Gestational Diabetes in Ohio:

2009-2016

Ohio Department of Health

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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 American College of Obstetricians and Gynecologists (ACOG) has published an updated practice bulletin that outlines clinical considerations and recommends that all pregnant women be, "…screened for GDM with a laboratory-based screening test(s) using blood glucose levels." Specific recommendations on timing vary, but are generally performed at 24-28 weeks gestation. Follow-up recommendations include glucose screening performed at 4-12 weeks postpartum, and every 1-3 years in women with a history of GDM. Additional recommendations include nutrition counseling and achieving at least 150 minutes of moderate-intensity aerobic exercise per week. (ACOG, 2018.)

The Ohio Department of Health (ODH) has published two GDM Databooks in 2011 and in 2016 using multiple administrative data sources to describe Ohio trends from 2006 through 2008 and 2006 through 2011 in GDM risk factors, prevalence, co-morbidities, and healthcare experiences during preconception, pregnancy, and postpartum. This 2009-2016 data book presents a more current picture of GDM in Ohio.

Findings

Preconception: Risk Factors for GDM

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 during 2014-16, 76.3 percent were white, 13.8 percent were black, and 4.8 percent were Hispanic (Table 1a). About half of women were ever married, almost two thirds (62.6%) had a college education, and half (42.8%) resided in a metropolitan county. More than half of women were covered by insurance from an employer (55.3%). The most significant difference is the change in insurance rates, which increased 75% between timeframes. Another significant difference under Income-Level, where the lowest level decreased 4.5% and the highest level increased 6.6%.

Table 1a. Prevalence of demographic preconception risk factors among women aged 18-44 years, Ohio 2011-13 and 2014-16

		2011-13		2014-16	
		%	95% CI	%	95% CI
Overall		(n=5118)		(n=4176)	
Age (years)	18-24	27.6	25.8-29.4	28.0	25.9-34.7
	25-34	36.1	34.3-37.8	36.7	34.7-38.7
	35-44	36.3	34.7-37.9	35.4	33.5-37.3
Race/Ethnicity	Non-Hispanic White	76.9	74.0-79.9	76.3	74.3-78.2
	Non-Hispanic Black	14.4	11.9-16.9	13.8	12.1-15.4
	Hispanic	4.2	2.6-5.8	4.8	3.8-5.8
	Multi-racial	0.9	0.4-1.4	2.0	1.4-2.5
	Other	3.5	2.2-4.9	3.2	2.3-4.0
Marital Status[a]	Ever Married	52.8	51.0-54.6	52.4	50.2-54.5
	Never Married	47.2	45.4-49.0	47.6	45.5-49.8
Education	Less than High School	12.2	10.6-13.7	10.2	8.5-11.9
	High School Graduate	26.6	25.0-28.3	27.1	25.2-29.0
	Some College	35.9	34.1-37.7	35.1	33.1-37.2
	College Graduate	25.3	24.0-26.7	27.5	25.9-29.2
Insurance	Plan	16.2	14.8-17.6	91.2	89.9-92.5
	No Plan	83.8	82.4-85.2	8.8	7.5-10.1
Income-Level	Less than $15,000	16.9	15.3-18.4	12.4	10.8-14.0
	$15,000-$24,999	20.2	18.6-21.7	19.5	17.6-21.3
	$25,000- $34,999	11.5	10.2-12.8	10.2	8.8-11.6
	$35,000 -$49,000	13.3	12.0-14.6	13.2	11.7-14.8
	$50,000 or More	38.2	36.4-40.0	44.8	42.6-47.0
County Type[b]	Suburban	29.0	27.4-30.7	31.6	29.4-33.7
	Rural	9.7	8.7-10.8	8.9	7.8-10.0
	Metropolitan	44.4	42.8-46.1	42.8	40.6-45.1
	Appalachian	16.8	15.6-18.1	16.7	15.4-18.0

(Table 1a con't.)

Source: Ohio Behavioral Risk Factor Surveillance System (BRFSS), Ohio Department of Health, 2018
Note: This table has been updated. The previously published table did not restrict the female population to women of reproductive age (WRA), as the title references.
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

Table 1b displays preconception health status and presence of risk behaviors among women of reproductive age in Ohio. In 2014-16, the percent of Ohio women of childbearing age that reported ever smoking decreased to 37.5 percent. Furthermore, more than half of these women were overweight or obese and almost one third did not attend a routine medical check-up in the past 12 months.

Table 1b. Prevalence of preconception health status and risk behaviors among women aged 18-44 years, Ohio 2011-13 and 2014-16

		2011-13		2014-16	
		%	95% CI	%	95% CI
Overall		(n=5118)		(n=4176)	
BMI (kg/m²)	Underweight (< 18.5)	3.1	2.4-3.8	2.7	1.9-3.5
	Normal weight (18.5 - 24.99)	44.9	43.0-46.8	41.9	39.7-44.1
	Overweight (25.00-29.99)	25.5	23.8-27.1	28.0	26.0-30.1
	Obese (30.0+)	26.6	24.9-28.2	27.3	25.4-29.3
Smoker	Ever Smoker	43.6	41.8-45.5	37.5	35.4-39.6
	Never Smoker	56.4	54.5-58.2	62.5	60.4-64.6
History of Diabetes (not Gestational)	Yes	3.1	2.5-3.7	3.1	2.5-3.8
	No	96.9	96.3-97.5	96.9	96.2-97.5
History of Hypertension[a]	Yes	10.6	9.2-12.0	10.2	7.9-12.4
	No	89.4	88.0-90.8	89.8	87.6-92.1
Time since Last Routine Checkup-Up	Within the Past Year	65.4	63.7-67.2	68.1	66.1-70.1
	More than a Year	34.6	32.8-36.3	31.9	29.9-33.9
Exercise in the Past 30 Days[b]	Yes	77.7	76.2-79.3	79.9	78.2-81.7
	No	22.3	20.7-23.8	20.1	18.3-21.8

Source: Ohio Behavioral Risk Factor Surveillance System (BRFSS), Ohio Department of Health, 2018
Note: This table has been updated. The previously published table did not restrict the female population to WRA, as the title references.
[a] Question not asked in 2012 and 2016. Estimates derived from 2011, 2013, 2014, and 2015 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, during 2009-11, and during 2016. More than half of the women who delivered a child in 2016 were between the ages of 25-34 years. Almost three-quarters of the women were white and 17 percent black. Almost one third had high school education or less and three percent were uninsured.

Table 2a. Prevalence of preconception risk factors among women with a live birth, by demographics, Ohio 2006-08, 2009-10, and 2016

		2006-08		2009-10		2016	
Overall (n)		(4358)		(2639)		(3386)	
		%	95% CI	%	95% CI	%	95% CI
Age (years)	18-24	34.3	32.4-36.3	32.7	30.3-35.2	27.0	24.2 - 29.9
	25-34	53.3	51.3-55.3	54.6	52.0-57.1	58.1	55.2 - 61.0
	35-44	12.4	11.2-13.7	12.7	11.2-14.5	13.4	11.7 - 15.0
Race/Ethnicity	Non-Hispanic White	76.9	75.7-78.1	76.8	75.3-78.3	72.2	69.8 - 74.7
	Non-Hispanic Black	14.7	14.4-15.1	15.3	14.9-15.8	17.7	15.4 - 19.9
	Hispanic	3.3	2.6-4.2	3.4	2.5-4.6	5.5	4.2 - 6.8
	Other[a]	5.0	4.2-6.1	4.5	3.5-5.7	4.6	3.7 - 5.6
Education	Less than HS	14.7	13.2-16.4	13.9	12.1-15.9	9.9	8.1 - 11.6
	HS Graduate	28.0	26.2-29.8	25.2	23.0-27.6	22.4	19.8 - 25.0
	Some College	21.1	19.6-22.7	22.3	20.3-24.4	22.0	19.5 - 24.6
	College Graduate	36.2	34.4-38.1	38.7	36.3-41.2	45.7	42.9 - 48.5
Pre-Pregnancy Health Insurance[b,c]	Uninsured	36.3	34.4-38.3	17.3	15.3-19.4	3.6	2.6 - 4.6
	Medicaid	15.2	13.9-16.7	23.6	21.6-25.8	38.8	35.9 - 41.8
	From Job	--	--	55.3	52.8-57.9	44.0	41.3 - 46.8
	Self Pay (not from job)	--	--	3.8	2.9-5.0	8.1	6.2 - 10.0
	TRICARE or Other Military	--	--	1.4	0.9-2.1	1.4	0.8 - 2.0
	Other	--	--	3.4	2.5-4.5	4.1	2.8 - 5.4
Annual Household Income[e]	Less than $15,000	28.9	27.1-30.8	31.6	29.2-34.1	21.2	18.7 - 23.7
	$15,000-$24,999	13.0	11.6-14.5	13.4	11.7-15.4	12.5	10.4 - 14.5
	$25,000- $34,999	11.4	10.1-12.8	8.4	7.0-9.9	8.8	7.0 - 10.6
	$35,000 -$49,999	10.9	9.6-12.2	11.0	9.5-12.8	10.2	8.4 - 12.1
	$50,000 or More	35.9	34.0-37.9	35.6	33.2-38.1	47.3	44.5 - 50.1
County Type[d]	Metropolitan	52.4	50.4-54.3	55.0	52.5-57.5	58.9	56.7 - 61.0
	Suburban	16.4	15.0-18.0	16.0	14.2-18.1	15.2	12.9 - 17.5
	Appalachian	16.4	14.9-18.0	14.8	13.0-16.8	13.0	10.9 - 15.1
	Rural	14.9	13.4-16.4	14.2	12.4-16.1	12.9	10.8 - 15.0

Sources: 2006-2010 Analyses using Pregnancy Risk Assessment Monitoring System (Ohio Department of Health). 2016 Analyses using Ohio Pregnancy Assessment Survey.

Footnotes: [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

[e] Household income categories changed substantially in Ohio Pregnancy Assessment Survey, making it not possible to do a direct comparison to previous years' data. New categories include $0-16,000, $16,001-$24,000, $24,001-$32,000, $32,001-$48,000, and >$48,000.

Table 2b displays behavioral and health status risks during the preconception period among women who had a live birth in Ohio during 2006-08, 2009-11, and 2016. One third of women (33.7 percent) were obese before pregnancy in 2016, representing an increase over previous periods. Less than one in ten Ohio women (6.2 percent) were diagnosed or treated for hypertension before becoming pregnant. Behaviors also put women at risk of gestational diabetes. Less than one quarter of women having a live birth in 2016 reported having a visit with a health care provider in the year before becoming pregnant (19.3 percent). Further, significantly fewer women (17.2 percent) indicated that they smoked in the past 2 years in 2016 compared to 2009-10 (37.3 percent).

Table 2b. Prevalence of preconception health status and behavioral risk factors among women with a live birth, Ohio 2006-08, 2009-10, and 2016

	2006-08		2009-10		2016	
Overall (n)	(4358)		(2639)		(3386)	
	%	95% CI	%	95% CI	%	95% CI
History of Diabetes (not Gestational)[c]						
Yes	2.6	2.0-3.3	1.9	1.3-2.7	3.9	2.6 - 5.2
Checked/Treated for Hypertension Before Pregnancy[c]						
Yes	--	--	9.3	7.9-10.8	6.2	4.8 - 7.5
Pre-Pregnancy BMI (kg/m²)						
Underweight (< 18.5)	6.9	6.0-8.0	7.6	6.3-9.1	11.9	10.0 - 13.8
Normal weight (18.5 - 24.9)	48.0	46.0-50.0	44.4	41.9-47.0	41.4	38.6 - 44.1
Overweight (25.0-29.9)	23.8	22.2-25.6	23.7	21.5-26.0	13.0	11.1 - 14.9
Obese (30.0+)	21.2	19.7-22.9	24.3	22.2-26.6	33.7	31.0 - 36.5
Smoker						
Smoked in the Past 2 Years	32.5	30.6-34.5	37.3	34.8-39.9	17.2	14.8 - 19.6
Preconception Visit[a]						
Yes	27.4	25.7-29.2	29.8	27.5-32.1	19.3	17.2 - 21.4
No	72.6	70.9-74.4	70.2	67.9-72.5	80.7	78.6 - 82.8
Pre-Pregnancy Exercise 3+ times per week[b]						
Yes	--	--	41.8	39.2-44.3	--	--
No	--	--	58.3	55.7-60.8	--	--

Sources: 2006-2010 Analyses using Pregnancy Risk Assessment Monitoring System (Ohio Department of Health). 2016 Analyses using Ohio Pregnancy Assessment Survey.

Footnotes:

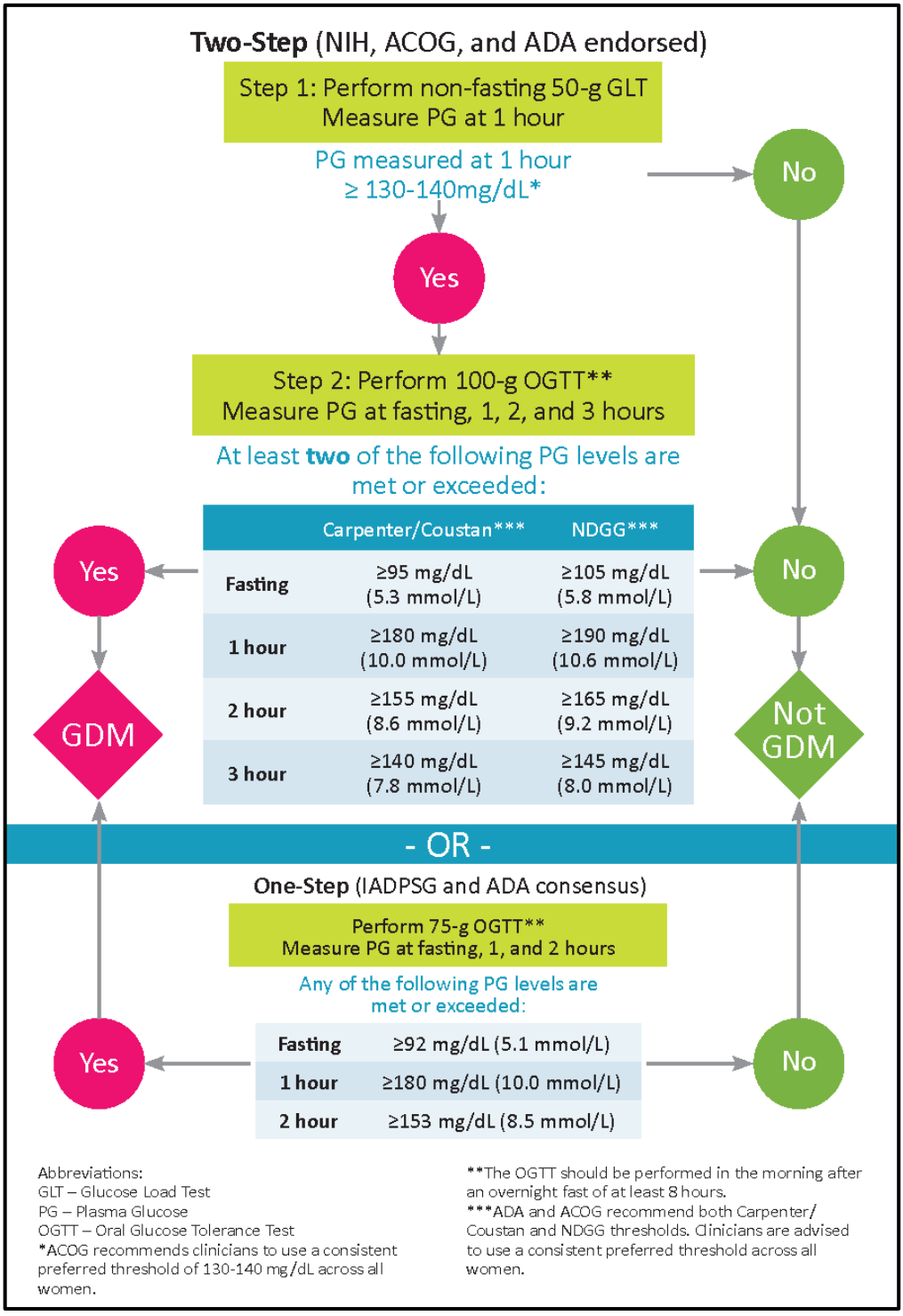
[a] In 2006-10, based on answers to the question: "*Before* you got pregnant with your new baby, did a doctor, nurse, or other health care worker talk with you about how to prepare for a healthy pregnancy and baby?" In 2016, based on answer f to Q12: "*During any of your health care visits in the 12 months before you got pregnant did a doctor, nurse or other health care worker do any of the following things?*" (Answer f: Talk to me about how I could improve my health before a pregnancy)
Only respondents who indicated they had had any type of health care visit in the 12 months prior to pregnancy answered this question.

[b] In 2006-10, 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?" In 2016, the question was not assessed.

[c] Based on answers a or b to the question: "*During the 3 months before you got pregnant with your new baby, did you have any of the following health conditions?*" (Answer a: Type 1 or Type 2 diabetes (not gestational diabetes); Answer b: b. High blood pressure or hypertension)

GDM Screening and Diagnosis

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



Source: Provider Toolkit, Ohio Gestational Diabetes Postpartum Care Learning Collaborative. Provider Toolkit may be downloaded at http://ohiogdm.com/Providers

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. Table 4 displays incidence rates estimated from several systems, though each has limitations. Between 2012 and 2016, the incidence of GDM in Ohio ranged from 6.7% to 12.5%.

Table 4. Summary of GDM Incidence in Ohio, multiple sources, 2009-16

Data Source	Timeframe	GDM Incidence (Percent)
Medicaid Claims	2012-14	12.5%
Medicaid Claims	2015-16	8.18%
Ohio Hospital Association Discharge Data	2013	6.8%
Ohio Pregnancy Assessment Survey (OPAS)	2016	8.1%
Vital Statistics	2012-14	6.7%
Vital Statistics	2015-16	7.5%

According to VS, GDM prevalence has increased in Ohio overall and with most population subgroups (see Table 5a, next page). Among women with a live birth during the years 2006-08, 2009-11, 2012-14, and 2015-16 higher incidence of GDM were found among women 45 years or greater; who were not black, white or Hispanic; who were married; with some college education; were not insured by Medicaid, and residing in a Metropolitan area.

Table 5a. GDM incidence among women with a live birth, by demographics, Ohio 2006-08, 2009-11, 2012-14, and 2015-16

		2006-08 (n=438373)		2009-11 (n=412631)		2012-14 (n=411357)		2015-16 (n=278761)	
		%	95% CI	%	95% CI	%	95% CI	%	95% CI
Overall		**4.9**	**4.8-4.9**	**5.8**	**5.8-5.9**	**6.7**	**6.7-6.8**	**7.3**	--
Age (years)	18-24	2.7	2.6 -2.8	3.3	3.2-3.4	3.9	3.8-4.0	4.1	1.4-2.2
	25-34	5.6	5.5 -5.7	6.6	6.5-6.7	7.2	7.1-7.3	7.7	4.0-4.3
	35-44	9.0	8.7 -9.2	10.6	10.3-10.8	12.4	12.1-12.7	12.8	7.6-7.8
	45+	12.0	9.2 -14.9	13.2	10.4-16.0	18.7	15.4-22.0	17.0	12.4-13.1
Race/Ethnicity	Non-Hispanic White	4.8	4.7-4.9	5.7	5.6-5.8	6.6	6.5-6.7	7.1	7.0-7.2
	Non-Hispanic Black	4.2	4.1 -4.3	5.1	5.0-5.3	5.9	5.7-6.0	6.2	6.0-6.4
	Hispanic	6.3	5.9 -6.6	7.6	7.2-7.9	8.8	8.4-9.2	9.8	9.3-10.2
	Other[a]	9.0	8.5 -9.6	10.8	10.2-11.3	11.9	11.4-12.4	13.1	12.5-13.8
Currently Married	Yes	5.7	5.6 -5.8	6.6	6.5-6.7	7.6	7.5-7.7	8.2	8.1-8.4
	No	3.7	3.6 -3.8	4.8	4.7-4.9	5.6	5.5-5.7	6.1	5.9-6.2
Education	Less than High School	3.4	3.2-3.5	4.2	4.1-4.4	4.9	4.7-5.1	5.7	5.4-5.9
	High School Graduate	4.8	4.7-5.0	5.8	5.6-5.9	6.5	6.3-6.6	6.7	6.6-6.9
	Some College	5.4	5.2-5.5	6.4	6.3-6.6	7.2	7.0-7.4	8.2	8.0-8.4
	College Graduate	5.3	5.2-5.4	6.2	6.1-6.3	7.3	7.2-7.4	7.6	7.4-7.8
Migrant Status[b]	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	6.8	6.7-7.0
	No	5.3	5.3-5.4	6.2	6.1-6.3	7.0	6.9-7.1	7.6	7.5-7.8
WIC	Yes	4.5	4.4-4.6	5.7	5.6-5.8	6.7	6.6-6.9	7.2	7.0-7.4
	No	5.1	5.0-5.2	6.0	5.9-6.1	6.8	6.7-6.9	7.4	7.3-7.5
County Type	Metropolitan	4.8	4.5-5.1	6.6	6.3-7.0	8.1	7.8-8.5	7.7	7.6-7.8
	Suburban	4.7	4.6-4.9	5.4	5.2-5.5	6.0	5.8-6.2	6.6	6.3-6.9
	Appalachian	4.4	4.3-4.6	6.1	5.9-6.3	7.7	7.5-7.9	5.9	5.6-6.2
	Rural	4.7	4.5-4.8	5.5	5.3-5.6	6.5	6.3-6.6	6.4	6.1-6.7
Birth Order	First Born	7.6	6.0-9.6	7.4	5.5-9.9	N/A	N/A	6.0	5.9-6.2
	Not First Born/Unknown	10.9	9.5-12.6	11.2	9.4-13.3	N/A	N/A	7.9	7.8-8.0

Source: Vital Statistics; Resident File was used.

Footnotes:

[a] Includes those who reported multiple races

[b] This variable was not available in the data set.

Table 5b displays GDM incidence by maternal behaviors, health status, and health care utilization. GDM incidence increased from 2006-08 to 2015-16 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, 2012-14, and 2015-16

	2006-08		2009-11		2012-14		2015-16	
	Percentage of Respondents with GDM In Most Recent Pregnancy							
	%	95% CI	%	95% 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	6.7	6.5-6.9
No	5.3	5.3-5.4	5.9	5.8-6.0	6.8	6.7-6.9	7.5	7.4-7.6
First Trimester Prenatal Care								
Yes	3.7	3.6-3.7	4.4	4.4-4.5	5.1	5.1-5.2	7.8	7.6-7.9
No	1.1	1.1-1.2	1.4	1.3-1.4	1.7	1.6-1.7	6.7	6.5-6.8
Pre-pregnancy BMI (kg/m2)								
Underweight (BMI<18.5)	2.0	1.8-2.2	2.4	2.2-2.7	2.9	2.6-3.2	3.3	3.0-3.7
Normal weight (18.5-24.99)	2.6	2.6-2.7	3.3	3.2-3.3	3.7	3.6-3.8	4.1	4.0-4.2
Overweight (25.00-29.99)	5.1	4.9-5.2	6.0	5.8-6.1	6.6	6.5-6.8	7.4	7.2-7.6
Obese (30.0+)	9.7	9.5-9.9	11.1	10.9-11.3	12.5	12.3-12.7	--	--
Obese Class I (30.0 - 34.99)	--	--	--	--	--	--	10.8	10.5-11.2
Obese Class II (35.0 - 39.99)	--	--	--	--	--	--	13.5	13.0-13.9
Obese Class III (>40.0)	--	--	--	--	--	--	15.4	15.0-15.9
Weight gain during pregnancy[a]								
Inadequate	5.7	5.6-5.9	6.9	6.7-7.1	8.0	7.8-8.2	7.3	7.1-7.6
Excessive	4.4	4.3-4.5	5.3	5.2-5.4	6.0	5.9-6.1	5.9	5.7-6.0
Gestational Hypertension								
Yes	9.2	8.8-9.7	10.9	10.5-11.3	12.2	11.8-12.6	12.6	12.2-13.1
No	4.7	4.6-4.7	5.6	5.5-5.6	6.4	6.3-6.4	6.9	6.8-7.0

Source: Vital Statistics; Resident File was used.
Footnotes:
[a] Weight gain during pregnancy defined using the IOM 2009 guidelines (http://nationalacademies.org/hmd/~/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 2006-17

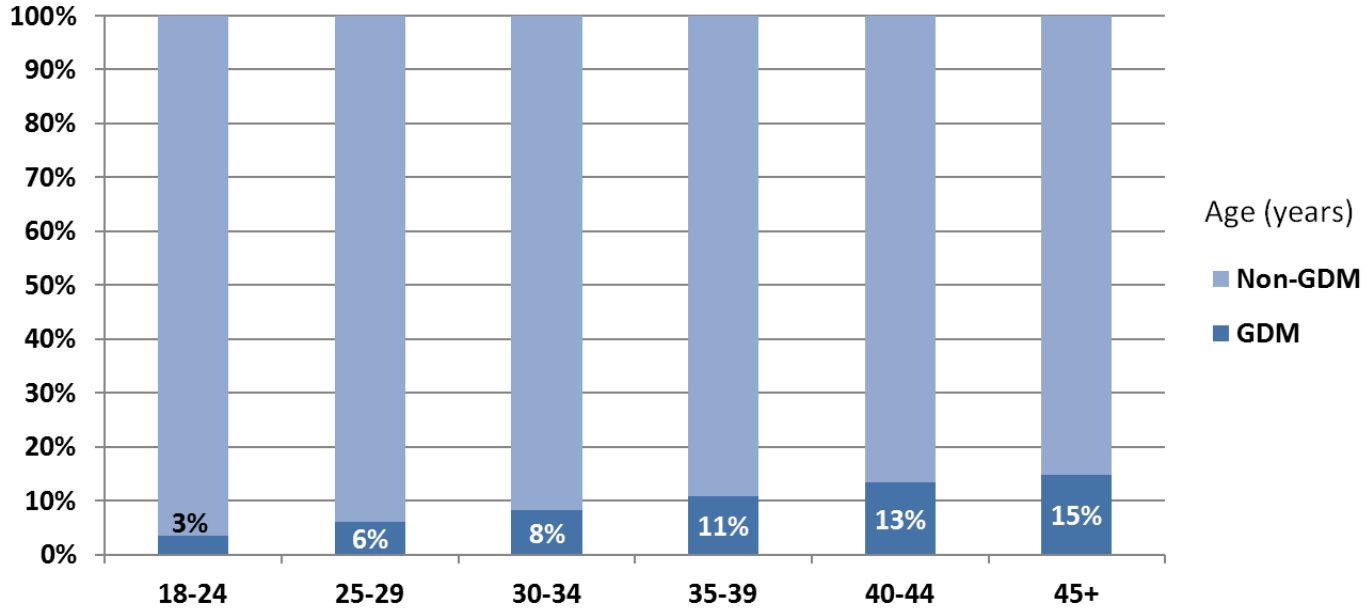
Year	GDM Incidence (%)
2006	5.1
2007	5.4
2008	5.2
2009	5.8
2010	6.1
2011	6.4
2012	6.8
2013	6.8
2014	6.9
2015	7.1
2016	7.4
2017	7.7

Source: Data provided by OHA.

As seen in Table 6, the incidence of GDM in Ohio has varied by year, increasing over the last several years up to 7.7% in 2017.

Figure 2 displays the proportion of obstetric discharges associated with a GDM diagnosis, by age group. Among Ohio women aged 18-24 years with an obstetric discharge, 3.4% had GDM compared to 14.7% of women aged 45 years and older.

Figure 2. Proportion of GDM-related obstetric discharges, by age group, Ohio 2008-17



Source: Data provided by OHA.

Note: Age group 45+ is not truncated and may include potentially erroneous ages.

Table 7 displays the incidence of GDM among deliveries billed to Medicaid insurance by year from 2007-16. The proportions of deliveries that were associated with GDM during these timeframes ranged from 7.5 percent to 13.2 percent. Furthermore, increases were observed from 2015-16 for women age 25-34 and 35-44, race/ethnicity groups of non-Hispanic white and non-Hispanic other, and within women living in both urban and non-urban areas.

Table 7. Incidence of GDM among Ohio Medicaid deliveries, by year, 2007-16

(n=552,757)		2007 (%)	2008 (%)	2009 (%)	2010 (%)	2011 (%)	2012 (%)	2013 (%)	2014 (%)	2015 (%)	2016 (%)
Overall		**9.5**	**9.8**	**10.7**	**11.6**	**12.2**	**13.2**	**12.1**	**12.2**	**7.5**	**7.6**
Age (years)[a]	18-24	7.2	7.4	8.2	8.9	9.0	9.3	8.0	8.2	6.0	6.0
	25-34	13.0	13.3	14.0	14.8	15.7	15.5	14.9	14.5	8.3	8.7
	35-44	21.1	21.1	22.5	23.0	23.6	24.8	23.8	24.0	12.6	13.2
Race [b]	Non-Hispanic White	10.3	10.6	11.7	12.8	13.3	13.3	12.8	--	8.1	8.6
	Non-Hispanic Black	7.6	7.7	8.4	8.6	9.7	10.2	10.3	--	6.9	6.4
	Hispanic	9.1	10.7	11.0	10.5	12.1	12.9	13.8	--	5.8	5.6
	Non-Hispanic Other	12.2	13.0	12.6	13.1	13.0	14.6	10.8	--	6.9	7.0
Urbanicity	Urban	8.9	9.0	9.7	10.3	11.4	11.9	11.8	11.9	7.5	7.6
	non-Urban	10.0	10.6	11.7	12.8	13.0	13.0	12.4	12.6	7.9	8.1

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 Ohio Department of Health; analysis of 2012-14 data by Ohio Department of Medicaid. 2015-2016 data from Ohio Department of Medicaid claims.

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

Tables 8a and 8b show prevalence of delivery-related maternal and infant outcomes that may be associated with a GDM pregnancy. In all time periods, infants born to women with GDM were more frequently born preterm, admitted to the NICU, and delivered by C-Section. NICU admission increased over time both among infants born to women with and without GDM. In 2016, the data analyzed was not statistically significant therefore it was challenging to draw accurate comparisons across years for length of hospitalization, NICU length of stay, and high blood pressure.

Table 8a. Prevalence of maternal and delivery outcomes, by GDM status, Ohio 2006-08, 2009-10, and 2016

	2006-08					2009-10					2016				
	% With GDM	95% CI	% Without GDM	95% CI	P-Value	%With GDM	95% CI	% With-out 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	14.3	9.1 - 19.5	12.9	11.1 - 14.7	ns
Length of Hospitalization					p<0.01					p=0.05					ns
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		58.4	49.5-67.2	57.1	54.1-60.0	
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		29.6 (3-5 days)	21.5–37.6	29.7 (3-5 days)	26.9-32.4	
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		9.6	5.6-13.6	8.9	7.3-10.5	
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	18.7	12.1-25.2	12.8	10.9-14.8	ns
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	Not assessed				
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	43.7	34.2-53.1	27.9	25.3-30.5	<0.01

Sources: 2006-2010 Pregnancy Risk Assessment Monitoring System, Ohio Department of Health. 2016 Ohio Pregnancy Assessment Survey.
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)?" OPAS 2016 Question #30 (and consistent with PRAMS Phase 7) determined GDM from the following question: "During your most recent pregnancy, did you have any of the following health conditions? a) Gestational diabetes (diabetes that started during this pregnancy)."
* 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, 2012-14, and 2015-16

	2006-08				2009-11				2012-14				2015-16	
	% 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	% With GDM	% W/out GDM
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	15.0	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	13.4	8.8
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	43.8	29.7
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	1.0	1.1
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	1.6	1.4
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	97.4	97.5

Source: Vital Statistics; Resident File was used.

Postpartum and Ongoing Care

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.

Note: Table 9 was not updated.

In Ohio, self-reported postpartum visit rates were around 90 percent among women with GDM in 2006-08 and 2009-10, and 2016 (Table 10). In 2009-10 and 2016, differences in postpartum visit rates were found by race/ethnicity. 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, 2009-10, and 2016

	2006-08						2009-10						2016					
	% 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	% 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**		**94.8 (275)**	**90.2-99.3**		**91.7 (3087)**	**89.9-93.5**	
Age (years)			**ns**			**ns**			**ns**			**0.05**						**ns**
<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		83.4	64.7-100.0		90.3	86.2 - 94.4	
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		98.1	95.8-100.0		93.2	91.2 - 95.2	
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		97.4	93.8-100.0		89.5	84.2 - 94.8	
45+	–	–		–	–		–	–		–	–		--	--		--	--	
Race/Ethnicity			**0.04**			**0.02**			**<0.01**			**ns**						**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		96.9	93.0-100.0		92.6	90.5 - 94.8	
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		83.2	64.5-100.0		87.8	83.3 - 92.3	
Hispanic	–	–		87.6	77.8-93.4		–	–		91.5	76.5-97.3		--	--		88.9	79.5 - 98.4	
Other	–	–		85.5	76.7-91.4		–	–		92.6	83.9-96.8		--	--		94.5	88.8 – 100.0	
Marital Status			**0.04**			**<0.01**			**ns**			**<0.01**			ns			**<.0001**
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		97.1	94.5-99.7		95.1	93.5 - 96.7	
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		91.7	81.7-100.0		87.6	84.1 - 91.1	
Education			**ns**			**<0.01**			**ns**			**<0.01**						**<.0001**
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		--	--		79.4	70.3 - 88.5	
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		84.1	67.5-100.0		87.7	82.7 - 92.8	
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		99.2	97.6-100.0		92.1	89.0 - 95.3	
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		99.1	97.9-100.0		95.9	94.1 - 97.6	

See sources and notes following continuation of Table 10 on next page.

Table 10 (con't). Prevalence of self-reported postpartum visit completion, Ohio 2006-08, 2009-10, and 2016

	2006-08						2009-10						2016					
	% 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	% 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**		**94.8 (275)**	**90.2-99.3**		**91.7 (3087)**	**89.9-93.5**	
County Type			**ns**			**ns**			**ns**			**<0.01**						**ns**
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		92.8	86.1 - 99.4		91.7	89.8 - 93.6	
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		--	--		92.4	86.3 - 98.6	
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		--	--		87.1	80.4 - 93.9	
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		--	--		95.5	91.2-99.9	
Insurance Status (Prenatal Care)[a]									**N/A**			**N/A**						**<.0001**
Uninsured	N/A	N/A		N/A	N/A		–	–		70.7	53.2-83.7		--	--		80.2	68.5 - 91.9	
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		92.9	84.5 – 100.0		91.0	88.0 - 93.9	
Health Insurance From Job	N/A	N/A		N/A	N/A		97.0	90.1-99.1		95.8	93.9-97.1		99.0	97.8 – 100.0		97.1	95.7 - 98.5	
Health Insurance Paid For (not from job)	N/A	N/A		N/A	N/A		–	–		99.2	97.5-99.8		--	--		88.7	81.0 - 96.5	
TRICARE Or Other Military Health Care	N/A	N/A		N/A	N/A		–	–		94.5	76.3-98.9		--	--		97.4	93.3 – 100.0	
Other	N/A	N/A		N/A	N/A		–	–		85.6	73.3-92.8		--	--		74.9	58.0 - 91.7	
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		N/A[b]	N/A[b]		N/A[b]	N/A[b]	
Foreign-Born	98.3	95.7-99.7		85.6	78.6-90.6		–	–		88.6	80.2-93.7		N/A[b]	N/A[b]		N/A[b]	N/A[b]	
WIC during Pregnancy			**0.05**			**<0.0**			**0.02**			**<0.01**			**ns**			**<.05**
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		93.6	86.8 – 100.0		89.2	85.6 - 92.7	
No	93.7	88.7-96.5		91.9	90.2-93.9		96.9	91.7-98.9		93.0	90.9-94.7		95.6	89.5 – 100.0		93.0	91.0 - 95.1	

Sources: 2006-2010 Pregnancy Risk Assessment Monitoring System (PRAMS), Ohio Department of Health. 2016 Ohio Pregnancy Assessment Survey (OPAS).
Notes: GDM was determined by the following questions: Phase 5 of PRAMS (2004-08), "Did you have high blood sugar (diabetes) that started during this pregnancy?"; Phase 6 (2009-11) , "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)?" OPAS 2016 Question #30 (and consistent with PRAMS Phase 7) determined GDM from the following question: "During your most recent pregnancy, did you have any of the following health conditions? a) 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).
[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; cells with denominators less than 30 are not presented due to confidentiality concerns.
[b] This variable was not available in the data set.
P-values are not produced in 2016 categories with at least one group reporting zero observations.

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, 2013-14, and 2015-16. About one-third of women with GDM had a billing for a postpartum visit, but billings for postpartum visits were higher in all previous years. Women with GDM were more likely to have a postpartum visit than women without GDM. The postpartum visits did not vary by age, with the exception of women greater than 45 without GDM which was only 12 percent. While Hispanic women and Non-Hispanic women of other races were less likely to have a visit compared to Non-Hispanic white or black women in previous years; the visits did not vary by race in 2015-16. Postpartum visits also did not vary by geographic region.

Table 11. Prevalence of trends in postpartum visit claims among women with Medicaid insurance, Ohio 2007-09, 2010-12, 2013-14, and 2015-16

	2007-09		2010-12		2013-14		2015-16	
	% With GDM	% W/out GDM	% 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**	**n=11,855**	**n=133,762**
Age (years)								
18-24	53.6	49.6	53.0	50.1	47.8	42.5	30.4	26.7
25-34	53.6	48.6	54.9	51.1	50.9	44.4	32.7	28.7
35-44	50.7	45.1	53.6	48.4	47.7	39.1	32.8	27.5
≥45[a]	-	-	-	-	-	-	31.3	12.7
Race[b]								
Non-Hispanic White	51.3	51.4	52.7	52.7	-	-	32.7	27.8
Non-Hispanic Black	50.2	47.7	54.0	49.2	-	-	29.3	26.8
Hispanic	12.5	26.0	16.8	27.8	-	-	30.5	21.4
Other	12.8	34.9	16.7	38.5	-	-	34.0	26.4
Geographic Region								
Urban	37.5	47.9	41.2	50.4	49.3	42.6	31.1	27.0
Non-Urban	58.2	49.8	60.3	51.2	49.6	43.8	31.9	28.1

Source: 2007-12 data obtained from Ohio Department of Medicaid QDSS (Medstat Advantage Suite® V 4.0, Truven Health Analytics) accessed April & May, 2014, Ohio Department of Health; analyses of 2012-14 data were performed by 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. Any missing data is included in Other.

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 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

Postpartum Behaviors

Appropriate 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. Those rates fell significantly to one in ten women self-reporting cigarette smoking in 2016. Two-thirds of women attempted to breastfeed, with 85 percent still breastfeeding at two weeks postpartum in 2010. Those rates continued to rise in 2016, with three-quarters of women self-reporting ever breastfeeding, and 99.2% of mothers with a history of GDM still breastfeeding at two weeks postpartum. In 2016, women with GDM were less likely to breastfeed than women without GDM.

Table 13. Postpartum health behaviors among women with a recent history of GDM compared to women with no GDM history, Ohio 2006-08, 2009-10, and 2016

	2006-08				2009-10				2016			
	% With GDM	95% CI	% W/out GDM	95% CI	% 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	9.8	4.9 - 14.8	17.8	15.2 - 20.3
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	75.4	53.5 - 97.3	49.7	40.0 - 59.3
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	24.6	2.7 - 46.5	50.3	40.7 - 60.0
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	75.8	67.4 - 84.3	85.1	82.8 - 87.5
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	24.2	15.7 - 32.6	14.9	12.5 - 17.2
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	99.2	97.7-100.0	98.4	97.7 - 99.1
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	0.8	0.0 - 2.3	1.6	0.9 - 2.3
Postpartum Depression[1]												
Yes	--	--	--	--	13.0	8.6-19.2	13.2	11.4-15.2	--	--	--	--

Sources: 2006-2010 Pregnancy Risk Assessment Monitoring System (PRAMS), Ohio Department of Health. 2016 Ohio Pregnancy Assessment Survey (OPAS).

Footnotes:

GDM was determined by the following questions: Phase 5 of PRAMS (2004-08): "Did you have high blood sugar (diabetes) that started during this pregnancy?"; Phase 6 (2009-11), "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)? OPAS 2016 Question #30 (and consistent with PRAMS Phase 7) determined GDM from the following question: "During your most recent pregnancy, did you have any of the following health conditions? a) Gestational diabetes (diabetes that started during this pregnancy)."

The question format changed in 2009-10

1 This variable was not available in the data set.

Prevalence of GDM History among Women of Reproductive Age

Prevalence of a GDM history refers to the estimated population of people who 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 3.1 percent of Ohio women self-reported having been diagnosed with diabetes only during pregnancy, whereas 2.5 percent self-reported the same information in 2016. Any difference by demographics (Table 14a), or by behavioral risk factors (Table 14b) were not statistically significant in either 2011-13 or 2016.

Table 14a. Prevalence of a history of GDM only, among women aged 18-44 years, by demographics, Ohio 2011-13 and 2014-16

		2011-13 (n=151)		2014-16 (n=103)	
		%	95% CI	%	95% CI
Overall		3.1	2.4-3.8	**2.5**	**1.8-3.3**
Age (years)	18-24	1.7	0.3-3.0	N/A[1]	N/A[1]
	25-34	3.5	2.2-4.8	3.5	1.8-5.1
	35-44	3.7	2.7-4.7	3.5	2.1-4.9
Race/Ethnicity	Non-Hispanic White	2.7	1.4-4.0	2.9	1.9-3.9
	Non-Hispanic Black	2.5	0.0-5.2	1.7	0.2-3.2
	Hispanic	N/A[1]	N/A[1]	N/A[1]	N/A[1]
	Other	N/A[1]	N/A[1]	N/A[1]	N/A[1]
Marital Status	Ever Married	3.5	2.7-4.4	3.5	2.2-4.8
	Never Married	2.5	1.4-3.7	1.5	0.7-2.3
Education	Less than HS	6.3	2.6-10.0	4.6	0.8-8.5
	HS Graduate	2.1	1.2-3.1	1.5	0.7-2.3
	Some College	3.1	1.9-4.4	3.2	1.5-4.9
	College Graduate	2.4	1.7-3.2	2.0	1.2-2.8
Insurance	Plan	3.0	2.2-3.7	2.5	1.7-3.3
	No Plan	3.3	1.4-5.3	3.1	0.6-5.6
Income-Level	Less than $15,000	2.8	0.6-5.1	4.1	1.0-7.3
	$15,000-$24,999	2.6	1.3-4.0	3.7	0.6-6.8
	$25,000-$34,999	2.6	0.9-4.2	1.2	0.0-2.8
	$35,000-$49,000	3.8	1.4-6.2	1.9	0.2-3.6
	$50,000 or More	3.1	2.1-4.1	2.2	1.2-3.2
Geographic Region	Suburban	3.9	2.2-5.6	3.1	1.2-5.1
	Rural	4.1	1.9-6.3	1.9	0.6-3.3
	Metropolitan	3.0	1.8-4.2	1.9	1.0-2.9
	Appalachian	1.7	0.7-2.6	2.4	1.2-3.6

Table 14a (con't)
Source: Ohio Behavioral Risk Factor Surveillance System, Ohio Department of Health, 2018
Note: This table has been updated. The previously published table did not restrict the female population to WRA, as the title references.
[1]Estimate does not meet the reliability criteria for reporting set by the CDC.

Table 14b. Prevalence of a history of GDM only among women aged 18-44 years, by behavioral risk factor, Ohio 2011-13 and 2014-16

		2011-13 (n=151)		2014-16 (n=103)	
		%	95% CI	%	95% CI
BMI [2]	Underweight (< 18.5)	N/A[1]	N/A[1]	N/A[1]	N/A[1]
	Normal weight (18.5 - 24.99)	2.9	1.6-4.1	1.6	0.6-2.5
	Overweight (25.00-29.99)	2.6	1.5-3.7	3.9	1.6-6.1
	Obese (30.0+)	3.9	2.7-5.2	3.3	1.8-4.9
Smoking Status	Ever Smoker	3.3	2.3-4.4	4.1	2.3-5.8
	Never Smoker	2.9	1.9-3.9	1.6	0.9-2.3

Source: Ohio Behavioral Risk Factor Surveillance System, Ohio Department of Health, 2018
Note: This table has been updated. The previously published table did not restrict the female population to WRA, as the title references.
[1]Estimate does not meet the reliability criteria for reporting set by the CDC.
[2]BMI was calculated from self-reported height and weight

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 half of Ohio women with a GDM history self-reported having a history of smoking, one-third did not meet the physical activity recommendation and one in five has not had a routine health checkup within the last 2 years. Self-reported smoking rates increased in 2016 with three in five women reporting a history of smoking. 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 and 2014-16

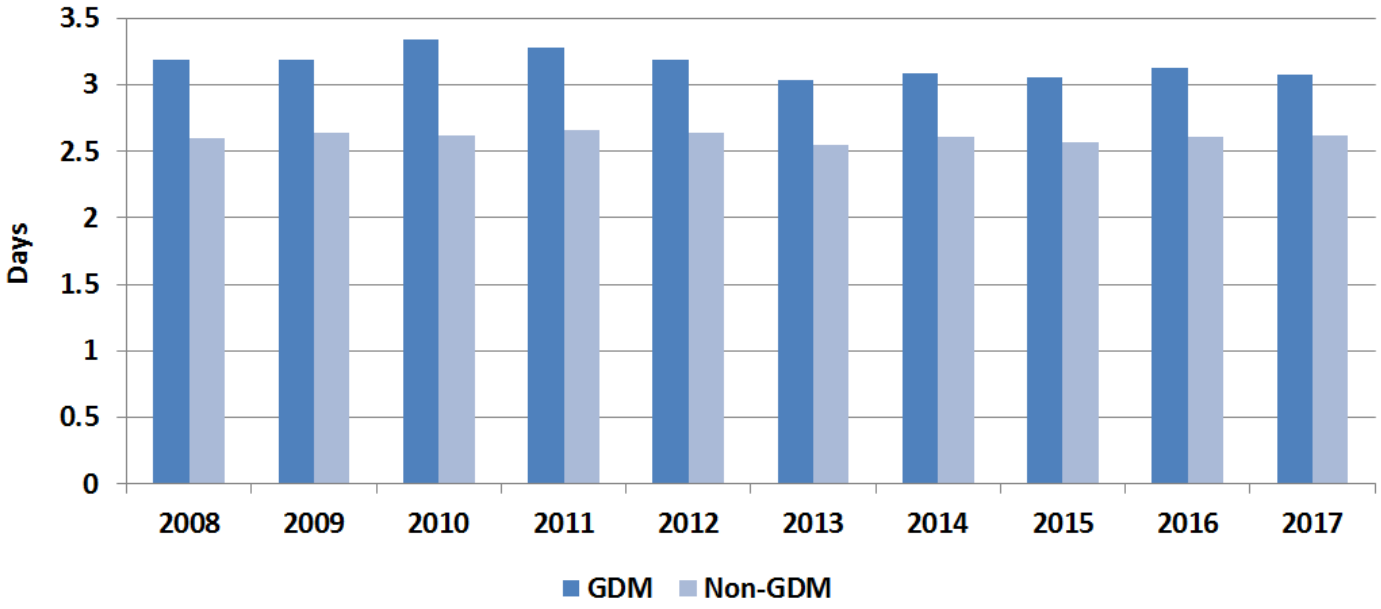
	2011-13						2014-16					
	History of GDM (%)	95% CI	Current Diabetes (%)	95% CI	No Diabetes History (%)	95% CI	History of GDM (%)	95% CI	Current Diabetes (%)	95% CI	No Diabetes History (%)	95% CI
	n=151		n=196		n=4766		n=103		n=170		n=3896	
Smoker												
Ever Smoker	47.0	35.3-58.8	56.5	46.6-66.4	43.1	41.2-44.9	59.8	44.9-74.7	47.9	37.6-58.2	36.6	34.4-38.7
Never Smoker	53.0	41.2-64.7	43.5	33.6-53.4	56.9	55.0-58.8	40.2	25.3-55.1	52.1	41.8-62.4	63.4	61.3-65.6
Met aerobic physical activity recommendation[1]												
Yes	32.0	14.5-49.4	24.1	9.9-38.3	30.6	28.2-33.1	N/A[2]	N/A[2]	35.1	21.7-48.6	52.6	49.5-55.8
No	68.0	50.6-85.5	75.9	61.6-90.1	69.4	66.9-71.8	N/A[2]	N/A[2]	64.9	51.4-78.3	47.4	44.2-50.5
Last routine health check-up												
Within past 2 years	80.0	70.1-89.9	91.3	86.9-95.7	81.7	80.3-83.2	82.3	72.1-92.6	81.7	72.8-90.7	83.8	82.2-85.4
Within past 5 years	11.5	2.9-20.1	6.1	2.2-10.0	10.2	9.0-11.4	N/A[2]	N/A[2]	N/A[2]	N/A[2]	8.5	7.2-9.7
5 or more years	8.5	2.4-14.6	N/A[2]	N/A[2]	8.1	7.0-9.1	N/A[2]	N/A[2]	N/A[2]	N/A[2]	7.7	6.5-8.8

Source: Ohio Behavioral Risk Factor Surveillance System, Ohio Department of Health, 2018
Note: This table has been updated. The previously published table did not restrict the female population to WRA, as the title references.
[1]Question not asked in 2012. Estimates derived from 2011 and 2013 data only. Question not asked in 2014. Estimates derived from 2015 and 2016 data only.
[2]Estimate does not meet the reliability criteria for reporting set by the CDC.

The Cost of Gestational Diabetes

As shown in Figure 5, the mean length of stay (LOS) was consistently greater among GDM-related hospital discharges. In 2017, the mean LOS among GDM-related hospital discharges was approximately 3.07 days and non-GDM-related hospital discharges were approximately 2.62 days.

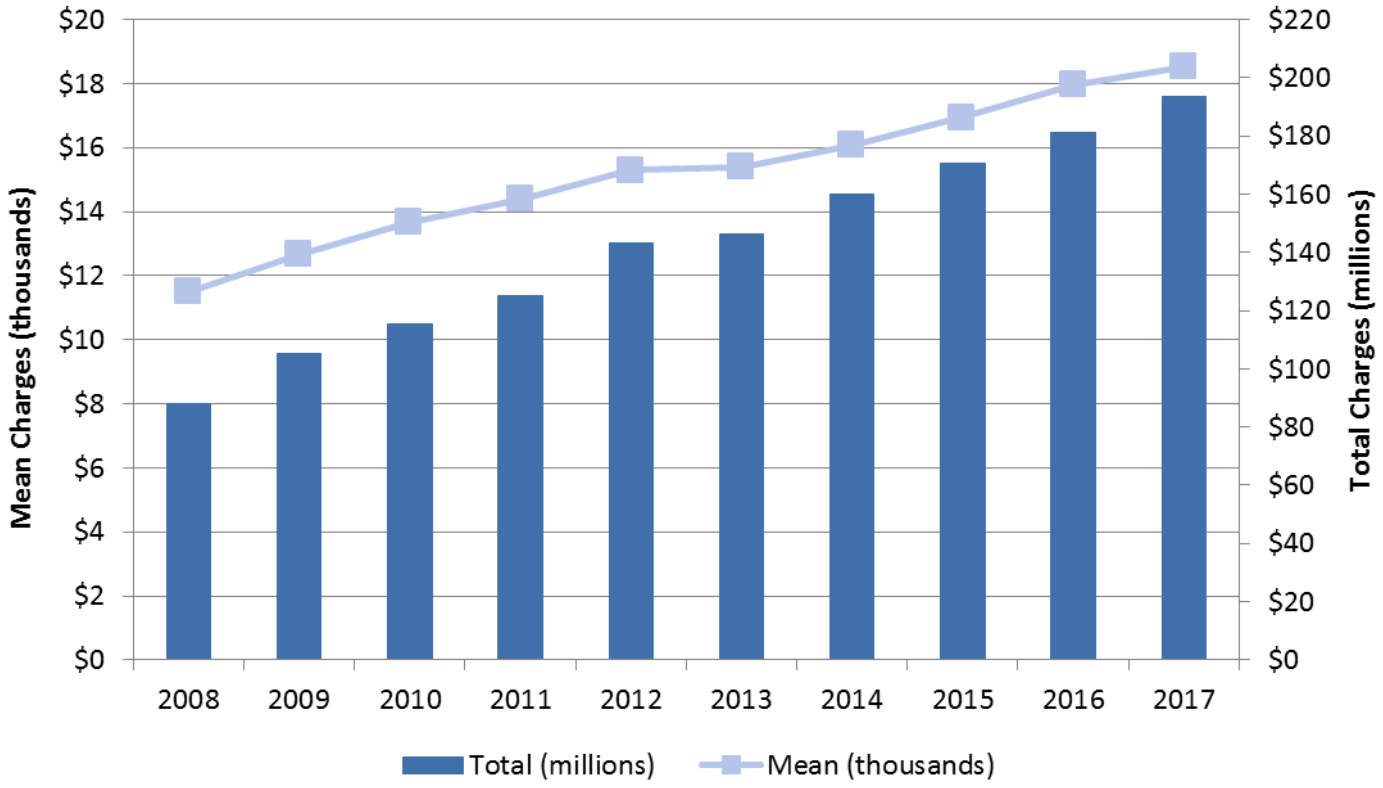
Figure 5. Mean length of stay (LOS) among GDM and non-GDM-related obstetric discharges, Ohio 2008-17



Source: Data provided by OHA.

Figure 6. Total and mean charges among GDM-related obstetric discharges, Ohio 2008-17

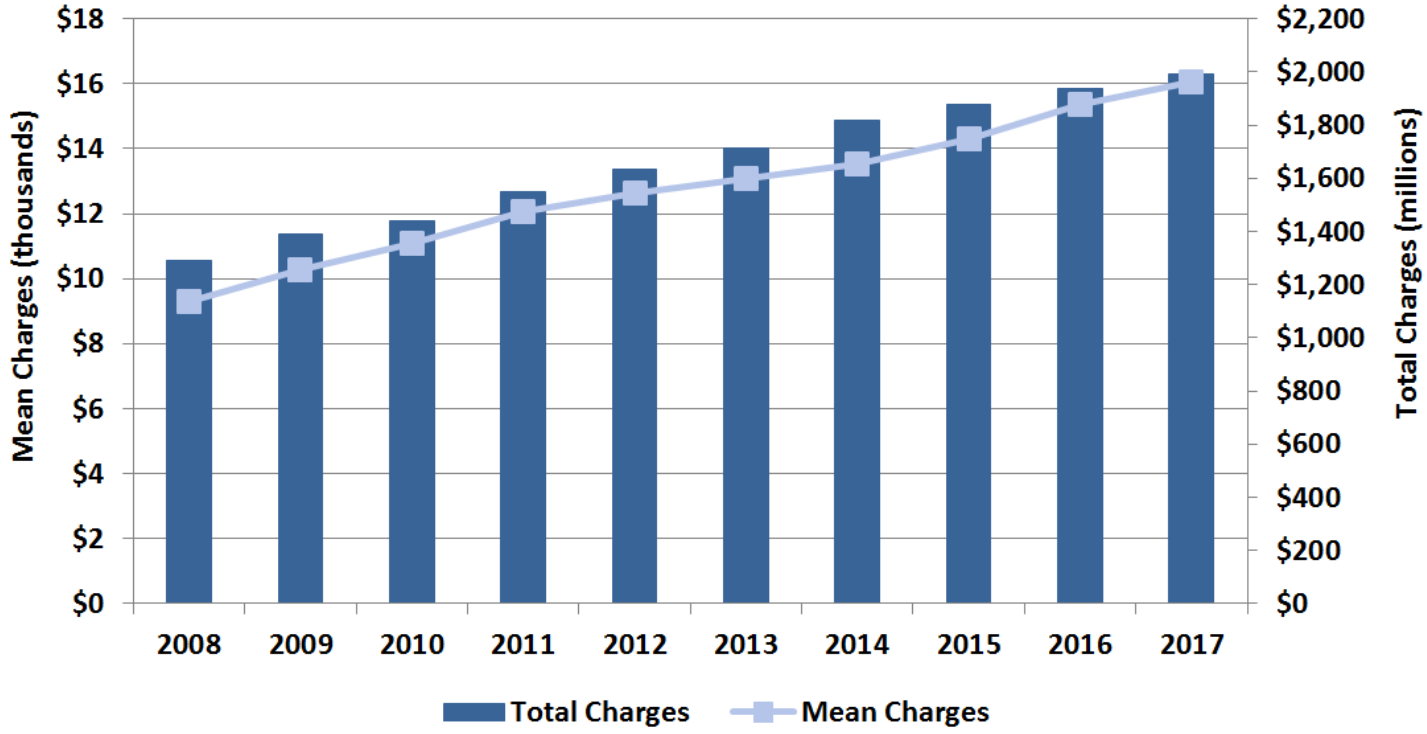
As shown in Figure 6, both the mean and total charges for GDM-related obstetric discharges have been consistently increasing since 2008. The highest amount occurred in year 2017, with mean charges of approximately $18,500 and total charges of $193 million.



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

Figure 7. Total and mean charges among non-GDM-related obstetrics discharges, Ohio 2008-17

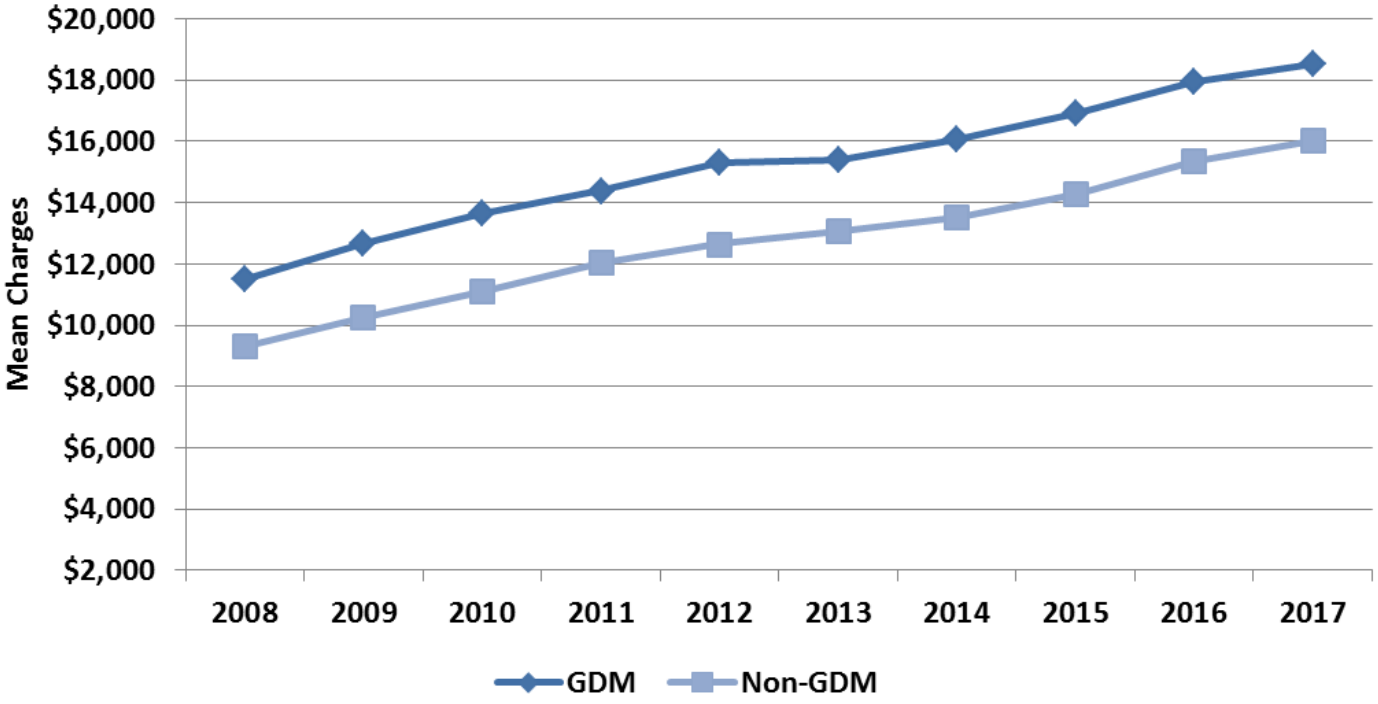
As shown in Figure 7, similar to GDM-related discharges, non-GDM related obstetrics discharge costs consistently increased reaching an all-time high in 2017 with mean charges of approximately $16,000 and total charges of $1,993 million.



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

Figure 8. Mean charges among GDM and non-GDM-related obstetric discharges, Ohio 2008-17

From 2008 – 2017 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.

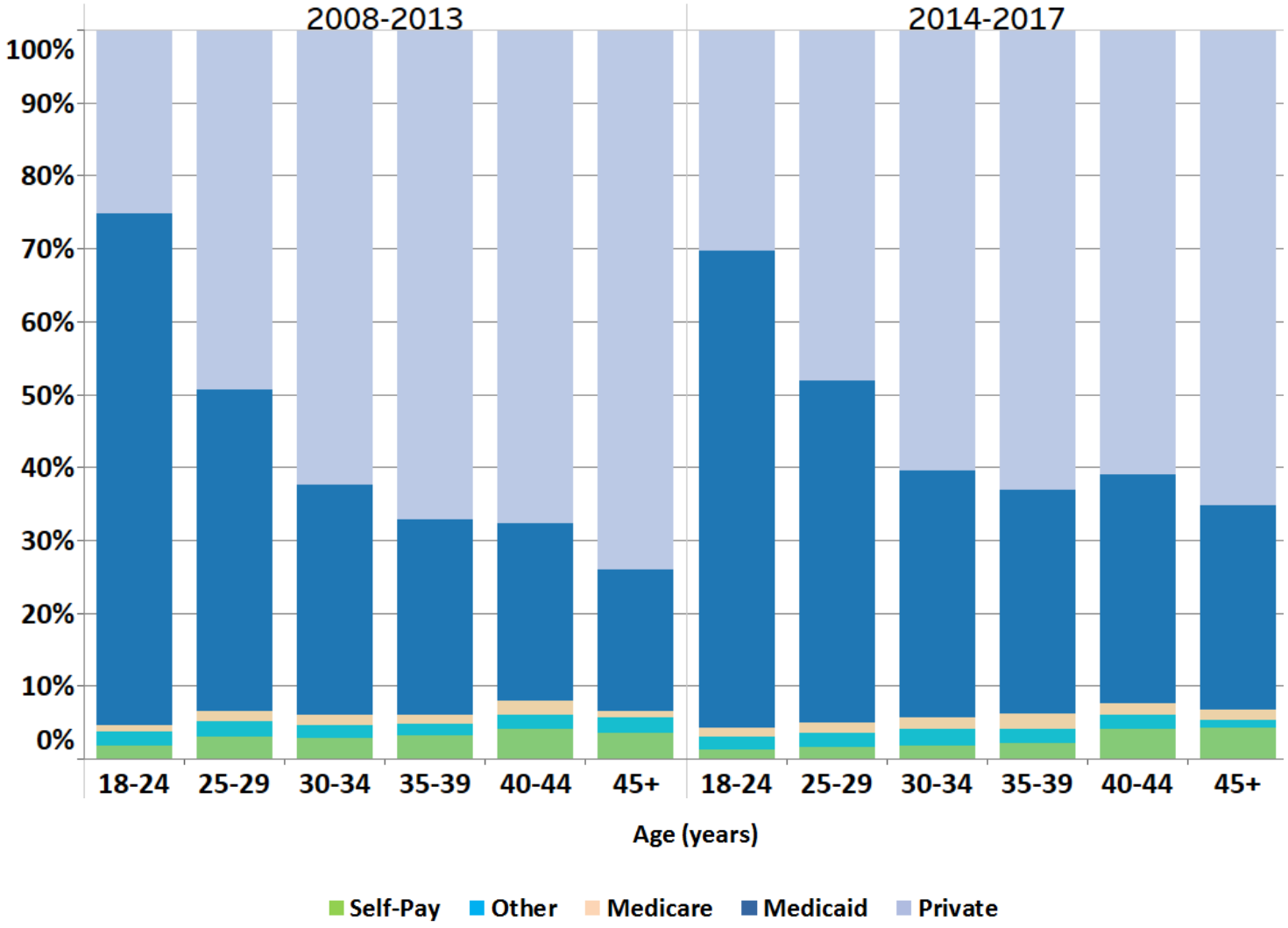


Source: Data provided by OHA.
Footnote: Adjusted for medical cost inflation, charges represent total amount billed, not actual amount collected.

Displayed in Figure 9, among women aged 18-24 years, Medicaid was the primary payer for approximately 70 percent of all costs for GDM-related discharges in 2008-2013 and 65 percent in 2014-2017. Although Medicaid is the primary payer for the majority of 18-24 year old GDM-related hospital discharges, less than 4 percent of hospital discharges occurring for this age group are affected by GDM (as shown in Figure 2.)

For women aged 25 years and older, private insurance was the primary payer, followed by Medicaid. In addition, Medicaid costs for GDM-related obstetric discharges increased between 2 and 9 percent during 2014-2017 over the 2008-2013 timeframe for women aged 25 and older.

Figure 9. Percent of total charges for GDM-related obstetric discharges by primary payer and age group, Ohio 2008-2013 and 2014-2017



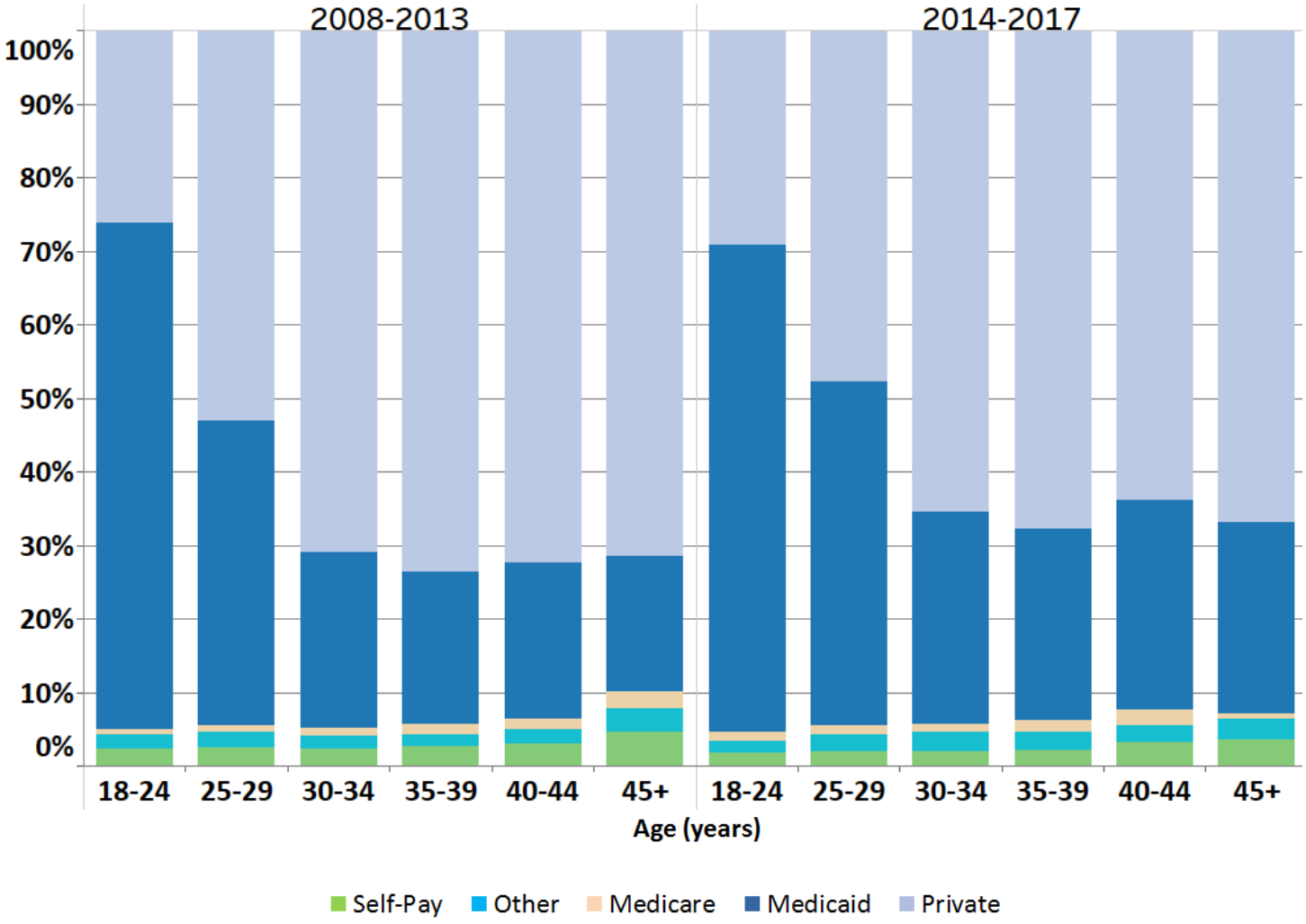
Source: Data provided by OHA.
Footnote:

1. Adjusted for medical cost inflation, charges represent total amount billed, not actual amount collected.
2. Age group 45+ is not truncated and may include potentially erroneous ages.

Similar to GDM-related hospital discharges, the provider type varied greatly by age for non-GDM-related hospital discharges (Figure 10.) In 2008-2013, Medicaid was the primary payer for approximately 69 percent of non-GDM-related discharge costs for women aged 18-24 years; this decreased slightly to 66 percent for 2014-2017.

While the proportions varied by maternal age, private insurance was the primary payer for approximately 53 to 74 percent of discharges for women aged 25 and older during the 2008-2013 timeframe. Total costs for non-GDM-related obstetric discharges to Medicaid in 2014-2017 increased between 5 and 8 percent over 2008-2013 timeframe for women aged 25 and older.

Figure 10. Percent of total charges for non-GDM obstetric discharges by primary payer and age group, Ohio 2008-2013 and 2014-2017



Source: Data provided by OHA.
Footnote:

1. Adjusted for medical cost inflation, charges represent total amount billed, not actual amount collected.
2. Age group 45+ is not truncated and may include potentially erroneous ages.

Appendices

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

To strengthen 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, OPAS, and OHA every 2 to 3 years.

WIC instituted a GDM-specific system into their system in Fall of 2016. These 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 could 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 to better understand the accuracy of Medicaid data related to postpartum glucose screening so that these data can be best applied to program planning and evaluation.

Appendix B: Data Source Descriptions, Strengths and Limitations

Ohio Hospital Association (OHA)

OHA represents 13 health systems and 233 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; or ICD-10 Codes beginning with 244XX but excluding Z8632)
- 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, 2009). This result suggests 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, 2014, and 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, 2009). 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 is 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. Center for Disease Control (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.

PRAMS ended in Ohio following 2015 births.

Ohio Pregnancy Assessment Survey

The Ohio Pregnancy Assessment Survey (OPAS) is a statewide, ongoing, targeted population-based survey that utilizes the CDC Pregnancy Risk Assessment Monitoring System (PRAMS) methodology to collect information on and attitudes of residential women who give birth in Ohio. OPAS began fielding in 2016, and provides information not available from other sources about pregnancy and the first few months after birth. OPAS questions are group to reflect experiences before, during and after pregnancy. This information can be used to identify groups of women and infants at high risk for health problems, to monitor changes in health status, and to measure progress towards goals in improving the health of mothers and infants. Additionally, the OPAS provides data to measure progress in Ohio's maternal and infant health (MIH) initiatives and is used by researchers to investigate emerging issues in the field of reproductive health.

The OPAS is a stratified mixed collection mode random survey of residential women who gave birth in Ohio. Relevant populations of interest, such as the nine Ohio Health Equity Institute (OEI) counties, are oversampled to facilitate analysis of Ohio's MIH initiatives and ongoing program development. Sampled women are contacted approximately 2-4 months after delivery and can participate by completing a mailed survey, online survey, or telephone survey.

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.

Additionally, some subgroups had small sample sizes, so subgroups with denominators less than 30 were suppressed to maintain respondent confidentiality. These lead to gaps in the analysis reflected on the tables as NA.

Additional changes from the original 2011-2013 ODH data book include:

- The original team who conducted the analysis discovered that the previously published tables for 2011-13 did not restrict the female population to women of reproductive age (WRA) as previously indicated.
- Some of the estimates that were previously reported no longer met the reliability criteria for reporting.
- A change from ICD-9 codes to ICD-10 codes was required due to the federally mandated conversion that occurred on October 1, 2015.

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