

# Evaluation of a Program for Prenatal Care Case Management

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*A prenatal care case-management program in Tennessee was evaluated to determine its effectiveness in improving the adequacy of prenatal care and reducing the odds of preterm birth (gestation less than 37 weeks) and very low birth weight births (less than 1,500 g). The case-management program, Project HUG, included care provider referrals, visit scheduling, assistance with transportation and nutritional and health education. In a cohort of 66,051 Medicaid women with a birth during the period July 1989 through December 1991, 6% received HUG services. HUG participants had improved utilization of prenatal care, significantly decreased odds of inadequate prenatal care (an odds ratio of 0.71) and significantly increased odds of obtaining prenatal vitamins within 120 days of the last menstrual period (1.79). The apparent benefit of Project HUG was greater among blacks than among whites. However, there was no significant reduction in the incidence of preterm births or very low birth weight births among program participants.*

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Strategies to reduce the high rate of infant mortality in the United States have had two components: prevention of preterm births and improvement in the survival rate of premature infants. The reduction in infant mortality in the last 20 years (from 18 deaths per 1,000 live births in 1973 to nine per 1,000 in 1992<sup>1</sup>) largely reflects advances in neonatal medicine that have improved survival for premature infants.<sup>2</sup> However, prevention of preterm birth has been more elusive; the proportion of infants born weighing less than 1,500 g was 1.1% in 1973 and 1.3% in 1992.<sup>3</sup> Further reduction in infant death rates will require better prevention of preterm births.<sup>4</sup>

Evidence suggests that inadequate prenatal care is associated with an increased risk of prematurity,<sup>5</sup> and that among women at highest risk of adverse outcomes, financial barriers to obtaining prenatal care are significant obstacles.<sup>6</sup> Therefore, recent U. S. efforts to prevent preterm births have focused on removing these barriers. The major federal initiative has been modification of the Medicaid program to include more pregnant women and to remove administrative barriers to enrollment during early pregnancy.<sup>7</sup> For example, in Tennessee, the proportion of

births in which the mother was enrolled in Medicaid on the date of delivery increased from 17% in 1983 to 51% by 1992. Similar initiatives by state and other governmental entities have sought to fund prenatal care for the uninsured.<sup>8</sup>

However, financial access to prenatal care does not guarantee that such care will be obtained or will be of high quality.<sup>9</sup> Other potential barriers include provider availability, transportation, social support and behavioral factors.<sup>10</sup> One proposed solution to these problems is case management, where a medical or social service professional coordinates prenatal care and provides health education.

One of the early programs that enabled states to provide case-management services was the federal Improving Pregnancy Outcome project, a block-grant program that by 1980 was providing funding for 34 states. North Carolina's Improving Pregnancy Outcome program,<sup>11</sup> which targeted low-income mothers and infants in two counties (most of whom were eligible for Medicaid), included a strong case-management component.

A retrospective evaluation of the North Carolina program found that black registrants were 55% less likely to receive less-than-adequate prenatal care after initiation of the program than before, but there was no corresponding reduction in the incidence of low-birth-weight births. However, concerns about the comparability of the control group, which consisted of women with more favorable risk-factor profiles,

and about the limited amount of information on potentially confounding factors, limit the predictive value of this finding.

A smaller, more recent program in a semirural New York setting found that a series of home visitations by nurses improved some aspects of prenatal care utilization, but did not reduce the overall incidence of low birth weight.<sup>12</sup>

To date, no study has convincingly demonstrated that case-management improves birth outcomes. In 1989, Tennessee implemented a health department-based case-management program for women enrolled in Medicaid. The objective of this article is to evaluate that program, focusing on three issues: program utilization by high-risk mothers; changes in the utilization of prenatal care; and changes in the rate of preterm births.

## Methods

### Case-Management Program

The case-management program for Medicaid enrollees, Project HUG (Helping Us Grow), began on July 1, 1989. Women entered the program at the county health department (by walk-in, referral or, in some counties, outreach programs) and were assigned a care coordinator (a registered nurse or social worker). The coordinator completed a baseline assessment of nutritional and family status, obtained medical information from records of other providers and developed a prenatal care plan.

The key elements of the program were identifying care providers, scheduling visits, assisting women with transportation, referring women to nutritional programs, following up after missed appointments, and providing health education. Medicaid reimbursed county health departments for the assessment visit and for the monthly coordination visits over the course of the program and for two months following delivery. Women in 89 of 95 Tennessee counties received HUG services during the study period.

### Cohort

We conducted a retrospective cohort analysis of pregnant Medicaid enrollees who did or did not receive HUG services for the pe-

Joyce M. Piper is deceased. Wayne A. Ray is professor of preventive medicine and Edward F. Mitchel, Jr., is a data analyst and programmer at Vanderbilt University School of Medicine, Nashville, Tenn. The second and third authors dedicate this article to the memory of Joyce M. Piper, "whose untimely death took much from us all." This project was supported in part by grant #18-C-90029 from the Health Care Financing Administration.

**Table 1. Percentage of Medicaid mothers with selected characteristics, by enrollment in a project to improve pregnancy outcomes, Tennessee, 1989–1991**

Characteristic	Enrolled (N=3,859)	Not enrolled (N=62,192)
Black	20.9	38.6***
Age<20	52.6	30.5***
Education<12th grade	59.7	46.8***
Not married	55.1	58.9***
Primiparous	60.0	35.5***
Prior adverse reproductive outcome	3.9	6.1***
Prior pregnancy termination	14.7	19.4***
Smokes cigarettes	33.1	30.9**

\*\*p<.01. \*\*\*p<.001.

riod July 1, 1989, through December 31, 1991. Cohort members were identified from linked Medicaid–vital records files.<sup>13</sup> The linkage between the Medicaid files and vital records was required to assure complete ascertainment of births among Medicaid women and to obtain additional information on the women and their offspring available only from vital records. The study cohort consisted of white or black women with single live births or with fetal deaths whose last menstrual period fell within the study period and who were enrolled in Medicaid from 120 days following the last menstrual period through delivery.

Women of other races were excluded from the study because births to these women accounted for fewer than 1% of deliveries in Tennessee. Women with multiple births were excluded as well, as these births are relatively infrequent and have different outcome expectations than single births. Women who enrolled in Medicaid late in pregnancy lacked the opportunity to obtain HUG services and may have enrolled because of complications of pregnancy. Therefore, these women were not included in the sample.

Also excluded were women with implausible birth weights (less than 500 g or more than 6,000 g) or whose birth weights were not recorded, as well as those with missing demographic information on the birth or fetal death certificates. (Because we did not require Medicaid enrollment for the child in order to ascertain maternal enrollment, the cohort included women who had a stillbirth and women whose newborn infant died prior to Medicaid enrollment.<sup>14</sup>)

**Program Status**

Use of HUG case management during pregnancy was determined from reimbursed Medicaid claims. Women who had claims submitted for HUG case-management services within the first six months following the last menstrual period were

defined as HUG users; women with later or no HUG claims were classified as nonusers. The HUG group excluded women whose only use of HUG was late in pregnancy because such women, by definition, were less likely to have preterm births,<sup>15</sup> and would have had limited opportunity to benefit from HUG services.

**Other Potential Risk Factors**

Vital records provided information on maternal race, age, education, residence in a Standard Metropolitan Statistical Area (SMSA), marital status, reproductive history and cigarette use during pregnancy.<sup>16</sup> A prior adverse reproductive outcome was defined as a prior infant or fetal death, preterm birth, birth weight low for gestational age or an interval of less than 12 months from the most recent pregnancy. Medicaid files<sup>17</sup> provided information on timing of Medicaid enrollment and Medicaid enrollment category<sup>18</sup> (Aid to Disabled or Blind; Aid to Families with Dependent Children; or Pregnancy).

**Outcomes**

The primary study outcomes were prenatal vitamin use, inadequate prenatal care, preterm birth and very low birth weight. As an indicator of prenatal care utilization, we used Medicaid pharmacy files to track prescriptions for prenatal vitamin supplements that were filled during the 120 days following the last menstrual period. We defined inadequate prenatal care by using the modified Kessner index.<sup>19</sup> This index defines prenatal care as adequate, intermediate or inadequate based on the number and timing of prenatal visits in relation to the length of gestation. For example, inadequate care for a full-term pregnancy entails no receipt of prenatal care until the beginning of the third trimester.

Gestational age was the number of complete weeks from the last menstrual period to the date of the birth. If the day of the month of the last menstrual period was missing, we

imputed a value of 15. If the date of the last menstrual period was missing (true of less than 5% of certificates), we estimated this date from the birth weight, using the race-specific distributions of gestational age in the population for whom both gestational age and birth weight were known. Preterm birth was defined as a gestational age of less than 37 weeks. Finally, we defined very low birth weight as a birth weight, taken from the birth certificate, of less than 1,500 g.

**Analysis**

Unconditional logistic regression was used to assess the independent association between enrollment in Project HUG and study outcomes. The model included maternal race, age (younger than 20 vs. 20 and older), education (less than 12 years vs. 12 years or more), marital status, parity (primiparous vs. multiparous), prior adverse reproductive outcome, prior pregnancy terminations and cigarette use. Alternative models that were fit included such additional factors as county of residence, timing and category of Medicaid enrollment, block-group income (from census data<sup>20</sup>) and nonvitamin drug prescriptions during pregnancy (a surrogate measure of illness), as well as additional levels for each factor (e.g., four maternal age-groups). These did not significantly alter the estimates for HUG status, however. Because there is some evidence that prenatal care affects outcomes in blacks to a greater extent than in whites,<sup>21</sup> we performed analyses stratified by race. All p-values are two-sided.

**Results**

During the study period, 83,401 white or black women who met study criteria were enrolled in Medicaid. Of these, 82,841 had adequate data for inclusion; 66,051 had been enrolled in Medicaid from 120 days following their last menstrual period through delivery, and thus were included in the study cohort. Maternal characteristics suggested the women in this cohort were at high risk of adverse outcomes:<sup>22</sup>

**Table 2. Adjusted odds ratios (and 95% confidence intervals) for inadequate prenatal care and adverse birth outcomes, by maternal characteristics**

Characteristic	Inadequate prenatal care	Preterm birth	Very low birth weight
Black	2.66 (2.49–2.83)**	1.81 (1.71–1.92)**	2.00 (1.72–2.32)**
Age<20	1.15 (1.08–1.23)**	1.12 (1.06–1.19)**	1.09 (0.94–1.26)
Education<12th grade	1.53 (1.45–1.62)**	1.09 (1.03–1.15)*	1.14 (1.01–1.30)*
Not married	1.78 (1.66–1.90)**	1.27 (1.20–1.34)**	1.11 (0.96–1.30)
Primiparous	0.40 (0.38–0.43)**	0.96 (0.90–1.02)	1.44 (1.23–1.69)**
Prior adverse reproductive outcome	1.39 (1.27–1.52)**	2.13 (1.96–2.27)**	2.94 (2.50–3.57)**
Prior pregnancy termination	0.68 (0.63–0.73)**	1.03 (0.97–1.10)	1.70 (1.46–1.97)**
Smokes cigarettes	1.24 (1.17–1.32)**	1.10 (1.04–1.16)*	1.18 (1.03–1.35)*

\*p<.05. \*\*p<.01

Thirty eight percent were black, 32% were younger than 20, 48% had less than 12 years of education, 59% were unmarried, 37% were primiparous, 6% had a prior adverse reproductive outcome, 19% had a prior pregnancy termination and 31% were smokers. Overall, 11% of the women in the study cohort received inadequate prenatal care, 13% had a preterm birth and 2% had a very low birth weight birth.

Approximately 6% of the sample (3,859 women) received HUG services within six months of their last menstrual period. The initial HUG visit occurred a median of 96 days following the last menstrual period, and the women made a mean of 5.6 visits. Women using HUG differed significantly from nonusers (Table 1). The HUG mothers were more likely to be younger than 20, to be primiparous and to be smokers, but were less likely to be black, to be unmarried, to have graduated from high school or to have had a prior adverse reproductive outcome or pregnancy termination.

Maternal factors were strong predictors of adverse outcomes for all women in the sample, regardless of HUG enrollment (Table 2). The odds of inadequate prenatal care were greater for women who were black, were unmarried, had not completed high school, were under 20, had smoked during pregnancy or had a prior adverse reproductive outcome. Inadequate care was less likely among primiparous women and among women with a prior pregnancy termination.

The odds both of a preterm birth and of a very low birth weight birth were markedly higher among women who had a prior adverse reproductive outcome or who were black. Smoking and an education of less than 12 years slightly increased the odds of a preterm birth and a very low birth weight birth. Preterm birth was found to be slightly more likely among unmarried women and among women under 20. The likelihood of a very low birth weight birth was greater among women who had a prior pregnancy termination or who were primiparous.

After controlling for these factors, we found that women who received HUG services made better use of prenatal care (Table 3). Women in the HUG group were 79% more likely to have filled a prescription for prenatal vitamins in the first 120 days after their last menstrual period (an odds ratio of 1.79), and 29% less likely to have received inadequate prenatal care (an odds ratio of 0.71). The difference was more pronounced for blacks than for whites. Among black HUG mothers, the odds ratios for early prenatal vitamin receipt and inadequate prenatal care were 2.32 and 0.46, respectively;

these differed significantly ( $p < .05$ ) from the odds ratios of 1.65 and 0.87 seen among white HUG mothers.

There were no corresponding reductions in the risk of adverse pregnancy outcomes. Among HUG mothers, the adjusted relative odds of preterm birth and very low birth weight were 1.13 and 1.03, respectively. In the stratified analysis, there was no evidence of a beneficial effect of HUG for either race. Given that some previous studies have utilized incidence of stillbirths, rather than rate of preterm births, to assess the impact of prenatal

care, we performed a secondary analysis utilizing fetal deaths (ascertained from vital records) as the dependent variable. The findings of that analysis were almost identical to those for preterm birth.

The slight but significant elevation in the rate of preterm births among HUG participants was puzzling. Inspection of the data revealed that several women had very early preterm births at or near the time of their HUG enrollment. This suggested that some women may have enrolled in HUG as the result of pregnancy complications that may have led to premature labor.

To assess the potential for bias due to this phenomenon, we conducted an analysis that required HUG participants to have entered the program within 120 days of their last menstrual period. In this analysis, the odds ratios (and 95% confidence intervals) were 2.37 (2.18–2.58) for prenatal vitamin receipt, 0.70 (0.59–0.84) for inadequate prenatal care, 1.06 (0.94–1.20) for preterm birth and 0.95 (0.69–1.32) for very low birth weight births. Thus, the significant odds ratio for preterm birth in the primary analysis is likely to have resulted from late HUG enrollment of high-risk mothers.

## Discussion

Since the premise that prenatal care decreases the risk of premature birth is both plausible and supported by several observational studies,<sup>23</sup> it is ethically difficult, as well as logistically complex, to conduct rigorous randomized controlled trials of programs or policies designed to enhance prenatal care for women at high risk of premature delivery. In post-hoc evaluations of such pro-

**Table 3. Percentage of Medicaid mothers with selected prenatal and birth outcomes, by project enrollment status, and adjusted odds ratios (with 95% confidence intervals) for these outcomes, all according to race**

Outcome	Enrolled	Not enrolled	Adjusted odds ratio
<b>All women</b>			
Prenatal vitamins in first 120 days	62.2	46.1	1.79*** (1.67–0.92)
Inadequate prenatal care	5.8	10.8	0.71*** (0.61–0.82)
Preterm birth	12.6	12.8	1.13* (1.02–1.25)
Very low birth weight	1.6	1.7	1.03 (0.79–1.34)
<b>Black women</b>			
Prenatal vitamins	63.6	41.9	2.32** (2.00–2.69)
Inadequate prenatal care	7.8	18.2	0.46** (0.35–0.60)
Preterm birth	19.1	18.2	1.10 (0.91–1.31)
Very low birth weight	2.2	2.6	0.87 (0.54–1.40)
<b>White women</b>			
Prenatal vitamins	61.2	48.8	1.65** (1.53–1.79)
Inadequate prenatal care	5.2	6.1	0.87 (0.74–1.03)
Preterm birth	10.9	9.4	1.15* (1.02–1.30)
Very low birth weight	1.4	1.2	1.11 (0.81–1.52)

\* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ . Note: Odds ratios are adjusted for the effects of age, education, marital status, number of previous births, previous adverse reproductive outcomes, previous pregnancy terminations and smoking history. In the overall analysis, odds ratios are adjusted for race as well.

grams, it is difficult to control for variables that may confound program benefits, given the many factors that affect the risk of preterm birth and the likely influence of social and behavioral factors.<sup>24</sup> Thus, there remains considerable scientific uncertainty about the effects of such programs.<sup>25</sup>

Like others of its type, Tennessee's Project HUG was focused on service delivery and did not include a concurrent evaluation component. However, several aspects of the program made it attractive for evaluation. By providing access to Medicaid enrollees (a high-risk population), the program eliminated the financial barrier to prenatal care. Since the case-management services were reimbursed by Medicaid, county health departments had an incentive to provide these services. Finally, a linked Medicaid-vital records database,<sup>26</sup> which provided essential demographic and reproductive information, was in place for evaluation. Unfortunately, this database lacked information on such potentially important factors as nutritional status, health behavior and intercurrent complications of pregnancy.

The HUG program reached only a small fraction of high-risk mothers. Overall, only 6% of women in the Medicaid cohort received HUG services in the first six months of pregnancy; among blacks, who are at greatest risk of adverse outcomes, only 3% of women used HUG. We were unable to ascertain what percentage of Medicaid enrollees obtained their prenatal care through county health departments. The low penetration of the HUG program may be due in part to an underrepresentation of high-risk women visiting those sites. Future pro-

grams may need to include other major public and private providers of prenatal care that serve high-risk women.

We found that women receiving HUG case-management services made better use of prenatal care. The odds of inadequate prenatal care were reduced by 29% in the HUG group, and the odds of filling a Medicaid prescription for vitamin supplements early in pregnancy were increased by 79%. These benefits were greater among blacks than whites. Whether the improvement in prenatal care was due to the effect of HUG per se or resulted from utilization of HUG services by women who would have had better prenatal care in any case cannot be determined from our retrospective analysis.

Even though prenatal care among HUG users was improved, there was no corresponding reduction in risk of preterm births or very low birth weight births, a finding that is consistent with those of other studies.<sup>27</sup> However, our study only had adequate power ( $\alpha=.05$ ,  $1-\beta=.20$ ) to detect reductions in preterm birth and very low birth weight births of at least 14% and 34%, respectively.

Publication of the seminal Institute of Medicine report in 1985 led to the implementation of numerous programs to increase women's financial access to and utilization of prenatal care.<sup>28</sup> Although our study adds to the evidence that such programs increase the use of prenatal care,<sup>29</sup> it also contributes to the scientific uncertainty as to whether such programs ultimately improve outcomes.<sup>30</sup>

However, it is premature to conclude that providing better prenatal care does not reduce the risk of preterm birth. Programs implemented to date have focused on service delivery, and have lacked the means for concurrent evaluation. This has forced analysts to utilize retrospective designs, which may not capture many important risk factors.<sup>31</sup> For this reason, it also has not been possible to fully assess the quality of prenatal care provided by such programs or to determine their efficacy in modifying intervening variables, such as maternal infections or complications of pregnancy. Furthermore, most studies have lacked the power to detect small reductions in adverse outcomes.

Two types of further research would be useful. First, there is a need to rigorously evaluate programs that provide "state of the art" prenatal care, with standard care as the reference. In the absence of such definitive evaluations, the equivocal findings of extant studies may jeopardize the allocation of funds for prenatal care. Second, there is a need to develop and evaluate programs that focus more extensively on

social and behavioral risk factors, which may be as important as customary medical care in reducing the incidence of low birth weight and premature births.

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