THE MATERNAL-INFANT IMPACTABILITY SCORE™ (MIIS) FOR CARE MANAGERS:

A Demonstrated Approach for Reducing Low Birth Weight Through Pregnancy Care Management

Community Care OF NORTH CAROLINA

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KEY POINTS FROM THIS BRIEF:

- Women on Medicaid experience numerous medical, social, and behavioral risks that increase their likelihood of delivering a low birth weight (less than 2,500 gram) infant. Some of these risk factors are modifiable through pregnancy care management. Limited public maternity care resources should be optimally focused to improve pregnancy outcomes.
- In 2011, North Carolina launched a Pregnancy Medical Home program to enhance access to high quality prenatal care and improve low birth weight rates for pregnant women with Medicaid coverage. The program includes standardized risk screening of all pregnant women with nurse and social work care management of those women at elevated risk of preterm birth and low birth weight.
- Building on more than 5 years of care management experience, coupled with risk screening and birth outcome data from more than 200,000 women, CCNC evaluated the effectiveness of care management for women in the program, in terms of impact on the rate of low birth weight.
- The result was the development of the Maternal-Infant Impactability Score™ (MIIS), a score used to prioritize the provision of pregnancy care management to women most likely to experience measurable benefit, based on previous data derived from a similar population of women. The score was built using data from the first 4 years of the program (2011 – 2014) and validated on a later period (2015-2016).
- The MIIS score identifies women who are not only at elevated risk of low birth weight but who also have characteristics that have been shown to benefit from pregnancy care management in terms of a reduction in low birth weight risk. The MIIS score prioritizes 20-25% of pregnant women with Medicaid, compared to 70% of women who were prioritized based on the presence of one or more low birth weight risk factors included in the standardized form.
- Patients prioritized using the MIIS score require at least 8-10 patient-centered care management interventions during the pregnancy in order to achieve optimal impact on the risk of low birth weight. Women with higher scores require more of those interventions to be face-to-face encounters vs. telephonic encounters.
- The use of an “impactability” score allows CCNC to maximize limited resources by delivering the right amount and type of care management intervention to the women who will benefit most.

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Background

Community Care of North Carolina (CCNC) launched the Pregnancy Medical Home (PMH) program in 2011, to enhance access to comprehensive care for pregnant Medicaid beneficiaries and to improve rates of low birth weight (LBW) births. The PMH program promotes evidence-based, high-quality maternity care in more than 400 practices across the state. PMH practices represent 95 percent of prenatal care providers who serve the Medicaid population and include obstetricians, family physicians, nurse midwives, nurse practitioners and physician assistants, in community practices, academic medical center clinics, high-risk OB clinics, federally qualified health centers, and county health departments.

Patients at risk of LBW are identified through a standardized risk screen administered at the first prenatal visit. Risk screening is a required component of the PMH model, and PMH offices can bill Medicaid for an incentive payment for completing screens on their pregnant Medicaid patients. The PMH risk screening form includes about 30 discrete items representing medical, obstetric, and social risk factors. Validated screening instruments are used to screen for psychosocial risk factors, such as tobacco use, food insecurity, substance use and domestic violence. However, approximately 70% of women in this Medicaid population have one of these risk factors, suggesting the need for a more refined prioritization algorithm.

Pregnancy care management is provided by county health department nurses and social workers, working by contract with local CCNC networks. These care managers partner with prenatal care providers; many are embedded in the prenatal care setting, enabling effective integration with the care team and face-to-face interaction with patients.

Following a thorough assessment of each priority patient, the care manager intervenes to ensure the patient receives needed medical care and diagnostics, understands treatment recommendations, and is referred to community resources, such as food pantries, transportation services, or treatment for substance use disorder. Care managers intervene directly with the patient to offer education and social support and with the broader medical and social services community to coordinate the care plan, facilitate referrals, and advocate for needed services.

CCNC supports the PMH provider community through clinical leadership, provider education, technical assistance and by providing practice-level analytics. PMH clinical leadership teams (“OB teams”) at each of CCNC’s 14 regional networks support providers to offer high quality care to the pregnant Medicaid population by disseminating statewide care pathways which establish best practices based on current evidence. OB teams also share meaningful data about key quality and performance metrics and support PMH practices to implement quality improvement strategies.

Initial Approach to Care Management Prioritization

When the PMH program was initially launched, women were prioritized for care management based on having at least one of ten modifiable risk factors associated with LBW (Table 1). This approach identified 70% of all pregnant women with Medicaid coverage as high priority for care management, exceeding program capacity. Further, although it is well-established that these medical, obstetric, or psychosocial issues increase the risk of LBW delivery, there is conflicting evidence regarding whether care

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management intervention will effectively reduce such risk. This led CCNC to pursue an alternative prioritization strategy, seeking to identify which women would benefit the most from care management, or an "impactability" method for prioritization.

Table 1: Prevalence of Risk Factors Used to Prioritize OB Care Management from 2011-2016

Priority Risk Factors	Prevalence Among NC Medicaid Pregnant Women
Multifetal gestation	1%
Fetal complications	1%
Chronic medical conditions	14%
History of preterm birth or low birth weight	7%
Current use of drugs or alcohol	15%
Any tobacco use during pregnancy	30%
Late entry into prenatal care	23%
Hospital utilization during the first two trimesters	35%
Missing prenatal appointments (prior to screen)	1%
Unsafe relationships	6%
Unsafe/unstable housing	3%
Any of above	70%

Signals of Impactability

To discern whether pregnancy care management services were improving low birth weight rates for pregnant women with Medicaid, CCNC examined 78,913 births during 2011-2014 where the patient had at least one intervention with a pregnancy care manager during pregnancy. For this evaluation, we counted any interaction (by telephone or face-to-face) between the care manager and the pregnant woman as an intervention. We considered a total of 27 unique risk factors in this analysis, both modifiable and inherent (such as maternal age, race, and parity; see Table 3 for a complete listing). For each individual risk factor, we measured whether the rate of low birth weight (LBW, <2500g) varied as a function of the number of interactions (either telephonically or face-to-face) the care manager had with the pregnant woman during the course of her pregnancy (see Figure 1 for examples). Although we could not entirely control for selection biases associated with receiving the intervention, we did observe that for certain risk factors, the higher level of intervention correlated with significantly lower rate of low birth rate. In other words, for some risk factors, a much greater "dose-response" to the level of intervention was observed. The regression slopes for each risk factor (Figure 1) were then used to develop a scoring algorithm for estimating impactability. To further address potential confounding factors, we conducted several

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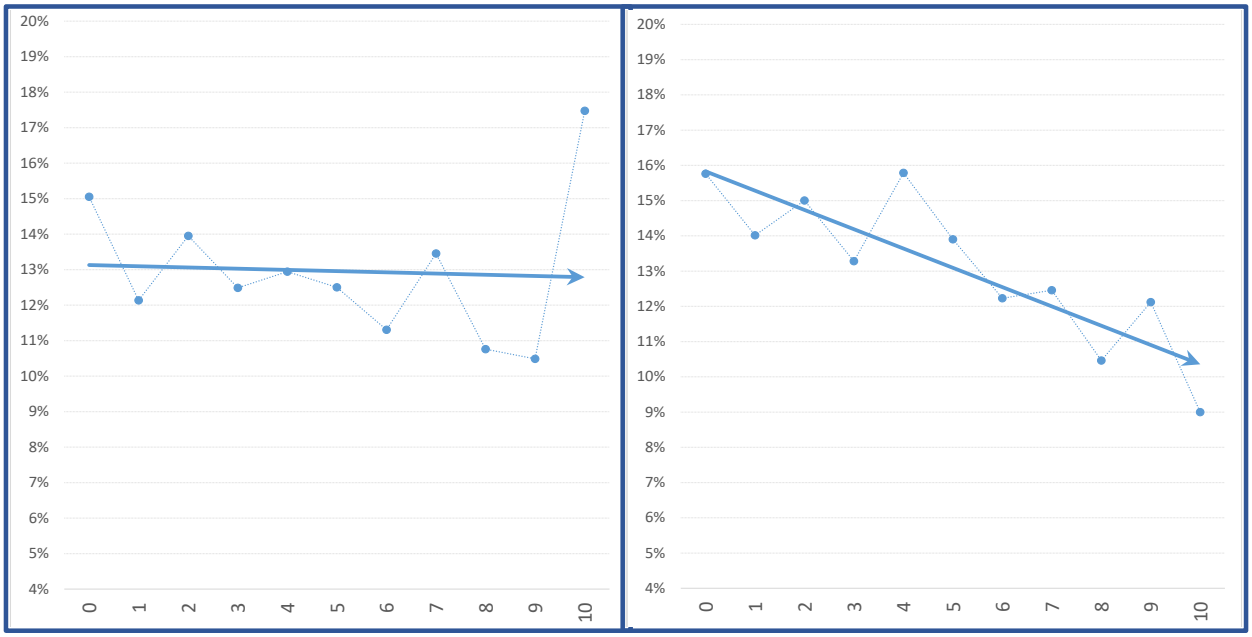
sensitivity analyses, including limiting the cases to those who started care management prior to 30 weeks gestation.

Figure 1: Two Examples of Risk Factors and Their Individual Level of "Impactability"

Pregnancy Intendedness
("I did not want to be pregnant")

Current use of drugs or alcohol



Number of Interactions

Number of Interactions

Maternal-Infant Impactability™ Score Stratification

CCNC operationalized these findings as the Maternal-Infant Impactability Score™ (MIIS), a score from 0-1,000 assigned to every pregnant woman based on her own characteristics and risk factors, which reflects the relative ability of a care manager to reduce the risk of LBW when the woman receives intensive care management. Greater weight was given to those factors shown to improve with care management (see Table 3 for a complete listing of all the variables that were tested in the model).

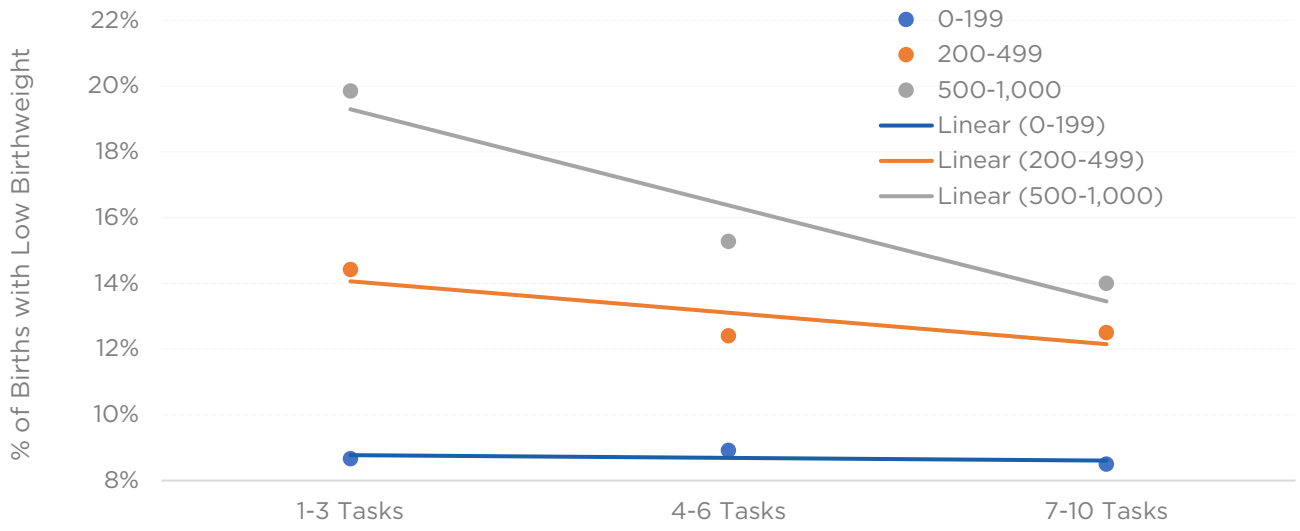
A MIIS score at or above 200 prioritizes approximately one-quarter of pregnant women with Medicaid. Women in this group typically have multiple medical, obstetric, and psychosocial risk factors, including but not limited to those originally used to prioritize women for care management, listed in Table 1. This group of priority patients averages two emergency department visits while pregnant and is twice as likely as low-impactability patients to have an inpatient stay prior to delivery.

We conducted stratified logistic regression analyses to determine whether intensity of care management activity was associated with a reduction in LBW across three tiers of impactability, controlling for predicted risk of LBW at the individual patient level. As shown in Figure 2, these analyses confirmed that as impactability increased, greater frequency of face-to-face care management intervention was associated with lower incidence of LBW. While care management did not impact the odds of LBW

among women with scores <200 (OR 0.92, p=0.08), the odds of LBW was significantly lower for women with MIIS scores in the medium range (OR 0.83, p<0.05) and high range (OR 0.80, p<0.05) who received care management.

Additionally, it should be noted that those patients with no face-to-face care management interventions, who were not included in the validation sample because of potential selection bias, had even higher actual rates of LBW (500+ group = 23.9%, 200-499 group = 17.4%, 0-199 group = 11.1%).

Figure 2: LBW Outcomes as a Function of Care Management Intensity, by Impactability Tier



Validation of the Impactability Approach

To further validate this prioritization method, and to test whether the scores held up in a later time period, we separately examined a cohort of women who received pregnancy care management and gave birth during 2015-2016 (N=27,562 births). To avoid selection bias, we limited this analysis to women who started care management by the 30th week of gestation, and who received at least one face-to-face interaction with a care manager, in the medical office, a community setting, or the patient's home. Table 3 describes the sample population for the validation analysis, stratified by MIIS score. As expected, women with certain risk factors were overrepresented in the high and medium impactable groups. African American women tended to have higher MIIS scores.

In the validation analysis, to control for variability in underlying risk within each stratum of impactability, we calculated the expected likelihood of delivering a LBW baby based on the mother's individual risk factors. To create this relative risk variable, we developed a predictive model for LBW using all available risk data and selected the model that most reliably predicted LBW with greatest parsimony. The final model took into account race, chronic hypertension, mental illness, multifetal gestation, obesity, history of spontaneous preterm birth, and current smoking status.

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Table 2: Risk Factors Reported for Patients in the Validation Sample, by Impactability Tier

Impactability Group	High (500-1000)	Medium (200-499)	Low (0-199)	Total
N	**1,908**	**8,144**	**17,510**	**27,562**
Expected LBW Rate	20.5%	14.3%	9.8%	11.9%
Actual LBW Rate	18.2%	13.9%	8.7%	10.9%
Demographic Characteristics				
Mean age (years)	26.9	26.1	24.8	25.4
African American	39%	39%	35%	36%
Hispanic	3%	5%	9%	7%
No high school diploma or GED	37%	26%	26%	27%
Pregnancy History				
Nulliparous (never delivered before)	20%	32%	42%	37%
Short inter-pregnancy interval	19%	14%	10%	12%
History of preterm birth	38%	22%	5%	12%
History of spontaneous preterm birth	30%	13%	0%	6%
Current Pregnancy				
Did not want to be pregnant	15%	11%	8%	10%
Multifetal gestation	5%	3%	3%	3%
Fetal complications	12%	10%	8%	9%
Mean prenatal appointments (as reported on the birth certificate)	12.5	12.7	12.2	12.4
Medical, Behavioral, and Social Risk Factors				
Mean pre-pregnancy Body Mass Index	35.4	34.6	36.6	35.9
Chronic hypertension	63%	45%	0%	18%
Gestational diabetes	8%	8%	5%	6%
Mental illness	59%	38%	27%	32%
History of postpartum depression	13%	8%	5%	7%
Ever smoked	82%	65%	53%	59%

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Impactability Group	High (500-1000)	Medium (200-499)	Low (0-199)	Total
Medical, Behavioral, and Social Risk Factors (cont.)				
Still smoking after learning she was pregnant	60%	34%	22%	28%
Ever problem with drugs or alcohol	48%	24%	1%	11%
Current problem with drugs or alcohol	44%	22%	0%	10%
History of domestic violence in past year	39%	12%	0%	6%
Unsafe/unstable housing	7%	4%	3%	3%
Food insufficiency	22%	9%	6%	8%
Care Management				
Started care management by gestational week 14	51%	50%	42%	45%
Mean number of patient-centered tasks	6.9	5.8	4.9	5.3
Mean number of face-to-face encounters	3.0	2.7	2.6	2.6

Data and Methods

Patient risk factor data was obtained from the standardized CCNC PMH Risk Screening Form administered by a physician, mid-level provider or registered nurse at the first prenatal visit and entered into CCNC's web-based Care Management Information System (CMIS). Pregnancy care managers document their interventions in CMIS throughout the pregnancy. A woman was considered to have received care management if she was assigned an active case status by the care manager (heavy, medium or light) during the gestational period, with at least one patient-centered task (phone call, home visit, community encounter, practice encounter, or hospital visit with patient). To control for selection biases around patient's willingness to be managed in person, and because face-to-face interactions were associated with better outcomes, in the validation analysis, only face-to-face patient-centered tasks were considered.

Birth weight was obtained from birth certificates matched to Medicaid delivery claims in CCNC's data warehouse using Structured Query Language Server Integration Services Fuzzy Lookup component software, producing a match rate of >95%. Parity, race/ethnicity, smoking status, and BMI values were collected from the birth certificate data if they were missing from the risk screening data. Medicaid claims data were used to assess frequency of emergency department and inpatient utilization during pregnancy, though these variables were not included in the development of the impactability score models.

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Conclusion

North Carolina consistently ranks among the states with the highest rates of LBW. In 2016, NC ranked 8th with a rate of 9.2% compared to the national rate of 8.2% (Centers for Disease Control and Prevention, 2018). Among North Carolina women with Medicaid coverage in pregnancy, the 2016 LBW rate was 11.5%. Forty-eight percent of pregnant women in 2016 had Medicaid coverage during pregnancy and another 7% had emergency Medicaid for the delivery only. Annually, this represents over 65,000 pregnancies resulting in a live birth of an infant who will have Medicaid coverage. Infants born preterm or at a low birth weight are at higher risk for neonatal intensive care admission with prolonged hospital stay, re-hospitalization in the first years of life, and other longer-term respiratory, gastrointestinal, and neurodevelopmental morbidities. These health complications have a large societal cost as well as an emotional cost to parents and families.

Since the 1970s, researchers have attempted to develop risk screening tools to identify women early in pregnancy who will deliver preterm though no predictive model has been deemed accurate enough to justify its widespread use thus far (National Institute of Child Health and Human Development, 2017). Given an increasing appreciation for social determinants of health, there is growing momentum that risk assessment combined with patient-centered care management during prenatal care can improve birth weight among high-risk pregnant women and can minimize the use of costly health care resources for lower-risk patients (Honest, 2004). To our knowledge, North Carolina's Pregnancy Medical Home program is the first to implement an empirically derived impactability score as a methodology for prioritizing women for care management.

Focusing care management services on women with higher MIIS score can reduce their risk of LBW, resulting in better short- and long-term outcomes for the infant, significant cost savings for the state, and improved quality of life for the family.

This method of identifying "highly impactable" patients identifies approximately 1,000 new pregnant Medicaid patients statewide for care management each month, reducing the proportion of women who are prioritized for care management to one-quarter of the pregnant Medicaid population from 70% using the previous "risk factor" method. This approach allows for more productive use of limited care management resources, and favors more intensive, longitudinal services for a smaller number of patients in order to optimize the benefits across the population.

References

Centers for Disease Control and Prevention. (2018, April 10). Stats of the State of North Carolina. https://www.cdc.gov/nchs/pressroom/states/northcarolina/northcarolina.htm.

Honest, H (2004). The accuracy of risk scores in predicting preterm birth—A systematic review. J of Obstet Gynecol, 24(4), 343-359.

National Institute of Child Health and Human Development. (2017, January 31). What are the risk factors for preterm labor and birth?. https://www.nichd.nih.gov/health/topics/preterm/conditioninfo/who_risk.

NC Medicaid Division of Health Benefits. (2019, November 8). Pregnancy Risk Screening Form. https://files.nc.gov/ncdma/CMHRP-Pregnancy-Risk-Screening-Form-V1.pdf.

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Pediatrics. 2007 Jul;120(1):e1-9. Cost of hospitalization for preterm and low birth weight infants in the United States. Russell RB1, Green NS, Steiner CA, Meikle S, Howse JL, Poschman K, Dias T, Potetz L, Davidoff MJ, Damus K, Petrini JR. http://www.marchofdimes.org/peristats/pdfdocs/cts/Thomson Analysis2008_SummaryDocument_final121208.pdf.

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