Type 2 Diabetes Mellitus in Family Medicine

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Objectives

- Risk factors
- Screening
- Diagnostic criteria
- History and physical exam
- Complications
- Management- nonpharmacological
- Prevention

Facts and Prevalence

- Serious and complex chronic condition with potentially devastating complications [1]
- 2015: estimated 9.3% of the Canadian population had diabetes and 22.1% had prediabetes [2]
- Prevalence of diabetes projected to increase by 44% from 2015 to 2025 [2]
- Leading cause of blindness, end stage renal disease and nontraumatic amputations in Canadian adults [1]
- CV disease is the leading cause of death in those with DM and occurs 2-4X more often than in those without DM [1]
- DM and its complications increase costs and service pressures on our publicly funded health care system [1]
- Fifty-seven percent of Canadians with diabetes reported they cannot adhere to prescribed treatment due to the high out-of-pocket cost of needed medications, devices and supplies. The average cost for these supports is >3% of income or >$1,500 [2]

1. Cheng, A. Canadian Diabetes Association 2013 Clinical Practice Guidelines for the Prevention and Management of Diabetes in Canada:. Can J Diabetes 2013;37(suppl 1):S1-S3.
2. Diabetes Canada. Diabetes statistics in Canada. http://www.diabetes.ca/how-you-can-help/advocate/why-federal-leadership-is-essential/diabetes-statistics-in-canada

Case

- Mr. Sugar is a 45 yr old caucasian male who presents to your office for a periodic health exam. His past medical history is significant for hypertension, for which he takes Ramipril 5 mg OD, and for obstructive sleep apnea, for which he uses cpap. He works for the federal government and finds his job busy and stressful. He is married with 2 young children. You review his family history and he mentions his mother was diagnosed at age 55 with diabetes. He is a non-smoker and rarely drinks EtOH. You ask him about diet, and he says as a family they try to eat healthy but do order take-out about twice/week. He says he is too busy between work and family to have time to exercise.

- ROS is negative for any symptoms of concern

- BP is 146/96 and his BMI is 30

Question

- What risk factors does Mr. Sugar have for diabetes?

Risk Factors

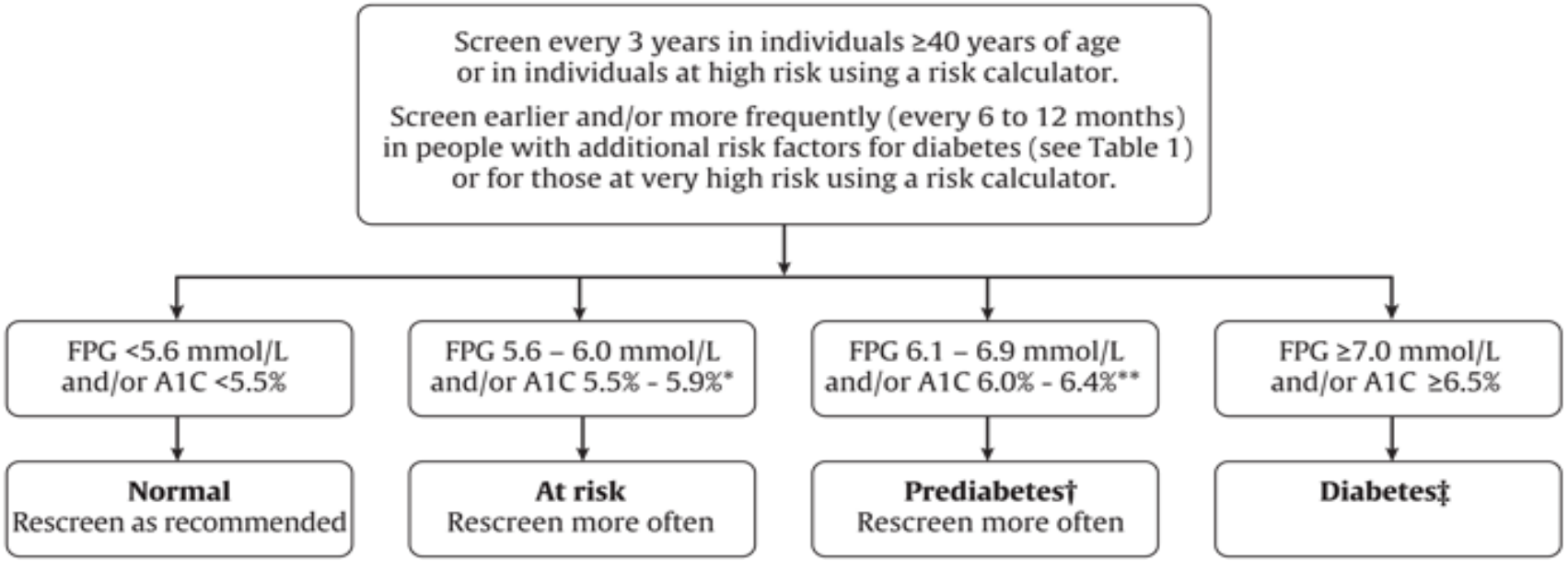
- **Age >= 40**
- **1st degree relative with DM2**
- **High risk population (Eg.. African, Arab, Asian, Hispanic, Indigenous or South Asian descent, low SES)**
- **History of prediabetes**
- **Gestational diabetes or macrosomic infant**
- **Presence of end organ damage associated with DM (micro or macrovascular)**
- **Presence of vascular risk factors**
  - **HDL-C <1.0 mmoL/L males, <1.3 mmol/L females, TG >= 1.7 mmol/L, Hypertension, Overweight, Abdominal obesity, smoking**
- **Presence of associated diseases**
  - **PCOS**
  - **History of pancreatitis**
  - **Acanthosis nigricans**
  - **Hyperuricemia/gout**
  - **Non alcoholic steatohepatitis**
  - **Psychiatric disorders (bipolar disorder, depression, schizophrenia)**
  - **HIV infection**
  - **OSA**
  - **CF**
- **Use of drugs associated with DM**
  - **Glucocorticoids, Statins, Atypical antipsychotics, HAART, anti-rejection drugs, other**
- **Other secondary causes**

Ekoe JM et al. *Diabetes Canada 2018 Clinical Practice Guidelines for the Prevention and Management of Diabetes in Canada*.

Case

- Mr. Sugar mentions he is worried about the possibility of having diabetes, given his mother's history.
- Given the number of risk factors he has, you decide it is important to screen him for diabetes.
- Which lab test(s) should you order?

Screening and diagnosis algorithm for type 2 diabetes



If both FPG and A1C are available, but discordant, use the test that appears furthest to the right side of the algorithm.

*Consider 75 g OGTT if ≥1 risk factors; ** Consider 75 g OGTT (see Tables 3 and 5 in the Definition, Classification and Diagnosis of Diabetes, Prediabetes and Metabolic Syndrome chapter, p. S10 for interpretation of 75 g OGTT).

†Prediabetes = IFG or A1C 6.0 to 6.4% (see Table 5 in the Definition, Classification and Diagnosis of Diabetes, Prediabetes and Metabolic Syndrome chapter, p. S10).

‡In the presence of symptoms of hyperglycemia, a single test result in the diabetes range is sufficient to make the diagnosis of diabetes. In the absence of symptoms of hyperglycemia, if a single laboratory test result is in the diabetes range, a repeat confirmatory laboratory test (FPG, A1C, 2hPG in a 75 g OGTT) must be done on another day. It is preferable that the same test be repeated (in a timely fashion) for confirmation, but a random PG in the diabetes range in an asymptomatic individual should be confirmed with an alternate test. If results of two different tests are available and both are above the diagnostic cut points the diagnosis of diabetes is confirmed.

A1C, glycated hemoglobin; *FPG*, fasting plasma glucose; *IFG*, impaired fasting glucose

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SCREENING & DIAGNOSIS

Who to screen and what do you screen with?

Screen every 3 years in individuals ≥40 years of age or in individuals at high risk using a risk calculator.

Screen earlier and/or more frequently in people with additional risk factors for diabetes or for those at very high risk using a risk calculator.

DIAGNOSIS OF PREDIABETES & DIABETES

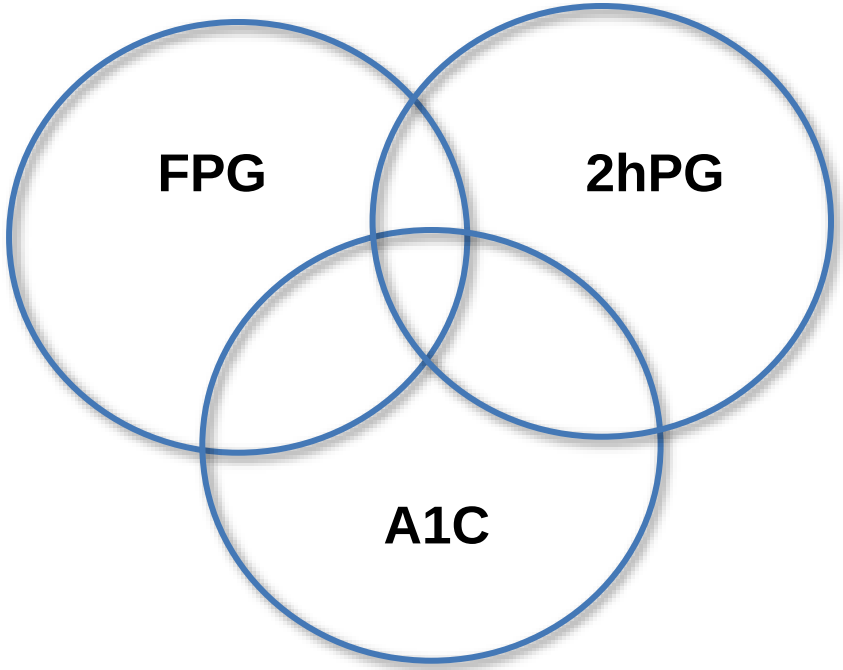
Test	Result	Dysglycemia category
FPG (mmol/L) No caloric intake for at least 8 hours	6.1 – 6.9	IFG
	≥7.0	Diabetes
2hPG in a 75 g OGTT (mmol/L)	7.8 – 11.0	IGT
	≥11.1	Diabetes
A1C (%) Standardized, validated assay, in the absence of factors that affect the accuracy of A1C and not for suspected type 1 diabetes	6.0 – 6.4	Prediabetes
	≥6.5	Diabetes
Random PG (mmol/L)	≥11.1	Diabetes

If asymptomatic, a repeat confirmatory test (FPG, A1C, or a 2hrPG in a 75 g OGTT) must be done. If symptomatic, diagnosis made, and begin treatment.

http://guidelines.diabetes.ca/screeninganddiagnosis/refguide

Diagnostic Testing With 3 Different Tests

Dealing with Discordance



- Many people identified as having diabetes using A1C will not be identified as having diabetes by traditional glucose criteria, and vice versa.
- When results of more than one test are available (amongst FPG, A1C, 2hPG in a 75-g OGTT) and the results are discordant, the test whose result is above diagnostic cut-point should be repeated, and the diagnosis made on basis of the repeat test.

Advantages and Disadvantages of Diagnostic Tests for Diabetes

Parameter	Advantages	Disadvantages
FPG	• Established standard • Fast and easy • Single sample • Predicts microvascular complications	• Sample not stable • High day-to-day variability • Inconvenient (fasting) • Reflects glucose homeostasis at a single point in time
2hPG in a 75 g OGTT	• Established standard • Predicts microvascular complications	• Sample not stable • High day-to-day variability • Inconvenient • Unpalatable • Cost
A1C	• Convenient (measure any time of day) • Single sample • Predicts microvascular complications • Better predictor of CVD than FPG or 2hPG in a 75 g OGTT • Low day-to-day variability • Reflects long-term glucose concentration	• Cost • Misleading in various medical conditions (e.g., hemoglobinopathies, iron deficiency, hemolytic anaemia, severe heaptic or renal disease) • Altered by ethnicity and aging • Standardized, validated assay required • Not for diagnostic use in children and adolescents** (as the sole diagnostic test), pregnant women as part of routine screening for gestational diabetes***, those with cystic fibrosis or those with susected type 1 diabetes

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A1C Level and Future Risk of Diabetes

A1C Category (%)	5-year incidence of diabetes
5.0-5.5	<5 to 9%
5.5-6.0	9 to 25%
6.0-6.5	25 to 50%

Zhang X et al. *Diabetes Care*. 2010;33:1665-1673.

*The combination of an FPG of 6.1 to 6.9 mmol/L and an A1C of 6.0% to 6.4% is predictive of 100% progression to type 2 diabetes over a 5-year period

Heianza Y, Arase Y, Fujihara K, et al. Diabet Med 2012;29:e279–85

Case

- You get the results of Mr. Sugar's bloodwork a few days later

- FPG: 6.3
- A1C 5.9

- What test would you order now?

- What is his diagnosis?

Prevention of diabetes

- Lifestyle modifications
  - Diabetes Prevention Study and Diabetes Prevention Program
  - In those with IGT, dietary modification targeted a low-calorie, low-fat, low-saturated fat, high-fibre diet and moderate-intensity physical activity of at least 150 minutes per week resulted in a moderate weight loss of approximately 5% of initial body weight. In both studies, the risk reduction for diabetes was 58% at 4 years

- Pharmacotherapy
  - Metformin- ~30% reduction
  - Others studied: acarbose, liraglutide, TZDs, orlistat

Recommendations for Prevention in those with Prediabetes

- structured program of healthy behaviour interventions that includes moderate weight loss and regular physical activity of a minimum of 150 minutes per week over 5 days a week should be implemented to reduce the risk of type 2 diabetes

- dietary patterns may be used to reduce the risk of diabetes, specifically: Mediterranean-style , DASH (Dietary Approaches to Stop Hypertension), AHEI (Alternate Healthy Eating Index)

- pharmacologic therapy with metformin may be used to reduce the risk of type 2 diabetes

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Case

- 2 years later Mr. Sugar presents for his PHE
- Life has been busy and he hasn’t had time to make any of the lifestyle changes you discussed in past visits
- ROS: fatigue, new urinary frequency, difficulty with maintaining erections
- Knowing he already has prediabetes, you’re concerned this may have progressed now to diabetes.

Diabetes- History

- What do you want to ask him about?

Case

- You send Mr. Sugar for bloodwork

- His HbA1C: 7.2
- What is the diagnosis?

- You see him again to review the diagnosis, perform a relevant physical exam and counsel.

Diabetes Focused Physical Exam

- What physical examination should be included?

Diabetes: complications

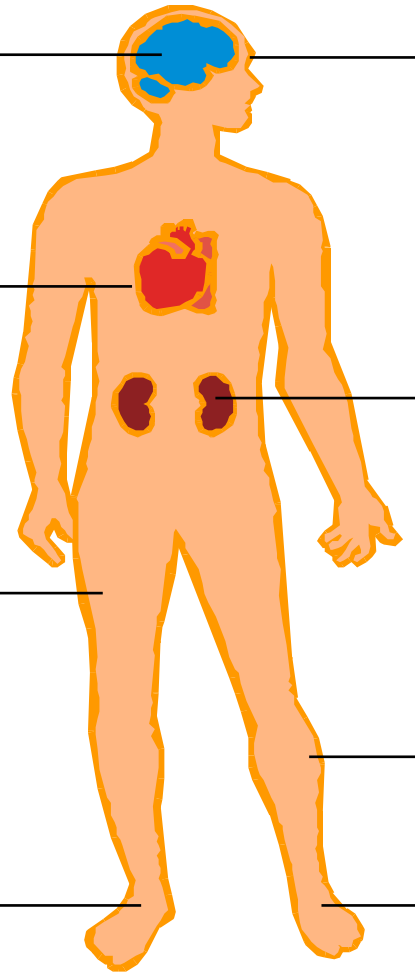
MACROvascular

Stroke

Heart disease & hypertension

Peripheral vascular disease

Foot problems



MICROvascular

Diabetic eye disease (retinopathy & cataracts)

Nephropathy

Neuropathy

Foot problems

Waist Circumference

- Place a tape measure around your bare abdomen just above the iliac crest.
- Be sure that the tape is snug, but does not compress skin, and is parallel to the floor.
- Measure at the end of exhalation.

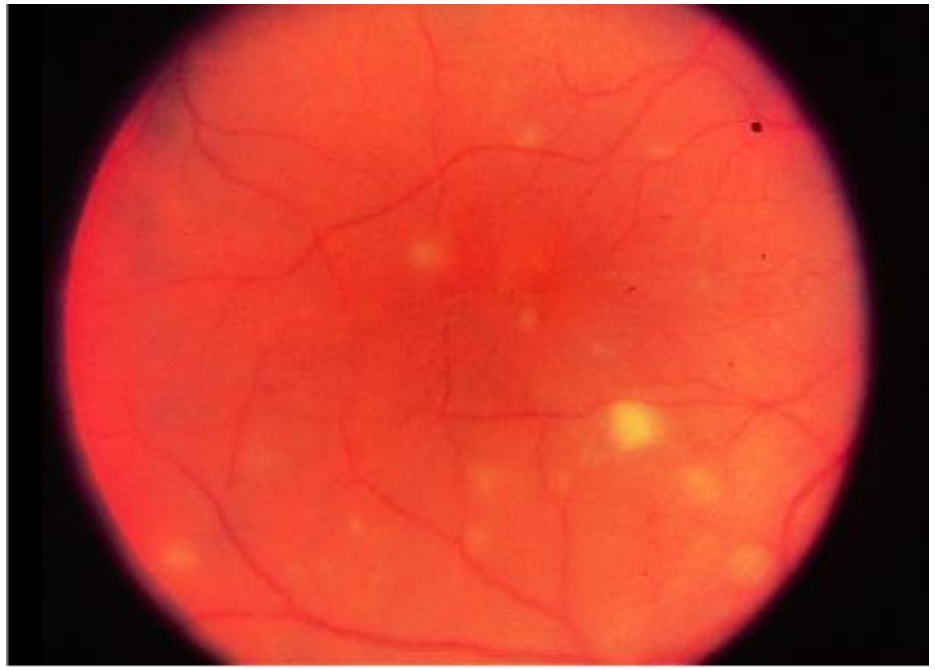
- 

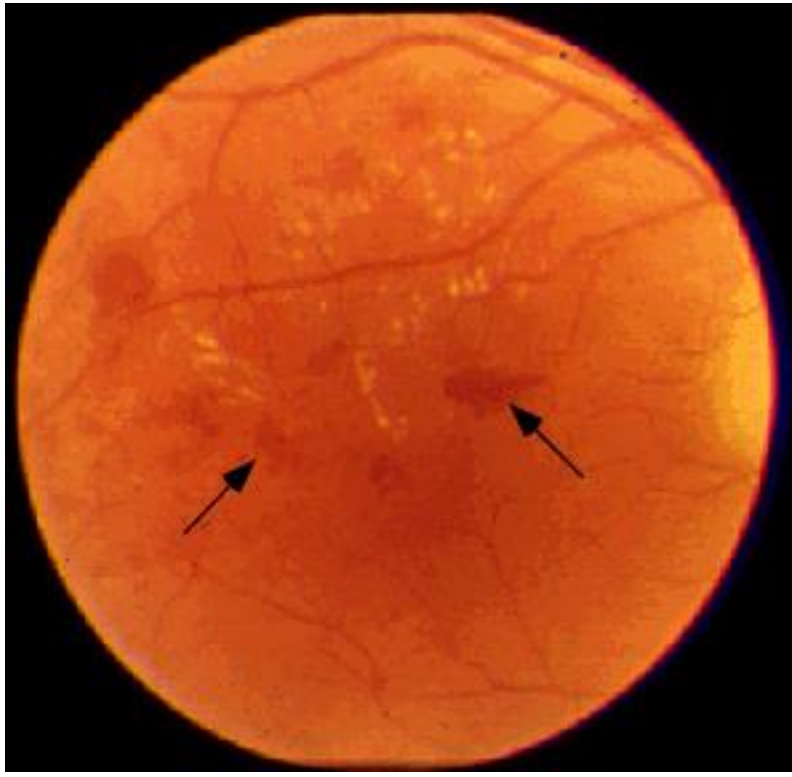

Central Obesity

International Diabetes Federation classification

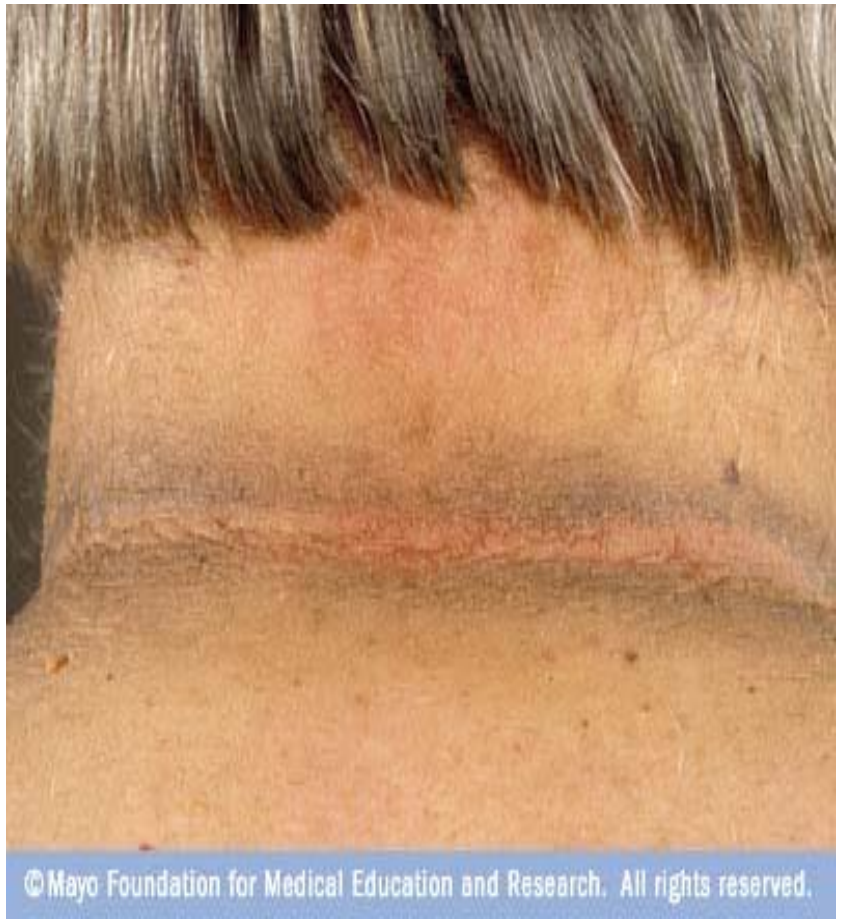
- Waist circumference
- Europids Men ≥94 cm; women ≥80 cm
- South Asians Men ≥90 cm; women ≥80 cm
- Chinese Men ≥90 cm; women ≥80 cm
- Japanese Men ≥90 cm; women ≥80 cm
- Ethnic South and Central Americans, First Nations: Use South Asian recommendations until more specific data are available
- Sub-Saharan Africans, Eastern Med, Arabic: Use European data until more specific data are available

Diabetic Retinopathy



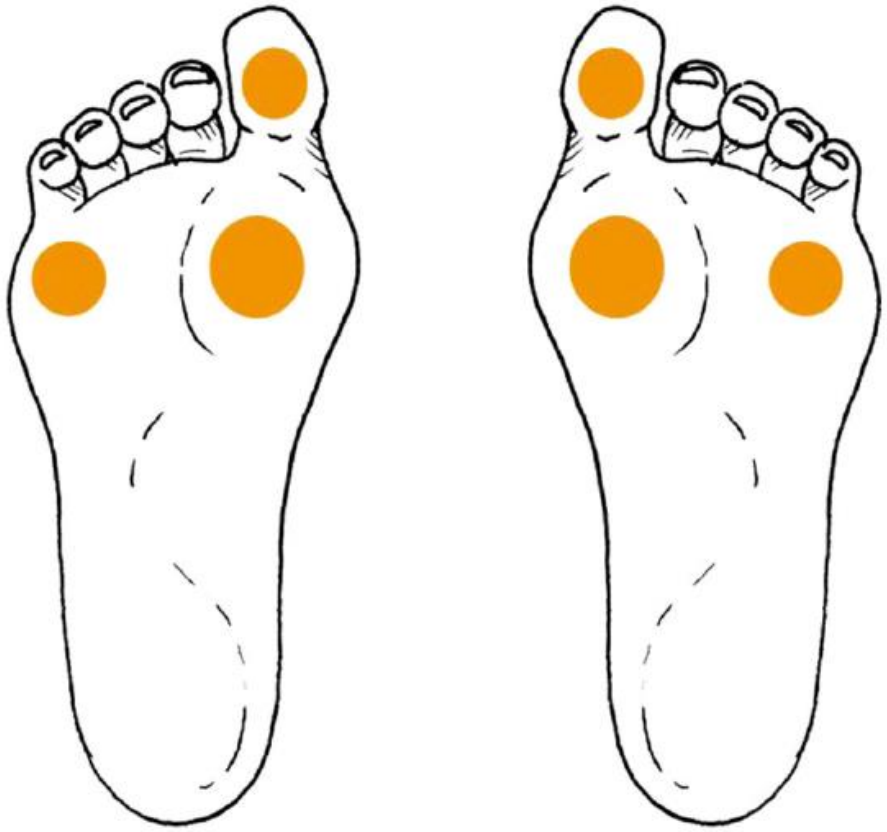


Acanthosis Nigrans



Diabetic Foot Ulcer

Screening for Protective Sensation Using The 10 gram Monofilament



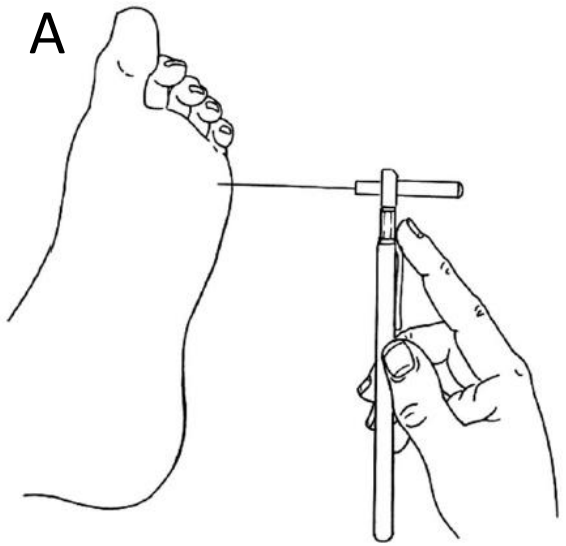
How to perform the sensory examination:

- Conduct in a quiet and relaxed setting.
- Begin by applying the monofilament to the hands, elbow or forehead so that patient what to expect.
- Ensure that the patient can not see whether or where the monofilament is being applied.
- Test the three sites on both feet shown in the figure.

Modified from: Schaper NC, Van Netten JJ, Apelqvist J, Lipsky BA, Bakker K; International Working Group on the Diabetic Foot. Prevention and management of foot problems in diabetes: A Summary Guidance for Daily Practice 2015, based on IWGDF Guidance Documents. Diabetes Metab Res Rev 2016;32 Suppl 1:7-15

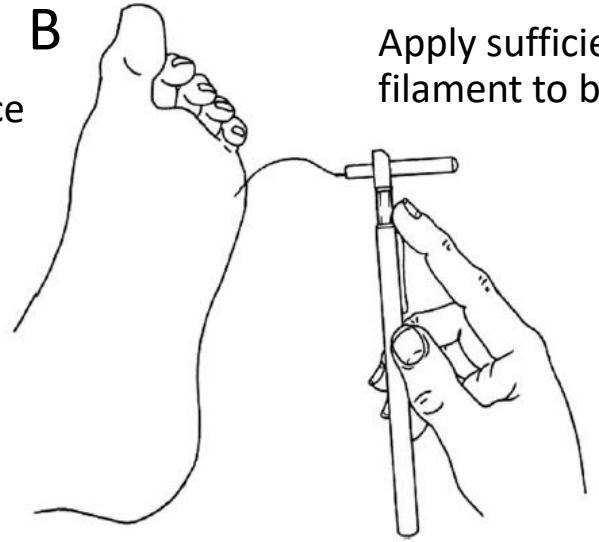
Screening for Protective Sensation Using The 10 gram Monofilament

A



Apply the monofilament perpendicular to the skin surface

B



Apply sufficient force to cause the filament to bend or buckle

How to Apply the monofilament:

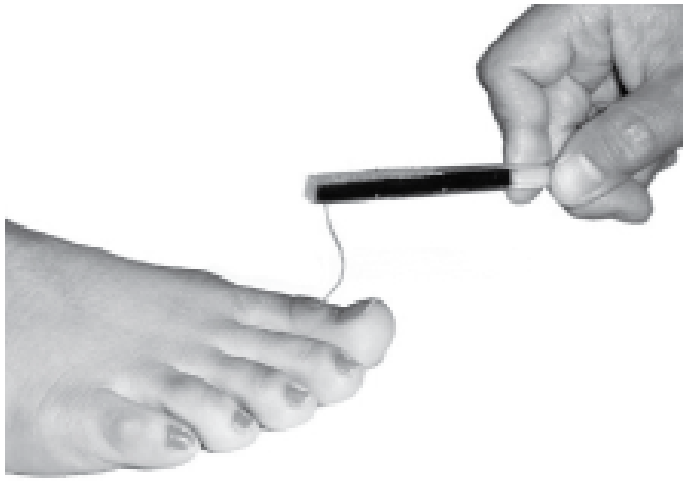
- Repeat the application twice at the same site, but alternate the application with at least one ‘mock’ application in which no filament is applied (total three questions per site).
- Protective sensation is present at each site if the patient correctly answers two out of three applications. Incorrect answers – the patient is then considered to lack protective sensation and is at risk of foot ulceration.

Modified from: Schaper NC, Van Netten JJ, Apelqvist J, Lipsky BA, Bakker K; International Working Group on the Diabetic Foot. Prevention and management of foot problems in diabetes: A Summary Guidance for Daily Practice 2015, based on IWGDF Guidance Documents. Diabetes Metab Res Rev 2016;32 Suppl 1:7-15

Rapid Screening for Diabetic Neuropathy Using the 10 g Semmes-Weinstein Monofilament

Rapid Screening for Diabetic Neuropathy Using the 10-g Semmes-Weinstein Monofilament

1. Show the 10-g Semmes-Weinstein monofilament to the patient.
2. Touch it first to the patient's forehead or sternum so that the sensation is understood.
3. Instruct the patient to say "yes" every time the monofilament stimulus is perceived.
4. With the patient's eyes closed, apply the monofilament to the dorsum of the great toe proximal to the nail bed as shown in the illustration below. Use a smooth motion-touch the skin, bend the filament for a full second, then lift from the skin.



5. Perform this stimulus 4 times per foot in an arrhythmic manner so the patient does not anticipate when the stimulus is to be applied.
6. For each of the 8 stimuli, assign a score of 0 if it is not perceived, 0.5 if it is substantially less than that perceived on the forehead or sternum, and 1 if it is perceived normally. A score of 3 out of 8 correct responses means that the presence of neuropathy is likely. A score of 3.5 to 5 means that the risk of new onset neuropathy in the next four years is high. A score of 5.5 or greater indicates that there is a low risk of neuropathy onset in the next four years.

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Case

- You have a discussion with Mr. Sugar about pharmacologic vs. nonpharmacologic management of his diabetes

Individualized goal setting

Potential Self-management Goals	Examples
Eat healthier	See a dietitian to help develop a healthy eating plan.
Be more active	Increase physical activity with the goal of getting to 150 minutes aerobic activity/week and resistance exercise 2-3 times/week. Choose physical activity that meets preferences/needs.
Lose weight	Use strategies (e.g., reduce calories or portions) to lose 5-10% of initial weight.
Take medication regularly	Taking medication will help to improve symptoms and take control of your life. Consider using a pillbox or setting a timer.
Avoid hypoglycemia	Recognize the signs of hypoglycemia and take action to prevent it.
Check blood glucose	Establish a routine and act accordingly.
Check feet	Do a daily self-check and follow-up with a health-care provider if anything is abnormal.
Manage stress	Screen for distress (depressive and anxious symptoms) by interview or a standardized questionnaire (e.g. PHQ-9 www.phqscreeners.com).
Reduce or stop smoking	Identify barriers to quitting and develop a plan to address each of these.

Case

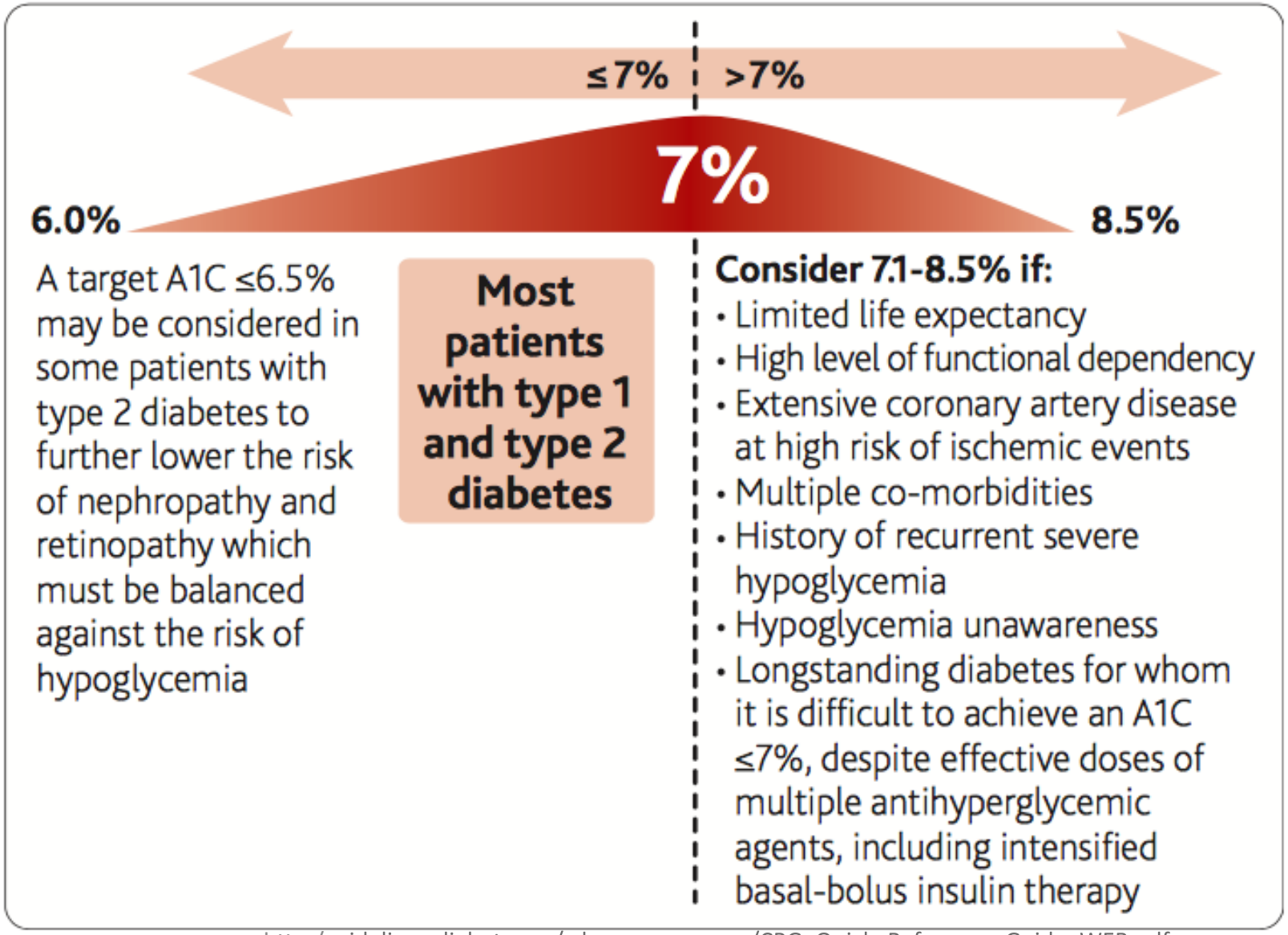
- He decides he wants to try and implement lifestyle changes in the next 3 months rather than start medication right away
- He is agreeable to you referring him to a Diabetes Education program
- He asks you how we'll know if the changes he makes are working

Is it all working?

- **Targets**:

- HBA1C: 7 %
- AC BS: 4-7
- PC BS: 5-10 (5-8)
- Lipids: LDL < 2
- BP: <130/80

WHAT A1C SHOULD I TARGET?



http:/guidelines.diabetes.ca/cdacpg_resources/CPG_Quick_Reference_Guide_WEB.pdf

ABCDES of diabetes care

		GUIDELINE TARGET (or personalized goal)
A	**A1C** targets	A1C ≤7.0% (or ≤6.5% to ↓ risk of CKD and retinopathy) If on insulin or insulin secretagogue, assess for hypoglycemia and ensure driving safety
B	**BP** targets	BP <130/80 mmHg If on treatment, assess for risk of falls
C	**Cholesterol** targets	LDL-C <2.0 mmol/L (or >50 % reduction from baseline)
D	**Drugs** for CVD risk reduction	ACEi/ARB (if CVD, age ≥55 with risk factors, OR diabetes complications) Statin (if CVD, age ≥40 for type 2, OR diabetes complications) ASA (if CVD) SGLT2i/GLP1ra with demonstrated CV benefit (if have type 2 with CVD and A1C not at target)
E	**Exercise** goals and healthy eating	150 minutes of moderate to vigorous aerobic activity/ week and resistance exercises 2-3 times/week Follow healthy dietary pattern (eg Mediterranean diet, low glycemic index)
S	**Screening** for complications	Cardiac: ECG every 3-5 years if age >40 OR diabetes complications Foot: Monofilament/Vibration yearly or more if abnormal Kidney: Test eGFR and ACR yearly, or more if abnormal Retinopathy: type 1 - annually; type 2 - q1-2 yrs
S	**Smoking** cessation	If smoker: Ask permission to give advice, arrange therapy and provide support
S	**Self-management,** stress, other barriers	Set personalized goals (see "individualized goal setting" panel) Assess for stress, mental health and financial or other concerns that might be barriers to achieving goals

Educational grant funding for this resource was provided in part by AstraZeneca, Boehringer-Ingelheim Canada /Eli Lilly Canada Alliance, and Novo Nordisk Canada Inc. Diabetes Canada thanks these organizations for their commitment to diabetes in Canada.

Sample Diabetes Patient Care Flow Sheet For Adults

Name:	Type of diabetes: Type 1 ☐ Type 2 ☐ Other ☐	Date of birth:	Date of Diagnosis:

Risk factors, co-morbidities

☐ Hypertension ☐ Dyslipidemia ☐ Coronary Artery Disease (CAD)
☐ Peripheral Artery Disease ☐ Chronic Kidney Disease
☐ Mental health diagnosis ☐ Polycystic Ovarian Syndrome
☐ Foot disease ☐ Erectile Dysfunction
☐ Smoking _____ (Date stopped)
☐ Alcohol: _____ (Assess/discussed)

Vaccinations

Flu (annual) Date: _____ Date: _____
Pneumococcus Date: _____

Self-management (discuss with patient add date and location in chart)

Patient Goals: _____
Possible Barriers to Self–management: _____
Diabetes Self-management Education: _____
☐ Weight management:
Ht: _____ Target Wt: _____ Target BMI: _____
☐ Physical activity (aerobic 150 min/week; resistance 2-3 times/week)
☐ Glucose meter/lab comparison
☐ Patient Care Plan (Pregnancy Planning/ Driving License):
_____ date discussed

Visits (Every 3 to 6 months)

Date	BP	Weight	A1C Target ≤7% or _____	Notes (Goals, clinical status)	Hypo-glycemia	Antihyperglycemic Agents / CV protection agents (ACEi / ARB / Statin / ASA as indicated*)

Review SMBG records. Target: pre-prandial 4-7 mmol/L; 2-hour post-prandial 5-10 mmol/L (5-8 mmol/L if A1C not at target)

Screen for diabetes complications annually or as indicated

Nephropathy

Date	ACR	eGFR

Neuropathy

- Check feet for lesions and sensation (10-g monofilament or 128 Hz tuning fork)
- Check for pain, ED, GI symptoms

Date: _____ Findings: _____
Date: _____ Findings: _____
Date: _____ Findings: _____

Retinopathy

Annual eye exam:
Date: _____
Date: _____

Ophthalmologist/
Optometrist:

***For vascular protection:**

☐ Statins if ≥40 yrs OR >30 yrs and >15 yrs duration OR end organ damage
☐ ACEi/ARB if ≥55 yrs OR end organ damage (even in the absence of hypertension)

Lipids Targets: If indicated to treat LDL-C ≤2 mmol/L

Date	Medication	LDL-C	HDL-C	TG	(Non-HDL-C)	(Apo B)

CAD Assessment

ECG: _____
Stress ECG: _____
Other: _____

Helping prevent complications

- DM confers a significantly increased risk of CVD (CAD, PVD, CVA)- 2-4 fold higher than those without DM

- For most >40 yo with DM, 10 year and lifetime risk of CVD is high (>20%)- → health behaviour modification and pharmacologic interventions

Which cardiovascular protection medications are indicated for my patient?

Does the patient have cardiovascular disease? YES - Cardiac ischemia (silent or overt) - Peripheral arterial disease - Cerebrovascular/carotid disease	**Statin[1]** + **ACEi/ARB[2]** + **ASA[3]**
AND if the patient is NOT at glycemic target ADD NO	**Liraglutide, Empagliflozin** or **Canagliflozin[4]** (*only* for patients with type 2 diabetes)
Does the patient have microvascular disease? YES - Retinopathy - Kidney disease (ACR ≥2.0) - Neuropathy NO **Is the patient:** - age ≥55 with additional CV risk factors? YES	**Statin[1]** + **ACEi/ARB[2]**
- age ≥40? - age ≥30 and diabetes >15 years? - warranted for statin therapy based on the Canadian Cardiovascular Society Lipid Guidelines? YES	**Statin[1]**

1 Dose adjustments or additional lipid therapy warranted if lipid target (LDL-C <2.0 mmol/L) not being met.

2 ACE-inhibitor or ARB (angiotensin receptor blocker) should be given at doses that have demonstrated vascular protection (eg. perindopril 8 mg once daily [EUROPA trial], ramipril 10 mg once daily [HOPE trial], telmisartan 80 mg once daily [ONTARGET trial]).

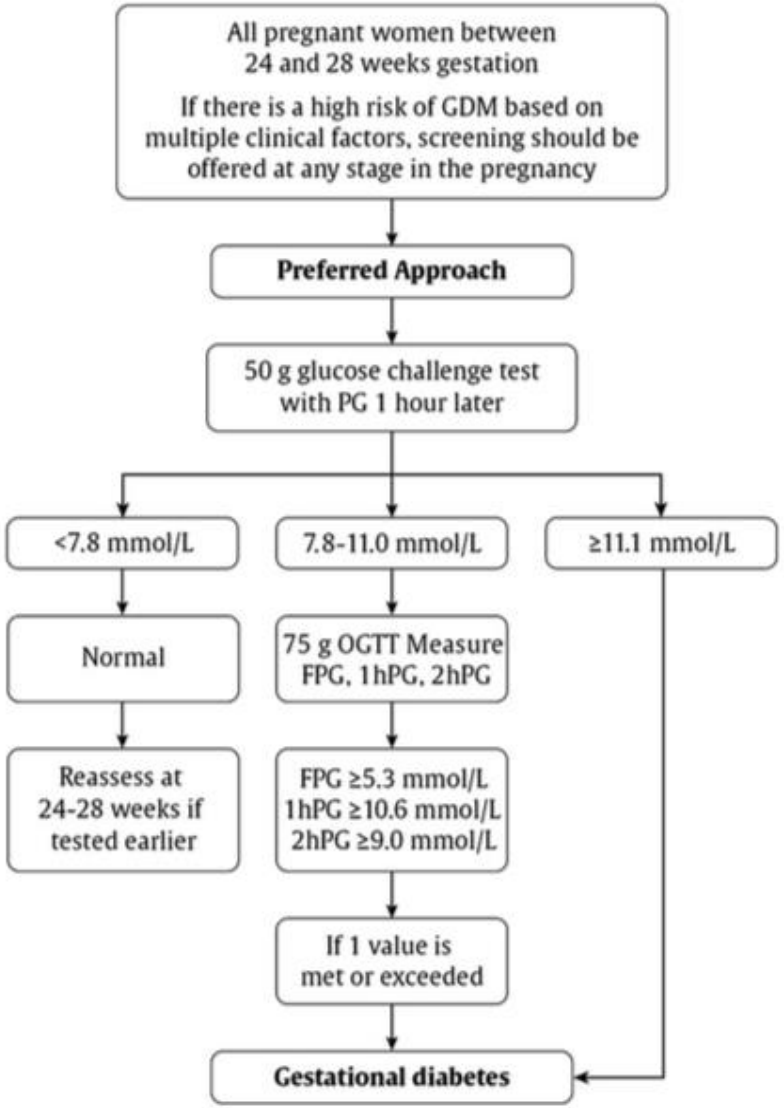
3 ASA should not routinely be used for the primary prevention of cardiovascular disease in people with diabetes. ASA may be used for secondary prevention. Consider clopidogrel if ASA-intolerant.

4 Canagliflozin: avoid in people with prior lower extremity amputation.

Case: 32 yo pregnant woman

- Gestational diabetes- why is this important?
- Multiple associated adverse outcomes on pregnancy:
  - miscarriage, congenital anomalies
  - macrosomia, operative delivery, preeclampsia, hydramnios, fetal organomegaly, maternal and infant birth trauma, perinatal mortality, neonatal respiratory problems and metabolic complications

Case: 32 yo pregnant woman



Case: 13 yo boy with obesity

- Screening for type 2 diabetes should be considered every 2 years using a **combination of an A1C and a FPG or random plasma glucose** in children and adolescents with any of the following conditions:
- ≥3 risk factors in nonpubertal children beginning at 8 years of age or ≥2 risk factors in pubertal children [Grade D, Consensus]. Risk factors include:
  - Obesity (BMI ≥95th percentile for age and gender)
  - Member of a high-risk ethnic group (e.g. African, Arab, Asian, Hispanic, Indigenous or South Asian descent)
  - First-degree relative with type 2 diabetes and/or exposure to hyperglycemia in utero
  - Signs or symptoms of insulin resistance (including acanthosis nigricans, hypertension, dyslipidemia, NAFLD [ALT >3X upper limit of normal or fatty liver on ultrasound])
- PCOS
- IFG and/or IGT
- Use of atypical antipsychotic medications

Case: 88 yo with dementia and diabetes

- Functionally independent older pt with life expectancy of > 10 years -treat to achieve the same targets as younger pt with DM
- In older pt with DM and multiple comorbidities and/or frailty- goal to prevent hypoglycemia- consider choice of antihyperglycemic therapy and less stringent A1C target
- Antihyperglycemic agents that increase the risk of hypoglycemia or have other side effects - discontinue
- A higher A1C target may be considered in older people with diabetes taking antihyperglycemic agent(s) with risk of hypoglycemia, with any of the following
  - Functionally dependent: 7.1–8.0%
  - Frail and/or with dementia: 7.1–8.5%
  - End of life: A1C measurement not recommended. Avoid symptomatic hyperglycemia and any hypoglycemia

References and resources

- Diabetes Canada Clinical Practice Guidelines Expert Committee. *Diabetes Canada 2018 Clinical Practice Guidelines for the Prevention and Management of Diabetes in Canada*. Can J Diabetes. 2018;42(Suppl 1):S1-S325.