Gestational Diabetes in Ohio:
2006-2008

Ohio Department of Health

Ohio Gestational Diabetes Collaborative Team

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EXECUTIVE SUMMARY

Gestational diabetes mellitus (GDM) presents a significant challenge to the health of both the mother and her infant. GDM is characterized by glucose intolerance appearing or first diagnosed during pregnancy and represents the failure of the normal regulation of blood sugar during pregnancy which causes high blood sugar.

Women with GDM are at risk for pregnancy-related blood pressure problems and are more likely to require a Cesarean section. Furthermore, infants born to a mother with GDM are more likely to be large-for-gestational age, have low blood sugar or require oxygen for respiratory problems after delivery and are more likely to suffer birth trauma. Women who develop GDM are more likely to develop type 2 diabetes mellitus at some later point in their lives and are at risk for developing GDM in each subsequent pregnancy. Children of mothers with a history of GDM are also at greater risk throughout their lifetime for metabolic diseases, including obesity and type 2 diabetes.

Women who are at greater risk for developing GDM include women with a personal history of GDM, a history of having a prior baby with birth weight of more than 4000 grams, glucose in the urine, a first-degree family history of type 2 diabetes or GDM, maternal history of unexplained fetal demise, maternal age greater than 25 years of age, and overweight or obese status. Certain groups are recognized to be at higher risk for glucose intolerance during pregnancy and include women of Hispanic, African, Native American, South/East Asian or Pacific Islander ancestry.

To address the significant impact that GDM has on the life of the mother and infant, the Association of Maternal and Child Health Programs (AMCHP), the Centers for Diseases Control and Prevention (CDC) and the National Association of Chronic Disease Directors (NACDD) formed a collaborative project to foster integration of maternal and child health (MCH) and chronic disease programs in the development of diabetes prevention initiatives. As one of three sites chosen for this collaborative, the Ohio Department of Health (ODH) formed the Ohio Gestational Diabetes Mellitus Collaborative Team to identify goals and strategies to prevent GDM in all women and prevent type 2 diabetes in women with a history of GDM. This report is part of the Collaborative Team's efforts and represents available data regarding GDM in Ohio.

Prevalence of GDM-related risk factors among women of reproductive age in Ohio

There are two main sources that provide data on the prevalence of GDM-related risk factors among women of reproductive age (18-44 years) in Ohio: the Behavioral Risk Factor Surveillance System (BRFSS) (includes adults aged 18 years and older) and the Pregnancy Risk Assessment Monitoring

System (PRAMS) (includes women with a recent live birth). Analysis of data from 2006 -2008 showed the following among Ohio women:

- More than 15 percent (older than 18 years) belong to racial or ethnic groups with higher risk of developing GDM.
- Approximately 50 percent are overweight or obese.
- More than 20 percent are physically inactive.
- Between 4-6 percent had hypertension during pregnancy.
- Between 17-27 percent are current smokers.

Summary of GDM Prevalence in Ohio

Six data sources available in Ohio capture the prevalence of GDM: BRFSS, Vital Statistics, PRAMS, Medicaid claims data, Child and Family Health Services (CFHS) clinics and the Ohio Hospital Association's (OHA) discharge data. Each estimate varies from the next, due to the population represented, by the method of collection and other factors. While each data source has its own strengths and weaknesses, each conveys important information regarding the burden of GDM in Ohio.

	Behavioral Risk Factor Surveillance Survey	Vital Statistics	Pregnancy Risk Assessment Monitoring System	Medicaid Claims Data	Child and Family Health Services Clinics	Ohio Hospital Association Discharge Data
GDM Prevalence (Percent)	1.9	5.0	10.0	7.6	3.3	5.0

The table shows:

- Among the entire population of women aged 18-44 in Ohio, BRFSS data show approximately 1.9 percent of women reported having diabetes only in pregnancy.
- The number of births complicated by GDM in a given year ranges from 5.0 percent (approximately 7,228 per year) reported by hospitals on birth certificates to 10.0 percent from self-reporting by women within several months after delivery.
- Medicaid claims data show that 7.6 percent of pregnant women enrolled in Medicaid (approximately 4,759 per year) were diagnosed with GDM.
- Among women using CFHS prenatal clinics (high-percentage of Medicaid recipients), data show that 3.3 percent had a GDM diagnosis.
- Approximately 5.0 percent of obstetrics-related discharges were complicated by GDM, according to OHA hospital discharge data.

Additional data within this databook show:

- Increasing prevalence of GDM with pre-pregnancy BMI.
- Increasing GDM prevalence with age until ages 45 and above.
- No greater prevalence among Hispanic or African-American women compared to white women in Ohio, possibly due to high GDM prevalence in among non-Hispanic white women in Ohio compared to national estimates, reducing racial or ethnic differences.
- Mean hospital charges among GDM-related obstetrics discharges were approximately $2000 higher than non-GDM discharges.
- Total hospital charges among GDM-related obstetrics discharges increased 11 percent between 2006 and 2008, while total charges among non-GDM discharges increased only 5 percent.
- The mean length of hospital stay was consistently lower among non-GDM-related hospital discharges.
- Adjusted for medical cost inflation, total charges increased among GDM-related hospital discharges 11 percent from 2006 to 2008 ($82 million to $91 million).

Post-partum visits and screening

While it is recommended that all women with a history of GDM receive screening for elevated blood glucose or diabetes after delivery, this is often not the case. In Ohio, these post-partum visit rates are tracked by three sources of data, PRAMS, CFHS clinics and Medicaid claims data. These data show married women and women with non-Medicaid insurance have the highest post-partum visit rates, while women with GDM who receive Medicaid have lower rates.

Future Considerations

Although informative when assessing GDM prevalence among specific target populations, the different data sources used in this report to estimate the burden of GDM in Ohio yielded different prevalence estimates, resulting in the lack of a valid statewide prevalence estimate. However, because there is currently no gold standard for assessment of GDM, a statewide estimate is not essential to establish a systematic process of tracking GDM prevalence using these data sources.

The recent addition of enhanced questions on GDM history to existing ODH data sources (PRAMS, BRFSS) will soon allow for better differentiation between pre-pregnancy diabetes and GDM. Additionally, the inclusion of questions on post-partum glucose screening will allow for better ascertainment of screening practices and associated diagnoses among women with a history of GDM.

Summary

This databook summarizes existing information about GDM, identifies gaps in knowledge and outlines the ODH Collaborative Team's activities in primary data collection. It should be noted that there is no one best source to obtain GDM prevalence data for Ohio. Each has its own strengths and limitations. The team also developed survey instruments, focus group discussion guides and a preliminary social media campaign. Other interventions will be developed pending the results of these activities.

The ODH Collaborative Team's current projects include a survey of more than 1000 providers in Ohio to assess their attitudes, knowledge and practices around preventing GDM and caring for women with a history of GDM, and focus groups with women in Ohio who are at risk for, or are diagnosed with, GDM. These strategies will inform future efforts to improve coordination of care and improve type 2 diabetes prevention efforts. Additional team projects include using social media to link health messaging with text messaging.

Half of all women in Ohio were overweight or obese when they became pregnant, increasing their risk of gestational diabetes.

INTRODUCTION

What is gestational diabetes mellitus (GDM)?

GDM is defined as glucose intolerance that first occurs or is first identified during pregnancy.[1] It occurs when a woman's body is not able to properly metabolize glucose and results in abnormally elevated blood glucose levels. Glucose is normally transported, with the help of insulin, from the bloodstream into most of the body's cells where it is used for energy. When a woman develops GDM, changes occur in the way her body responds to insulin and other hormones. The cells in her body have a decreased sensitivity to insulin and thus cannot respond to an increase in glucose as efficiently. This glucose intolerance typically develops around mid-pregnancy for women who develop GDM.[2] Even if there is clinical suspicion for pre-existing glucose intolerance (i.e. pre-pregnancy), if glucose intolerance is initially detected during pregnancy, it is clinically classified and documented as GDM. GDM is a serious public health concern because prevalence in the United States ranges from 1to 14 percent, resulting in about 200,000 cases annually.

Maternal and child health implications

There are both short and long term implications for women with GDM. Adverse outcomes for the current pregnancy include increased risk of developing hypertensive disorders and delivering by Cesarean section.[3] There is also an increased risk for recurrence of GDM for subsequent pregnancies.[4] A 2010 study[4] found that women with a history of GDM had a risk of developing GDM in a second pregnancy of 41.3 percent, compared to a risk of only 4.2 percent in women without a history of GDM in a previous pregnancy. Furthermore, this risk increased as the number of GDM-affected pregnancies increased. In fact, a woman with a history of GDM in two prior pregnancies is 25 times more likely to develop GDM in a third pregnancy. The risks of recurrence were even greater for women from high risk groups, specifically Hispanics and Asian/Pacific Islanders.

Most women with GDM will see their blood sugars normalize immediately after delivery, yet about one-third will have an abnormal post-partum (approximately 6 weeks after delivery) screening test. However, regardless of this return to normal, all women with a history of GDM have an elevated risk of redeveloping glucose intolerance or actual type 2 diabetes throughout their lives. In fact, up to 50 percent will be diagnosed with diabetes within the 20 years following the GDM-affected pregnancy.[5]

GDM impacts more than just the short- and long-term health of the mother. Fetuses exposed to high levels of insulin are more at risk for health problems during and after delivery, as well as throughout childhood and even into adulthood. Glucose and other nutrients circulating within the pregnant mother are delivered to the fetus to provide energy and promote development. As the mother's blood glucose levels rise, the baby's levels also rise and induce the production of extra insulin, which in turn causes the baby to grow larger. Large-for-gestational age babies have an increased risk for complications during delivery, such as musculoskeletal and nerve injuries, including clavicular fractures. As newborns, babies born to mothers with GDM can continue to have extra insulin in their body. Without the abnormally high glucose being delivered from the mother, that extra insulin causes the babies blood glucose levels to fall too low (hypoglycemia), which, if severe enough, can lead to additional medical problems. These newborns also are more likely to have breathing problems after birth requiring treatment with oxygen or other medications.

Unfortunately, the effects of GDM on the child do not end after the newborn period. Babies born to mothers with GDM are more likely to be overweight or obese as children and are more likely to have elevated blood pressure or cholesterol as adults. Furthermore, they may be at greater risk for developing type 2 diabetes at some point throughout their lifetime.

GDM screening and diagnosis

Studies have shown that diagnosing and treating GDM significantly decreases the risk of fetal morbidity and mortality.[3] Screening all pregnant women for GDM is universally recommended.[11, 12] Unfortunately, the use of historical or clinical risk factors by clinicians as a screening tool is limited in its success, and fails to identify approximately half of all GDM cases.[1] Thus, an oral glucose tolerance test to screen for GDM is preferred.[13] The most recent guidelines from the American Diabetes Association consider a blood sugar level threshold between 130 and 140 mg/dL as acceptable. The screening test is traditionally administered between 24-28 weeks gestation. For patients with risk factors for GDM, the screening typically would be administered prior to 20 weeks' gestation and, if negative, repeated at the traditional time.

A positive screening test is followed by a diagnostic test specific to pregnancy. Since 1964, the recommended screening test has been the 100 gram, three hour glucose tolerance test administered in the fasting state with three successive blood sugar readings hourly after an initial fasting measurement.[14] The values below (Table 1) are derived from those proposed by Carpenter and Coustan[15] and recommended by expert panels. A positive diagnosis requires elevation of two of four values. [14]

TABLE 1.

Above-normal results for the oral glucose tolerance test.

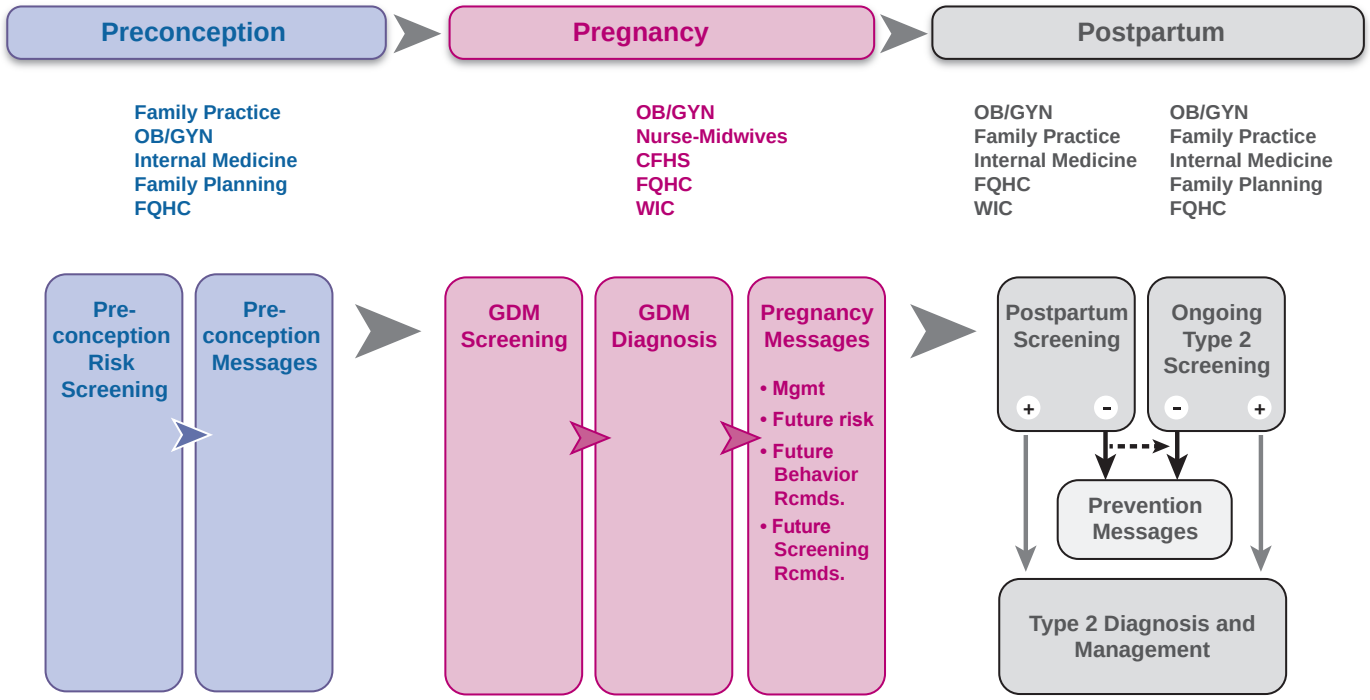
Above-normal results for the oral glucose tolerance test*	
Fasting	95 or higher
At 1 hour	180 or higher
At 2 hours	155 or higher
At 3 hours	140 or higher
Note: Some labs use other numbers for this test.	
**These numbers are for a test using a drink with 100 grams of glucose.*	

Although we can assume the data presented in this databook are likely based on the test and results in Table 1, we cannot be sure because data on how GDM diagnoses were made are not explicitly collected.

Ohio Department of Health's (ODH) GDM Collaborative Team

In 2010, the Association of Maternal and Child Health Programs (AMCHP), the Centers for Diseases Control and Prevention (CDC) and the National Association of Chronic Disease Directors (NACDD) formed a collaborative project to foster integration of maternal and child health (MCH) and chronic disease programs. GDM was chosen as a focus due to the impact of this disease on pregnancy, the significant risks for both mother and infant, and the long-term potential for the development of chronic diseases throughout adulthood. The Ohio Department of Health was one of three state agencies chosen to be part of this collaborative. The Ohio GDM Collaborative Team consists of the Division of Family and Child Health Services, the Office of Healthy Ohio, and the State Epidemiology Office. The Team has also partnered with Ohio Medicaid throughout the process. The following schematic adapts the Life Course model[16] to address this clinical issue. We used this framework to develop goals and strategies around GDM, with the intent to form future interventions. As the team developed a workplan, it was apparent there were no comprehensive sources of GDM data available. This databook summarizes existing information about GDM, identifies gaps in knowledge and outlines the ODH Collaborative Team's activities in primary data collection. It should be noted that there is no one best source to obtain prevalence data for Ohio. Each has its own strengths and limitations. Some data sources, such as hospital discharge data, are not readily available in detail which limits prevalence estimation. For more information on the ODH Collaborative Team (see Appendix A), please visit: http://www.odh.ohio.gov/ASSETS/24036492CF394035977E4902063ECD34/OhioGDM.pdf.

FIGURE 1. Gestational Diabetes Healthcare Continuum



RISK FACTORS FOR GDM

What are the risk factors for developing GDM?

It is not clear why some woman develop GDM while others do not, but certain risk factors and characteristics are associated with increased risk of developing the disease. GDM prevalence varies in direct proportion to the prevalence of type 2 diabetes in a given population or ethnic group.[1]

Risk factors for developing GDM include the following: a personal history of GDM, history of having a baby with birth weight of more than 4000 grams, glucose in the urine, a first-degree family history of type 2 diabetes or GDM, maternal history of unexplained fetal demise, maternal age greater than 25 years of age, and overweight or obese status.[1] Current literature on the association between smoking during pregnancy and GDM risk is mixed, with some studies showing a positive association.[6]

Certain groups are recognized to be at higher risk for glucose intolerance during pregnancy and include women of Hispanic, African, Native American, South/East Asian, or Pacific Islander ancestry.[7] A recent study[8] utilized National Hospital Discharge Survey data to evaluate trends of GDM overall and by race, age and geographic area. An increase of 122 percent in overall prevalence was seen from the time period of 1989-1990 to 2003-2004. The rate for whites was relatively stable with an increase of 2.2 percent, but there was a marked increase for African-Americans of 260 percent during the same time period. The largest increase for African-Americans occurred in women less than 25 years of age. This trend for increasing prevalence is also seen in other studies[9] performed in the United States and Australia. These increases range from 16 percent to 127 percent. Underlying reasons may include increasing maternal age and the disproportionately elevated prevalence of obesity in these racial and ethnic groups.

Some studies have shown women with GDM may have a two-to-three times greater risk of preeclampsia (hypertension during pregnancy)[10] yet an association may be difficult to prove as risk factors for the development of preeclampsia overlap with GDM risk factors (overweight or obese status, race/ethnicity). According to data from Ohio Vital Statistics 2006-2008, approximately 4.5 percent of women with GDM have pre-pregnancy hypertension, compared to only 1.6 percent of women without GDM.

Prevalence of GDM-related risk factors among women of reproductive age in Ohio

In Ohio, there are two main sources that provide data on the prevalence of GDM-related risk factors among women aged 18-45 years: the Behavioral Risk Factor Surveillance System (BRFSS) (includes adults aged 18 years and older) and the Pregnancy Risk Assessment Monitoring System (PRAMS) (includes women with a recent live birth). Although the majority of women in Ohio are non-Hispanic white, more than 15 percent of women 18 years or older belong to racial or ethnic groups at higher risk of developing GDM. Additionally, approximately 50 percent of women in this age group are considered to be overweight or obese. More than 20 percent of these women are physically inactive; between 4-6 percent had hypertension during pregnancy; and between 17-27 percent are current smokers. Such data can provide insights into the potential future burden of GDM in Ohio and indicate where prevention efforts are most necessary (Table 2).

TABLE 2.

Prevalence of GDM-related risk factors among women aged 18-44 years, Ohio BRFSS and PRAMS 2006-2008.

Risk Factor		BRFSS		PRAMS	
		%	95% CI	%	95% CI
Age	18-24	11.4	10.3-12.5	34.1	32.2-36.1
	25-34	16.8	15.9-17.7	53.7	51.6-55.7
	35-44	18.2	17.4-19.0	12.2	11.0-13.5
Race[a]	Non-Hispanic White	84.3	83.0-86.0	79.8	78.8-80.7
	Non-Hispanic Black	9.5	8.2-10.8	14.3	13.7-14.8
	Hispanic	2.4	1.7-3.0	2.8	2.3-3.5
	Other	3.8	3.0-4.6	3.1	2.5-3.8
BMI[b]	Underweight (BMI < 18.5)	3.5	2.5-4.5	4.4	3.8-5.2
	Normal weight (18.5 - 24.99)	46.0	43.6-48.4	49.1	47.4-50.8
	Overweight (25.00-29.99)	24.4	22.4-26.3	24.0	22.6-25.5
	Obese (30.0+)	26.2	24.0-28.4	22.5	21.1-24.0
Physical Inactivity[c]		22.0	20.1-23.9	N/A	N/A
Smoking[d]		27.1	25.4-28.8	31.2	29.7-32.7

Sources: Analyses using Behavioral Risk Factor Surveillance System (BRFSS) 2006-2008 by Dan Moffat, Epidemiologist, Ohio Diabetes Prevention and Control Program, Ohio Department of Health; Analyses using Pregnancy Risk Assessment Monitoring System (PRAMS) 2006-2008 by Reena Oza-Frank, CDC/CSTE Fellow, State Epidemiology Office, Ohio Department of Health

Footnotes:

BRFSS sample includes adults aged 18 years and older. For the purposes of this table, age was restricted to include only women aged 18-44

a Other race includes those that reported multiple races.

b BMI in BRFSS = self-reported BMI at time of interview; BMI in PRAMS = self-reported pre-pregnancy BMI

c Physical inactivity from BRFSS based on responses from adults that report doing physical activity or exercise during the past 30 days other than their regular job

d Smoking in BRFSS = Current/former smoker; Smoking in PRAMS = smoking 3 months prior to getting pregnant or during first trimester

GDM IN BURDEN OHIO

There are six sources that provide data on GDM prevalence in Ohio. According to these data sources, the range of GDM prevalence in 2006-2008 was between 1.9 and 10.0 percent (Table 3). Although informative when assessing GDM prevalence among specific target populations, this wide range results in the lack of a precise statewide prevalence estimate. However, a statewide estimate is not needed to establish a systematic process of tracking GDM prevalence over time using these data sources. The next six sections in this chapter provide an overview of each of these six data sources and include data by select demographic characteristics.

TABLE 3.
GDM prevalence from six state-based data sources, Ohio 2006-2008.

	Behavioral Risk Factor Surveillance Survey	Vital Statistics	Pregnancy Risk Assessment Monitoring System	Medicaid Claims Data	Child and Family Health Services Clinics	Ohio Hospital Association Discharge Data
GDM Prevalence (Percent)	1.9	5.0	10.0	7.6	3.3	5.0

Sources: Analyses using birth certificate data from Vital Statistics, Pregnancy Risk Assessment Monitoring System (PRAMS), Ohio Hospital Association (OHA) 2006-2008 by Reena Oza-Frank, CDC/CSTE Fellow, State Epidemiology Office, Ohio Department of Health; Analyses using Behavioral Risk Factor Surveillance System (BRFSS) 2006-2008 by Dan Moffat, Epidemiologist, Center for Public Health Statistics and Informatics, Ohio Department of Health; Analyses using Medicaid 2006-2008 by Donald Reed, Health Services Policy Specialist, Center for Public Health Statistics and Informatics, Ohio Department of Health; Analyses using Integrated Perinatal Health Information System (IPHIS) 2006-2008 by Russell Satori, Researcher, Bureau of Child and Family Health Services, Ohio Department of Health.

Data Sources

Data Source: Behavioral Risk Factor Surveillance System (BRFSS)

Data description:

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. BRFSS was established in 1984 by the CDC. 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.[17]

TABLE 4.
GDM prevalence only in pregnancy by demographics, Ohio BRFSS 2006-2008.

		Percentage of women with history of GDM (%)	95% CI
Overall		**1.9**	
Age (years)	18-24[a]	1.9	0.4-3.3
	25-34	4.0	2.7-5.2
	35-44	3.0	1.9-4.0
	45+	0.9	0.7-1.1
Race[b]	Non-Hispanic White	1.7	1.4-2.0
	Non-Hispanic Black	2.7	1.1-4.2
	Hispanic[a]	1.9	0.4-3.5
	Other[a]	4.8	0.0-9.8
Marital Status	Married	2.2	1.7-2.6
	Unmarried	1.5	1.1-2.0
Education	Less than HS[a]	2.4	0.9-4.0
	HS grad	1.5	1.0-2.0
	Some college	1.6	1.2-2.1
	College grad	2.5	1.7-3.3
Geographic Region	Urban - Metro	1.9	1.5-2.3
	Rural - Nonmetro	1.9	1.1-2.7
Insurance Status	Plan	1.8	1.4-2.1
	No Plan	2.8	1.3-4.3
BMI (kg/m^2)	Underweight (BMI < 18.5)[a]	1.2	0.0-2.5
	Normal weight (18.5 - 24.99)	2.1	1.4-2.7
	Overweight (25.00-29.99)	1.6	1.1-2.1
	Obese (30.0+)	2.1	1.5-2.8

Sources: Analyses using Behavioral Risk Factor Surveillance System (BRFSS) 2006-2008 by Dan Moffat, Epidemiologist, Center for Public Health Statistics and Informatics, Ohio Department of Health and Reena Oza-Frank, CDC/CSTE Fellow, State Epidemiology Office, Ohio Department of Health.

Footnotes:

a Unreliable estimates; relative standard error >30%

b Other race includes those that reported multiple races

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 respondent is female, ask "Was this only when you were pregnant?")

95% confidence interval (CI): If the survey were repeated 100 times, 95% of the time the interval will contain the true estimate. The more narrow a CI, the more precise the estimate

Interpretation of BRFSS GDM data:

Approximately 1.9 percent of females in Ohio self-reported having had diabetes only during pregnancy. Women aged 25-34 had the highest prevalence of a history of only GDM, as did women with no insurance.

Limitations of BRFSS GDM data:

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.[18] Despite this, the accuracy of self-reporting for diabetes is reasonably high in population surveys.[19]

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

Future considerations:

Beginning in 2011, the Ohio survey added the following questions if there is an affirmative response to the question about having diabetes when pregnant. The goal is to capture information about post-partum visits, in general and specifically, the rate of follow-up diabetes screening among women with a history of GDM:

- ❑ Did you have a test for high blood sugar 6-12 weeks after delivery?
- ❑ Did your health care provider recommend being tested for diabetes every 1 to 3 years?
- ❑ Did your health care provider discuss the long-term risks of developing type 2 diabetes?

Women aged 25-34 had the highest prevalence of a history of diabetes only during pregnancy. These women are at high risk for developing type 2 diabetes and for having another pregnancy affected by diabetes.

Data Source: Vital Statistics

Data description:

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, mother's medical records, labor and delivery records, as well as the 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.

TABLE 5.

Prevalence of GDM-affected live births by maternal demographics, Ohio Vital Statistics 2006-2008.

		Percentage of GDM-affected births (%)
Overall (n = 21685)		5.0
Age (years)	18-24	2.7
	25 - 34	5.6
	35-44	9.0
	45+	11.2
Race[a]	Non-Hispanic White	4.9
	Non-Hispanic Black	4.5
	Hispanic	9.1
	Other	6.5
Marital Status	Married	5.7
	Not married	3.9
Education	Less than HS	3.8
	HS grad	4.9
	Some college	5.6
	College grad	5.1
Migrant Status	U.S. Born	4.8
	Foreign-Born	7.3
Pre-pregnancy BMI (kg/m^2)	Underweight (<18.5)	3.2
	Normal weight (18.5-24.9)	2.7
	Overweight (25.0-29.9)	5.2
	Obese (30.0+)	9.4
Weight gain during pregnancy[b]	Adequate	4.6
	Insufficient	6.0
	Too much	4.6

Sources: Analyses using Vital Statistics 2006-2008 by Reena Oza-Frank, CDC/CSTE Fellow, State Epidemiology Office, Ohio Department of Health.

Footnotes:

a Other race includes those that reported multiple races

b Weight gain during pregnancy defined using the IOM 2009 guidelines [20]

Interpretation of Vital Statistics GDM data:

Approximately 5 percent of live births were affected by GDM during pregnancy in Ohio in 2006-2008. As expected, the prevalence varies by demographic characteristics. The data show that GDM is higher among Hispanics, married, better educated, older and foreign-born women. Additionally, GDM is highest among women with a pre-pregnancy BMI of 30 kg/m^2 or more.

Strengths of GDM data:

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.[21]

Limitations of GDM data:

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[22-24], 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.[25] However, in Minnesota, hospital discharge data performed better in identifying GDM and pre-pregnancy diabetes than birth certificates.[23] Validity of birth certificates to report GDM in Ohio has not yet been quantified.

Data Source: Pregnancy Risk Assessment Monitoring System (PRAMS)

Data description:

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. PRAMS was developed by CDC in 1987. Currently, 37 states and New York City participate in PRAMS (including Ohio since April 1999). These findings will be 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 post-partum. If there is no response to repeated mailings, women are contacted and interviewed by telephone.[26] (Results are described in Table 6, page 21.)

Interpretation of PRAMS GDM data:

Approximately 10.0 percent of the women having a live birth in 2006-8 in Ohio self-reported having diabetes during pregnancy, with the highest prevalence among women aged 35-44 and those with a pre-pregnancy BMI of greater than or equal to 30 kg/m^2.

Strengths and limitations of PRAMS GDM data:

Overall, the accuracy of self-reporting for diabetes is reasonably high in population surveys.[19] Despite this, the data from Ohio's most recent PRAMS survey includes 49 women who reported both GDM and pre-pregnancy diabetes because there is no definitive way to determine if these women do or do not have GDM. Additionally, similar to BRFSS, data collected from PRAMS are self-reported, which is subject to recall bias, social desirability bias, and measurement bias resulting from wording and questionnaire design.[18] Finally, although the question asks about GDM history in the most recent pregnancy, respondents may answer based on any past pregnancy.

Future considerations:

Beginning with Phase 6 (2009-2011), the core PRAMS survey questions (all states participating in PRAMS) pertaining to diabetes were changed to be more specific, which will hopefully result in better differentiation between pre-pregnancy diabetes and GDM:

- ❑ Before you got pregnant, were you ever told by a doctor that you had type 1 or type 2 diabetes (not the same as gestational)?
- ❑ During your most recent pregnancy, were you told by a doctor that you had gestational diabetes (diabetes that started during this pregnancy)?

TABLE 6.
Prevalence of GDM by maternal demographics Ohio PRAMS 2006-2008.

		Percentage of Respondents with GDM in most recent pregnancy %[a]	95% CI
Overall (n = 404)		10.0	8.9-11.4
Age (years)	18-24	8.0	6.2-10.1
	25 - 34	10.1	8.5-12.0
	35-44	15.7	12.1-20.1
	45+[b]	.	.
Race	Non-Hispanic White	10.3	8.9-11.9
	Non-Hispanic Black	9.6	7.8-11.7
	Hispanic[b]	.	5.1-22.2
	Other[b,c]	.	5.0-21.3
Marital Status	Married	10.4	8.9-12.1
	Unmarried	9.3	7.5-11.4
Education	Less than HS	10.3	7.1-14.5
	HS grad	11.8	9.4-14.6
	Some college	11.5	9.4-14.0
	College grad	6.3	4.7-8.4
Geographic Region	Urban	10.1	8.8-11.6
	Rural	10.2	7.7-13.3
Insurance Status (Prenatal Care)	Medicaid - No	9.5	8.1-11.2
	Medicaid - Yes	10.7	8.7-13.0
Pre-pregnancy BMI (kg/m^2)	Underweight (BMI<18.5)[a]	.	0.3-2.2
	Normal weight (18.5-24.99)	6.9	5.5-8.6
	Overweight (25.00-29.99)	9.7	7.4-12.5
	Obese (30.0+)	19.3	16.0-23.0
Weight gain during pregnancy[d]	Adequate	10.1	7.9-13.0
	Insufficient	11.8	9.6-14.6
	Too much	8.97	7.40-10.84

Sources: Analyses using Pregnancy Risk Assessment Monitoring System (PRAMS) 2006-2008 by Reena Oza-Frank, CDC/CSTE Fellow, State Epidemiology Office, Ohio Department of Health. Survey response rates: 2006=72%; 2007=67%; 2008=68%

Footnotes:

a Based on answers to the question: "Did you have any of these problems during your most recent pregnancy? For each item, circle Y (Yes) if you had the problem or circle N (No) if you did not."
High blood sugar (diabetes) that started before this pregnancy
High blood sugar (diabetes) that started during this pregnancy

b Unreliable estimates; relative standard error >30% or cell sizes <30

c Other race includes those that reported multiple races

d Weight gain during pregnancy defined using the IOM 2009 guidelines [20]

95% confidence interval (CI): If the survey were repeated 100 times, 95% of the time the interval will contain the true estimate. The more narrow a CI, the more precise the estimate

Data Source: Ohio Medicaid Claims Data

Data description:

The database from which Medicaid data originate contains eligibility, demographic and transactional data for all Medicaid recipients. Data are updated monthly and can be obtained either at a summary level, or at the record level, using ICD-9 or CPT codes.

TABLE 7.
Prevalence of GDM by maternal demographics, Ohio Medicaid 2006-2008

		Percentage of Participants with GDM (%)
Overall (n=14,278)		7.6
Age (years)	18-24	5.6
	25 - 34	10.5
	35-44	17.0
	unknown	2.8
Race[a]	Non-Hispanic White	8.4
	Non-Hispanic Black	6.1
	Hispanic	5.8
	Other	8.7
Geographic Region[b]	Urban	6.8
	non-Urban	4.4

Source: Analyses using Medicaid 2006-2008 by Donald Reed, Health Services Policy Specialist, Center for Public Health Statistics and Informatics, Ohio Department of Health.

Footnotes:

Deliveries are identified by either an Ohio admission DRG code of 0370-0375 on the facility header, or by a Managed Care Plan delivery payment on the financial table

Deliveries in 2006-2008 are the denominator (not all participants in 2006-2008)

GDM identified by a principal diagnosis ICD-9 code of 64880-64884 on a facility or professional claim during the 270 day period prior to delivery

Only data from one of the following types of providers were included in the analysis: advanced practice nurse, comprehensive clinic, federally qualified health center, general hospital, nurse, nurse midwife, nurse practitioner, osteopath group, osteopath individual, physician group, physician individual, public health department clinic, rural health facility

a Other race includes those that reported multiple races

b Urban refers to the 7 largest counties in Ohio: Cuyahoga (Cleveland), Franklin (Columbus), Hamilton (Cincinnati), Lucas (Toledo), Mahoning (Youngstown), Montgomery (Dayton), Summit (Akron)

Interpretation of Ohio Medicaid GDM data:

Approximately 7.6 percent of the Medicaid participants who delivered in 2006-2008 in Ohio had a GDM-affected pregnancy. Women aged 35-44 years had the highest GDM prevalence. Non-Hispanic white women had higher prevalence than other race/ethnicities, which is the reverse of what is expected.

Strengths and limitations of Ohio Medicaid GDM data:

Even if the 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 if Medicaid did not pay for the service. Although probably rare, individuals could be receiving care through a non-Medicaid provider.

Data Source: Child and Family Health Services (CFHS) Clinics

Data description:

The Integrated Perinatal Health Information System (IPHIS) is the designated data collection system for local health departments and organizations in Ohio who have applied for and have been awarded ODH Child and Family Health Services (CFHS) perinatal enabling and direct care dollars. The IPHIS system collects demographic and encounter information. The data for the IPHIS system are collected through Web-based data entry by the local health departments and organizations, and accessed through direct query by ODH. Ohio has integrated the new birth certificate system with a perinatal screening system that allows for better screening of prenatal factors of newborns. The ODH CFHS program provides direct care and enabling services (family planning, perinatal health, child health) to low-income women and children in racial and ethnic groups that are disproportionately affected by poor health outcomes. Compared to non-CFHS perinatal clients, CFHS participants are generally less educated, younger, African-American, and smoke more. Furthermore, they are more likely to be unmarried and have an unintended pregnancy. In 2006, of the 92 percent of Medicaid-eligible Ohio mothers, 78 percent were enrolled in the program. (Results are described in Table 8, page 25.)

Interpretation of CFHS GDM data:

Approximately 3.3 percent of the CFHS participants in Ohio have GDM. Women with a higher pre-pregnancy BMI had the highest GDM prevalence.

Strengths and limitations of CFHS GDM data:

GDM was queried on patient records from CFHS clinics from 2006-2008. However, if a patient had pregnancy visits prior to January 1, 2006, where GDM may have been diagnosed or noted in the record, then there is a chance that the GDM risk factor was not carried through and missed in the 2006-2008 queries.

As mentioned earlier, while the majority of women seeking care at CFHS clinics are on Medicaid, these clinics only serve a proportion of patients on Medicaid and are not representative of the entire Medicaid population. Data may not be as reliable during this time period due to decreased staffing, resulting in less data quality management and/or technical assistance for data entry.

Future Considerations:

A new data system will be implemented by the ODH Bureau of CFHS in the coming years that should address the limitations listed above.

TABLE 8.
Prevalence of GDM by maternal demographics, Ohio CFHS Clinics 2006-2008.

		Percentage of Respondents with GDM in most recent pregnancy %
Overall (n=624)		3.3
Age (years)	18 -24	1.9
	25 – 34	5.4
	35 – 44	8.4
	45+	0.0
Race[a]	Non-Hispanic White	2.5
	Non-Hispanic Black	3.3
	Hispanic	5.7
	Other	7.0
Marital Status (from birth record)	Married	5.3
	Unmarried	2.7
Education	Less than HS	3.3
	HS grad	3.0
	Some college	4.1
	College grad	5.7
Insurance Status (Prenatal Care)	***CHAMPUS/TRICARE***	0.0
	Medicaid	3.0
	Medicare	0.0
	Other	2.0
	Other Government	3.3
	Private Insurance	2.8
	Self Pay	1.2
	Uninsured	2.5
	No Risk	2.0
Weight Risk from First Encounter	Underweight (< or = 90% Standard wt/ht)	2.2
	Overweight (120-134% Standard wt/ht)	4.6
	Obese (> or = 135% Standard wt/ht)	9.5

Source: Analyses using Integrated Perinatal Health Information System (IPHIS) 2006-2008 by Russell Satori, Researcher, Bureau of Child and Family Health Services, Ohio Department of Health.[27]

Footnotes:

a Other race includes those that reported multiple races

Data Source: Ohio Hospital Association (OHA) Discharge Data

Data description:

The Ohio Hospital Association (OHA) represents 18 health systems and 170 hospitals (78 percent) throughout Ohio and 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 were as follows:

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

• **HOSPITAL INPATIENT DISCHARGES**

TABLE 9.

The number of GDM- and non-GDM hospital discharges, Ohio 2006-2008.

Year	Number of GDM Cases	Number of non-GDM Cases	GDM Prevalence
2006	7,846	146,325	5.1%
2007	8,194	144,795	5.4%
2008	7,983	142,113	5.3%

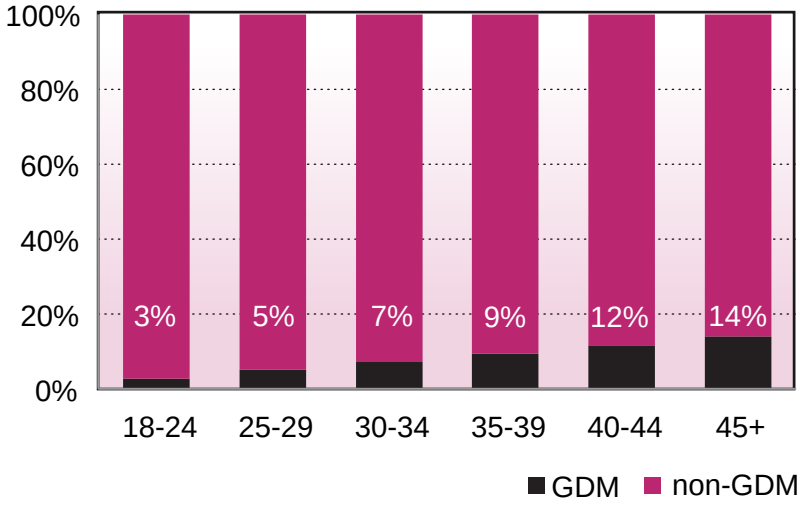
Source: Data provided by Ohio Hospital Association (OHA) and analyses by Reena Oza-Frank, CDC/CSTE Fellow, State Epidemiology Office, Ohio Department of Health.

Interpretation of OHA discharge GDM data:

GDM discharges between 2006-2008 constituted approximately 5 percent of all obstetrics discharges, ranging from 5.1 to 5.4 percent. The number of GDM discharges increased 2 percent from 7,846 in 2006 to 7,983 in 2008. Conversely, the number of non-GDM discharges decreased 3 percent from 146,325 to 142,113.

As shown in Figure 2, GDM prevalence increased with increasing age. Among women aged 18-24 years, 3 percent had GDM, whereas among women aged 45 and older, 14 percent had GDM.

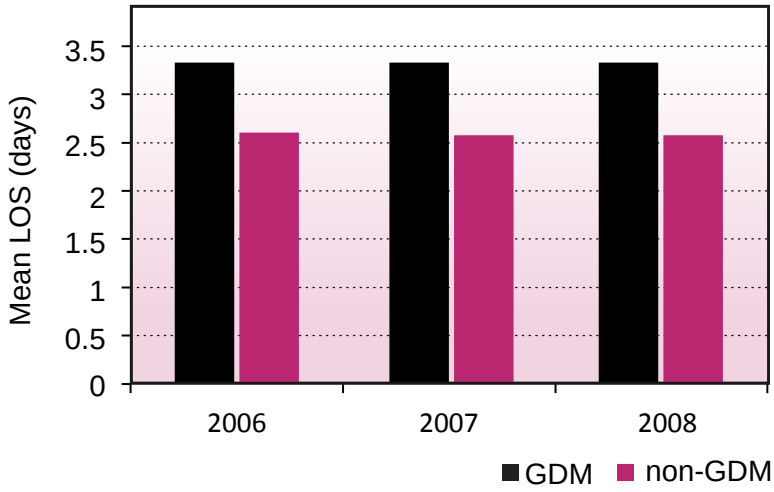
FIGURE 2.
Proportion of GDM-related obstetrics discharges by age group, Ohio 2006-2008.



Source: Data provided by Ohio Hospital Association (OHA) and analyses by Reena Oza-Frank, CDC/ CSTE Fellow, State Epidemiology Office, Ohio Department of Health.

As shown in Figure 3, the mean length of stay (LOS) was consistently lower among non-GDM related hospital discharges. Specifically, mean LOS was approximately 3.3 days among GDM related hospital discharges and approximately 2.6 among non-GDM related hospital discharges, resulting in a difference of approximately 0.7 days. There was no statistically significant difference between 2006-2008.

FIGURE 3.
Mean length of stay (LOS) among GDM- and non-GDM-related obstetrics discharges, Ohio 2006-2008.

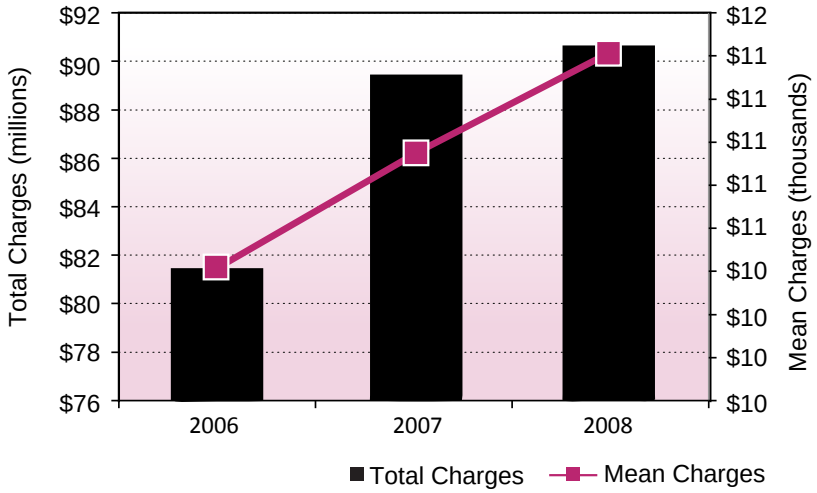


Source: Data provided by Ohio Hospital Association (OHA) and analyses by Reena Oza-Frank, CDC/ CSTE Fellow, State Epidemiology Office, Ohio Department of Health.

• HOSPITAL INPATIENT CHARGES

Adjusted for medical cost inflation, total charges increased among GDM related hospital discharges by 11 percent ($82 million to $91 million; Total charges in 2006-2008 = $262,138,991).

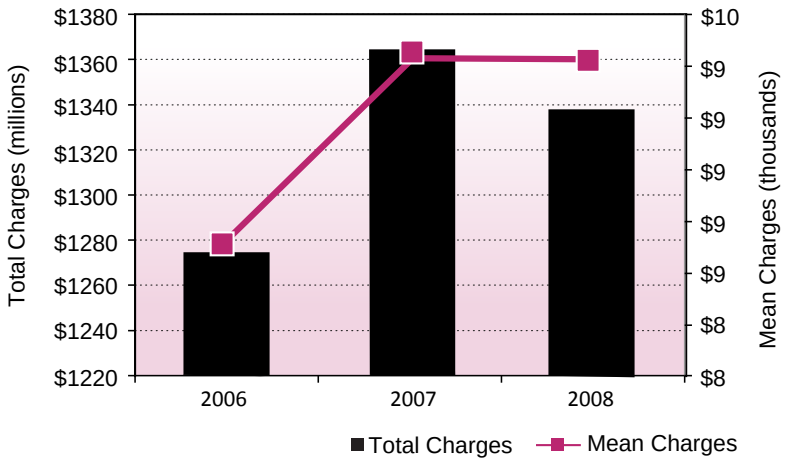
FIGURE 4.
Total and mean charges among GDM-related obstetrics discharges, Ohio 2006-2008.



Source: Data provided by Ohio Hospital Association (OHA) and analyses by Reena Oza-Frank, CDC/CSTE Fellow, State Epidemiology Office, Ohio Department of Health.
Footnote: Adjusted for medical cost inflation; charges represent total amount billed, not actual amount collected.

Total charges increased five percent ($1,275,976,127 to $1,342,563,943), mean charges increased eight percent ($8,720 to $9,447). Total charges in 2006-2008 = $3,987,099,720.

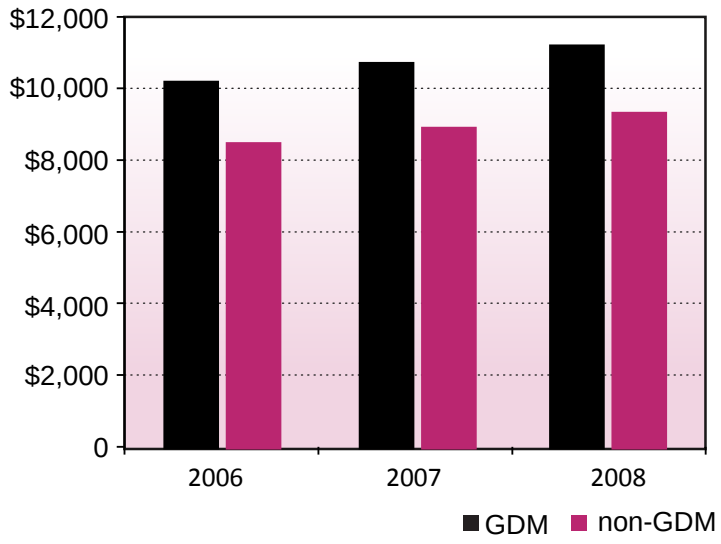
FIGURE 5.
Total and mean charges among non-GDM-related obstetrics discharges, Ohio 2006-2008.



Source: Data provided by Ohio Hospital Association (OHA) and analyses by Reena Oza-Frank, CDC/CSTE Fellow, State Epidemiology Office, Ohio Department of Health.
Footnote: Adjusted for medical cost inflation; charges represent total amount billed, not actual amount collected.

Mean charges increased for GDM by 9 percent ($10,395 to $11,385). Mean charges increased for any by 8 percent among non-GDM discharges ($8,720 to $9,447).

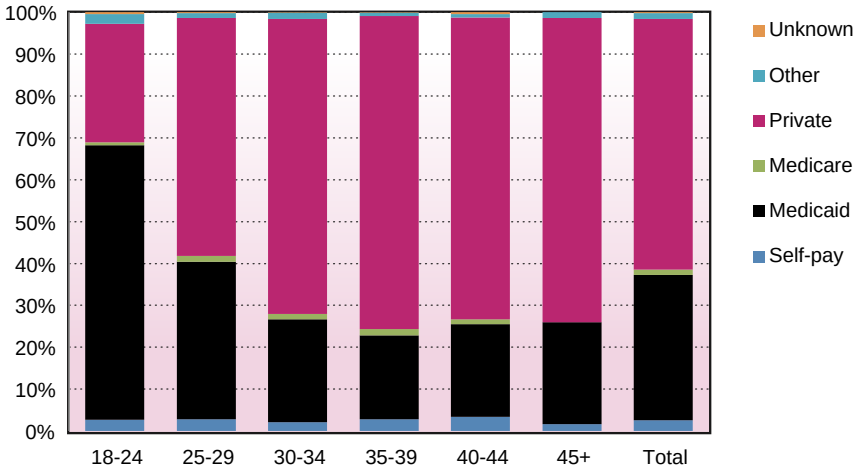
FIGURE 6.
Mean charges among GDM- and non-GDM-related obstetrics discharges, Ohio 2006-2008.



Source: Data provided by Ohio Hospital Association (OHA) and analyses by Reena Oza-Frank, CDC/CSTE Fellow, State Epidemiology Office, Ohio Department of Health.
Footnote: Adjusted for medical cost inflation; charges represent total amount billed, not actual amount collected.

From 2006-2008, total charges billed for GDM-related hospital discharges were approximately $251 million. Since insurance coverage varies greatly by age, the primary medical insurance payers were analyzed by patient age groups.

FIGURE 7.
Percent of total charges for GDM-related obstetrics discharges by primary payer and age group, Ohio 2006-2008.



Source: Data provided by Ohio Hospital Association (OHA) and analyses by Reena Oza-Frank, CDC/CSTE Fellow, State Epidemiology Office, Ohio Department of Health.
Footnote: Adjusted for medical cost inflation; charges represent total amount billed, not actual amount collected.

Among women aged 18-24, Medicaid was the primary payer for over half of discharges. For all other age groups, private insurance was the primary payer for the majority of discharges.

Although Medicaid is the primary payer billed for the majority of discharges in the youngest age category, this age group also has the lowest proportion of GDM. Therefore, private insurance is the primary payer being billed for 60 percent of all GDM discharges,with Medicaid in second place with 35 percent of all GDM discharges. Thirty-six percent ($230 million) of GDM-attributed medical costs are paid for through government programs (primarily Medicaid); 56 percent ($335 million) by private insurers; 8 percent ($51 million) by uninsured and self-pay patients, which includes charity care for patients unable to pay.

These figures represent charges associated with inpatients only. These figures do not include costs associated with emergency transport, physician fees, medications, rehabilitation, lost work, lost wages and long-term care.

Strengths and limitations of OHA discharge GDM data:

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 for the condition being examined. A previous study that evaluated ICD-9-CM codes in hospital discharge data for use in obstetric research reported high positive predictive values (96 percent) and moderate sensitivity (64 percent) for the full spectrum of diabetes codes.[28] Similar results were reported in another study that assessed the validity of hospital discharge data for identifying diabetes-complicated births.[23] This result suggests the potential for underestimation rather than overreporting 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 increases. Population-based studies of laboratory-based diagnoses of GDM over similar time intervals, however, also documented increasing trends similar to what we report.[23, 28]

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 a 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 differences in the prevalence of several GDM complications, as shown in Table 10. Additionally, women with GDM may also have higher rates of indirect costs resulting from increased time off work and psychological stress.[29]

Pregnancy complications associated with GDM

TABLE 10.

Prevalence of GDM-related complications, Vital Statistics and PRAMS Ohio 2006-2008.

	Gestational Diabetes % (95% CI)	No Gestational Diabetes % (95% CI)
Gestational hypertension[a]	7.30	3.60
C-section[a]	43.46	29.40
High Birth Weight[a,b]	11.15	7.85
# days mom in hospital after baby is born[c,d]	3.0	3.0
# days baby in hospital after birth[c]		
1-2 days	51.2 (44.3-58.0)	59.4 (57.3-61.5)
3 days	23.5 (18.1-29.8)	22.8 (201.0-24.7)
4 days	2.4 (9.0-18.5)	7.2 (6.2-8.3)
5 days	4.3 (2.4-7.7)	2.4 (1.8-3.1)
6 days or more	7.6 (5.1-11.0)	5.8 (5.1-6.6)
NICU admission[c]	14.4 (10.7-19.2)	9.5 (8.5-10.7)

Source: Analyses by Reena Oza-Frank, CDC/CSTE Fellow, State Epidemiology Office, Ohio Department of Health.

Footnotes:

a Data from Vital Statistics 2006-2008

b Birthweight not adjusted for gestational age

c Data from Pregnancy Risk Assessment Monitoring System (PRAMS) 2006-2008

d Median values

- Excluded women with pre-pregnancy diabetes

95% confidence interval (CI): If the survey were repeated 100 times, 95% of the time the interval will contain the true estimate. The more narrow a CI, the more precise the estimate

Summary of GDM Burden in Ohio

Data on the prevalence of GDM and related complications have never been comprehensively compiled for Ohio. This initial description of the available data sources sheds light on the burden of GDM in Ohio and reveals the limitations of what can be inferred at present. The various data sources each represent different populations, different measures or different definitions for GDM prevalence. Thus, they each tell a slightly different story and have their own strengths and limitations.

Population of Women Aged 18-44

- Among the entire population of women aged 18-44 in Ohio, the BRFSS data show approximately 1.9 percent of women reported having diabetes in pregnancy only. This estimates the number of women in Ohio at risk for developing type 2 diabetes at some point in the future based on GDM history. These estimates, however, do not include women with a history of GDM who currently have other types of diabetes.

Births Complicated by GDM

- From Vital Statistics and PRAMS, we can estimate the number of births or pregnancies complicated by GDM in a given year. This prevalence ranges from 5.0 percent (approximately 7,228 per year) reported by hospitals on birth certificates to 10.0 percent from self-report by women within several months of delivery. As seen in reports from other states, birth certificates can underreport GDM prevalence, and while outpatient prenatal care records are the most reliable source, birth certificates are still more reliable for GDM data than hospital discharge records.[23]

- One state, New York, reported a similar difference in GDM prevalence by birth certificates (5.7 percent) and PRAMS (9.0 percent). However, this study also determined that with 93.8 percent agreement, self-report by PRAMS respondents is feasible for the identification of GDM.[21]

- Medicaid claims data showed that 7.6 percent of pregnant women enrolled in Medicaid (approximately 4,759 per year) had an insurance claim for GDM. Medicaid participants are an important population to follow, as more than half of all births in Ohio are to women enrolled in Medicaid. Furthermore, as a significant percentage of state spending is on Medicaid, a better understanding of the health and risks among this population can aid other programs in the identification and improvement of care for high-risk women and children.

- Among women using publicly funded CFHS prenatal clinics, administrative data show that 3.3 percent have a GDM diagnosis. Most of these women are Medicaid recipients and the data quality is unknown.

Hospital Discharges

- From OHA hospital discharge data, we know that among all obstetrics-related hospital discharges for inpatient stays, approximately 5 percent were complicated by GDM. While most (almost 80 percent) Ohio hospitals participate in this system, not all hospitals are OHA members.

- OHA data indicate an increase in the number of GDM-related obstetrics discharges between 2006-2008.

- Related to cost, total charges among GDM-related obstetrics discharges increased 11 percent between 2006 and 2008, while total charges among non-GDM discharges increased only 5 percent. Mean charges among GDM-related obstetrics discharges were consistently approximately $2000 higher than non-GDM discharges.

- Among women aged 18-24, Medicaid was the primary payer for over half of discharges. For all other age groups and overall, private insurance was the primary payer for the majority of discharges.

Demographics

- As expected, all data sources show an increasing prevalence of GDM by pre-pregnancy BMI.

- Also as expected, there is an increasing GDM prevalence with age for births in 2006-2008 until maternal age of 45 and above. In BRFSS, which captures any history of GDM in women without a history of other types of diabetes, women aged 25-34 had the highest prevalence of GDM only. While the cause for this peak in an earlier age group is unknown, it may be because many women aged 35 and older with a gestational diabetes history have subsequently developed type 2 diabetes.

- Unexpectedly, in most of the data sources Hispanic women and African American women do not appear to have a greater prevalence of GDM compared to white women in Ohio. The reasons for this are unknown and warrant further exploration while simultaneously accounting for other risk factors. One potential explanation may be that GDM prevalence in Ohio may be higher in non-Hispanic white women compared to national estimates, reducing race and ethnic differences.

There is no widely accepted gold standard for GDM surveillance. However, Ohio has several data sources that offer glimpses at various populations and measures of GDM. Improved data collection methods are currently being used within PRAMS and BRFSS, however, it will be one to two years before the results become available. Improvements to other data sets are currently being planned and could be informed by this report. While we await the availability of this improved data and work toward other improvements, we may still use the existing data to drive decisions and evaluate strategies designed at improving care for women with GDM. It is clear that as the burden of GDM in Ohio grows, the number of women at risk for developing type 2 diabetes will also increase. This has important health care and public health implications due to the high cost of care and considerable morbidity and mortality associated with diabetes.

POST-PARTUM VISITS AND SCREENING

Post-partum visits among women with a history of GDM

Data on the prevalence of GDM and related complications have never been comprehensively compiled. The post-partum visit (the mother's first visit after delivery) is a time to reinforce healthy lifestyles and provides the venue to follow-up on unresolved clinical issues from pregnancy such as:

- Family planning
- Glucose testing if GDM was present
- Vaccinations such as rubella, hepatitis B and varicella for the non-immune
- Colposcopy and biopsy if indicated for abnormal pap smears
- Weight optimization
- Smoking cessation
- Post-partum depression screening
- Management/referral for chronic diseases.

This visit occurs about 4-6 weeks after delivery but may be modified according to the needs of a patient's complications. The post-partum visit is an excellent time for inter-conception counseling for future pregnancies.[30] The post-partum visit is also a crucial time to assess the mother's risk for developing diabetes. Pregnancy is often considered to be a stress test for future development of diabetes due to the relatively normal development of some degree on insulin resistance during pregnancy. GDM represents a failure in the mother's ability to control this insulin resistance and can signal a similar failure in the years after delivery. Indeed, several studies have shown that history of GDM increases future risk of both pre-diabetes and type 2 diabetes (Table 11).

Table 11. Proportion of women with pre-diabetes or type 2 diabetes at post-partum visit, 5 years post-partum, and 10 years post-partum.[31-33]

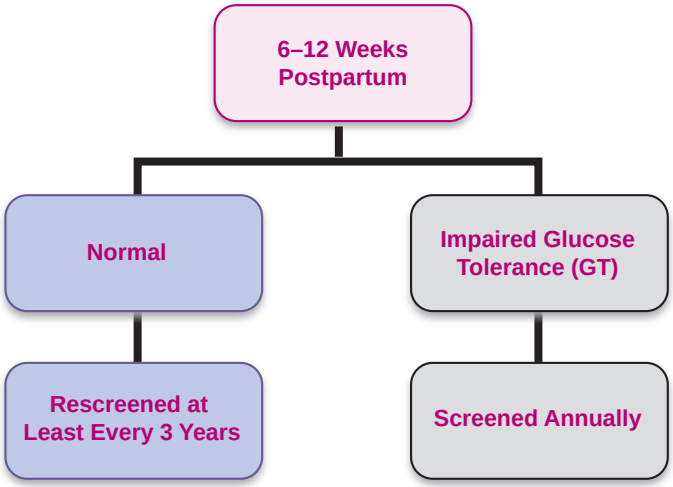
Condition (fasting plasma glucose)	At post-partum visit	After 5 years	After 10 years
Pre-diabetes (100-<126 mg/dl)	~25%	~80%	No studies yet, >80%?
Type 2 diabetes (>126 mg/dl)	~10%	~50%	~70%

The post-partum visit gives medical providers the first opportunity to assess the health of the mother, her risks for developing diabetes and to recommend appropriate referrals. An important part of this visit is to screen for an elevated blood sugar, either by a fasting glucose test or an oral glucose tolerance test.

According to the American Diabetes Association and the American College of Obstetrics and Gynecology, women with GDM should have their blood glucose tested at 6-12 weeks after delivery and, subsequently, every one to three years to monitor glucose levels and detect type 2 diabetes (Figure 7).[5,9] More frequent screening may be advised based on individual risk factors. This screening allows providers to identify those women needing further care to prevent diabetes in the

future or treat new-onset diabetes. Once identified, these women have been shown to benefit from counseling and appropriate referral to address modifiable risk factors, such as overweight and obesity. Healthy eating habits, regular physical activity and maintaining a healthy weight have all been shown to delay or prevent women with a history of GDM from progressing to diabetes later in life.[5]

Figure 8. Recommendations for post-partum blood glucose screening.[11, 12]



Despite these recommendations, published rates of testing range from 20 percent to 57.8 percent.[34-36] Unfortunately, women who are most at risk for developing diabetes are those who are less likely to return for testing. For a woman to receive a glucose screening at the post-partum visit, she must schedule the visit, attend the visit, and have a glucose screening ordered to be completed at that visit, or at another visit. A study of a case manager program to enhance post-partum screening practice[37] found that women who failed to return for screening had more severe GDM (higher glucose levels during pregnancy and/or need for medication or insulin for treatment) than women who returned and were more likely to have previously had GDM and higher pre-pregnancy weight.

Barriers to screening identified in a survey of obstetrician-gynecologists and primary care providers[38] included lack of communication between providers, lack of provider familiarity with guidelines, lack of screening for a GDM history, and lack of patient understanding about the long-term risks of GDM. To address some of these barriers, a group in Canada used postal reminder cards to increase post-partum screening rates.[39] This study showed an increase in return rates from 14.3 to 60.5 percent when both providers and patients received reminders compared to when no reminders were sent.

Data Sources

Data Source: Pregnancy Risk Assessment Monitoring System (PRAMS)

In Ohio, post-partum visit rates are tracked by three sources of data collection, PRAMS, CFHS Clinics and Medicaid claims data. The following tables represent data from these systems and discussion of each source.

TABLE 12.
Percentage of participants with and without GDM who attended a post-partum visit, Ohio PRAMS 2006-2008.

		% without GDM	95% CI	% with GDM	95% CI
Overall		90.0	88.7-91.3	90.3	85.9-93.4
Age (years)	18-24	92.0	89.6-93.9	87.2	76.5-93.5
	25 - 34	89.9	87.9-91.6	92.1	86.3-95.6
	35-44	84.9	80.2-88.6	89.3	77.8-95.2
	45+	.	.	.	.
Race[a]	Non-Hispanic White	89.8	88.2-91.3	90.6	85.2-94.1
	Non-Hispanic Black	90.6	88.3-92.4	85.0	75.7-91.1
	Hispanic	88.2	76.5-94.5	.	.
	Other	88.0	75.4-94.6	.	.
Marital Status	Married	89.5	87.7-91.1	93.4	88.4-96.3
	Unmarried	91.0	88.6-92.9	84.4	75.1-90.6
Education	Less than HS	89.3	84.2-93.0	81.4	65.1-91.1
	HS grad	88.0	84.9-90.6	89.8	81.3-94.7
	Some college	88.4	85.8-90.6	93.0	85.3-96.8
	College grad	94.1	92.0-95.6	92.3	78.8-97.5
Geographic Region	Urban	90.0	88.4-91.4	89.2	83.9-92.9
	Rural	89.4	85.9-92.1	93.9	84.9-97.7
	Medicaid - No	90.4	88.7-91.9	94.0	89.1-96.7
	Medicaid - Yes	89.4	86.8-91.5	85.2	76.3-91.2
	Underweight (BMI<18.5)	99.5	97.3-99.9	.	.
	Normal weight (18.5-24.99)	93.3	91.5-94.8	87.7	77.5-93.7
	Overweight (25.00-29.99)	90.2	87.1-92.6	91.7	81.0-96.6
	Obese (30.0+)	80.9	76.9-84.3	91.1	84.7-95.0
Weight gain during pregnancy[b]	Adequate	90.0	87.0-92.3	90.3	78.9-95.9
	Insufficient	87.7	84.7-90.3	89.8	82.1-94.5
	Too much	91.2	89.2-92.8	90.6	83.4-94.8

Source: Analyses using Pregnancy Risk Assessment Monitoring System (PRAMS) 2006-2008 by Reena Oza-Frank, CDC/CSTE Fellow, State Epidemiology Office, Ohio Department of Health. Survey response rates: 2006=72 percent; 2007=67 percent; 2008=68 percent

Footnotes:

Cells denoted with (.) are unreliable estimates; relative standard error >30% or cell sizes <30

Based on answers to the question: Since your new baby was born, have you had a post-partum checkup for yourself? (A post-partum checkup is the regular checkup a woman has after she gives birth)

95% confidence interval (CI): If the survey were repeated 100 times, 95 percent of the time the interval will contain the true estimate. The more narrow a CI, the more precise the estimate

a Other race includes those that reported multiple races

b Weight gain during pregnancy defined using the IOM 2009 guidelines [20]

Interpretation of data:

Among women with a history of GDM, those that are married or those not on Medicaid during prenatal care are more likely to have a post-partum visit (PPV). An analysis using PRAMS data from 11 states and NYC (not including Ohio) also found that PPV rate high (89 percent) overall, with some variation among states and by certain population subgroups.[40] Specifically, PPV rates were significantly lower among women with fewer years of education, who received no or late prenatal care, and whose infants did not have a well-baby checkup. To help reach all population subgroups, the importance of the PPV should be communicated to all women at the time of discharge from the hospital after delivery.[40]

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Data Source: Child and Family Health Services (CFHS) Clinics

TABLE 13.

Percentage of women with and without GDM and pre-pregnancy diabetes who attended a post-partum visit, Ohio CFHS Clinics 2006-2008

		% without GDM or pre-pregnancy diabetes	% with pre-pregnancy diabetes	% with GDM
Overall (n=624)		14.9	2.9	7.2
Age (years)	18-24	14.2	0.0	9.5
	25 - 34	16.7	4.9	6.8
	35-44	15.8	4.2	3.5
	45+	11.4	0.0	0.0
Race[a]	Non-Hispanic White	14.1	2.7	11.2
	Non-Hispanic Black	13.4	2.8	1.2
	Hispanic	19.3	5.6	5.7
	Other	17.8	0.0	10.9
Marital Status (from birth record)	Married	15.2	4.3	11.1
	Unmarried	14.9	2.1	5.3
Education	Less than HS	15.5	4.4	3.7
	HS Grad	14.9	2.2	12.1
	Some College	13.9	0.0	6.2
	College Grad	15.8	9.1	7.3
Insurance Status (Prenatal Care)	Champus/Tricare	7.7	0.0	0.0
	Medicaid	16.5	3.3	8.0
	Medicare	0.0	0.0	0.0
	Other	2.5	0.0	0.0
	Other Government	2.2	0.0	0.0
	Private Insurance	5.5	0.0	8.7
	Self Pay	9.1	0.0	12.5
	Uninsured	6.2	1.6	4.6
Weight Risk from First Encounter	No Risk	15.1	1.4	6.5
	Underweight (> or = 90% Standard Wt/Ht)	16.1	25.0	5.3
	Overweight (120-134% Standard Wt/Ht)	17.5	4.5	11.9
	Obese (> or = 135% Standard Wt/Ht)	16.4	4.5	5.2

Source: Analyses using Integrated Perinatal Health Information System (IPHIS) 2006-2008 by Russell Satori, Researcher, Bureau of Child and Family Health Services, Ohio Department of Health.

Footnotes:

a Other race includes those that reported multiple races

Interpretation of Data:
The proportion of women attending CFHS Clinics for PPVs is very low, especially among women with GDM. This is likely reflective of the large proportion of women on Medicaid, which ends after two months of giving birth, meaning the mother may no longer have insurance to receive the recommended post-partum care. Alternatively, although probably rare, individuals could be receiving care through another provider.

Data Source: Ohio Medicaid Claims Data

TABLE 14.
Percentage of women with and without GDM who attended a post-partum visit, Ohio Medicaid 2006-2008.

	Percentage
Without GDM	45.4%
With GDM	51.3%
Overall Post-partum Visit	45.8%

Source: Analyses using Medicaid claims data 2006-2008 by Donald Reed, Health Services Policy Specialist, Center for Public Health Statistics and Informatics, Ohio Department of Health.
Footnote: n=187,517

Interpretation of data:
The proportion of women with GDM attending PPVs is slightly higher than women without GDM.

Strengths and limitations of data:
Even if the mother is enrolled as a Medicaid recipient, if Medicaid does not pay for the service it will not be documented. Although probably rare, individuals could be receiving care through another provider. A limitation of the Medicaid program is that, after two months of giving birth, the mother will no longer qualify for Medicaid. This makes post-partum follow up with the mother and child difficult.

RECOMMENDATIONS TO IMPROVE EPIDEMIOLOGY CAPACITY FOR GDM SURVEILLANCE IN OHIO

While these activities are ongoing, the Collaborative Team has considered other projects to further elucidate the prevalence of GDM and its risk factors.

1. PRAMS offers the opportunity to ask women who recently delivered a live infant about their experiences before, during and after pregnancy. Some states have added the following questions to better understand post-partum glucose screening practices and associated diagnoses among women with a history of GDM:

    - Since your new baby was born, have you been tested for diabetes or high blood sugar?
    - Since your new baby was born, did a doctor, nurse, or other health care worker tell you that you had diabetes?
    - Since your new baby was born, did a doctor, nurse, or other health care worker tell you that you had pre-diabetes, borderline diabetes or high blood sugar?

    It would also be beneficial to conduct a more detailed follow-up questionnaire among PRAMS respondents with a history of GDM to get further information on post-partum screening and diagnoses.

2. When the state WIC data system is updated, it is recommended that GDM become a distinct risk code.

3. None of the data sources included in this databook are considered to be a gold standard for GDM surveillance. The only gold standard data source is the medical chart. By conducting a retrospective medical chart review among PRAMS respondents reporting GDM history, ODH could estimate the reliability and validity of both PRAMS and Vital Statistics data.

Appendix A

Ohio Department of Health
Gestational Diabetes Collaborative Team

In 2010, ODH was selected, after competitive review, to be part of a three-state year-long GDM action learning collaborative. The collaboration receives technical assistance from the project sponsors: the National Association of Chronic Disease Directors, the Association of Maternal and Child Health Programs and the CDC, while also sharing ideas with and learning from the Missouri and West Virginia teams. Working together, the ODH Collaborative Team has pooled resources, skills and enthusiasm to do more for Ohioans than any one program could accomplish alone. The team's key objectives focus on improving preventive healthcare provided in Ohio in accordance with national guidelines; increasing the public's knowledge about GDM, reducing the risk and increasing access to preventive care; and improving the understanding of the epidemiology of GDM in Ohio by increasing the availability, use and dissemination of public health data. The ODH GDM Collaborative Team aims to increase the number of women who receive post-partum screening and education for type 2 diabetes so health risks are addressed early and effectively.

Goal: To foster integration of maternal and child health (MCH) and chronic disease (CD) programs in the development of diabetes prevention initiatives

- **Three states:** Missouri, West Virginia and Ohio
- **Information sharing among states**
  - Data, strategies, current prevention activities
- **Technical assistance from national groups**
- **State action plans**
  - Prevent or delay the development of type 2 diabetes among women with a history of GDM
- **Link between MCH and CD/Health Promotion**
  - Chronic diseases can complicate pregnancy
  - Improving health before pregnancy leads to better birth outcomes
  - Rising prevalence of CD coinciding with pregnancy
  - Pregnancy can unmask potential for chronic disease
  - Pregnancy is often an entry point into the healthcare system
  - GDM during pregnancy increases the risk of diabetes later in life

Ohio believes that a more global approach to health promotion that includes health across the lifespan can impact long-term outcomes and improve the ways we preserve, protect and promote the health of Ohioans.

The Division of Family and Community Health Services, Office of Healthy Ohio, and the State Epidemiology Office form the ODH GDM Collaborative Team. The team also includes Ohio Medicaid as an additional partner.

The Collaborative includes staff from:

- Bureau of Child and Family Health Services
- Healthy Ohio's Ohio Diabetes Prevention and Control Program
- Women, Infants, and Children (WIC) program
- State Epidemiology Office
- Women's Health Program
- Obesity Prevention Program
- Ohio Department of Jobs and Family Services

In addition to this databook, the ODH GDM Collaborative Team has been involved in several other activities related to the team's goals.

1. **ODH Provider Survey.** To understand the current state of care for women with a history of GDM, a survey was conducted of more than 1000 certified nurse midwives, obstetricians, family physicians and internal medicine physicians in Ohio. In partnership with the CDC's EpiAid mechanism and the Prevention Research Center for Healthy Neighborhoods at Case Western Reserve University, ODH surveyed more than 900 health-care providers on their knowledge, attitudes, practices, and beliefs on providing care for women at risk for GDM and women with a history of GDM. Completed at the end of 2010, The response rate was 46 percent.

   These data are currently being cleaned and analyzed, with final reporting to be completed.

2. **Focus groups.** In order to gather data on the attitudes and practices of women with GDM, ODH will hold focus groups with women of reproductive age (18-45) and currently diagnosed with or having a history of GDM within the past 10 years. The women chosen will be members of high risk populations (i.e. African-American, Hispanic/Latino, Appalachian, and/or with income at or below 185 percent of the Federal Poverty Level). The goal is to complement the information in the provider survey by exploring the perceptions, opinions, attitudes and knowledge of GDM of patients and to improve coordination of care. Specifically, focus groups will discuss the following: 1) GDM-related health information women received before, during and after pregnancy; 2) Perceived barriers to post-partum care; 3) Understanding of lifelong risk for developing type 2 diabetes; and, 4) Potential educational messages to which women are more likely to respond. The focus groups will be conducted late fall/winter 2011.

3. **Behavioral Risk Factor Surveillance System (BRFSS).** Beginning in 2011, the Ohio module added the following questions if there is an affirmative response to a question about having diabetes when pregnant. The goal is to capture information about post-partum visits, specifically, the rate of follow-up diabetes screening among women with a history of GDM:

   - Did you have a test for high blood sugar 6-12 weeks after delivery?
   - Did your health care provider recommend being tested for diabetes every 1 to 3 years?
   - Did your health care provider discuss the long-term risks of developing type 2 diabetes?

4. **Social Media Campaign.** The team developed a social media campaign with GDM-specific messages for National Diabetes Month in November, 2010. These were provided via public service announcements on radio stations across Ohio, ODH Web site features, and the ODH Facebook and Twitter accounts. The topic of GDM and the collaborative was the focus of the quarterly newsletter put out by the Ohio Diabetes Prevention and Control Program (ODPCP). In addition, an article on the collaborative was featured in ODH publication, *Inside ODH*.

The ODPCP adapted GDM awareness posters from the National Diabetes Education Program and featured models representing high risk groups such as Hispanics and African-Americans. ODPCP created several different posters, including one in Spanish. These posters were sent to public health clinics (Title V, Title X, WIC, Federally Qualified Health Centers) and other providers.

For spring 2011, ODH partnered with text4baby, a national coalition that uses text messages to provide informational messaging to pregnant women. These messages include tips on following up with prenatal care visits, healthy living while pregnant, facts to help women understand the link between GDM and type 2 diabetes and reminders to follow up for post-natal visits. More targeted messaging will be developed based on the final results of the patient focus groups and the provider surveys.

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