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Effect of an Intensive Nurse Home Visiting Program on Adverse Birth Outcomes in a Medicaid-Eligible Population

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Roadmap

- Background on need for intervention and partnership in South Carolina
- Pragmatic study design
- Results
- Discussion
- Time for questions

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Motivation

- Need: scalable, effective interventions for reducing adverse birth outcomes and improving disparities
- Intensive nurse home visiting has been recommended
 - Significant federal investment through the Maternal, Infant and Early Childhood Home Visiting (MIECHV) program

What is nurse home visiting?

- Many varieties
 - Healthy Families America
 - Parents as Teachers
 - Family Connects
 - Nurse Family Partnership
 - ..., many others
- Nurse Family Partnership is a flagship program

What is the Nurse Family Partnership (NFP)?

Home visits with a registered nurse

- Pregnancy → first 2 years of child's life
- Bi-weekly/monthly visits
- First-time low-income pregnant people

Model of “evidence-based policy”

- 3 small-scale RCTs (1977-1994)
- Positive impacts on pregnancy health, child education, and maternal employment
- Operates in 40 states



What do NFP nurses do?

- Health assessments
 - Prenatal health assessment at intake
 - Monitoring (e.g. maternal weight or blood pressure)
 - Screening for depression, anxiety, intimate partner violence
- Referrals to health care providers and community resources
- Educational content focused on clients' priorities
- Psychosocial support

Maternal / Child Health Context in South Carolina

- 22% of children born into households below the federal poverty line (45th of 50 states)¹
- Over half of births in the state covered by Medicaid²
- No Medicaid expansion
- Substantial disparities in maternal and neonatal health outcomes
 - Large racial disparities in outcomes – one example is 11.1% overall preterm birth rate; 14.1% for black mothers²
 - Rate of maternal mortality in the first 6 weeks of life was 26 per 100,000 – more than 2x higher among black mothers³
 - Significant access issues in rural areas, many closures of OB and NICU facilities⁴

1. Kaiser Family Foundation. State Health Facts, Insurance Coverage for Low-Income Children (0- 18). Washington, DC: Kaiser Family Foundation. Accessed September 23, 2022. <http://kff.org/other/state-indicator/low-income-children/>

2. National Center for Health statistics. Final natality data. Accessed September 23, 2022. www.marchofdimes.org/peristats.

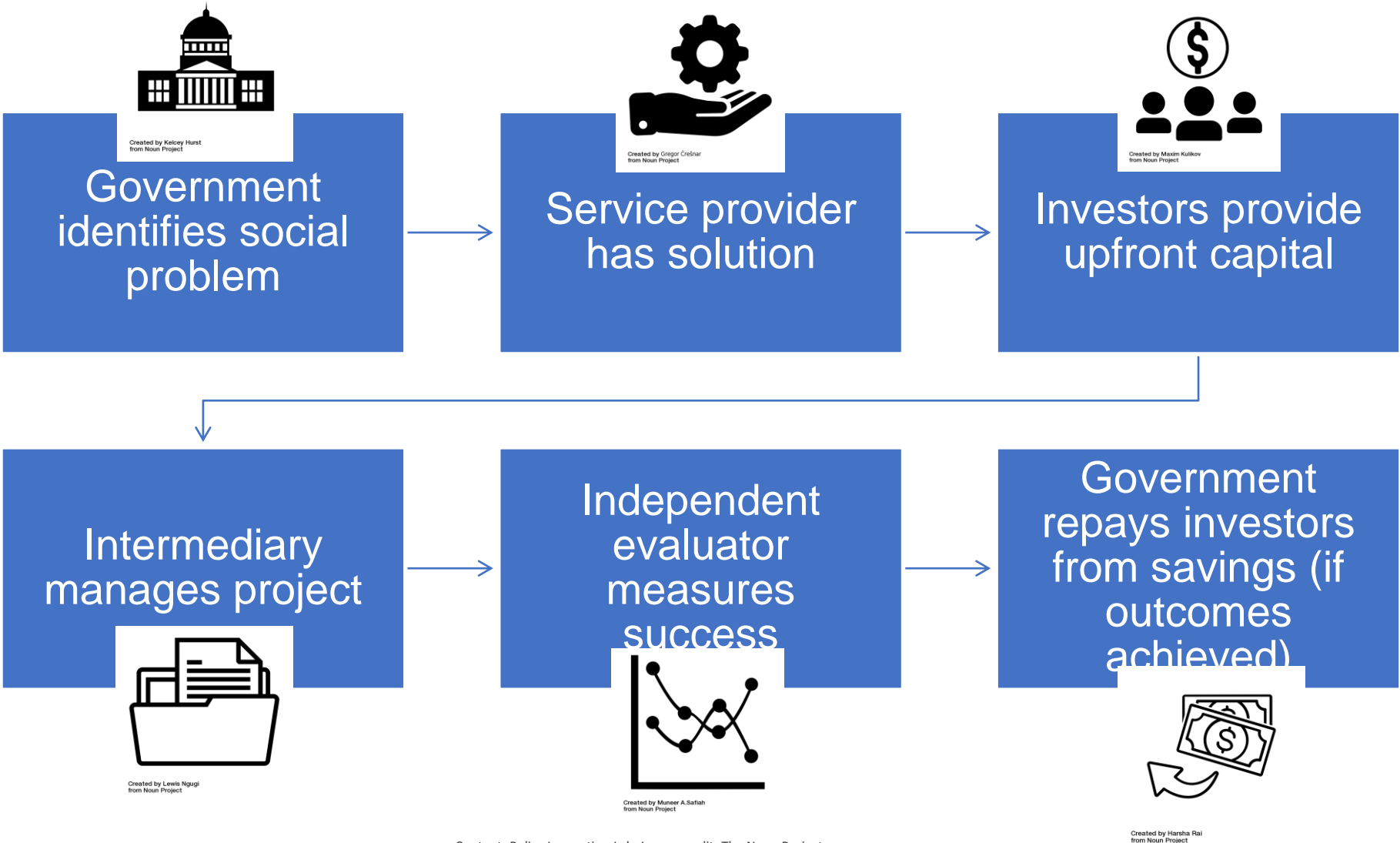
3. South Carolina Vital and Morbidity Statistics 2018. Accessed September 23, 2022. <https://scdhec.gov/health/sc-public-health-statistics-maps/biostatistics-publications>.

4. March of Dimes. Nowhere to Go: Maternity Care Deserts Across the U.S. 2020. Accessed September 23, 2022. <https://www.marchofdimes.org/research/maternity-care-deserts-report.aspx>

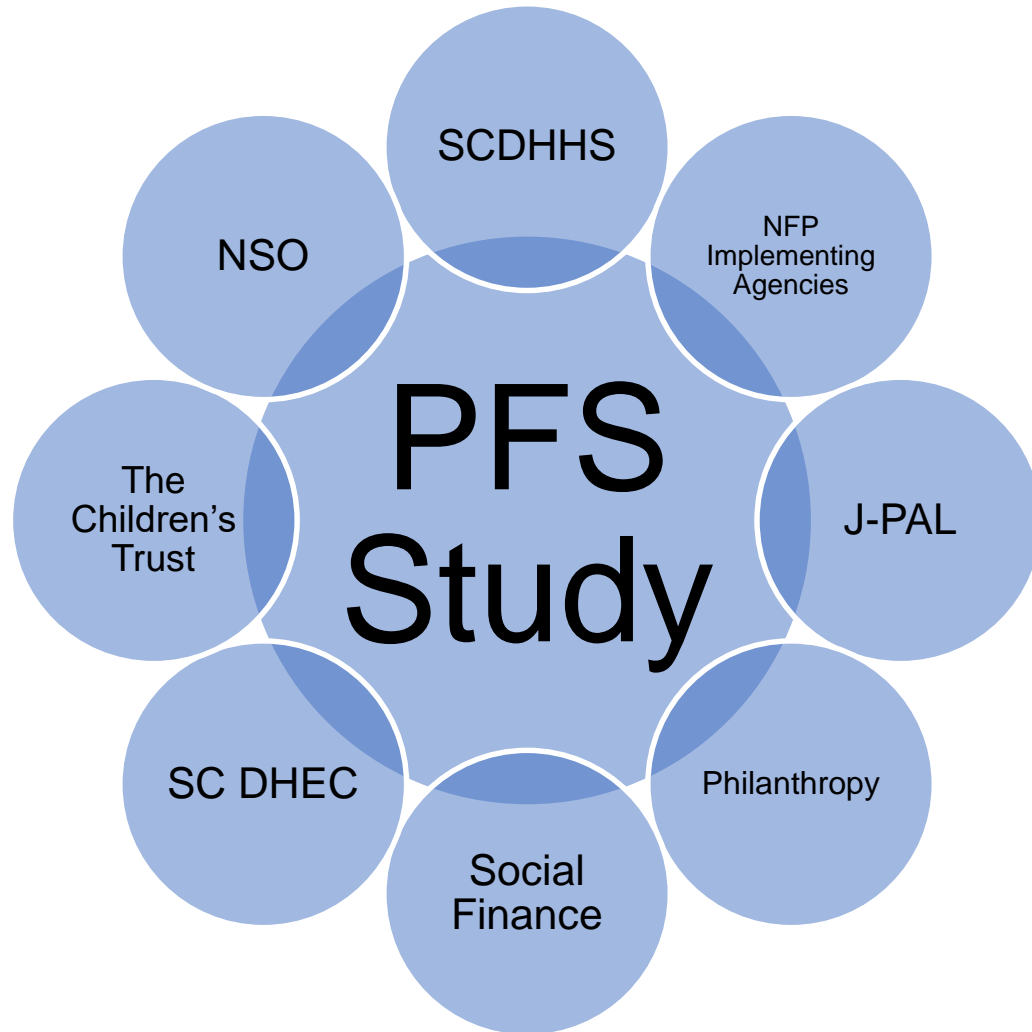
Research Context

- SC State Medicaid office saw potential for NFP to improve maternal and child health outcomes in Medicaid population
 - “Pay for Success” contract enabled state to promise funds for further expansion conditional on positive evidence of impact from randomized trial
- Evaluation question: What is the impact of NFP on *health outcomes* when delivered at scale?

What is Pay for Success?



Pay for Success framework

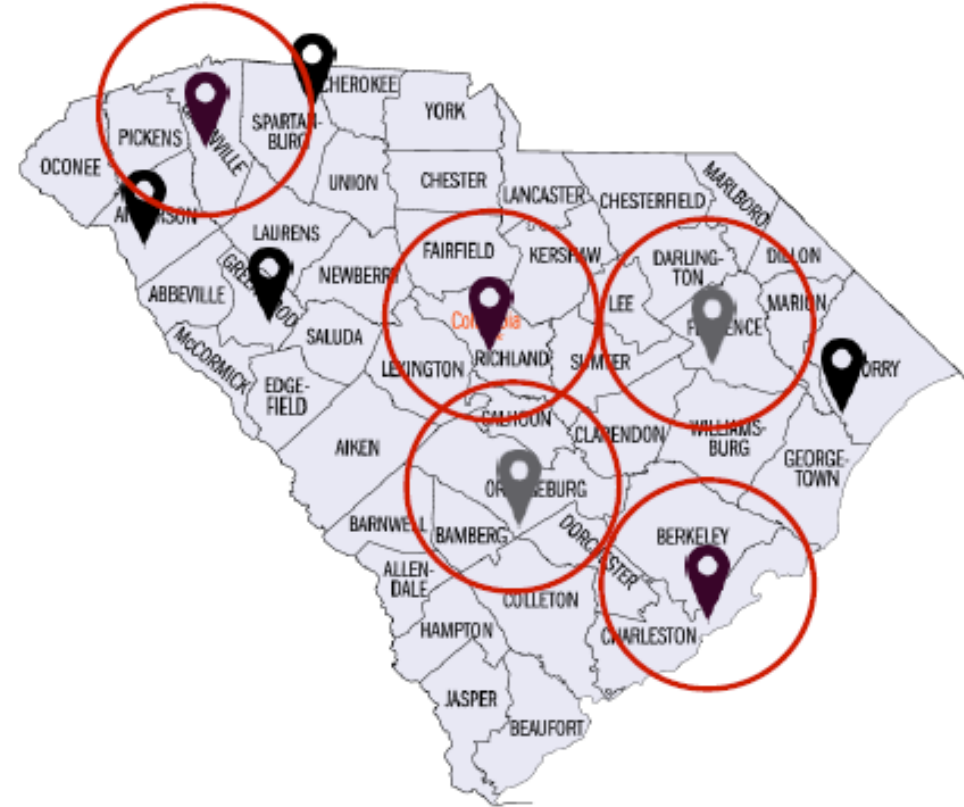


Funding mechanisms:

- Medicaid Waiver
- Pay for Success (PFS) contract
- Both contingent on randomized evaluation

Potential to expand

- The Nurse-Family Partnership (NFP), served less than **600 of 11,500** eligible mothers each year before the project.
- Medicaid waiver allowed Medicaid to cover home visiting services by NFP nurses
 - Waiver covers up to 40 visits during period covering pregnancy and first two years of child's life



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Evaluation Design

- Randomized Controlled Trial

- Simple randomization, enrolled 5670 mothers into the evaluation between 2016 and 2020, with 2/3 allocated to the intervention group
- Randomization after consent, enrollment (all conducted by trained NFP nurses)

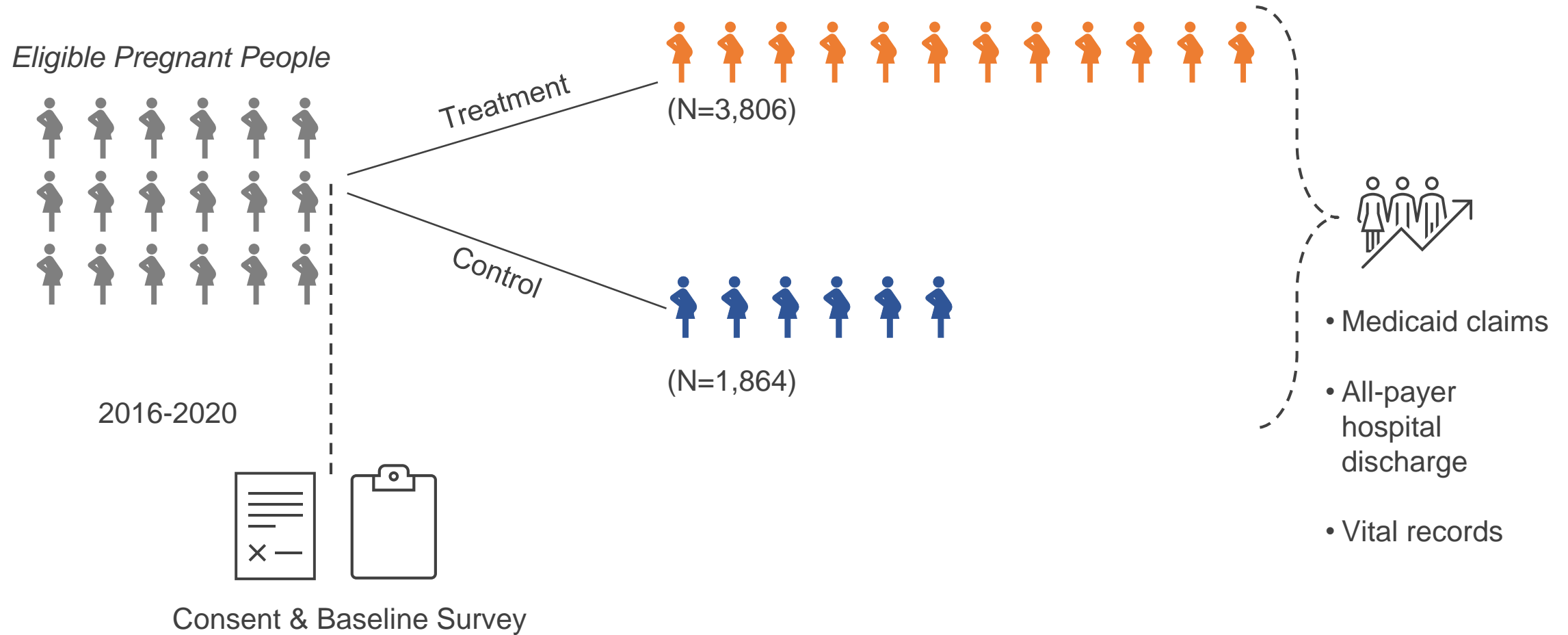
- Eligibility Criteria

- First-time mothers aged 15 and older
- Meet the income-eligibility criteria for Medicaid
- No more than 28-weeks gestation at enrollment

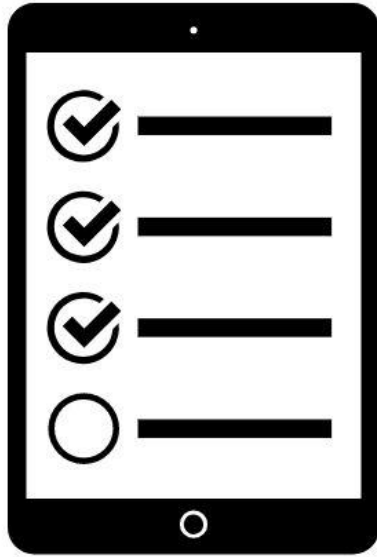
- Data Collection

- Baseline Survey
- Outcomes observed entirely through Administrative Data
 - Mothers consent to follow their outcomes and their children's outcomes for up to 30 years
 - Data sources for analysis of birth outcomes: vital records, Medicaid and hospital discharge claims

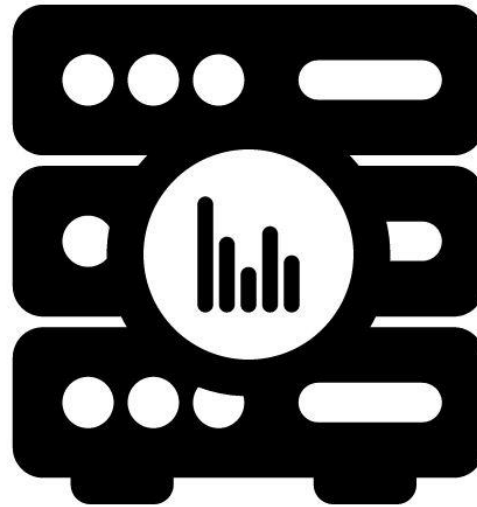
Study design



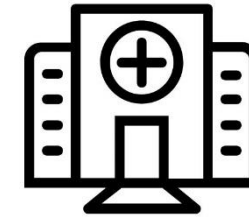
Data collection & analysis



Baseline Survey



Administrative Data



**Data
collected by
NFP**

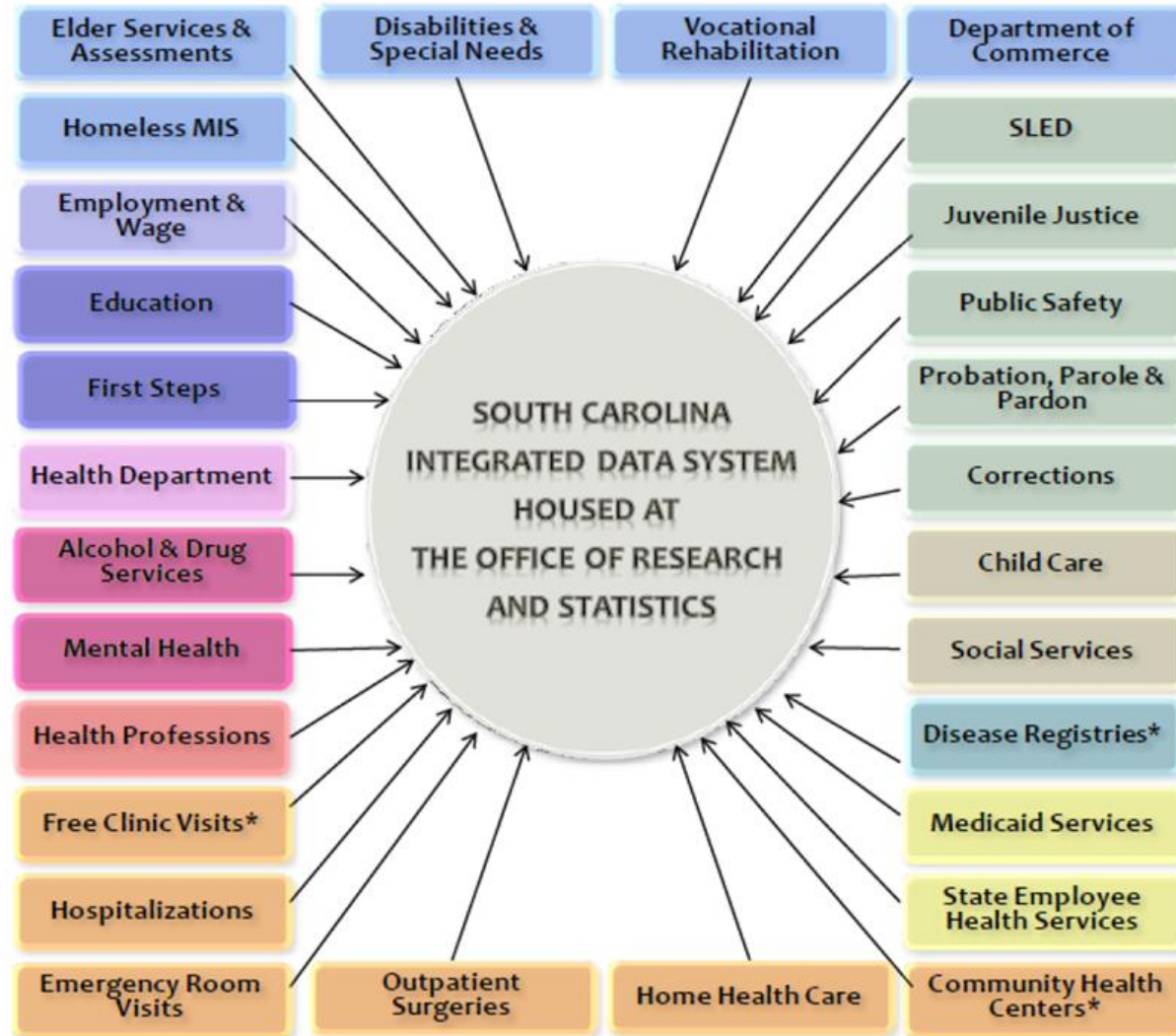


**Data
collected by
SC**

Baseline survey

- Administered by Nurse Home Visitors
- Collects identifiers to link to administrative data
- Collects information to allow for sub-group analysis

Study enabled by South Carolina's administrative data hub



Analyses related to birth outcomes

- **Primary outcome:**

- Composite of at least one of: small for gestational age, or low birth weight, or preterm birth or perinatal mortality

- **Secondary outcomes**

- *Neonatal outcomes:* large for gestation age, NICU admission, neonatal morbidity
- *Maternal outcomes:* Cesarean delivery, maternal morbidity and mortality, substance abuse, experience of violence or homicide, utilization of routine postpartum care, utilization and quality of prenatal care, mental health care utilization
- Today we will primarily show outcomes related to birth

Analyses related to 2-year outcomes

- **Primary outcomes:**

- Composite of at least one of: Health care encounter or mortality from major injury, or concern for abuse or neglect
- Birth interval of less than 21 months

- **Secondary outcomes**

- Emergency department utilization, all-cause mortality
- *Preventative child health care utilization*: proportion of recommended well-child visits, lead screening, developmental screening, dental care utilization
- *Family planning utilization*: counseling for family planning, utilization of moderately or highly effective contraception, intrauterine device insertion

- Not yet analyzed

Longer-term outcomes observed following moms and babies for up to 30 years

- Health care utilization
- Timing of subsequent pregnancies
- Use of social services
- Criminal justice involvement
- Educational outcomes
- Economic opportunity

Home Visiting & Birth outcomes: prior evidence

- Evidence from previous NFP trials
 - RCT of NFP in Elmira, NY:
 - adolescent mothers who received NFP had babies with higher birth weights¹
 - among mothers who reported smoking during pregnancy, mothers in the treatment group experienced a reduced likelihood of preterm birth¹
 - RCT of NFP in Memphis, TN:
 - mothers receiving NFP less likely to experience hypertensive disorders of pregnancy²
 - no change in preterm birth or low birth weight²
- Large-scale RCT evaluating the impact of the MIECHV program and an evaluation of a home visiting program in UK found no evidence of impacts on birth outcomes³

1. Olds DL, Henderson CR, Tatelbaum R, Chamberlin R. Improving the delivery of prenatal care and outcomes of pregnancy: a randomized trial of nurse home visitation. *Pediatrics*. 1986;77(1):16-28.

2. Kitzman H, Olds DL, Henderson CR, et al. Effect of prenatal and infancy home visitation by nurses on pregnancy outcomes, childhood injuries, and repeated childbearing. A randomized controlled trial. *JAMA*. 1997;278(8):644-652.

3. Robling M, Bekkers M-J, Bell K, et al. Effectiveness of a nurse-led intensive home-visitation programme for first-time teenage mothers (Building Blocks): a pragmatic randomised controlled trial. *The Lancet*. 2016;387(10014):146-15

5. doi:10.1016/S0140-6736(15)00392-X

Pre-specified sub-group at elevated risk

We pre-specified a sub-group of moms as having elevated risks for adverse outcomes based on previous trials of NFP and targeting of home visiting programs:

- Less than HS
- < 19 years old
- PQH 2 score indicating depression (≥ 3), or reported having mental health help or treatment in past year
- Consistent with how many programs define elevated risk: i.e focus on adolescents, socio-economic disadvantage and risk of depression
- Approximately 46% of sample meet this criteria

Because of substantial racial disparities, we pre-specified a plan to look at differences between Black moms and other moms in the sample

Sample and Analysis

- Results shown today are intent-to-treat
 - All models control for a pre-specified vector of baseline characteristics
 - Binary outcomes estimated with linear probability models
 - Continuous outcomes estimated with OLS
- We also estimate
 - LATE models
 - Adjustment for multiple hypothesis testing

COVID

- Study enrollment ended prematurely on March 17, 2020
 - South Carolina's stay at home order went into effect on March 23rd, 2020
- 87% of enrollees delivered their babies prior to March 17, 2020

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Sample Characteristics & Balance (1)

	Nurse Home Visiting Group (N = 3794)	Usual Care Group (N = 1861)
Median gestational age in weeks at enrollment (IQR)	13.0 (9.0-20.0)	13.0 (9.0-19.0)
Received at least one antenatal care visit before enrollment	3139/3750 (83.7%)	1511/1837 (82.3%)
Age in years		
15-18	679 (17.9%)	324 (17.4%)
19-24	2067 (54.5%)	1011 (54.3%)
25-34	932 (24.6%)	485 (26.1%)
35+	116 (3.1%)	41 (2.2%)
Race and ethnicity		
Asian, Indigenous, Native Hawaiian and Pacific Islander, non-Hispanic	51/3548 (1.4%)	15/1730 (0.9%)
Hispanic	217/3548 (6.1%)	108/1730 (6.2%)
More than one race reported, non-Hispanic	105/3548 (3.0%)	56/1730 (3.2%)
Non-Hispanic Black	1936/3548 (54.6%)	957/1730 (55.3%)
Non-Hispanic White	1239/3548 (34.9%)	594/1730 (34.3%)
Highest education level		
Less than high school diploma	851/3780 (22.5%)	409/1855 (22.0%)
High school diploma or equivalent	1375/3780 (36.4%)	639/1855 (34.4%)
Some college, less than bachelor's degree	1270/3780 (33.6%)	665/1855 (35.8%)
Bachelor's degree or higher	283/3780 (7.5%)	142/1855 (7.7%)
Economic conditions		
Received one or more social service program	2416/3712 (65.1%)	1205/1820 (66.2%)
Worked for pay at time	1979/3791 (52.2%)	953/1859 (51.3%)
Lived with parents	1599/3789 (42.2%)	800/1858 (43.1%)
Experienced housing insecurity	663/3788 (17.5%)	334/1857 (18.0%)

Sample Characteristics & Balance (2)

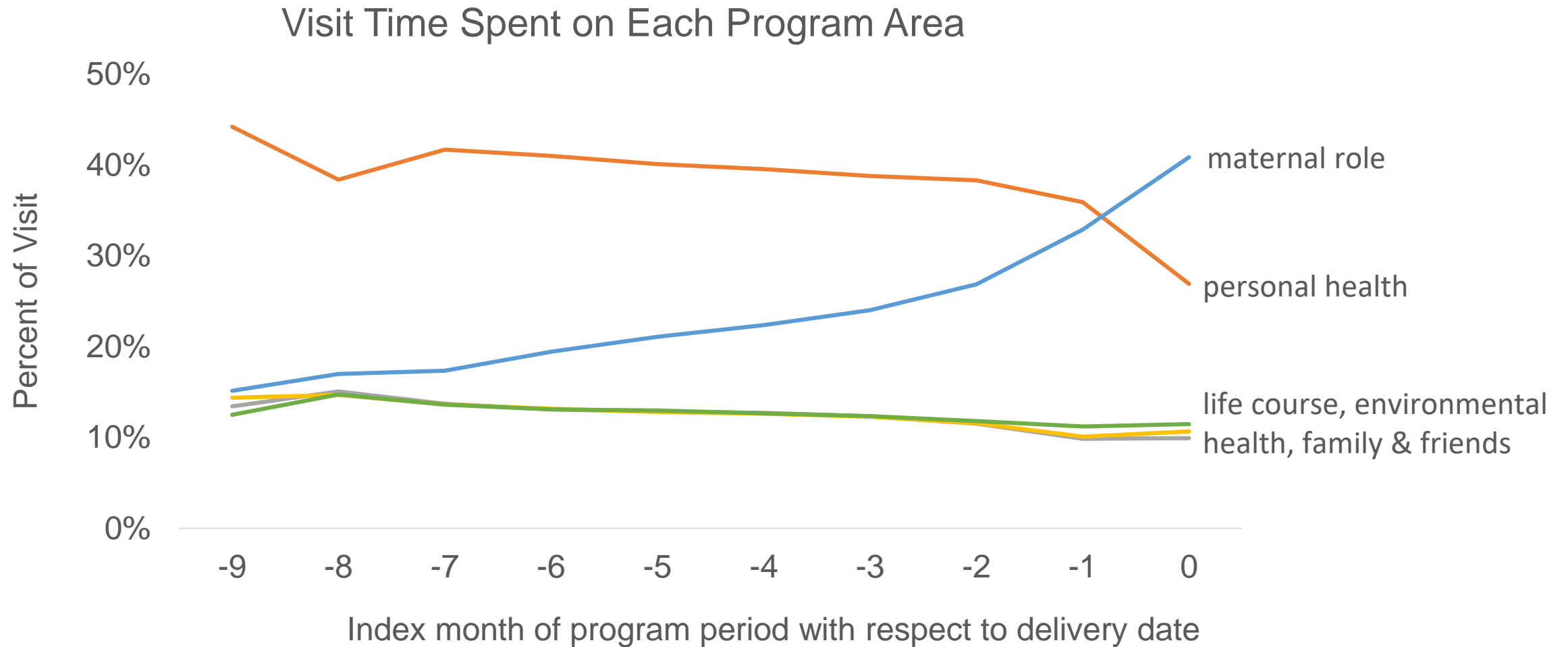
	Nurse Home Visiting Group (N = 3794)	Usual Care Group (N = 1861)
Mental health		
High stress, (Perceived Stress Scale-4 \geq 4)	2458/3741 (65.7%)	1215/1836 (66.2%)
Depressive symptoms, (PHQ-2 \geq 3)	730/3766 (19.4%)	352/1853 (19.0%)
Received mental health treatment in last year	508/3788 (13.4%)	249/1856 (13.4%)
Body Mass Index		
Below 18.5	205/3672 (5.6%)	92/1784 (5.2%)
18.5 - 24.9	1361/3672 (37.1%)	702/1784 (39.3%)
25 - 29.9	832/3672 (22.7%)	388/1784 (21.7%)
30.0 and above	1274/3672 (34.7%)	602/1784 (33.7%)
Health behaviors and care seeking		
Reported using emergency department in six months before enrollment	1945/3793 (51.3%)	978/1858 (52.6%)
Reported drinking alcohol in the three months before pregnancy	1902/3771 (50.4%)	927/1849 (50.1%)
Reported smoking cigarettes in the three months before pregnancy	939/3736 (25.1%)	495/1838 (26.9%)
Reported health as fair/poor	483/3774 (12.8%)	206/1854 (11.1%)
Family Planning		
Reported a desire for more children in the future	2575/3793 (67.9%)	1274/1860 (68.5%)
Reported previously obtaining family planning or birth control	2100/3785 (55.5%)	1010/1856 (54.4%)
Reported interacting with the father of the child daily	3028/3778 (80.1%)	1484/1852 (80.1%)

Study Design: Visits Throughout Pregnancy

- Zero control group enrollees received home visits
- 98% of treatment group enrollees received at least one home visit

	Estimate within Treatment Group
Received visits to birth	78.3%
Number of visits in the prenatal period (median)	9.0
Duration of in-person visit (minutes)	65.5
Received at least one telehealth visit (phone or video)	28.0%
Average share of total visits conducted via telehealth	5.0%

Study Design: Visits Throughout Pregnancy



Results: program participation

- Length of home visit meets minimum program expectations
 - Median home visit length was 65 minutes
 - Program expectation is that visits last at least 60 minutes
 - Most common referrals
 - General services (housing, transport, CPS) (25% referred)
 - Health care services (23% referred)
- Number of visits during pregnancy mirrors other implementation settings
 - Median number of visits 9 visits
 - Similar to other evidence from multistate evaluations that included NFP
 - Program expects up to 12 visits during pregnancy

No impact on birth outcomes

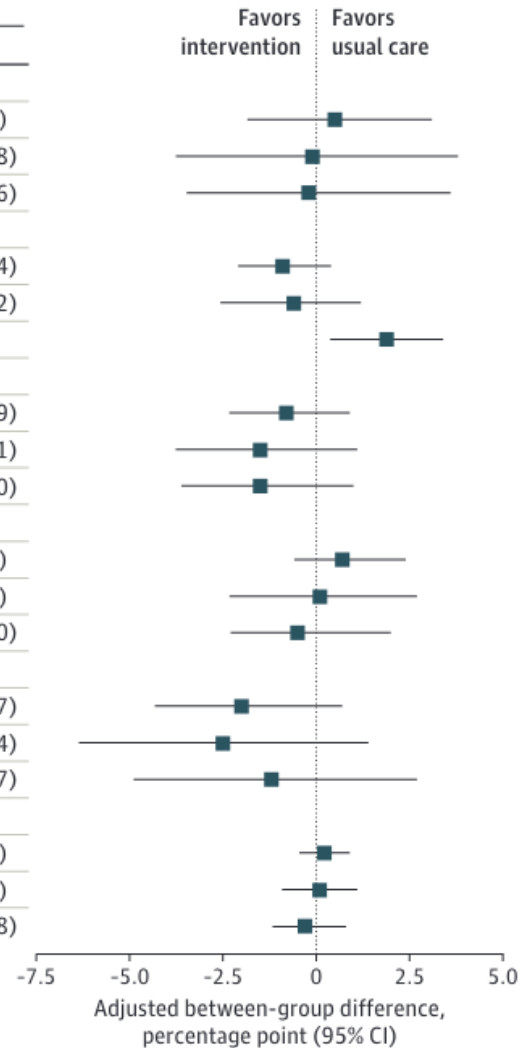
Table 3. Effects of Intervention on Primary and Secondary Outcomes Related to Maternal and Newborn Health

Outcomes	No./total (%) ^a		Between-group difference, percentage point (95% CI)	
	Nurse home visiting group	Usual care group	Unadjusted ^b	Adjusted ^c
Primary outcome ^d				
Composite adverse birth outcome ^e	892/3319 (26.9)	430/1647 (26.1)	0.8 (-1.8 to 3.4)	0.5 (-2.1 to 3.1)
Secondary infant outcomes (components of primary outcome)				
Small for gestational age ^f	553/3295 (16.8)	265/1637 (16.2)	0.6 (-1.6 to 2.8)	0.7 (-1.5 to 2.9)
Low birth weight (<2500 g)	436/3295 (13.2)	219/1637 (13.4)	-0.1 (-2.2 to 1.9)	-0.4 (-2.4 to 1.6)
Preterm (<37 wk gestation)	379/3295 (11.5)	190/1637 (11.6)	-0.1 (-2.0 to 1.8)	-0.5 (-2.4 to 1.3)
Neonatal morbidity ^g	328/3295 (10.0)	144/1637 (8.8)	1.2 (-0.6 to 2.9)	0.7 (-1.1 to 2.4)
Very low birth weight (<1500 g)	78/3295 (2.4)	48/1637 (2.9)	-0.6 (-1.5 to 0.4)	-0.7 (-1.6 to 0.3)
Extremely preterm (<28 wk gestation)	32/3295 (1.0)	16/1637 (1.0)	0.0 (-0.6 to 0.6)	0.0 (-0.6 to 0.5)
Perinatal mortality ^h	27/3319 (0.8)	10/1647 (0.6)	0.2 (-0.3 to 0.7)	0.3 (-0.3 to 0.8)
Secondary infant outcomes (not in primary outcome)				
Overnight NICU stay ⁱ	241/3046 (7.9)	128/1497 (8.6)	-0.6 (-2.3 to 1.1)	-0.8 (-2.5 to 0.9)
Large for gestational age ^f	166/3295 (5.0)	95/1637 (5.8)	-0.8 (-2.1 to 0.6)	-0.9 (-2.3 to 0.4)
Birth weight, g			-10.4 (-46.8 to 25.9)	-7.8 (-43.7 to 28.0)
No.	3295	1637		
Mean (SD)	3085.2 (609.6)	3095.7 (622.0)		
Gestational age, wk			0.1 (-0.1 to 0.2)	0.1 (0.0 to 0.2)
No.	3295	1637		
Mean (SD)	38.2 (2.3)	38.1 (2.3)		
Secondary maternal level outcomes				
Cesarean delivery	1015/3295 (30.8)	530/1637 (32.4)	-1.6 (-4.3 to 1.2)	-2.0 (-4.7 to 0.7)
Severe maternal morbidity ^j	56/3464 (1.6)	23/1694 (1.4)	0.3 (-0.5 to 1.0)	0.2 (-0.5 to 0.9)

No impact on birth outcomes

Figure 2. Effect Heterogeneity

Outcomes	No./total (%)		Between-group difference, percentage point (95% CI)	
	Nurse home visiting ^a	Usual care ^a	Unadjusted ^b	Adjusted ^c
Composite adverse birth outcome				
Whole sample	892/3319 (26.9)	430/1647 (26.1)	0.8 (-1.8 to 3.4)	0.5 (-2.1 to 3.1)
Vulnerable subgroup	423/1567 (27.0)	198/737 (26.9)	0.1 (-3.8 to 4.0)	-0.1 (-4.0 to 3.8)
Non-Hispanic Black	547/1713 (31.9)	269/852 (31.6)	0.4 (-3.5 to 4.2)	-0.2 (-4.0 to 3.6)
Large for gestational age^d				
Whole sample	166/3295 (5.0)	95/1637 (5.8)	-0.8 (-2.1 to 0.6)	-0.9 (-2.3 to 0.4)
Vulnerable subgroup	67/1554 (4.3)	37/733 (5.0)	-0.7 (-2.6 to 1.1)	-0.6 (-2.5 to 1.2)
Non-Hispanic Black	68/1705 (4.0)	18/846 (2.1)	1.9 (0.4 to 3.3)	1.9 (0.4 to 3.4)
Overnight NICU stay^e				
Whole sample	241/3046 (7.9)	128/1497 (8.6)	-0.6 (-2.3 to 1.1)	-0.8 (-2.5 to 0.9)
Vulnerable subgroup	118/1441 (8.2)	64/681 (9.4)	-1.2 (-3.8 to 1.3)	-1.5 (-4.1 to 1.1)
Non-Hispanic Black	133/1572 (8.5)	74/769 (9.6)	-1.2 (-3.6 to 1.3)	-1.5 (-4.0 to 1.0)
Neonatal morbidity^f				
Whole sample	328/3295 (10.0)	144/1637 (8.8)	1.2 (-0.6 to 2.9)	0.7 (-1.1 to 2.4)
Vulnerable subgroup	160/1554 (10.3)	73/733 (10.0)	0.3 (-2.3 to 3.0)	0.1 (-2.6 to 2.7)
Non-Hispanic Black	168/1705 (9.9)	82/846 (9.7)	0.2 (-2.3 to 2.6)	-0.5 (-2.9 to 2.0)
Cesarean delivery				
Whole sample	1015/3295 (30.8)	530/1637 (32.4)	-1.6 (-4.3 to 1.2)	-2.0 (-4.7 to 0.7)
Vulnerable subgroup	427/1554 (27.5)	219/733 (29.9)	-2.4 (-6.4 to 1.6)	-2.5 (-6.5 to 1.4)
Non-Hispanic Black	553/1705 (32.4)	283/846 (33.5)	-1.0 (-4.9 to 2.9)	-1.2 (-5.0 to 2.7)
Severe maternal morbidity^g				
Whole sample	56/3464 (1.6)	23/1694 (1.4)	0.3 (-0.5 to 1.0)	0.2 (-0.5 to 0.9)
Vulnerable subgroup	26/1625 (1.6)	11/759 (1.4)	0.2 (-0.9 to 1.2)	0.1 (-1.0 to 1.1)
Non-Hispanic Black	28/1789 (1.6)	15/875 (1.7)	-0.1 (-1.2 to 0.9)	-0.3 (-1.3 to 0.8)



Results: impact on birth outcomes

- Substantial adverse outcomes (26% for full sample control group)
 - large racial disparities (31% for Black study participants control group)
- No impact on primary or secondary outcomes
- No improvement in outcomes for any subgroup
- Consistent with findings from recent evaluations looking at birth outcomes (MIHOPE, FNP in UK)

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Limitations

- Results are incomplete pending the analysis of other primary outcomes related to child well-being and maternal life-course
- The use of administrative data doesn't allow us to capture participant's subjective well-being or subjective experience in the program

Discussion – why no impact on birth outcomes

- Major changes since original trials (expansion of Medicaid coverage during pregnancy, lower rates of adolescent pregnancy, smoking)
 - Nonetheless we still see high and inequitable rates of adverse birth outcomes
- Most striking pattern of adverse outcomes is driven by racial inequities
 - Outcomes may be driven by pre-pregnancy health or structural factors (racism, poverty) program not designed to address
- Trial population already well connected to clinical services (~85% had already received prenatal care prior to enrollment)
 - In-home nurse visiting may be appealing to those already receiving services
 - Future analyses will compare study population to likely eligible population

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- Questions?

THANK YOU