How Much Money Can Early Prenatal Care for Teen Pregnancies Save?: A Cost-Benefit Analysis

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Background: Pregnant teens in the United States are at high risk for not obtaining prenatal care and for having low-birth weight deliveries. This observation suggests that significant cost savings might be realized if teens were able to obtain prenatal care in a timely fashion.

Methods: To determine the optimal time for teens to start prenatal care, we conducted a cost-benefit analysis from the perspective of Medicaid, the predominant payer for pregnancy-related services for teens. Cost projections were based on current recommended prenatal care testing, the cost of vaginal and cesarean deliveries, and the estimated costs for care of the child in the first year of life. We then compared average cost per person and performed sensitivity analyses based on when prenatal care would have started.

Results: Compared with no prenatal care, any prenatal care saves between $2,369 and $3,242 per person, depending on when care is initiated. All savings are related to reductions in the cost of caring for low-birth weight babies. We found no cost advantage to starting prenatal care earlier compared with later months.

Conclusion: If prenatal care does reduce the rate of low-birth weight babies, prenatal care is cost beneficial. If a program was developed to improve access for teens and applied to all pregnant teens not in care by 6 months' gestation, the program would have to average $95 or less per person to be cost beneficial if it reduced the number of low-birth weight deliveries by 50%. (J Am Board Fam Med 2008; 21:184–190.)

Rates of teen pregnancies in the United States, although falling over the past decade,[1] still remain among the highest in the developed world.[2] Among the problems with adolescent pregnancy is the risk for preterm or low birth weight (LBW) delivery. Fourteen percent of pregnancies in adolescents under the age of 17 result in LBW babies, a rate almost twice that of adult populations.[3] Consequently, reducing pregnancies in this population or preventing preterm birth should be a high priority.

In addition to higher rates of LBW deliveries, adolescents are also more likely to receive late or no prenatal care.[4] Reasons for this delay include the lack of perceived importance of early care,

difficulty with insurance, unawareness of public resources, and a delay in the diagnosis of pregnancy.[5] Several programs have shown improvements in birth weight[6] or reductions in the risk of a LBW delivery.[7] However, these studies do not address when it is best to initiate prenatal care.

It is clear from other studies that no prenatal care is associated with higher costs and poorer outcomes for both teens and adults,[8–10] but few studies address whether earlier care results in better outcomes and higher cost savings and whether investments in programs that encourage earlier prenatal care are cost effective. The purpose of this study was to explore whether an optimal time for prenatal care initiation can be identified that will maximize outcomes and minimize costs.

Methods
Perspective and Time Horizon
We approached this issue from the perspective of the payer, specifically state Medicaid programs. We selected this approach because Medicaid insures most pregnant adolescents.

Table 1. Assumptions About Prenatal Care Use Used in the Analysis

Care Begun (mo)	Prenatal Care Services Used
Month 1–4	• Prenatal visit once a month until 7th month; then 2 visits per month for months 7 and 8 and 4 visits during month 9 • Two screening ultrasounds • Maternal screening for neural tube defects and Down syndrome • Screening for gestational diabetes • Screening for group B streptococcus
Month 5–6	• Prenatal visit once a month until 7th month; then 2 visits per month for months 7 and 8 and 4 visits during month 9 • One screening ultrasound • Screening for gestational diabetes • Screening for group B streptococcus
Month 7–9	• 2 prenatal visits per month for months 7 and 8 and 4 visits during month 9 • One screening ultrasound • Screening for group B streptococcus
No care	• No prenatal care or screening tests

We selected a time horizon for 1 year because medical costs for the care of LBW infants have been estimated for this period. In addition, Medicaid budgets typically span 1 year. Most programs must pay for current costs out of their budget and have little ability to invest more in 1 year to save costs in future years. Hence, a 1-year time horizon is consistent with most Medicaid budget planning.

Data Sources

We relied on birth certificate data collected for all births in 2004 in the United States by the Center for Health Statistics to estimate the rates of LBW and cesarean delivery. LBW was defined as a live birth less than 2500 g. We also calculated cesarean birth rates for all women between the ages of 13 and 19 who delivered a live infant during that index year. Rates for all women in this age range were calculated, as were race-specific rates for African-Americans and whites, because others have found a difference in the cost-effectiveness of care based on maternal race.[11]

Our assumptions about the types of services and number of services are shown in Table 1 and a summary of our cost estimations is shown in Table 2. The cost of individual visits, laboratory tests noted above, and ultrasounds were based on the current (2006) payment schedule of South Carolina Medicaid. The costs for hospital care for a routine vaginal delivery or cesarean section also were based on the average 2006 hospital payments for uncomplicated vaginal and cesarean deliveries made to the Medical University Hospital of the Medical University of South Carolina. Routine prenatal care testing (blood type, hemoglobin, serology, hepatitis B, etc) was not included in our model because these would be obtained for all women, including those who did not have any prenatal care.

Table 2. Assumed Costs for Components of Care

Service	Cost* (dollars)	Source
Prenatal care visit	28.87	Medicaid payment schedule in 2006
Level I ultrasound	69.80	Medicaid payment schedule in 2006
4-component neural tube/Down screening	68.94	Medicaid payment schedule in 2006
Maternal diabetes screening	6.32	Medicaid payment schedule in 2006
Group B streptococcus culture	10.23	Medicaid payment schedule in 2006
Routine vaginal delivery (physician reimbursement)	1200.00	Medicaid payment schedule in 2006
Routine vaginal delivery (hospital reimbursement)	2142.91	Mean hospital reimbursement for vaginal delivery without complication in 2006
Cesarean delivery	1200.00	Medicaid payment schedule in 2006
Cesarean delivery (hospital reimbursement)	4450.14	Mean hospital reimbursement for cesarean delivery without complication in 2006
Normal-birth weight infant[†]	3168.99	From Henderson,[10] adjusted to 2006 dollars
LBW infant[†]	28,887.10	From Henderson,[10] adjusted to 2006 dollars

*Costs expressed as average cost expected to state Medicaid program in 2006 dollars.
[†]Represents average cost of first year of life.
LBW, low birth weight.

The cost of newborn care was based on whether the delivery was low or normal birth weight. Data about the cost of care of children was based on the total cost in the first year of life, as determined in Henderson.[10] Costs from Henderson's estimates were updated to 2006 dollars using annual consumer price indices for medical care.

Finally, we added the projected additional costs of caring for a LBW pregnancy to the cost of care of women who received prenatal care. We projected that these costs would include 2 additional ultrasounds, 2 non-stress tests, and 2 additional physician visits. The total cost for these services was projected at $318.47.

Cost-Benefit Model

Our cost-benefit model began with the month that prenatal care started and ranged from month 1 to no prenatal care at all (Figure 1). Using the probability of LBW and cesarean delivery for each branch, we determined the overall average cost for each month that care was started using Microsoft Excel software (Microsoft Corp, Redmond, WA). We also calculated costs separately for whites and African-Americans to assess how race might influence the benefits of earlier prenatal care.

Hypothetical Intervention Model

We then conducted an analysis to determine the price threshold in which a hypothetical program that could reduce the number of teens receiving no prenatal care would break even. In doing this, we assumed that the population would have identical costs and rates of cesarean sections as the 2004 birth certificate data file and that the target population for such a hypothetical program would be all teens who had not received care by the end of their 6th month of pregnancy. Because it is unlikely a program would be 100% effective at reducing LBW, we varied the effectiveness of the program from 10% to 100% and calculated the cost savings based on each level of effectiveness. To determine the threshold cost, we divided the total cost savings for the population by the total number of pregnant teens who had not received care by 6 months.

Sensitivity Analysis

We performed a range of sensitivity analyses to explore how changes in health care delivery might alter our calculation. We varied the hospital cost of
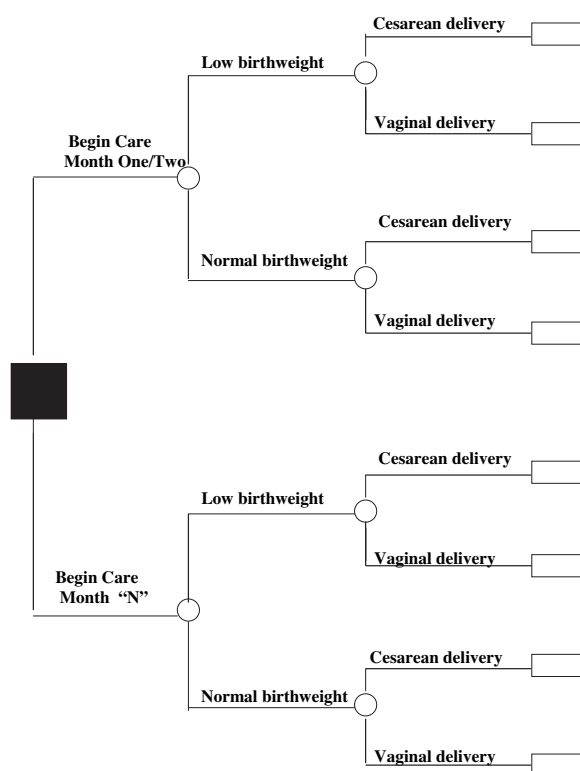

Figure 1. Decision tree for analysis of costs of care for teens starting pregnancy in a particular month. The solid square indicates the patient's decision of when to initiate prenatal care, circles indicate probabilities, and open rectangles indicate the utility (in this instance, the cost of care). Month "N" indicates a reiteration of the decision model for each month that prenatal care was begun or for no prenatal care.

cesarean delivery by 20% to reflect trends toward faster discharge of women after operative deliveries, and we varied the cost of LBW infant care by 30% to reflect current or future advances in the care of preterm and other LBW infants. We also explored how limiting prenatal care to a single ultrasound in the second trimester would affect overall costs.

Results

Low-Birth Weight and Cesarean Delivery Rates

During 2004 there were 478,510 births to mothers between the ages of 13 and 19 in the United States. The majority of pregnant teens were white (72.3%) and 23.7% were African-American; the remaining 3.9% were categorized as "other race." Rates of LBW babies were significantly higher for women

Table 3. Rates of Low-Birth Weight and Cesarean Delivery for Teens Based on Month of Prenatal Care Initiation

| Prenatal Care Began (mo) | LBW Rates (%) | | | Cesarean Section Rates (%) | | | | | |
| | All Women | Whites | African-Americans | All Women | | Whites | | Africa-American | |
				NBW	LBW	NBW	LBW	NBW	LBW
1 or 2	9.9	8.4	14.9	19.9	34	19.4	34.8	21.9	32.9
3	9.4	8.0	13.9	18.9	32.5	18.2	33.1	21.5	31.3
4–6	9.3	7.9	13.0	18.1	30.1	17.4	31.2	20.6	29.3
7–9	7.9	6.6	11.6	17.0	24.6	16.6	24.0	19.0	25.5
None	21.5	18.4	30.0	13.8	22.4	14.3	23.0	13.9	21.4

LBW, low birth weight; NBW, normal birth weight.

who obtained no prenatal care compared with those receiving any prenatal care. The rate of LBW babies was fairly consistent for women who began care at any time (Table 3), with a small increase in women who started their care very early in their pregnancy. This is most likely related to women with high-risk medical problems seeking earlier care. Also worth noting is that rates of LBW babies dropped significantly for women starting care in the 7th through 9th month, which is probably related to a "survival bias" that occurred because their pregnancy had progressed to this point in time without delivering. In addition to rates of LBW babies, Table 3 shows cesarean delivery rates based on month of prenatal care initiation and race.

Cost-Benefit Model
Using the rates of LBW and cesarean deliveries above, we found that the cost of pregnancy care and early newborn care was fairly constant regardless of when prenatal care was begun (Figure 2). A drop in costs was noted in girls beginning care in the 7- to 9-month range, but this is probably related to the "pregnancy survival bias." Compared with teens who received prenatal care, Figure 2 demonstrates a sharp rise in the cost of care for women who received no prenatal care.

Using teenagers who received no prenatal care as a reference, we calculated that prenatal care saves between $2,369 to $2,665 for girls who receive care before their 7th month (Table 4). Because of racial differences in rates of LBW babies, savings were higher for African-American teens compared with whites.

Hypothethical Intervention Model
We then modeled the additional potential cost savings over the population of teens who had not

received prenatal care, assuming an intervention program of varying effectiveness (Figure 3). This model shows that the average savings per individual for such a program ranges from approximately $20 for a minimally effective program to a maximum of approximately $185 if the program is 100% successful. For a program that was 50% effective at reducing LBW and provided to all girls who did not have prenatal care by their 6th month, the necessary cost to break even based on projected savings was $95 per participant. As noted in Figure 3, interventions aimed at African-American girls would be 30% more cost beneficial than those targeting white girls.

Sensitivity Analyses
To examine the utility of our model under potentially alternate circumstances, we performed sensitivity analyses on cesarean delivery, ultrasound use, and costs of routine prenatal care. Wide variation in all of these did not influence our outcomes.

When we examined changes in the cost of caring for a LBW baby and rates of LBW babies,
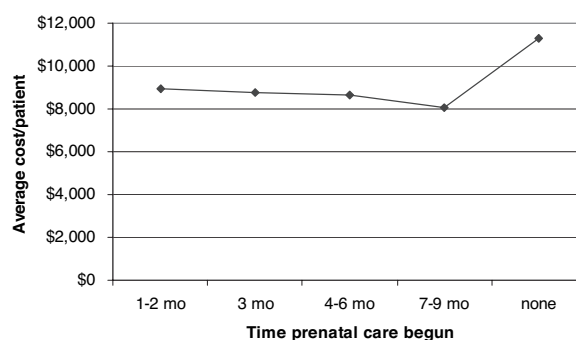
Figure 2. The cost of prenatal care based on the time of prenatal care initiation for teens.

Table 4. Incremental Cost Savings for Pregnant Teens Dependent on the Month Prenatal Care Was Begun*

Prenatal Care Began (mo)	All Women	Whites	African-Americans
1 or 2	2274	2051	3047
3	2457	2137	3390
4–6	2580	2258	3735
7–9	3146	2450	4321
None	0	0	0

*All figures represent the average net savings (dollars) compared to the cost for women receiving no prenatal care.

we found that our results were altered only at extreme changes in these values. For example, the cost of caring for a LBW baby would have to decrease by 70% to 75% to equalize the costs for those receiving no prenatal care and those receiving prenatal care. Similarly, the rates of LBW babies for girls with no prenatal care would have to decline by 50% before receiving no care was not more costly than obtaining prenatal care before the 7th month.

Discussion

The results confirm that prenatal care obtained at any time during pregnancy is associated with less cost than no prenatal care mainly because of the high rate of LBW babies and the large cost differential in caring for these babies. However, the benefit of prenatal care was equal regardless of when prenatal care was initiated. This suggests that it is
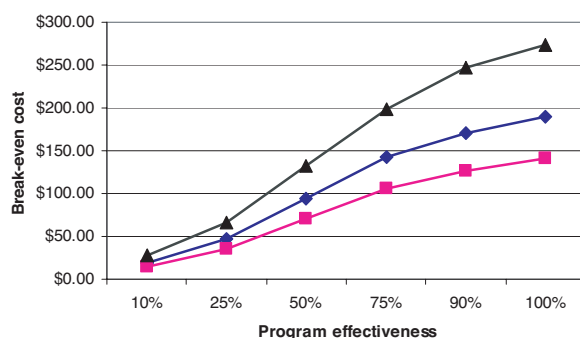

Figure 3. The estimated cost savings for all women (diamonds), whites (triangles), and African-American (squares) women based on the effectiveness of a hypothetical intervention aimed at all pregnant teens who had not received prenatal care by 6 months.

more important for teens to obtain any prenatal care than to get their care early.

Although comparable studies have not been performed on adult populations, our results are consistent with other studies examining care in selected populations. Morales and colleagues[8] estimated the cost savings in neonatal costs for prenatal care to be close to $4,000 (in 1983 dollars) and that every dollar invested in prenatal care saved $7 in neonatal costs. Henderson[10] estimated the cost savings in hospital care alone for women who receive prenatal care to be over $1,000. The benefits of prenatal care for adults are reported to persist beyond pregnancy. Conway and Kustinova[11] report that women who receive prenatal care are more likely to obtain lifelong health benefits from avoiding future obesity.

Although the value of prenatal care is clear, convincing teens to use prenatal care is not easy. Pregnant teens who do not receive prenatal care are uncommon; they comprise only 2% of all teen pregnancies. Any intervention designed to identify these girls is likely to include many more girls who would have obtained care for every one who would not. Even though the projected cost savings would be high per LBW case that is avoided, the large number of girls who would qualify for an intervention would greatly reduce any cost benefit.

Secondly, data that support the theory that earlier prenatal care will reduce the rates of LBW babies is limited to small interventions on select populations.[12–16] Many women who do not obtain prenatal care may have social conditions that increase the risk of LBW regardless of whether or when they receive care. Assumptions regarding the effectiveness of prenatal care at reducing rates of LBW babies are based on associations between prenatal care and LBW deliveries. Also worth considering is how cost beneficial early prenatal care is compared with pregnancy prevention in teens.

Our study does have several limitations. First, we narrowed our analysis to include only the costs associated with LBW and cesarean delivery rates. Several other factors may be affected by prenatal care, including congenital birth defects that would probably result in higher costs during the first year of life but that would be present regardless of the amount or quality of prenatal care provided. Cesarean delivery rates may be independent of prenatal care because many indi-

cations for cesarean delivery, such as fetal presentation and failure to progress, are unlikely to be changed by prenatal care. Maternal comorbidities, such as sickle cell disease or pre-existing diabetes, are not factored in even though these mothers are more likely to present earlier with their pregnancies because of more routine medical care in general.

Second, our perspective only examined the potential costs and savings to a single payer (Medicaid) associated with delays in prenatal care. In doing so, we present a narrow focus that does not account for additional costs that Medicaid would not pay. However, indirect costs such as interruptions in parents' education or work schedules related to caring for a LBW infant and the financial impact of a special-needs child on future earning capacity are not included because they are not paid by Medicaid. These additional societal costs are difficult to gauge but are likely to be another benefit of earlier prenatal care. These additional societal benefits should be considered when conceptualizing the benefits of LBW prevention programs; however, from strictly a payer perspective it would not be cost beneficial for the payer to cover these costs because the benefits do not accrue to Medicaid.

Third, several studies emphasize that not only is the quantity of prenatal care valuable in reducing LBW and costs, but the content and quality of care also matters.[14–16] We were not able to assess the impact of quality in our analysis.

Finally, our rates of LBW deliveries and cesarean sections are based on birth certificate data. Others[17] have challenged the validity of many data elements in birth certificate data and questioned its use in examining issues related to prenatal care. In particular, information based on patient recall may be suspect. However, in our study the key outcomes (LBW and Cesarean delivery) should not be subject to recall bias. And although patients may poorly estimate the month in which prenatal care was begun, the ability of a patient to remember whether she did or did not get any care is less likely to be mistaken. Therefore, for the purposes of our study the data from birth certificates seems to be suitable, especially given the small variations between girls who started care between the first and 7th month, when patient recall is most likely to be an issue.

Conclusion

Our study shows that teens who receive prenatal care are less costly than those who receive no care. However, there is no optimal time to start care. Any care is equally better than none. Because our calculations show that the cost at which programs that encourage prenatal care break even is $95 per person, programs should focus on convincing teens to obtain prenatal care and not necessarily on starting care earlier.

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