



TYPE 2 DIABETES IN THE CHILD AND ADOLESCENT

DR. Trinh Thi Kim Hue

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DEFINITION

- Complex metabolic disorder characterized by chronic hyperglycemia result from defects in insulin secretion, insulin action, or both.
- Abnormalities of carbohydrate, fat and protein metabolism.
- T1D – deficiency of insulin secretion (>90% of all diabetes in young people)
- T2D – resistance to insulin action and an inadequate compensatory insulin secretory response (Most countries < 10% - Japan 60-80%)

DIAGNOSIS

ADA 2014 Guidelines



Criteria for Diabetes Diagnosis

A1C $\geq 6.5\%$ *

Perform in lab using NGSP-certified method and standardized to DCCT assay

OR

FPG ≥ 126 mg/dL (7.0 mmol/L)*

Fasting defined as no caloric intake for ≥ 8 hrs

OR

2-hr PG ≥ 200 mg/dL (11.1 mmol/L) during OGTT (75-g)*

OR

Random PG ≥ 200 mg/dL (11.1 mmol/L)

In persons with symptoms of hyperglycemia or hyperglycemic crisis

*In absence of unequivocal hyperglycemia, result to be confirmed by repeat testing

FPG=fasting plasma glucose; OGTT=oral glucose tolerance test; PG=plasma glucose

American Diabetes Association. *Diabetes Care*. 2014;37(suppl 1):S14-S80.

DIAGNOSIS

- Diabetes autoantibody testing should be considered in all pediatric patients with the clinical diagnosis of T2D because of the high frequency of islet cell autoimmunity in otherwise “typical” T2D.
- 10-20% of patients.
- Rapid development of insulin requirement and risk for other autoimmune disorders.

	Type 1 diabetes	Type 2 diabetes
Prevalence	Common	Increasing
Age at presentation	Throughout childhood	Puberty
Onset	Acute severe	Insidious to severe
Ketosis at onset	Common	About 1/3
Affected relative	5 – 10%	75 – 90%
Female:male	1:1	~ 2:1
Inheritance	Polygenic	Polygenic
HLA-DR3/4	Strong association	No association
Ethnicity	Most common in non-Hispanic white	All
Insulin secretion	Decreased/absent	Variable
Insulin sensitivity	Normal when controlled	Decreased
Insulin dependence	Permanent	Episodic
Obese or overweight	20 – 25% overweight	>80% obese
Acanthosis nigricans	12%	50 – 90%
Pancreatic antibodies	85 – 98%	10 – 20%

DIAGNOSIS

- Prediabetes
 - Impaired glucose tolerance: Fasting blood sugar is 5.6-6.9 mmol/L (100-125 mg/dL)
 - Impaired glucose tolerance: Postchallenge plasma glucose 7.8 – 11.1 mmol/L (140-199 mg/dL)
 - HbA1C 5.8-6.4%

TREATMENT

- Treatment goal
 - Education for Self-management
 - Normalization of glycemia
 - Weight loss
 - Reduction in carbohydrates and calories intake
 - Increase in exercise capacity
 - Control comorbidities (hypertension, dyslipidemia, nephropathy, sleep disorders, hepatic)

TREATMENT – Education

DIABETIC FOOD PYRAMID::

Is a guide to appropriate eating, which divides food into six key groups of varying sizes.

The largest group grains, beans, rice, starchy vegetables is at the bottom. This means that more servings of these food should be consumed more than of any others.

Choose a variety of fruits and vegetables daily.

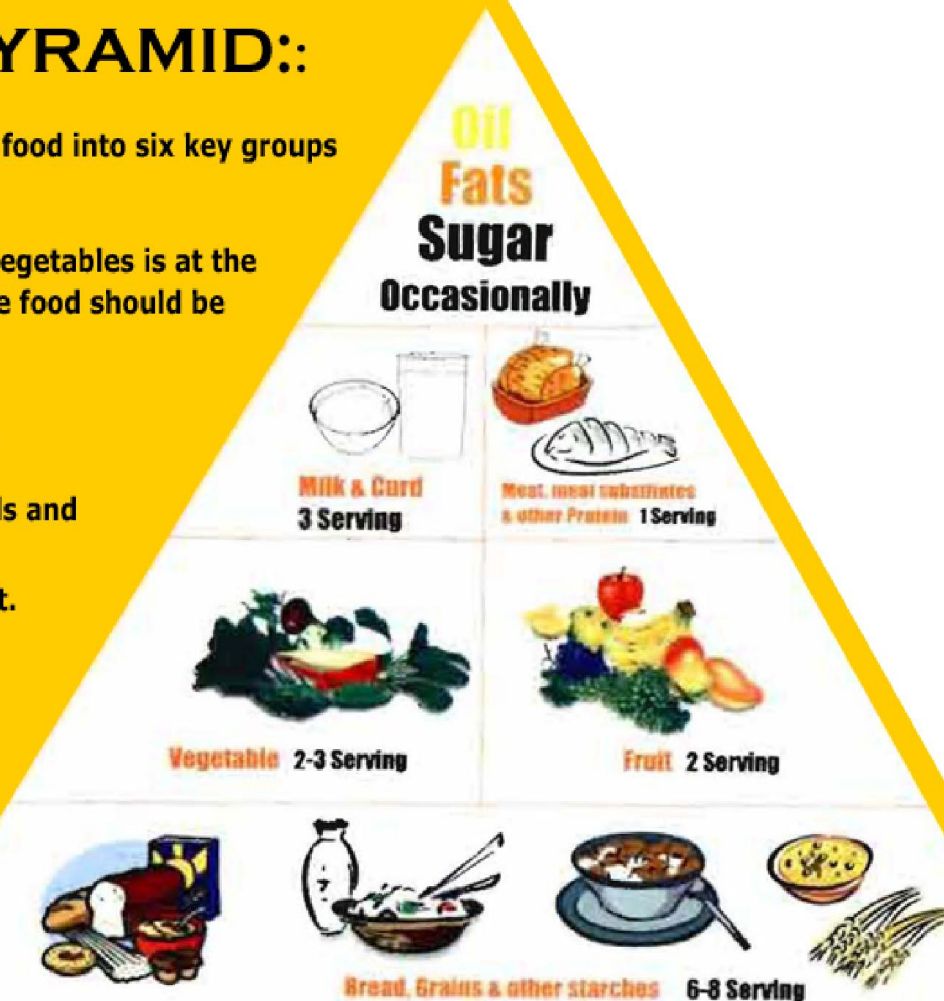
Choose a diet that is low in saturated fatty acids and cholesterol, and moderate in fat.

Choose and prepare foods which are less in salt.

If alcohol beverage is taken, have it in moderation.

Choose food high in fibre, vitamins and minerals such as whole grain, vegetables and fruits.

Be physically active for at least 30 minutes in a day.



- Exercise training
 - At least 60 minutes daily
 - Screen times should be limited < 2h daily
 - Promotion of physical activities
- No Smoking and tobacco use



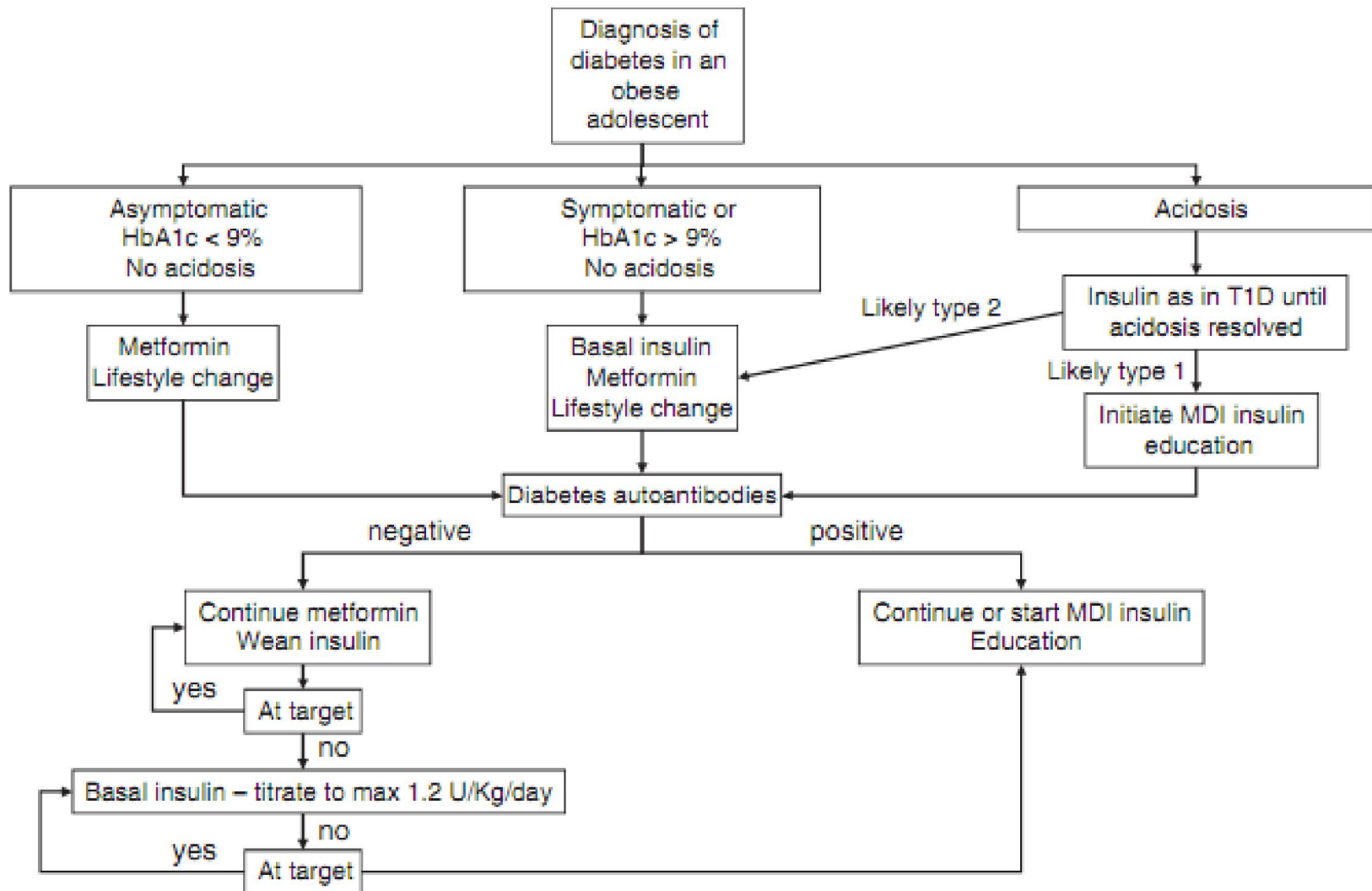
Normalization of glycemia

	ADA 2014	AACE 2013	IDF 2012
Fasting Glucose	70-130 mg/dL	<110 mg/dL	<115 mg/dL
Post Prandial Glucose	<180 mg/dL (Peak)	<140 mg/dL	<160 mg/dL
HBA1C	< 7%	≤ 6.5%	< 7%

ADA: American Diabetes Association

AACE: American Association of Clinical Endocrinologists

IDF: International Diabetes Federation

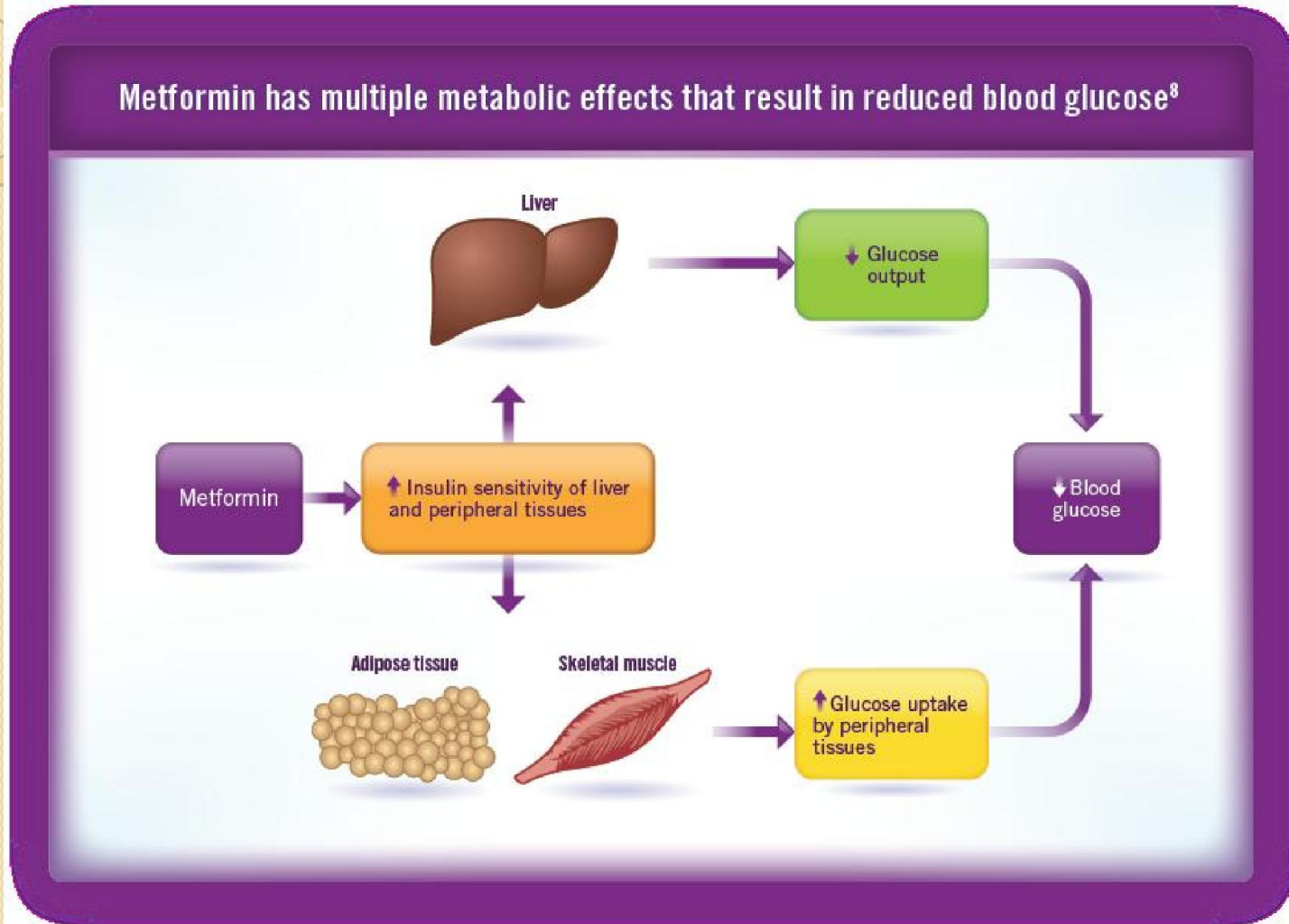


Zeitler et al. *Fig. 1.* Approach to initial and subsequent treatment of youth with type 2 diabetes.

TREATMENT - Metformin

- Metformin
 - Begin with 500 mg daily x 7 days
 - Titrate by 500 mg once a week
 - Maximum dose 2000 mg daily
 - 90% cases success with metformin monotherapy

Metformin Mechanism of Action

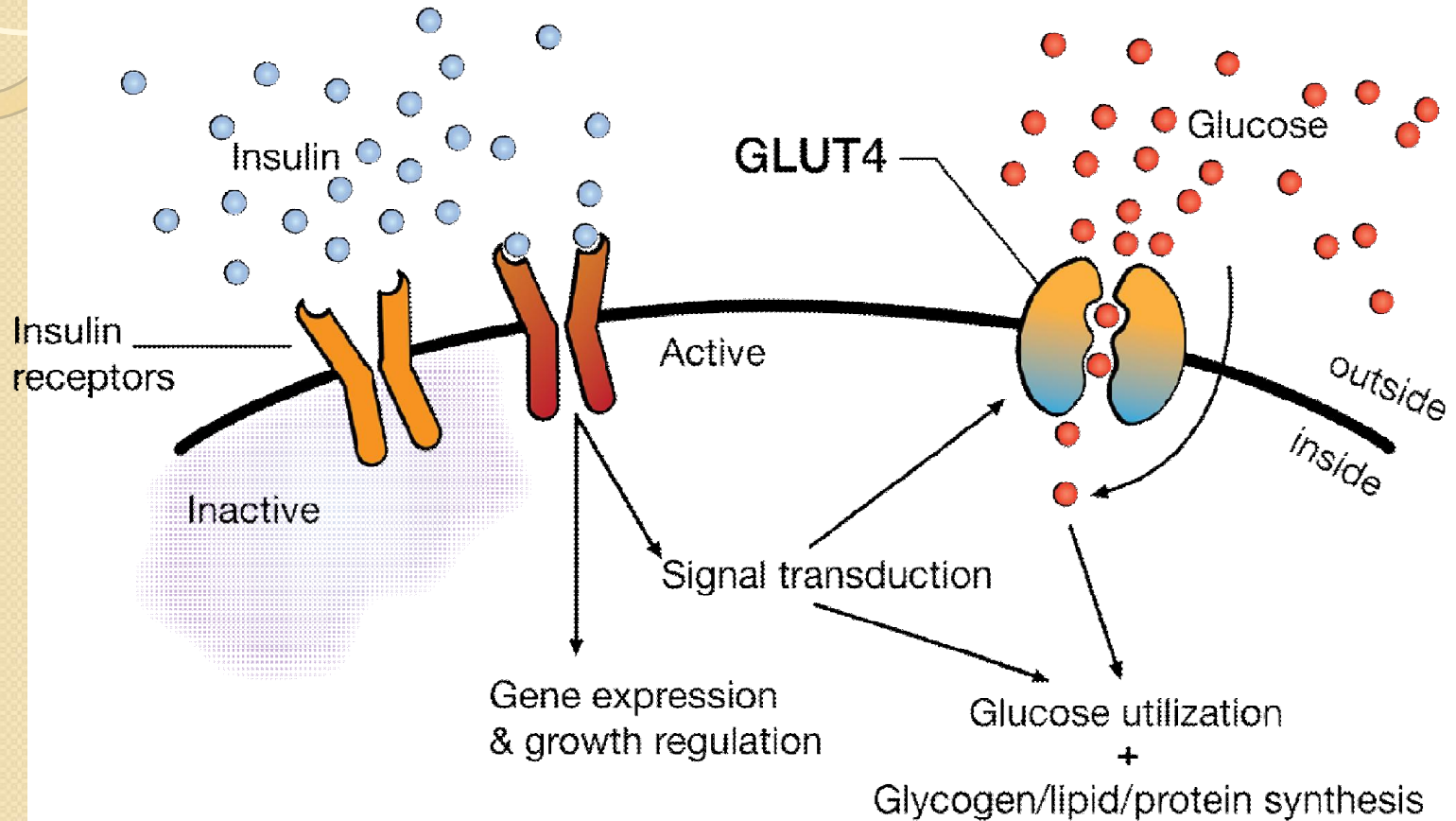


- Metformin

TREATMENT - Insulin

- Basal insulin
 - Begin with 0.25 – 0.5 IU/kg/day
 - Titrate to max 1.2 IU/kg/day
- Insulin + metformin: Improve insulin sensitivity
- Insulin → metformin monotherapy
 - Reduce insulin dose 30 – 50% AND
 - Increase metformin dose
 - Usually successful after 2 – 6 weeks

TREATMENT - Insulin



TREATMENT

- Subsequent treatment
 - Failing target HbA1c within 3-4m on metformin alone, addition of basal insulin
 - If metformin and basal insulin (up to 1.2IU/kg/d) fail → prandial insulin should be initiated and titrated to reach target HbA1c.
 - Limited studies of other pharmacologic agents and generally not approved.

Comorbidities & Complications

Comorbidites	When?	Result - Goal	Treatment
Nephropathy: Urine Albumin/Creatinin Ratio (ACR)	At the time of diagnosis 3 – 6 months there after	> 30 mg/g in a spot urine sample	ACEI/ARB, titrated every 3 months until ACR is normal
Blood pressure (Hypertension >95 th percentile: age, sex, height)	Every visit	<90 th percentile	Life style (Weight loss, Reduce salt intake, Excercise) ACEI /ARB ± CCB, Diuretic
Dyslipidemia	At the time of diagnosis Annually thereafter	LDL-C < 100mg/dL HDL-C > 35 mg/dL TG < 150 mg/dL	Statin Fibrate
Retinopathy	At the time of diagnosis Annually thereafter		
NAFLD (Non Alcoholic Fatty Liver Diseases)	At the time of diagnosis Annually thereafter	Elevated LEs	Refer to gastroenterology

Comorbidities & Complications

- Polycystic ovarian syndrome (PCOS)
- Systemic inflammation
- Obstructive sleep apnea
- Depression
- Additional health problems related to obesity and T2D: orthopedic problems, pancreatitis, cholecystitis, pseudotumor cerebri, deep tissue ulcers.

SCREENING for T2D in at-risk youth

- Undiagnosed T2D is very rare in the adolescent population.
- Generalized screening of obese youth is unlikely to be cost-effective in most population
- Clinical testing for dysglycemia in obese at-risk youth should occur in the setting of clinical assessment of obesity-related comorbidities (NAFLD, elevated TG, elevated BP) that are more prevalent than dysglycemia.

SCREENING for T2D in at-risk youth

Table 5—Testing for type 2 diabetes in asymptomatic children*

Criteria

- Overweight (BMI >85th percentile for age and sex, weight for height >85th percentile, or weight >120% of ideal for height)

Plus any two of the following risk factors:

- Family history of type 2 diabetes in first- or second-degree relative
- Race/ethnicity (Native American, African American, Latino, Asian American, Pacific Islander)
- Signs of insulin resistance or conditions associated with insulin resistance (acanthosis nigricans, hypertension, dyslipidemia, polycystic ovarian syndrome, or small-for-gestational-age birth weight)
- Maternal history of diabetes or GDM during the child's gestation

Age of initiation: age 10 years or at onset of puberty, if puberty occurs at a younger age

Frequency: every 3 years

REFERENCES

- ISPAD Clinical Practic Consensus Guideline 2014
- ADA Diabetes Mellitus Guideline 2014
- Uptodate: Epidemiology, presentation, and diagnosis of type 2 diabetes mellitus in children and adolescents