**Maryland Department of
Health and Mental Hygiene**

Maryland Infant Mortality Epidemiology Work Group

Findings from Data Analysis and Overall Recommendations

August 24, 2011

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Workgroup Charge

The Maryland Infant Mortality Epidemiology Workgroup was charged with reviewing the current *Plan for Reducing Infant Mortality in Maryland* , reviewing available data on infant mortality and its risk factors in Maryland, and identifying additional opportunities to address infant mortality that are not explicitly stated in the Plan.

Workgroup Members

Diana Cheng, M.D.
Medical Director, Women's Health
Center for Maternal and Child Health
Maryland Department of Health and Mental Hygiene

Renee Ellen Fox, M.D.
Associate Professor
Division of Neonatology
Department of Pediatrics
University of Maryland School of Medicine

Bernard Guyer M.D., M.P.H.
Zanvyl Krieger Professor of Children's Health, Emeritus,
Department of Population, Family and Reproductive Health,
Johns Hopkins Bloomberg School of Public Health

Isabelle Horon, Dr.P.H.
Director
Vital Statistics Administration
Maryland Department of Health and Mental Hygiene

Lee Hurt, M.P.H.
MCH Epidemiologist
Center for Maternal and Child Health
Maryland Department of Health and Mental Hygiene

David Mann, M.D., Ph.D.
Physician Epidemiologist
Office of Minority Health and Health Disparities
Maryland Department of Health and Mental Hygiene
and
Instructor
Department of Epidemiology and Preventive Medicine
University of Maryland School of Medicine

Yolanda Ogbolu, CRNP-Neonatal, PhD
Deputy Director, Office of Global Health
Assistant Professor, Pediatric Nurse Practitioner Program
University of Maryland School of Nursing

Donna Strobino, Ph.D.
Professor
Department of Population, Family and Reproductive Health,
Johns Hopkins Bloomberg School of Public Health

Executive Summary

The Infant Mortality Epidemiology Workgroup was charged to examine the risk factors associated with infant mortality in Maryland and to identify interventions that were most likely to enhance the state's ability to achieve the goal of 10% reduction in infant mortality and to reduce the health disparities gap in infant mortality rates.

The Workgroup examined linked birth and infant death data from the Maryland Vital Statistics Administration, and data from the Maryland Pregnancy Risk Assessment Monitoring System.

It was clear from an analysis of the data that multiple strategies need to be implemented to reduce infant mortality in the state. Many of these strategies will result separately in small reductions in infant mortality, but when taken together may improve rates in the long run.

In addition, multiple strategies may need to be applied to each high risk pregnant woman in order to improve outcomes, particularly for Non-Hispanic Black mothers.

The Workgroup's review of Maryland data revealed the following risk factors to prioritize for intervention

1) **Chronic Conditions Before and During Pregnancy**
Maryland PRAMS Data
- *Hypertensive disorders during pregnancy* (11% prevalence) and *chronic hypertension before pregnancy* (4% prevalence) had the largest adverse association with very low birth weight (VLBW) and very preterm birth (VPTB) rates of any medical or behavioral factor. VLBW and VPTB rates were three times higher among NH Black than NH White women.
- Other medical conditions such as *gestational diabetes and pre-pregnancy diabetes, heart disease, obesity, and asthma* as well as **tobacco use,** *binge drinking, intimate partner violence and depression* were also associated (to lesser degrees) with infant VLBW or VPTB. As in the current state plan to reduce infant mortality, family planning (FP) visits are an opportune preconception and inter-conception time for women to be screened, treated or referred for chronic medical problems such as hypertension, diabetes, heart disease, and asthma.. Healthy behaviors such as smoking cessation and women's wellness activities are far more easily integrated into visits before pregnancy than during pregnancy.
- Consider expansion of comprehensive women's health-FP sites into other regions of the state.
- Broaden the plan to include primary care providers (PCP) who see non-pregnant women of reproductive age with chronic medical conditions. Encourage training for PCP in preconception care so that women are counseled about the impact of chronic health conditions on future pregnancies, teratogenicity of medications, folic acid supplementation, and smoking cessation.

- Facilitate access to mental health, domestic violence and substance abuse services, and encourage their use. Failure to treat common co-morbid conditions may increase the risk of adverse pregnancy outcomes, especially among women with underlying medical conditions.
- Advocate for more accessible FP services and promote reproductive planning. The prevention of pregnancy in a woman with uncontrolled medical problems (such as a diabetic woman with poor glucose control) may prevent an infant born prematurely or with a birth defect.
- Continue to reinforce a life course approach to women's health so that women enter pregnancy in a healthier state. The prevention or early management of hypertension and other disorders may be possible through proper nutrition, regular physical activity, maintenance of a healthy weight, and avoidance of tobacco and other substances.

2) Fertility Treatment *Maryland PRAMS Data*
- For 2009 births, 9% of NH White and 3% of NH Black mothers reported use of fertility treatments, including "fertility drugs" and assisted reproductive technology (ART) procedures. As the age of mothers continues to increase, use of fertility treatments may also rise.
- Further analysis of birth certificate and PRAMS data is necessary to assess the number of multiple gestations resulting from infertility treatments and to ascertain the contribution of ART and other infertility treatments to multiple gestations, infant morbidity and mortality in Maryland.

3) Infant Sleep Position, Co-sleeping, Postpartum Maternal Tobacco Use
Maryland PRAMS Data
- In 2009, 17% of NH White and 41% of NH Black mothers reported primarily placing their ***babies to sleep on their* stomachs or sides and *not on their backs***. ***Co-sleeping*** was reported by 14% of White NH and 30% of NH Black mothers. ***Postpartum smoking*** was reported by 22% of NH White and 17% of NH Black mothers.
- Include prevention activities for Sudden Infant Death Syndrome (SIDS), the leading cause of post-neonatal mortality, in the State Plan. Introduce or increase educational programs such as Baltimore City's "Safe Sleep" campaign, to other areas of the state, especially in African American communities.
- Encourage more accessible smoking cessation programs for pre-pregnancy women, pregnant women, and postpartum mothers.

4) Timing And Effectiveness of Prenatal Care *Vital Statistics data*
- Continue efforts to bring pregnant women into first trimester prenatal care, although it is not clear that poor outcomes among infants whose mothers received late or no prenatal care can be substantially reduced by prenatal care as it is currently delivered.
- Improvements in the content and EFFECTIVENESS of prenatal care, in addition to improving timing, will be required for larger reductions.
    - Home visiting programs and comprehensive prenatal care interventions that are risk-targeted can reduce rates of low birth weigh.

- o Routine prenatal care and home visitation programs delivered without regard to risk have failed to reduce low birth weight and preterm birth in numerous adequate studies to date.
- o New approaches to the management of preterm labor may change this assessment.

5) **Maternal age** *Vital Statistics data*
- Continue efforts to prevent teen pregnancy, particularly among Hispanic teens, where rates are high and where post-neonatal mortality is responsible for a larger than expected share of infant deaths.
- Contribution of this approach to sustained 10% IMR reduction is expected to be small.
- No meaningful difference in Black IMR by teen vs. young adult age.
- Therefore, there may be little to no expected benefit to Black IMR from teen pregnancy reduction alone.

6) **Prior Pre-term Birth** *Vital Statistics data*
- Mothers with a previous pre-term birth have 2 to 3 times higher infant mortality rates.
- This identifiable risk group is appropriate for inter-conception and during pregnancy interventions.

7) **Birth Hospital Level of Care, if Very Low Birth Weight (VLBW)** *Vital Statistics data*
- Approximately 10% of VLBW Maryland infants are born outside Level III hospitals.
- Birth at a non-level III hospital adds 20% to 70% to infant mortality risk, depending on race/ethnic group.
- Every effort should be made to deliver infants expected to be VLBW at level III hospitals.

8) **Early Term Deliveries (37-38 weeks gestation)** *Vital Statistics data*
- The infant mortality rate is twice as high for infants delivered at 37-38 weeks gestation (early term) compared with infants delivered at 39-41 weeks. Both medical factors and early elective deliveries are likely to be responsible for the poorer outcomes.
- Further studies should be conducted on the prevalence, circumstances and medical indications surrounding early term births.
- All Maryland hospitals with obstetrical units should prohibit non-medically indicated (elective) deliveries occurring before 39 weeks gestation.
- The prevalence of early term non-medically indicated (elective) deliveries in Maryland should be assessed.

The Workgroup had the following comments and overall recommendations regarding the _Plan for Reducing Infant Mortality in Maryland_:

The group thought that the overall approach of the Plan was sound, with its focus on preconception, pregnancy, and post-delivery health issues and its strategies of data and disparities focus, leveraging partnerships, and a comprehensive systems approach. Focusing on the counties with the highest infant mortality rate was a strategy that was enthusiastically supported by all. The group had suggestions to improve the effectiveness of those strategies.

The Workgroup had five overarching recommendations for the Plan:
1. Sustain adequate funding for this effort over the long run
2. Develop community collaboratives that can be accountable for local infant mortality outcomes.
3. Assure that programs reach the persons most in need (the 'high hanging fruit").
4. Widen the reach of programs: total resources, available hours, and geographic reach.
5. Encourage use of FIMR process to inform communities.

Other recommendations for infant mortality reduction included:

Involve other State agencies:
- Social factors such as education, race, stress and poverty are associated with infant mortality.
- This creates important roles for other State agencies beyond DHMH

Before pregnancy strategies
- A life-course approach to women's health is essential.
- Comprehensive women's health centers are a logical approach, provided that
   o   A sufficient number of such centers exist to assure reach
   o   Comprehensive services can be on site, rather than by referral

During pregnancy strategies
- The group supported improved timing of onset of prenatal care, but noted that
   o   A relatively small proportion of infant mortality is due to timing of care
- Include approaches to improving outcomes for women with early pre-natal care

After delivery strategies
- The group supported improved discharge planning for all women after delivery
- Maternal complications indicate future high risk regardless of infant outcomes

Regarding Partners
- The group noted the list of 14 partners at the end of the plan.
- The group recommends specific roles and responsibilities be assigned to partners

1. Introduction and Methods

Trends in Infant Mortality by Black or White Race

The time trend of infant mortality by Black or White race for Maryland and the US is shown in the table below:

Infant Mortality Rates, Maryland and US, by Black or White Race 1982-2009
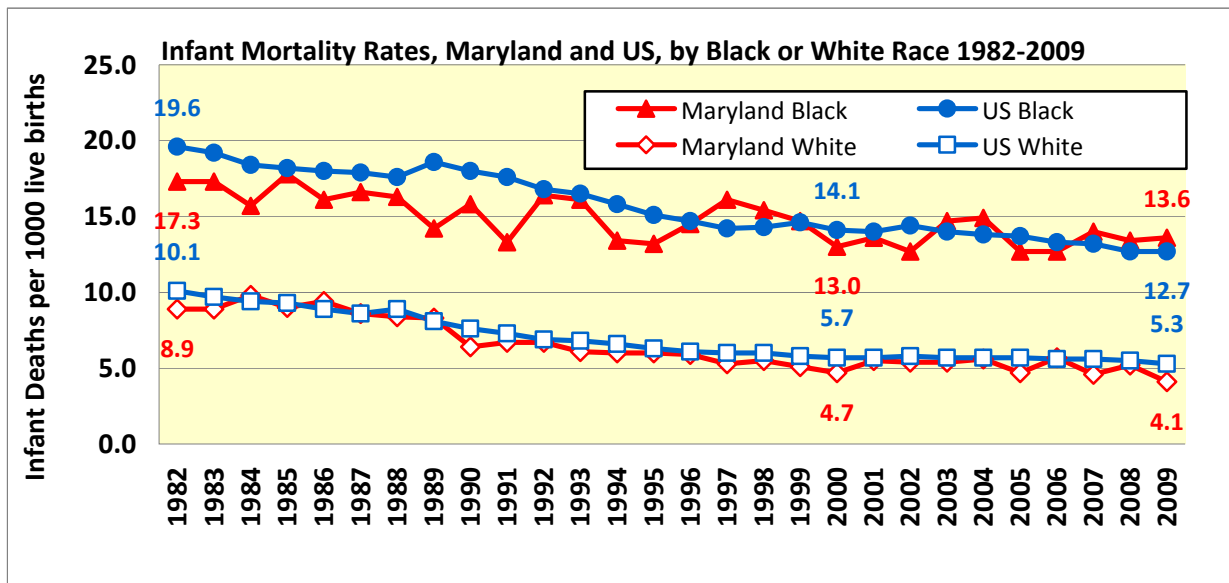
Key observations from these data include:

- From 1982 to 2000, infant mortality rates declined for all four race-geography groups.

- From 2000 to 2008, infant mortality rates showed no meaningful improvement in all groups except US Blacks.

- In 2009, Maryland had its lowest ever infant mortality rate. This was due to a very low rate among Whites.

- Maryland Blacks did not share in this 2008 to 2009 progress in infant mortality.

Data Sources for Infant Mortality Risk Factors in Maryland

Vital Statistics Data

The birth and death data used to calculate the infant mortality rates presented in this report were obtained from the linked birth/infant death files maintained by the DHMH Vital Statistics Administration. These linked files contain birth certificate data for all infants born to Maryland residents and corresponding death certificate data for infants who died before reaching one year of age.

This report examines relationships between selected maternal and infant characteristics and infant mortality for the birth cohort years 2004-2008. When calculating a birth cohort infant mortality rate, the denominator is defined as the number of infants born in a given year, and the numerator as the number of those infants who died during the first year of life. Since an infant death can occur anytime before the first birthday, deaths for a birth cohort year can occur in the birth year or in the following calendar year. In the traditional manner of calculating infant mortality, the numerator is defined as the number of infant deaths and the denominator as the number of births occurring in the same calendar year. Therefore, the two types of infant mortality rates use the same denominator data; the difference between the rates is in the numerator.

Only basic associations between maternal and infant risk factors and infant death are presented in this report. Interrelationships between risk factors are not described.

Maryland Pregnancy Risk Assessment Monitoring System (PRAMS)

PRAMS is an ongoing surveillance project of the Centers for Disease Control and Prevention (CDC) with 38 states and the New York City health departments. The Center for Maternal and Child Health and the Vital Statistics Administration work jointly to implement the Maryland PRAMS project. Every month, survey information is collected from approximately 200 women two to nine months after delivery of a live birth. The Maryland PRAMS survey includes questions about unintended pregnancy, breastfeeding, alcohol and tobacco use, violence, fertility treatment, preconception health, depression and many other factors. To obtain responses from high risk mothers, Maryland over-samples mothers 35 years of age or older at the time of delivery and those who have delivered a low birth weight infant (<2500 grams). Each mother is sent up to three surveys and then interviewed by phone if no mail surveys have been returned. Response rates were over 70% each year for 2001-2008 births and 69% for 2009 births.

The PRAMS data in this report are based on the responses of 8,040 mothers who delivered live-born infants in 2005-2009. Sampling, non-response and non-coverage adjustments are applied to the data in order to make the results generalizable to Maryland women delivering a lie birth in the state during the study period. PRAMS data are retrospective and subject to recall error. Data are also based on the mother's perceptions of events and may not be completely accurate.

Approach to Risk Factor Assessment

The approach taken to review the various risk factors for adverse pregnancy outcomes and infant mortality was to examine the prevalence of the risk factor, the additional risk associated with presence of the risk factor, in categories of race and ethnicity.

Where the data exist in the Vital Statistics Administration birth and death certificate database, that source was used to determine the prevalence of that risk factor in Maryland, by race and ethnicity. Infant mortality rates associated with the presence or absence of the risk factor (or in some cases, with various levels of the risk factor) were determined in categories of race and ethnicity.

For risk factors where data were unavailable from Vital Statistics, the PRAMS database was examined to estimate the prevalence of those risk factors in Maryland, by race and ethnicity. Since the PRAMS database does not include complete infant mortality data, we used very low birth weight rates (<1500 grams) and very preterm birth rates (<32 weeks gestation) as the adverse pregnancy outcome to associate with the presence or absence (or in some cases, with various levels) of the risk factor, in categories of race and ethnicity. The number of responses from Asian and Hispanic mothers was small for many of the risk factors examined. Therefore, the data for Asian and Hispanic mothers is presented only where the prevalence for the risk factor was high or where there were sufficient numbers to show that the risk factor was associated with VLBW or VPTB for that population.

Where the association of a risk factor with adverse outcomes appeared clear in the data, was supported in the literature, and had opportunities for intervention, those risk factors were classified as ones to prioritize for intervention and are reported on in detail.
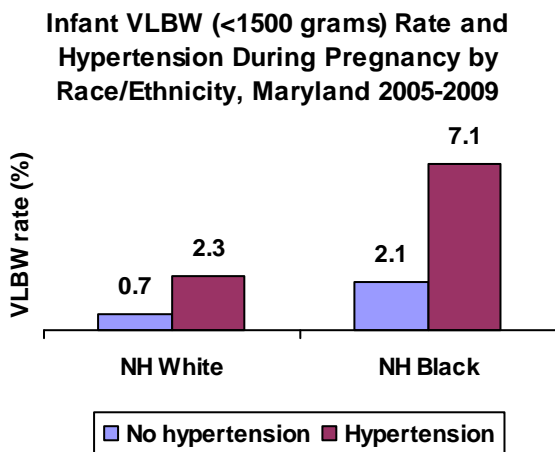
2. Risk Factors to Prioritize for Intervention

Pre- and/or During Pregnancy Maternal Conditions

Maternal Hypertension

Hypertension during Pregnancy

PRAMS Survey: "Did you have high blood pressure, hypertension (including pregnancy-induced hypertension, preeclampsia, or toxemia) during the most recent pregnancy?"

| Prevalence: | NH White ('05-'08) = 11.7% | ('09) = 8.6% |
| | NH Black ('05-'08) = 12.8 % | ('09) = 16.2% |

Infant VLBW (<1500 grams) Rate and Hypertension During Pregnancy by Race/Ethnicity, Maryland 2005-2009

A major contributing factor to preterm birth is preeclampsia/eclampsia and related hypertensive complications of pregnancy which frequently require very early delivery.

The very low birth weight (VLBW) rate for infants of NH Black women with prenatal hypertension was over three times the rate for NH Black mothers without hypertension (7.1% vs. 2.1%) and over three times the rate for NH White mothers with hypertension (7.1% vs. 2.3%). The very preterm birth (VPTB; <32 weeks gestation) rate among NH Black mothers with hypertension was 6.9% compared with

2.1% for among NH White mothers. In 2009, approximately 11% of Maryland mothers (n~8,250 mothers) reported they were hypertensive during pregnancy, including 9% of NH White and 16% of NH Black women. The prevalence of hypertension during pregnancy decreased 26% in 2009 among NH White mothers; it increased 27% among NH Black mothers compared to 2005-2008.

[Note: Seven percent of Hispanic mothers who delivered in 2009 reported hypertension during pregnancy; 10.5% had VLBW infants – even higher rates than among NH Black mothers. Four percent of Asian mothers reported hypertension during pregnancy, 4.8% had VLBW infants.]

Hypertension before Pregnancy

PRAMS Survey: "During the 3 months before you got pregnant with your new baby, did you have hypertension?"

Prevalence: NH White ('05-'08) = 2.4%   ('09) = 3.1%
NH Black ('05-'08) = 3.9%   ('09) = 5.7 %

Infant VLBW (<1500 grams) Rate and Hypertension Before Pregnancy by Race/Ethnicity, Maryland 2005-2009
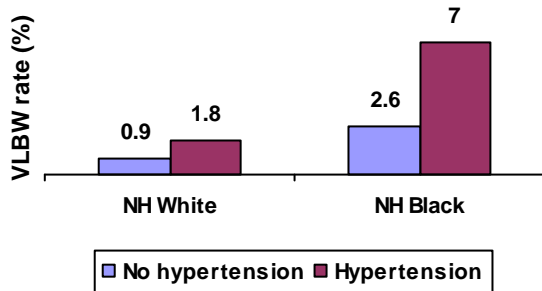
The VLBW rate among NH Black women who reported they had hypertension before pregnancy was 2.7 times the rate for NH Black women who did not report hypertension (7.0% vs. 2.6%) and nearly four times the rate of NH White women with hypertension before pregnancy (7.0% vs. 1.8%). Approximately 3% of mothers (~2,250 mothers) reported they were hypertensive before pregnancy, including 3% of NH White mothers and 6% of NH Black mothers. Compared to 2005-2008 rates, the prevalence of chronic hypertension increased 29% in 2009 among NH White and 72% among NH Black women.

Maternal Diabetes

Diabetes before Pregnancy

PRAMS Survey: "Did you have high blood sugar (diabetes) that started before this pregnancy?"/ "Before you got pregnant with your new baby, were you told by a doctor, nurse or health care provider that you have Type 1 or Type 2 diabetes?"

Prevalence:	NH White ('05-'08) = 0.8%	('09) = 1.9%
	NH Black ('05-'08) = 1.7%	('09) = 1.8%

Infant VLBW (<1500 gms) Rate and Diabetes Before Pregnancy by Race/Ethnicity, Maryland 2005-2009
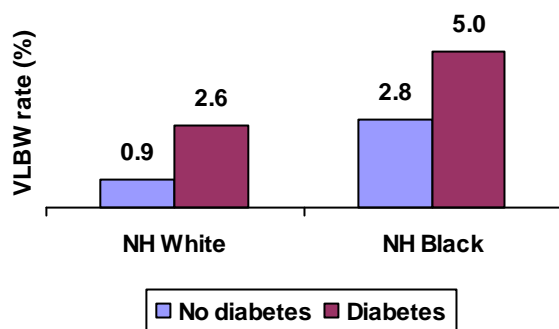
The VLBW rate among NH White and NH Black mothers who reported they had diabetes before pregnancy was nearly twice the rate for mothers who did not report diabetes. Nearly 2% of NH White and Black mothers (~1,500 mothers) reported they had diabetes before pregnancy. Compared to 2005-2008 rates, the prevalence of diabetes nearly doubled in 2009 among NH White mothers and increased 6% among NH Black mothers.

Diabetes during Pregnancy (Gestational Diabetes)

PRAMS Survey: "During your most recent pregnancy, were you told by a doctor, nurse or health care provider that you had gestational diabetes (diabetes that started during this pregnancy)?"

Prevalence:	NH White ('05-'08) = 6.7%	('09) = 9.0%
	NH Black ('05-'08) = 9.8%	('09) = 8.0%

Infant VPTB (<32 weeks) Rate and Diabetes during Pregnancy by Race/Ethnicity, Maryland 2005-2009
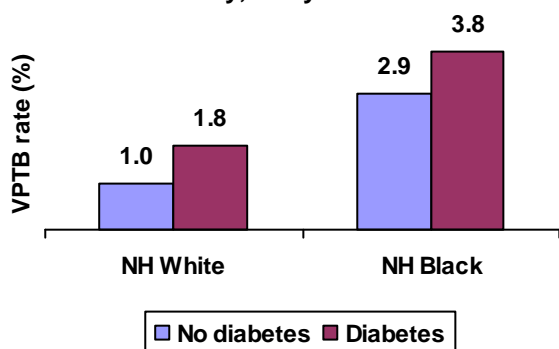
The VPTB rate among NH White and NH Black mothers who reported gestational diabetes was 2.9 and 1.8 times the rate respectively for White and Black mothers who did not report gestational diabetes. Ten percent of Maryland mothers (~7,500 mothers) reported they had gestational diabetes. [Note: 18% of Asian mothers reported they had gestational diabetes – more than any other racial/ethnic group.]

Maternal Tobacco Use

Tobacco Use before and during Pregnancy
PRAMS Survey: "In the 3 months before you got pregnant, how many cigarettes did you smoke in an average day?" "In the last 3 months of your pregnancy, how many cigarettes did you smoke in an average day?"

Prevalence (before): NH White ('05-'08) = 25%   ('09) = 22%
                      NH Black ('05-'08) = 13%   ('09) = 17%

Prevalence (during): NH White ('05-'08) = 14%   ('09) = 13%
                      NH Black ('05-'08) = 8%   ('09) = 8%

Infant VPTB (<32 weeks) Rate and Tobacco Use During Pregnancy by Race/Ethnicity, Maryland 2005-2009

The respective VPTB rate among NH White and NH Black mothers who reported tobacco use during pregnancy was 1.9 and 1.6 times the rate for NH White and Black mothers who did not smoke. Nine percent of Maryland mothers (~6,750 mothers) reported they smoked during pregnancy.

Mothers who reported that they smoked during the 3 months just before pregnancy most likely smoked during early pregnancy until the time of pregnancy confirmation. The VPTB rates are similar to rates of mothers who smoked during pregnancy.

Other Factors

Intimate partner violence, binge drinking during pregnancy and *pre-pregnancy factors such as BMI <18.5 (underweight), BMI ≥30 (obese), asthma, depression, and anxiety*—all were found to be associated with VLBW or VPTB among NH White or NH Black women when compared to women without the corresponding risk factors. For example, the VPTB rate among NH Black mothers who reported they were obese (prevalence=25%) or underweight (prevalence = 3%) before pregnancy was 1.4 times higher than normal weight mothers (3.8 and 3.9 vs. 2.8 respectively); and the VPTB rate was over two time higher among NH Black mothers who reported binge drinking during pregnancy (prevalence = 1%) compared with NH black mothers who did not binge drink (6.5 vs. 3.1). The VPTB rate of NH White women who reported intimate partner violence during pregnancy (prevalence=3%) was over two times the rate (2.4 vs. 1.1) of NH White women who did not report violence. [Note: the VLBW rate among Asian mothers who reported that they were obese before pregnancy (prevalence = 5.4%) was four times higher than Asian mothers who were normal weight (3.2% vs. 0.8%)].
See Table in appendix.

Fertility Treatments

PRAMS Survey: "Did you take any fertility drugs or receive any medical procedures from a doctor, nurse, or other health care worker to help you get pregnancy with your baby?"

Prevalence: NH White ('05-'08) = 6.8%   ('09) = 8.7%
                        NH Black ('05-'08) = 2.3%   ('09) = 2.6%

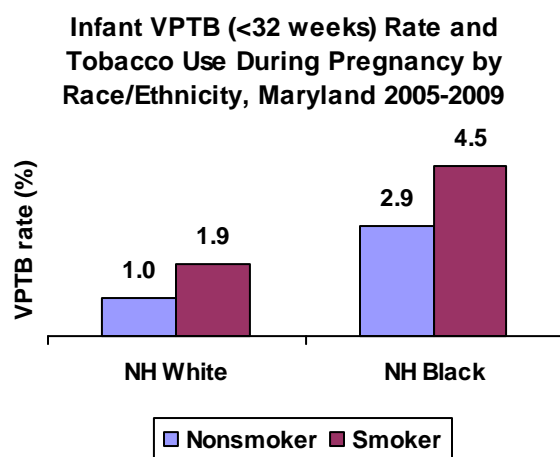**Infant VLBW (<1500 gms) Rate and Fertility Treatments by Race/Ethnicity, Maryland 2005-2009**
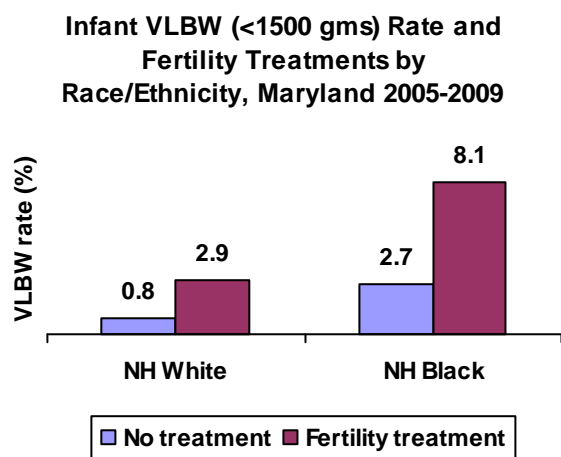
Fertility treatments, including fertility drugs and assisted reproductive technology procedures, generally increase the risk of multiple gestations. Multiple gestation is related to about a 3-fold increase in VLBW infants for NH White and Black mothers compared to women not using fertility treatments. NH Black women using fertility treatments are 2.8 times more likely to deliver a VLBW infant than NH White women using fertility treatments.
[Note: 10% of Asian mothers reported the use fertility treatments, more than any other racial/ethnic group.]

Post Partum Factors

Infant Sleep Position, Co-Sleeping, Maternal Tobacco Use

PRAMS Survey: "In which position do you most often lay your baby down to sleep?"
Prevalence (not on back):   NH White ('05-'08) = 21%   ('09) = 17%
                             NH Black ('05-'08) = 45%   ('09) = 41%

PRAMS Survey: "How often does your new baby sleep in the same bed with you or anyone else?" ('09 data only)
Prevalence (always/often- yes):   NH White ('09) = 14%
                                       NH Black ('09) = 30%

PRAMS Survey: "How many cigarettes do you smoke on an average day now?"
Prevalence (smokes):   NH White ('05-'08) = 19%   ('09) = 18%
                            NH Black ('05-'08) = 12%   ('09) = 14%

We did not have information about Sudden Infant Death Syndrome (SIDS) in PRAMS data and therefore present only prevalence data for selected factors. Placing infants to sleep on the stomach or side, allowing infants to sleep with someone else in the same bed, and exposing infants to cigarette smoke are predisposing factors related to sudden infant death syndrome (SIDS). Despite improvement in the percentage of NH Black mothers not placing their infants to sleep on their backs, it is still more than double that of the NH White rate (41% vs. 17%); co-sleeping is common (30%), and postpartum maternal tobacco use is increasing. The SIDS prevention interventions targeting Black mothers remain important.

[Note: For 2009 births, 55% of Asian mothers and 20% of Hispanic mothers reported co-sleeping; 23% of Asian mothers and 25% of Hispanic mothers reported that they did not place their infants to sleep on their backs.]

Timing of Onset of Prenatal Care

Starting prenatal care early in pregnancy provides the opportunity to identify and intervene on certain pre-existing maternal risk factors, to counsel the woman regarding nutrition, to provide prenatal vitamin supplementation, and to monitor for pregnancy related complications. If all other factors are equal, earlier onset of prenatal care should be associated with better outcomes (less prematurity, higher birth weights, and lower infant mortality).

Prevalence of Late Onset of Prenatal Care

Onset of pre-natal care data are obtained from birth certificates, and prenatal care onset is reported as first trimester, second trimester, third trimester, no care, or not stated. The table and chart below show the distribution this timing of the onset of prenatal care by race/ethnicity.

**Distribution of Births by Onset of Prenatal Care,
Race and Hispanic Origin**
Maryland Vital Statistics, 2004-2008 birth cohorts combined

	All Race/Ethnicity	NH White	NH Black	Hispanic
First	80.2%	88.4%	73.5%	63.2%
Second	14.1%	8.6%	18.1%	26.4%
Third	2.9%	1.6%	4.0%	5.3%
No care	1.3%	0.6%	2.2%	2.3%
Not stated	1.5%	0.8%	2.1%	2.8%

Distribution of Births by Onset of Prenatal Care, Race and Hispanic Origin, Marryland 2004-2008 Combined
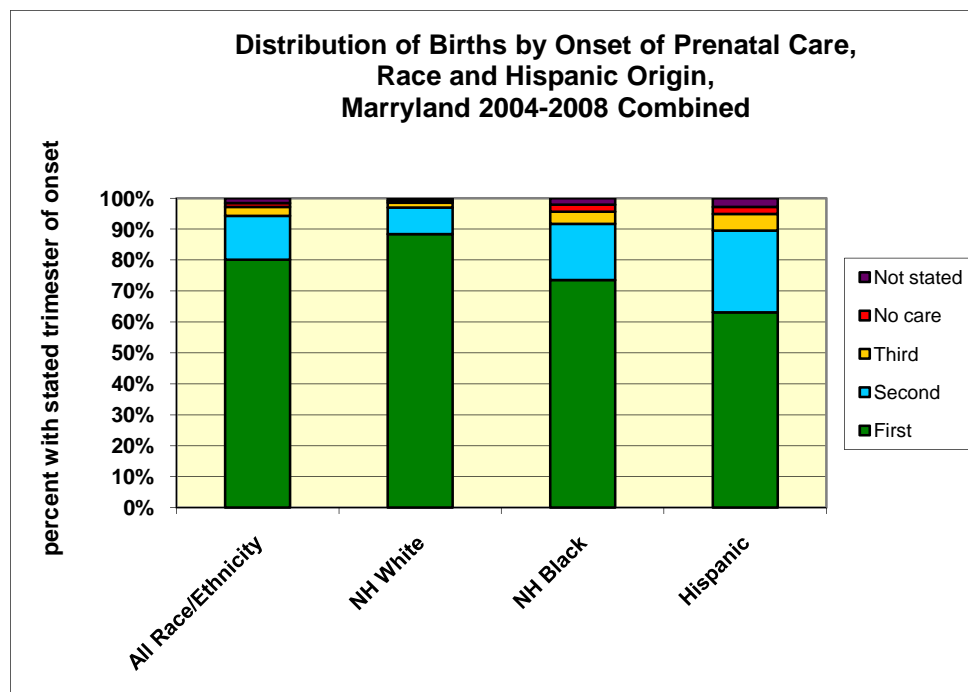
Most women, regardless of racial or ethnic group, have first or second trimester onset of prenatal care. First trimester onset of prenatal care is highest for Non-Hispanic Whites, lower for Non-Hispanic Blacks, and lowest for Hispanics.

Observed Risks Associated with Late Onset of Prenatal Care

The infant mortality outcomes associated with these times of onset of prenatal care, by race/ethnicity groups, are given the table below:

Infant Mortality Rates by Trimester Prenatal Care Began,
Race and Hispanic Origin
Maryland Vital Statistics, 2004-2008 birth cohorts combined
(deaths per 1000 live births)

	All	NH White	NH Black	Hispanic
First	6.9	4.6	12.2	4.6
Second	6.9	6.9	8.9	3.7
Third	5.7	6.4	7.1	2.0
No care	35.9	31.6	43.1	22.9
Not stated	33.0	30.4	40.8	20.9

Some of these outcome results are counter-intuitive: why should second trimester onset of care appear better than first trimester onset for Non-Hispanic Blacks and Hispanics and why should third trimester care onset appear superior to second trimester onset? These patterns are most likely due to selection biases and confounding inherent in public health surveillance data and which are not easily removed.

For Non-Hispanic Blacks and Hispanics, where access to care is more limited, perhaps it is women at high risk, or who are already experiencing some pregnancy difficulty, who begin care in the first trimester. This selects a first trimester group that is higher risk to begin with. In order to start care in the third trimester, the pregnancy must have reached 26 weeks, and thus by definition some very premature births can't happen in this group.

For Non-Hispanic Blacks, the infant mortality rate of 12.2 for first trimester onset of care is nearly as high as the overall Non-Hispanic Black infant mortality rate (12-14 depending on year). This suggests that whatever the issues are that cause the high risk in Non-Hispanic Black women, early onset of prenatal care does not appear to be a sufficient solution.

For no care and for care not stated, infant mortality rates are up to 5 times higher than for first trimester onset of care. Clearly this identifies a very high risk group. What is not clear is whether the elevated risk comes from the absence of prenatal care, or if it comes from other risk factors associated with not getting care, but that cannot be effectively modified by early care.

Caveats and Recommendations

The Department should continue its efforts to bring pregnant women into first trimester prenatal care, while recognizing the limitations of this approach. For the highest risk groups (NH Black women and women with no care), it is not clear that the issues causing their very high risk can be resolved by prenatal care as currently delivered. It is also important to note that only 20% of NH White and 25% of NH Black infant mortality occurs among infants born to mothers who started prenatal care after the first trimester. Since early prenatal care won't reduce the risk for these women to zero, and since the expected reduction in prevalence of late care during the period of the Plan may be in the range of 10%, the expected short term impact of intervention in this area could be about 1% to 2% reduction in infant mortality.

Improvements in the EFFECTIVENESS of prenatal care, in addition to improving the timing of it, will be necessary to make larger impacts on infant mortality rates.

- There is evidence that comprehensive prenatal care for low income women may reduce LBW rates, assuring that women with medical risk and complications receive appropriate care; and that targeting home visiting to women with medical risk and at social and psychosocial risk may improve low birth weight rates.

- By contrast, routine prenatal care alone and routine home visiting regardless of risk has failed to improve LBW or preterm birth rates in numerous adequate studies to date.

- There are, however, emerging approaches to identify diagnose, and treat preterm labor which could improve the impact of routine prenatal care.

Maternal Age

Infant mortality rates vary by maternal age. Generally, women aged 20 to 34 have lower risk for infant mortality, while women younger than this age range generally have higher risk for infant mortality, and women older may have higher risk depending on race/ethnicity.

Prevalence of Young or Old Maternal Age

Maternal age data are obtained from birth certificates, and reported by age groups as shown in the table and chart below, which shows the distribution of maternal age by race/ethnicity.

**Distribution of Births by Maternal Age,
Race and Hispanic Origin**
Maryland Vital Statistics, 2004-2008 birth cohorts combined

	All Race/Ethnicity	NH White	NH Black	Hispanic
<16 years	0.5%	0.2%	1.0%	0.7%
16-17 years	2.4%	1.4%	3.9%	3.2%
18-19 years	5.8%	4.1%	8.8%	6.7%
20-24 years	20.7%	17.1%	25.9%	27.1%
25-34 years	51.9%	55.2%	45.0%	50.0%
35-39 years	15.0%	17.7%	12.0%	9.7%
40+ years	3.8%	4.3%	3.3%	2.6%

Distribution of Births by Maternal Age, Race and Hispanic Origin, Maryland 2004-2008
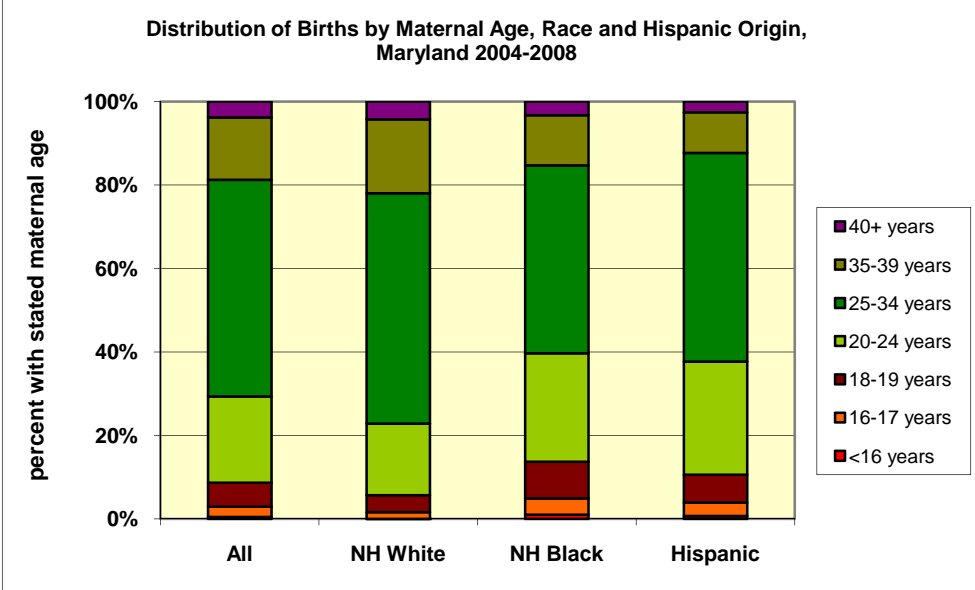
Approximately three-quarters of all births are born to mothers between 20 and 34 years of age. The highest percentage of births to older women occurs among Non-Hispanic Whites, while the highest percentage of births to teens occurs among Non-Hispanic Blacks.

Observed Risks Associated with Maternal Age

Infant mortality rates by maternal age group, race and Hispanic origin are given in the table below:

Infant Mortality Rates by Maternal Age Stratified by Race and Hispanic Ethnicity *Maryland Vital Statistics, 2004-2008 birth cohorts combined*			
All Race/Ethnicity	**NH White**	**NH Black**	**Hispanic**
<16 years 14.0	14.0	12.7	17.9
16-17 years 10.2	7.2	10.7	13.1
18-19 years 9.2	6.8	11.6	6.3
20-24 years 8.6	6.9	12.4	3.5
25-34 years 6.7	4.4	12.1	4.7
35-39 years 7.8	5.1	15.4	6.5
40+ years 9.7	6.0	16.6	9.0

For Non-Hispanic Whites, dramatically higher risk is seen in the youngest age group, while there is less additional risk in the older ages. For Non-Hispanic Blacks, the lowest risk is paradoxically seen for ages 16-17, and the highest risks at ages 35 and older. For Hispanics, there is a strikingly higher risk in the two youngest age groups, as well increased risk in the two oldest age groups.

These observed differences in risk undoubtedly include selection biases and confounding inherent in public health surveillance data and which are not easily removed. For example, there is no reason to think that women age 20-24 are less fit for pregnancy than women 25-34, yet Non-Hispanic White risk is higher for the younger group. This likely represents the effects of lower socio-economic status (SES), which is more likely to be present in the group of age 20-24. The elevated risk seen at even younger ages may represent combinations of SES differences and actual age-related issues of fitness for pregnancy.

Infant mortality rates were relatively high for the two youngest age groups for Non-Hispanic Whites and in particular for Hispanics. The rates for these young ages were not different from young adults for Non-Hispanic Blacks, who show double digit rates across all age groups.

Caveats and Recommendations

The Department should continue its efforts to prevent teen pregnancy, particularly in Hispanic teens, while recognizing the limitations of this approach. The highest risk group (age < 18) represents 1.6% and 3.9% of NH White and Hispanic live births respectively, and accounts for perhaps 1.5% of NH White, and 7% of Hispanic infant deaths. Given that Hispanic infant deaths are only about 0.5% of Maryland infant mortality, the contribution of teen pregnancy reductions to reaching the Governor's goal of sustained 10% reduction in Statewide infant mortality is likely to be small.

The lack of a meaningful difference in infant mortality rates between NH Black teens under age 18 and NH Black women 20 to 34 years of age calls into question whether reducing NH Black teen pregnancy will have any beneficial effect on NH Black infant mortality. This is the first statement of what will be a recurring theme in this report: that the NH Black infant mortality is unacceptably high in what should be the "low risk" groups. Progress in reducing NH Black infant mortality will depend on reducing the infant mortality rate among "low risk" women.

Prior Pre-term Birth

Prevalence of Prior Pre-term Birth

Prior pre-term birth data come from birth certificates, and the table below shows its distribution by race/ethnicity.

Distribution of Births by Prior Pre-term Delivery, Race and Hispanic Origin
Maryland Vital Statistics, 2004-2008 birth cohorts combined

	All Race/Ethnicity	NH White	NH Black	Hispanic
No	99.0	98.9	98.9	99.5
Yes	1.0	1.1	1.1	0.5

Mothers with a history of a previous pre-term birth represent only about 1% of Maryland live births. Because the risk factor is so rare, interventions in this risk group, while advisable, will have a small impact on overall Maryland infant mortality.

Observed Risks Associated with Prior Pre-term Birth

The infant mortality outcomes associated with presence or absence of a history of prior preterm birth, by race/ethnicity groups, is given the table below:

Infant Mortality Rates by Prior Pre-term Birth Stratified by Race and Hispanic Ethnicity
Maryland Vital Statistics, 2004-2008 birth cohorts combined

	All Race/Ethnicity	NH White	NH Black	Hispanic
No	7.5	5.1	12.3	5.1
Yes	23.3	11.8	40.1	16.5

History of prior pre-term birth is associated with a two- to three-fold higher infant mortality rate compared to no such history. This represents an identifiable high risk group that is appropriate for targeting with effective inter-conception and during pregnancy interventions.
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Level of Care in Hospital of Birth, if Very Low Birth Weight

Prevalence of Non-Level III Birth among Very Low Birth Weight Babies

Data on the percentage of VLBW infants delivered in non-level III hospitals come from birth certificates. The table below shows the distribution of these births by race/ethnicity.

Very Low Birth Weight Babies Only:
Distribution of Births by Level of Care in Birth Hospital,
Race and Hispanic Origin
Maryland Vital Statistics, 2004-2008 birth cohorts combined

	All Race/Ethnicity	NH White	NH Black	Hispanic
Level III	91.0%	89.4%	91.6%	91.5%
Not Level III	9.0%	10.5%	8.4%	8.5%

Nine percent of all VLBW infants are born in non-level III hospitals. This figure is slightly higher for NH White infants than for NH Black or Hispanic infants.

Observed Risks Associated with Non-Level III Birth among Very Low Birth Weight Babies

The infant mortality rates associated with non-level III birth of VLBW babies by race/ethnicity groups are given in the table below:

Very Low Birth Weight Babies Only:
Infant Mortality Rates by Level of Care in Birth Hospital
Stratified by Race and Hispanic Ethnicity
Maryland Vital Statistics, 2004-2008 birth cohorts combined

	All Race/Ethnicity	NH White	NH Black	Hispanic
Level III	249.7	225.4	266.3	224.8
Not Level III	387.4	330.2	450.5	272.7

The infant mortality rates for all VLBW infants are strikingly high. In this high risk pool, the NH Black to NH White rate ratio is rather small: 1.18 for births at a level III hospital. Birth at a non-level III hospital adds 20% to 70% to the risk of infant death depending on race/ethnic group: infant mortality rates are particularly high among Non-Hispanic Black infants.

Every effort should be made to deliver infants expected to be very low birth weight at level III hospitals.

Gestational Age at Time of Birth

Infants born at 37-41 weeks of completed gestation are considered to be term. Nevertheless, mortality rates are substantially higher among infants born at 37-38 weeks gestation than among infants born at 40-41 weeks gestation. The higher mortality rates among infants born at 37-38 weeks gestation may be explained in part by medical factors related to the mother and/or infant. However, elective deliveries prior to 39 weeks gestation may also be associated with poorer outcomes.

Overall, the infant mortality rate is twice as high for infants delivered at 37-38 weeks gestation compared with infants delivered at 39-41 weeks. Both neonatal and postneonatal mortality rates are higher among the early term births. This relationship exists for NH White, NH Black and Hispanic infants.

Infant, Neonatal and Postneonatal Mortality Rates by Gestational Age, Race and Hispanic Origin, Maryland, 2004-2008 Birth Cohorts.		
Race, Hispanic origin and gestational age (wks.)	Mortality rate per 1000 live births	
	Infant Neonatal Postneonatal	
Total		
37-38	3.0	1.3	1.7
39-41	1.5	0.5	1.0
White non-Hispanic		
37-38	2.8	1.3	1.5
39-41	1.4	0.5	0.9
Black non-Hispanic		
37-38	3.7	1.4	2.4
39-41	1.9	0.6	1.4
Hispanic		
37-38	2.0	1.1	0.9
39-41	1.2	0.4	0.7

Caveats and Recommendations

- Further studies should be conducted on the prevalence, circumstances and medical indications surrounding early term births in Maryland.
- All Maryland hospitals with obstetrical units should prohibit non-medically indicated (elective) deliveries occurring before 39 weeks gestation.

3. Summary and Conclusions from Data Analysis

The Infant Mortality Epidemiology Workgroup was charged to examine the risk factors associated with infant mortality in Maryland and to identify interventions that were most likely to enhance the state's ability to achieve the goal of 10% reduction in infant mortality and to reduce the health disparities gap in infant mortality rates.

The Workgroup examined linked birth and infant death data from the Maryland Vital Statistics Administration, and data from the Maryland Pregnancy Risk Assessment Monitoring System.

It was clear from an analysis of the data that multiple strategies need to be implemented to reduce infant mortality in the state. Many of these strategies will result separately in small reductions in infant mortality, but when taken together may improve rates in the long run.

In addition, multiple strategies may need to be applied to each high risk pregnant woman in order to improve outcomes, particularly for Non-Hispanic Black mothers. Attention to one risk factor for a mother who has multiple risk factors may be disappointing in terms of outcomes: addressing her entire set of risk factors is necessary. Solutions may include providing a complete package of interventions to a small group of high risk women along with delivering a single intervention to a larger group of high risk women.

The Workgroup recommends the following opportunities (with caveats) for intervention

1) **Chronic Conditions Before and During Pregnancy**
- *Hypertensive disorders during pregnancy* and ***chronic hypertension before pregnancy***
- Other medical conditions such as ***gestational diabetes and pre-pregnancy diabetes, heart disease, obesity, and asthma*** as well as ***tobacco use***, ***binge drinking, intimate partner violence and depression***

2) **Fertility Treatment**

3) **Infant Sleep Position, Co-sleeping, Postpartum Maternal Tobacco Use**

4) **Timing and Effectiveness of Prenatal Care**

5) **Maternal age**

6) **Prior Pre-term**

7) **Birth Hospital Level of Care, if Very Low Birth Weight (VLBW)**

8) **Early Term Deliveries (37-38 weeks gestation)**

4. Overall Recommendations Regarding the *Plan for Reducing Infant Mortality in Maryland*

The group thought that the overall approach of the Plan was sound, with its focus on preconception, pregnancy, and post-delivery health issues and its strategies of data and disparities focus, leveraging partnerships, and a comprehensive systems approach. Focusing on the counties with the highest infant mortality rate was a strategy that was enthusiastically supported by all. The group had suggestions to improve the effectiveness of those strategies.

The Workgroup had five overarching recommendations for the Plan:

- Sustain adequate funding for this effort over the long run
- Develop community collaboratives that can be accountable for local infant mortality outcomes.
- Assure that programs reach the persons most in need (the 'high hanging fruit").
- Widen the reach of programs: total resources, available hours, and geographic reach.
- Encourage use of FIMR process to inform communities.

Sustain the effort

The group observed that the State's prioritization and consequent allocation of resources for improving pregnancy outcomes and reducing infant mortality tends to wax and wane over time. Prioritization and resources need to be sustained over time.

Accountable community collaboratives

The group felt that intervention efforts need to focus on the populations in neighborhoods and also felt that communities should be engaged and supported in efforts to take responsibility for their outcomes. They felt this would be best accomplished by developing local community collaboratives that can be accountable for birth outcomes and infant mortality rates.

Reach those most in need and have sufficient scope and reach

The observation was made that many small-scale intervention programs report excellent outcomes for the participants who complete the program, and yet the overall statistics for the jurisdiction remain unchanged. This may indicate a selection bias in that the persons who chose to participate and who remain to completion may be the healthiest subset of the target population. Thus the excellent results observed may not be that different from what this healthy subset would experience even without the program. The other implication of this observation is that effective programs, if too small in scale and not sustainable, cannot impact jurisdiction-level statistics.

Programs must increase their efforts to impact the most at risk, hardest to reach parts of the population, who have the most barriers to good outcomes. Programs must also have sufficient scope and reach: wide hours of availability of services, accommodation of transportation barriers, a wide geographic presence, and enough capacity to reach a meaningful proportion of the population at highest risk.

The role of other State agencies

Social factors such as education, race, stress and poverty are associated with infant mortality. Therefore, other State agencies that can beneficially impact education, employment, housing, community safety, community planning and community resources also have an important role to play in infant mortality prevention.

Regarding the three time-specific strategies in the Plan, the group had additional comments.

Before pregnancy strategy

A life-course approach to women's health was viewed as a critical adjunct to preconception, inter-conception, and prenatal health. Comprehensive women's health care begun early in life, regardless of pregnancy intention or status, will ultimately ensure good health through future pregnancies and beyond.

The group supported the transition of centers from family planning to comprehensive women's health centers. This was seen as a logical entry point for women into the system. Two considerations were offered for this strategy. One was to have a sufficient number of such centers converted to assure reach. This would include involving family planning entities in the evolution toward including a wider range of services. The second was to consider whether some services identified in the course of providing family planning services could be provided onsite, rather than requiring a referral outside the center.

During pregnancy strategy

While the group supported any efforts to improve the timing of onset of prenatal care the group recognizes that a relatively small proportion of Maryland infant mortality is due to adverse timing of care entry. The group recommends that the during pregnancy strategy also include approaches to improving the birth outcomes of women with early pre-natal care onset. An illustration of this need is that in 2007 to 2008 Maryland data, the IMR for Black women with first trimester prenatal care was still 12.0. Two factors may limit the impact of prenatal care: First, the prenatal care office visit provides assessment and treatment planning; however, patients may have barriers to faithfully following the treatment plan. Second, while pregnant women receive important screening and care during their prenatal visits, any referrals made for specialty care must be coordinated and followed up by the woman. She may experience difficulties scheduling or accessing this specialty care.

With this in mind, the group felt that for the during pregnancy strategy, the Plan could be more explicit about supporting pregnant women's self-care at home with navigators, home visitation services, and meaningful case management. The group felt that in particular the Plan might address the provision of these services to pregnant Medicaid enrollees by their MCO providers. The plan should also explore ways to facilitate the exchange of information between community home visiting agencies and private clinicians. Screening for depression, anxiety and stress was felt to be an important component of the during pregnancy approach. The group also wanted to be sure that high risk women had access to fetal-maternal medicine specialists. Finally, the group emphasized the need for very low birth weight infants to be delivered at hospitals with appropriate levels of neonatal care capacity.

After delivery strategy

The group supported the idea of improved discharge planning for all women after delivery, especially women with a poor pregnancy outcome. The group noted that all of the services mentioned under this strategy are important for all women regardless of birth outcome. The group felt that in addition to adverse outcomes for the child, a mother experiencing pregnancy complications even with a good outcome for the child should be considered high risk for future problems. The group saw an opportunity in this time period to connect women with family planning services and close the loop back to pre-conception (now inter-conception) health, and to promote appropriate inter-pregnancy intervals. Screening for post-partum depression was identified as an important issue at this time. Finally, the group saw the opportunity to link these post-delivery services with the well baby care process.

Regarding Partners

The group noted the list of 14 partners at the end of the plan. The group wondered what specific roles and responsibilities the various partners have in implementing the plan. The designation of such roles and responsibilities would serve to define what partnership means in this context. Being a partner should go beyond just being "someone we talk to" and should evolve to include partner-specific action steps to implement the plan.

In summary, the group was in agreement with the overall focus and strategies of the Plan, and had some overarching recommendations, and several period-specific suggestions to bring more specificity to the pre-pregnancy, during pregnancy, and post-deliver strategies.

APPENDIX

Maryland PRAMS Data, 2004-2008

Prevalence of Infant Very Low Birth Weight (VLBW, <1500 grams) and Very Preterm Birth (VPTB, < 32 weeks gestation) among Women with Selected Maternal Prepregnancy and Antenatal Factors by Race and Ethnicity, Maryland 2005-2009						
	Factor Prevalence %		**% VLBW**		**% VPTB**	
Factor	**NH White**	**NH Black**	**NH White**	**NH Black**	**NH White**	**NH Black**
Total			0.9	2.8	1.1	3.0
<u>**Pre-pregnancy**</u>						
Hypertension	2.6	4.3	1.8	7.0	2.2	7.8
Diabetes	1.0	1.7	2.6	5.0	3.4	5.8
Tobacco use	24.5	14.2	1.3	3.7	1.6	4.3
Fertility treatment	7.2	2.4	2.9	8.1	3.0	7.9
Binge drinking**	26.5	12.8	0.7	2.1	1.0	2.0
BMI <18.5	3.9	3.4	0.4	2.1	0.6	3.9
BMI $\geq$30	17.6	25.2	1.0	3.8	1.2	3.8
Asthma	7.6	10.6	1.2	2.8	1.5	3.5
Depression*	12.0	8.3	1.3	3.4	1.2	4.1
Anxiety*	14.6	5.8	1.3	3.2	1.6	3.9
<u>**Antenatal**</u>						
Hypertension	11.0	13.4	2.3	7.1	2.1	6.9
Diabetes	7.1	9.6	1.3	3.3	1.8	3.8
Tobacco use	13.5	7.8	1.7	3.5	1.9	4.5
Binge drinking**	0.4	0.9		3.8		6.5
Intimate partner violence***	2.8	6.4	1.7	1.3	2.4	1.8

*only 2009 data was available

**Definition for binge drinking changed in 2009 surveys from 5 to 4 or more drinks in one sitting

***2009 survey did not include abuse from a former partner, as in earlier years