V.12.2 Special Report: Perinatal Complications associated with Gestational and Pregestational Diabetes

I. Introduction

Diabetes mellitus is a metabolic disease characterized by chronic hyperglycemia and disturbance in carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action or both. Long term effects of diabetes may involve retinopathy, nephropathy, neuropathy, and cardiac involvement of peripheral arterial and cerebrovascular disease [1-4]. Clearly a diabetic woman will need close monitoring during pregnancies to manage the disease and limit risks to maternal and fetal well-being. Type 1 diabetes occurs when pancreatic beta-cell destruction is present, usually leading to absolute insulin deficiency. Type 2 diabetes is the most common type presenting with disorders of insulin action (insulin resistance) with insulin deficiency relative to a predominant secretory defect. Other specific types of diabetes primarily are genetically linked or associated with disease or drugs. Gestational diabetes refers to hyperglycemia (glucose intolerance) with onset on first recognition during pregnancy [1-4].

The range of clinical stages of glucose tolerance extends from normoglycemia, to intermediate hyperglycemia [impaired fasting glucose (IFG) and impaired glucose tolerance (IGT)] to diabetes[1-4]. The 2011 World Health Organization (WHO) Consultation affirms the 1999 WHO recommendations for diagnostic criteria for these states and endorses the term "intermediate hyperglycemia "for IGT and IFT, instead of the term "pre-diabetes"[5]. The WHO has maintained the recommendation that a 2 hour 75g oral glucose tolerance test (OGTT) in pregnancy be the diagnostic test for impaired glucose tolerance. The WHO criteria for diagnosing GDM use these cutoff values: fasting ≥ 126mg/dl; 2 hour plasma glucose ≥ 140 mg/dl [6]. The lack of international consistency with regard to the diagnosis of GDM led to The Hyperglycemia and Adverse Pregnancy Outcome (HAPO) Study. The study sought to determine the level of glucose intolerance during pregnancy, short of overt diabetes, that is associated with adverse outcomes[7]. Primary outcomes were measured by birth weight 90th percentile for gestational age, primary cesarean delivery, clinical neonatal hypoglycemia and hyperinsulinemia (derived from cord serum C-pepticide, 90th percentile). Secondary outcomes included preterm birth, shoulder dystocia, birth injury, sum of skinfold thickness > 90th percentile, percentage body fat > 90th percentile, NICU admission, hyperbilirubinemia and pre-eclampsia. The study concluded that no clear inflection points could be identified and the relationship between maternal glucose levels and fetal growth appeared to be a basic biological phenomenon, not a clearly demarcated disease state. The study indicated that the construction of diagnostic criteria for GDM would be difficult to accomplish directly from the association of maternal hypoglycemia and outcomes[8]. A committee of experts was convened by the International Association of Diabetes and Pregnancy Study Groups (IADPSG) to develop a consensus regarding appropriate diagnostic criteria. The task force from the IADSG has recommended that the diagnosis of gestational diabetes be made when any of the following based on a 2 hour 75g OGTT are met or exceeded: fasting glucose ≥ 92 mg/dl, or a one hour result of ≥ 180mg/dl or a two hour result of ≥153mg/dl[9].

Pregnancies complicated by pregestational diabetes (pre-GDM), defined as Type 1 or Type 2 diabetes diagnosed at least 12 months before pregnancy, have an increased risk of birth defects and perinatal mortality and morbidity[10, 11]. A study from New South Wales reviewed the linked records of 1272 women with pre-GDM and found a higher rate of pre-existing hypertension and a risk of maternal mortality or morbidity three times greater than in women without diabetes[12]. The aim of the study was to determine the population –based outcomes of pre-GDM women compared to women with GDM. Pre-GDM and GDM women continued to have an increased risk of adverse maternal and neonatal outcomes but the adverse outcomes were less frequent in the woman with GDM. The study also found that rates of pre GDM and GDM were increasing. Another study compared obstetric and perinatal outcomes in women with Type 1 diabetes (408 women) and Type 2 (274 women) diabetes in relation to maternal risk factors of age, parity, ethnicity, glycemic control obesity and social disadvantages[13]. Despite increased age, parity, obesity and social disadvantage, women with Type 2 diabetes had better glycemic control, fewer large-for-gestational-age infants, fewer preterm deliveries and fewer NICU admissions. A study of 220 women with GDM were found to have a higher incidence of pre-eclampsia, preterm delivery, induction of labor, cesarean delivery, higher mean birth weight of babies, large-for-gestational-age, macrosomia, and NICU admissions compared with the control group[14]. Even the milder forms of GDM seemed to have adverse risks leading the researcher to recommend early diagnosis and aggressive management. An increase in the incidence of GDM has been concurrent with the rise in pre-pregnancy obesity and an increase in Type 2 diabetes in the general population. Kim et al[15] calculated the percentage of GDM cases that could potentially be prevented if all women who are overweight or obese had a GDM risk equivalent to that of women with normal weight. Their conclusion was that if all overweight and obese women (BMI of 25kg/m^2 or above) had a GDM risk equal to that of women with a normal weight, nearly half of GDM could be prevented. The combination of pre-gravida obesity and GDM has shown to be associated with an increased risk of adverse pregnancy outcomes. In a study of 3,798 patients with singleton pregnancies and GDM, maternal and neonatal outcomes were compared between obese (pre-pregnancy BMI $\geq$ 30 kg/m^2) and non-obese (pre-pregnancy BMI, 30 kg/m^2)[16]. Maternal obesity was significantly associated with the development of pregnancy-related hypertension, interventional delivery and cesarean delivery. Adverse neonatal outcomes were also increased including stillbirth, macrosomia, shoulder dystocia, need for NICU admission, hypoglycemia and jaundice.

Strategies are needed to reduce pre-pregnancy obesity and encourage preconception counseling for women with Type 1 and Type 2 diabetes. Aggressive management of pregnant women with pregestational diabetes, pre-GDM and GDM are essential components in improving maternal and neonatal outcomes.

II. Description of Tables and Graphs

The **V12.2 Special Report: Perinatal Complications associated with Gestational and Pregestational Diabetes** is designed to provide you with an analysis of maternal and neonatal complications for diabetic mothers. The tables display data for delivered mothers subdivided into the following categories: gestational diabetes (abnormal glucose tolerance-dx code 648.8x), pre-gestational diabetes (diabetes mellitus codes 648.0x and/or 250.xx), non-diabetic (not coded with 648.8, 648.0x or 250.xx), and all cases. The information displayed represents data for your hospital compared to your subgroup average and to the database as a whole. This report includes data for discharge date range 7/1/2011 – 6/30/2012.

Medical record numbers of those cases driving your rates are available by emailing mservices@npic.org. We are also happy to answer any questions you may have regarding this analysis.

Table 1A and 1B: Maternal Complications

Table 1A and Table 1B begin with a display of the count and percent of total deliveries by category. In Table 1A, the maternal complications section follows with a display of the number of cases and percent of delivered women in each category who had an operative vaginal delivery; vaginal or c- section delivery with induction; and vaginal delivery with length of stay (LOS) > 3 days or c- section delivery with LOS > 5 days. Selected complications/conditions associated with gestational and pregestational diabetes appear in Table 1B. These include obesity (dx code 649.1x); hypertension (642.0x, 642.1x and 642.9x); excessive fetal growth (656.6x); shoulder dystocia (660.4x); and maternal age 35 or older.

Graphs 1 - 4 display your hospital's data for the period 2007-2012(Q2) compared to the NPIC/QAS Trend Database, a subgroup of 52 hospitals that have participated in the NPIC/QAS database for the same period. Below each graph is a table which includes all the data displayed for the trend analysis period: the trend database average rate, the hospital's rate with upper and lower confidence intervals and the hospital's count of numerator and denominator cases for each year.

Trendlines for the time period are displayed on the graphs for your hospital and the trend database. If your hospital has not submitted data for the entire period, trendlines will only be displayed for the years that data was submitted.

Graph 1: Rate of Gestational Diabetes 2007-2012 (Q1-Q2)
Graph 2: Rate of Pregestational Diabetes 2007-2012 (Q1-Q2)
Graph 3: Rate of Delivered Mothers with age ≥ 35 years
Mothers coded with Gestational diabetes vs. Non-diabetic Mothers 2007-2012 (Q1-Q2)
Graph 4: Rate of Delivered Mothers with age ≥ 35 years
Mothers coded with Pregestational Diabetes vs. Non-diabetic Mothers 2007-20012 (Q1-Q2)

Graphs 5-6 display your hospital's rate of vaginal or c-section deliveries with induction in mothers coded with gestational diabetes compared to subgroup and database average rates for non-diabetic mothers. Date range of data is 7/1/2011 – 6/30/2012.

Graph 5: Rate of Vaginal Deliveries with Induction in Delivered Mothers coded with Gestational Diabetes
Graph 6: Rate of C-section Deliveries with Induction in Delivered mothers coded with Gestational Diabetes

Table 2A and 2B: Neonatal Complications

Table 2A and 2B present a linked mother/baby analysis using the mother's medical record number that appears on the baby's record as part of the hospital's NPIC/QAS data submission. (If your hospital's data submission does not provide mother's medical record on the baby's record, we will not be able to link the records. Your report will only display your subgroup and the database averages.)

The first section of each Table displays for each category the total inborns linked to a mother and linked inborns as a percent of total deliveries in the category.

The neonatal complications section in Table 2A begins with a display of the number of linked inborns admitted to special care (defined as discharges with neonatal intensive care (NICU) or neonatal intermediate care (NINT) accommodation days or charges on the data submission); their average length of stay (ALOS); and percent of total for each category of delivered mothers.

Additional complications/conditions associated with infants of diabetic women are displayed in Table 2B, in a similar format (without ALOS). These complications include delivered < 37 weeks; "heavy for dates" (dx code 766.1); syndrome of "infant of a diabetic mother" (775.0); neonatal hypoglycemia (775.6); neonatal jaundice associated with pre-term delivery (774.2); unspecified fetal and neonatal jaundice (774.6); and injury to brachial plexus (767.6).

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12. Shand, et al, Ibid, pg 710.

13. Murphy, et al, op.cit, pg 1062-1064.

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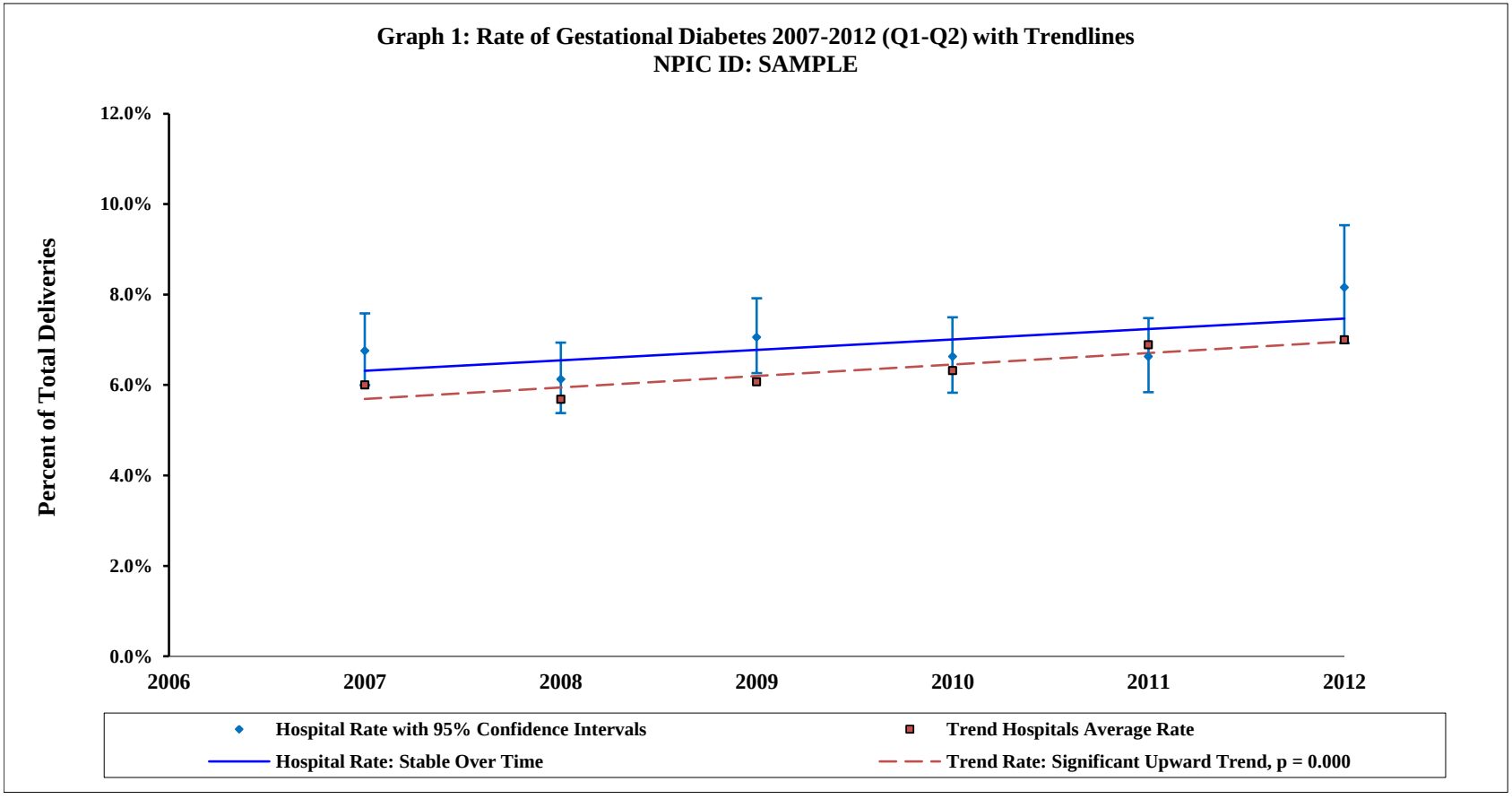
Table 1A: Maternal Complications

NPIC ID: SAMPLE	**Gestational Diabetes** Delivered Mothers coded with 648.8x (Abnormal glucose tolerance)		**Pregestational Diabetes** Delivered Mothers coded with 648.0x and/or 250.xx (Diabetes Mellitus)		**Non-diabetic** Delivered Mothers not coded with 648.8x, 648.0x, and 250.xx		**All Delivered Mothers**	
Total Deliveries	**# of Cases**	**% of Total Deliveries**	**# of Cases**	**% of Total Deliveries**	**# of Cases**	**% of Total Deliveries**	**# of Cases**	**% of Total Deliveries**
Hospital	268	7.6%	38	1.1%	3,246	91.4%	3,552	100.0%
Subgroup Average	310	7.6%	67	1.7%	3,875	90.7%	4,252	100.0%
Database Average	300	7.1%	52	1.3%	3,841	91.6%	4,193	100.0%
Maternal Complications	**# of Cases**	**% of Category**	**# of Cases**	**% of Category**	**# of Cases**	**% of Category**	**# of Cases**	**% of Category**
Operative Vaginal deliveries								
Hospital	7	2.6%	2	5.3%	215	6.6%	224	6.3%
Subgroup Average	10	3.3%	1	1.8%	170	4.4%	181	4.3%
Database Average	10	3.5%	1	2.2%	170	4.4%	181	4.3%
Vaginal Deliveries with induction								
Hospital	66	24.6%	6	15.8%	578	17.8%	650	18.3%
Subgroup Average	64	20.9%	12	17.4%	709	18.5%	785	18.7%
Database Average	59	18.5%	9	15.7%	641	16.1%	708	16.3%
C-Section Deliveries with induction								
Hospital	17	6.3%	2	5.3%	109	3.4%	128	3.6%
Subgroup Average	22	7.1%	6	10.1%	178	4.6%	206	4.8%
Database Average	22	7.0%	5	8.3%	180	4.6%	207	4.8%
Vaginal Deliveries with LOS > 3 days								
Hospital	13	4.9%	2	5.3%	206	6.4%	221	6.2%
Subgroup Average	18	6.0%	6	8.2%	143	4.0%	167	4.2%
Database Average	16	5.1%	4	7.1%	129	3.3%	149	3.5%
C-Section Deliveries with LOS > 5 days								
Hospital	18	6.7%	5	13.2%	102	3.1%	125	3.5%
Subgroup Average	16	5.1%	9	13.2%	100	2.6%	125	3.0%
Database Average	16	4.5%	7	11.0%	91	2.2%	114	2.5%

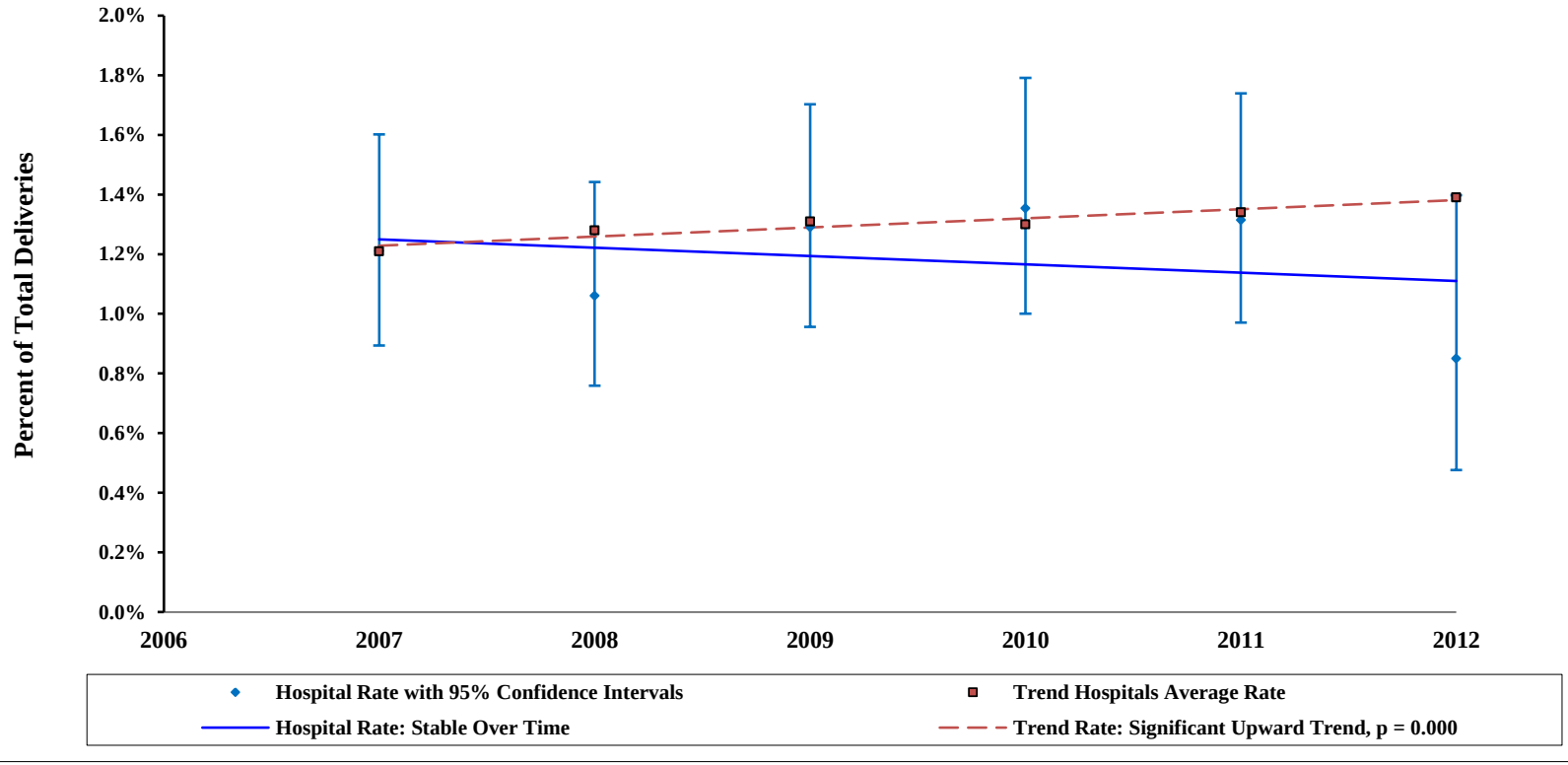
V12.2 Special Report: Perinatal Complications associated with Gestational and Pregestational Diabetes
Table 1B: Maternal Complications

NPIC ID: SAMPLE	**Gestational Diabetes** Delivered Mothers coded with 648.8x (Abnormal glucose tolerance)		**Pregestational Diabetes** Delivered Mothers coded with 648.0x and/or 250.xx (Diabetes Mellitus)		**Non-diabetic** Delivered Mothers not coded with 648.8x, 648.0x, and 250.xx		**All Delivered Mothers**	
Total Deliveries	**# of Cases**	**% of Total Deliveries**	**# of Cases**	**% of Total Deliveries**	**# of Cases**	**% of Total Deliveries**	**# of Cases**	**% of Total Deliveries**
Hospital	268	7.6%	38	1.1%	3,246	91.4%	3,552	100.0%
Subgroup Average	310	7.6%	67	1.7%	3,875	90.7%	4,252	100.0%
Database Average	300	7.1%	52	1.3%	3,841	91.6%	4,193	100.0%
Maternal Complications	**# of Cases**	**% of Category**	**# of Cases**	**% of Category**	**# of Cases**	**% of Category**	**# of Cases**	**% of Category**
Obesity (dx code 649.1x)								
Hospital	47	17.5%	11	29.0%	147	4.5%	205	5.8%
Subgroup Average	34	11.3%	13	20.5%	126	3.8%	173	4.7%
Database Average	37	13.5%	12	22.3%	175	5.3%	224	6.1%
Hypertension (dx codes 642.0x, 642.1x and 642.9x)								
Hospital	14	5.2%	6	15.8%	69	2.1%	89	2.5%
Subgroup Average	16	5.2%	10	14.3%	85	2.3%	110	2.7%
Database Average	14	5.1%	7	13.6%	77	2.2%	99	2.5%
Excessive fetal growth (dx code 656.6x)								
Hospital	11	4.1%	2	5.3%	52	1.6%	65	1.8%
Subgroup Average	16	5.4%	6	10.4%	66	1.8%	89	2.3%
Database Average	18	6.9%	5	10.4%	86	2.3%	109	2.7%
Shoulder dystocia (dx code 660.4x)								
Hospital	8	3.0%	0	0.0%	63	1.9%	71	2.0%
Subgroup Average	6	2.2%	1	2.2%	53	1.5%	60	1.5%
Database Average	5	2.0%	1	2.7%	50	1.4%	56	1.4%
Mothers with age ≥ 35 years								
Hospital	88	32.8%	7	18.4%	668	20.6%	763	21.5%
Subgroup Average	107	34.5%	23	33.9%	785	20.1%	915	21.4%
Database Average	104	32.9%	17	32.0%	775	18.6%	896	19.8%



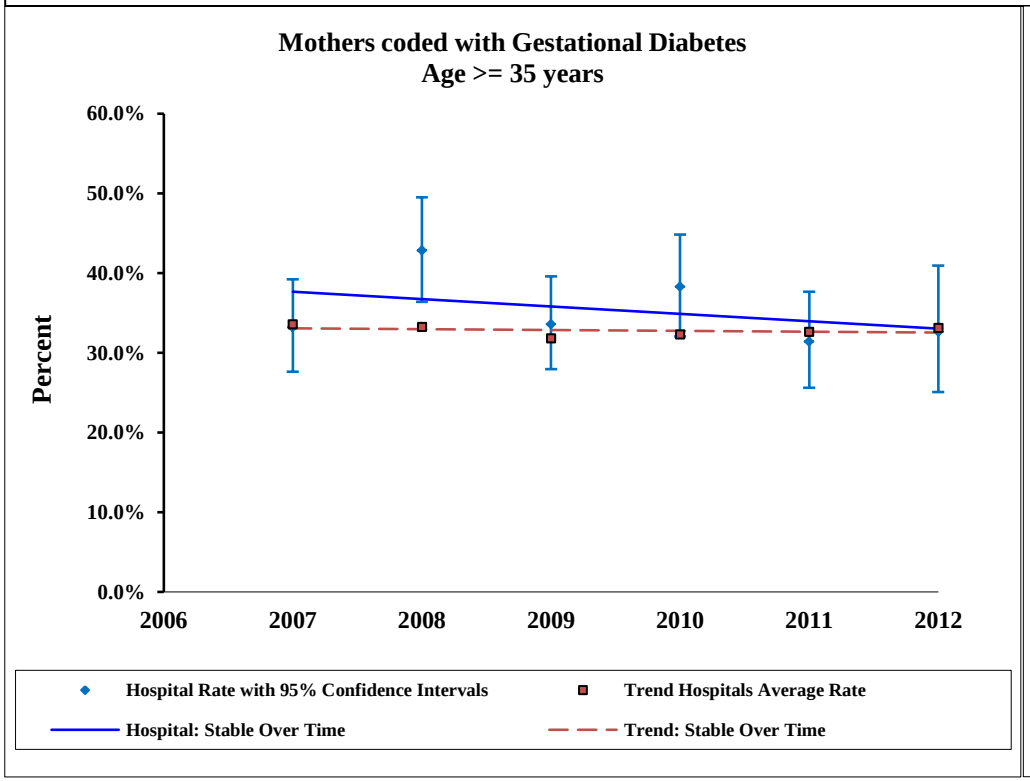
	2007	2008	2009	2010	2011	2012 (Q1-Q2)
Trend Rate	6.0%	5.7%	6.1%	6.3%	6.9%	7.0%
Hospital Rate	6.8%	6.1%	7.1%	6.6%	6.6%	8.2%
Hospital Numerator	268	231	268	235	242	144
Hospital Denominator	3966	3771	3797	3545	3652	1765
Lower CI	6.0%	5.4%	6.3%	5.8%	5.8%	6.9%
Upper CI	7.6%	6.9%	7.9%	7.5%	7.5%	9.5%

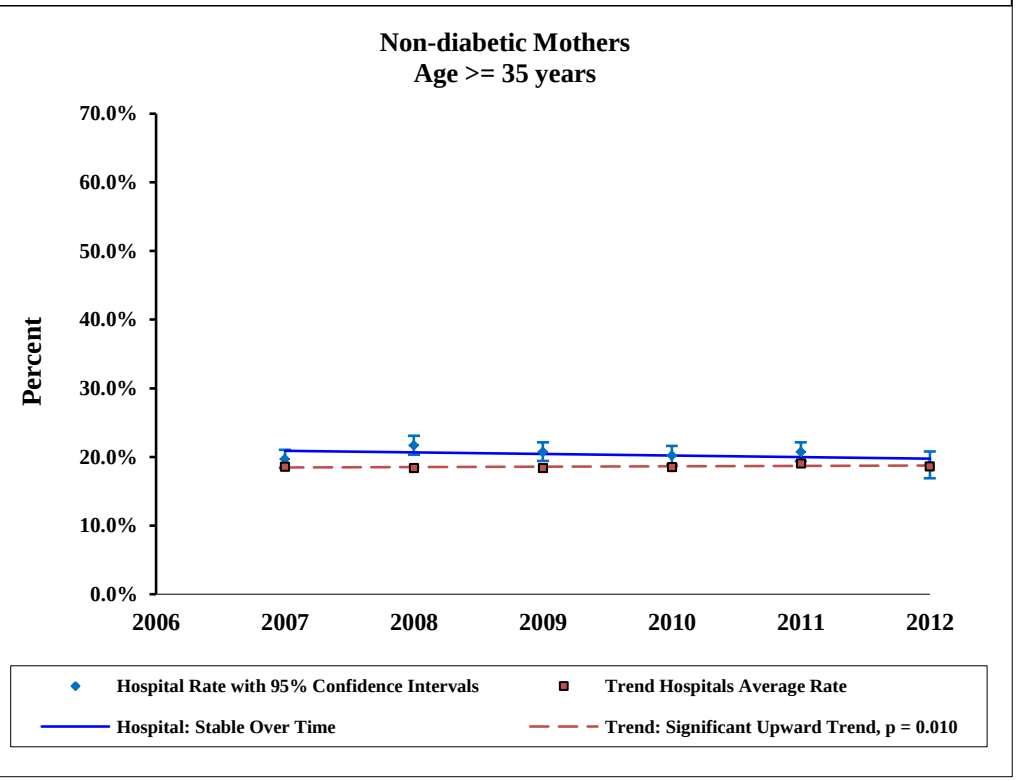
Graph 2: Rate of Pregestational Diabetes 2007-2012 (Q1-Q2) with Trendlines
NPIC ID: SAMPLE



	2007	2008	2009	2010	2011	2012 (Q1-Q2)
Trend Rate	1.2%	1.3%	1.3%	1.3%	1.3%	1.4%
Hospital Rate	1.2%	1.1%	1.3%	1.4%	1.3%	0.9%
Hospital Numerator	48	40	49	48	48	15
Hospital Denominator	3966	3771	3797	3545	3652	1765
Lower CI	0.9%	0.8%	1.0%	1.0%	1.0%	0.5%
Upper CI	1.6%	1.4%	1.7%	1.8%	1.7%	1.4%

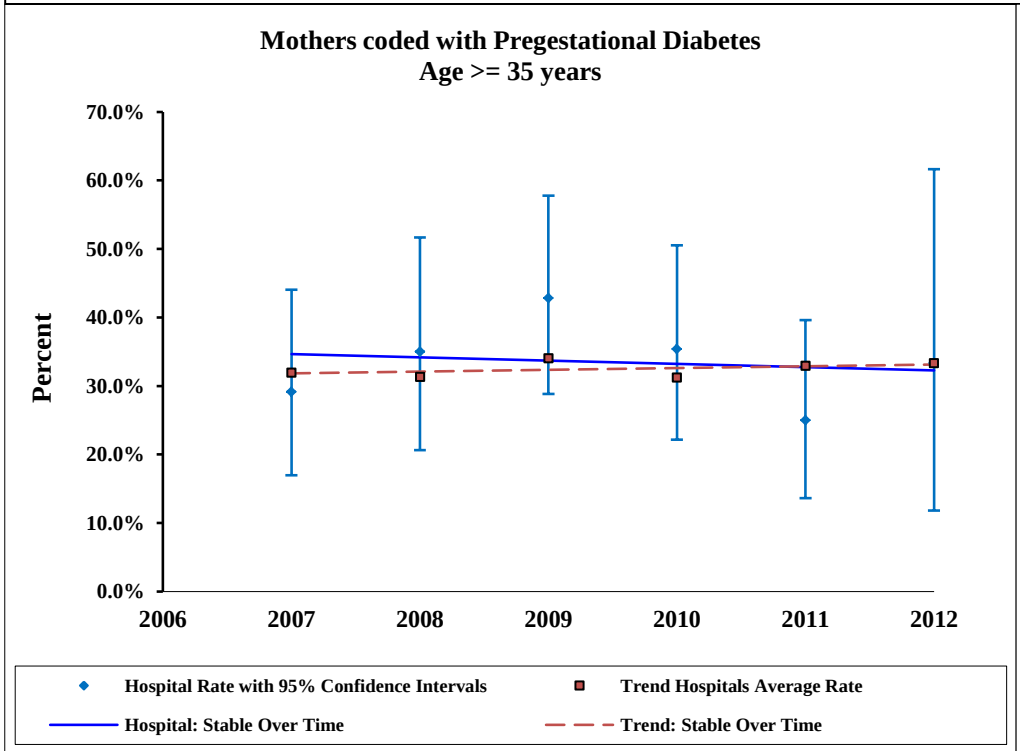
Graph 3: Rate of Delivered Mothers with age >= 35 years
Mothers coded with Gestational Diabetes vs. Non-diabetic Mothers
2007-2012 (Q1-Q2) with Trendlines
NPIC ID: SAMPLE

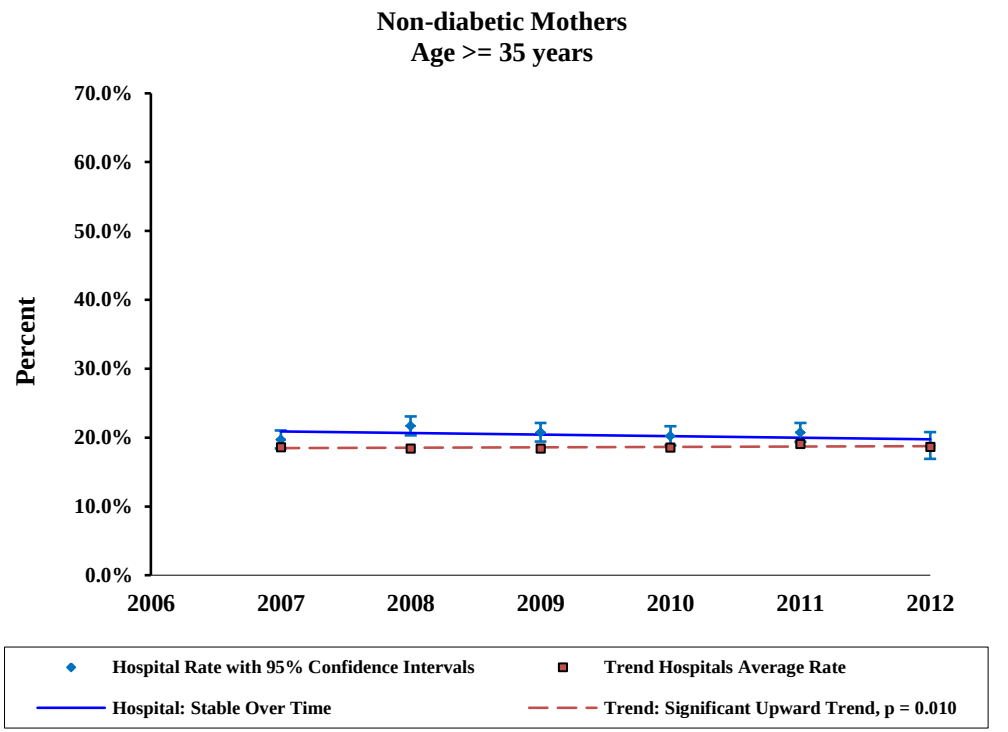




	2007		2008		2009		2010		2011		2012 (Q1-Q2)	
	Diabetic	Non-diabetic	Diabetic	Non-diabetic	Diabetic	Non-diabetic	Diabetic	Non-diabetic	Diabetic	Non-diabetic	Diabetic	Non-diabetic
Trend Rate	33.6%	18.6%	33.3%	18.4%	31.8%	18.4%	32.3%	18.6%	32.7%	19.1%	33.1%	18.6%
Hospital Rate	33.2%	19.7%	42.9%	21.7%	33.6%	20.8%	38.3%	20.2%	31.4%	20.7%	32.6%	18.8%
Hospital Numerator	89	719	99	759	90	722	90	659	76	697	47	302
Hospital Denominator	268	3650	231	3500	268	3480	235	3262	242	3362	144	1606
Lower CI	27.6%	18.4%	36.4%	20.3%	28.0%	19.4%	32.1%	18.8%	25.6%	19.4%	25.1%	16.9%
Upper CI	39.2%	21.0%	49.5%	23.1%	39.6%	22.1%	44.8%	21.6%	37.7%	22.1%	40.9%	20.8%

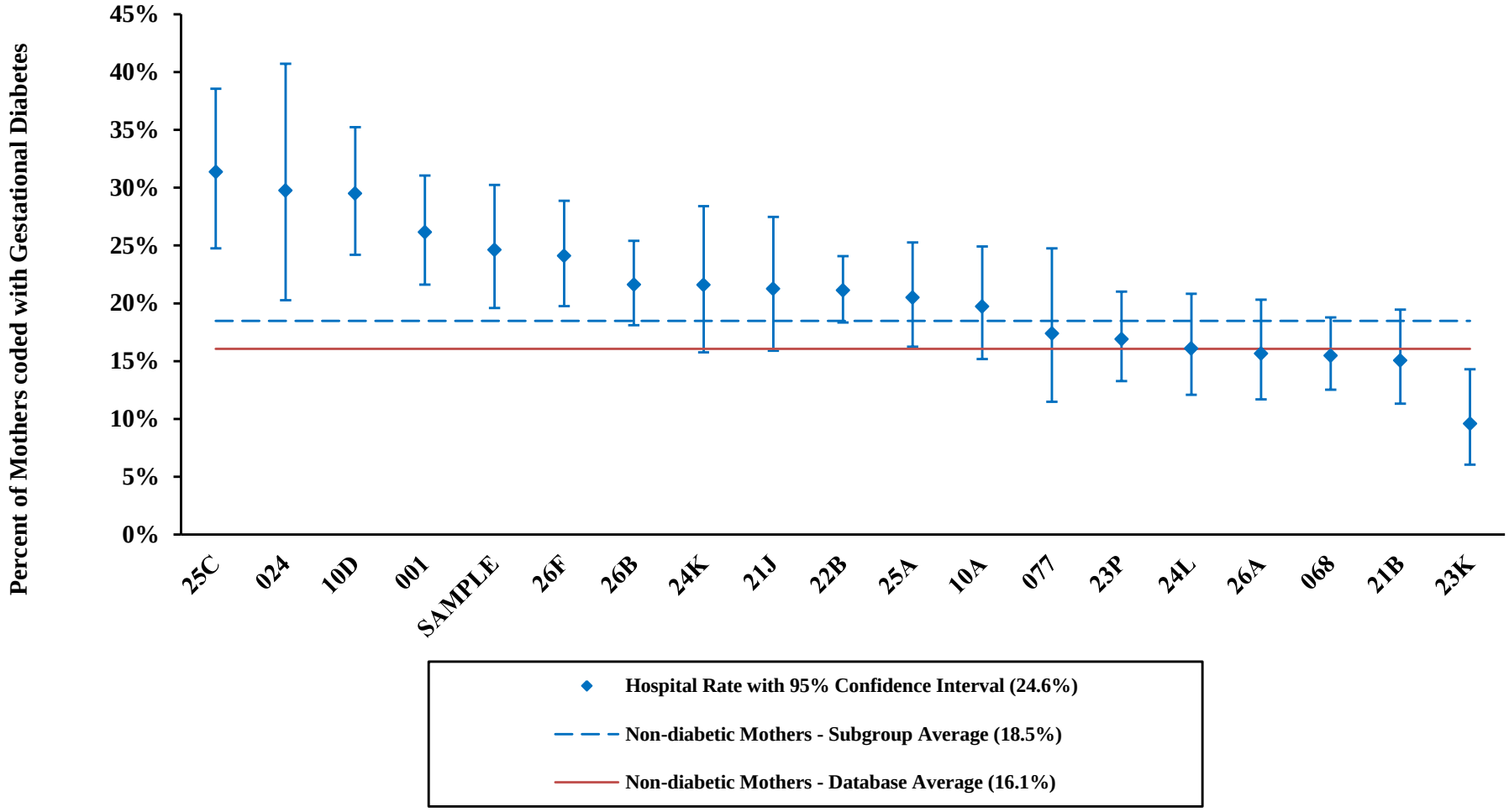
Graph 4: Rate of Delivered Mothers with age >= 35 years
Mothers coded with Pregestational Diabetes vs. Non-diabetic Mothers
2007-2012 (Q1-Q2) with Trendlines
NPIC ID: SAMPLE





	2007		2008		2009		2010		2011		2012 (Q1-Q2)	
	Diabetic	Non-diabetic	Diabetic	Non-diabetic	Diabetic	Non-diabetic	Diabetic	Non-diabetic	Diabetic	Non-diabetic	Diabetic	Non-diabetic
Trend Rate	32.0%	18.6%	31.4%	18.4%	34.1%	18.4%	31.3%	18.6%	33.0%	19.1%	33.3%	18.6%
Hospital Rate	29.2%	19.7%	35.0%	21.7%	42.9%	20.8%	35.4%	20.2%	25.0%	20.7%	33.3%	18.8%
Hospital Numerator	14	719	14	759	21	722	17	659	12	697	5	302
Hospital Denominator	48	3650	40	3500	49	3480	48	3262	48	3362	15	1606
Lower CI	17.0%	18.4%	20.6%	20.3%	28.8%	19.4%	22.2%	18.8%	13.6%	19.4%	11.8%	16.9%
Upper CI	44.1%	21.0%	51.7%	23.1%	57.8%	22.1%	50.5%	21.6%	39.6%	22.1%	61.6%	20.8%

Graph 5: Rate of Vaginal Deliveries with Induction in Delivered Mothers coded with Gestational Diabetes
NPIC ID: SAMPLE



Graph 6: Rate of C-section Deliveries with Induction in Delivered Mothers coded with Gestational Diabetes
NPIC ID: SAMPLE

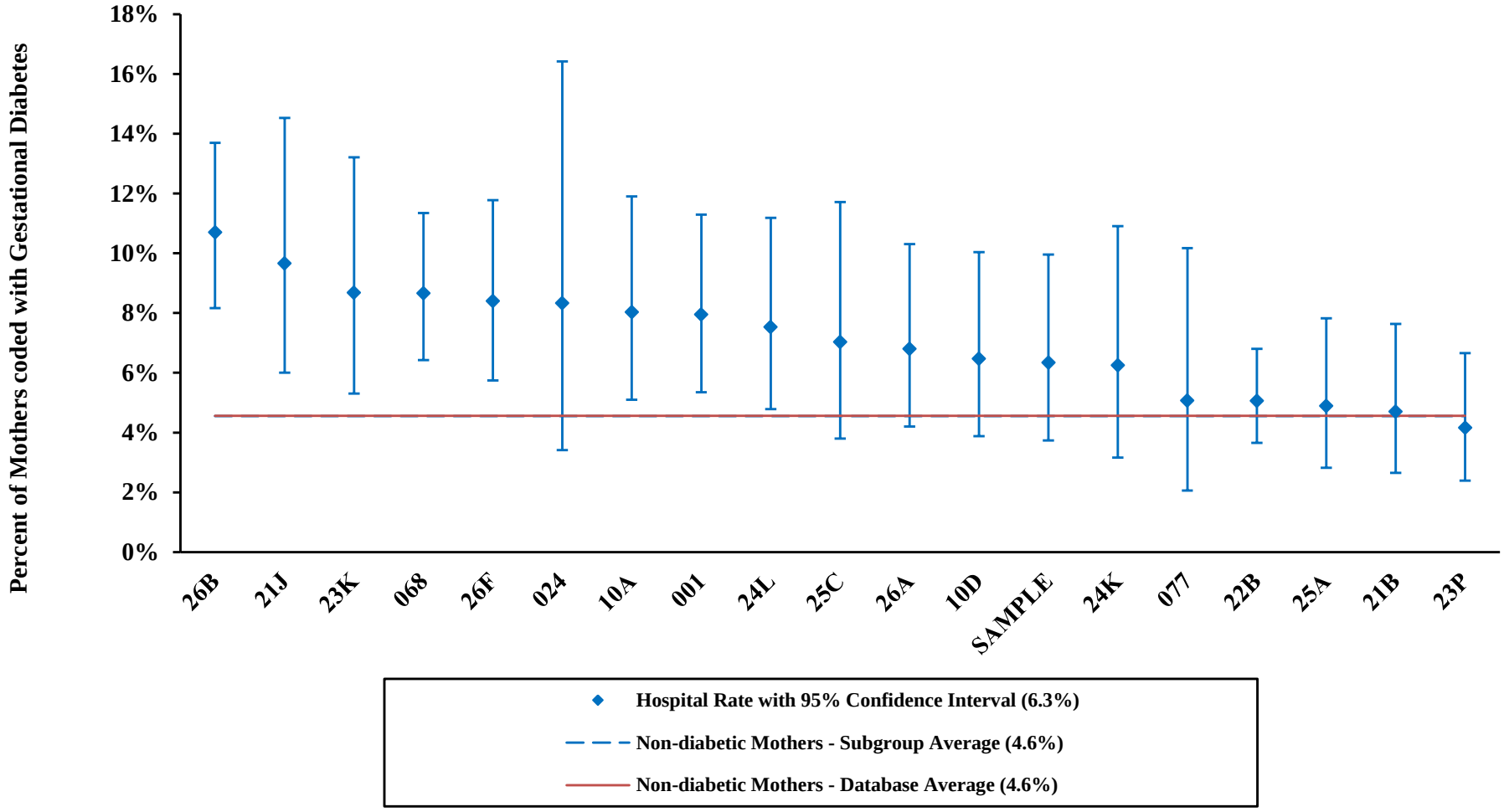


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Table 2A: Neonatal Complications

NPIC ID: SAMPLE	Gestational Diabetes Delivered Mothers coded with 648.8x (Abnormal glucose tolerance)		Pregestational Diabetes Delivered Mothers coded with 648.0x and/or 250.xx (Diabetes Mellitus)		Non-diabetic Delivered Mothers not coded with 648.8x, 648.0x, and 250.xx		All Delivered Mothers	
Total Linked Inborns	**# of Cases**	**% of Deliveries in Category**	**# of Cases**	**% of Deliveries in Category**	**# of Cases**	**% of Deliveries in Category**	**# of Cases**	**% of Deliveries in Category**
Hospital	194	72.4%	27	71.1%	2,402	74.0%	2,623	73.9%
Subgroup Average	298	95.9%	60	91.5%	3,663	94.8%	4,021	94.8%
Database Average	291	93.8%	47	90.9%	3,678	93.7%	4,017	93.7%
Neonatal Complications	**# of Cases**	**% of Category**	**# of Cases**	**% of Category**	**# of Cases**	**% of Category**	**# of Cases**	**% of Category**
Linked Inborns admitted to Special Care (ALOS) [1]								
Hospital	23 (8.4)	11.9%	7 (10.3)	25.9%	234 (18.3)	9.7%	264 (17.2)	10.1%
Subgroup Average	59 (13.1)	20.2%	25 (13.8)	41.7%	512 (16.5)	14.6%	597 (16.0)	15.4%
Database Average	58 (11.5)	20.5%	19 (12.0)	37.5%	469 (13.4)	12.9%	546 (13.2)	13.7%
Linked Inborns delivered < 37 weeks								
Hospital	14	7.2%	6	22.2%	222	9.2%	242	9.2%
Subgroup Average	49	16.6%	18	29.2%	425	12.1%	492	12.7%
Database Average	44	14.3%	14	25.0%	387	10.2%	445	10.7%
Heavy for Dates (dx code 766.1)								
Hospital	12	6.2%	2	7.4%	126	5.3%	140	5.3%
Subgroup Average	13	5.1%	5	9.2%	145	4.6%	162	4.6%
Database Average	17	6.1%	5	9.6%	193	5.0%	214	5.1%
Syndrome of "infant of a diabetic mother" (dx code 775.0)								
Hospital	22	11.3%	10	37.0%	1	0.0%	33	1.3%
Subgroup Average	44	15.7%	22	35.8%	5	0.2%	71	2.0%
Database Average	38	13.3%	16	31.7%	5	0.2%	59	1.5%

[1] Special Care discharges are those having NICU or NINT days > 0 and/or NICU or NINT charges > 0

V12.2 Special Report: Perinatal Complications associated with Gestational and Pregestational Diabetes
Table 2B: Neonatal Complications

NPIC ID: SAMPLE	Gestational Diabetes Delivered Mothers coded with 648.8x (Abnormal glucose tolerance)		Pregestational Diabetes Delivered Mothers coded with 648.0x and/or 250.xx (Diabetes Mellitus)		Non-diabetic Delivered Mothers not coded with 648.8x, 648.0x, and 250.xx		All Delivered Mothers	
Total Linked Inborns	**# of Cases**	**% of Deliveries in Category**	**# of Cases**	**% of Deliveries in Category**	**# of Cases**	**% of Deliveries in Category**	**# of Cases**	**% of Deliveries in Category**
Hospital	194	72.4%	27	71.1%	2,402	74.0%	2,623	73.9%
Subgroup Average	298	95.9%	60	91.5%	3,663	94.8%	4,021	94.8%
Database Average	291	93.8%	47	90.9%	3,678	93.7%	4,017	93.7%
Neonatal Complications	**# of Cases**	**% of Category**	**# of Cases**	**% of Category**	**# of Cases**	**% of Category**	**# of Cases**	**% of Category**
Neonatal hypoglycemia (dx code 775.6)								
Hospital	0	0.0%	0	0.0%	36	1.5%	36	1.4%
Subgroup Average	2	0.7%	1	1.3%	65	1.9%	68	1.8%
Database Average	3	1.0%	1	1.1%	63	1.6%	66	1.5%
Neonatal jaundice associated with pre-term delivery (dx code 774.2)								
Hospital	5	2.6%	5	18.5%	113	4.7%	123	4.7%
Subgroup Average	25	8.1%	10	16.1%	197	5.8%	232	6.1%
Database Average	22	6.8%	8	13.1%	179	4.7%	209	5.0%
Unspecified fetal and neonatal jaundice (dx code 774.6)								
Hospital	22	11.3%	4	14.8%	264	11.0%	290	11.1%
Subgroup Average	56	16.1%	11	18.3%	516	13.3%	584	13.6%
Database Average	52	15.6%	10	19.7%	544	13.6%	606	13.9%
Injury to brachial plexus (dx code 767.6)								
Hospital	0	0.0%	0	0.0%	2	0.1%	2	0.1%
Subgroup Average	0	0.1%	0	0.3%	3	0.1%	3	0.1%
Database Average	1	0.2%	0	0.3%	3	0.1%	4	0.1%

[1] Special Care discharges are those having NICU or NINT days > 0 and/or NICU or NINT charges > 0