Gestational Diabetes in Ohio: 2009-2014

Ohio Department of Health

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Gestational Diabetes in Ohio: 2009-2014

Executive Summary

Gestational diabetes mellitus (GDM) presents a significant challenge to the health of both mother and infant. GDM is characterized by glucose intolerance appearing or first diagnosed during pregnancy, and greater than half of women with GDM will subsequently be diagnosed with type 2 diabetes mellitus (T2DM).

The Ohio Department of Health (ODH) developed the first GDM Databook in 2011 using multiple data sources to describe Ohio trends from 2006 through 2008 in GDM risk factors, prevalence, and co-morbidities during preconception, pregnancy and postpartum. Data sources included vital statistics (VS) birth records, the Behavioral Risk Factor Surveillance System (BRFSS), the Pregnancy Risk Assessment Monitoring System (PRAMS), Ohio Medicaid claims, and Ohio Hospital Association's (OHA) hospital discharge data. Building on the first edition, this 2009-14 data book presents a more current picture of GDM in Ohio and includes additional details on the preconception and postpartum periods.

Highlights of the findings include the following.

- Among women of reproductive age, the prevalence of risk factors for GDM is high and in some cases worsening. Among women giving birth in 2009-10, during the preconception period almost a quarter (24.3 percent) were obese, an increase from 2006-08 (21.2 percent); almost one in ten had hypertension; fewer than one third reported visiting a health care provider in the year before pregnancy; fewer than half reported exercising ≥3 times per week; and about one third reported smoking in the past 2 years (37.3 percent), an increase from 2006-08 (32.5 percent).

- Annual GDM incidence estimates were 6.7 percent (VS 2012-14); 6.8 percent (OHA 2012-13); 10.1 percent (PRAMS 2009-10) and 12.5 percent (Medicaid 2012-14). While estimates varied somewhat by data source, all show an increase in trends over time. Differences in burden were seen across a number of variables, including age, obesity status, race, education, and migrant status.

- Newborns exposed to GDM were more likely to be born by cesarean section and had longer hospital stays. Their mothers were more likely to have also had hypertension.

- Healthcare utilization among women with a GDM history impacts their risk of having a timely diagnosis and management of T2DM. Among women with Medicaid insurance, only half have a claim for a postpartum visit. Postpartum visit billing varies by ethnicity with only 28 percent of Hispanic women with GDM having a postpartum visit recorded. Among all women aged 18-44 with a GDM history, one in five has not seen a healthcare provider in the past 2 years.

- Health behaviors of women with a GDM history impact their risk of developing T2DM later in life. Among women with a GDM pregnancy who gave birth in 2009-10, one quarter smoked in postpartum period, and 30 percent did not breastfeed. Among women aged 18-44 with a GDM history, half do not meet physical activity recommendations.

- While nearly four out of five women with a history of GDM (in the past 10 years) report that their doctor discussed the long term risks of GDM, only half report that their doctor recommended they have their glucose tested within 3 years after delivery. About 3 percent of Ohio women aged 18-44 have a history of GDM, but have not yet been diagnosed with T2DM.

The Ohio GDM collaborative is using these data to improve adoption of evidence-based prenatal and postpartum care for T2DM screening and prevention. Specific initiatives include development of provider and patient toolkits and initiation of a quality improvement project to improve attendance at the postpartum visit and rate of postpartum screening for T2DM. These efforts ultimately aim to improve interconception and ongoing health for women; improving maternal health is a key strategy for reducing infant mortality and improving health outcomes across the lifespan. Since publication of the 2006-08 data book, Ohio has made improvements in GDM-related data. Namely Ohio BRFSS added more detailed questions on postpartum experiences among women who had GDM and the findings from those questions are included here. In 2016, the WIC program will begin to capture specific GDM risk (i.e., GDM code 302) or history of GDM (code 303) among participants and in the future those data will be available.

Ohio Department of Health, November 2016

Introduction

Gestational diabetes mellitus (GDM) presents a significant and lifelong challenge to the health of both mother and infant. GDM is characterized by glucose intolerance appearing or first diagnosed during pregnancy and greater than half of women with GDM will be diagnosed with type 2 diabetes mellitus (T2DM) at some point in the future.

The Ohio Department of Health (ODH) published the first Ohio data book on GDM in 2011. It presented multiple data sources from 2006-08 to describe GDM risk factors, prevalence, and co-morbidities during preconception, pregnancy, and postpartum. Those findings were used to plan efforts to improve prenatal education and postpartum health care for women with GDM.

This second data book updates the previous one with data from 2009-14 and includes data from the following sources: Vital Statistics (VS) birth records, Behavioral Risk Factor Surveillance System (BRFSS), the Pregnancy Risk Assessment Monitoring System (PRAMS), Ohio Medicaid claims, and Ohio Hospital Association's (OHA) hospital discharge data. This publication goes further than its predecessor in its inclusion of postpartum risk factors. Also described are the Ohio GDM collaborative activities to increase awareness of GDM in Ohio and to change provider practice to increase postpartum screening for T2DM among women with a GDM history.

What is Gestational Diabetes Mellitus?

GDM is defined as abnormal glucose intolerance first occurring or identified during pregnancy (ACOG, 2013). While all women become somewhat glucose insensitive during pregnancy, GDM occurs when this normal insensitivity surpasses the corresponding insulin response, leading to abnormally elevated levels of blood glucose (hyperglycemia). While there may be clinical suspicion for this elevation to be unrecognized T2DM unless the clinical presentation is consistent with overt T2DM before pregnancy, it is classified as GDM (ADA, 2011). The prevalence of GDM in the United States is not precisely known, but estimates vary from 2 -10 percent (Hunt, 2007), impacting ~200,000 women annually (Gabbe, 2012). Successful management of GDM is associated with improved maternal and infant outcomes. While management is most often achieved through lifestyle changes, including improved nutrition and increased physical activity, some women may also require insulin or oral hypoglycemic agents.

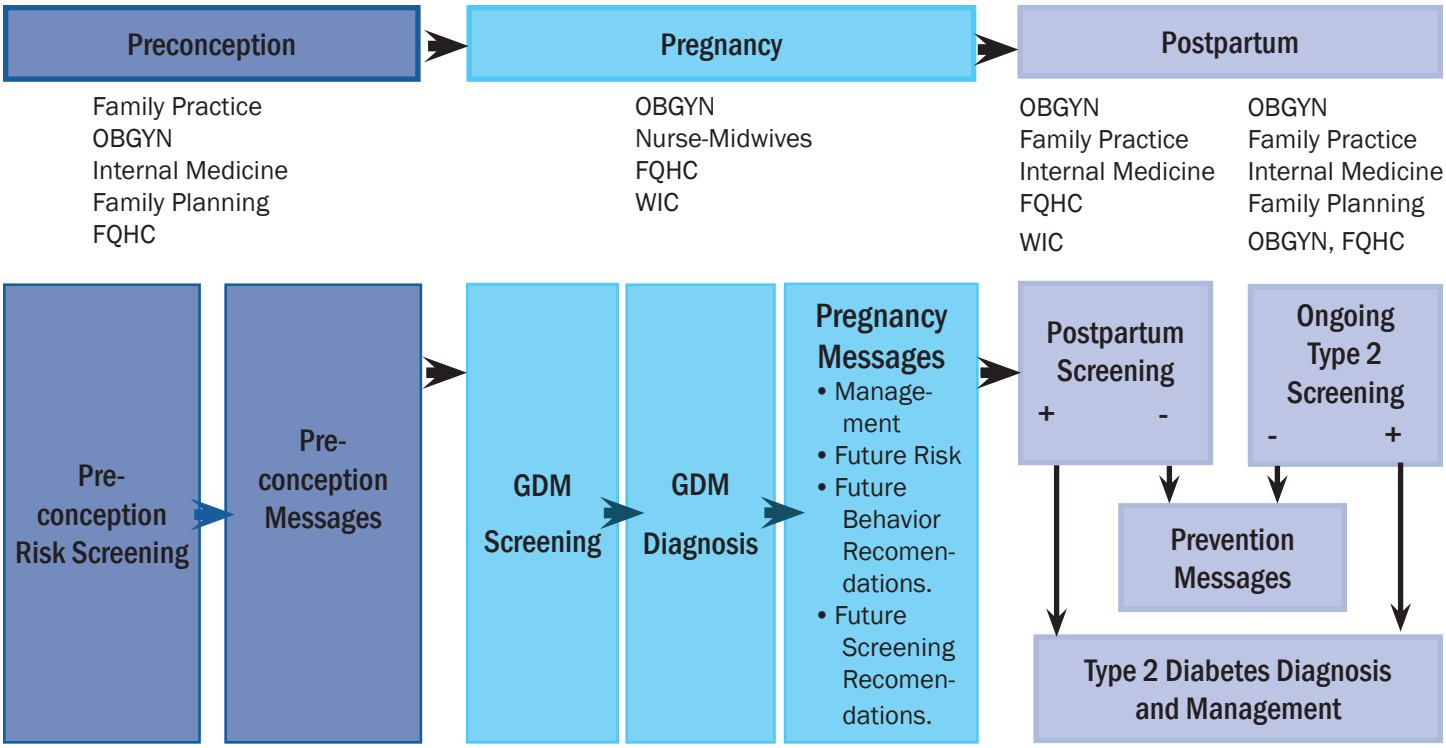
The Life Course: Maternal and Child Health Implications of GDM

The burden of GDM extends well beyond pregnancy. Women with a history of GDM are at increased risk for recurrence of GDM in future pregnancies (Getahun 2010; Kwak 2008) by 40 percent or more, a risk that continues to increase with each pregnancy (Getahun, 2010). Although most women with GDM return to normal glucose sensitivity immediately after delivery, up to one-third will either continue to have abnormal glucose intolerance or will develop overt T2DM (Gabbe, 2012). For those women with a return to normal postpartum blood glucose levels, all have an elevated lifetime risk of developing glucose intolerance and T2DM. In fact, as many as 50 pecent of women with a GDM history will be diagnosed with T2DM within the 20 years following a GDM-affected pregnancy (Kim, 2002). Furthermore, babies born to mothers with GDM are more likely to experience complications during and after delivery and are also at life-long risk for metabolic disease (e.g. T2DM and obesity).

Because of this, efforts to reduce the burden of GDM must consider a life course approach. This model accounts for the clinical, social, economic, and environmental factors that impact health throughout the stages of life (e.g. infancy, childhood, adolescence, preconception, pregnancy, and older age)*. The life course model considers maternal health as a product of a woman's developmental trajectory, as influenced by her early life experiences and the cumulative effect of those experiences over time (Lu, 2003).

This life course approach can be applied across the healthcare continuum for women with GDM. Figure 1 represents the interaction between women and healthcare providers before, during, and after pregnancy and the clinical management pathway for GDM prevention, management, and follow up. This visualization emphasizes the relationship between GDM risk, diagnosis, and progression to T2DM and can be used to plan interventions to reduce disease burden. The format of this databook follows this model. First, the prevalence of preconception risk factors for GDM are presented. This is followed by the population burden of GDM during pregnancies, in addition to prenatal complications of GDM. Next, birth outcomes associated with GDM deliveries are presented. Finally, we present postpartum care for women with a GDM pregnancy as well as postpartum behaviors that may impact risk for T2DM.

Figure 1: Gestational Diabetes Healthcare Continuum



*Association of Maternal & Child Health Programs. http://www.amchp.org/programsandtopics/LifecourseFinal/Pages/default.aspx Accessed 6/24/2014.

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Findings

Preconception: Risk Factors for GDM

Several factors are associated with an increased risk of developing GDM: a personal history of GDM; previous delivery of infant with a birth weight of more than 4,000 grams or 8.8 pounds; glucose present in the urine; first-degree family history of T2DM or GDM; history of unexplained fetal demise; maternal age greater than 25 years; and overweight or obese status (ACOG, 2013). While the association between smoking during pregnancy and GDM risk is inconclusive, several studies show a positive association (Wendland, 2008). Additionally, race and ethnicity play a significant role, with women of Hispanic, African, Native American, South/East Asian, and Pacific Islander ancestry having a higher risk for glucose intolerance during pregnancy (Creasy, 2004).

When considering GDM risk, it is important to understand that much of the difference in disease risk and subsequent health outcomes among populations (e.g., different race or ethnicities) comes not just from clinical or personal factors (i.e., genetics) but also from the social, economic, and/or environmental disadvantages impacting populations differently. Called health disparities, these disadvantages are considered the root cause of much of the variation in burden of disease in Ohio and the United States.

Health disparities transcend all sectors of the healthcare system, but are especially striking in maternal and child health. For example, black mothers have an increased risk of pregnancy complications as compared to white mothers (Lu, 2003); pregnant women whose first language is not English are more likely to have inadequate healthcare (Derose, 2000); black babies born in Ohio are more than twice as likely to die in their first year of life compared to white babies; and pregnant mothers who have a lower socioeconomic status are more likely to be uninsured and uneducated and have infants born with more adverse health outcomes (Lu, 2003).

The demographic characteristics of women of reproductive age (aged 18-44 years) in Ohio influence the risk for GDM in the population. Among Ohio women of reproductive age from 2011-13, 77.7 percent were white, 14.8 percent were black, and 3.1 percent were Hispanic (Table 1a.). About half (53.5 percent) of women were ever married, almost two thirds (61.3 percent) had a college education, and half (54.5 percent) resided in a metropolitan county. More than a half of women were covered by insurance from an employer (55.3 percent).

Table 1a. Prevalence of demographic preconception risk factors among women aged 18-44 years, Ohio 2011-13

		2011-13	
		%	95% CI
Overall (n=5393)			
Age (years)	18-24	29.1	27.4 - 31.0
	25-34	35.3	33.6 - 37.0
	35-44	35.5	33.9 - 37.1
Race/Ethnicity	Non-Hispanic White	77.7	75.8 - 79.6
	Non-Hispanic Black	14.8	13.2 - 16.4
	Hispanic	3.1	2.3 - 4.0
	Multi-racial	1.1	0.7 - 1.5
	Other	3.2	2.4 - 4.0
Marital Status[a]	Ever Married	53.5	51.7 - 55.3
	Never Married	46.5	44.6 - 48.3
Education	Less than High School	12.1	10.6 - 13.5
	High School Graduate	26.7	25.1 - 28.3
	Some College	35.9	34.1 - 37.6
	College Graduate	25.4	24.1 - 26.7
Insurance	Plan	83.9	82.5 - 85.3
	No Plan	16.1	14.7 - 17.5
Income-Level	Less than $15,000	16.7	15.3 - 18.3
	$15,000-$24,999	20.2	18.7 - 21.8
	$25,000- $34,999	11.5	10.3 - 12.8
	$35,000 -$49,000	13.3	12.0 - 14.5
	$50,000 or More	38.2	36.3 - 40.0
County Type[b]	Suburban	15.1	13.8 - 16.4
	Rural	13.1	11.9 - 14.3
	Metropolitan	54.5	52.6 - 56.3
	Appalachian	17.3	16.0 - 18.7

Source: Analyses using Behavioral Risk Factor Surveillance Survey (BRFSS) by Tyler Payne (Ohio Department of Health).

Footnotes: 95 percent confidence interval (CI): if the survey was repeated 100 times and 100 different confidence intervals were calculated, 95 percent of the intervals would contain the true estimate. The more narrow a CI, the more precise the estimate.

[a] Ever Married=Married, Divorced, Widowed, Separated; Never Married=Never Married, Member of Unmarried Couple

[b] Rural and suburban excludes counties otherwise designated as Appalachian by the Appalachian Regional Commission

[c] Includes those who reported multiple races

Table 1b displays preconception health status and presence of risk behaviors among women of reproductive age in Ohio. In 2011-13, more than half of Ohio women of childbearing age were overweight or obese. Furthermore, a fourth were ever smokers and one third did not attend a routine medical check-up in the past year.

Table 1b. Prevalence of preconception health status and risk behaviors among women aged 18-44 years, Ohio 2011-13

		2011-13	
		%	95% CI
Overall (n=5393)			
BMI (kg/m^2)	Underweight (< 18.5)	3.1	2.4 - 3.8
	Normal weight (18.5 - 24.99)	44.8	42.9 - 46.7
	Overweight (25.00-29.99)	25.5	23.8 - 27.1
	Obese (30.0+)	26.7	25.0 - 28.4
Smoker	Ever Smoker	28.4	26.7 - 30.0
	Never Smoker	71.6	70.0 - 73.3
History of Diabetes (not Gestational)	Yes	3.5	2.9 - 4.2
	No	96.5	95.8 - 97.1
History of Hypertension[a]	Yes	11.1	9.7 - 12.4
	No	88.9	87.6 - 90.3
Time since Last Routine Checkup-Up	Within the Past Year	66.4	64.7 - 68.1
	More than a Year	33.6	31.9 - 35.3
Exercise in the Past 30 Days[b]	Yes	77.8	76.2 - 79.3
	No	22.2	20.7 - 23.8

Source: Analyses using Behavioral Risk Factor Surveillance Survey (BRFSS) by Tyler Payne (Ohio Department of Health).

Footnotes: 95 percent confidence interval (CI): if the survey was repeated 100 times and 100 different confidence intervals were calculated, 95 percent of the intervals would contain the true estimate. The more narrow a CI, the more precise the estimate.

[a] Question not asked in 2012. Estimates derived from 2011 and 2013 data only

[b] Any physical activity or exercise outside of respondent's regular job

Table 2a displays the demographics of women who had a live birth in Ohio during 2006-08 and during 2009-11. More than half of the women who delivered a child in 2009-10 were between the ages of 25-34 years. Three-quarters of the women were white and 15 percent black. Almost 40 percent had high school education or less and 17 percent were uninsured.

Table 2a. Prevalence of preconception risk factors among women with a live birth, by demographics, Ohio 2006-08 and 2009-10

		2006-08		2009-10	
Overall (n)		(4358)		(2639)	
		%	95% CI	%	95% CI
Age (years)	18-24	34.3	32.4-36.3	32.7	30.3-35.2
	25-34	53.3	51.3-55.3	54.6	52.0-57.1
	35-44	12.4	11.2-13.7	12.7	11.2-14.5
Race/Ethnicity	Non-Hispanic White	76.9	75.7-78.1	76.8	75.3-78.3
	Non-Hispanic Black	14.7	14.4-15.1	15.3	14.9-15.8
	Hispanic	3.3	2.6-4.2	3.4	2.5-4.6
	Other[a]	5.0	4.2-6.1	4.5	3.5-5.7
Education	Less than HS	14.7	13.2-16.4	13.9	12.1-15.9
	HS Graduate	28.0	26.2-29.8	25.2	23.0-27.6
	Some College	21.1	19.6-22.7	22.3	20.3-24.4
	College Graduate	36.2	34.4-38.1	38.7	36.3-41.2
Pre-Pregnancy Health Insurance[b,c]	Uninsured	36.3	34.4-38.3	17.3	15.3-19.4
	Medicaid	15.2	13.9-16.7	23.6	21.6-25.8
	From Job	--	--	55.3	52.8-57.9
	Self Pay (not from job)	--	--	3.8	2.9-5.0
	TRICARE or Other Military	--	--	1.4	0.9-2.1
	Other	--	--	3.4	2.5-4.5
Annual Household Income	Less than $15,000	28.9	27.1-30.8	31.6	29.2-34.1
	$15,000-$24,999	13.0	11.6-14.5	13.4	11.7-15.4
	$25,000- $34,999	11.4	10.1-12.8	8.4	7.0-9.9
	$35,000 -$49,999	10.9	9.6-12.2	11.0	9.5-12.8
	$50,000 or More	35.9	34.0-37.9	35.6	33.2-38.1
County Type[d]	Metropolitan	52.4	50.4-54.3	55.0	52.5-57.5
	Suburban	16.4	15.0-18.0	16.0	14.2-18.1
	Appalachian	16.4	14.9-18.0	14.8	13.0-16.8
	Rural	14.9	13.4-16.4	14.2	12.4-16.1

Source: Analyses using Pregnancy Risk Assessment Monitoring System by Missy Vonderbrink Ohio Department of Health.

Footnotes: 95 percent confidence interval (CI): if the survey was repeated 100 times and 100 different confidence intervals were calculated, 95 pecent of the intervals would contain the true estimate. The more narrow a CI, the more precise the estimate.

[a] Includes those who reported multiple races

[b] Significant change in structure of survey questions about pre-pregnancy health insurance in 2009-10. Comparison with 2006-08 may not be valid

[c] In 2009-10, mothers could select all insurance options that applied, therefore total will not add up to 100 percent

[d] Rural and suburban excludes counties otherwise designated as Appalachian by the Appalachian Regional Commission

Table 2b displays behavioral and health status risks during the preconception period among women who had a live birth in Ohio during 2006-08 and during 2009-11. Almost a quarter of women (24.3 percent) were obese before pregnancy in 2009-10, representing an increase from 2006-08. Almost one in ten Ohio women were diagnosed or treated for hypertension before becoming pregnant. Behaviors also put women at risk of gestional diabetes. Fewer than one third of women having a live birth in 2009 or 2010 reported having a visit with a health care provider in the year before becoming pregnant (29.8 percent). Fewer than half reported exercising at least 3 times per week before pregnancy. Further, about one third of women reported smoking cigarettes in the past two years, and this risk behavior has increased. In addition, significantly more women (37.3 percent) indicated that they smoked in the past 2 years in 2009 and 10 compared to 2006-08 (32.5 percent).

Table 2b. Prevalence of preconception health status and behavioral risk factors among women with a live birth, Ohio 2006-08 and 2009-10

	2006-08		2009-10	
Overall (n)	(4358)		(2639)	
	%	95% CI	%	95% CI
History of Diabetes (not Gestational)				
Yes	2.6	2.0-3.3	1.9	1.3-2.7
Checked/Treated for Hypertension Before Pregnancy				
Yes	--	--	9.3	7.9-10.8
Pre-Pregnancy BMI (kg/m^2)				
Underweight (< 18.5)	6.9	6.0-8.0	7.6	6.3-9.1
Normal weight (18.5 - 24.9)	48.0	46.0-50.0	44.4	41.9-47.0
Overweight (25.0-29.9)	23.8	22.2-25.6	23.7	21.5-26.0
Obese (30.0+)	21.2	19.7-22.9	24.3	22.2-26.6
Smoker				
Smoked in the Past 2 Years	32.5	30.6-34.5	37.3	34.8-39.9
Preconception Visit[a]				
Yes	27.4	25.7-29.2	29.8	27.5-32.1
No	72.6	70.9-74.4	70.2	67.9-72.5
Pre-Pregnancy Exercise 3+ times per week[b]				
Yes	--	--	41.8	39.2-44.3
No	--	--	58.3	55.7-60.8

Source: Analyses using Pregnancy Risk Assessment Monitoring System by Missy Vonderbrink (Ohio Department of Health).

Footnotes: 95 percent confidence interval (CI): if the survey was repeated 100 times and 100 different confidence intervals were calculated, 95 percent of the intervals would contain the true estimate. The more narrow a CI, the more precise the estimate.

[a] Based on answers to the question: "*Before* you got pregnant with your new baby, did a doctor, nurse, or other health care worker talk with you about how to prepare for a healthy pregnancy and baby?"

[b] Based on answers to the question: "During the 3 months before you got pregnant with your new baby, how often did you participate in any physical activities or exercise for 30 minutes or more?"

GDM Screening and Diagnosis

The use of historical or clinical risk factors as a screening tool during pregnancy are limited in success while important tools for identifying women at risk for GDM fail to identify approximately half of all GDM cases (ACOG, 2013); thus, laboratory screening of all pregnant women for GDM is universally recommended (ACOG, 2013). Because early treatment improves outcomes, screening is most often done between 24-28 weeks gestation as this period corresponds with normal pregnancy-related changes in glucose sensitivity. Screening can be done prior to 20 weeks gestation for patients at a high risk of developing GDM (i.e., prior pregnancy complicated by GDM). If this early screen is negative, the test is repeated at the standard time.

Two approaches for laboratory screening are currently recommended. The one-step procedure combines both screening and diagnosis through a single fasting 75-gram glucose load with pre-load, one- and two-hour post-load blood glucose measurements and is advocated by the American Diabetes Association (Landon, 2011). Diagnosis of GDM is made with an elevation of any of the following three values:

- Fasting: >92 mg/dL *but* <126 mg/dL
- One hour: >180 mg/dL
- Two hour: >153 mg/dL

The two–step procedure, first proposed in 1973 (O'Sullivan, 1973), is recommended by the American College of Obstetricians and Gynecologists (ACOG, 2013). The screening part of the two-step process consists of a non-fasting 50-gram oral glucose load with subsequent blood glucose measurement at one hour. While there is no universal threshold for this initial step, blood glucose values at or below either 135 or 140 mg/dL are typically considered acceptable. Women with abnormal values are then given a second diagnostic test consisting of a fasting 100-gram glucose load and subsequent glucose measurements. Two sets of diagnostic criteria are currently used in the United States: criteria established by Carpenter and Coustan and those from the National Diabetes Data Group (Coustan, 1993). While there is little evidence to suggest using one set over another, at least one study has demonstrated a 50 percent increase in GDM diagnoses using the Carpenter & Coustan criteria (Ferrara, 2002). Threshold values for both criteria are listed in Table 3.

Table 3. Diagnostic Criteria for Diagnostic Step of Two-Step Gestational Diabetes Mellitus Procedure[a]

	Carpenter & Coustan (mg/dL)	National Diabetes Data Group (mg/dL)
Fasting	95 or higher	105 or higher
At 1 hour	180 or higher	190 or higher
At 2 hours	155 or higher	165 or higher
At 3 hours	140 or higher	145 or higher

[a]Test using 100 gram glucose load

Several other countries and a number of organizations within the U.S. support the one-step approach. However, a 2013 National Institutes of Health expert panel recommended the two-step approach until further studies are conducted. This recommendation was confirmed by ACOG.

Incidence of GDM in Ohio

Gestational Diabetes incidence refers to the annual diagnosis rate, or the number of new cases of GDM diagnosed within pregnancies that were completed that year. Incidence can be estimated from several systems, though each has limitations (see Table 4).

Table 4. Summary of GDM Incidence in Ohio, multiple sources, 2009-14

	Pregnancy Risk Assessment Monitoring System (2009-10)	Vital Statistics (2012-2014)	Ohio Hospital Association Discharge Data (2013)	Medicaid Claims Data (2012-14)
GDM Incidence (Percent)	10.1%	6.7%	6.8%	12.5%

Estimates from PRAMS show that GDM incidence in 2009-10 was 10.1 percent. This was based on Phase 6 of PRAMS where GDM was determined by the following question: "During your most recent pregnancy, were you told by a doctor, nurse, or other health care worker that you had gestational diabetes (diabetes that started during *this* pregnancy)?" Comparatively, in 2006-08, GDM incidence estimate from PRAMS was 10.0 percent. This was from Phase 5 of PRAMS where GDM was determined by the following question: "Did you have high blood sugar (diabetes) that started during pregnancy?" PRAMS has been shown to overestimate GDM prevalence (Choi, 2005). Estimates from VS and OHA are similar at 6.7 percent of live births and 6.8 percent of delivery hospitalizations. VS has been shown to underestimate GDM prevalence (Northam, 2016; Devlin, 2009; Deitz, 1998). Medicaid claims for a delivery associated with GDM had the highest incidence at 12.5 percent.

Acccording to VS, GDM prevalence has increased in Ohio overall and with most population subgroups (see Table 5a). Among women with a live birth during the years 2006-08, 2009-12, and 2012-14, higher incidence of GDM were found among women 45 years or greater; who were not black, white or Hispanic; who were married; born outside of the US; with some college education; insured by Medicaid or residing in an Appalachian county.

Table 5a. GDM incidence among women with a live birth, by demographics, Ohio 2006-08, 2009-11, and 2012-14

		2006-08 (n=438373)		2009-11 (n=412631)		2012-14 (n=411357)	
		%	95% CI	%	95% CI	%	95%
Overall		**4.9**	**4.8-4.9**	**5.8**	**5.8-5.9**	**6.7**	**6.7-6.8**
Age (years)	18-24	2.7	2.6 -2.8	3.3	3.2-3.4	3.9	3.8-4.0
	25-34	5.6	5.5 -5.7	6.6	6.5-6.7	7.2	7.1-7.3
	35-44	9.0	8.7 -9.2	10.6	10.3-10.8	12.4	12.1-12.7
	45+*	12.0	9.2 -14.9	13.2	10.4-16.0	18.7	15.4-22.0
Race/Ethnicity	Non-Hispanic White	4.8	4.7-4.9	5.7	5.6-5.8	6.6	6.5-6.7
	Non-Hispanic Black	4.2	4.1 -4.3	5.1	5.0-5.3	5.9	5.7-6.0
	Hispanic	6.3	5.9 -6.6	7.6	7.2-7.9	8.8	8.4-9.2
	Other[a]	9.0	8.5 -9.6	10.8	10.2-11.3	11.9	11.4-12.4
Currently Married	Yes	5.7	5.6 -5.8	6.6	6.5-6.7	7.6	7.5-7.7
	No	3.7	3.6 -3.8	4.8	4.7-4.9	5.6	5.5-5.7
Education	Less than High School	3.4	3.2-3.5	4.2	4.1-4.4	4.9	4.7-5.1
	High School Graduate	4.8	4.7-5.0	5.8	5.6-5.9	6.5	6.3-6.6
	Some College	5.4	5.2-5.5	6.4	6.3-6.6	7.2	7.0-7.4
	College Graduate	5.3	5.2-5.4	6.2	6.1-6.3	7.3	7.2-7.4
Migrant Status	US Born	4.7	4.6-4.7	5.6	5.5-5.6	6.4	6.3-6.5
	Foreign Born	6.9	6.7-7.2	8.8	8.5-9.1	10.0	9.7-10.3
Medicaid	Yes	4.3	4.2-4.4	5.3	5.2-5.4	6.4	6.3-6.5
	No	5.3	5.3-5.4	6.2	6.1-6.3	7.0	6.9-7.1
WIC	Yes	4.5	4.4-4.6	5.7	5.6-5.8	6.7	6.6-6.9
	No	5.1	5.0-5.2	6.0	5.9-6.1	6.8	6.7-6.9
County Type	Metropolitan	4.8	4.5-5.1	6.6	6.3-7.0	8.1	7.8-8.5
	Suburban	4.7	4.6-4.9	5.4	5.2-5.5	6.0	5.8-6.2
	Appalachian	4.4	4.3-4.6	6.1	5.9-6.3	7.7	7.5-7.9
	Rural	4.7	4.5-4.8	5.5	5.3-5.6	6.5	6.3-6.6
Birth Order	First Born	7.6	6.0-9.6	7.4	5.5-9.9	N/A	N/A
	Not First Born/Unknown	10.9	9.5-12.6	11.2	9.4-13.3	N/A	N/A

Sources: Analyses using Vital Statistics by BJ Matson and Elizabeth Conrey (Ohio Department of Health).

Footnotes:
95 percent confidence interval (CI): if the survey was repeated 100 times and 100 difference confidence intervals were calculated, 95 percent of the intervals would contain the true estimate. The more narrow a CI, the more precise the estimate.
* Too small for meaningful analysis; less than 30 respondents in subpopulation for mothers ≥ 45 years
[a] Includes those who reported multiple races

Table 5b displays GDM incidence by maternal behaviors, health status, and health care utilization. GDM incidence increased from 2006-08 to 2012-14 within all subgroups. Incidence was greater among non smokers compared with smokers. Furthermore, incidence increased with increasing BMI category; GDM incidence was about three times higher in obese women compared to normal weight women. GDM incidence was also associated with gestational hypertension; women with hypertension had almost two times the GDM incidence as normotensive women.

Table 5b. GDM incidence among women with a live birth, by pregnancy risk factors, Ohio 2006-08, 2009-11, and 2012-14

	2006-08		2009-11		2012-14	
	Percentage of Respondents with GDM in Most Recent Pregnancy					
	%	9% CI	%	95% CI	%	95% CI
Smoker						
Yes	4.3	4.2-4.4	5.8	5.6-5.9	6.4	6.3-6.6
No	5.3	5.3-5.4	5.9	5.8-6.0	6.8	6.7-6.9
First Trimester Prenatal Care						
Yes	3.7	3.6-3.7	4.4	4.4-4.5	5.1	5.1-5.2
No	1.1	1.1-1.2	1.4	1.3-1.4	1.7	1.6-1.7
Pre-pregnancy BMI ($kg/m^{2)}$						
Underweight (BMI<18.5)	2.0	1.8-2.2	2.4	2.2-2.7	2.9	2.6-3.2
Normal weight (18.5-24.99)	2.6	2.6-2.7	3.3	3.2-3.3	3.7	3.6-3.8
Overweight (25.00-29.99)	5.1	4.9-5.2	6.0	5.8-6.1	6.6	6.5-6.8
Obese (30.0+)	9.7	9.5-9.9	11.1	10.9-11.3	12.5	12.3-12.7
Weight gain during pregnancy[a]						
Inadequate	5.7	5.6-5.9	6.9	6.7-7.1	8.0	7.8-8.2
Excessive	4.4	4.3-4.5	5.3	5.2-5.4	6.0	5.9-6.1
Gestational Hypertension						
Yes	9.2	8.8-9.7	10.9	10.5-11.3	12.2	11.8-12.6
No	4.7	4.6-4.7	5.6	5.5-5.6	6.4	6.3-6.4

Source: Analyses using Vital Statistics 2006-2012 by BJ Matson and Elizabeth Conrey (Ohio Department of Health).

Footnotes:
95 percent confidence interval (CI): if the survey were repeated 100 times and 100 different confidence intervals were calculated, 95 percent of the intervals would contain the true estimate. The more narrow a CI, the more precise the estimate.
[a] Weight gain during pregnancy defined using the IOM 2009 guidelines (http://iom.edu/~/media/Files/Report%20Files/2009/Weight-Gain-During-Pregnancy-Reexamining-the-Guidelines/Report%20Brief%20-%20Weight%20Gain%20During%20Pregnancy.pdf)

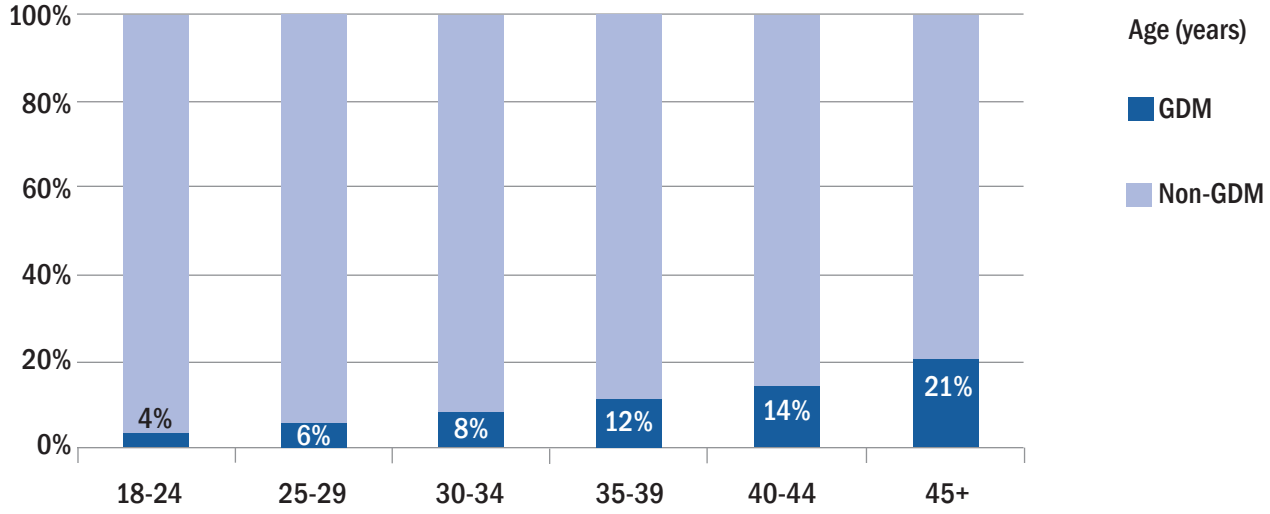
Table 6: Incidence of GDM among delivery hospitalizations, by year, Ohio 2006-13

Year	GDM Incidence (%)
2006	5.1
2007	5.4
2008	5.2
2009	5.8
2010	6.1
2011	6.4
2012	6.8
2013	6.8

Source: Analysis of Ohio Hospital Association Discharge data, 2006-07 analyzed by Reena Oza-Frank and 2008-13 by Kelci Haydocy.

The proportion of delivery discharges associated with GDM varied by the age of the mother. Figure 2 displays the proportion of obstetric discharges associated with a GDM diagnosis, by age group. Among women aged 18-24 years with an obstetric discharge, 4 percent had GDM, whereas among women aged 45 years and older, 21 percent had GDM-related.

Figure 2. Proportion of GDM-related obstetric discharges, by age group, Ohio 2011-13



Source: Analysis of Ohio Hospital Association Discharge data by Kelci Haydocy

The Table 7 displays the incidence of GDM among deliveries billed to Medicaid insurance by year from 2007-12. The proportions of deliveries that were associated with GDM increased from 9.5 percent to 12 percent. Furthermore, increases were observed within all age and race/ethnicity groups, and within women living in both urban and non-urban areas.

Table 7. Incidence of GDM among Ohio Medicaid deliveries, by year, 2007-14

(n=552,757)		2007 (%)	2008 (%)	2009 (%)	2010 (%)	2011 (%)	2012 (%)	2013 (%)	2014 (%)
Overall		**9.5**	**9.8**	**10.7**	**11.6**	**12.2**	**13.2**	**12.1**	**12.2**
Age (years)[a]	18-24	7.2	7.4	8.2	8.9	9.0	9.3	8.0	8.2
	25-34	13.0	13.3	14.0	14.8	15.7	15.5	14.9	14.5
	35-44	21.1	21.1	22.5	23.0	23.6	24.8	23.8	24.0
Race [b]	Non-Hispanic White	10.3	10.6	11.7	12.8	13.3	13.3	12.8	--
	Non-Hispanic Black	7.6	7.7	8.4	8.6	9.7	10.2	10.3	--
	Hispanic	9.1	10.7	11.0	10.5	12.1	12.9	13.8	--
	Non-Hispanic Other	12.2	13.0	12.6	13.1	13.0	14.6	10.8	--
Urbanicity	Urban	8.9	9.0	9.7	10.3	11.4	11.9	11.8	11.9
	non-Urban	10.0	10.6	11.7	12.8	13.0	13.0	12.4	12.6

Source: Analysis of 2007-11 data obtained from Ohio Department of Medicaid QDSS (Medstat Advantage Suite® V 4.0, Truven Health Anlytics) accessed April and May, 2014 by Don Reed Ohio Department of Health; analysis of 2012-14 data were peformed by Habteab Gebreab, Ohio Department of Medicaid.

Notes:
Deliveries were identified by an admission for DRG's 765 - 768, 774 or 775
Gestational diabetes is identified by a principal or secondary diagnosis code of 64880 - 64884 on a facility or professional claim during the 270 days period prior to delivery admission.
A postpartum visit is identified by ICD-9, CPT and UB codes specified by HEDIS® on a facility or professional claim during the 21 to 56 day period after delivery.
Data from the following provider types were included:

- Comprehensive Clinic
- Federally Qualified Health Center
- General Hospital
- Nurse Midwife
- Nurse Practitioner
- Physician Group
- Physician Individual
- Public Health Department Clinic

[a] Less than 30 respondents in subpopulation for mothers ≥ 45 years therefore that age group is too small for meaningful analysis

[b] After 2013 data on race and ethnicity are no longer collected for all Medicaid enrollees

Maternal and Infant Complications

Birth-related complications of GDM include an increased risk of cesarean delivery (and associated risks, such as infection and damage to maternal bowel, bladder, or uterus) and of developing gestational hypertension or pre-eclampsia (ACOG, 2013). As a result of blood glucose crossing the placenta, maternal hyperglycemia precipitates metabolic changes in the fetus, including an increased secretion of insulin causing an increased growth rate and eventual macrosomia *. The high growth rate and larger size accounts for many of the delivery complications seen in newborns born to mothers with GDM, such as a higher risk for cesarean delivery, elevated bilirubin (jaundice), and shoulder dystocia or other birth trauma. The increased fetal insulin secretion increases the likelihood of low blood glucose (hypoglycemia) upon delivery and cutting of the umbilical cord, often requiring medical intervention. These newborns also are more likely to experience neonatal apnea after birth. In addition to these complications, untreated or undertreated GDM is associated with higher rates of infant mortality (Ostlund, 2003). The long-term impact of GDM on infant health extends throughout the lifespan. Fetal macrosomia and GDM are correlated with the development of obesity (in childhood and as an adult), diabetes, and metabolic syndrome (Dabelea, 2007). Therefore, optimizing the treatment of GDM is important to improve not only infant health, but childhood metabolic health and to reduce population-level diabetes burden.

Tables 8a and 8b show prevalence of delivery-related maternal and infant outcomes that may be associated with a GDM pregnancy. During 2009-2010, infants born after a GDM pregnancy had longer hospital stays, and women with GDM were more likely to have high blood pressure during pregnancy and deliver by cesarean section. Additionally, babies born with Apgar scores of 5-6 were more likely to have a mother with GDM than babies with high scores (data not shown).

Table 8a. Prevalence of maternal and delivery outcomes, by GDM status, Ohio 2006-08 and 2009-10

	2006-08					2009-10				
	% With GDM	95% CI	% Without GDM	95% CI	P-Value	%With GDM	95% CI	% With-out GDM	95% CI	P-Value
Infant										
Baby in ICU	16.1	12.4-20.5	10.7	9.7-11.8	0.01	13.5	9.7-18.4	10.4	9.1-11.8	ns
Length of Hospitalization					p<0.01					p=0.05
1-2 days	48.2	41.8-54.7	57.9	55.8-559.9		53.3	45.3-61.2	61.8	59.2-64.3	
3 days	24.5	19.3-30.6	22.9	21.2-24.7		35.2 (3-5 days)	28.0-43.4	28.7 (3-5 days)	26.3-31.1	
4 days	13.3	9.5-18.3	7.5	6.5-8.6						
5 days	4.0	2.3-7.0	2.5	2.0-3.2						
6 days +	8.9	6.5-12.1	6.8	6.0-7.6		10.1	6.7-15.0	6.8	5.9-7.9	
Maternal										
High Blood Pressure	23.3	18.6-28.8	12.0	10.8-13.4	<0.01	24.8	18.7-32.2	13.5	11.8-15.4	<0.01
Preterm Labor	20.7	25.2-36.9	23.9	22.2-25.7	<0.01	29.4	22.7-37.1	22.3	20.2-24.6	ns
Cesarean Section Delivery	37.1	31.3-43.3	28.4	26.6-30.3	<0.01	46.8	39.0-54.8	28.9	26.5-31.3	<0.01

Source: Pregnancy Risk Assessment Monitoring System, Ohio Department of Health.

Footnotes:
PRAMS Phase 5 of (2004-08) GDM was determined by the following questions: "Did you have high blood sugar (diabetes) that started during this pregnancy?"
PRAMS Phase 6 (2009-11) GDM was determined by the following question: "During your most recent pregnancy, were you told by a doctor, nurse, or other health care worker that you had gestational diabetes (diabetes that started during this pregnancy)?"
95 percent confidence interval (CI): if the survey were repeated 100 times and 100 different confidence intervals were calculated, 95 percent of the intervals would contain the true estimate. The more narrow a CI, the more precise the estimate.
* CDC. Gestational Diabetes and Pregnancy. http://www.cdc.gov/pregnancy/diabetes-gestational.html

Table 8b. Prevalence of delivery complications, by GDM status, Ohio 2006-08, 2009-11, and 2012-14

	2006-08				2009-11				2012-14			
	% With GDM	95% CI	% W/out GDM	95% CI	% GDM	95% CI	% W/out GDM	95% CI	% With GDM	95% CI	% W/out GDM	95% CI
Preterm												
Preterm	15.6	15.1-16.0	10.5	10.5-10.6	14.9	14.5-15.4	9.9	9.8-10.0	14.4	14.0-14.8	10.0	9.9-10.1
NICU Admission												
Yes	9.4	9.0-9.8	5.9	5.8-5.9	10.3	9.9-10.7	6.5	6.4-6.6	12.1	11.7-12.5	8.0	7.9-8.1
C-section												
Yes	43.2	42.5-43.8	29.2	29.1-29.3	44.2	43.6-44.8	30.2	30.0-30.3	44.0	43.4-44.6	29.9	29.8-30.1
Apgar Group												
0-4	1.3	1.2-1.5	1.4	1.3-1.4	1.1	1.0-1.3	1.2	1.1-1.2	1.1	0.9-1.2	1.1	1.1-1.2
5-6	2.1	1.9-2.3	1.6	1.6-1.6	1.4	1.3-1.6	1.3	1.2-1.3	1.5	1.4-1.6	1.3	1.2-1.3
7-10	96.5	96.2-96.7	96.7	96.7-96.8	97.3	97.1-97.5	97.3	97.3-97.4	97.3	97.1-97.5	97.3	97.3-97.4

Footnotes:
Source: Analyses using Vital Statistics 2006-12 by BJ Matson and Elizabeth Conrey (Ohio Department of Health).
95 percent confidence interval (CI): if the survey were repeated 100 times and 100 different confidence intervals were calculated, 95 percent of the intervals would contain the true estimate. The more narrow a CI, the more precise the estimate.

Postpartum and Ongoing Care

The initial postpartum visit is a time to reinforce healthy lifestyles and discuss family planning and provides the venue to follow-up on clinical concerns after pregnancy. Typically occurring 4-6 weeks after delivery, the visit is also a critical time to assess risk for developing T2DM. Pregnancy is often considered to be a "stress test" for future development of T2DM; GDM can be the first warning for a future metabolic failure. Immediately after delivery, up to one-third of women with GDM will either continue to have abnormal glucose intolerance or will have developed overt T2DM, however, most women will return to normal glucose sensitivity (ACOG, 2013; Gabbe, 2012).

For women who return to normal postpartum blood glucose levels, all have an elevated lifetime risk of developing glucose intolerance and T2DM. In fact, as many as 50 percent of women with a GDM history will be diagnosed with T2DM within the 20 years following a GDM-affected pregnancy (Kim, 2002). Women with GDM history are also at increased risk for other complications such as metabolic syndrome (insulin resistance, dyslipidemia, and hypertension) and cardiovascular disease (Wizntzer, 2009). Table 9 presents the published proportion of women with prediabetes or T2DM at the postpartum visit, and at 1 and 10 years following delivery.

Table 9. Proportion of women with gestational diabetes who develop prediabetes or type 2 diabetes at postpartum visit, 5 years postpartum, and 10 years postpartum

Condition (fasting plasma glucose)	At post-partum visit	After 5 years	After 10 years
Pre-diabetes (100-<126 mg/dl)	~25%	~80%	No studies yet, >80%?
Type 2 diabetes (>126 mg/dl)	~10%	~50%	~70%

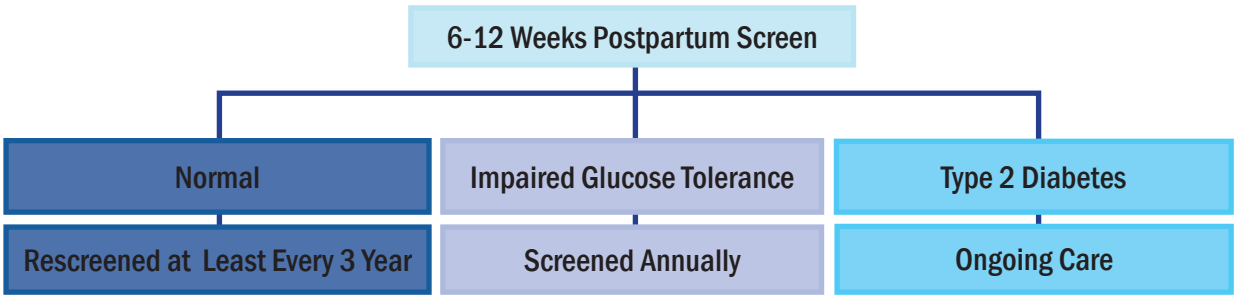
Sources:

1. Kjos SL, Buchanan TA, Greenspoon JS, et all. *Gestational Diabetes mellitus: the prevalence of glucose intolerance and diabetes mellitus in the first two months postpartum. AM J Obstet Gynec 1990; 163:93-8*
2. Kim C, Newton KM, Knopp RH. *Gestational diabetes and the incidence of type 2 diabetes:a systematic review.* Diabetes Care 2002; 25(10): 1862-8
3. Dietz PM, Vesco KK, Callaghan WM et al. *Postpartum screening for diabetes after a GDM-affected pregnancy.* Obstet Gynecol 2008; 112(4): 868-74.

Women with a history of GDM are also at an increased risk for recurrence of GDM in subsequent pregnancies (Getahun, 2010; Kwak, 2008). For example, women with a GDM history have been noted to have a 41.3 percent risk of developing GDM in a second pregnancy, compared to 4.2 percent in women without a GDM history (Getahun, 2010). Furthermore, this risk increased as the number of GDM-affected pregnancies increased (Getahun, 2010).

The American Diabetes Association (ADA) and ACOG guidelines recommend women with GDM be screened for persistent hyperglycemia or T2DM at 6 to 12 weeks after delivery, then, subsequently every 1 to 3 years, as shown in Figure 2. Recommendations from ACOG for testing include either fasting blood glucose or 75-gram oral glucose tolerance test (OGTT). While a single fasting value is more convenient for the woman, the OGTT is more sensitive in the identification of T2DM and other conditions of abnormal glucose intolerance (England, 2009). More frequent screening may be advised based on individual risk factors. Repeated and life-long screening allows for timely identification of prediabetes or T2DM and increases success with efforts to prevent progression of or to manage T2DM.

Figure 3. Postpartum blood glucose screening pathway



Source: (ADA#2/ACOG#2)

Despite these recommendations, rates of postpartum screening range from 20 percent to 57.8 percent (Dietz, 1998). Women who fail to return for screening after pregnancy have been found to have more severe GDM (higher glucose levels during pregnancy and/or need for medication or insulin for treatment) compared with women who returned for screening (Hunt, 2007). Additionally, women who did not return for screening were more likely to have previously had GDM and higher pre-pregnancy weight than women who did return for screening (Hunt, 2007).

In Ohio, self-reported postpartum visit rates were around 90 percent among women with GDM in both 2006-08 and 2009-10 (Table 10). In 2009-10, differences in postpartum visit rates were found by race/ethnicity and by WIC status. Non-Hispanic black women and women enrolled in WIC were less likely to report completing a visit following a GDM pregnancy.

Table 10. Prevalence of self-reported postpartum visit completion, Ohio 2006-08 and 2009-10

	2006-08						2009-10					
	% With GDM	95% CI	p-value	% W/out GDM	95% CI	p-value	% With GDM	95% CI	p-value	% W/ out GDM	95% CI	p-value
Overall (n)	**90.5 (382)**	**86.3-93.5**		**90.0 (3513)**	**88.6-91.2**		**91.0 (259)**	**85.4-94.6**		**90.4 (2146)**	**88.6-91.9**	
Age (years)			**ns**			**ns**			**ns**			**0.05**
<18	–			88.0	78.6-93.6		–	–		86.9	72.5-94.3	
18-24	87.5	77.4-93.5		86.3	83.5-88.7		90.8	79.3-96.2		87.1	83.4-90.0	
25 - 34	92.2	86.5-95.7		92.1	90.4-93.6		90.3	80.4-95.4		92.2	89.8-94.0	
35-44	89.4	78.2-95.2		92.1	88.3-94.7		92.0	80.8-96.9		92.7	87.7-95.8	
45+	–	–		–	–		–	–		–	–	
Race/Ethnicity			**0.04**			**0.02**			**<0.01**			**ns**
Non-Hispanic White	90.7	85.5-94.1		90.9	89.4-92.4		95.2	88.5-98.0		91.0	88.9-92.8	
Non-Hispanic Black	85.3	76.4-91.3		87.1	84.7-89.1		81.2	70.7-88.5		86.4	83.1-89.1	
Hispanic	–	–		87.6	77.8-93.4		–	–		91.5	76.5-97.3	
Other	–	–		85.5	76.7-91.4		–	–		92.6	83.9-96.8	
Marital Status			**0.04**			**<0.01**			**ns**			**<0.01**
Married	93.5	88.7-96.4		92.4	90.8-93.8		92.3	84.0-96.5		93.9	91.9-95.5	
Unmarried	84.6	75.6-90.7		86.4	84.0-88.5		89.4	80.0-94.6		85.7	82.5-88.4	
Education			**ns**			**<0.01**			**ns**			**<0.01**
Less than High School	81.8	65.9-91.3		81.5	76.7-85.5		96.7	88.4-99.1		76.2	69.2-82.1	
High School grad	90.1	81.9-94.8		86.6	83.5-89.1		79.9	62.4-90.5		88.2	84.1-91.3	
Some college	93.1	84.0-97.2		92.0	89.5-93.9		95.4	89.1-98.1		91.7	88.3-94.2	
College grad	92.6	83.5-96.8		95.7	94.1-96.9		93.6	84.9-97.5		97.0	95.1-98.1	
County Type			**ns**			**ns**			**ns**			**<0.01**
Metro	91.7	86.9-94.9		89.8	88.0-91.3		87.0	77.3-92.9		89.1	86.6-91.1	
Suburban	89.1	73.3-96.1		89.8	86.0-92.6		94.3	78.4-98.7		95.7	92.2-9.7	
Appalachia	87.8	72.0-95.2		88.9	84.7-92.0		98.1	94.6-99.3		85.4	79.0-90.1	
Rural	90.2	75.4-96.5		92.1	88.4-94.7		93.4	74.4-98.6		94.8	90.1-97.3	
Insurance Status (Prenatal Care)[a]									**N/A**			**N/A**
Uninsured	N/A	N/A		N/A	N/A		–	–		70.7	53.2-83.7	
Medicaid	85.6	77.1-91.4		85.6	82.9-87.9		86.0	76.0-92.3		86.0	82.8-88.6	
Health Insurance From Job	N/A	N/A		N/A	N/A		97.0	90.1-99.1		95.8	93.9-97.1	
Health Insurance Paid For (not from job)	N/A	N/A		N/A	N/A		–	–		99.2	97.5-99.8	
TRICARE Or Other Military Health Care	N/A	N/A		N/A	N/A		–	–		94.5	76.3-98.9	
Other	N/A	N/A		N/A	N/A		–	–		85.6	73.3-92.8	
Migrant Status			**p<0.01**			**ns**			**ns**			**ns**
U.S. Born	89.6	85.1-92.9		90.3	88.9-91.5		91.5	85.6-95.1		90.5	88.7-92.1	
Foreign-Born	98.3	95.7-99.7		85.6	78.6-90.6		–	–		88.6	80.2-93.7	
WIC during Pregnancy			**0.05**			**<0.01**			**0.02**			**<0.01**
Yes	86.0	78.1-91.4		87.3	84.5-89.3		86.6	76.7-92.7		87.2	84.1-89.7	
No	93.7	88.7-96.5		91.9	90.2-93.3		96.9	91.7-98.9		93.0	90.9-94.7	

Table 10 (con't)
Source: Pregnancy Risk Assessment Monitoring System (PRAMS), Ohio Department of Health.
Footnotes:
Phase 5 of PRAMS (2004-08), GDM was determined by the following questions: "Did you have high blood sugar (diabetes) that started during this pregnancy?" ; Phase 6 (2009-11) GDM was determined by the following question: "During your most recent pregnancy, were you told by a doctor, nurse, or other health care worker that you had gestational diabetes (diabetes that started during this pregnancy)?"
Based on answers to the question : Since your new baby was born, have you had a postpartum checkup yourself? (A postpartum checkup is a regular checkup a women has after she gives birth).
Ninety-five percent confidence interval (CI): if the survey were repeated 100 times and 100 different confidence intervals were calculated, 95 percent of the intervals would contain the true estimate. The more narrow a CI, the more precise the estimate.
[a] Refers to insurance status for prenatal care. Significant change in structure of survey questions about health insurance for prenatal care in 2009-2010. Also, from 2009 forward mothers chose all that applied.
—too small for meaningful analysis; less than 30 respondents in subpopulation

ns

Table 11 displays the prevalence and trends in billing for a postpartum visit among women with deliveries paid by Ohio Medicaid insurance, during 2007-09, 2010-12, and 2013-14. About half had a billing for a postpartum visit and billings for postpartum visits were slightly higher in 2010-12 and 2013-14 compared to 2007-09. Women with GDM were more likely to have a postpartum visit than women without GDM. The postpartum visits did not vary by age; Hispanic women and Non-Hispanic women of other races were less likely to have a visit compared to Non-Hispanic white or black women. Only 16.8 percent of Hispanic women with a GDM pregnancy had a billing for a postpartum visit. About 2 in 5 women living in urban areas had a postpartum visit following a GDM pregnancy compared to 3 in 5 women in non-urban areas.

Table 11. Prevalence of trends in postpartum visit claims among women with Medicaid insurance, Ohio 2007-09, 2010-12, and 2013-14

	2007-09		2010-12		2013-14	
	% With GDM	% W/out GDM	% With GDM	% W/out GDM	% With GDM	% W/out GDM
Total	**n=10,481**	**n=85,969**	**n=12,621**	**n=84,959**	**n=16,282**	**n=118,045**
Age (years)						
18-24	53.6	49.6	53.0	50.1	47.8	42.5%
25-34	53.6	48.6	54.9	51.1	50.9	44.4%
35-44	50.7	45.1	53.6	48.4	47.7	39.1%
≥45[a]	-	-	-	-	-	-
Race[b]						
Non-Hispanic White	51.3	51.4	52.7	52.7	-	-
Non-Hispanic Black	50.2	47.7	54.0	49.2	-	-
Hispanic	12.5	26.0	16.8	27.8	-	-
Other	12.8	34.9	16.7	38.5	-	-
Geographic Region						
Urban	37.5	47.9	41.2	50.4	49.3%	42.6%
Non-Urban	58.2	49.8	60.3	51.2	49.6%	43.8%

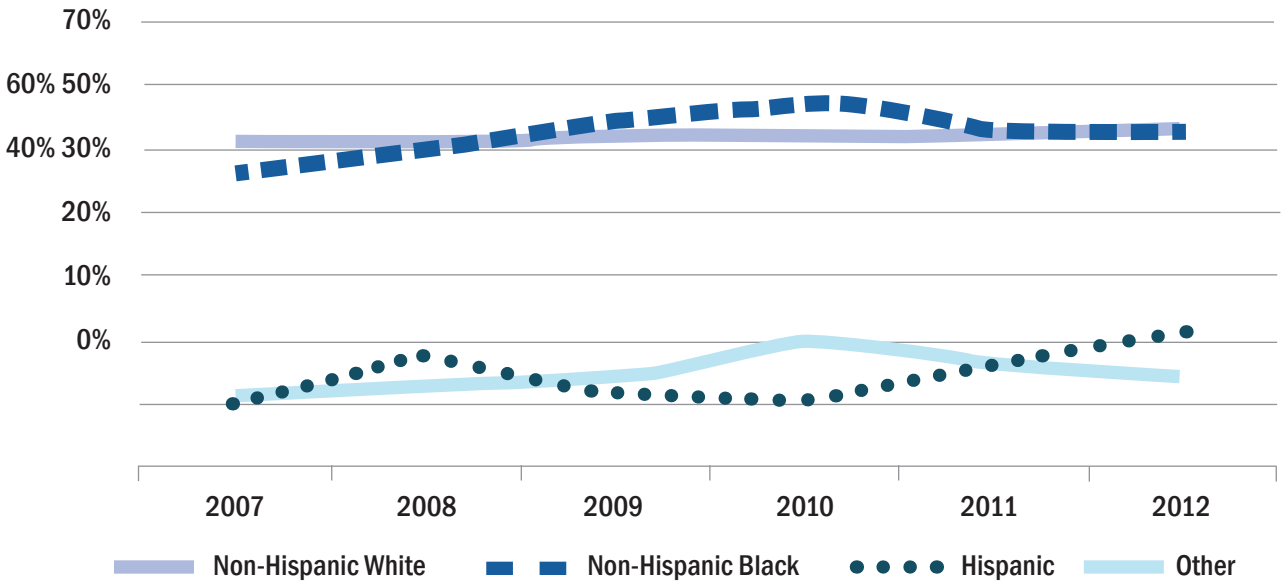
Source: 2007-12 data obtained from Ohio Department of Medicaid QDSS (Medstat Advantage Suite® V 4.0, Truven Health Analytics) accessed April & May, 2014 by Don Reed, Ohio Department of Health; analysis of 2012-14 data were performed by Habteab Gebreab, Ohio Department of Medicaid.

[a]Too small for meaningful analysis; less than 30 respondents in subpopulation for mothers ≥ 45 years

[b]After 2013 data on race and ethnicity are no longer collected for all Medicaid enrollees

Deliveries were identified by an admissionfor DRG's 765 - 768, 774 or 775. Gestational diabetes is identified by a principal or secondary diagnosis code of 64880 - 64884 on a facility or professional claim during the 270 day period prior to delivery admission. A postpartum visit is identified by ICD-9, CPT and UB codes specified by HEDIS® on a facility or professional claim during the 21 to 56 day period after delivery. Only data from the following provider types were included in the analysis: Comprehensive Clinic; Federally Qualified Health Center; General Hospital; Nurse Midwife; Nurse Practitioner; Physician Group; Physician Individual; Public Health Department Clinic; Rural Health Facility

Figure 4. Percentage of women with GDM who attended a postpartum visit stratified by race, Ohio Medicaid 2006-12



Source: Data obtained from Ohio Department of Medicaid QDSS (Medstat Advantage Suite® V 4.0, Truven Health Analytics) accessed April & May, 2014. Analyses by Don Reed.

Following recommendation from the previous GDM data book, 3 questions were added to the Ohio BRFSS (Table 12). Among women in Ohio who had a GDM pregnancy in the past 10 years, 85.6 percent self-reported having had their blood sugar tested within 12 weeks of delivery. Approximately half of women reported that their healthcare providers recommended they get tested for diabetes within 3 years after delivery, and most women (78.8 percent), self-reported that their providers had a discussion with them about the long-term risk of developing type 2 diabetes.

Table 12. Postpartum screening for T2DM among women aged 18-44 years,with a GDM History in the past 10 years, Ohio 2011-13

	2011-2013	
	%	95% CI
Overall (n=103)		
Blood sugar tested within 12 weeks of delivery		
Yes	85.6	77.8 - 93.3
No	14.4	6.7 - 22.2
Provider recommendation for diabetes testing within 3 years after delivery*		
Yes	54.8	39.9 - 69.6
No	45.2	30.4 - 60.1
Provider discussion of long-term risk of developing Type 2 Diabetes*		
Yes	78.8	68.4 - 89.1
No	21.2	10.9 - 31.6

Sources: Analyses using Behavioral Risk Factor Surveillance Survey (BRFSS) by Tyler Payne, Epidemiology Investigator (Ohio Department of Health).
* The confidence intervals for these variables are very large, possibly due to the sample size. They should be interpreted with caution.
95 percent confidence interval (CI): if the survey were repeated 100 times and 100 different confidence intervals were calculated, 95 percent of the intervals would contain the true estimate. The more narrow a CI, the more precise the estimate.

Postpartum Behaviors

Approprate risk reduction after pregnancy is important in reducing subsequent GDM pregnancies and the development of T2DM, including breastfeeding (Ziegler, 2012) and avoidance of tobacco. In 2009-10, one in four women in Ohio were smoking 2-4 months following a GDM pregnancy, similar to 2006-08. Two-thirds of women attempted to breastfeed, with 85 percent still breastfeeding at two weeks postpartum.

Table 13. Postpartum health behaviors among women with a recent history of GDM compared to women with no GDM history, Ohio 2006-08 and 2009-10

	2006-08				2009-10			
	% With GDM	95% CI	% W/out GDM	95% CI	% With GDM	95% CI	% W/out GDM	95% CI
Current Smoker								
Yes	26.6	21.1-32.9	23.1	21.3-24.9	26.0	19.4-33.9	24.0	21.7-26.5
Smokers Relapse								
Previous Smokers that Quit During Pregnancy and Did Not Relapse	47.5	31.5-64.1	53.4	47.5-59.2	60.3	39.5-77.9	64.3	58.0-70.2
Quit for Pregnancy and Relapsed	52.5	35.9-68.5	46.6	40.8-52.5	39.7	22.1-60.5	35.7	29.8-42.0
Breastfeeding Status								
Ever	70.5	64.1-76.2	70.4	68.4-72.3	69.4	61.3-76.5	74.2	71.7-76.6
Never	29.5	23.9-36.0	29.6	23.9-36.0	30.6	23.5-38.7	25.8	23.4-28.3
Breastfeeding Duration (among those who ever breastfed)								
At 2 weeks Postpartum	88.8	83.3-92.6	90.6	89.0-92.0	85.2	75.5-91.4	90.4	88.3-92.2
Not at 2 weeks Postpartum	11.2	7.4-16.7	9.4	8.0-11.0	14.9	8.6-24.5	9.6	7.8-11.7
Postpartum Depression[1]								
Yes	--	--	--	--	13.0	8.6-19.2	13.2	11.4-15.2

Source: Pregnancy Risk Assessment Monitoring System (PRAMS), Ohio Department of Health.
Footnotes:
Phase 5 of PRAMS (2004-08), GDM was determined by the following questions: "Did you have high blood sugar (diabetes) that started during this pregnancy?"; Phase 6 (2009-11) GDM was determined by the following question: "During your most recent pregnancy, were you told by a doctor, nurse, or other health care worker that you had gestational diabetes (diabetes that started during this pregnancy)?
95 percent confidence interval (CI): if the survey were repeated 100 times and 100 different confidence intervals were calculated, 95 percent of the intervals would contain the true estimate. The more narrow a CI, the more precise the estimate.
[1] The question format changed in 2009-10

Prevalence of GDM history among Women of Reproductive Age

Prevalence of a gestational diabetes history refers to the estimated population of people who have had GDM in a current or past pregnancy. BRFSS identifies women whose first diagnosis of GDM was during a pregnancy. This measure excludes women who had GDM but subsequently developed T2DM. This population may be thought of as the population of women with a GDM history at risk of T2DM.

From 2011-13, approximately 2.9 percent of Ohio women self-reported having been diagnosed with diabetes only during pregnancy. Any difference by demographics (Table 14a), or by behavioral risk factors (Table 14b) were not significant.

Table 14a. Prevalence of a history of GDM only, among women aged 18-44 years, by demographics, Ohio 2011-13

		2011-13	
		%	95% CI
Overall (n=264)		**2.9**	**2.4-3.3**
Age (years)	18-24	1.7	0.4-3.0
	25-34	3.5	2.2-4.8
	35-44	3.6	2.6-4.6
Race/Ethnicity	Non-Hispanic White	3.4	2.4-4.3
	Non-Hispanic Black	2.1	0.5-3.7
	Hispanic	4.6	0.0-13.3
	Other	1.4	0.0-3.0
Marital Status	Ever Married	3.5	2.6-4.3
	Never Married	2.5	1.4-3.6
Education	Less than HS	6.2	2.6-9.8
	HS Graduate	2.2	1.2-3.1
	Some College	3.1	1.9-4.3
	College Graduate	2.4	1.7-3.1
Insurance	Plan	3.0	2.2-3.7
	No Plan	3.1	1.4-4.8
Geographic Region	Suburban	4.7	1.9-7.4
	Rural	3.6	1.8-5.4
	Metropolitan	3.0	2.1-4.0
	Appalachian	1.6	0.7-2.5

Sources: Analyses using Behavioral Risk Factor Surveillance Survey (BRFSS) by Tyler Payne, Epidemiology Investigator (Ohio Department of Health).

Footnotes:
95 percent confidence interval (CI): if the survey was repeated 100 times and 100 different confidence intervals were calculated, 95 percent of the intervals would contain the true estimate. The more narrow a CI, the more precise the estimate.
Excludes women who might have had GDM at one time and now have a diagnosis of diabetes and women with pre-existing diabetes. Based on answers to the question: Have you ever been told by a doctor that you have diabetes?" (If "Yes" and the respondent is female, ask "Was this only when you were pregnant?")

Table 14b. Prevalence of a history of GDM only among women aged 18-44 years, by behavioral risk factor, Ohio 2011-13

		2011-13	
		%	95% CI
Overall (n=264)		**2.9**	**2.4-3.3**
BMI [a]	Underweight (< 18.5)	0.3	0.0-0.8
	Normal weight (18.5 - 24.99)	2.9	1.6-4.1
	Overweight (25.00-29.99)	2.5	1.5-3.5
	Obese (30.0+)	4.0	2.7-5.4
Smoking Status	Ever Smoker	3.4	2.1-4.7
	Never Smoker	2.9	2.1-3.7

Sources: Analyses using Behavioral Risk Factor Surveillance Survey (BRFSS) by Tyler Payne, Epidemiology Investigator (Ohio Department of Health).

Footnotes:
[a] BMI was calculated from self-reported height and weight.
95 percent confidence interval (CI): if the survey was repeated 100 times and 100 different confidence intervals were calculated, 95 percent of the intervals would contain the true estimate. The more narrow a CI, the more precise the estimate.

The current behaviors of women with a GDM history will impact whether or not they go onto develop T2DM. In general, the behaviors of Ohio women with a GDM history are more similar to women who have never been diagnosed with diabetes than with women who have received a T2DM diagnosis. From 2011-13, almost one in three Ohio women with a GDM history smoked, half did not meet the physical activity recommendation and one in five has not had a routine health checkup within the last 2 years. These factors further increase a woman's risk for developing T2DM and jeopardize timely diagnosis and management if they do develop T2DM.

Table 15. Health care and health behaviors among women aged 18-44 years with a history of GDM compared to women with current T2DM and women with no diabetes history, Ohio 2011-13

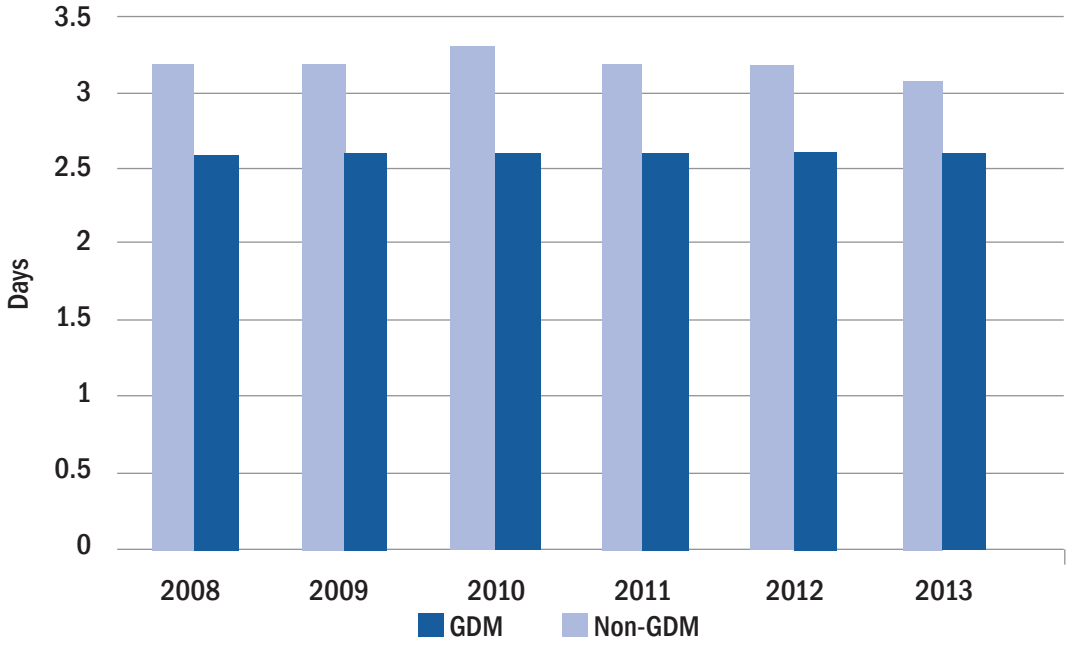
2011-13							
		History of GDM (%)	95% CI	Current T2DM[a] (%)	95% CI	No Diabetes History (%)	95% CI
		n=264		n=1,558		n=4,935	
Smoker							
Ever Smoker		30.5	22.1 - 39.0	17.3	14.1 - 20.4	27.8	26.1 - 29.5
Never Smoker		69.5	61.0 - 77.9	82.7	79.5 - 85.9	72.2	70.5 - 73.9
Met aerobic physical activity recommendation*							
	Yes	51.2	39.1 - 63.3	--[b]	--	50.7	48.1 - 53.3
	No	48.8	36.7 - 60.9	--	--	49.3	46.7 - 51.9
Last routine health check-up							
Within past 2 years		81.5	73.9 - 89.1	95.3	93.8 - 96.9	82.0	80.5 - 83.4
Within past 5 years		10	3.3 - 16.7	3.2	1.8 - 4.5	10.0	8.9 - 11.1
5 or more years		8.5	3.9 - 13.1	1.5	0.8 - 2.3	8.1	7.1 - 9.1

Sources: Analyses using Behavioral Risk Factor Surveillance Survey (BRFSS) by Tyler Payne, Epidemiology Investigator (Ohio Department of Health).
Footnotes:
95 percent confidence interval (CI): if the survey was repeated 100 times and 100 different confidence intervals were calculated, 95 percent of the intervals would contain the true estimate. The more narrow a CI, the more precise the estimate.
Excludes women who might have had GDM at one time and now have a diagnosis of diabetes and women with pre-existing diabetes. Based on answers to the question: Have you ever been told by a doctor that you have diabetes?" (If "Yes" and the respondent is female, ask "Was this only when you were pregnant?")
*Due to the size of the confidence intervals, estimates should be interpreted with caution.
-Question not asked in 2012. Estimates derived from 2011 and 2013 data only.
[a] State-added question regarding diabetes type was only asked 2011-2012.
[b] Sample size for generated estimate does not meet reporting criteria determined by CDC
Aerobic physical activity recommendation: Calculated Variable (variable name _PAINDEX)
Last routine health check-up
Within past 2 years including 1 year but less than 2 years
Within past 5 years including 2 year but less than 5 year

The Cost of Gestational Diabetes

As shown in Figure 5, the mean length of stay (LOS) was consistently greater among GDM related hospital discharges. The mean LOS among GDM related hospital discharges was approximately 3.2 days and non-GDM related hospital discharges were approximately 2.6 days.

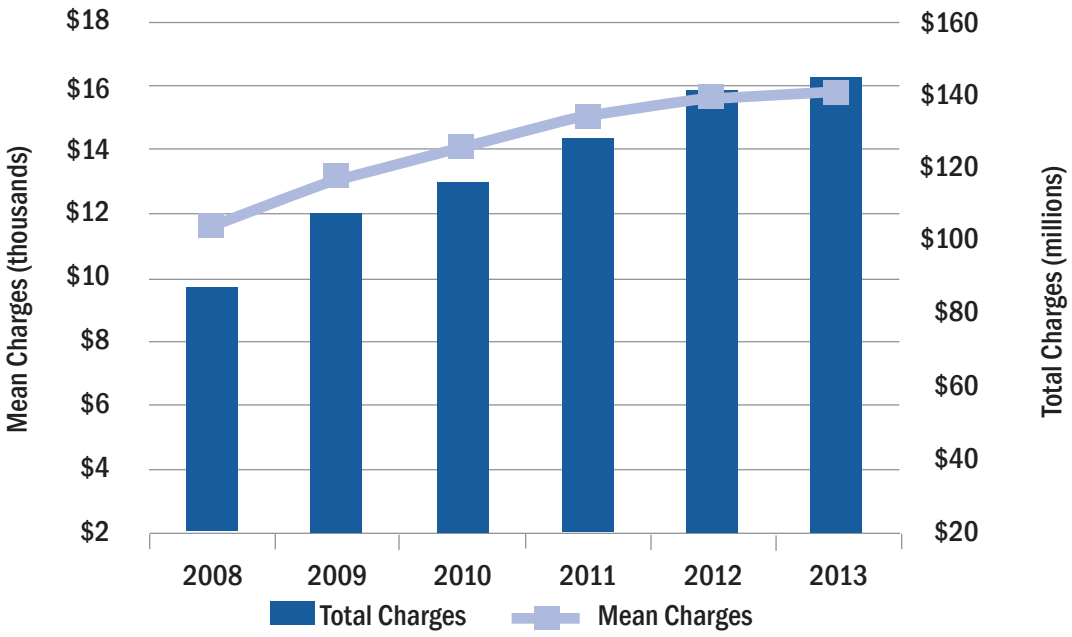
Figure 5. Mean length of stay (LOS) among GDM and non-GDM-related obstetric discharges, Ohio 2008-13



Source: Data provided by OHA and analyzed by Kelci Haydocy.

As shown in Figure 6, both the mean and total charges for GDM-related obstetric discharges have been consistently increasing since 2008, reaching the highest amount in the year 2013, with mean charges of approximately $16,000 and total charges of $145 million.

Figure 6. Total and mean charges among GDM-related obstetric discharges, Ohio 2008-13

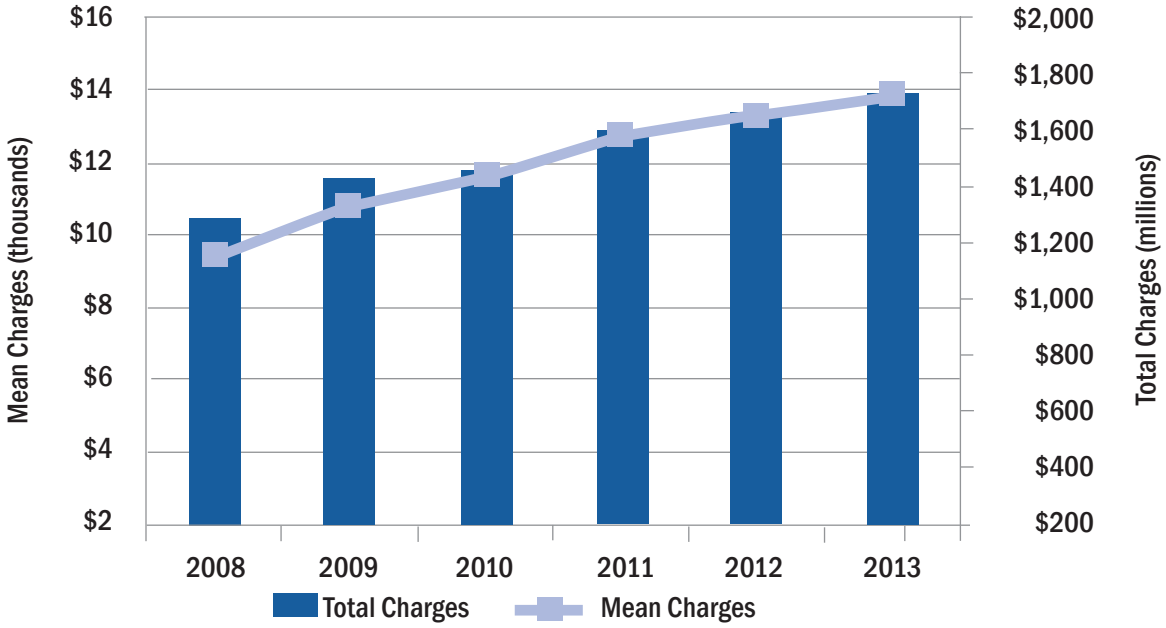


Source: Data provided by OHA and analyzed by Kelci Haydocy.

Footnote: Adjusted for medical cost inflation, charges represent total amount billed, not actual amount collected.

As shown in Figure 7, similar to GDM-related discharges, non-GDM related discharges consistently increased reaching an all-time high in 2013 with mean charges of approximately $16,000 and total charges of $140,000 million.

Figure 7. Total and mean charges among non-GDM-related obstetrics discharges, Ohio 2008-13

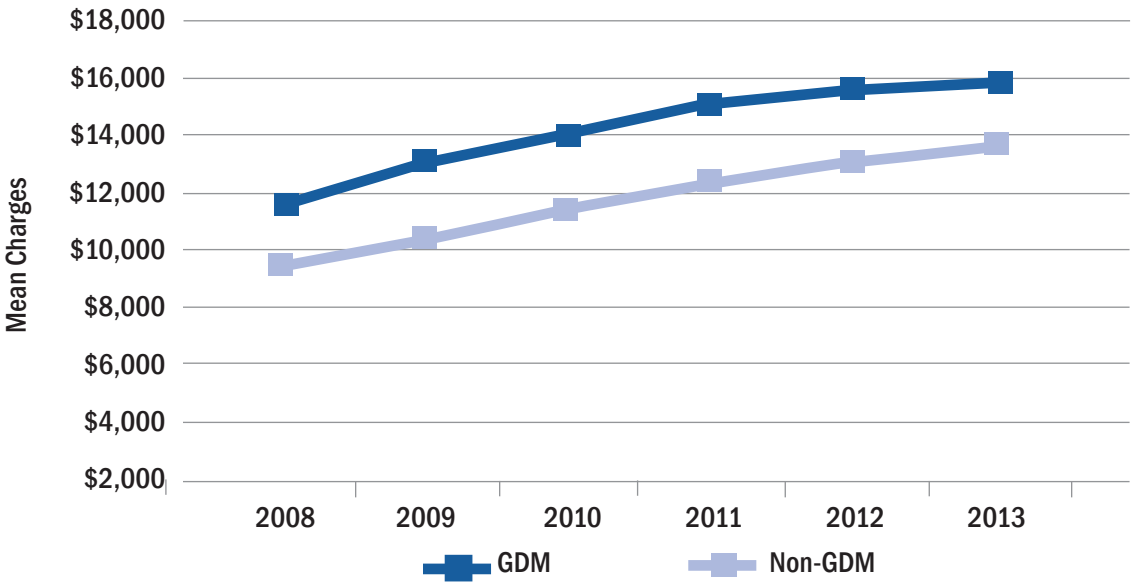


Source: Data provided by OHA and analyzed by Kelci Haydocy.

Footnote: Adjusted for medical cost inflation, charges represent total amount billed, not actual amount collected.

From 2008-13 mean charges for GDM-related obstetric discharges were higher than non-GDM related discharges, as shown in Figure 8. Both GDM and non-GDM- related cases have increased consistently since 2008.

Figure 8. Mean charges among GDM and non-GDM-related obstetric discharges, Ohio 2008-13



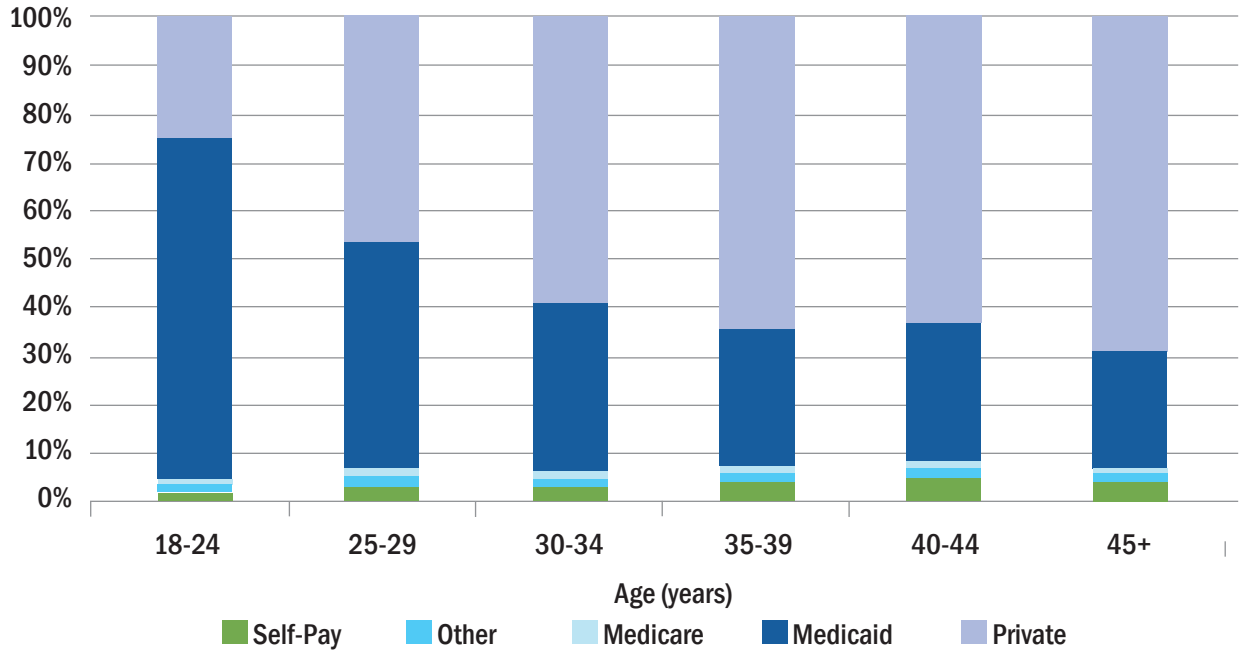
Source: Data provided by OHA and analyzed by Kelci Haydocy.
Footnote: Adjusted for medical cost inflation, charges represent total amount billed, not actual amount collected.

From 2011-13, total charges billed for GDM-related hospital discharges were approximately $371 million, as shown in Figure 9. Additionally, insurance coverage varied greatly by age.

Among women aged 18-24 years, Medicaid was the primary payer for approximately 70 percent of all GDM-related discharges. Although Medicaid is the primary payer billed for the majority of 18-24 year old GDM-related hospital discharges, only 4 percent of hospital discharges during this age group are affected by GDM. For women aged 25 years and older, private insurance was the primary payer for approximately 59 percent of discharges, with Medicaid following with 35 percent of all GDM discharges.

Governmental programs (predominantly Medicaid) paid for approximately 40 percent ($149,353,496) of GDM-attributed medical costs for all age groups combined. Private insurance accounted for approximately 53 percent ($197,987,246). Additionally, approximately 5 percent ($18,815,254) of GDM-attributed medical costs came from uninsured people or self-pay patients, inclusive of charity care from patients unable to pay. The proportions varied by maternal age.

Figure 9. Percent of total charges for GDM-related obstetric discharges by primary payer and age group, Ohio 2011-13



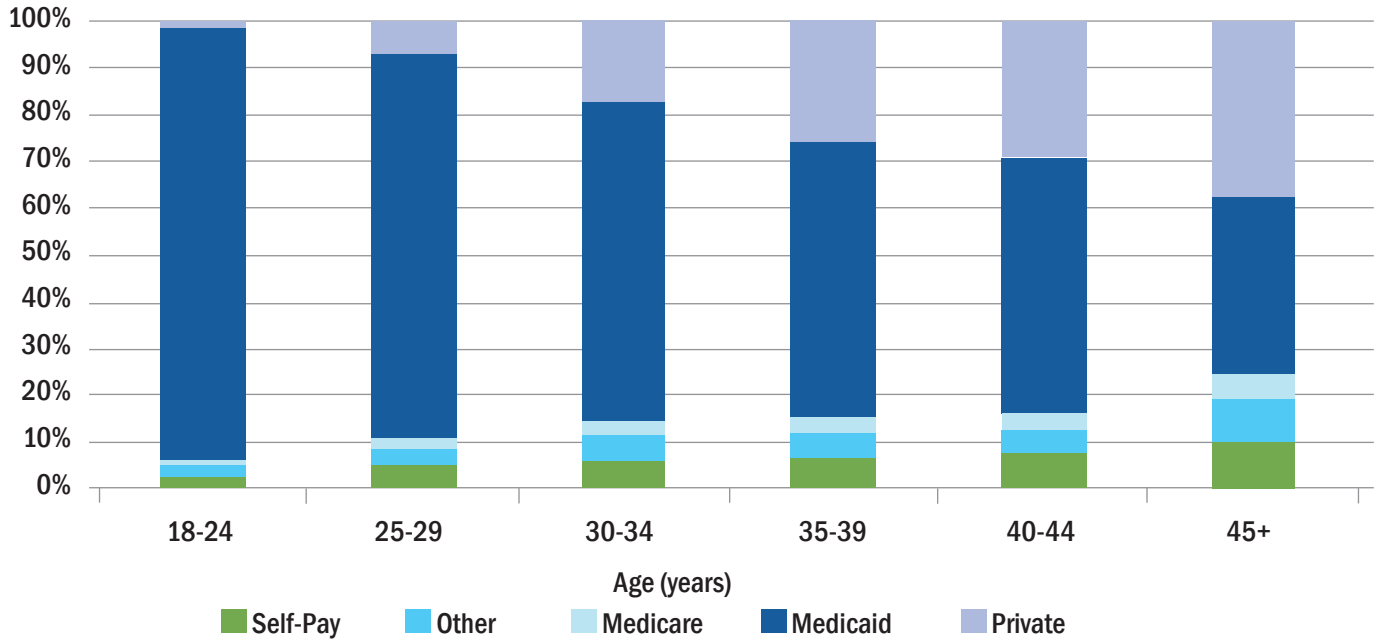
Source: Data provided by OHA and analyzed by Kelci Haydocy.

Footnote: Adjusted for medical cost inflation, charges represent total amount billed, not actual amount collected.

Similar to the GDM-related hospital discharges, insurance coverage varied greatly by age for non-GDM-related hospital discharges (Figure 10). Between 2011-13, total charges billed were approximately $4.4 billion. Medicaid was the primary payer for approximately 70 percent of non-GDM-related discharges for women aged 18-24 years. For women age 25 and older, private insurance was the primary payer for approximately 62 percent of discharges.

Overall, for all age groups governmental programs (predominantly Medicaid) paid for approximately 44 percent ($1.9 billion) of non-GDM-attributed medical costs. Private insurance accounts for approximately 51 percent ($2.2 billion). Additionally, approximately 4 percent ($197 million) of non-GDM-attributed medical costs come from uninsured people or self-pay patients, inclusive of charity care from patients unable to pay.

Figure 10. Percent of total charges for non-GDM obstetric discharges by primary payer and age group, Ohio 2011-13



Source: Data provided by OHA and analyzed by Kelci Haydocy.

Footnote: Adjusted for medical cost inflation, charges represent total amount billed, not actual amount collected.

Appendices

Appendix A: Summary of Primary Data Collected by Ohio's GDM Collaborative

Healthcare Provider Knowledge and Practices on Care for Women with a GDM History

The purpose of this survey was to assess knowledge, attitudes, perceived roles, and postpartum practices regarding diabetes prevention for women with a history of GDM (Oza-Frank, 2014). It was completed in fall 2010, and again a second survey in 2015. The providers surveyed were: Obstetrician/ Gynecologists (OBGYN), Certified Nurse Midwives (CNM), Family Practitioners (FP), and Internists. The survey provided a wealth of information, which is utilized to try to improve care for women with a GDM history.

The 2010 survey shows that most providers (68.7 percent) did not have issues receiving information regarding a woman's GDM status (Oza-Frank, 2014). However, there was a lack of knowledge of the risk of T2DM, as only about one-third of practitioners knew that more than 40 percent of women with GDM were at risk of developing T2DM in the future (Rodgers, 2014).

Screening was associated with the provision of higher quality of care, and screening practices were substantially associated with attitudes towards screening for T2DM. Overall, the prevalence of postpartum screening was suboptimal; 36 percent of OBGYN providers indicated that they always or often screened women with GDM-affected pregnancies for T2DM at the postpartum visit (Ko, 2013a).

Of the CNMs surveyed, only half stated that they routinely screened for abnormal glucose tolerance after a GDM pregnancy at the postpartum visit, regardless of race/ethnicity, location of clinic, or whether an individual was covered by Medicaid insurance (Ko, 2013b). There was no difference in postpartum screening rates by the number of years a CNM had practiced or by their practice type. It should be acknowledged that CNMs primarily serve a patient population that is disproportionately vulnerable to poor health care access and at risk for poor pregnancy outcomes.

The providers had many suggestions on how to improve care for women with histories of GDM. Approximately half of all responding CNMs (49.3 percent) reported a need for improved GDM patient education, and 71.9 percent reported a need for increased responsibility for self-preventive care (Ko, 2013b). In addition, approximately 63 percent of providers were of the opinion that improvement in coverage and reimbursement for women with a history of GDM was necessary (Oza-Frank, 2014). Also, 63 percent of providers stated that improvement in provider reimbursement for counseling patients on nutrition and exercise would better support postpartum care of women with a history of GDM (Oza-Frank, 2014). Although 79 percent of all respondents reported counseling women with histories of GDM about nutrition, only 27 percent of women with GDM-affected pregnancies were provided referrals to dietary counseling and 16 percent of women with GDM history reported that provisions were made to refer overweight or obese women to a diet support group or for nutrition counseling (Ko, 2013a).

Additionally, the survey showed that systems of care that support providers to effectively follow up on GDM patients could help improve provider performance. An example of such a system would be the adoption of reminders (electronic, mailed, or by telephone) to alert clinicians that specific patients are due for postpartum diabetes screening. This survey revealed that only 45 percent of providers indicated that they retest women with histories of GDM for T2DM every 1-3 years

(Rodgers, 2014). Reminders have been shown to be an efficacious means of improving screening long-term.

Perspectives of Ohio Women with Gestational Diabetes

In order to better understand the women with a history of GDM, the GDM Collaborative engaged an external partner in 2012 to conduct focus groups with Ohio women with GDM history. The major goals of these focus groups were to identify women's knowledge about the long-term implications of having GDM and obtain information about the possible barriers to having a postpartum visit and screening. Additionally, education messages were tested in order to develop messages to which women will best respond.

These focus groups were conducted in all 5 regions of Ohio. Women who were 18-44 years of age and diagnosed with GDM within the past 10 years were eligible. The study focused on three high-risk populations: Appalachian, African-American, and Hispanic/Latino. The women who participated in these focus groups were compensated for their participation.

The preliminary results from the focus groups found that the majority of women were scheduled for 6-week postpartum appointments. However, for some women inhibiting factors such as time, money, and coverage prohibited them from attending their appointments. Women who did attend the postpartum visit assumed their doctor had prior knowledge of their GDM diagnosis because of the questions they were asked regarding their medical history. Thus, these women did not discuss T2DM with their doctor and were unaware of their need to be tested for T2DM. Women who were tested were unsure if they had been specifically tested for T2DM because they assumed their doctor would inform them of what tests had been conducted. Finally, women were ill informed of the risk of T2DM to their infants by providers.

Participants identified three broad themes around barriers to GDM care, management, and follow-up: (1) Communication Issues; (2) Personal and environmental barriers; and (3) Type and quality of healthcare. Many women felt communication with their provider could be improved, including more education on the severity of GDM, streamlining information to be less overwhelming, and providing additional support through referrals to community resources. Although women expressed interest in receiving more actionable advice for managing GDM during pregnancy and for the preventing T2DM postpartum, few women reported changing behaviors due to barriers related to cost, transportation, and competing demands. Several opportunities for improved care were elucidated.

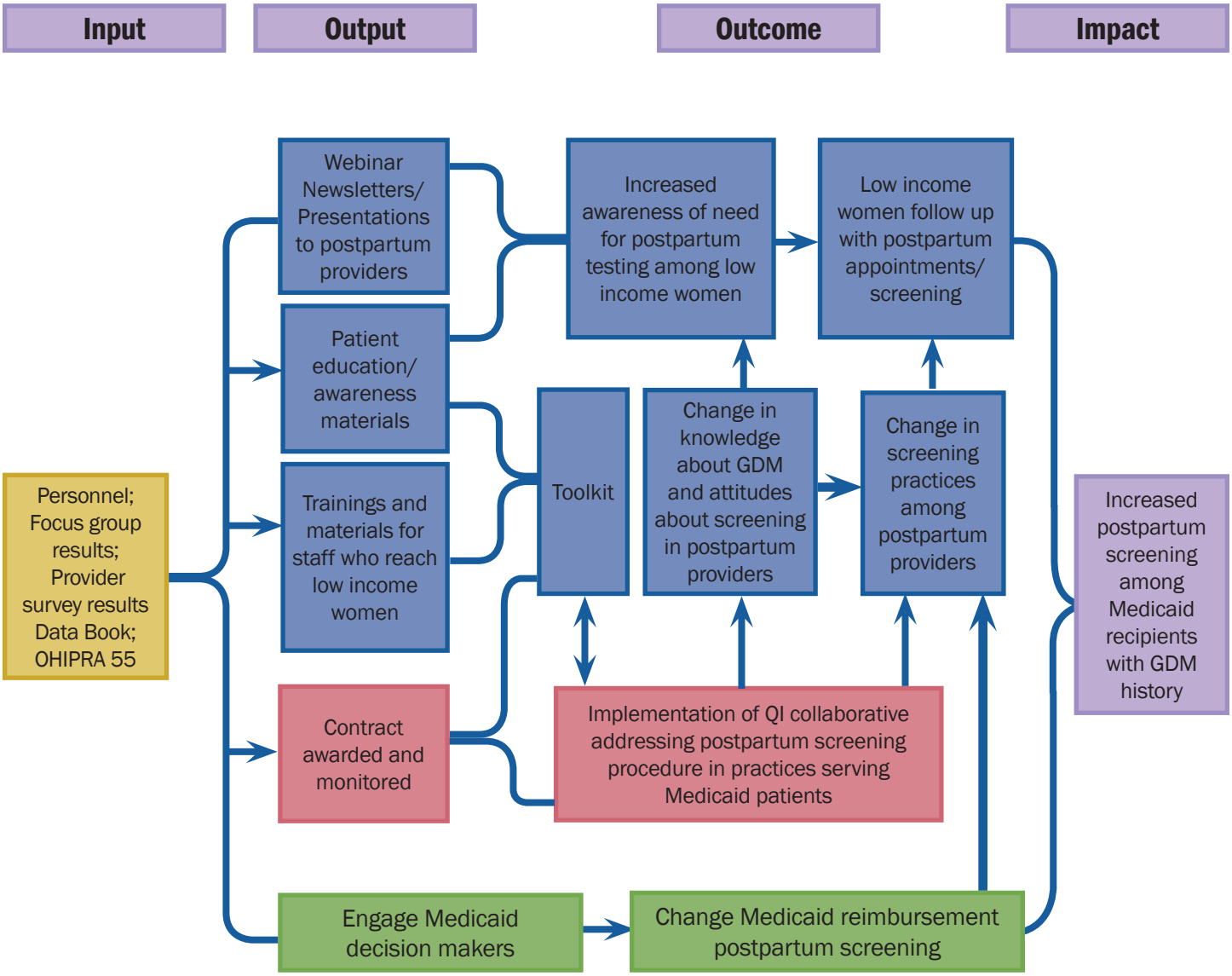
Our findings indicate that regardless of race/ethnicity women with GDM experience similar communication, personal, and environmental barriers related to the healthcare they receive for their GDM. Although culturally specific issues exist, there are opportunities to address barriers among women with GDM across cultures.

Appendix B: Reducing the Burden of GDM in Ohio

Ohio GDM Collaborative

ODH was selected in spring of 2010 to participate in a year-long collaboration sponsored by the Association of Maternal and Child Health Programs (AMCHP), the National Association of Chronic Disease Directors (NACDD) Women's Health Council, and the Centers for Disease Control and Prevention (CDC). The goal of the project was to develop a statewide plan to prevent T2DM among women with a history of GDM. Developing out of this initial collaboration, the Ohio Gestational Diabetes Collaborative has since successfully produced the state's first GDM data book, surveyed women's health providers on their knowledge and practices GDM, and hosted focus groups of women on their experiences with GDM. In 2013, the Collaborative developed a logic model to move forward from these initial successes, with a focus on increasing postpartum screening rates for women receiving Medicaid. Figure 11 shows the logic model describing the outputs and expected outcomes to reach that goal.

Figure 11. Logic Model for Ohio GDM Collaborative 2013-16



Improving Postpartum Screening Rates through Quality Improvement and toolkits

The primary focus of the collaborative for 2013-16 has been to improve both provider practice and patient knowledge around GDM and immediate postpartum care. To do this, the collaborative is conducting a quality improvement (QI) initiative with clinical care centers to improve postpartum screening and increasing lifelong screening rates among more than 1000 mothers with GDM in Ohio. The goals of the project are:

- Increase the postpartum visit rate for women with history of GDM of participating practices by 25 percent.
- Increase the rate of postpartum T2DM screenings among women with history of GDM of participating practices by 50 percent.

The initiative uses proven QI strategies to engage healthcare providers to systematically change practice to improve care for women with a history of GDM. Two toolkits were specifically created for this project, one for providers and one for patients. They were designed by nationally renowned healthcare experts in the management of GDM and development was guided by data from the Ohio provider survey and the focus groups described in Appendix A. The provider toolkit was created to increase provider knowledge of GDM and the subsequent risk of developing T2DM; to increase capacity to provide guidance on proper nutrition and physical activity levels, management of overweight and obesity, tobacco cessation, postpartum family planning, breastfeeding, and behavior modification; and to provide recommendations for appropriate postpartum visit care, screening and referral. The patient toolkit focuses on expectant mothers newly diagnosed with GDM and educates them on the long term risks associated with GDM for themselves and their babies, while providing specific recommendations such as physical activity during pregnancy, healthy nutrition, strategies to help quit tobacco, the importance of breastfeeding, and the benefits of birth spacing. The toolkits were piloted in wave 1 of the collaborative in 2015 and updated for wave 2 in 2016. More emphasis on care coordination between providers was added. A third wave begins recruitment in the winter of 2016-17.

Quality improvement data from the first wave demonstrated increases in timely prenatal GDM screening; and the proportion of patients receiving prenatal education on topics including weight gain, tobacco use, breastfeeding, and risk and impact of T2DM (Shellhaas). Providers responded postively to the toolkits, reporting they were easy to use and helpful when treating patients. Patients also reported they found the toolkit helpful in conveying GDM information.

The website **www.OhioGDM.com** features the patient (English and Spanish) and provider toolkit resources. Recordings from learning sessions and other resources are available as well.

Ohio Gestational Diabetes Mellitus
Postpartum Care Learning Collaborative

Check her risk. Protect her health.

Appendix C: Recommendations to Improve Epidemiology Capacity for GDM Surveillance in Ohio

The collaborative has considered other projects to further demonstrate the prevalence of GDM and its risk factors. To improve GDM surveillance, an annual update and review of data from vital statistics and Medicaid is recommended. It would also be beneficial to have an update and review of statistics from BRFSS, PRAMS, and OHA every 2-3 years. Additionally, WIC instituted a new GDM risk code specific in fall 2016. Beginning in 2017, the data should be analyzed and reviewed to identify their usefulness in describing GDM burden in this population and to inform prevention and control strategies. Furthermore, the use of Medicaid data should be explored to a) assess the timing of prenatal GDM screening, and b) assess ongoing (beyond postpartum) T2DM glucose screening among women with a GDM history. Lastly, it is recommended that the GDM provider survey is conducted again in 2020 to monitor trends in care for women with a GDM history and to adjust efforts to improve care.

Appendix D: Data Sources Descriptions, Strengths and Limitations

Ohio Hospital Association (OHA)

OHA represents 13 health systems and 220 hospitals in Ohio (www.ohiohospitals.org). OHA provides claims information on individuals who were admitted and discharged from the hospital. Hospital discharge data were collected by OHA and provided to ODH for analysis. Data requested from OHA for this data book were as follows:

- Women with Gestational Diabetes (ICD-9 Codes: 6488, 64880, 64881, 64882, 64883, 64884)
- Obstetrics
- Inpatients
- Ohio Residents

Record identification with diabetes was based on discharge ICD-9-CM codes without knowledge of the criteria used to make the diagnosis. In general, studies that use ICD-9-CM codes to describe disease trends may suffer from bias, depending on the validity of the code from the condition being examined. A previous study that evaluated ICD-9-CM codes in hospital discharge data for one in obstetric research reported high positive predictive values (96 percent) and moderate sensitivity (64 percent) for the full spectrum of diabetes codes (Yasmeen, 2006). Similar results were reported in another study that assessed the validity of hospital discharge data for identifying diabetes-complicated births (Delvin). This result suggest the potential for underestimation rather than over reporting in our numbers but would not deter from our conclusions regarding the impact of diabetes among pregnant women in the U.S. Similarly, because of the nature of the data, we also cannot rule out improvement in reporting quality over time as a partial explanation for the temporal increased. Population based studies of laboratory-based diagnosis of GDM over similar time intervals; however, also documented increasing trends similar to what we report (Delvin, 2009; Yasmeen, 2006). Another limitation of the hospital discharge data is that a woman may be counted more than once if she had multiple pregnancies complicated by GDM within the time period examined.

Furthermore, the charges represent the total amount billed, not the actual amount collected and while this is sufficient information to assess overall trends of disease-related cost burden, it is inadequate for measuring the financial impact in absolute terms within various demographic groups. Currently, no data on GDM-associated complications – including Cesarean sections, high birth weight in previous delivery or hypoglycemia – are available from OHA to examine reasons for longer hospital stay and associated increased charges. However, further analysis of hospital data showed a difference in the prevalence of several GDM complications.

Additionally, women with GDM may also have higher rates of indirect costs resulting from increased time off work and psychological stress (Yasmeen, 2006).

Behavior and Risk Factors Surveillance Survey (BRFSS)

The BRFSS is a state-based system of health surveys that collects information on health risk behaviors, preventive health practices and health care access primarily related to chronic disease and injury in the adult population (18 years of age or older) living in households. The CDC established BRFSS in 1984. Currently, data are collected monthly in all 50 states, the District of Columbia, Puerto Rico, the U.S Virgin Islands, and Guam. More than 350,000 adults are interviewed each year, making the BRFSS the largest telephone health survey in the world. States use BRFSS data to identify emerging health problems, establish and track health objectives, and develop and evaluate public health policies and programs (www.cdc.gov/brfss). The Ohio BRFSS has some state-added questions, which includes questions pertaining to Gestational Diabetes Mellitus. The state-added GDM questions were asked in 2012, 2013, and 2014, and will be asked again in 2016. All data collected from BRFSS are self-reported, which is subject to recall bias, social desirability bias, and measurement bias resulting from wording and questionnaire design (Choi, 2005). Despite this, the accuracy of self-reporting for diabetes is reasonably high in population surveys (Saydah, 2004).

Another limitation is that GDM question in BRFSS is not specific to a current or recent pregnancy, and includes all women who had GDM in the past 10 years, regardless of age, resulting in more a cumulative prevalence estimate, rather than a cross-sectional estimate.

Vital Statistics

In 2006, Ohio adopted the revised National Center for Health Statistics 2003 birth certificate. Under the section on the birth certificate titled "Risk Factors for Pregnancy" the following options for diabetes are available:

- Pre-pregnancy (Diagnosis prior to this pregnancy)
- Gestational (Diagnosis in this pregnancy)

These data should come from the mother's prenatal care records, labor and delivery records, as well as infant's medical record (each of which contributes to the facility worksheet). If the mother's prenatal care record is not in her hospital chart, Ohio Vital Statistics recommends that the doctor and/or clerical staff contact her prenatal care provider to obtain the record or a copy of the prenatal care information.

Birth certificates only allow for one diabetes response to be chosen. This change was implemented after 2004 in most states (in 2006 in Ohio), and increases the validity of GDM reporting on birth certificates (Hoslet, 2010). The Ohio Perinatal Quality Collaborative (OPQC) in 2008 introduced a charter that would prevent unnecessary scheduled births without proper medical indications between 36 and 38 weeks. As a result of this initiative many births have been moved beyond 39 weeks, decreasing the amount of NICU admissions annually. In mid 2013, OPQC began promotion and training on accurate reporting of 13 key birth registry variables. Gestational diabetes was one of the 13.

Previous studies have shown that birth certificates underreported GDM. The accuracy of the birth certificate data relies on both the medical provider's accurate completion of the health history and proper training of clerical staff. Without review by clinicians and little incentive for quality improvement (Northam, 2006; Devlin, 2009; Deitz, 1998), it is difficult to assess the quality of the birth certificate data, which may vary by state. For example, birth certificates in New York State showed high validity when compared to medical charts (Roohan, 2003). However, in Minnesota, hospital discharge data performed

better in identifying GDM and pre-pregnancy diabetes than birth certificates (Devlin). Validity of birth certificates to report GDM in Ohio has not been quantified.

Some of the height, weight and BMI values were considered biologically implausible and hence, had to be removed from the analyses. This could be due to the fact that individuals could have been asked for their height, weight and BMI instead of actually being assessed at the health facility. Possible self-reporting of these values are therefore, a possible contribution to the discrepancy and biological implausible values that were witnessed in the dataset. Efforts to improve quality improvement in data collection can be considered for future work.

Pregnancy Risk Assessment Monitoring System (PRAMS)

PRAMS is a population-based survey that asks about maternal behaviors and experiences before, during, and after a woman's pregnancy and during the early infancy of her child. CDC developed PRAMS in 1987. Currently, 37 states and New York City participate in PRAMS (including Ohio since 1999). Findings are used to develop and assess public health programs and policies to reduce adverse pregnancy outcomes. The PRAMS sample includes women who have had a recent live birth. A stratified sample of such women is selected each month from the state's birth certificate files. Ohio PRAMS sampling strata include mothers of low birth weight infants and African-Americans. Selected women are first contacted by mail 2-4 months postpartum. If there is no response to repeated mailings, women are contacted and interviewed by telephone (www.cdc.gov/PRAMS).

Overall, the accuracy of self-reporting for diabetes is reasonably high in population surveys (Saydah, 2004). Data collected from PRAMS is completely self-reported, which is subject to recall bias, social desirability bias, and measurement bias resulting from working and questionnaire design (Choi, 2005). Additionally, PRAMS does not include fetal deaths or still births, which could have an association with gestational diabetes (Racusin, 2012). Although the question asks about GDM history in the most recent pregnancy, respondents may answer based on any past pregnancy. There is some reporting bias in regards to diabetes in PRAMS, a small proportion of women report having both GDM and pre-pregnancy diabetes. However, the proportion of misreporting has decreased in recent years.

Medicaid

The database from which Medicaid data originate contains eligibility, demographic and transactional data for all Medicaid recipients. Data are uploaded monthly and can be obtained either at a summary level, or at the record level. Even if a mother is enrolled as a Medicaid recipient, if the service is not paid for by Medicaid, there is no record of the service in the Medicaid claims database. Only services billed to Medicaid for enrollees are included. Although probably rare, Medicaid enrolled individuals could be receiving care though a non-Medicaid provider.

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Notes


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