Implementing an Interpregnancy Care Project among Rural and Urban Mississippi Cohorts

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Abstract

The Interpregnancy Care Project of Mississippi investigated whether primary health care and social support following very low birthweight delivery improved subsequent child spacing and pregnancy outcomes among low income black women. Two cohorts of women were enrolled following very low birthweight deliveries: an urban cohort (n=47) and a rural cohort (n=85). Subsequent reproductive outcomes were compared with retrospective control cohorts. In the urban group, pregnancies within nine months were significantly lower (p=0.05) for intervention participants. Although not significantly different, the trend for fewer pregnancies and adverse outcomes was positive at 9 and 18 months in both urban and rural intervention groups. Two important study findings include identification of implementation barriers (providers, transportation, continuity of care) and identification of previously unrecognized or inadequately managed chronic conditions (urban 62%; rural 63%) associated with adverse pregnancy outcomes. Increasing interpregnancy care implementation and primary healthcare access for low income Mississippi women will reduce very low birth weight deliveries and, subsequently, their chronic health problems and exorbitant costs.

Keywords: Infant mortality, low birth weight, premature birth, interpregnancy care, preconceptual care

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In the United States, low birth weight (LBW; < 2500 grams) remains the leading cause of black infant mortality.[1] Survivors of very low birth weight (VLBW; < 1500 grams) frequently experience severe chronic health problems and lifelong disability. The black vs. white disparity (2:1) in infant mortality persists throughout the United States, and the rate of VLBW is nearly 3 times greater among black infants.[1,2] The societal costs of the outcomes of these pregnancies – physical, emotional, and fiscal – soar into the billions.[3,4] Mississippi (MS) has the highest percentage (43%) of infants born to blacks of any state in the nation (Massachusetts-7%), and the socioeconomic and public health impacts are dramatic.[5]

Recent research has focused on fetal origins of adult chronic diseases such as obesity, diabetes, and hypertension.[6,7] Poor pregnancy outcomes, such as VLBW, are often trans-generational problems, more common among less healthy women experiencing difficult socioeconomic conditions and lacking access to comprehensive primary health care and social support.[8,9]

The best clinical predictor of a VLBW delivery is a maternal history of previous VLBW delivery.[10] The 2014 rate of VLBW for the general U.S. population was 1.4% of live births.[11] In the same year, Mississippi VLBW deliveries accounted for only 2.3% of the 38,736 live births but 49% of infant deaths.[12] After the first VLBW birth, black women have a 13.4% chance of having another VLBW birth.[10] These figures double among adolescent pregnancies and progressively rise with each additional VLBW birth.

Life course theory proposes that adverse pregnancy outcomes may be the product of events that occur throughout life rather than simply events incurred during pregnancy.[13] Thus, addressing social, economic, and physical life course experiences prior to pregnancy could reduce adverse pregnancy outcomes. Multiple research studies suggest that strategies offering the highest potential for healthy full-term births include preconceptual and interpregnancy care.[14,15,16,17] A recent opinion of the American College of Obstetricians and Gynecologists (ACOG) promotes optimizing postpartum, or interpregnancy care, as an ongoing process, rather than a limited patient encounter.[18]

Availability of interpregnancy care services is limited in rural, medically underserved Mississippi. Socioeconomically challenged Mississippi women encounter difficulty securing health care coverage and reproductive planning in the interpregnancy period. Mississippi did not expand Medicaid, leaving Medicaid coverage for able-bodied adults as nearly non-existent.[19] Mississippi Medicaid eligibility covers only the pregnancy period and up to 60 days post-partum. Consequently, many women do not receive medical care for chronic health conditions except during pregnancy when they gain Medicaid eligibility, thus decreasing the likelihood of optimal maternal health. It is well established that health care access in Mississippi remains an important issue. Mississippi is the most medically underserved state in the nation. The Health Resources & Services Administration (HRSA) federally designates at least part of all 82 Mississippi counties as medically underserved.[20] Subspecialty services such as high-risk prenatal care may be difficult to acquire.

Program Description

The goal of interpregnancy care for women who have delivered VLBW infants is not to limit pregnancies but to increase the interval between pregnancies. This strategy is known to be safer for the woman. Specifically, the outcome of future pregnancies and the overall health and well-being of the mother should improve.

Considering the contribution of VLBW to infant morbidity and mortality, and especially given the above challenges, Mississippi was deemed an optimal setting to implement an interpregnancy program modeled after the Grady Memorial Hospital program in Atlanta, Georgia.[14] Following the Atlanta project model and using a similar database, forms, and program strategies, the Interpregnancy Care Project of Mississippi (IPCM) developed a pilot project to be implemented within two regions of the state. One region was the rural Mississippi Delta (aka DIME), and the other was a more urban, metropolitan region (aka MIME). These locations provide two perspectives (rural vs. urban) on implementing interpregnancy care.

Since the IPCM enrolled black, low income women exclusively, issues of cultural sensitivity and ethical training of the staff were extremely important. All authors completed CITI training (Research Ethics and Compliance Training) prior to approval of the project and annually. CITI training specifically addresses ethical concerns that have arisen in the past regarding medical research on vulnerable populations (such as the Tuskegee experiments on African Americans). UMMC and the Mississippi Department of Health (MSDH) require cultural and sensitivity training upon employment and annually for all staff.

The lead IPCM project partners included the University of Mississippi Medical Center (UMMC) and the Mississippi State Department of Health (MSDH). The MSDH is Mississippi's legislatively authorized public health agency, and UMMC is Mississippi's level 4 care center for maternal and infant health.

At the time of discharge following the birth of a VLBW infant, women were identified and enrolled in the IPCM. Each participant established a comprehensive health plan, including reproductive planning. The goal was to delay subsequent pregnancies for a minimum of nine - 18 months, which is a well-documented benchmark for child spacing.[21] The IPCM provided participants 24 months of primary, continuous health care, enhanced nurse case management, and community outreach via *resource mothers*. Resource mothers were a unique aspect of the project. The concept of "resource mothers" (non-professional, community health workers) was to connect them with the participant women. The resource mothers who were black, ages 22-60, and lived in the community, would provide "individualized" support to the participants (i.e., 1:1 relationships). "Individualized" meant getting to know the participant, reinforcing the importance of compliance with medications and clinic appointments, and assisting with transportation. The workers also provided social support by focusing on education, job training skills, parenthood preparedness, and safe housing through group meetings, home visits, and telephone contact. Since the resource mothers did not need to be professional social workers or registered nurses, they provided an important opportunity for cost savings. The resource mothers were recruited, trained, and supervised by the district health social workers and registered nurses. A training manual was developed by MSDH specifically for the IPC project. The authors and our consultant from Emory visited the district health offices for in-service training.

Primary health care was provided by local family physicians and federally qualified community health centers (FQCHC). They addressed vital areas epidemiologically linked to VLBW delivery, including poorly managed risk factors, chronic health conditions, psychosocial issues, and short interpregnancy intervals.

The first IPCM aim was to compare health outcomes among IPCM participants before and after the intervention. The second aim was to compare pregnancy outcomes among IPCM intervention and control cohorts. Across cohorts, the program compared interpregnancy intervals, birth weight distributions, birth outcomes, morbidity, and mortality among subsequent pregnancies conceived within 18 months of the index VLBW delivery. Overall, the project aimed to assess the feasibility and acceptability of delivering interpregnancy care to women in two geographic communities with differing access to medical and enabling services.

Ethical and Funding Considerations

The study received dual oversight and approval by the Institutional Review Boards (IRB) of UMMC and MSDH and was carried out in compliance with the approved protocol and ethical standards throughout all interactions with program participants. The consent form included all CITI training and IRB guidelines and was approved for implementation. The content was the same as the form previously approved by Emory University in the Georgia IPC project.

The IPCM was funded through a combination of community and state sources. The Delta Health Alliance initially provided financing for the rural arm of the study later covered by the MSDH. The MSDH funded the primary health care component of the metropolitan arm of the project. UMMC provided the care through the West Jackson Family Medicine Clinic. A March of Dimes grant funded the resource mother in the metropolitan area.

Although Medicaid transportation was available, it did not allow family members (i.e., their children) to travel. Bus vouchers were offered to these participants for transportation to clinic visits, pharmacy, group meetings, and visiting their infants. In DIME, $50 Wal-Mart cards were also available for transportation to clinics and pharmacy which were up to 50 miles away. There were no other rewards or enticements.

Methods

Study Design

This study compared subsequent reproductive outcomes of two black, female cohorts among rural and urban arms of the study. The urban study arm, the Metropolitan Infant Mortality Elimination (MIME), included Hinds County in central Mississippi (Jackson). The rural study arm, the Delta Infant Mortality Elimination (DIME), incorporated 18 Mississippi River Delta counties. Black retrospective control cohorts, geographically and socioeconomically matched to their respective intervention cohorts, had delivered VLBW infants within 24 months prior to the initial IPCM enrollment.

The study team estimated sample sizes for each of the MIME and DIME intervention and control groups to be at least 62 participants, for a total of at least 248 subjects (statistical significance level 0.05; power level 0.80). Intervention group to control group ratios were 1:1 for both the MIME and DIME study arms. The IPCM intervention was implemented and performed through UMMC's West Jackson Family Medical Clinic, MSDH county health departments, two rural family practice clinics, and federally qualified comprehensive community health centers in the target regions.

Sample

Within all cohorts, enrollment eligibility criteria were identical except for county of residence. Eligibility criteria included black race, indigent care status (operationalized as Medicaid eligibility), and a VLBW infant born or treated at UMMC. Residential eligibility for the MIME required permanent maternal residence in Hinds County. DIME eligibility required permanent maternal residence in one of the 18 Delta counties. MIME and DIME enrollment occurred consecutively among consenting participants following delivery of a VLBW infant. All women who met the eligibility requirement were approached to participate. The same clinical coordinator, a women's health nurse practitioner, consented and enrolled all participants except one. That participant was enrolled by the principal investigator.

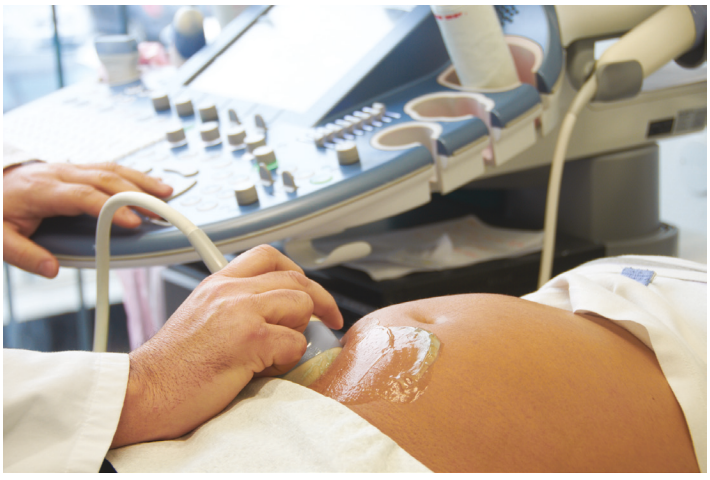
The study team identified control cohort candidates using maternal demographic information from a perinatal database of VLBW infants delivered or transferred into the UMMC Neonatal Intensive Care Unit (NICU). Inclusion criteria for the retrospective control cohort candidates included black race, county of residence, age, prior LBW or preterm delivery, and indigent status. Historical controls were matched one for one by census tracts, residing either nearest the intervention participant or a closely matching proxy census tract. Other control cohort eligibility criteria were the same as for intervention participants.

Measures and Outcomes

As with the Atlanta project, primary outcomes of interest were the number of pregnancies conceived within 18 months of the index VLBW delivery and the number of those pregnancies with adverse outcomes.[14] In this study, the operational definition of adverse pregnancy outcome included ectopic pregnancy, pregnancies ending in late spontaneous abortion (12-20 weeks of gestation), stillbirth, or the live birth of an LBW infant (< 2,500 grams). The interpregnancy interval, expressed in months, was calculated by subtracting the date of the index delivery (ID) from the date of the subsequent delivery (SD), minus the estimated gestational age (EGA) of the subsequent delivery, divided by 30.

$$\left[\frac{SD - ID - EGA}{30}\right]$$

Data related to women's past medical and obstetrical histories, outcomes of index deliveries and subsequently conceived pregnancies were collected by UMMC medical record review. For the intervention cohort, IPCM program records, such as personalized reproductive plans, diagnostic and treatment records, and psychosocial support service documentation provided additional data.



Data Analysis

Participants' baseline social, medical, and obstetrical characteristics were compared across cohorts. Proportions of women who became pregnant within 18 months of the index delivery were measured using Fisher's exact test. Replicating the Atlanta project, Poisson regression evaluated intervention effect by comparing event counts that occurred more than once. Multivariable Poisson regression investigated the effect of potential confounders (number of previous terms and preterm deliveries, whether labor was spontaneous or induced, maternal age, or multiple gestations). Data analysis used SAS Version 9.2.

Results

The primary desired outcome for all IPCM program participants was the minimally desirable interpregnancy spacing of nine months, but ideally the interpregnancy spacing of eighteen or more months.[21] Forty-five of 47 MIME and 79 of 85 DIME intervention participants achieved the desired nine-month interpregnancy interval.

MIME Cohort Findings

Twenty-nine (62%) of the 47 MIME intervention cohort participants completed 12 months of the 24-month intervention. These 29 women comprised the research sample used to determine the effectiveness of the MIME program in identifying and managing chronic and acute diseases. Among MIME participants, 24% held no high school diploma or GED, and 66% were unemployed.

MIME participants experienced 73% fewer pregnancies conceived within nine months of the index delivery (2 vs. 7). Using the Poisson Regression method, pregnancy numbers were significantly lower (p=0.05) within the intervention cohort. At nine months, there was one adverse pregnancy outcome (ectopic pregnancy) in the intervention group as compared with three in the control group. At 18 months, the intervention group had 43% fewer pregnancies (7 vs. 12), although not statistically significant (p=0.17). Three of the seven pregnancies had an adverse outcome, including one VLBW birth, as compared with seven adverse outcomes in the control group (p=0.20). Tables 1, 2, 3, and 4 summarize additional MIME cohort findings.

Table 1. Baseline Characteristics of intervention and control cohorts.

	MIME			DIME		
Characteristic	IPCM cohort (n=47)	Control cohort (n=47)	P-value[a]	IPCM cohort (n=85)	Control cohort (n=85)	P-value[a]
Maternal Age group			.70			.49
Teenagers (< 20 years)	9 (19%)	6 (13%)		23 (27%)	18 (21%)	
20 yrs ≤ Age < 35 yrs	37 (79%)	40 (85%)		56 (66%)	63 (74%)	
Advanced age (≥ 35 yrs)	1 (2%)	1 (2%)		6 (7%)	4 (5%)	
Primiparous	14 (30%)	11 (23%)	.48	25 (29%)	32 (38%)	.26
Previous term	16 (34%)	13 (28%)	.50	30 (35%)	27 (32%)	.63
Previous preterm	19 (40%)	13 (28%)	.19	22 (26%)	17 (20%)	.36
Previous abortion	16 (34%)	20 (43%)	.40	23 (27%)	24 (28%)	.86
Preeclampsia/ eclampsia	15 (32%)	9 (19%)	.16	17 (20%)	23 (27%)	.28
Hypertension	13 (28%)	7 (15%)	.13	24 (28%)	16 (19%)	.15
Diabetes	2 (4%)	–	.50[b]	4 (5%)	5 (6%)	.73[b]
Single (marital status)	40 (85%)	–	–	74 (87%)	–	–
Illicit substance abuse	8 (17%)	5 (11%)	.37	17 (20%)	8 (9%)	.05
Tobacco abuse	11 (23%)	6 (13%)	.18	20 (24%)	9 (11%)	.03
Multiple gestation	8 (17%)	9 (19%)	.79	9 (11%)	10 (12%)	.81
Stillbirth	1/55 infants	0/56 infants	.50[b]	5/93 infants	2/96 infants	.25
Birthweight mean (range)	1024g (454-1810g)	1055g (417-1735g)	.65[c]	985g (360-1490g)	1028g (480-2020g)	.33[c]

[a]P-value for Chi-square test unless otherwise specified.
[b]P-value for Fisher's exact test.
[c]P-value for independent *t*-test.

Table 2. MIME and DIME participant pregnancy outcomes at 9 and 18 months of follow-up.

	MIME				DIME			
	Intervention		Control		Intervention		Control	
	9	18	9	18	9	18	9	18
Adverse outcomes	1 (2%)	3 (6%)	3 (6%)	7 (15%)	3 (4%)	3 (4%)	4 (5%)	6 (7%)
Live births ≥ 2,500g	1 (2%)	4 (9%)	4 (9%)	5 (11%)	0	1 (1%)	1 (1%)	4 (5%)
Unknown outcome	–	–	–	–	2 (2%)	2 (2%)	0	4 (5%)
Total pregnancies	2 (4%)	7 (15%)	7 (15%)	12 (26%)	5 (6%)	6 (7%)	5 (6%)	14 (16%)

Table 3. Distribution of pregnancies and adverse pregnancy outcomes within 18 months of the index VLBW.

No. of pregnancies conceived within 18 months	Number of women in each cohort experiencing 0, 1, or 2 pregnancies			
	MIME		DIME	
	Intervention (n=47)	Control (n=47)	Intervention (n=85)	Control (n=85)
0	41	36	79	76
1	5	10	6	8
2	1	1	0	1
Sample mean	0.15[a]	0.26[a]	0.07[c]	0.11[c]
No. of adverse pregnancy outcomes within 18 months	**Number of women in each cohort experiencing 0, 1, or 2 adverse pregnancy outcomes**			
	MIME		DIME	
	Intervention (n=47)	Control (n=47)	Intervention (n=85)	Control (n=85)
0	44	41	82	80
1	3	5	3	4
2	0	1	0	1
Sample mean	0.06[b]	0.17[b]	0.04[d]	0.07[d]
Poisson Regression P-values: [a]P-value = 0.17; [b]P-value = 0.20; [c]P-value = 0.18; [d]P-value = 0.25				

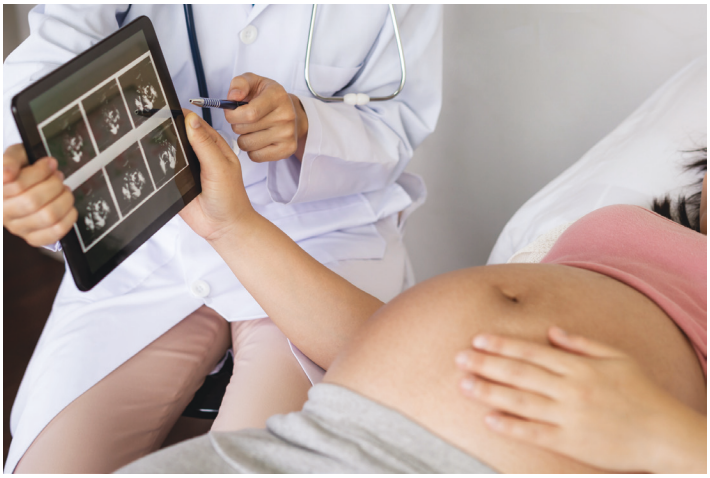
Table 4. Documented health risk factors and conditions by intervention cohort.

		MIME (n=47)	DIME (n=85)
Risk factors	Overweight (25 ≤ BMI < 30)	4 (9%)	6 (7%)
	Obese (BMI ≥ 30)	10 (21%)	17 (20%)
Conditions / Diseases	Hypertension	13 (28%)	24 (28%)
	Diabetes	2 (4%)	4 (5%)
	Asthma	2 (4%)	2 (2%)
	Cardiovascular problems / disease	1 (2%)	5 (6%)
	Gynecological issues / STD	–	5 (6%)
	Kidney disease	1 (2%)	3 (4%)
	Thyroid / Parathyroid problems	–	3 (4%)
	Chronic pain (various locations)	–	10 (12%)
	Grand mal seizures	1 (2%)	–
	Pseudo tumor cerebri	1 (2%)	–
	Severe vitiligo	1 (2%)	–
	Liver problems	–	1 (1%)
	Neurofibromatosis	–	1 (1%)
	Sickle cell trait	–	2 (2%)
Psychosocial / Behavioral Conditions	Substance / Tobacco use	11 (23%)	20 (24%)
	Mental illness / Stress / Anxiety	–	3 (4%)
	Depression	11 (23%)	2 (2%)

Of the 47 women initially enrolled in MIME, 20 (43%) completed the full two years of IPCM intervention and did not become pregnant. Eight (17%) discontinued the program due to subsequent pregnancy. Four (9%) became ineligible due to relocation (n=3) or incarceration (n=1) and one (2%) voluntarily withdrew. The remaining 14 (30%) MIME participants were lost to follow-up.

DIME Cohort Findings

DIME enrolled 85 participants in the intervention cohort, of which 45 (53%) completed 24 months of the IPCM intervention with no pregnancies. Among DIME intervention participants, 59 (69%) completed 12 months of IPC. Thirty-two (38%) were unemployed. Five (6%) DIME intervention participants became pregnant within nine months, as did five within the DIME the control group. At 18 months, there were six pregnancies among the DIME intervention group, as compared to 14 among the DIME control group (p=0.18). There were three adverse pregnancy outcomes among the DIME intervention cohort versus six among the DIME control. Tables 1, 2, 3, and 4 summarize additional DIME intervention and control group findings.



Thirty-nine (46%) DIME participants withdrew during the 24-month intervention period. Of those participants, 15 (18%) discontinued the program due to pregnancy. Nine (11%) became ineligible due to relocation (n=8) or incarceration (n=1). Twelve (14%) voluntarily withdrew. One participant (1%) died in an accident unrelated to the program. Three (4%) were lost to follow-up.

Discussion

HRSA's Maternal and Child Health Bureau leads a national collaborative improvement and innovation network (COIIN) to reduce infant mortality and identifies preconception and interconception care as one of its six COIIN strategies.[24] ACOG agrees and also promotes interpregnancy care.[18] This study identified challenges and barriers to implementation of interpregnancy care among low income Mississippi women.

A statistically significant difference was found in the number of pregnancies at nine months in the metropolitan (MIME) cohort and also fewer adverse pregnancy outcomes. There were also fewer pregnancies and adverse outcomes in MIME at 18 months, and fewer pregnancies and adverse outcomes in DIME at 9 and 18 months. However, these findings did not reach statistical significance. The lack of statistical significance might be explained by the small sample size due to participant attrition.

Strikingly, nearly two-thirds (62% in MIME and 63% in DIME) of the 132 women in both intervention groups had one or more previously unrecognized or poorly managed chronic or high-risk conditions. This finding has significant long-term implications since women who experienced preterm and particularly very preterm (<32 weeks) delivery may be at increased risk for future cardiovascular events including myocardial infarction and stroke.[23]

Systems-level Findings

Among both MIME and DIME cohorts, barriers were found at all three levels of the health care delivery system (as described by Dr. Alfred W. Brann, Jr., 2017, personal communication): 1) Informal- mother, family, community; 2) Formal- providers, institutions, systems; and, 3) Intersection- transportation, insurance, education. As anticipated by the design of the project, the urban and rural settings – one highly resourced and one poorly resourced – varied in feasibility and acceptability of the intervention.

Informal systems. In both MIME and DIME, women agreed to reproductive plans, stating a desire to defer pregnancy for 9-18 months. However, between 40-50% of participants missed their six-week postpartum appointment secured before discharge. These women may have been without contraception for an extended period. The clinical coordinator enrolled all participants at 24-48 hours postpartum before hospital discharge and then forwarded all information to local staff and clinics, who attempted to make contact within 2 weeks.

In retrospect, multiple barriers may have contributed to noncompliance with the postpartum visit. Knowledge gaps related to the significance of followup, stress associated with premature delivery and possibly critically-ill infant, ongoing treatment of medical conditions at the time of delivery, and lack of familiarity with the healthcare system may all have played a role. Additional barriers included social factors among many women living in multigenerational households with weak family support. Community support for daycare, deferring pregnancy, and encouraging education were sparse. In some instances, participants came from situations of instability and violence. Among both intervention cohorts, women continually experienced overwhelming complexities, including limited education, unemployment, housing problems, and poverty. Participants existed in *double jeopardy* since they were both medically and socioeconomically at risk.

Formal systems. MIME and DIME groups encountered different barriers. Of note, specialized Medicaid providers remain basically nonexistent in some DIME counties. DIME is a poorly resourced, largely rural area. The Mississippi River Delta is approximately 200 miles long and some 70 miles wide. Mississippi Medicaid lists 35 obstetrical providers for the 18 counties included in the DIME project area.[22] The 35 obstetrical providers are disparately distributed across the DIME counties. Fourteen of the 35 obstetrical providers are in Desoto County which is a suburb of Memphis, TN. Nine counties have no Medicaid obstetrical providers.

In stark comparison, MIME is in a highly resourced urban community. Mississippi Medicaid lists more than 60 obstetrical providers in Hinds County alone, with many more in neighboring Madison and Rankin Counties.[23]

In MIME, one resource mother and one female family medicine physician followed all the patients. Despite 1:1 contact with the women and availability of a dedicated support system, many women were lost to followup. The lack of adequate tracking systems exacerbated this problem. Several participants who became pregnant did not initially reveal their pregnancies, citing a desire to stay in the program. However, for these women, the program did not seem to engender health-seeking behaviors, which may take a longer period of participation.

In DIME, care provision obstacles were often the product of participant distribution across a poorly resourced and large geographic area. Most participants were merged into existing [and understaffed] county public health clinics, which proved problematic in consistently delivering the proposed level of individualized care. From project onset, the resource mother role had to be modified to cover the larger geographical area. The substitution was a revolving list of social work students. The intent of the resource mother role was to provide an individualized, community-based support system for program participants. The intermittent student workers could not provide consistent, individualized, *maternal-like* care, largely due to inexperience.

Intersection of systems. Transportation has historically presented a barrier to delivering health care in Mississippi. In the Mississippi Delta, few communities have public transportation. Public programs place restrictions on who may be present when utilizing services. Medicaid transportation frequently declined to transport the mother's children with her if the children did not have a concomitant Medicaid-covered medical appointment. Wal-Mart vouchers for gas and pharmacy were offered to facilitate access to transportation and prescription medications. Again, geographic rurality interfered, since some participants lived more than 50 miles from the nearest Wal-Mart.

In MIME, bus vouchers were available but with similar barriers. Mothers were prohibited from boarding city buses with technology-dependent infants. Other transportation options were explored but proved fruitless. Liability risks eliminated the use of volunteers, churches or resource mothers to provide transportation.

Comparison with Atlanta project. The Atlanta study demonstrated the importance of interpregnancy care in a densely populated, highly urbanized area. All care was provided at a large, urban, county supported hospital. The pay source was not an issue. Care and pharmacy were available at this single location. Participants had access to a metro subway system, so transportation was not an impediment. Important findings were a significant reduction in pregnancies conceived within 18 months of index VLBW birth and reduction in adverse pregnancy outcomes in the intervention cohort. The Mississippi study identified barriers to implementation and potential solutions to overcome these barriers. Therefore, the studies are complementary and should benefit Mississippi, Georgia and other states wishing to implement an IPC program particularly in rural areas. In addition, a subsequent project in Georgia has initiated "Gateways," which is a support system for IPC participants to encourage enrollment and compliance.

Future Plans. Further exploration of the feasibility and acceptability of interpregnancy care among diverse communities and populations is warranted. To clarify, future plans to implement interpregnancy care may address: 1) offering long-acting reversible contraception (LARC) prior to hospital discharge; 2) deferring enrollment to provide more in-depth education and understanding of the program; 3) developing a strategy to address the special problems of distance and resources in rural areas; 4) obtaining consent at enrollment to follow the women and their offspring to determine the long-term impact of IPC on health-seeking behaviors and pregnancy outcomes; 5) establishing a primary care medical home for high-risk women; 6) funding and liability insurance for transportation by community health workers; 7) establishing a Medicaid waiver to provide primary health care to low income, medically high risk women during the interpregnancy period; and 8) engaging community stakeholders as partners to address social barriers to care.

Community involvement will be extremely important to the successful implementation of future IPC programs. Obviously, professional organizations such as the American Academy of Pediatrics, the American Academy of Family Physicians, and associations of educators should coordinate their efforts. Churches, particularly in the Deep South, have been recognized as important resources. Volunteer and advocacy associations are commonly anxious to participate and support programs to improve the lives of at risk women and their children.

For example, Oren Renick, JD, MPH, Th.M., Professor of Health Administration, Texas State University, supervises a student volunteer service in San Marcos which provides transportation, respite care, and home maintenance services to elderly and disabled recipients. The program is associated with the National Volunteer Caregiving Network. It is an intergenerational model called the *Mutual Adoption Pact*. It has found that connecting elders and youth benefits both groups. The students provide needed services, and the elders become mentors. Subsequently, hospitals, local churches, and businesses have become involved, which benefits the community (Oren Renick, personal communication, 2019).

Conclusion

Interpregnancy care provides a unique and potentially valuable contribution of care to a very small (2%) but very high-risk group of women. However, program administration and implementation remain fraught with challenges at all levels of the healthcare system. The IPCM enrolled 132 postpartum women, individually matched with 132 controls. Nearly two-thirds of MIME (62%) and DIME (63%) participants had at least one chronic condition or risk factor epidemiologically linked to VLBW, either previously unrecognized or poorly managed. Forty-five (96%) MIME and seventy-nine (93%) DIME cohort participants achieved the desired nine-month child spacing. Our study identified

multiple, correctable barriers (transportation, provider access, and limited continuity of care) in the rural, underserved Delta region. Despite more easily accessible services in the urban setting, participant utilization was less than anticipated. Future implementation plans should address solutions that ameliorate primary health care and socioeconomic issues faced by high risk, childbearing aged women. Decreasing medical risks and improving child spacing have been shown to reduce long-term morbidity, mortality, and exorbitant costs associated with adverse birth outcomes.[14]

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Dr. Brann is a Professor of Pediatrics at the Emory University School of Medicine. He is Director of the Global Collaborating Center in Reproductive Health (GCC/RH) in the Woodruff Health Sciences Center of Emory University. Dr. Brann is also the Director of the Global Collaborating Center in Reproductive Health for the World Health Organization and has consulted on infant mortality reduction projects in Russia, Cuba, Mexico, Atlanta, and Mississippi. In 2014 Dr. Brann was selected as the first recipient of the Alfred W. Brann Chair in Pediatrics for Reproductive Health and Perinatal Care, designated for the person who directs the GCC/RH. This endowed chair was established by the very generous gift of Drs. Ann and Frank Critz to Emory University. The Critzes live in Atlanta. They were both graduates of the University of Mississippi School of Medicine, Class of 1969.

Conflict of Interest Disclosures: *The authors have nothing to disclose.*

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