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# Weighing Costs and Benefits of Adequate Prenatal Care for 12,023 Births in Missouri's Medicaid Program, 1988

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## Synopsis .....

*Numerous studies have shown that the receipt of adequate prenatal care is associated with improvements in pregnancy outcome, particularly a reduction in the risk of low birth weight. Since medical costs for these low birth weight infants are several times higher than for normal birth weight infants, one would expect that medical costs for newborns would be lower for babies whose mothers have had adequate prenatal care than for those with inadequate prenatal care.*

*Explored in this paper is whether the reduction in Medicaid costs for newborn and post-partum*

*maternal care is greater than the increase in prenatal costs for a Medicaid population. The analysis used a file of 12,023 Missouri Medicaid records linked with the corresponding 1988 birth certificates. A modified version of the Kessner index was used to define the adequacy of prenatal care.*

*Prenatal care costs were \$233 higher for pregnancies with adequate prenatal care than for those in which prenatal care was inadequate. Newborn and post-partum costs starting within 60 days after the birth were \$347 lower for the adequate prenatal care pregnancies, resulting in a savings of \$1.49 for each extra \$1 spent on prenatal care. Among the other factors studied in determining this benefit to cost ratio were global billing, Supplemental Food Program for Women, Infants, and Children (WIC), and participation in Medicaid under the expanded eligibility provisions that were effective in Missouri in 1988.*

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**N**UMEROUS STUDIES (1-5) have shown that the receipt of adequate prenatal care is associated with improvements in pregnancy outcome, particularly a reduction in the risk of low birth weight. Since medical costs for these low birth weight infants are several times higher than for normal weight infants, one would expect that newborn medical costs would be lower for babies when mothers have adequate prenatal care than for those when mothers have inadequate prenatal care. Few studies have been published examining the cost versus benefits of prenatal care. Among those that have been done, most have primarily involved the calculation of synthetic estimates based on various assumptions. Four of these studies (6-9) had benefit-cost ratios ranging from 1.9 to 9.4 to 1. The most widely quoted is the 3.38 to 1 ratio from the 1985 Institute of Medicine's (6) report which had the following statement (6a):

... the provision of more adequate prenatal care services to a cohort of women who are at

*'Mothers in their first pregnancies are more likely to obtain adequate prenatal care. Mothers with inadequate prenatal care are more likely to be unmarried, have less than a high school education, be black, or smoke during pregnancy.'*

high risk of delivering a low birth weight infant could reduce total expenditures for direct medical care of their low birth weight infants by \$3.38 for each additional \$1.00 spent on their prenatal care.

Missouri Department of Health researchers did a study (10) similar to this one involving 1981 and 1982 Medicaid births and found that the increased

Table 1. Selection of study sample, Missouri Medicaid births, 1988

Category	Number
Initial newborn Medicaid population	16,479
Exclusions:	
No matching birth certificate	360
No matching Medicaid record for mother	1,745
Prepaid care plan	221
Mother's paid claims less than \$200	680
Newborn paid claims less than \$200	882
Kessner Prenatal Index unknown	568
Total exclusions	4,456
Final study sample	12,023
Adequate prenatal care	5,639
Intermediate prenatal care	4,435
Inadequate prenatal care	1,949

Table 2. Modified Kessner prenatal care definitions: two-factor prenatal care index controlled for gestation and based upon number of prenatal visits and interval to first prenatal visit

Prenatal care Index	Gestation (weeks)	Number of prenatal visits
Adequate <sup>1</sup>	14-17	and 2 or more
	18-21	and 3 or more
	22-25	and 4 or more
	26-29	and 5 or more
	30-31	and 6 or more
	32-33	and 7 or more
	34-35	and 8 or more
Inadequate <sup>2</sup>	36 or more	and 9 or more
	17-21	and 0
	22-29	and 1 or less
	30-31	and 2 or less
	32-33	and 3 or less
Intermediate	34 or more	and 4 or less
Intermediate	All combinations other than specified above	

<sup>1</sup> In addition to the specific number of visits indicated for adequate care, the interval to the first prenatal visit had to be 3 months or less (first trimester). All women starting care in the first trimester with at least 9 visits were classified adequate.

<sup>2</sup> In addition to the specific number of visits indicated for inadequate care, all women who started their prenatal care during the third trimester (7 months or later) or who had no visits were classified inadequate.

maternal costs associated with providing adequate prenatal care outweighed the reduction in newborn costs within 45 days after birth. The benefit-cost ratios were less than \$0.10 saved for every extra \$1 spent on prenatal care.

Numerous changes have taken place in Medicaid reimbursement and eligibility policies since 1982, including expansion of the Medicaid Program. Therefore, this study is an attempt to update the earlier Missouri study by examining 1988 Medicaid births and costs beginning with the first 60 days following birth.

## Methods

The basic design of this study involves the linking of (a) Medicaid paid claims; (b) birth certificates; and (c) Supplemental Food Program for Women, Infants, and Children (WIC) certifications. The Medicaid file for paid claims was needed to obtain Medicaid cost data and rates of admission to Neonatal Intensive Care Units (NICU). The birth certificate file provided data on prenatal care, maternal characteristics, and birth weight. The WIC file provided data on use of WIC, which can be considered an intervening variable to adjust since WIC has been shown to affect costs (11).

Initially, a computer file of 16,479 newborn Medicaid records was created from Missouri Medicaid claim tapes of January 1988 to September 1989. Only claims for newborns with a first date of service within 60 days of birth, and only babies born in calendar year 1988 were included.

These Medicaid records for newborns were then matched with their mothers' claim records, primarily using a household reference number. All claims for the mother with a date of service within 60 days after or 9 months before the birth of the infant were included. No match was found for 1,745 records, thus resulting in an 89 percent match rate.

The Medicaid records for newborns were then linked to their corresponding birth certificates, using name and date of birth as the principal matching criteria. No match was found for 360 records, resulting in a 98 percent match rate.

Additional exclusions were made so that the final study file contained Medicaid cost data that were as complete as possible. As shown in table 1, 221 records were excluded because of participation in a prepaid care plan, 680 because mothers' total paid claims were less than \$200, and 882 were excluded because claims for newborns totaled less than \$200.

Table 1 shows that after all of these exclusions, (including 568 for missing Kessner index data), the final study sample contained 12,023 records or 73 percent of the original Medicaid newborn file. Adequately cared for mothers accounted for 47 percent of the sample and intermediate care for 37 percent; 16 percent of mothers were classified as having inadequate prenatal care.

Table 2 shows how the adequacy of prenatal care was defined. It is a Modified Kessner (2) Prenatal Care Index based on the number of prenatal visits and interval to first visit controlled for gestational age. In addition to the specific number of visits indicated for adequate care, care had to begin in

the first trimester. All women starting care in the first trimester with at least nine visits were considered to have received adequate care. All women who started prenatal care in the third trimester or who had no care were considered to have received inadequate care. Otherwise, if the month that prenatal care began or number of visits or gestational age is unknown, the index is unknown.

In testing the major hypothesis that adequate prenatal care reduces Medicaid costs after birth and reduces them by more than it increases maternal costs before birth, correlations were run between selected variables and the principal independent variable, prenatal care, and the dependent variables, Medicaid claim amounts before and after birth. Variables that were significantly correlated with either prenatal care or Medicaid costs were selected as covariates.

Analysis of covariance was used to test this hypothesis since the dependent variable (medical costs) was continuous, and the principal independent variable (prenatal care) was categorical. Covariates included WIC participation, number born, age of mother, live birth order, marital status, education and race of mother, third party liability, hospital claim status, global billing, smoking during pregnancy, mother's prepregnancy weight, and hospital's per diem costs.

Analysis of covariance was also used to test whether the receipt of adequate prenatal care reduced birth weight. Covariates included WIC participation, number born, age, marital status, education, and race of mother, smoking during pregnancy, and mother's prepregnancy weight. Unconditional logistic regression was used to test whether adequate prenatal care is associated with reduced low birth weight—less than 2,500 grams (g)—or very low birth weight—less than 1,500 g. The same covariates used in the birth weight test were also used for these tests.

## Results

Table 3 shows the percent distributions of selected birth variables by level of prenatal care. There is little association between adequacy of care and multiple births or age of mother. Mothers in their first pregnancies are more likely to obtain adequate prenatal care. Mothers with inadequate prenatal care are more likely to be unmarried, have less than a high school education, be black, or smoke during pregnancy.

As table 4 shows, adequately cared for pregnancies have higher rates of third party payers, WIC

Table 3. Percentages of selected birth variables by level of prenatal care, Missouri Medicaid births, 1988

Category	Adequate	Intermediate	Inadequate
Multiple births.....	1.3	1.4	1.3
Mother's age (years):			
Under 18.....	9.8	13.2	11.3
35 and more.....	2.6	2.3	1.9
First births.....	42.0	39.5	28.4
Out-of-wedlock births.....	63.9	68.7	73.6
Mother's education less than 12 years.....	43.6	48.7	55.1
Mother of black race.....	37.3	39.1	46.8
Mother smoked during pregnancy.....	38.2	41.7	49.1

Table 4. Percentages of selected Medicaid variables by level of prenatal care, Missouri Medicaid births, 1988

Category	Adequate	Intermediate	Inadequate
Third party liability.....	10.3	9.1	7.2
Global billing.....	26.9	29.5	29.4
OBRA participant <sup>1</sup> .....	19.9	17.8	13.5
Per diem hospital costs of \$350 or more.....	34.7	41.3	49.3
WIC participant <sup>2</sup> .....	54.8	48.9	37.6

<sup>1</sup> Omnibus Budget Reconciliation Act.

<sup>2</sup> From Supplemental Food Program for Women, Infants, and Children file.

participation, and OBRA participation. OBRA is defined as Omnibus Budget Reconciliation Act, a law passed by Congress in 1987 that included Medicaid eligibility expansion, which in Missouri went from 37 percent of poverty to 100 percent of poverty. Table 4 also shows that mothers with inadequate care are more likely to deliver in hospitals with per diem costs of \$350 or more.

After adjustment for the appropriate covariates, adequate prenatal care was indeed associated with increased birth weight and with reduced rates of low birth weight and very low birth weight. Mean birth weight was 89 g higher for babies of mothers with adequate prenatal care than for babies of mothers with inadequate care, and 47 g higher than babies in the intermediate care category. Table 5 shows that the relative risks of low birth weight and very low birth weight were significantly greater than one for all comparisons with adequate prenatal care. Babies of mothers with inadequate prenatal care had 1.58 times the risk of very low birth weight and 1.52 times the relative risk of low birth weight than did babies of mothers with adequate prenatal care.

As would be expected, costs are much higher for low birth weight pregnancies than for normal weight pregnancies. Totals for claims paid for

Table 5. Relative risks of intermediate and inadequate prenatal care to adequate prenatal care for very low and low birth weight, Missouri Medicaid births, 1988

Category	Relative risks	
	Intermediate to adequate care	Inadequate to adequate care
Very low birth weight (under 1,500 grams) .....	1.63	1.58
Low birth weight (under 2,500 grams) .....	1.27	1.52

NOTE: These relative risks were calculated using unconditional logistic regression with WIC participation, number born, age, marital status, education and race of mother, smoking during pregnancy, and mother's prepregnancy weight. All relative risks are significantly greater than 1 at the .05 level.

Table 6. Prenatal and post-partum costs for mothers and newborns by level of prenatal care with benefit-cost ratio, Missouri Medicaid births, 1988

Category	Total	Mother	Newborn
<b>Prenatal:</b>			
Adequate .....	\$ 659	\$ 659	...
Intermediate .....	562	562	...
Inadequate .....	425	425	...
Difference—adequate - inadequate .....	233	233	...
<b>Post-partum:</b>			
Adequate .....	3,329	1,312	2,018
Intermediate .....	3,522	1,308	2,214
Inadequate .....	3,676	1,368	2,309
Difference—adequate - inadequate .....	-347	-46	-291
Benefit to cost ratio = \$347 to \$233 = \$1.49			

NOTE: Numbers may not add to total due to rounding. Costs were adjusted using analysis of covariance with WIC participation, number born, age of mother, live birth order, marital status, education and race of mother, third party liability, hospital claim status, global billing, smoking during pregnancy, mother's prepregnancy weight, and per diem costs selected as covariates.

newborns were 5 times higher for low birth weight births and 16 times higher for very low birth weight births than the costs for normal weight births.

The relation of costs to benefits for prenatal care are illustrated in table 6. Prenatal costs averaged about \$233 higher for mothers with adequate prenatal care than for mothers with inadequate prenatal care. Post-partum costs were \$347 less for the pregnancies involving adequate care than for the pregnancies with inadequate prenatal care. Most of these savings (\$291) were savings in medical care costs for newborns.

The benefit-costs ratio is \$347 in maternal post-partum and newborn savings versus \$233 extra prenatal costs or \$1.49 saved per extra \$1 spent on prenatal care. Multiplying these averages by the 5,639 Medicaid pregnancies involving adequate prenatal care yields a total of \$1.3 million in extra

prenatal costs and \$2 million in post-partum and newborn savings for a net savings of nearly \$700,000.

The primary reasons for the cost-benefits of adequate prenatal care are the improved birth weight distributions associated with such care. When the analysis of covariance for maternal post-partum and newborn paid claims was re-run adjusting for birth weight, the cost differences between adequate and inadequate prenatal care categories completely disappeared.

This reduction in rates of very low and moderately low birth weights associated with adequate prenatal care resulted in a reduction in NICU costs. The NICU admission rate was 7 percent for adequate prenatal care births compared with 10 percent for inadequate care births, and NICU newborn costs averaged \$9,000 more per newborn than non-NICU newborn costs.

Table 7 shows the benefit-cost estimates of prenatal care by a few selected subgroups. First, the ratio of post-partum savings to prenatal costs was greater for non-WIC than for WIC participants. There is little difference in the benefit-cost ratios between OBRA and non-OBRA participants, although cost differentials are greater for the non-OBRA group. Table 7 also shows greater benefit-cost ratios for pregnancies of white mothers than for black mothers. Although some of these comparisons are interesting, the only groups in which maternal post-partum and newborn savings were statistically significant were the non-OBRA and pregnancies of white women.

## Discussion

The cost benefits of this study were somewhat lower than those found in other studies involving synthetic estimates. This finding may be related to faulty assumptions in the other studies or inaccuracies in the Missouri Medicaid data. For example, there was an apparent overestimate of low birth weight infants who require neonatal intensive care in the Institute of Medicine's report. The IOM report assumed that all low birth weight infants receive intensive care. An alternate assumption in the appendix of this report which assumed that all very low birth weight and 40 percent of the 1,500-2,499 g babies received this care reduced the benefit-cost ratio from 3.38 to 1 to 2.17 to 1 (6b). In this Missouri study, 81 percent of the very low and 31 percent of the moderately low birth weight infants received neonatal intensive care.

Another reason for the smaller benefit-cost ratio

Table 7. Selected subgroups by prenatal and post-partum costs for mothers and newborns with benefit-cost ratios of adequate versus inadequate prenatal care, Missouri Medicaid births, 1988

Category	Prenatal care paid claims (dollars)			Newborn and post-partum paid claims (dollars)			Benefit-cost ratio
	Adequate	Inadequate	Difference	Adequate	Inadequate	Difference	
WIC.....	\$696	\$511	<sup>1</sup> \$185	\$3,216	\$3,417	\$201	1.09
Non-WIC ....	621	364	<sup>1</sup> 256	3,438	3,843	405	1.58
OBRA.....	456	338	<sup>1</sup> 118	2,998	3,158	160	1.36
Non-OBRA ..	705	448	<sup>1</sup> 257	3,398	3,788	<sup>1</sup> 390	1.52
White .....	642	394	<sup>1</sup> 248	2,922	3,344	<sup>1</sup> 422	1.70
Black .....	675	480	<sup>1</sup> 195	3,955	4,190	235	1.21

<sup>1</sup> Statistically significant at .05 level.

<sup>2</sup> Omnibus Budget Reconciliation Act.

NOTE: Costs were adjusted using analysis of covariance with number born,

age of mother, live birth order, marital status, education of mother, third party liability, hospital claim status, global billing, smoking during pregnancy, mother's pregnancy weight, and per diem costs selected as covariates.

found in the Missouri study is that Medicaid paid claims are not equivalent to medical costs. Not all medical expenses are covered by Medicaid, and eligibility is not always constant throughout the pregnancy and post-partum period. In addition, Braveman and coworkers (12) found that Medicaid newborns receive less hospital care than privately insured newborns.

The cost-benefits of this 1988 Missouri Medicaid study were much larger than the negligible benefits found in the 1981-82 Missouri Medicaid study. The primary reason for this differential is that the earlier study used paid claims with a last date of service within 45 days of birth. This study uses claims with a first date of service within 60 days of birth. Therefore, NICU admissions with long stays and high costs may have been omitted in the earlier study. In addition, the Missouri Medicaid Program covered more medical expenses for newborns in 1988 than in 1982 such as longer hospital stays, greater physician expenses, and increased reimbursement for hospitals with a disproportionate share of low-income patients. A different definition of adequate prenatal care was used in the earlier study, but when this definition was used with the 1988 data, the results were nearly identical to the results using the Kessner index.

A primary source of potential error in both Medicaid studies was incomplete Medicaid cost data. All eligible costs may not have been claimed or received by the cutoff time for the tape creation. Billing problems with many rural hospitals also may have reduced claims. It is possible, although not probable, that the adequate and inadequate prenatal care populations varied with respect to these complicating factors.

The exclusion of 27 percent of Medicaid records may possibly have biased results. The level of prenatal care was similar for the omitted records,

*'Mothers who did not obtain adequate prenatal care may not trust physicians; therefore, they may be less willing to seek medical help when they are sick. This speculation, in turn, could reduce their Medicaid paid claims.'*

although the low birth weight rates were somewhat higher than the study cases. Low birth weight rate differentials between adequate and inadequate prenatal care categories were greater for the excluded records. Therefore, if these records had had complete data for Medicaid paid claims, inclusion of these records would have tended to increase the benefit to cost ratio for adequate prenatal care.

Another possible source of error is misclassification of the prenatal care variable. Using a public use tape from the 1980 National Natality Survey (13), Kessner prenatal care definitions were compared between birth certificates and physician records. There was 39 percent disagreement in the two sources between adequate, intermediate, and inadequate definitions. Using only adequate versus inadequate, 11 percent disagreement was reported. This is why most comparisons in this study were between adequate and inadequate prenatal care. Misclassifications would tend to obscure differences between levels of prenatal care.

Other factors not available from the birth or Medicaid records may have influenced the results. Women obtaining prenatal care are self-selected in that they were motivated to obtain physician care regularly before pregnancy. These women therefore may be more concerned for their own and their babies' health. Mothers who did not obtain ade-

quate prenatal care may not trust physicians; therefore, they may be less willing to seek medical help when they are sick. This practice, in turn, could reduce their Medicaid paid claims. These factors may have artificially inflated the birth weight and cost differentials by level of prenatal care.

## Summary

This study of 1988 Missouri Medicaid births shows that the receipt of adequate prenatal care is apparently cost beneficial. For each extra \$1 spent on prenatal care, an estimated savings of \$1.49 in newborn and post-partum costs resulted. The primary reason for these savings was a reduction in low birth weight rates among the adequately cared for pregnancies.

While the cost-benefit ratios of this study were not as large as those found in other studies, this observation does not negate the positive aspects of prenatal care. Increasing prenatal care Medicaid budgets appear to result in an overall savings in Medicaid costs as well as a reduction in negative pregnancy outcomes such as low birth weight infants.

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