Learning Objectives

• List the criteria needed to diagnose diabetes mellitus type 2 (DM2).

• Demonstrate the ability to perform an appropriate physical exam in the context of DM2 and its complications.

• Discuss the non-pharmacological approach to diabetes management.

• Discuss primary cardiovascular prevention for diabetics.

• Explain the importance of monitoring for complications of DM2.

• Discuss a multidisciplinary approach to the management of DM2.

• Perform and interpret glucometer testing.

• Perform and interpret monofilament testing.
Learning Objectives for Diabetes Pharmacology Lecture (coming up next)

• Discuss the mechanism of action of oral hypoglycemic medications and their use.
• Discuss insulin use and its mechanism of action.
CASE 1

- Katie is a 41-year-old woman who presents to your family medicine office for a “check up”.
- She tells you that she has not seen a doctor in the past 2 years because she feels well, however, she recently found out her mother was diagnosed with diabetes and worries that she may also be diabetic.

What would you like to ask Katie?
History of Presenting Illness?
Past Medical History?
Family History?
Medications?
Social History?
Summary of Risk Factors for DM2

- Age ≥40 years
- First-degree relative with type 2 diabetes
- Member of high-risk population (e.g., African, Arab, Asian, Hispanic, Indigenous or South Asian descent, low socioeconomic status)
- History of prediabetes (IGT, IFG or A1C 6.0–6.4%)*
- History of GDM
- History of delivery of a macrosomic infant
- Presence of end organ damage associated with diabetes:
  - Microvascular (retinopathy, neuropathy, nephropathy)
  - CV (coronary, cerebrovascular, peripheral)
- Presence of vascular risk factors:
  - HDL-C <1.0 mmol/L in males, <1.3 mmol/L in females*
  - TG ≥1.7 mmol/L*
  - Hypertension*
  - Overweight*
  - Abdominal obesity*
  - Smoking
- Presence of associated diseases:
  - History of pancreatitis
  - Polycystic ovary syndrome*
  - Acanthosis nigricans*
  - Hyperuricemia/gout
  - Non-alcoholic steatohepatitis
  - Psychiatric disorders (bipolar disorder, depression, schizophrenia†)
  - HIV infection‡
  - Obstructive sleep apnea§
  - Cystic fibrosis
- Use of drugs associated with diabetes:
  - Glucocorticoids
  - Atypical antipsychotics
  - Statins
  - Highly active antiretroviral therapy‡
  - Anti-rejection drugs
  - Other (see Appendix 1)
- Other secondary causes (see Appendix 1)
Back to Katie

- Katie is asymptomatic and she is not on any meds
- Her past medical history is significant for gestational diabetes (diet controlled) and her family history is significant for diabetes in her mother
- She has a sedentary job and finds it hard to make time for exercise between work and being a single mom to her 3yo daughter
- She often buys her meals since it’s quick and easy.

What physical examination should you do?
Physical Examination
Waist Circumference

• Place a tape measure around patient’s 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
Acanthosis Nigricans
• Katie’s physical exam reveals a BMI of 33, waist circumference of 89cm, and BP of 144/91mmHg.
• The remainder of her physical examination is normal.

What would you like to do next?
Investigations
## Advantages and Disadvantages of Diagnostic Tests for Diabetes

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

- FPG = 9.0 mmol/L
- TC = 6.8 mmol/L
- LDL = 3.6 mmol/L
- TGs = 2.0 mmol/L
- HDL = 1.2 mmol/L
- Cr = 75 umol/L
- eGFR > 90
- Urine ACR normal
- ECG normal

Does Katie have Diabetes?

What about metabolic syndrome?
Diagnostic Criteria for DM2

- HbA1c ≥ 6.5%
- FPG ≥ 7 mmol/L
- OGTT ≥ 11.1 mmol/L
- RPG ≥ 11.1 mmol/L
Diagnostic Criteria for PREdiabetes

- HbA1C = 6.0-6.4%
  - Prediabetes
- FPG = 6.1-6.9 mmol/L
  - Impaired fasting glucose (IFG)
- OGTT = 7.8-11.0 mmol/L
  - Impaired glucose tolerate (IGT)
Diagnostic Criteria for Metabolic Syndrome

- WHO criteria:
- DM, IFG or IGT + 2 of following:
  - BP > 140/90 mmHg
  - TG > 1.7 mmol/L
  - HDL < 0.9 mmol/L in men or < 1.0 mmol/L in women
  - WC > 102 cm in men and > 88 cm in women
Katie’s results

- FPG = 9.0 mmol/L
- TC = 6.5 mmol/L
- LDL = 3.6 mmol/L
- TGs = 2.0 mmol/L
- HDL = 0.9 mmol/L
- ratio TC/HDL = 7.2

= Diabetes?  
(need to confirm)

= Metabolic Syndrome
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.
Figure 1
Screening and diagnosis algorithm for type 2 diabetes.

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 (every 6 to 12 months) in people with additional risk factors for diabetes (see Table 1) or for those at very high risk using a risk calculator.

- FPG < 5.6 mmol/L and/or A1C < 5.5%
  - Normal
  - Rescreen as recommended

- FPG 5.6 - 6.0 mmol/L and/or A1C 5.5% - 5.9%
  - At risk
  - Rescreen more often

- FPG 6.1 - 6.9 mmol/L and/or A1C 6.0% - 6.4%
  - Prediabetes
  - Rescreen more often

- FPG ≥ 7.0 mmol/L and/or A1C ≥ 6.5%
  - 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
Back to Katie (3)

- Katie’s repeat FPG is **8.8 mmol/L**
- You diagnose her with DM2 (and metabolic syndrome)
- She is sad about this news, but says she is not surprised since she had diabetes during pregnancy
- She wishes that she kept her good eating habits that she developed during her pregnancy but says life got chaotic after having her baby and having to go back to work
- She tells you she is afraid of needles and hopes that she won’t have to start insulin

**What advice would you give Katie regarding management of DM2?**
Management

• Non Pharmacological
  • Eating Habits
  • Physical activity guidelines (150 minutes mod-intense activity per week, spread over at least 3 non-consecutive days)
  • Resistance exercises
  • Refer to Diabetes Education Program (dietician + nurse)
  • Stress test if sedentary and high risk for CAD
  • Routine diabetic follow-up visits

• Pharmacological – see “Diabetes Pharmacology Lecture”
  • Oral hypoglycemics, insulin
  • Statin, ACEI/ARB
Back to Katie (4)

- Katie returns to your office after 3 months
- She tells you that she met with the dietician and has modified her diet to include less fast-food
- She also started taking her daughter out on walks in her stroller at least 3 times a week for 30mins each time
- On exam, she has lost 5lbs and her BP is slightly better at 134/83mmHg
- She really hopes to avoid medications so she is eager to see her blood work results
Back to Katie (5)

You review her most recent lab results with her:

- FPG = 5.5 mmol/L
- HbA1c = 6.3%
- TC = 5.6 mmol/L
- LDL = 2.8 mmol/L
- TG = 1.7 mmol/L
- HDL = 1.1 mmol/L
- ratio TC/HDL = 5.1

Is she at target?
Does she need medications?
Treatment Targets

- HbA1C: ≤7.0%
- Fasting PG: 4-7 mmol/L
- 2hr PG: 5-10 mmol/L
- Lipids:
  - LDL < 2.0 mmol/L
  - ratio TC/HDL <4
- BP: <130/80mmHg
Is she at target?

- BP = 134/83  no
- FPG = 5.5    yes
- HbA1c = 6.3% yes
- LDL = 2.8    no
- ratio TC/HDL = 5.1 no
You praise Katie for her improved glycemic control and wt loss
Her BP and lipid profile have also improved, but you explain that there are tighter cutoffs for patients with DM2 and suggested pharmacotherapy (e.g. ACEI and/or statin)
Katie tells you she really does not want to take medications on a daily basis and that she does not have insurance to help her pay for prescriptions drugs
She feels motivated to continue with lifestyle modifications and weight loss to continue managing her diabetes, HTN, and dyslipidemia
She will follow-up with you again in 3 months with repeat blood work and has an appointment for an eye exam next month
CASE 2

- Mr. Sharma is a 59-year-old South Asian gentleman who is seeing you for his routine diabetic visit.

What do you want to ask him?

What physical examination should you do?
History
Physical Exam
Diabetes: complications

MACROvascular
- Stroke
- Heart disease & hypertension
- Peripheral vascular disease

MICROvascular
- Diabetic eye disease (retinopathy & cataracts)
- Nephropathy
- Neuropathy
- Foot problems
Fundoscopy – diabetic retinopathy
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.

Screening for Protective Sensation Using The 10 gram Monofilament

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.

Mr. Sharma feels well and denies any symptoms

His PMHx is significant for:

- CAD
- HTN
- Dyslipidemia
- Erectile dysfunction

He reports good compliance with:

- Metformin 1000mg BID
- Bisoprolol 2.5mg daily
- ASA 81mg daily
- Ramipril 5mg daily
- Atorvastatin 40mg daily
Back to Mr. Sharma (2)

• He quit smoking 4 years ago following his first heart attack and tries to exercise 150 minutes/week but finds this hard to do with his job as a truck driver.

• He admits that he does not check his blood sugar at home but denies any hypoglycemic episodes.

• He had his annual eye exam last month and it was reported as normal.
Back to Mr. Sharma (3)

- On exam, his BMI is 30, WC is 92cm, and BP is 140/90.
- His feet have decreased sensation to monofilament testing and his nails are gryphotic and discoloured
- You review his most recent lab results with him
  - HbA1c = 7.3%
  - Random glucose (using glucometer in office) = 12.0
  - LDL = 2.7, TC/HDL = 5.2
  - Urine ACR normal

What do you think about his diabetes control?
Treatment Targets

- HbA1C: <7.0%
- Fasting PG: 4-7mmol/L
- 2hr PG: 5-10mmol/L
- Lipids:
  - LDL < 2.0 mmol/L
  - ratio TC/HDL <4
- BP: <130/80 mmHg
Back to Mr. Sharma (4)

• BMI and WC = obesity
• HbA1c above target
• Random blood sugar above target
• BP above target
• Lipid profile above target

How would you counsel him?
Management
THANK YOU!

QUESTIONS?
### Useful Links / Resources

- **Diabetes Canada 2018 guidelines**  
  - [https://guidelines.diabetes.ca/cpg](https://guidelines.diabetes.ca/cpg)

- **SLM on Diabetes**  
  - [https://curriculum.med.uottawa.ca/eng/year3/clerkship/diabetes_mellitus_type2/](https://curriculum.med.uottawa.ca/eng/year3/clerkship/diabetes_mellitus_type2/)

- **Video on Motivational Interviewing of Diabetic Patient (~25mins long)**  
  - [https://www.youtube.com/watch?v=qzKZzrc4ShA&sns=em](https://www.youtube.com/watch?v=qzKZzrc4ShA&sns=em)
Special consideration: screening for Gestational Diabetes

• 50g glucose challenge test @24-28 weeks gestation
  – Screen earlier if risk factors (e.g. PCOS, obesity, etc – see RFs slide)

• 75g OGTT (if 50g GCT is positive)
  – If any 1 of the 3 results are positive = GDM
  – Refer to Diabetes guidelines for cut-offs (but this is not in objectives)

• Management includes:
  – Nutritional intervention
  – Usually try to control with diet and home blood glucose monitoring, but may use insulin, if needed