Obesity and Diabetes in Pregnancy: a Pragmatic, Unconventional Approach

SRPC Rural and Remote - April 6, 2019

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Introduction

- Gale Payne
  - Registered dietitian in Yellowknife, NT since 2011
- Dr. Andrew Kotaska
  - Obstetrician and Gynecologist and Clinical Director of Obstetrics at Stanton Territorial Hospital in Yellowknife, NT since 2006

Disclosures

- Gale Payne
  - none
- Dr. Andrew Kotaska
  - Has received teaching stipends from the Universities of B.C. and Toronto, Vancouver Island Health Authority, and the Alberta Association of Midwives

Learning objectives

At completion of this presentation, participants will be able to:

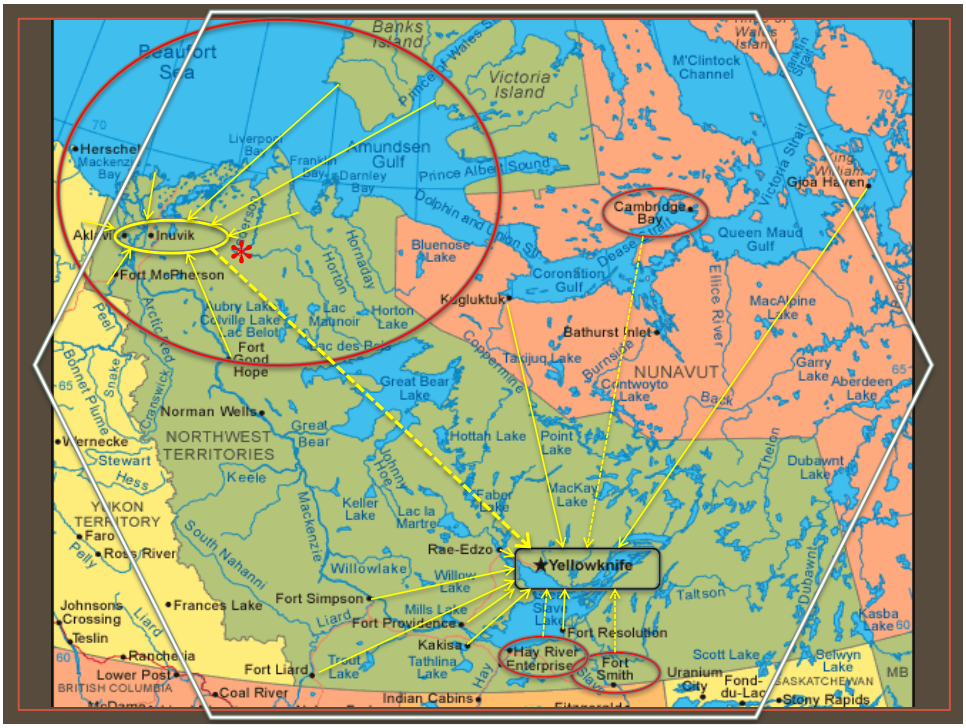
- Describe why avoiding weight gain in obese pregnant women is advisable.
- List the advantages of metformin compared with insulin as initial medical treatment of GDM.
- List risk factors for gestational diabetes that should prompt early screening.
- Define diagnostic criteria for early diagnosis of GDM.
- Appreciate the advantages of a centralized, no frills approach to diabetes management in pregnancy.

Outline

- Introduction
- Obesity in pregnancy
  - Weight gain recommendations
- Medical management in GDM and Type 2 DM
  - Metformin vs insulin
- Gestational diabetes screening
  - Early screening – how and why
  - Screening algorithm
- Our approach
  - Referrals
  - Data management
- Our findings
- Document review: 'Diabetes and Obesity in Pregnancy – NWT'
- Questions/Discussion

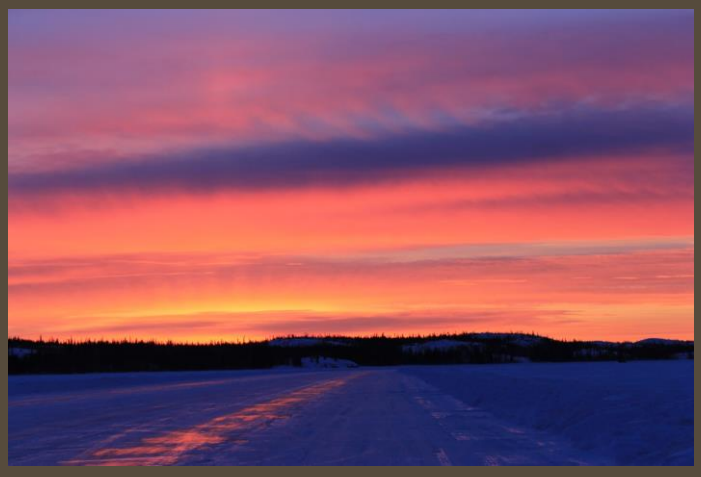
Introduction

- Stanton Territorial Hospital
  - 100-bed tertiary hospital servicing 44000 residents of NWT + 6000 residents of Kitikmeot region of Nunavut
  - Approx 575-600 births per year
- Regional centres offering birthing services
  - Hay River Regional Health Centre
  - Fort Smith Health Centre
  - Inuvik Regional Hospital
  - Cambridge Bay Regional Birthing Centre (NU)
  - Cumulatively approx 130-150 births per year



Introduction

- Diabetes in pregnancy working group
  - Dept of Obstetrics and Gynecology, Stanton Territorial Hospital
  - Yellowknife Region Diabetes Program (RD, LPN, NP)
  - Northern Women's Health Program, Stanton Territorial Hospital (NP, RN)
- History
  - Group originated in 2014
  - Initially in combination with internal medicine
  - Expanded geographical service area for diabetes management in pregnancy
  - Transition from insulin to metformin as first-line medical therapy
  - Development of guidelines for diabetes and obesity in pregnancy
  - Ongoing education sessions (grand rounds, lunch and learns, etc)



Obesity in pregnancy

Obesity in pregnancy

- Confers an increased risk of
  - Hypertensive disorders of pregnancy
  - Gestational diabetes
  - Fetal macrosomia (>4000g)
  - Operative delivery, including caesarean section[1]
- Limiting gestational weight gain in obese women can reduce these risks[2,9]

Obesity in pregnancy

- Institute of Medicine recommends[3]:

Pre-pregnancy BMI	Total Weight Gain	
	Range in kg	Range in lbs
Underweight (< 18.5 kg/m^2)	12.5–18	28–40
Normal weight (18.5–24.9 kg/m^2)	11.5–16	25–35
Overweight (25.0–29.9 kg/m^2)	7–11.5	15–25
Obese (≥ 30.0 kg/m^2)	5–9	11–20

Obesity in pregnancy

- SOGC recommends[1]:

Pre-pregnancy BMI	Total Weight Gain	
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Normal weight (18.5–24.9 kg/m^2)	11.5–16	25–35
Overweight (25.0–29.9 kg/m^2)	7–11.5	15–25
Obese Class I (30.0-34.9 kg/m^2)	7	15
Obese Class II (35.0-39.9 kg/m^2)	7	15
Obese Class III (≥40.0 kg/m^2)	7	15

Obesity in pregnancy

- We recommend:
  - In pregnant women with BMI >30, that it is desirable to not gain weight during pregnancy
  - In pregnant women with BMI > 35, that it is desirable to maintain weight, with a small amount of weight loss being permissible
  - In either scenario, important that adequate nutrition maintained
    - Protein
    - Iron
    - Calcium

Obesity in pregnancy

- Our approach to this
  - Consistent messaging across health care providers
  - No shaming or blaming
  - Counselling re: risks associated with excessive gestational weight gain
  - Encouraging healthy lifestyle behaviors
    - ↓ refined sugars
    - Moderating CHO intake, choosing lower Glycemic Index options when possible
    - ↑ protein and fibre
    - ↑ physical activity

Obesity in pregnancy

- My obese pregnant patient has ketones in her urine – what should I do?

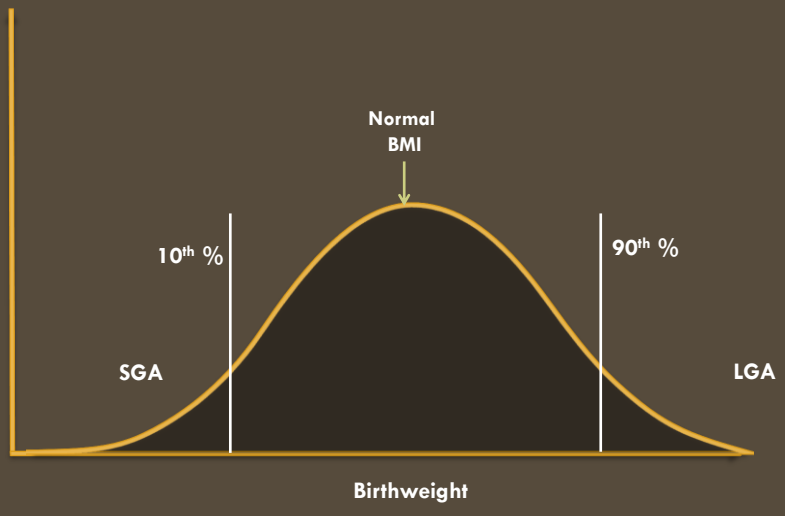
Obesity in pregnancy

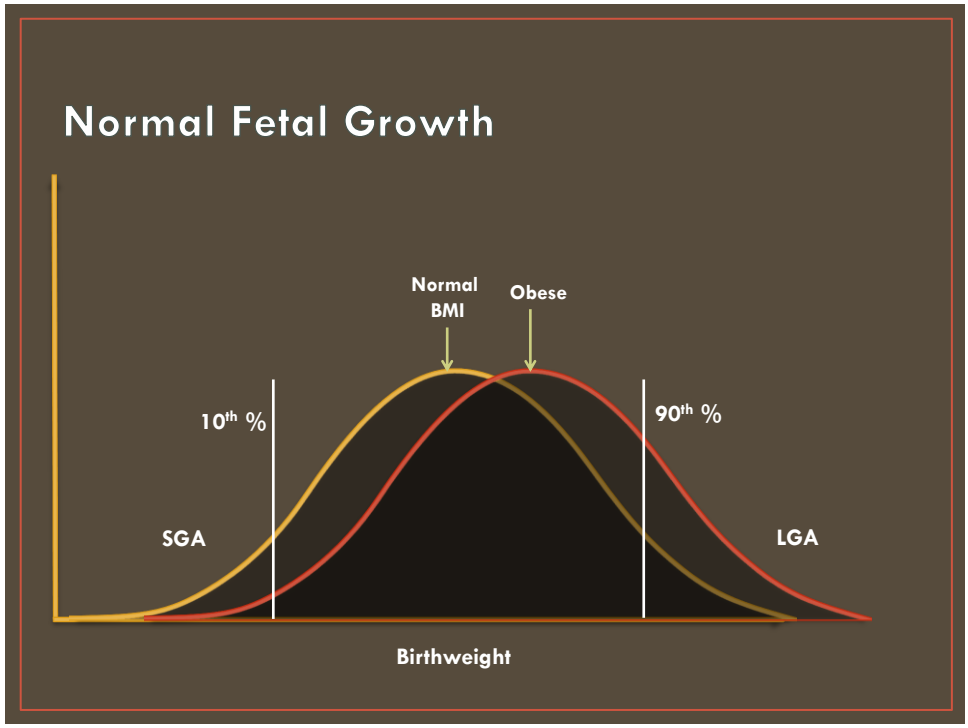
- My obese pregnant patient has ketones in her urine – what should I do?
  - Typically, nothing.
  - In pregnant women with Type 1 DM or poorly controlled Type 2 DM, may be a sign of diabetic ketoacidosis (DKA) → serious metabolic derangement
  - In women **without** Type 1 diabetes, ketones are a by-product of fat metabolism
    - Ketones + fatty acids are energy source for mother and fetus
    - Unlike sugar, do not accelerate fetal growth or result in macrosomia
    - Not harmful to fetus[4] – even if test positive for urine ketones, blood ketones would be at levels of 10 to 100x lower
    - Does not need to be treated with sugar!

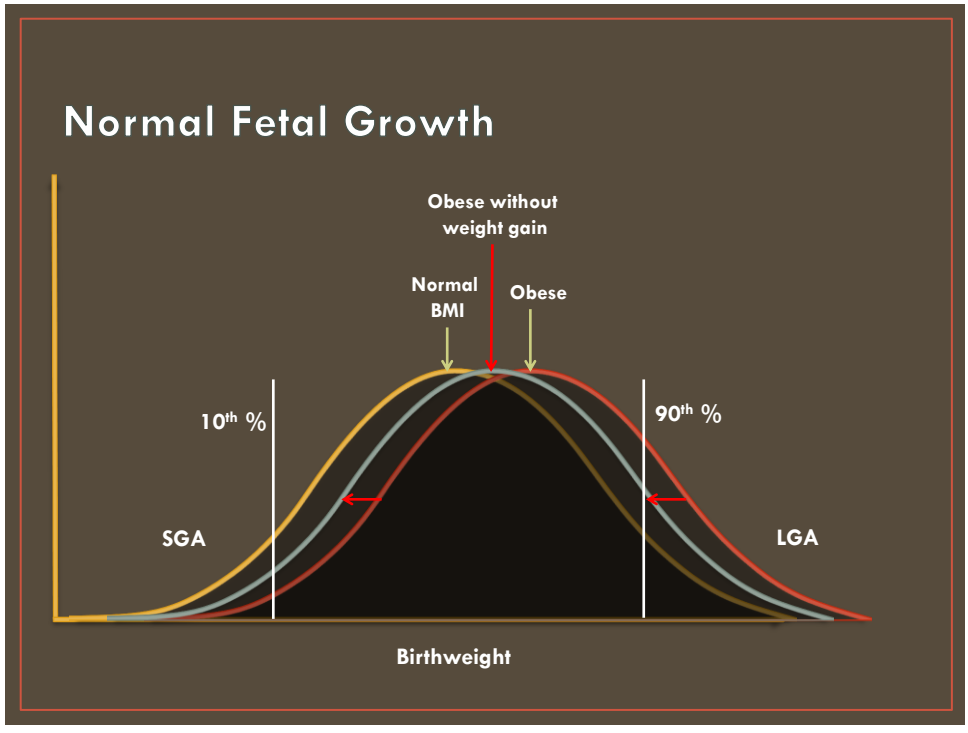
Obesity in pregnancy

- But won't there be an increased risk of SGA infants if obese women are not gaining any weight?

Normal Fetal Growth




Normal Fetal Growth
Normal BMI
Obese
10th %
90th %
SGA
LGA
Birthweight


Normal Fetal Growth
Obese without weight gain
Normal BMI
Obese
10th %
90th %
SGA
LGA
Birthweight

Our findings – Weight gain in pregnancy

- 70 women with BMI >30 at initial prenatal visit
  - dx with GDM (either early or at usual screening time)
  - Average GA at dx = 25w+5d

Average BMI 1st PN (kg/m^2)	Average BMI Dx (kg/m^2)	Average BMI closest to birth (kg/m^2)
37.45	38.86	39.74

Medical management of GDM and type 2 DM in pregnancy

Medical management of GDM & type 2 DM

- For GDM, Diabetes Canada 2018 CPGs recommend:
  - "If women with GDM do not achieve glycemic targets within 1–2 weeks with nutritional therapy and physical activity, pharmacologic therapy should be initiated [Grade D, Consensus].
    - a. Insulin in the form of basal-bolus injection therapy may be used as first-line therapy [Grade A, Level 1 (129) for insulin]
    - b. Rapid-acting analogue insulin aspart, lispro or glulisine may be used over regular insulin for postprandial glucose control, although perinatal outcomes are similar [Grade B, Level 2 (356,357) for aspart and lispro; Grade D, Consensus for glulisine]
    - c. Metformin may be used as an alternative to insulin [Grade A, Level 1A for metformin]; however, women should be informed that metformin crosses the placenta, longer-term studies are not yet available, and the addition of insulin is necessary in approximately 40% to achieve adequate glycemic control [Grade D, Consensus]. (362)"[5]

Medical management of GDM & type 2 DM

- For Type 2 DM, Diabetes Canada 2018 CPGs recommend:
  - "Once pregnant, women with type 2 diabetes should be switched to insulin for glycemic control [Grade D, Consensus]. Noninsulin antihyperglycemic agents should only be discontinued once insulin is started [Grade D, Consensus]."[5]

Medical management of GDM & type 2 DM

- Gestational diabetes is characterized by increasing insulin resistance related to placental hormones
- Type 2 diabetes is often characterized by insulin resistance
- Metformin = insulin sensitizer

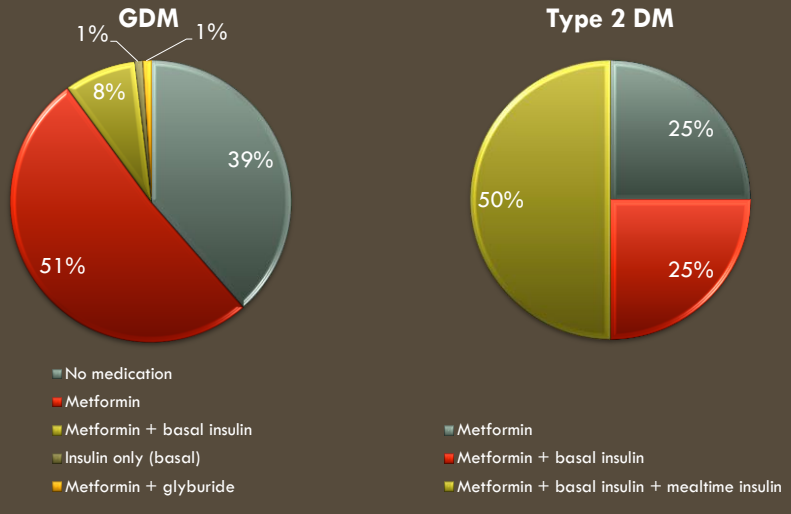
Medical management of GDM & type 2 DM

- The evidence does show that use of metformin in GDM results in
  - Less maternal weight gain
  - Less pregnancy-induced hypertension
  - Less neonatal hypoglycemia
  - Lower risk of fetal macrosomia
  - Lower risk of maternal hypoglycemia
  - Increased maternal satisfaction
  - Lower usage of insulin overall[6,7,11]
- No increased risk of SA in 1st trimester use in type 2 DM[8]
- Conflicting evidence re: preterm birth
- Childhood outcomes
  - Recent study looking at school-aged children found no appreciable difference in growth and development parameters[10]

Medical management of GDM & type 2 DM

- Our approach in women with GDM:
  - Lifestyle management first and foremost
  - If inadequate glycemic control after 1-2 weeks, initiate metformin at 250 mg BID x 3/7, then 500 mg BID
    - Increase dose as necessary
  - If glycemic control remains inadequate or worsens as pregnancy progresses, initiate bedtime basal insulin
- Our approach in women with type 2 DM:
  - Lifestyle management concurrently with use of metformin +/- insulin
  - Discontinue any other oral antihyperglycemics
  - Discontinue any ACE-inhibitors, statins

Medical management of GDM & type 2 DM



Early screening for gestational diabetes

Early screening

- Diabetes Canada 2018 CPGs recommend:
  - Women identified as being at high risk for type 2 diabetes should be offered earlier screening with an A1C test at the first antenatal visit to identify diabetes which may be pre-existing [Grade D, Consensus].
    - Evidence to show if ≥5.9% = increase in adverse obstetrical outcomes, later dx GDM, postpartum dysglycemia
      - Lack of intervention trials
    - If ≥6.5%, manage as if have pre-existing T2DM
    - Otherwise, screen between 24-28 weeks[5]
  - **Rationale for not using OGTT earlier in pregnancy:**
    24-28 week screening thresholds not validated earlier in pregnancy

Early screening

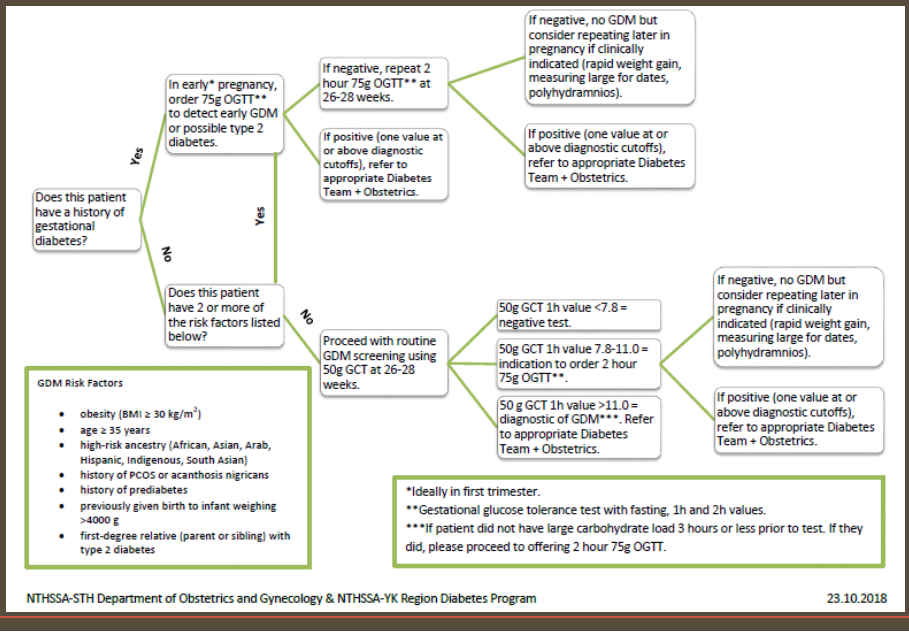
- Issues with A1C in 1st trimester
  - High specificity, low sensitivity
  - Physiologic changes of pregnancy
    - ↓ RBC lifespan
    - ↑ erythropoietin production
  - Spectrum of dysglycemia
    - Normal vs abnormal lab values

Early screening

- Our recommendation:
- In women with previous hx of GDM or ≥2 of following risk factors
  - obesity (BMI ≥ 30 kg/m^2)
  - age ≥ 35 years
  - high-risk ancestry (African, Asian, Arab, Hispanic, Indigenous, South Asian)
  - history of PCOS or acanthosis nigricans
  - history of prediabetes
  - previously given birth to infant weighing >4000 g
  - first-degree relative (parent or sibling) with type 2 diabetes

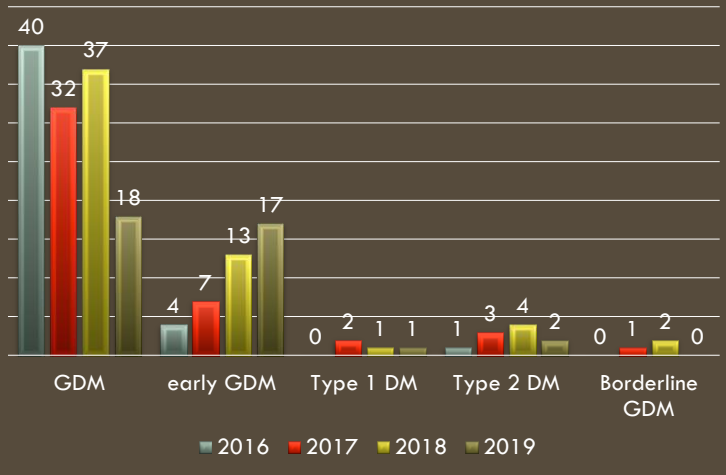
→ 75g OGTT early in pregnancy
  - Ideally in 1st trimester
  - If negative, repeat at usual screening interval
  - If positive, early GDM (eGDM)

Screening algorithm



NTHSSA-STH Department of Obstetrics and Gynecology & NTHSSA-YK Region Diabetes Program 23.10.2018

Referrals by type

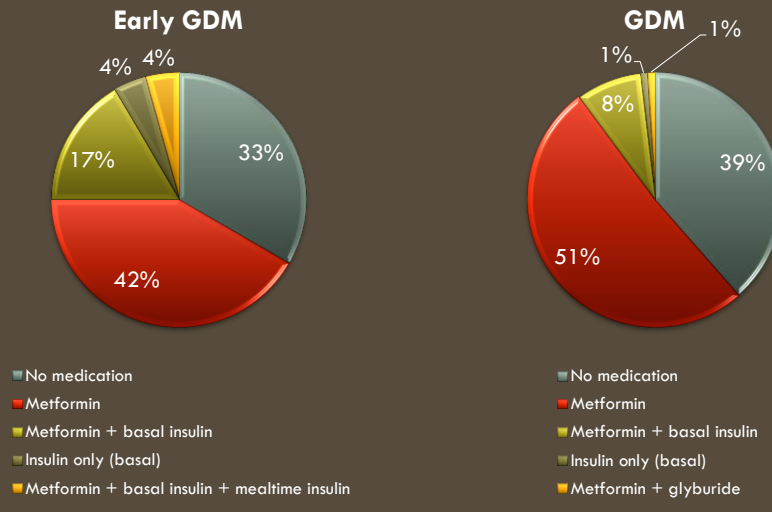


Early GDM vs GDM

	eGDM	GDM
n=	24	109
Avg GA at dx	15w6d	28w5d
Range of GA at dx	5w4d-23w6d	24w1d-39w3d
Avg maternal age at EDC	33.7	30.8
# of women with initial A1C ≥6.5%	1	--

- Medical management
  - 16 of 24 (66%) eGDM cases
    - 19w5d
    - Metformin in 15, basal insulin in 1
  - 5 of 16 went on to require basal insulin in addition to metformin
    - 26w4d

Early GDM vs GDM – Medication usage



Early GDM vs GDM

	eGDM	GDM
n=	24	103
Avg birthweight (g)	3531	3500
Average GA at birth	38w2d	39w
C-section rate (%)	12.5	24.3

Diabetes in pregnancy: our approach

Our approach

- Providing direct patient care and overseeing management of diabetes
  - In-person and remotely
  - Diabetes care primarily provided by diabetes program
- Coordinating care
  - Travel and appointments, reducing gaps in care
  - Communication
- Meeting q4-6 weeks to review all patients
- Providing practitioner support
- Antenatal surveillance
- Consistent messaging

Our approach

- Accept referrals from all NWT regions + Kitikmeot
  - Provide support to community-based diabetes programs
  - Transition of care for birth in YK
- 2016 – 45
- 2017 – 45
- 2018 – 57
- 2019 – 38*

*As of March 31, 2019

Data management

- Spreadsheet
  - Ensures patients not lost to follow-up
  - Overall picture of their care (who, what, when)
    - Appropriate referrals, antenatal surveillance, etc
  - Tracking data
    - Weight/BMI
    - HgbA1C
    - Medication use
    - Delivery mode
    - Birthweight
    - Postpartum OGTT completion

Data management

Age at EDD	Community	Dx (year dx if T1 or T2; e=early)	GPAL	Prev GDM (Y/N)	Prev C/S (Y/N)	EDD	Current Gestational Age
38	Deline	T2DM (2017)	11-4-6-3	N/A	N/A	20-Jun-19	10 weeks 6 days
31	Yellowknife	eGDM	2-1-0-1	N (but LGA)	Y	8-May-19	17 weeks 0 days
33	Yellowknife	eGDM	4-2-1-2	Y	N	29-Apr-19	18 weeks 2 days
37	Yellowknife	GDM	1-0-0-0	N/A	N/A	21-Feb-19	27 weeks 6 days

Data management

GDM screening	HgbA1C	Height (cm)	BMI (kg/m²)	Medications	Diabetes and PN Care
N/A	10.0% (22-Oct-18) Nov 27 pending	160	34.2 (27-Nov-18)	metformin 1000 mg BID, lantus 8 units at HS	diabetes program (YK) and PN appts (Deline)
20-Sep-18 (7w+1d) **5.3**/9.0/**9.2**	5.9% (10-Oct-18)	167	35.2 (19-Sep-18) 34.8 (26-Oct-18) 34.7 (15-Nov-18)	metformin 1000 mg BID, lantus 5 units at HS	diabetes program (YK) and PN appts
19-Oct-18 (12w+4d) **6.1**/7.1/6.8	5.7% (8-Nov-18)	164.4	44.5 (18-Oct-18)	none	diabetes program (YK) and PN appts
16-Nov-18 (26w+1d) GCT **8.1** 20-Nov-18 (26w5d) **5.6**/**11.0**/8.1	has req		25.3 (20-Aug-18) 28.1 (16-Nov-18)	metformin 500 mg BID	diabetes program (YK) and Centering Pregnancy

Data management

Diabetes Follow-up (next appts, etc)	OB referral/appt + monitoring	Delivery Date	GA at Delivery	Delivery Mode	Birthweight	Postpartum OGTT
phone call scheduled for Nov 29	has seen Dr. Guthrie, fetal echo arranged					
phone call scheduled for Nov 30	Seeing Dr. Kotaska December 17					
phone call schedule for Nov 30	has seen Dr. Kotaska; will see again in Dec. Int Med following ITP					
Follow-up booked Dec 7; moving to Ft Smith Dec 9	seeing gyne Dec 7					

Our findings

Rate of births to women with DM

Rate of births	2016	2017	2018
Total Births at STH	568	584	609
Births to women with GDM/T2DM at STH	44 (7.7%)	40 (6.8%)	51 (8.4%)

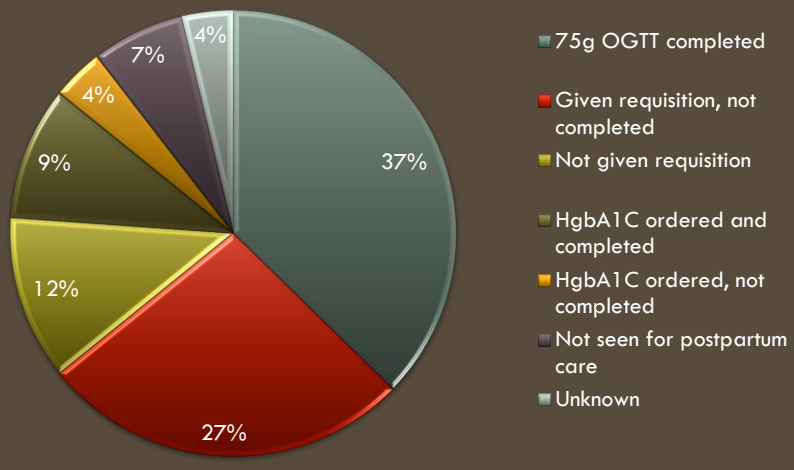
Average birthweight

Average Birthweight (g)	2016	2017	2018
GDM/T2DM births at STH	3517.6 (avg GA 38w5d)	3401.1 (avg GA 38w5d)	3495.3 (avg GA 38w6d)
All other births at STH	3496.5 (avg GA 39w1d)	3509.3 (avg GA 39w1d)	3556.5 (avg GA 39w2d)

C-section rates

C-section rate (%)	2016	2017	2018
GDM/T2DM births at STH	31.8	20.0	21.6
All other births at STH	15.8	16.2	16.3
Overall at STH	17.1	16.4	16.7

Postpartum screening



Document review

- Diabetes and Obesity in Pregnancy - NWT
  - Newly revised October 2018
  - Distributed to all prenatal care providers in NWT

In summary

- You should now be able to:
  - Describe why avoiding weight gain in obese pregnant women is advisable.
  - List the advantages of metformin compared with insulin as initial medical treatment of GDM.
  - List risk factors for gestational diabetes that should prompt early screening.
  - Define diagnostic criteria for early diagnosis of GDM.
  - Appreciate the advantages of a centralized, no frills approach to diabetes management in pregnancy.

References

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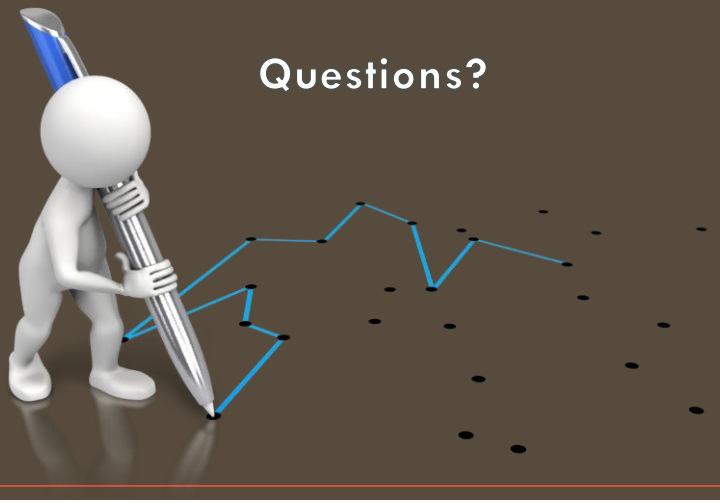
How does this improve patient care?



Questions?

Thank You!

Questions or comments? Gale_payne@gov.nt.ca

Diabetes & Obesity in Pregnancy – NWT

Resources available and their roles:

Yellowknife Diabetes Team (Dietitian Educator, Nurse Educator, Nurse Practitioner): offer diet and exercise advice, blood glucose monitoring education, initiation and adjustment of metformin and/or insulin for GDM and type 2 diabetes, and type 1 diabetes in coordination with Internal Medicine. The Diabetes Team is Yellowknife-based; however, their mandate includes providing care and support for pregnant women with diabetes and their care providers, *throughout the NWT and the Kitikmeot*. Please inform the team early about women with any form of diabetes who are planning or likely to deliver in Yellowknife: ph: 867-765-7728 or 867-765-7729; fax: 867 920-7711. For NWT communities using EMR, the Yellowknife Diabetes Team can be reached via a WOLF message to 'YK Intake Diabetes' under Group recipients.

Community Diabetes Teams: Hay River has a diabetes team that offers diet and exercise advice, blood glucose monitoring education, initiation and adjustment of metformin and/or insulin for GDM and type 2 diabetes. There are diabetes educators in Inuvik and Fort Smith who can see patients for diet and exercise advice, and blood glucose monitoring education. All community-based diabetes educators can liaise with the Yellowknife Diabetes Team for additional support as needed and to ensure a smooth transition for patients who come to Yellowknife to give birth. If patients have suboptimal glycemic control with complicated regimes, teams can also liaise with Internal Medicine.

Internal Medicine Specialist: Insulin adjustment in all patients with type 1 diabetes, complicated type 2 diabetes or GDM patients on insulin with suboptimal control.

Obstetrics Specialist: Review obstetrical implications and management with all pregnant women with diabetes or GDM on one or more occasions during pregnancy.

Northern Women's Health Program (NWHP) Nurse Practitioner: Helps coordinate ultrasounds & appointments for pregnant women from outside of Yellowknife as well as antenatal monitoring near term for all women delivering in Yellowknife.

When to refer and to whom:

Pre-existing type 1 diabetes → Refer to Diabetes Team, Internal Medicine, and Obstetrics pre-conceptually or as early in pregnancy as possible.

Pre-existing type 2 diabetes → Refer to Diabetes Team & Obstetrics pre-conceptually or as early in pregnancy as possible. The Diabetes Team will refer to Internal Medicine if control is poor and for insulin adjustment as necessary.

GDM → Refer to Diabetes Team & Obstetrics as soon as GDM is diagnosed. If control is poor despite initial management, the Diabetes Team will refer to Internal Medicine for insulin adjustment as necessary.

Considerations:

- **Women with pre-existing type 1 or type 2 diabetes** of reproductive age should receive ongoing counselling regarding reliable birth control, the importance of glycemic control prior to pregnancy, the impact of BMI on pregnancy outcomes, the need for folic acid supplementation and the need to stop potentially embryopathic drugs prior to pregnancy.

- **Women with pre-existing type 1 or type 2 diabetes** are at increased risk of congenital malformations and should be referred to Obstetrics and the appropriate Diabetes Team pre-conceptually if possible, or as soon as pregnancy is diagnosed. The risk of malformation is proportional to HbA1C during the first trimester, therefore optimal blood sugar control **BEFORE** conception is extremely important. Optimal blood sugar control pre-conceptually (HbA1C ≤6.5%) can reduce the risk of spontaneous abortion, congenital anomalies, preeclampsia, progression of retinopathy and stillbirth. **HbA1C measurements should be obtained prior to conception and monthly throughout pregnancy in all pregnant patients with diabetes.**

- **Women with pre-existing type 1 or type 2 diabetes:** ACE–inhibitors and Statin drugs should be discontinued prior to conception. Oral antihyperglycemic medications **other than metformin** should be discontinued prior to conception or as early in pregnancy as possible and management switched to metformin +/- insulin. **Folic Acid 1 mg daily** should be started before or early in pregnancy to minimize the risk of facial, cardiac, and neural tube defects. An ophthalmology exam for retinopathy should be completed pre-conceptually or early in pregnancy and repeated during pregnancy and post-partum at the discretion of the eye specialist. A urine albumin-creatinine ratio and serum creatinine should be measured each trimester to screen for nephropathy and OB & Internal Medicine consulted if abnormal.

- **Women with type 2 diabetes on metformin** can safely continue this medication throughout pregnancy. If their blood sugar control is good prior to pregnancy and they are attentive to diet and exercise, there is a good chance that they will be able to avoid insulin treatment.

- **Women with gestational diabetes** should be referred to the appropriate Diabetes Team for advice on lifestyle modifications and initiation of home glucose monitoring as soon as they are diagnosed. Home glucose monitoring is required to assess control. If the resources for this are available in the community then monitoring can be started immediately. If not, a Diabetes Team will help arrange for them. Women with gestational diabetes should also be referred to a specialist obstetrician. Referrals should include the patient's diagnostic glucose

testing results, EDC, current BMI, weight gain in pregnancy thus far, and whether or not they have been referred to the appropriate Diabetes Team. Appointments for out of town patients for Obstetrics and the Yellowknife Diabetes Team should be coordinated through the Northern Women's Health Program (NWHP) nurse practitioner.

Ultrasound and prenatal diagnosis

- Women with pre-existing diabetes should have a detailed fetal ultrasound with attention to cardiac views (including 4-chamber, 3-vessel view, and outflow tracts) to rule out a cardiac anomaly. If ultrasound cardiac views are sub-optimal **or** the HbA1C was > 7.0% in the first trimester, fetal echocardiography should be performed.

- Maternal Serum Screening for abnormal chromosomes can be performed in women with diabetes; the woman's diabetes diagnosis should be documented on the requisition.

Screening & Testing for diabetes (DM) & gestational diabetes (GDM)

All pregnant women should be **screened or tested** for diabetes in pregnancy. Ordering a screening HbA1C should be avoided unless a patient will simply not attend for an OGTT (oral glucose tolerance test). Women with a history of prior GDM **or** with two or more risk factors from the following list should have a **2 hour 75 gram OGTT diagnostic test** early in pregnancy (ideally in the first trimester) to detect early onset of gestational diabetes or possible type 2 diabetes:

- obesity (BMI ≥ 30 kg/m^2)
- age ≥ 35 years
- high-risk ancestry (African, Asian, Arab, Hispanic, Indigenous, South Asian)
- history of PCOS or acanthosis nigricans
- history of prediabetes
- previously given birth to infant weighing >4000 g
- first-degree relative (parent or sibling) with type 2 diabetes

If negative, it should be repeated at 26-28 weeks to detect GDM. Consider repeating OGTT again at 32 weeks in women with two or more risk factors but negative tests thus far, particularly if a prior OGTT had borderline results or if clinically indicated (rapid weight gain, measuring large for dates, polyhydramnios).

One abnormal OGTT value is a positive diagnosis of gestational diabetes:
fasting ≥ 5.3; 1 hour ≥ 10.6; 2 hour ≥ 9.0.

Women with one or no risk factors should receive a **screening 1 hour 50 g GCT** (glucose challenge test) at 26-28 weeks. To reduce the risk of a false positive result, women should have nothing to eat or drink except water for at least 3 hours before the test. If the 50g GCT is positive **(≥7.8 mmol/L)**, then a 2 hour 75 gram OGTT should be done. If the result of the 50g GCT is ≥ 11.1 mmol/L, it is diagnostic of GDM; however, consider a 2 hour 75 gram OGTT if patient had a large carbohydrate intake within 3h of the GCT.

Blood sugar control in Diabetes or GDM

- Recommended targets for blood sugars:

Fasting and pre-prandial BG:	3.8-5.2 mmol/L
1h postprandial BG:	less than 7.8 mmol/L
2h postprandial BG:	less than 6.7 mmol/L
HbA1C	≤6.0%

(HbA1C is artificially lower in pregnancy due to increased production of new RBCs that have not had time to become glycosylated).

- Blood sugars are physiologically lower in pregnancy. As such, a woman may have a blood glucose result less than the traditional hypoglycemia cutoff of <4.0 mmol/L and be asymptomatic. For women taking insulin, it is recommended to maintain blood glucose levels >3.7 mmol/L in order to avoid hypoglycemia.

Treatment of Diabetes in Pregnancy

- Women with type 1 diabetes need to continue their insulin regimen in close conjunction with their internist or endocrinologist.
- Women with type 2 diabetes on metformin or insulin can continue their regimen under the direction of the Diabetes Team with the assistance of Internal Medicine if needed.
- Women with type 2 diabetes on **other oral antihyperglycemic medication** should be switched to metformin +/- insulin **prior to or as early in pregnancy as possible.**
- Women diagnosed with GDM are initially managed with diet and exercise as they begin blood sugar monitoring. If blood sugars remain elevated despite one-two weeks of dietary modification and exercise, initial management is usually with metformin.
- However, **women with abnormal renal function should not receive metformin.**
- As primary agent, metformin has the following advantages over insulin:
    - An oral medication dosed twice daily
    - Better maternal satisfaction
    - Less maternal hypoglycemia
    - Lower maternal weight gain
    - Same neonatal outcomes
    - Lower overall need for insulin

To minimize GI side effects, metformin should be initiated at a low dose (250 mg BID) and titrated slowly - increasing by 250 mg BID every week to a maximum of 1 g BID.

Many women will be able to achieve adequate blood sugar control on metformin alone. Those who do not achieve adequate control or who cannot tolerate metformin will need to be treated with insulin in addition to, or instead of metformin. Women with GDM and type 2 diabetes

who require insulin should be cared for by the Diabetes Team in conjunction with Internal Medicine specialists as needed.

Maternal Weight Gain in Obese Women and Women with Diabetes

- **Women with type 1 diabetes** should review their dietary and insulin requirements with their Internist and maintain this program as much as possible. Most women with type 1 diabetes have a normal BMI → routine weight gain in pregnancy is recommended.

- **Obese women (BMI > 30), with or without diabetes,** should be encouraged to minimize weight gain in pregnancy while maintaining adequate nutrition, particularly calcium and iron intake. Obese women who limit gestational weight gain have a lower risk of gestational diabetes, gestational hypertension, fetal macrosomia, and operative delivery including cesarean section. It is desirable for women with a BMI > 30 not to gain weight during pregnancy, and if BMI is >35, a modest amount of weight loss is permissible.

- **Obese women** are also at increased risk of fetal anomalies. **Folic Acid 1 mg daily** should be started before or early in pregnancy to minimize this risk.

- For women unable or unwilling to ingest enough dairy products to provide 1 gram of elemental calcium per day, supplementation with 3 extra strength or ultra Tums per day will suffice. They should **not** be taken at the same time as prenatal vitamins or iron. Ensure at least 800 IU vitamin D intake as well.

Ketonuria in Pregnancy

Ketonuria alone is not harmful to a fetus. In a pregnant woman **with type 1 diabetes**, ketonuria may be a **sign** of diabetic ketoacidosis. Diabetic ketoacidosis is a metabolic emergency that puts mother and fetus at considerable risk. Immediate referral to Internal Medicine and Obstetrics is indicated. Women with severe, out-of-control type 2 diabetes (blood sugar > 18) may also have significant metabolic derangements requiring urgent referral.

In women **without diabetic ketoacidocis**, ketones are a physiological byproduct of fat metabolism. Along with fatty acids, they are a source of energy that can be used by both mother and fetus. Compared with sugar, they do not accelerate fetal growth or lead to macrosomia. In an obese woman, diet and exercise stimulate fat metabolism, and ketonuria is an expected result. **These ketones are not harmful.**

Many caregivers have been taught to treat ketonuria in pregnant woman by giving sugar or carbohydrate. In a woman with hyperemesis gravidarum, this may be appropriate; however in an obese woman, giving sugar will stop fat metabolism, undoing the metabolic process we are hoping to achieve. Ketones in the urine of an obese woman who is not in diabetic ketoacidosis are a sign that she is successfully metabolizing fat**.**

Assessment of fetal growth and wellbeing:

- Women with type 1 diabetes are at elevated risk of fetal growth restriction or macrosomia. They should have a growth U/S every 4 weeks from 28 weeks gestation, and an obstetrician should be closely involved in her care.

- In women with type 2 and gestational diabetes, fetal growth should be monitored clinically. If there is a suspicion of excessive or inadequate fetal growth, then NWHP referral for growth U/S is indicted. The NWHP NP will involve an obstetrician as needed.

- A plan for assessment of fetal wellbeing near term (NST, BPP, etc) should be determined in consultation with an obstetrician:
    - Women with type 1 diabetes or poorly controlled type 2 diabetes or GDM should begin weekly fetal assessment at 36 weeks, or earlier if clinically indicated.
    - Women with well-controlled type 2 diabetes or GDM with adequate fetal growth should have monitoring from 40 weeks gestation.

Timing of birth:

- Many variables determine the optimal timing of delivery. For all women with type 1 diabetes, ongoing specialist obstetrician care is required for 3rd trimester monitoring and determining timing of delivery, sometimes as early as 36 - 37 weeks.

- For women with type 2 or gestational diabetes and poor glycemic control, obstetrical consultation is recommended to determine monitoring and timing of delivery - usually by 39 weeks.

- In women with well-controlled type 2 or gestational diabetes with normal fetal growth, delivery is recommended by 40-41 weeks.

After Birth:

Women with a history of GDM are at increased risk of type 2 diabetes and need a 2 hour 75 gram OGTT six weeks to six months postpartum; please order a routine 75 gram OGTT with fasting and 2h values only, **not** the gestational 75 gram OGTT. A HbA1C or fasting glucose are not appropriate postpartum screening tests and may result in postpartum dysglycemia being missed. These women should be screened for diabetes every two years with FPG and/or HbA1C and with a 2 hour 75 gram OGTT early in any subsequent pregnancy.

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