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Med Care Res Rev 1999 56: 30
DOI: 10.1177/107755879905600102

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Using a natural experiment, this study estimates the effects of Medicaid managed care on total hospital costs of a birth. The authors study 5,585 vaginal deliveries from 1993 through 1995. Hospital length of stay for maternity care has been reduced by 21 percent after the introduction of managed care. The resultant program saving, however, is $280 in total hospital cost per delivery, 12 percent of the total hospital costs before managed care. Furthermore, when the full costs of an earlier discharge, including costs to patients and their families, are taken into account, the savings associated with a shortened hospital stay may be even smaller.

In recent years managed care organizations (MCOs) have reduced the length of hospital maternity stays—sometimes to as low as 24 hours—as a way to lower their costs. The practice of so-called drive-through deliveries originated in Kaiser Permanente in California for healthy newborns in the mid-1970s and did not then appear to lead to adverse results or cost savings as it was accompanied by an extensive program of prenatal education, assess-

The authors thank professors William Tierney, Clement McDonald, and Charles Clark of the Regenstrief Institute for providing data and valuable advice for this study and Professors Thomas Rice, Deborah Freund, and Siu Hui for helpful comments. Faye Smith of the Regenstrief Institute provided critical assistance in data abstraction. Ming Tai-Seale's work was supported by a faculty research fellowship from the Regenstrief Institute. Marc Rodwin's work is supported by an Investigator Award from the Robert Wood Johnson Foundation. An earlier version of the article was presented as a paper at the 14th annual meeting of the Association for Health Services Research held in June 1997. This article, submitted to *Medical Care Research and Review* on June 20, 1998, was revised and accepted for publication on October 7, 1998.

Medical Care Research and Review, Vol. 56 No. 1, (March 1999) 30-46

ment, and home visits (Yanover, Jaones, and Miller 1976). However, the evidence of safety for higher risk children is less certain and there have been concerns about ill effects on children and mothers (Conrad, Wilkening, and Rosenberg 1989; Fox and Kanarek 1995). The practice spread in the 1990s largely because payers believed it would produce significant cost savings.

Drive-through deliveries helped produce a backlash against managed care and a national controversy ensued over the appropriateness of the practice (Rodwin 1997). Opposition to drive-through deliveries by the American College of Obstetricians and Gynecologists and the American Academy of Pediatrics (1992, 1995), consumer groups and the press led Congress and 28 states to pass legislation restricting the practice (Bodenheimer 1996; Annas 1995). President Clinton signed legislation mandating that insurers reimburse hospitals and patients for up to 48 hours for a vaginal delivery and a 4-day stay for a cesarean delivery, effective January 1, 1998 (U.S. Congress 1996).

Savings from such practices remain unclear. There are little data, perhaps for three reasons. First, large-scale prospective experiments are expensive. Second, randomized controlled trials pose ethical problems when denying participants in control groups from receiving standard treatments. Third, cost accounting practices vary widely across hospitals. Formidable barriers exist in converting charge data to cost information or in developing true cost data that can be used to compare costs across hospitals. Our search of the literature uncovered only one reference that short maternity stays are *believed* to save payers $1,000 to $2,000 a day and a conceptual analysis suggesting that the cost savings would be very small (Reinhardt 1996).

A major component of hospital maternity care is length of stay (LOS). When hospitals were paid on a cost basis, the incentive was for them to keep the patients in the hospital. The opposite incentive emerges after the implementation of capitation payment. Hence, the average LOS for maternity care is expected to fall after capitation. The impact of the shorter LOS on hospital total cost is complex, however, because the most intense use of nursing, operating, or delivery room and other resources occur around labor and delivery, that is, the first day of the hospital stay. As subsequent days usually incur fewer input costs, eliminating them may not significantly reduce total cost of the stay.

There are other costs related to childbirth, including prenatal care, postdischarge home care, and possibly readmission for problems related to childbirth or neonatal problems. These are not measured in this study. Only inpatient hospital costs are investigated here. Such a study has merits. First, delivery at the hospital is the most expensive part of a pregnancy-delivery episode. Second, in the absence of any empirical study of the total cost of maternity care, this study is a useful beginning.

NEW CONTRIBUTION

This study is among the first to show empirical evidence on the impact of shortened LOS for labor and delivery on inpatient cost. It takes advantage of a natural experiment—implementation of Medicaid managed care in Indiana—which covers reasonable time spans both before and after the policy change. It shows that the hospital cost savings after the introduction of Medicaid managed care are $280; much less than previously assumed. Furthermore, when the full costs of an earlier discharge, including costs to patients and their families, are taken into account, the savings associated with a shortened hospital stay may be even smaller. The study results challenge decision makers to first estimate the total costs and benefits of an early discharge, rather than assume that there will be significant savings from early discharges. There may well be other ways of producing similar cost savings without early discharge, perhaps with greater patient satisfaction or quality.

PRIOR STUDIES OF THE MATERNITY STAY

Several studies have explored different approaches to accounting for hospitals costs as well as the relationship between hospital costs and charges (Finkler 1982; Wood 1982; Skydell and Arndt 1988; Arndt and Skydell 1982; Arndt and Bigelow 1994). One study has estimated the marginal cost of emergency room visits (Williams 1996). Most studies of maternity stays use data from middle-class, predominantly White women, with private insurance or employer-sponsored managed care plans (Braveman et al. 1995). More recently, Gazmararian and Koplan (1996) used administrative data to compare maternal LOS and readmission rates among HMO, point-of-service, and traditional indemnity health plans. They show that health plan type and geographic location influence maternal LOS but not newborn and maternal readmission rates. The authors call for study of the effects of shortened maternity LOS on vulnerable populations such as Medicaid enrollees and also advocate using clinical data and more detailed maternal risk information.

CONCEPTUAL MODEL

The estimation of hospital cost functions is a well-established practice. Several generations of cost functions can be found in the literature (Lave and Lave 1970; Robinson and Luft 1985; Grannemann, Brown, and Pauly 1986; Williams 1996). Our conceptual framework focuses on one product of the hospital, the provision of labor and delivery services in the inpatient setting. Two hypothetical effects of managed care on labor and delivery costs are postulated:

(1) cost reductions that occur indirectly due to reductions in the average LOS and (2) offsets to cost savings that are reflected in increased costs per day and that follow the introduction of managed care. For example, managed care is expected to reduce costs through LOS reductions. However, any cost savings may be offset to the extent that services are subsequently concentrated in the first day or two of the admission. The first effect is reflected in an LOS reduction, whereas the latter effect is reflected in increased costs per patient day.

Besides the Medicaid managed care policy change, a number of demand-side factors are expected to influence the costs of labor and delivery. They are age, race, and marital status of the mother; her insurance coverage; her history of substance abuse; and the number of previous pregnancies. The mother's use of prenatal care could also have an impact on inpatient costs. In addition, complications during labor and delivery should be controlled for. Some of these factors affect the level of health care resources the mother may require during labor and delivery. For example, advanced age, history of substance abuse, and frequent prenatal visits during the first trimester (only one visit is required of healthy mother and fetus) could be associated with poor maternal and fetal health status, which could indicate a greater likelihood of complications above and beyond the effect of coded complications. We expect them to increase costs during labor and delivery. In addition, African American mothers are found to be more likely to have babies with low birthweight (Oleske et al. 1998), which could require more resource use during labor and delivery, as well as during postpartum care. Similarly, the infant's APGAR score—a measure of the infant's health at birth—could also affect resource use. We expect babies with higher APGAR scores are less costly to deliver. The directions of these factors' effects on costs can be examined by the sign of the regression coefficients to be presented later; factors that should increase costs are predicted to have positive coefficients, whereas those that reduce costs should have negative coefficients.

METHOD

DATA SOURCE AND STUDY DESIGN

In July 1994, the state of Indiana instituted primary care case management (PCCM) and full-risk-based capitation (FRBC) to its Medicaid program for young pregnant women and children (Hinnefeld 1996). The implementation of these two managed care practices creates a natural experiment to study the impact of managed care on hospital costs of maternity care.

Wishard Memorial Hospital is a 317-bed inner-city, tertiary-care teaching hospital. It serves more than 80 percent of the Medicaid population in Indianapolis. It houses the Regenstrief Medical Record System (RMRS)—one of the most comprehensive medical information systems in the country with electronic patient records from billing, registration, pharmacy, and laboratory for all patients (McDonald et al. 1995; Tierney et al. 1995). We have clinical information for all vaginal deliveries, as well as the charges and factors used to convert charges to costs between January 1993 and December 1995. Patient characteristics that are usually not available from administrative data—such as substance abuse history—were available. These data allow us to estimate the cost of a maternity stay, taking into account various factors that influence cost. Because Medicaid covers 85 percent of deliveries at Wishard, we are able to investigate the impact of changes in Medicaid policy on hospital's cost of delivery and postpartum care.

The sample includes vaginal deliveries for 18 months prior to and 18 months after the implementation of managed care. The unit of analysis is an inpatient delivery episode. The data have two desirable features: (1) they come from a natural experiment showing the effect of the introduction of managed care on costs; and (2) they are longitudinal, which allows us to control for cost-accounting practices and other institutional characteristics.

Modeling Costs

Prevailing hospital cost-accounting practices make it impossible to actually measure the incremental changes in inputs, which is the key to capturing marginal costs (Finkler 1994). There is also a difference between accounting cost—as reported by hospitals for Medicare Cost Reports—and the cost of providing services as measured by an analysis of the actual economic inputs (Schimmel, Alley, and Heath 1987). Medicare Cost Reports allocate costs according to cost centers—a practice that may distort hospital input cost estimates. Despite these limitations, health economists frequently use Medicare Cost Reports to measure costs and estimate the marginal costs of hospital services using regression analysis (Grannemann, Brown, and Pauly 1986; Williams 1996).

We measure charges in each cost center for services that the patient used during her stay. The charges are then converted to costs for each cost center based on the cost-to-charge ratio (RCC) at Wishard. The RCC is generated by dividing the total costs (derived through the step-down method employed by Medicare Cost Report) by the total charges for each cost center. Multiplying the charge for each cost center by its RCC yields the cost of services incurred.

For example, in 1993, the RCC for obstetric services (OB) was 1.12, for pharmacy (Pharm) was 0.71, and 0.50 for laboratory services (Lab). If a patient received services from these three cost centers, the cost would be calculated by multiplying the charge for each cost center by the applicable RCC and then adding the resulting cost estimate of each service as in the following formula. Total Costs = 1.12 × OB charge + 0.71 × Pharm charge + 0.50 × Lab charge. The general formula is written as follows:

$$\text{Total Costs} = \sum_i RCC_i \bullet \text{Charge}_i,$$

where i = individual cost center.

Hence, the cost of each delivery episode varies depending on the number of cost centers from which the patient used services. Even after Medicaid implemented FRBC to women and children, the Wishard Hospital still generates charges for every patient regardless of their insurance status. Consequently, we have charges for deliveries both before and after the implementation of managed care measures. Finally, to control for a 5 percent annual charge inflation carried out at the Wishard Hospital, we use 1993's RCC and deflate the charges of 1994 and 1995 to a 1993 level by dividing the 1994 charges by 1.05 and the 1995 charges by 1.1025.

Effect of Managed Care on Total Hospital Maternity Stay Cost

A two-equation structure model is explored to capture the effects of Medicaid managed care on LOS and on the costs of inpatient labor and delivery. The model contains the following:

$$\text{LnLOS} = \alpha_1 + \beta_1 X + \gamma_1 MC + \varepsilon_1 \quad (1)$$

$$\text{LnCOST} = \alpha_2 + \delta \text{LnLOS} + \beta_2 X + \gamma_2 MC + \phi \text{LnLOS*MC} \quad (2)$$

LnLOS is the natural log of LOS; LnCost, the natural log of costs; X, a vector of patient characteristics; MC, an indicator variable for the implementation of Medicaid managed care (= 0 for the period before the introduction of managed care, = 1 for the period after); and LnLOS*MC, the interaction term of LnLOS and the indicator for Medicaid managed care.

The full effect of the managed care program variable on cost can be computed from the regression coefficients in the second equation. Specifically, we compute the full effect of managed care on costs as the sum of three factors. The first factor is the individual regression coefficient for the managed care program variable from the second equation (γ_2), which measures the direct effect of managed care on cost. The second factor is the product of two regression coefficients: $\gamma_1 \bullet \delta$, where γ_1 is the coefficient for the managed care program variable in the first equation, which measures the effect of managed care on ln LOS; and δ, the coefficient for LOS from the second equation, which measures the effect of LOS on total costs. This product measures the indirect effect of managed care on cost through LOS. The last factor captures the interaction of managed care with LOS on total cost (ϕ). The sum of these three factors is the full effect of managed care on total cost.

For the first equation, we hypothesize that LOS is determined by a vector of exogenous conditions as well as the program variable, managed care introduction (MC). For the second equation, we assume that the same vector of exogenous variables as specified in the first equation also determines costs. In other words, costs are driven by LOS as well as the implementation of managed care. It can be noted that managed care may also affect costs conditional on LOS—the second effect mentioned in the previous paragraph—by increasing costs per patient day.

The structure of the endogenous variables in the equations is triangular, which satisfies one of the two requirements for a recursive system. However, the second requirement—error terms across the two equations must be uncorrelated—is more difficult to meet. Given the nature of patient-level data that we have, separating the endogenous correlation between LOS and cost for each patient is very difficult. Because we lack suitable instruments to estimate the structural model, we turn to a reduced-form approach. Under the reduced-form approach, the choice of right-hand side variables is motivated using the same framework expressed in the Conceptual Model section. They include exogenous variables pertaining to patient characteristics and the managed care program variable (MC). The model is defined as follows:

$$\text{LnCost} = \alpha + \beta X + \gamma MC + \varepsilon, \tag{3}$$

where X is the vector of patient characteristics that includes age, mother being single and African American, maternal drug abuse, Medicaid coverage, normal delivery, APGAR score, number of prenatal visits in the first trimester, and pregnancy number. The parameter estimates are α, β, and γ; ε is the random error term.

The reduced-form results should provide a consistent estimate of the effects of managed care on delivery costs. We also present the results of the structural model as a comparison with the reduced form. To the extent that the measured effect of managed care is similar in the two approaches, we are able to conclude that the magnitude of bias in the structural model is minor.

RESULTS

Descriptive Statistics

Of the 5,538 episodes of vaginal deliveries that constitute our study sample, 55 percent of the patients are African American, and 83 percent are single or divorced. In addition, 85 percent of patients are on Medicaid, about 9 percent are self-paying, and 4 percent have private insurance. The average age of mothers is 22, ranging from 12 to 47. The average APGAR score for the newborns is 8.8. About 60 percent of the mothers do not have a prenatal visit during the first trimester. Eighteen percent have had one visit. The deliveries are defined as normal delivery if the primary diagnosis is code 650 under International Classification of Diseases-9th Revision (ICD-9-CM). Codes 640-648 and 660-669 comprise complicated vaginal deliveries. We note that some of the complicated deliveries are not life-threatening conditions. Yet, they are still qualified as complicated deliveries according to the ICD-9-CM. (The appendix displays ICD-9-CM codes of the primary discharge diagnoses.)

Descriptive statistics also show that the average LOS prior to the implementation of managed care is 2.7 days and is reduced to 2.1 days after managed care. It reflects a 22 percent reduction in LOS. A *t*-test indicates that the null hypothesis of no difference between the average LOS can be rejected. In Figure 1, we present the average LOS in each month during the study period. It can be noted that the LOS shifted gradually downward during the study period. Regression analysis presented later shows a significant change in LOS after the implementation of Medicaid managed care.

The inflation-adjusted charge is $2,658 before managed care and $2,395 after managed care, a 10 percent decrease. The inflation-adjusted average total cost per delivery is $2,334 before managed care and $2,134 after managed care, a 9 percent reduction. The reductions in charges and costs are both statistically significant as well. Table 1 displays descriptive statistics for LOS, total charges, and total costs. It also reports and compares the values of the explanatory variables between the two periods. Among these, all but maternal age, percentage single mother, pregnancy number, and APGAR scores, has experienced significant changes. The number of prenatal visits during the first trimester increased from .77 to .94, a significant 22 percent increase. Prior to the implementation of managed care, 61 percent of the patients had no prenatal care visit during the first trimester. The percentage drops to 54 percent during the postperiod. This may indicate the positive influence of case management and capitation on promoting prenatal care among Medicaid beneficiaries. The bivariate analyses also show a 4 percent increase of the proportion of patients who are African American, a 3 percent increase of maternal drug abuse, and a

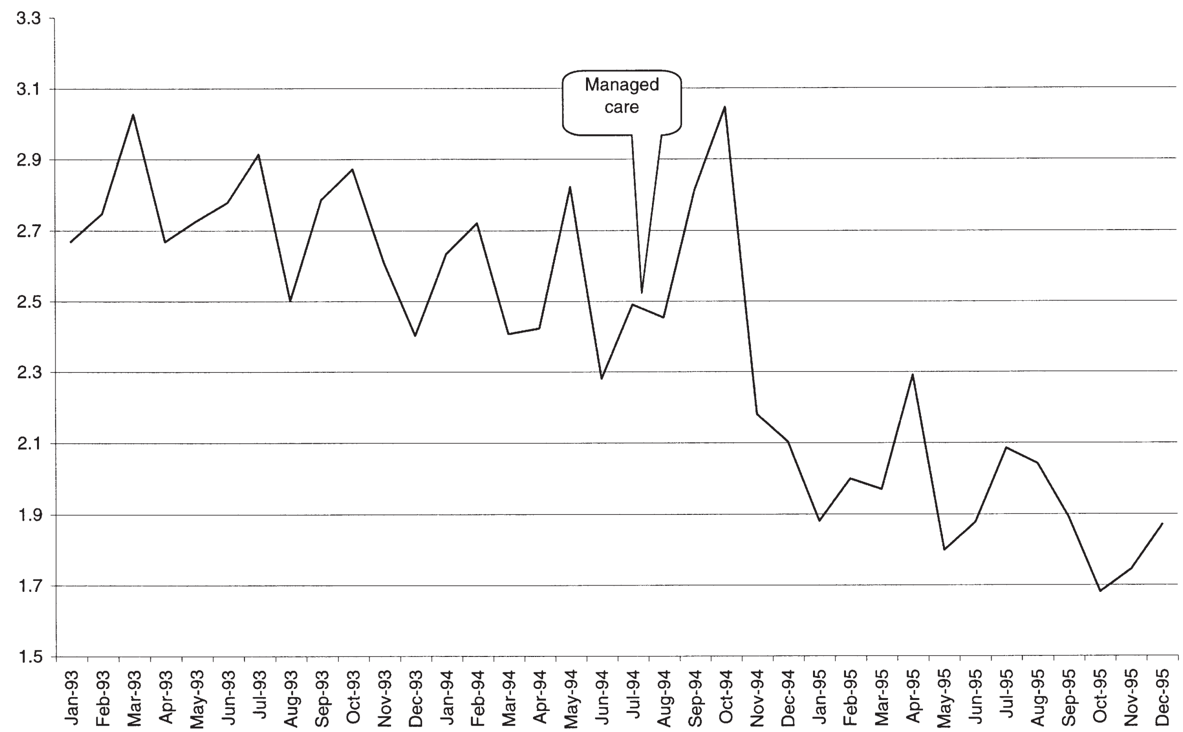

FIGURE 1 Length of stay before and after Medicaid Managed Care

TABLE 1 Descriptive Statistics

	Preperiod		*Postperiod*	
Variable	M	*Min-Max*	M	*Min-Max*
Length of stay (days)	2.68	.001-47	2.13**	.27-52
Total charges ($)[a]	2,658	475-22,979	2,395**	332-36,446
Total costs ($)[a]	2,334	375-20,150	2,134**	295-33,313
Maternal age	22.40	12-47	22.55	13-42
APGAR score	8.80	0-10	8.77	0-10
Pregnancy number	2.76	1-16	2.70	1-16
No. of prenatal visits in first trimester	0.77	0-9	0.94**	0-9
% single mother	83.91		83.73	
% mother African American	53.45		57.22**	
% maternal drug abuse	1.01		3.64**	
% covered by Medicaid	87.77		82.62**	
% normal delivery	8.26		12.77**	
Number of observations	2,939		2,646	

Note: *M* = mean.
Source: Regenstrief Medical Record System, authors' calculations.
* Statistically different from the measure taken in the preperiod, $p < 0.05$. ** Statistically different from the measure taken in the preperiod, $p < 0.01$.
a. 1993 dollars.

5 percent increase of the proportion of deliveries that are coded as normal deliveries, from 8 percent to 13 percent. The last increase may have been caused by the change in incentive brought by capitation since the complexity of delivery bears no implication on revenue. One significant decrease occurs in the percentage of patients covered by Medicaid. It is accompanied by a 5 percent increase in self-pay patients. This might be an indicator for the rise in number of uninsured patients delivering at Wishard, the city's largest public hospital.

Regression Findings

The values of the relevant coefficients obtained from the structural equations are as follows: $\gamma_1 = -.281$, $\delta = .542$, $\gamma_2 = .052$, $\phi = -.043$, all statistically significant at $p < 0.05$. Therefore, the full effect of managed care on cost: $\gamma_1 \bullet \delta + \gamma_2 + \phi \bullet \overline{LnLOS} = -.281 \bullet .542 + .052 + (-.043 \bullet .767) = -.133$. ($\overline{LnLOS}$ is the average of lnLOS obtained from descriptive analysis.) Hence, the structural model finds

TABLE 2 Regression Analysis: Impact of Managed Care on Total Costs; Dependent Variable: LnCost

Explanatory Variables	*Parameter Estimate*	SE
Maternal age	.006**	.001
Single mother	.007	.014
Mother African American	.026**	.010
Maternal drug abuse	–.033	.034
Covered by Medicaid	.050**	.014
Normal delivery	–.140**	.016
APGAR score	–.015**	.004
Pregnancy number	.000	.003
Number of prenatal visits in 1st trimester	.010**	.004
Managed care (MC)	–.128**	.010
Intercept	7.862**	.047
Number of observations	5,047	
R^2	.092	

Source: Author's calculations.
* Statistically significant at 5% level. ** Statistically significant at 1% level.

a 13 percent reduction in total costs after the implementation of Medicaid managed care, which is quite close to the 12 percent reduction found in the reduced-form model shown later on. The similarity between the two results indicates that there is only a very slight upward bias in the structural estimation.

One interesting parameter estimate is γ_2 in the structural model, which is positive. It indicates that after controlling for LOS, managed care increases cost per day. It may be inferred that the shortened LOS concentrated more resource use in each day during the shorter stay. Finally, the value of δ, an elasticity measure of costs to LOS, reveals the marginal cost to be 54 percent of average cost. This is consistent with the literature (Lave and Lave 1970). (Full regression results of the structural model are available from the authors.)

As shown in Table 2, the reduced-form analysis—equation (3) defined above—yields a negative and statistically significant regression coefficient, $\gamma =$ –.128, for the key managed care program dummy variable. The proportional change in total costs can be calculated as $(e^{\gamma} - 1) \cdot 100$, which means the reduction in total costs of delivery after managed care is 12 percent. Multiplying the percentage change by the average total cost before managed care ($2,334), a saving of $280 per delivery stay is found.

Among the explanatory variables, maternal age, mother being African American, Medicaid coverage, and the number of prenatal care visits during the first trimester show positive and significant effects on total costs. These are plausible effects. We posit that a high number of prenatal visits during the first trimester indicate greater probability of pregnancy-related illnesses of the mother or the fetus. Such cases are likely to result in higher inpatient care costs during labor and delivery. In addition, we find normal deliveries to cost 14 percent less than complex ones. Future research may be needed to investigate in greater detail the reason for such small cost differentials. Finally, it is worth noting that the structural model estimated by ordinary least squares (OLS) generates very similar results as the reduced-form estimates. Conceivably, the correlated error did not introduce a significant bias in the parameter estimates.

DISCUSSION

If we divide the total costs by the LOS, that is, allocating the total costs of a stay over the full course of a stay, we derive an average-cost-per-day measure for a delivery. It is $871 before managed care and $1,001 after managed care at Wishard. The average cost per day suggests that discharging a mother and child a day earlier will save about one thousand dollars. It ignores the decline in variable costs during the days when patients' use of nursing care and other resources is much less intense in comparison with the day immediately following the birth. A more appropriate measure of potential savings is the marginal cost, that is, the incremental costs incurred for an additional day. Existing research on hospital cost functions consistently shows that the marginal cost is often half the amount of average cost, from which it follows that the savings associated with shorter LOS could be considerably smaller than what they are assumed to be (Lave and Lave 1970). Although this study is unable to provide completely unbiased estimates for marginal cost in structural equations, the savings we document, $280, are significantly less than the savings that would be expected from reducing LOS by half a day.

How reliable are our cost estimates? They are limited by the accuracy of the hospital cost data because most hospitals do not measure the true economic costs of resources used during the course of a hospital stay. Given the institutional and public policy attempts to controls costs, it is surprising that most hospitals do not have cost-accounting systems that estimate their true input costs. However, at a time when MCOs can use a myriad of mechanisms to pay hospitals, it may appear to render unnecessary the need for hospitals to estimate marginal costs. MCOs can simply negotiate with hospitals for the lowest rate possible. Nonetheless, if MCOs and hospitals wish to manage health care effectively rather than cut services or shift costs, they need to know what their real costs are and where the most promising opportunities are for reducing them. For this, it is necessary for hospitals to develop more sophisticated ways to measure the marginal costs.

One hospital that does measure input costs is the Massachusetts Eye and Ear Infirmary, which has developed an accounting system that measures resource use, including the intensity of nursing care patients receive (Wood 1982). More recently, few hospitals have employed procedure cost accounting for labor and delivery. In a report on four academic medical centers and one 9-hospital health system, analysts at the Advisory Board found four of the five profiled hospitals account for labor and delivery costs associated with variable labor duration and three of them adjust birthing costs on the basis of patient acuity or severity-weighted measures. One of these hospitals uses time categories and patient acuity measures to determine the cost of labor and delivery. An acuity system with a scale ranging from 1 to 8 (1 representing the highest acuity) is used to assess variable costs associated with patients who experience complications. Their cost-accounting system then adjusts the staff labor component of a high-risk procedure to reflect the increased personnel usage. Another hospital charges patient flat rates for C-section or vaginal deliveries and accounts for variable labor duration by charging for every half hour that patients remain in labor. Another hospital assigns different costs to labor categories, depending on whether the baby is a vaginal or C-section delivery in addition to using both a flat charge and time categories to assess labor costs. Furthermore, additional intensive labor unit charge per hour is assessed for emergent cases, such as emergency C-sections and preeclampsia (Health Care Advisory Board 1997).

Are our cost estimates likely to hold for other patients and hospitals? We suspect that they may overestimate the marginal cost for commercially insured patients due to the high proportion of Medicaid patients. One study—not of maternity care—found patients of lower socioeconomic status to be more costly to treat (Epstein, Stern, and Weissman 1990). Also, Wishard is a teaching hospitals that might be prone to incur higher costs than nonteaching hospitals because of research and educational activities. However, Wishard Hospital was rated among the most efficient hospitals in the United States from 1993 to 1995 (Morrisey 1994, 1995). Hence, while the high percentage of Medicaid patients may elevate costs, Wishard's high operational efficiency could lead to lower costs. It is difficult to gauge how different other hospital costs are from Wishard given available data. This difficulty can be a limitation of the study.

How can estimates of cost savings be further refined? A measure of the true cost savings from reducing maternity hospital stays needs to account for costs incurred outside the hospital due to the earlier discharge. To calculate the true savings, the marginal cost of an extra hospital day should be reduced by the costs of home health nurse visits; readmission of some mothers and newborns due to the short hospital stay; additional visits to emergency rooms, urgent care centers, or primary care physicians; and consultations with lactation consultants and other health care providers (Parisi and Meyer 1995; Braveman et al. 1995). Furthermore, from the perspective of the providers, cost savings from early discharge could be offset by the loss of consumer goodwill (Bodenheimer 1996).

If we estimate cost savings from the point of view of consumers or society rather than managed care organizations or hospitals, then reductions in hospital costs need to be offset by increased costs to patients and families to yield a true measure of cost savings. We need to consider the personal costs incurred by families for additional postpartum care not paid for by insurance (both in services purchased by families and provided in kind) (Ward 1990). We might also look at other nonmonetary costs such as an increase in patient dissatisfaction and the reduction in quality of life and health outcomes (Croog et al. 1986; Ward and Brown 1994).

This study shows that the hospital cost savings after the introduction of managed care are $280, much less than previously assumed. The true total costs of early discharge—including costs to patients and their families—are unknown. The total cost savings of discharging maternity patients earlier cannot be accurately stated without data estimating the true total costs of an early discharge. Rather than assume that there will be significant savings for early discharges, MCOs should first estimate the total costs and benefits of an early discharge. There may well be other ways of producing similar cost savings without early discharge, perhaps with greater patient satisfaction or quality.

APPENDIX
Primary Discharge Diagnoses

ICD-9-CM Code[a]	*Primary Discharge Diagnosis*
Normal Delivery	
650	Normal Delivery
Complications mainly related to pregnancy	
642.41	pre-eclampsia
644.21	early onset of delivery (before 37 weeks)
645.01	prolonged pregnancy
646.61	infections of the genitourinary tract

(continued)

APPENDIX Continued

ICD-9-CM Code[a]	*Primary Discharge Diagnosis*
648.81	abnormal glucose tolerance
648.91	other conditions classifiable elsewhere
648.31-641.21	drug dependence, other current conditions classifiable elsewhere, mental disorders, other conditions in mother classified elsewhere, but complicating pregnancy, unspecified infections and parasitic diseases, other & unspecified complications of pregnancy, infectious & parasitic conditions in the mother-classified elsewhere, hypertension complicating pregnancy, childbirth, & puerperium, complications mainly related to pregnancy—hemorrhage, drug dependence, other & unspecified complications of pregnancy, hypertension complicating pregnancy, childbirth, & puerperium, hypertension complicating pregnancy, childbirth, & puerperium
Complications Occurring Mainly in the Course of Labor and Delivery	
654.21	previous cesarean delivery
656.31	fetal distress
656.51	poor fetal growth
658.01	premature rupture of membranes
658.11	oligohydramnios
658.41	infection of amniotic cavity
663.31	other and unspecified cord entanglement
664.01	first degree perinatal laceration
664.11	second degree perinatal laceration
664.21	third degree perinatal laceration
665.51	rupture of uterus during labor
669.51	forceps or vacuum delivery
651.01-659.21	twin pregnancy, breech presentation without mention of version, other specified malposition or malpresentation, polyhydramnios, fetopelvic disproportion, Rhesus isoimmunization, maternal pyrexia during labor, unspecified
V.24.0-660.01	postpartum care immediately after delivery, high vaginal laceration, laceration of the cervix, prolapse of cord, other and unspecified cord entanglement—with compression, shoulder (girdle) dystocia, obstruction caused by malposition of fetus at onset of labor, obstruction by bony pelvis, secondary uterine inertia

Source: U.S. Department of Health and Human Services (1996), pp. 281-98 and 460-62.
a. Individual ICD-9-CM codes with frequency below 100 are grouped together in the table.

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