done. Secondary causes for dyslipidemia due to associated conditions such as celiac disease and hypothyroidism should be evaluated.

Management. Pediatricians who recognize dyslipidemia in individuals with T1D should focus on improvement of glycemic control. Dietary modifications include 25–30% caloric consumption from fat, reduced trans-fat, increased fiber intake, limiting saturated fat to <7% and reducing cholesterol intake to <200 mg/day [1-3]. One should extensively counsel on weight reduction and regular aerobic exercises. In children with persistent elevation of LDL >130 mg/dL with risk factors, and LDL >160 mg/dL despite good glycemic control and lifestyle measures, statin therapy should be considered especially if they are above 10 years of age [1, 2]. Children with elevated triglyceride level above 1000 mg/dL should be medicated with oral fibrate therapy. Hypolipidemic therapy should be initiated on the lowest dose and titrated to maintain a target LDL <100 mg/dL. Assessment of liver functions and CPK for myopathy is necessary.

A summary of the important modalities for screening these complications and approach to these complications is summarized in Table 2 and 3. As many Indian studies report early occurrence of microvascular complications, timing of screening may be earlier to facilitate early recognition, especially with a poor glycemic control [15, 23]. The general measures to be adopted to prevent these complications is summarized in Box 2.

Table 2. Screening for microvascular and macrovascular complications in childhood DM

Complication	Timing of Screening	Screening modality	Frequency
Diabetic retinopathy	Puberty/11 years of chronological age with 2–5 years of diabetic duration in T1D, at diagnosis in T2D	Indirect Ophthalmoscopy with pupil dilatation	Every 2–3 years
Diabetic neuropathy	Puberty/11 years of chronological age with 2-5 years of diabetic duration in T1D, at diagnosis in T2D	Proper foot examination and neurological examination	Annually
Diabetic nephropathy	Puberty/11 years of chronological age with 2–5 years of diabetic duration in T1D, at diagnosis in T2D	Spot urine albumin creatinine ratio	Annually
Hypertension	Every clinic visit	Blood pressure measurement	Every clinic visit
Dyslipidemia	9–11 years with 2–5 years of diabetic duration. Screening can begin at 2 years with risk factors	Lipid profile	3 yearly

Abbreviations: T1D – Type 1 Diabetes mellitus, T2D – Type 2 Diabetes mellitus

Table 3. Approach to screening of children with diabetes mellitus for microvascular and macrovascular complications

Complication		Basic steps	Medication options
Diabetic retinopathy	IMPROVEMENT OF GLYCEMIC CONTROL. Maintain HbA1c in target.	More frequent follow-up, pediatric ophthalmology consultation	Pan-retinal photocoagulation, Anti-VEGF therapy
Diabetic neuropathy		Proper foot care, special foot wear	Pregabalin, gabapentin, amitryptiline, metoclopramide, erythromycin
Diabetic nephropathy		Repeat assessment of urine ACR in 3 samples in 3–6-month period Estimate eGFR	ACE inhibitors like enalapril (2.5–5 mg/day) or ARB like telmisartan (10–20 mg/day)
Hypertension		BP above 95th percentile – reconfirm in 3 different days. Consider ABPM/home monitoring BP. Persistent elevation of BP - screen for end organ complications (Echocardiogram for LVH, fundus screen for retinal changes of hypertension and proteinuria)	ACE inhibitors like enalapril (2.5–5 mg/day) or ARB like telmisartan (10–20 mg/day)
Dyslipidemia		Fasting sample confirmation. Lifestyle modifications.	Statin therapy of persistent elevation of LDL > 130 mg/dL or fibrate therapy if Triglycerides > 1000 mg/dL

HBA1C – Glycosylated hemoglobin, ACR – albumin creatinine ratio, ACE – Angiotensin converting enzyme

Box 2. Strategies to prevent Vascular complications of childhood DM

- Early initiation of Intensive insulin therapy using basal bolus regimen
- Target HbA1c below 7–7.5% in T1D and below 6.5–7% in T2D
- Maintain time in target using continuous glucose monitoring above 70%
- Screen for microvascular and macrovascular complications as per ISPAD guidelines
- Maintain BMI below the 23rd adult equivalent and waist circumference below the 70th percentile
- Monitor blood pressure in every clinic visit
- Smoking should be discouraged in all adolescents with DM

SUMMARY

It is pivotal that pediatricians, pediatric endocrinologists, diabetologists and physicians periodically screen children with diabetes for microvascular and macrovascular complications and identify them early. Screening for microvascular complications—nephropathy, neuropathy and retinopathy— should commence at puberty or at 11 years (with diabetic duration of 2–5 years) using urine albumin creatinine ratio, physical examination and mydriatic ophthalmoscopy, respectively. Blood pressure should be measured in every clinic visit. Lipid profile should be assessed at 9–11 years with diabetic duration of 2–5 years after glycemic stabilization, or, earlier by 2 years of age, in the presence of risk factors. Timing of screening can be individualized based on glycemic control. Specific intervention like ACE inhibitor therapy, retinal photocoagulation, statin therapy or fibrate therapy may be warranted after a proper evaluation and input from relevant pediatric subspecialities. Early initiation of basal bolus intensive insulin regimen, maintaining good HbA1c is the most important strategy to be adopted to prevent and control these complications.

REFERENCES

1. 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 Oct;19 Suppl 27(Suppl 27):262-274.
2. Bjornstad P, Dart A, Donaghue KC, Dost A, Feldman EL, Tan GS, et al. ISPAD Clinical Practice Consensus Guidelines 2022; Microvascular and macrovascular complications in children and adolescents with diabetes. Pediatr Diabetes. 2022; in press.
3. American Diabetes Association; 13. Children and Adolescents: Standards of Medical Care in Diabetes–2020. Diabetes Care. 2020;43 (Supplement_1): S163–S182.
4. Singh DP, Singh P, Sharma S, Aneja S, Seth A. Point Prevalence of Peripheral Neuropathy in Children and Adolescents with Type 1 Diabetes Mellitus. Indian J Pediatr. 2022 Mar;89(3):220-225.
5. Vágvölgyi A, Maróti Á, Szűcs M, Póczik C, Urbán-Pap D, Baczkó I, et al. Peripheral and Autonomic Neuropathy Status of Young Patients With Type 1 Diabetes Mellitus at the Time of Transition From Pediatric Care to Adult-Oriented Diabetes Care. Front Endocrinol (Lausanne). 2021 Aug 27;12:719953.
6. Franceschi R, Mozzillo E, Di Candia F, Rosanio FM, Leonardi L, Liguori A, et al. A systematic review of the prevalence, risk factors and screening tools for autonomic and diabetic peripheral neuropathy in children, adolescents and young adults with type 1 diabetes. Acta Diabetol. 2022;59(3):293-308.
7. Louraki M, Karayianni C, Kanaka-Gantenbein C, Katsalouli M, Karavanaki K. Peripheral neuropathy in children with type 1 diabetes. Diabetes Metab. 2012;38(4):281-9.
8. Kallinikou D, Soldatou A, Tsentidis C, Louraki M, Kanaka-Gantenbein C, Kanavakis E, Karavanaki K. Diabetic neuropathy in children and adolescents with type 1 diabetes mellitus: Diagnosis, pathogenesis, and associated genetic markers. Diabetes Metab Res Rev. 2019;35(7):e3178.
9. Varadharaju N, Jeevarathnam D, Rajan M, Nagarajan VP, James S. A case of treatment-induced neuropathy in an adolescent with type 1 diabetes. Ann Pediatr Endocrinol Metab. 2019;24(3):203-206.
10. Sudhanshu S, Nair VV, Godbole T, Reddy SVB, Bhatia E, Dabadghao P, et al. Glycemic Control and Long-term Complications in Pediatric Onset Type 1 Diabetes Mellitus: A Single-center Experience from Northern India. Indian Pediatr. 2019;56(3):191-195.
11. Rajalakshmi R, Amutha A, Ranjani H, Ali MK, Unnikrishnan R, Anjana RM, et al. Prevalence and risk factors for diabetic retinopathy in Asian Indians with young onset type 1 and type 2 diabetes. J Diabetes Complications. 2014;28(3):291-7.
12. Mayer-Davis EJ, Davis C, Saadine J, D'Agostino RB Jr, Dabelea D, Dolan L, et al; SEARCH for Diabetes in Youth Study Group. Diabetic retinopathy in the SEARCH for Diabetes in Youth Cohort: a pilot study. Diabet Med. 2012;29(9):1148-52.
13. Parameswarappa DC, Rajalakshmi R, Mohamed A, Kavya S, Munirathnam H, Manayath G, et al. Severity of diabetic retinopathy and its relationship with age at onset of diabetes mellitus in India: A multicentric study. Indian J Ophthalmol. 2021;69(11):3255-3261.
14. Karguppikar M, Oza C, Shah N, Khadilkar V, Gondhalekar K, Khadilkar A. Prevalence of nephropathy in Indian children and youth with type 1 diabetes mellitus. J Pediatr Endocrinol Metab. 2022;35(5):585-592.

15. Tan CSH, Ang SF, Yeoh E, Goh BX, Loh WJ, Shum CF, et al. MODY5 Hepatocyte Nuclear Factor 1ß (HNF1ß)-Associated Nephropathy: experience from a regional monogenic diabetes referral centre in Singapore. J Investig Med High Impact Case Rep. 2022 Jan-Dec;10:23247096211065626.

16. National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents. The fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents. Pediatrics. 2004 Aug;114(2 Suppl 4th Report):555-76.

17. 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 for Screening and Management of High Blood Pressure in Children and Adolescents. Pediatrics. 2017 Sep;140(3):e20171904.

18. Flynn JT, Daniels SR, Hayman LL. Update: ambulatory blood pressure monitoring in children and adolescents: a scientific statement from the American Heart Association. Hypertension. 2014;63:1116-1135

19. Lurbe E, Agabiti-Rosei E, Cruickshank JK. 2016 European Society of Hypertension guidelines for the management of high blood pressure in children and adolescents. J Hypertens. 2016;34:1887–1920.

20. Reynolds K, Saydah SH, Isom S, Divers J, Lawrence JM, Dabelea D, et al. Mortality in youth-onset type 1 and type 2 diabetes: The SEARCH for Diabetes in Youth study. J Diabetes Complications. 2018 ;32(6):545-549.

21. Patil AT, Rajashekara Murthy GR, Hema GR. A study on glycemic control and related complications in type I diabetic children. Pediatric Review: International Journal of Pediatric Research, 2015;2(4):100-106. https://doi.org/10.17511/ijpr.2015.i04.12

22. Selvaraj M, Prasad HK, White S, Prasanna B, Sangaralingam T. Prevalence and Determinants of Occurrence of Dyslipidemia in Subjects with Type 1 Diabetes Mellitus. Indian J Pediatr. 2022 Apr 2.doi: 10.1007/s12098-022-04130-2.

23. Shah N, Khadilkar A, Gondhalekar K, Khadilkar V. Prevalence of dyslipidemia in Indian children with poorly controlled type 1 diabetes mellitus. Pediatr Diabetes. 2020;21(6):987-994.

24. Shah N, Khadilkar V, Oza C, Karguppikar M, Bhor S, Ladkat D, Khadilkar A. Impact of decreased physical activity due to COVID restrictions on cardio-metabolic risk parameters in Indian children and youth with type 1 diabetes. Diabetes Metab Syndr. 2022;16(7):102564.

25. Khadilkar V, Yadav S, Agarwal KK, Tamboli S, ,Banerjee M, Cherian A, et al. Revised IAP growth charts for height, weight and body mass index for 5- to 18-year-old Indian children. Indian Pediatr. 2015;52(1):47-55.

26. Khadilkar A, Ekbote V, Chiplonkar S, Khadilkar V, Kajale N, Kulkarni S, et al. Waist circumference percentiles in 2-18 year old Indian children. J Pediatr. 2014;164(6):1358-62.e2.

Sick day management of children with diabetes: A guide to pediatricians

DR SAPNA NAYAK
Assistant Professor, Pediatric Endocrinology Unit,
Dept. of Pediatrics, Christian Medical College, Vellore, Tamil Nadu

INTRODUCTION

Diabetes in children is most commonly type 1 diabetes mellitus (T1D), characterized by hyperglycemia due to an absolute insulin deficiency resulting from the autoimmune destruction of pancreatic β-cells. Treatment consists of insulin injections guided by daily self-monitoring of blood glucose (SMBG) with the regulation of diet and physical activity. Other forms of diabetes including type 2 diabetes mellitus (T2D), and monogenic diabetes although uncommon can occur in children.

Childhood is prone to illnesses like upper respiratory, dental, urinary tract infections, bacterial infections of the skin (cellulitis), viral hepatitis, gastroenteritis with vomiting, diarrhea, mumps, dengue, etc. A child with any form of diabetes can also contract these infections.

Similarly, they can also develop non-communicable diseases like allergic rhinitis, asthma, autoimmune hepatitis, Graves' disease, etc. High-dose steroids used in treating some of these conditions cause insulin resistance and higher insulin requirements. Although uncommon and generally managed at specialized centers, one should be aware that these conditions may have acute exacerbations associated with hyperglycemia. In many of the above scenarios, general pediatricians are the point of first contact and referral to a pediatric diabetologist may be not possible and unnecessary in every situation, especially in remote settings.

This article aims to familiarize pediatricians with the management of sick days in children with diabetes and briefly address the common queries [1].

HOW IS A SICK DAY DIFFERENT IN A CHILD WITH DIABETES?

The pathophysiology of illness in diabetes is shown in Figure 1. While diabetes may not increase the occurrence of illnesses, it may be associated with increased severity due to altered immunity. If the relative insulinopenia during an acute illnesses is not counteracted by increased insulin dosing, diabetic ketoacidosis (DKA) can be precipitated, especially with preceding suboptimal glycemic control. DKA has high mortality and morbidity and should be prevented.

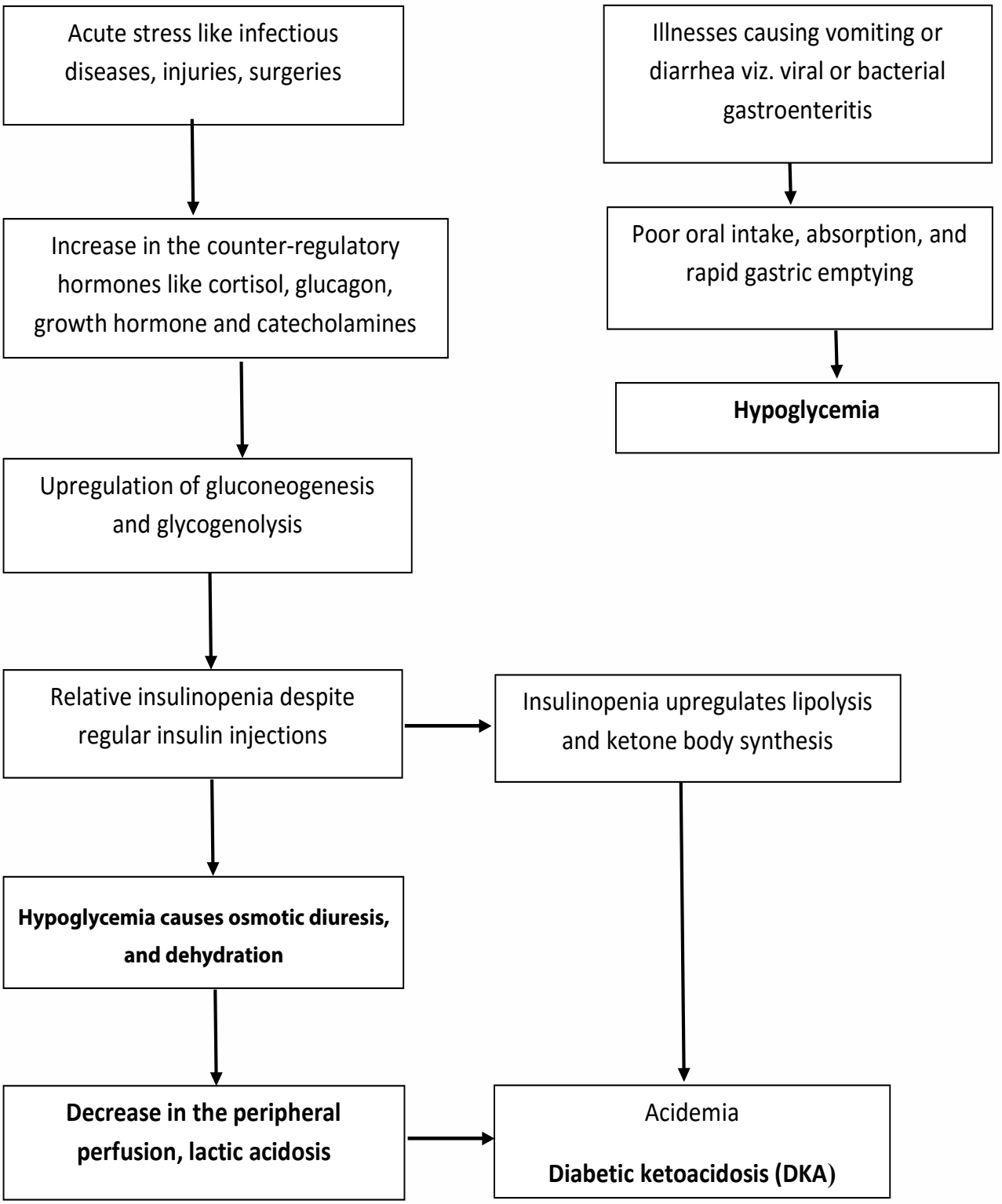
On the other hand, severe hypoglycemia can cause seizures, unconsciousness, and immediate death, apart from the long-term cognitive deficits.

Timely intervention by parents and healthcare providers can avoid adverse consequences, thereby limiting hospitalizations and the burden on the families.

PREPARATION FOR A SICK DAY: THE ROLE OF THE FAMILY

Diabetes education is central to the successful management and encompasses all aspects of insulin, injection techniques, the importance of SMBG, and hypoglycemia

Figure 1: Pathophysiology of illness in diabetes



management. Providing guidelines to manage a child during illnesses, as elaborated in Box 1, is an essential part of basic diabetes education and should be reviewed annually by the treating team. Nevertheless, families need support during stressful situations. Every family must be acquainted with the methods of urine or blood ketone testing and own the kits at home.

SICK DAY MANAGEMENT IN DIABETES: ROLE OF THE PEDIATRICIAN

How do I approach an ill child with diabetes presenting to my clinic or emergency? (Figure 2)

History regarding diabetes and illness. Take a thorough history of the onset and duration of the symptoms. Inquire into the current insulin regimen and doses and if insulin was being administered regularly with appropriate adjustments. Find out the ability of the child to tolerate orally.

Detailed physical examination. Examine for signs of dehydration like tachycardia, dryness of tongue, sunken eyes; respiratory rate and breathing pattern, and fruity breath odor, to look for acidosis. Measure blood pressure. It is not uncommon for a child to have these signs without symptoms other than generalized fatigue. Additionally, examine to localize the focus of infection, assess its severity, and formulate a plan of management.

Measure the blood glucose (BG) level and ketones. Measure the BG and urine/blood ketones bedside. Look at the BG log over the past few days if available. Ketonemia with hyperglycemia reflects insulin deficiency while ketogenesis with low or normal BG occurs in starvation, to serve as an alternative fuel to the brain during a lack of glucose. If the BG is >250 mg/dL and urine ketones are large or blood ketone is > 3 mmol/L, a venous blood gas (VBG) should follow. In the presence of acidosis, the child is classified as having DKA and hospitalized for appropriate management or immediately referred to a center with expertise and facilities for DKA management.

Treat the underlying illness. Hospitalize if required for treatment of the infection or if the child is unable to take orally. Intravenous fluids, antibiotics, antipyretics, etc. may be prescribed as necessary.

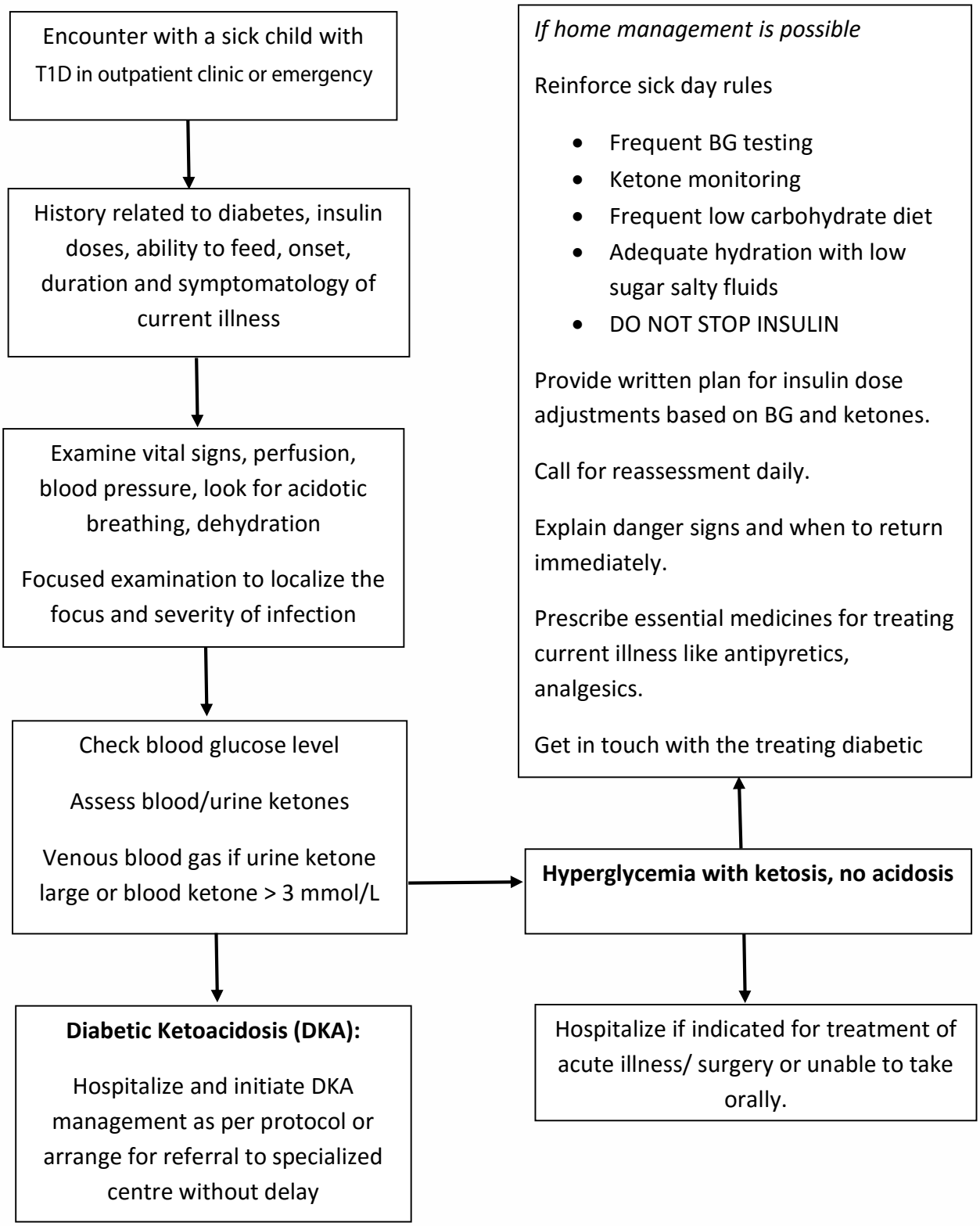
How do I proceed if the child is stable, and has ketosis but no acidosis?

Home management with sick day guidelines. The goal is to prevent the progression of ketosis. It is not necessary to hospitalize every child with diabetes. A stable child can be sent home with instructions to strictly follow the sick day guidelines (Box 1). The parents can follow-

Box 1: Sick day management guidelines in T1D

1. Monitor blood glucose (BG) levels frequently: Monitor BG levels every 1–2 hourly to recognize of high or low BG level that guide the subsequent steps. Parental assistance is inevitable even in an older child who is ill. The aim is to maintain BG level between 90–180 mg/dl.
2. Monitor ketones: Urine or blood ketones must be monitored every 2–4 hourly as per availability. A sick child with T1D can have ketosis with hyperglycemia due to insulin deficiency or with normo/hypoglycemia due to starvation ketosis.
3. Do not stop insulin: Insulin must not be skipped even if the child is unable to eat well. Doses of insulin should be adjusted based on the BG levels and ketone levels as detailed in Table 1.
4. Ensure adequate hydration and carbohydrate intake: Fever, vomiting, glycosuria, ketonuria contribute to dehydration. Adequate intake of fluids (4–6 ml/kg/hour) prevents dehydration. If the child is unable to eat well, give palatable semisolid or liquid preparations. If vomiting precludes any oral intake, hospitalization is necessary.

Figure 2:
Algorithm summarizing approach to a child with diabetes presenting with acute illness



up daily with BG and ketone charting until the child is well. Alternatively, the family can keep in touch with your team by telephone providing daily updates on the BG for dose adjustments. Tiny doses of sugary syrups do not raise the BG levels inadvertently if intensive sick day rules are followed.

Reinforcing sick day rules. Although sick day management guidelines are taught at diagnosis, it is important to revise them for the family during an illness. It is obvious that the parents of a sick child get anxious and irrespective of their educational status, may get confused between the management of high and low BG levels. The knowledge provided at diagnosis might be forgotten, especially if under irregular follow-up. Other than reassurance and reiteration of the sick day rules, also look at the insulin injections being used, storage conditions, injection techniques, presence of air bubbles in the cartridges, the technique of priming the insulin pens, and examine the injection sites for lipohypertrophy to ensure effective insulin delivery. If doubtful about the storage and potency of insulin being used, prescribe new vials or cartridges.

Guidelines for Insulin dose adjustments. The insulin dosage is guided by the BG levels and the presence of ketones.

- The dose of basal insulin (long-acting insulin like Glargine or intermediate-acting insulin like NPH) may be increased by 20–30% depending on the degree of hyperglycemia and the anticipated duration of illness.
- The dose of the rapid-acting insulin (like Lispro) or short-acting insulin (like Regular) are increased based on the degree of hyperglycemia and the quantity of ketones as suggested in Table 1.
- For parents not cognizant of the percentage computations, a calculated written plan of insulin dosage may be provided.

Contacting the diabetes team. The healthcare team less experienced to deal with the management of glucose fluctuations during an illness must not hesitate to contact the patient's diabetes team for guidance and to facilitate referral if needed. The parents generally have the emergency contact numbers of the diabetes team members.

Sick-day management in a child with vomiting or gastroenteritis. Vomiting in a sick child with hyperglycemia and ketosis indicates insulin deficiency. However, when associated with hypoglycemia, insulin doses may be reduced but not skipped. Manage hypoglycemia as shown in Figure 3 [2]. Anti-emetics may be used unless contraindicated. Use mini-dose glucagon in case of persistent hypoglycemia due to prolonged vomiting and food refusal (Table 2).

How do I manage a child with an injury or requiring surgery?

Children are prone to accidents and injuries due to their active lifestyle and inability to foresee dangers. The body reacts to injuries as any other illness and the sick day rules apply in these situations too. Basic wound care, analgesics, and antibiotics are advised as necessary. Tight glycemic control must be aimed for, as hyperglycemia delays wound healing [3].

Elective surgeries are better done in specialized centers after achieving target glycemic control and is not discussed here. However, some conditions viz. appendicitis and traumatic open fractures in children may require emergency surgery. Due to the associated infection, inflammatory and stress response associated, these situations carry a risk of hyperglycemia and DKA and the principles of a sick day must be followed. In these situations, children may be kept nil oral and started on intravenous hydration. This, however, does not preclude the need for insulin injections. Intravenous insulin infusion or frequent doses of short-acting insulin with 1–2 hourly BG monitoring must be used depending on the duration of surgery and the anticipated post-operative course.

Table 1: Guide to insulin dose adjustments for sick day management of a child with diabetes*

Blood ketones (mmol/L)	Urine ketones	Blood glucose levels (mg/dL)				
		<90	**90–180**	**180–250**	**250–400**	**>400**
<0.6	Negative/trace	Reduce insulin by 20%	Usual bolus dose of insulin[1]	Usual bolus dose of insulin with correction as per ISF		Add 10% of TDD to usual bolus
0.6–0.9	Trace/small	Reduce insulin by 15%		Add 5–10% of TDD to usual bolus dose[2]		
1.0–1.4	Small/moderate	Usual bolus when BGL>90		Add 10% of TDD to usual bolus dose		
1.5–2.9	Moderate/large		Add 5% of TDD to usual bolus	Add 10–20% of TDD to usual bolus dose		
>3	Large			**Hospitalize for management of DKA**		

**Modified from International Society of Pediatric and Adolescent Diabetes (ISPAD) Clinical Practice Consensus Guidelines 2022: Sick day management in children and adolescents with diabetes*

Abbreviations: TDD: total daily dose, DKA: Diabetic ketoacidosis

[1]Usual bolus dose of insulin: Based on preceding daily dosing or calculated using insulin carbohydrate ratio (ICR). Correction as per insulin sensitivity factor (ISF).

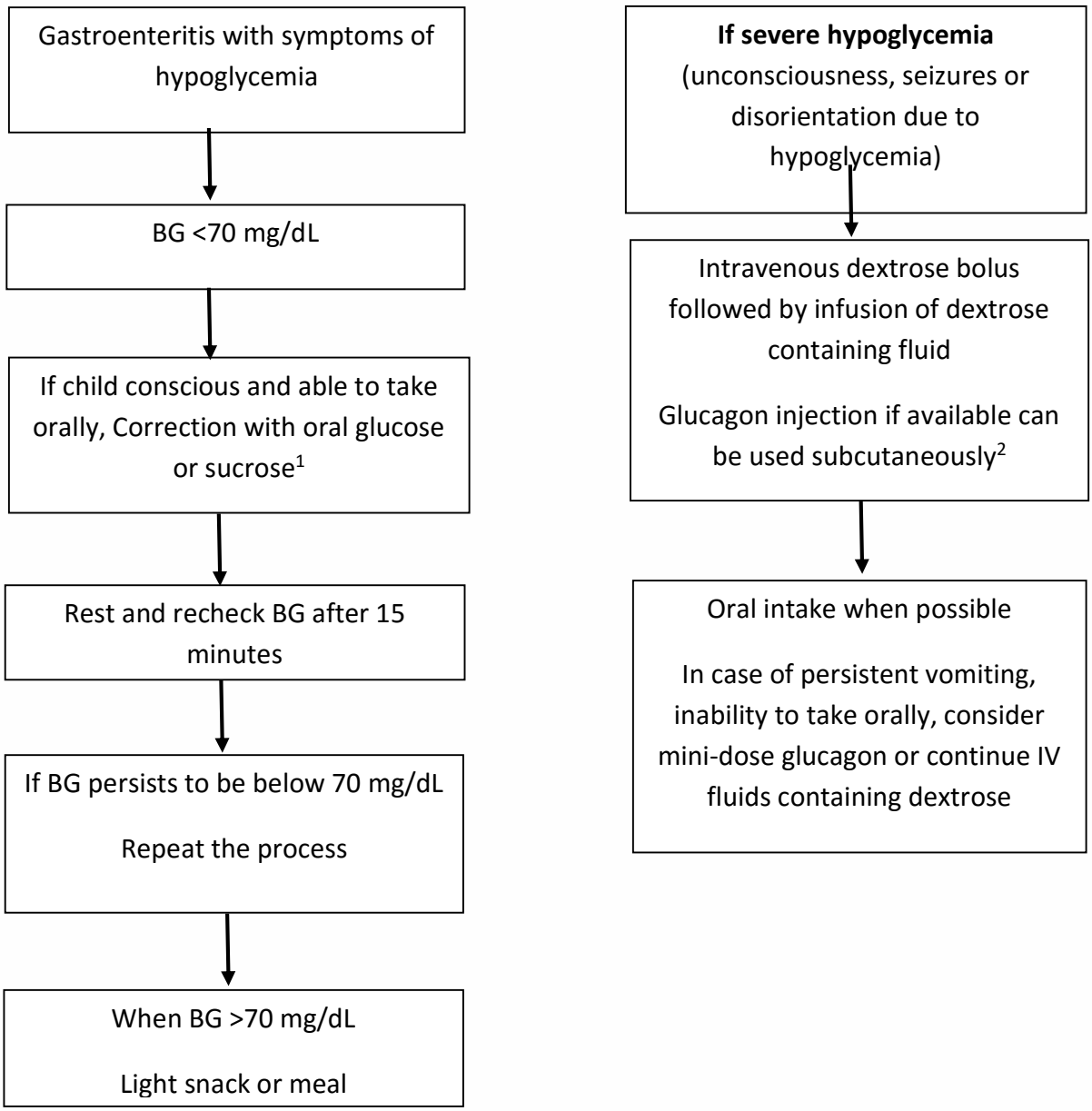
[2]Use a higher percentage of TDD if BG >400 mg/dL

If high BG level persists, a dose of rapid or short-acting insulin may be repeated after 2 hours

Extra carbohydrates must be taken when BG <180 mg/dL

Oral fluids must be taken at 4–6 mL/kg/hr for adequate hydration. Advise sugar-free fluids when BG > 250 mg/dL and carbohydrate-containing fluids when BG <250 mg/dL

Figure 3: Algorithm summarizing management of hypoglycemia in a sick child with diabetes and vomiting/gastroenteritis



Check ketones 2 hourly

Continue insulin, albeit in reduced doses

[1] Glucose about 0.3 g/kg i.e., 5 g for a 15 kg children and 15 g for 50 kg child

[2]The dose of glucagon in severe hypoglycemia is 0.5 mg for child weighing <25 kg and 1 mg for child >25 kg and adults.

Table 2: Dosage of mini-dose glucagon for use in persistent hypoglycemia due to prolonged vomiting and food refusal*

Age	Amount (micrograms)
< 2 years	20
2–15 years	10 per year of age
>15 years	150

The dose may be repeated in 30 to 60 minutes

**Modified from International Society of Pediatric and Adolescent Diabetes (ISPAD) Clinical Practice Consensus Guidelines 2022: Sick day management in children and adolescents with diabetes*

PREVENTION OF ILLNESS AND POOR OUTCOMES IN CHILDREN WITH DIABETES

Health education and immunization of children with diabetes

General preventive measures applicable to any other child viz. healthy lifestyle, hygienic practices, safe drinking water and eating habits, and road safety measures must be emphasized at every contact. Routine vaccines are not generally contraindicated in children with diabetes. General pediatricians should motivate families to get their children with T1D immunized, including influenza and COVID-19 vaccines to prevent serious childhood illness and its consequences. Hyperglycemia that may result immediately post-vaccination must be managed as per sick day guidelines.

OTHER FREQUENTLY ASKED QUESTIONS

Can continuous glucose monitoring (CGM) systems be used for BG monitoring during home management on a sick day?

Technology including CGM certainly offers an advantage during illness to track the BG levels and know its trend, but concerns about accuracy in states of poor perfusion, extremes of BG levels, and interference with medications used during an illness like paracetamol must be borne in mind. If used, it should be supplemented by frequent SMBG by finger-pricks.

What is better: measurement of urine ketones or blood ketones?

Urine ketone strips are readily available and detect acetone and acetoacetate (AcAc) while blood ketone β-hydroxybutyrate (BOHB) is measured by certain glucometers (Abbott's Optium Freestyle glucometer, among those available in India). However, blood ketone strips are costly and not widely available. Urine ketones appear later than blood ketones, causing a delay in the diagnosis, and remain positive for as long as 24 hours after the resolution of ketonemia, causing a false alarm. Hence, prefer bedside blood ketone testing, particularly in infants and young children, where obtaining urine samples is challenging. In case of non-availability, use urine dipsticks (ketodiastix) taking into account that ketonuria may be absent in the initial few hours of ketonemia.

Can the use of insulin pumps be continued during sick days?

The use of insulin pumps is not highly prevalent in India. However, in pump users, interruptions can rapidly precipitate DKA, especially during an illness, as there is no long-acting insulin in the body. Such families must immediately reach out to the diabetic team to ensure correct pump functioning. In the interim period, as the remote healthcare provider may not be familiar with insulin pumps, insulin must be administered using syringes or insulin pens to ensure adequate delivery.

What oral fluids can be advised during sick days?

Advise sugar-free fluids if BG level is >250 mg/dL and salted low sugar-containing fluids if BG level is <250. Choices of fluids include free water, lime juice without sugar, oral rehydration solution (ORS), milk, buttermilk with salt, and tender coconut water. Fresh fruit juices may be advised in case of BGL< 250 mg/dl. Advise against the consumption of carbonated soft drinks like Coke, Pepsi, etc.

What foods can be advised during sick days?

An ill child has decreased appetite and altered taste causing reduced oral intake. Advise frequent small portion feeds with simple carbohydrates if the child is unable to eat a complete meal. Porridge, vegetable soup, mashed vegetables, kheer (with less sugar), yogurt, bread, and melted ice cream are a few options.

Do oral anti-diabetic agents have a role during sick days?

Insulin is the primary treatment for T1D. However, if an adolescent with T2D is on metformin, it must be stopped as it increases the risk of lactic acidosis and DKA and insulin must be initiated.

SUMMARY

An ill child with diabetes is prone to glucose excursions, DKA, and hypoglycemia with adverse short-term and long-term consequences including death. Awareness, early intervention, and implementation of sick day rules can prevent deterioration. Frequent glucose and ketone monitoring, adequate hydration and intake of carbohydrates, and most importantly, continuing insulin with appropriate adjustments form the cornerstone of management while treating acute illness. As a point of first contact during acute illness, the pediatrician's role is crucial and can be life-saving.

REFERENCES

1. Phelan H, Hanas R, Hofer SE, James S, Landry A, Lee W, et al. ISPAD Clinical Practice Consensus Guidelines 2022. Sick day management in children and adolescents with diabetes. Pediatr Diabetes. 2022;23(7):912-925.
2. Abraham MB, Kargres B, Dove K, Naranjo D, Arbelaez AM, Mbogo J, et al. ISPAD Clinical Practice Consensus Guidelines 2022: Assessment and management of hypoglycemia in children and adolescents with diabetes. Pediatr Diabetes. 2022; In press.
3. Kapellen T, Agwu JC, Martin L, Kumar S, Rachmiel M, Cody D, et al. ISPAD Clinical Practice Consensus Guidelines 2022: Management of children and adolescents with diabetes requiring surgery. Pediatr Diabetes. 2022; In press.

Impact of COVID-19 on Incidence, Clinical Features, Access to Care, and Management of Pediatric Type 1 Diabetes Mellitus

DR. VARUNA VYAS
Associate Professor, Department of Pediatrics,
All India Institute of Medical Sciences, Jodhpur, Rajasthan

DR. PRAKSHI TYAGI
Senior Resident, Department of Pediatrics,
All India Institute of Medical Sciences, Jodhpur, Rajasthan

INTRODUCTION

Coronavirus disease 2019 (COVID-19) is caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) [1]. It has caused worldwide havoc. Apart from being a highly contagious viral illness that caused significant morbidity and mortality all around the globe, it caused a lot of collateral damage. In view of its contagiousness, lockdowns were declared in most parts of the world by government decrees to stop its spread. The children were thus stopped from going to schools and online education became the norm. There was limitation of physical activity and an imposed screen time for the children. There has also been a financial and a social fall out.

Type 1 diabetes mellitus (T1D) in children has also not remained an untouched arena. There have been varying effects on epidemiology of T1D as well as the clinical presentation besides the treatment of this condition during COVID-19 pandemic. We attempt to briefly review the published literature on the same.

COVID-19 AND THE INCIDENCE OF TYPE 1 DIABETES MELLITUS

The pathogenesis of T1D is poorly understood. Our current understanding is that in a person with a predisposing genetic makeup, an environmental trigger leads to the development of antibodies targeting the pancreatic islet cells. These destroy the beta islet cells which leads to absolute insulin deficiency and in turn manifests as T1D. The environmental trigger often implicated is a virus. Different viruses including coronaviruses have been implicated as the environmental triggers that lead to the development of T1D. Theoretically the is a possibility that SARS CoV2 could be one such trigger.

It was also a possibility that the lockdown led to decreased exposure to the existing viral triggers and hence a decreased incidence of T1D.

With the start of the pandemic there were initial case reports and later on studies that suggested that there was association of T1D. A

recently published meta-analysis comprising of 24 studies was performed comparing T1D between the COVID-19 pre-pandemic and pandemic periods. The incidence rate of T1D in 2019 was 19.73 per 100,000 children which has increased to 32.39 per 100,000 in 2020. [2]

COVID-19 AND DIABETIC KETOACIDOSIS

Diabetic ketoacidosis (DKA) is an acute life-threatening complication of T1D seen in untreated children. Sometimes previously undiagnosed children present to the hospital in DKA. Studies from across the world have reported that following the COVID-19 pandemic, more newly diagnosed children are reporting in DKA at the time of presentation [3]. A prospective cohort study conducted in Germany reported that during the COVID-19 in 2020, 44.7% of the patients presented in DKA as compared to the previous two years when it was only 24%. The incidence of severe DKA was 19.4% in 2020 vs 13.9% in 2019 vs 12.3% in 2018. Multifactorial reasons like fear of approaching health care system and various psychosocial factors have been postulated for this rise in number of ketoacidosis at admission [4].

COVID-19 AND MIS-C IN DIABETES MELLITUS

The clinical presentation of COVID-19 in children with diabetes is similar to other patients and included fever and upper respiratory tract symptoms.

Multisystem inflammatory syndrome in children (MIS-C) is an autoimmune inflammatory syndrome that was described in children for the first time after the COVID-19 Pandemic. There is very limited data on MIS-C in children with T1D. In a study from Egypt conducted over a period of 10 months and including 294 children with new onset diabetes, 6 were found to fulfil the criteria for MIS-C. All were hemodynamically unstable and required vasopressor support. High insulin requirements were noted due to usage of methylprednisolone for MIS-C. It was also observed that intravenous immunoglobulin (IVIG) and methylprednisolone were better administered after DKA resolution. Administration of IVIG during DKA led to pulmonary edema [5].

IMPACT OF COVID-19 ON THE LIVES AND TREATMENT OF CHILDREN WITH T1D

A telephonic survey of guardians of T1D children was conducted in North Western Rajasthan to study the impact of COVID-19 lockdown on lifestyle. It was observed that sleep duration and non-educational screen time had significantly increased post pandemic making lifestyle of these patients more sedentary [6]. Though telemedicine programs were initiated soon after the COVID-19 related lockdown, there were certain challenges faced while connecting the patients to a new telemedicine program. There was a lack of awareness and experience among people staying in both rural and urban areas. However studies showed that structured telephonic visits were an effective way to replace routine visits or integrate with them [7]. Studies also showed that telemonitoring helped in detecting clinical and psychological needs of patients with T1D during the pandemic and offer support to them [8].

SUMMARY

COVID-19 pandemic has had a multipronged effect on T1D and had changed certain aspects of patient care and interaction with health care system. Lifestyle due to digitalization has become more sedentary. There has been evolution of telemedicine and telenursing but more integration of these services are required into routine care and long-term outcomes need to be explored.

REFERENCES

1. Hu B, Guo H, Zhou P, Shi ZL. Characteristics of SARS-CoV-2 and COVID-19. Nat Rev Microbiol. 2021 Mar;19(3):141-154.
2. Rahmati M, Keshvari M, Mirnasuri S, Yon DK, Lee SW, Il Shin J, et al. The global impact of Covid-19 pandemic on the incidence of pediatric new-onset type 1 diabetes and ketoacidosis: A systematic review and meta-analysis. J Med Virol. 2022; 94(11):5112–27.
3. Gottesman BL, Yu J, Tanaka C, Longhurst CA, Kim JJ. Incidence of new-onset type 1 diabetes among US children during the COVID-19 global pandemic. JAMA Pediatr. 2022; 176(4):414-415.
4. Kamrath C, Mönkemöller K, Biester T, Rohrer TR, Warncke K, Hammersen J, et al. Ketoacidosis in children and adolescents with newly diagnosed type 1 diabetes during the COVID-19 pandemic in Germany. JAMA. 2020; 324(8):801.
5. Aly HH, Fouda EM, Kotby AA, Magdy SM, Rezk AR, Nasef MWA. Covid-19–related multisystem inflammatory syndrome in children presenting with new-onset type 1 diabetes in severe ketoacidosis: A case series. Diabetes Care. 2022; 45(4):983–9.
6. Vyas V, Singh K, Pareek P, Garg MK, Didel S, Priyanka P, Goel AD, Misra S. Guardian-Reported Impact of the COVID-19 Pandemic on the Lifestyle of Children with Diabetes Mellitus. J Trop Pediatr. 2022 Feb 3;68(2):fmac013. doi: 10.1093/tropej/fmac013.
7. Boscari F, Ferretto S, Uliana A, Avogaro A, Bruttomesso D. Efficacy of telemedicine for persons with type 1 diabetes during Covid19 lockdown. Nutr Diabetes. 2021 Jan 5;11(1):1.
8. de Mattos Matheus AS, Cabizuca CA, Tannus LRM, Passos AC, Schmidt AC, de Gouveia AT, et al. Telemonitoring type 1 diabetes patients during the COVID-19 pandemic in Brazil: was it useful? Arch Endocrinol Metab. 2021 Nov 1;65(1):105-111.

IAP Navi Mumbai

ACADEMIC –

1. 1st Nov – **Journal Journey, IAP Raigad**
   Expert – Dr Amol Jaybhaye, Dr Omprakash Jamadar
   Guide – Dr Nimain Mohanty

2. 4th Nov - **IAP PG Teaching**
   Expert - Dr Amdekar, Dr Balasubramaniam, Dr Srinivas
   https://us02web.zoom.us/j/86594773367?pwd=VlUvTUJCNUFUQWk5ZWtWT0RUTEhlUT09

3. 5th, 6th Nov- **1st Asian Congress of Adolescent Health, Kolkata**
   22nd National Conference AHA, IAP
   Faculty – Dr Kalyani Patra

4. 9th Nov **– IAP Disaster Management**
   Topic – Disasters in school- Impact, effect & resilience.
   Expert – Dr Nimain Mohanty
   https://diapindia.org/event-details.php?event=1901&title=IAP-DISASTER-MANAGEMENT-GROUP

5. 11th Nov – **IAP PG Teaching**
   Expert - Dr Amdekar, Dr Balasubramaniam, Dr Srinivas
   https://us02web.zoom.us/j/86594773367?pwd=VlUvTUJCNUFUQWk5ZWtWT0RUTEhlUT09

6. 11th Nov – **Maha subspeciality connect: Pearls in Pediatric Nephrology**
   Expert – Dr Pankaj Deshpande
   https://us02web.zoom.us/j/83530809696?pwd=MjRyeFRLQ3IxR21jRnFBVDdEdWtLZz09

7. 13th Nov – **CIAP Module, DAD – Demystifying allergic disorders**
   Topic- Approach to an Allergic Child
   Expert- Dr Mangai Sinha

   Topic - Allergic Skin diseases & Atopic dermatitis
   Expert – Dr Vikram Patra

   Moderator – Dr Kalyani Patra

8. 15th Nov – **Quiz for nurses on Neonatology organized by MAHAIAP**
   Expert – Dr Omprakash Jamadar
   https://tinyurl.com/mahaiaplive

9. 16th Nov – **Grand Rounds In NICU (Newborn Week Celebration)**
   Experts – Dr Piyush Jain, Dr Omprakash Jamadar
   Moderator – Dr Sheetal Kohle
   https://us06web.zoom.us/j/81610050082?pwd=ZHY0UVlNd3JySkJXdm11ZERCeHY1UT09

IAP Navi Mumbai

10. 18th, 19th, 20th Nov – **MAHAPEDICON 2022, Nashik**
    Workshop – UNICEF ECD
    Guest – Dr Upendra Kinjawdekar

    Topic – IV fluids – Which When & How Much.
    Moderator – Dr Jeetendra Gavhane

    Topic – Pattern recognition in Rheumatology.
    Expert – Dr Vijay Vishwanathan

    Topic – Ionotropes – Chasing the numbers.
    Expert – Dr Abhijeet Bagde

    Topic – Antibiotics – Think Before You Ink.
    Expert – Dr Vijay Yewale, Dr Dhanya Dharmapalan

    Topic – Urine Analysis simplified
    Expert – Dr Pankaj Deshpande

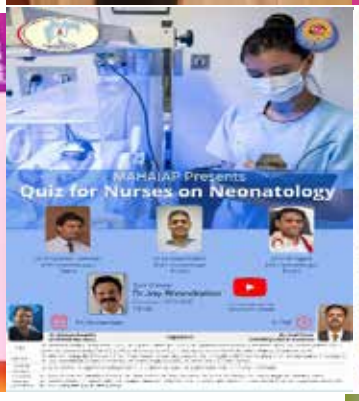
11. 22nd Nov-**MAHAIAP – TUESDAY TALKS**
    Expert – Dr Pankaj Deshpande
    https://us02web.zoom.us/j/84606192132?pwd=UWZKSUs0UXAzUVh3T1c1bm1ZREdaUT09
    https://tinyurl.com/mahaiaplive

12. 24th Nov - **Measles Outbreak: Protocols & Prevention**
    Moderator: Dr. Jeetendra Gavhane, PICU Incharge, MGM College (Navi Mumbai)
    EB Member CIAP 2023. https://us02web.zoom.us/j/84387825671?pwd=NmNGRTFSQ0hTMn-VuMld6bE0zR2JTUT09


IAP Navi Mumbai







IAP Navi Mumbai

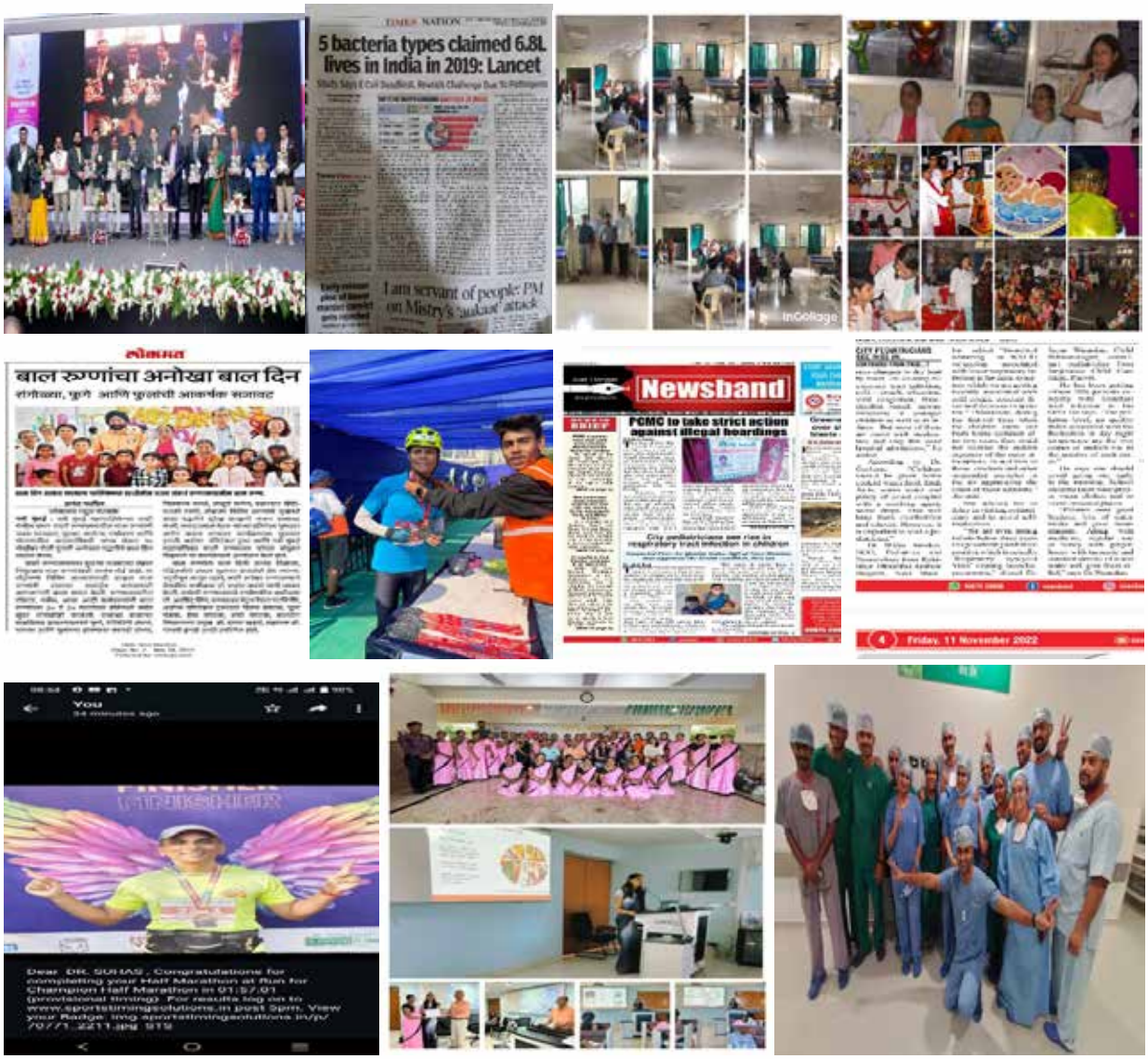
SOCIAL –

1. **Dr Shilpa Aroskar** and **Dr Jeetendra Gavhane** was quoted in The Newsband online website on the recent rise of respiratory illness in children.
2. **Dr. Yewale** talks about the various measures taken to create awareness against this deadly disease and various measures to prevent Pneumonia: The number 1 killer in Children. https://youtu.be/0vcq2eGjwgw
3. **Jio Cyclathon 100kms cycling** was completed **by Dr Pravin Gaikwad**, Senior Pediatrician from NMIAP.
4. Celebrating IAP Newborn week, some valuable tips for care of Newborns were shared by **Dr. Suresh Birajdar,** NMAP member and Consultant Neonatologist and NICU Incharge of Motherhood Hospital, Kharghar. This year's theme is "Homecare of Newborn in Urban Area" . In this Video, Dr. Birajdar has enumerated all the important aspects of care of Newborn in a simple and easy to understand way. https://youtu.be/5NMdhRTfd3M
5. **Dr Jeetendra Gavhane** was quoted on Measles, Symptoms & causes of Measle on ABP MAZA Marathi News Channel. https://youtu.be/0ybOMAERkPI
6. Parental Awareness about Childhood Pneumonia by **Dr. Sagar Warankar** on occasion of World Pneumonia Day. https://youtu.be/W6vXtX7v6H4
7. Children's day was celebrated in **Post Graduate Institute of Medical Sciences,Navi Mumbai at Pediatric ward, General Hospital, Vashi**. Apart from the entertainment games, drawing competitions, songs and dances performed by the admitted patients and Thalassemic patients, important life style education was given about Healthy and junk food, increased water consumption, minimal use of mobile, exercise and physical activities and many more through my posters and children were given a pledge to abide by the same. Apart from gifts and prizes, a magician show was also arranged. Children and their parents participated with zeal in the program.
8. Neonatologist **Dr Vikas Gupta** with his team has conducted very good practice oriented **newborn care to all postnatal mothers as well as antenatal mothers** in this Newborn Week celebration At **MGM Hospital and Medical College Kalamboli**, Navi Mumbai under guidance of mentor **Dr Vijay Kamale**.

IAP Navi Mumbai

9. **Dr Shekar Patil**, Pediatric Neurologist Apollo Hospital was quoted on ZEE NEWS channel on **brain diseases in children**. https://youtu.be/7bhELscUXi4
10. An informative video on the occasion of world pneumonia day **"Do Not Ignore!!! How to recognize pneumonia in children'**!!! by **Dr. Vikram Patra**" https://youtu.be/hyfgBw5PRfU
11. **Apollo Hospitals** launched **Pan India Antimicrobial Stewardship Program** for adults and children for 73 hospitals. **Dr. Dhanya Dharmapalan** is serving as **National Coordinator** of this **India's largest antimicrobial stewardship program** leading its design and its implementation. https://www.thehindu.com/news/cities/chennai/apollo-hospitals-launches-programme-to-promote-rational-use-of-antibiotics/article66148940.ece
12. **Dr Sandeep Sawant** was quoted on NDTV news channel on his views on the recent measles outbreak. https://youtu.be/xlX2KeR29I8
13. **Dr Dhanya Dharmapalan**, Infectious diseases experts article on respiratory transmission of polio and its connection with VDPV in New York, London and Israel, published today in The Vaccines journal.
14. **Dr V N Yewale**, senior pediatrician Navi Mumbai was quoted in Times of India news paper on his views on the recent article published in LANCET medical journal regarding the 5 major bacteria claiming 6.8l lives in 2019
15. **Dr Jeetendra Gavhane** was live on ABP MAAZA giving health tips on measles and chicken pox like viral exanthematous illnesses. https://marathi.abplive.com/lifestyle/health/health-tips-what-is-the-difference-between-measeals-and-chicken-pox-know-expert-advice-marathi-news-1123080
16. **Drushtikshep MAHAIAP Bulletin 3rd issue** was released officially at the inaugural function of **Mahapedicon 2022 at Nashik**. By the hands of our special guests and dignitaries **Dr. Upendra Kinjawadekar**, Dr. Remesh Kumar, Dr. Mrudula Phadke, Dr. Basavaraja, Dr. Chetan Shah, Dr. Samir Dalwai, Dr. Ramakant Patil, Dr. Hemant Gangolia, Dr. Amol Pawar.
17. Promoting fitness and healthy lifestyle, fitness enthusiast and NMIAP member **Dr Suhas Warad completed a half marathon** by participating in Champions Half Marathon.
18. Our Anganwadi Sevikas form the backbone of our healthcare system at the grassroots level, especially in small talukas and townships. Hands on training helps in making our pillars stronger and overall upliftment of the healthcare system in rural India. Keeping this in mind, NMAP EB member, **Dr Amog Shahane**, was part of a training **workshop of IMNCI (Integrated management of Neonatal and Childhood Illnesses) for anganwadi workers** and took a session on Paediatric malnutrition, Pneumonia and Diarrhoea and dehydration management for anganwadi Sevika workers from Panvel and Raigad district. This was a joint venture conducted by the **National Institute of Public health training and Research Centre (NIPHTR), Panvel and Sri Satya Sai Sanjeevani hospital, Kharghar with Navi Mumbai IAP**. The session was attended by 70 Anganwadi Sevikas and well appreciated by all.
19. **Dr Bhushan**, pediatric cardiologist successfully completed **Interventional Pediatric Cardiac camp at Apollo Hospital, Navi Mumbai** with **5 vsd devices...2 asd ...3 pda and 1 balloonplasty**. A total of 11 cases.

IAP Navi Mumbai



AWARDS WON BY NMIAP AT MAHAPEDICON 2022 –

1. **The Best Branch**
2. **Best ORS week Celebration**
3. **Best Breastfeeding Week celebration**
4. **Runner up- Charity Day celebrations**

IAP Kerala

Medical camp IAP Thiruvanthapuram

IAP Kerala

BNRP IAP Cochin

IAP Kerala

Gastro CME IAP Wayanad

IAP Kerala

Immunisation training IAP Kozhikode

IAP Kerala

Pre conference Workshop

IAP Kerala

Sports fest - Football champions - IAP Kozhikode

Sports fest - Football runners up - IAP Malappuram

IAP Kerala

Excecutive meeting of IAP Kerala

Honouring MBFHI Certified Hospitals

IAP Kerala

Beach Walkathon

Inaugration of Calpedicon 2022 by National president Dr Remesh Kumar

IAP Kerala

IAP Kerala with National President Dr Remeshkumar

Release of Manjadikkuru - Annual Arts Magazine of IAP Kerala