Health Maintenance Organizations, Independent Practice Associations, and Cesarean Section Rates

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Objective. This study tests two hypotheses: that a given delivery is less likely to be by cesarean section (c-section) in an HMO (closed-panel health maintenance organization) or IPA (independent practice association), than in other settings; and that where HMO and IPA penetration is high, the probability of a c-section will be reduced for all deliveries, whether in prepaid groups or not.
Data Sources and Study Setting. A data set consisting of 104,595 obstetric deliveries in New York state in 1986 is analyzed.
Study Design. A series of probit regressions is estimated, in which the dependent variable is either the probability that a given delivery is by c-section, or that a given delivery will result in a c-section for dystocia or fetal distress.
Data Collection/Extraction Methods. The Live Birth File is linked with SPARCS hospital discharge data and other variables.
Principal Findings. HMO setting reduces the probability of a cesarean section by 2.5 to 3.0 percentage points. However, this result is likely to be partly an artifact of offsetting diagnostic labeling and of choice of method of delivery, given diagnosis; a better estimate of the effect of HMO setting is −1.3 percentage points. IPA setting appears to affect the probability of a cesarean section even less, perhaps not at all. And HMO and IPA penetration in a region, as measured by HMO and IPA deliveries, respectively, as a percent of all deliveries, has relatively large depressing effects on the probability of a cesarean section.
Conclusions. *Ceteris paribus*, the probability of a c-section is lower for an HMO delivery than for a fee-for-service delivery; however, HMO effects are smaller than previously reported in the literature for other types of inpatient care. For IPA deliveries, the effects are still smaller, perhaps nil. However, HMO and IPA penetration, possibly measuring the degree of competition in obstetrics markets, have important effects on c-section rates, not only in HMO/IPA settings, but throughout an area. These results appear to have important implications for public policy.

Keywords. Health maintenance organization; independent practice association; cesarean section; obstetric delivery.

The literature on closed-panel health maintenance organizations (HMOs) strongly indicates lower expenditure levels, arising largely out of lower hospitalization rates. It would appear logical to expect HMOs to have lower cesarean section (c-section) rates, controlling for patient characteristics. C-sections require more physician skill and effort, and longer and more expensive hospital stays. To the extent that HMOs perform c-sections, they must absorb the additional costs.

What little literature exists on the subject does point to lower c-section rates. The purpose of the present study is to test the hypothesis that HMO c-section rates are lower, controlling for patient characteristics and complications of labor and delivery. We disaggregate the c-section decision according to the major diagnoses indicating c-section, and consider whether HMOs use these diagnosis labels differently from conventional fee-for-service (FFS) practice. We present a series of probit regressions in which the dependent variable is either the probability that a given delivery is by c-section, as opposed to vaginal delivery, or the probability that a given delivery results in a c-section for dystocia or fetal distress.

Independent practice associations (IPAs), in which physicians with ongoing practices join in prepaid managed care networks, usually on an FFS basis, also provide some incentive to economize. This study also tests the hypothesis that IPA c-section rates are lower than those of conventional FFS practice, although possibly these rates are higher than those of HMOs, when patient characteristics are controlled for. (We use the term HMO to refer only to closed-panel groups.)

THE EXISTING LITERATURE

Closed-panel HMO patients have about the same number of ambulatory visits as their conventional insurance counterparts but significantly lower hospitalization rates (Luft 1978; Manning et al. 1984). Literature reviews of selection bias in HMOs have found mixed results regarding the health status of HMO members and others (Luft 1981; Wilensky and Rossiter

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1986; cf. Welch, Frank, and Diehr 1984; Manning et al. 1984). There is some indication that prior use of health services by HMO enrollees is less than that of those who stay in FFS (Hellinger 1987; see also Buchanan and Cretin 1986).

There is little empirical literature on IPAs, and none on method of obstetric delivery in IPAs, so far as is known (cf. Johnson et al. 1989). Such evidence as exists points to relatively little cost saving in IPAs (Langwell and Nelson 1986; cf. Bradbury, Golec, and Stearns 1991).

Most c-sections are accounted for by four complications: breech and other abnormal presentation, dystocia,[1] fetal distress,[2] and previous cesarean section.[3] The rise in c-sections has been paralleled by a rise in prevalence of the diagnoses of dystocia and fetal distress. These increases point either to a remarkable increase in these complications in the population, or to a more liberal use by physicians of these elastic and often subjective labels. The probability that the latter is the case has prompted the suspicion that the rise in c-sections is due, at least in part, to nonmedical reasons, especially economic ones. These two diagnoses are relatively subjective, in the sense that two physicians may label the same case differently. The same is not true of the other two main indications for c-section, breech or other abnormal presentation and previous c-section, both of which are quite objective.

The literature on the determinants of c-sections occasionally addresses economic aspects, but rarely the HMO versus FFS issue (see Goldfarb 1984, 1985; Higgins 1985; and Stafford 1990). A number of studies focus on California HMOs and find their c-section rates to be lower than for FFS (Kizer and Ellis 1988; Stafford 1990; McCloskey, Petitti, and Hobel 1992). Wilner et al. (1981) and Wright, Gardin, and Wright (1984) find HMO patients in Boston and Detroit, respectively, to have higher risk profiles, lower c-section rates, and outcomes equally good as outcomes for other patients. Higgins (1985) uses a regional variable reflecting percent penetration of HMOs, which is negative and significant in explaining hospital c-section rates in 1977. Higgins takes this variable to be a proxy for HMO setting, but it may instead measure something else, such as the competitiveness of the area's market for medical care or physician services.

HMOS, IPAS, AND CESAREAN SECTIONS

We can distinguish between the incentives facing HMOs and IPAs as institutions, and those facing their physicians.

A number of reasons exist to expect both HMO and IPA settings to influence the probability of a c-section. To the extent that c-sections increase length of hospital stay and other hospital costs, those costs must be borne by the HMO. Hence, HMOs have a motive to select physicians with less invasive practice styles, and to reinforce those attitudes with an incentive structure that does not reward cesarean delivery.

HMO physician behavior can be analyzed by referring to the utility-maximizing models pioneered by Evans (1974), Sloan and Feldman (1978), and Wilensky and Rossiter (1981). These models were developed to focus on the question of self-interested physician-generated demand for their own services. For FFS physicians, the fee for a c-section is normally greater than that for a vaginal delivery, on average about one-third higher. Nonetheless, the average time required is less for a c-section. Thus, a physician can increase income while reducing workload by making a higher percentage of deliveries by cesarean. C-sections hence can increase physician utility. What holds this behavior in check is the assumption that physicians lose utility if they needlessly induce demand for their services. Even without this assumption, physicians' abilities to induce demand may be limited by patient wariness (Dranove 1988).

By contrast, an increase in the c-section rate for a salaried HMO physician will not increase income. C-sections may simplify the scheduling of work but are not likely to alter overall workload. Thus, the motives to perform c-sections where they are not medically required are weaker. The utility loss that would arise out of demand inducement would seem to be the same for HMO and FFS physicians. Hence, the HMO physician has less motive to perform c-sections for economic reasons. Where HMO physicians are paid on a basis which includes profit-sharing or other efficiency-based incentives, there may actually be economic inducements to perform fewer c-sections.

The need to manage time may influence HMO and FFS physicians differently. HMO obstetricians may work regular hours, and when labor is prolonged, responsibility may pass from one physician to another, depending on shift and on-call schedules. FFS physicians may have a greater need to manage time. Hence, HMOs may have lower c-section rates for dystocia.

To the extent that HMOs operate in an impersonal, clinic-like manner, understanding, communication, and sympathy between the doctor and patient may be less; and that may mean a higher cesarean rate in the HMO. Moreover, the types of physicians employed by HMOs may have an impact on clinical behavior.

The discounted fee and profit-sharing method of remuneration used by IPAs means that most IPA obstetricians will be paid more for a c-section than a vaginal delivery; IPA physician incentives differ from conventional

FFS only in degree. IPAs are likely to have lower c-section rates to the extent that they select and retain obstetricians on the basis of their resource use, including their c-section rates, and to the extent that the IPAs' managements stress reduced c-section rates when they communicate with their obstetricians.

In addition to these factors affecting the probability that HMO or IPA deliveries will be by c-section, is the effect that HMO/IPA penetration may have on the climate in which obstetric decisions are made, as in Higgins (1985).

Our main hypothesis is that with given cases—with given mothers, having given backgrounds and given illnesses and complications—HMOs and IPAs will have lower probabilities of c-section. Our second hypothesis is that where HMO or IPA penetration is high, the probability of a c-section will be reduced for all deliveries, whether in prepaid groups or not.

THE DATA

Our principal sources are from the New York State Department of Health. One is the Live Birth File, on all obstetric deliveries in New York state outside of New York City.[4] This file was linked to hospital discharge data from SPARCS (Statewide Planning and Research Cooperative System).[5] We also added data from the American Medical Association physician profile; small-area analysis data on gynecological procedures by county; medical malpractice insurance claims for obstetrics; and the U.S. census of population, 1980. The result is a data set consisting of 104,595 deliveries.

CESAREAN SECTION RATES

C-section rates for each of the major diagnoses indicating cesarean section and for all deliveries are given in Table 1, for HMOs, IPAs, and FFS. These rates are given for New York state and for counties with populations in excess of 250,000. The vast majority of HMO and IPA deliveries occur in these counties, and discussion pertains only to them. HMOs do have substantially lower c-section rates than FFS (line 1), about 3 percentage points lower; both HMOs and IPAs have lower primary rates (line 2), 2 to 3 points lower.

In Table 1 we also disaggregate these c-section rates by diagnosis. HMO patients are less likely to have had previous c-sections (line 3), and when they have had the procedure are less likely to have repeat sections (line 4). That is, HMOs' VBAC (vaginal birth after cesarean) rates

Table 1: Rates of Cesarean Section and Diagnoses Indicating Cesarean Section (HMOs, IPAs, and FFS, New York State, and Large Counties, 1986, in Percent)

	*New York State**			*Large Counties†*		
	FFS	*HMO*	*IPA*	*FFS*	*HMO*	*IPA*
1. C-sections/Deliveries‡	28.0	25.5	27.4	29.2	25.7	26.6
2. Primary c-sections/Deliveries§	20.1	18.7	18.9	21.2	19.1	18.0
3. Previous c-sections/Deliveries‡	11.2	10.1	11.7	11.6	10.1	11.8
4. C-sections/Previous c-sections‡	90.8	85.0	92.0	90.4	84.5	90.5
5. C-sections for previous c-section/ Deliveries¶	10.2	8.6	10.8	10.5	8.5	10.7
6. Dystocia/Deliveries‡	10.9	13.3	13.2	10.5	13.5	11.6
7. C-sections/Dystocia‡	74.0	57.7	64.5	75.2	58.0	68.6
8. C-sections for dystocia/Deliveries**	8.1	7.7	8.5	7.9	7.8	8.0
9. Fetal distress/Deliveries§	11.4	9.7	15.5	11.7	9.6	16.2
10. C-sections/Fetal distress§	44.2	51.3	33.1	46.2	53.1	32.6
11. C-sections for fetal distress/ Deliveries††	5.0	5.0	5.1	5.4	5.1	5.3
12. Malpresentation/Deliveries§	6.4	6.9	6.1	6.6	6.9	6.0
13. C-section/Malpresentation§	76.7	72.4	79.5	78.9	72.7	77.6
14. C-sections for malpresentation/ Deliveries‡‡	4.9	5.0	4.8	5.2	5.0	4.7

Note: Individual delivery may appear under more than one category. Not all diagnoses indicating cesarean are included.

*New York City omitted. See text.

†Large counties (population in excess of 250,000): Albany, Broome, Erie, Monroe, Nassau, Onondaga, Orange, Rockland, Suffolk, Westchester.

‡Cases with previous cesareans included. *N* = 104,595; HMO = 3,094; IPA = 2,364; large counties = 72,973; large counties, HMO = 3,003; large counties, IPA = 1,867.

§Cases with previous cesareans excluded. *N* = 92,918; HMO = 2,780; IPA = 2,088; large counties = 64,586; large counties, HMO = 2,699; large counties, IPA = 1,646.

¶Line (3) × line (4).

**Line (6) × line (7).

††Line (9) × line (10).

‡‡Line (12) × line (13).

are higher than in FFS practice. Putting these points together, a smaller fraction of HMO deliveries are by c-section for reason of previous cesarean section (line 5).

Dystocia is more likely to be diagnosed for HMO or IPA deliveries (line 6). When dystocia is diagnosed, HMO and IPA patients are less likely to undergo c-section (line 7). These two offset each other, producing a similar fraction of all deliveries that are by c-section for reason of dystocia (line 8). Similarly, fetal distress is less likely to be diagnosed for HMO deliveries (line 9), but HMO patients are more likely to have a c-section when fetal distress is reported (line 10). Again, the two offset each other, producing similar ratios of cesarean section for fetal distress to all deliveries (line 11). The opposite is true for IPAs: there is more fetal distress reported (line 9), but these cases are less likely to be delivered via c-section (line 10), again producing an overall ratio of c-section for fetal distress to deliveries similar to that for FFS (line 11). This raises the question whether the underlying population is different as between HMO/IPA and FFS practice, or whether there is a tendency of HMO/IPA physicians to use these elastic labels differently. The HMO/IPA populations also differ, to a lesser extent, in their previous c-section rate and malpresentation rate. These latter diagnoses are quite objective, and variations are likely to reflect differences in the populations.

The differences shown for these diagnoses (lines (8), (11), and (14).) do not explain the differences in primary rates (line (2)). Evidently these differences must be explained by an accretion of small differences in these diagnoses and in those not reported here.[6] The rates reported in Table 1 are crude rates, and do not control for maternal characteristics, complications other than the four diagnoses, or other influences.

THE EMPIRICAL MODEL

We estimate four equations, as follows:

$$C_i = C_i\,(M_i, D_i, F_i, I_i, L_i, R_i, A_i, P_i, S_i, HMO_i, IPA_i, FIPA_i) \quad (1.1)$$

$$C_i = C_i\,(M_i, D_i, F_i, I_i, L_i, R_i, A_i, P_i, S_i, HMO_i, IPA_i, HMO_iI_i, HMO_iD_i, HMO_iF_i, IPA_iI_i, IPA_iD_i, IPA_iF_i, FIPA_i) \quad (1.2)$$

$$C_iD_i = C_iD_i\,(M_i, I_i, L_i, R_i, A_i, P_i, S_i, HMO_i, IPA_i, FIPA_i) \quad (1.3)$$

$$C_iF_i = C_iF_i\,(M_i, I_i, L_i, R_i, A_i, P_i, S_i, HMO_i, IPA_i, FIPA_i) \quad (1.4)$$

C_i is the probability that the ith delivery is by c-section; M_i is a vector of maternal characteristics such as age and race; D_i is the use of the diagnosis label "dystocia"; F_i is the use of "fetal distress"; I_i is a vector consisting of the more objective main diagnoses indicating c-section, namely, breech and previous c-section; L_i is a vector of other maternal illnesses, and complications of labor and delivery; R_i is a vector of regional economic variables affecting obstetrics; A_i is a dummy for counties with populations in excess of 250,000; P_i is HMO and IPA penetration, measured by percent of county deliveries covered by HMOs and IPAs; and S_i is the method of payment of the *i*th delivery, including self-pay, Medicaid, or commercial insurance/Blue Cross, but not including HMO or IPA, which are instead measured by HMO_i and IPA_i.[7] And $FIPA_i$ measures whether IPA physicians are paid higher fees for cesarean delivery.

The control variables are taken from the literature (see Tussing and Wojtowycz 1992). A_i is included because HMOs and IPAs are overrepresented in more populated areas, and in the absence of such a control, the influence of population might be reflected in the HMO/IPA variables. P_i is included to reflect the competitiveness of medical care markets, although it may also indirectly reflect other regional factors, such as structure of employment markets or community health consciousness.

First we estimate Equation 1.1. The coefficients of HMO and IPA measure the net effect of these settings/methods of payment on the probability of a c-section, given the patient and all the conditions of delivery. Thus, this version tests the main hypothesis. The coefficients of P_i measure the effects of HMO and IPA penetration on the probability that deliveries in an area are by c-section, testing the second hypothesis.

Equation 1.1 implicitly assumes that HMOs and IPAs respond similarly to all diagnoses. The effect of HMO and IPA is treated as a simple intercept shift. This assumption is dropped in Equation 1.2, where HMO and IPA are interacted with the main diagnoses indicating cesarean section. Interaction with diagnosis allows the possibility, for example, that HMOs might be *less* likely to perform c-sections for dystocia and *more* likely to do so for fetal distress, or vice versa.

In the third and fourth versions, cesarean section is interacted with dystocia and fetal distress, respectively. In Equation 1.3, this dependent variable is equal to 1 where the indication is dystocia *and* the method of delivery is cesarean section, and 0 in all other cases. In Equation 1.4, the dependent variable is equal to 1 where the indication is fetal distress and the method of delivery is cesarean section. These versions follow from our observation in Table 1 that HMOs and IPAs appear to use the dystocia and fetal distress labels with frequencies that differ from those of other settings, but that HMOs and IPAs appear also to use cesarean section *given these diagnoses* in ways that offset these tendencies. Thus it may be that treating the diagnoses of dystocia and fetal distress as exogenous, as in Equations 1.1 and 1.2, may be incorrect, biasing the estimates of the influences of HMO and IPA. In Equations 1.3 and 1.4, the dependent variables are the equivalents of line 5 and line 8, respectively, of Table 1. In estimating Equation 1.3, cases diagnosed with fetal distress are excluded; likewise, in estimating Equation 1.4, cases with dystocia are excluded. Thus the total number of observations differs from those of Equations 1.1 and 1.2.

The regressions are estimated using probit analysis. Coefficients cannot be interpreted as in a least squares linear probability model. However, a simple adjustment yields intuitively understandable results: divide coefficients by 2.5, and add 1.25 to the constant term, and then interpret the results as in ordinary least squares (Maddala 1983).

REGRESSION RESULTS

Table 2 reports on regression results for Equations 1.1, 1.2, 1.3, and 1.4, respectively. Partial derivatives of linear probability equivalents calculated from Equation 1.2 in Table 2 for HMO and IPA variables appear in Table 3.[8] In Table 4, these partial derivatives are applied to diagnosis rates from Table 1 to provide estimates of the effects of HMO and IPA on cesarean section rates, by diagnosis.

The results can be summarized in nine points.

Point 1. The HMO variable in Equation 1.1 is negative and significant at better than 5 percent. Thus it does appear that HMOs are less likely to perform c-sections, with given cases, where the four main diagnoses indicating c-section are controlled for. The coefficient in Equation 1.1, transformed to a linear probability, corresponds to a difference of 3.0 percentage points.

Point 2. When HMO is interacted with the main diagnoses indicating cesarean section in Equation 1.2, HMO significantly reduces the probability of a c-section for dystocia, breech, and previous c-section. ("Breech" includes breech and other abnormal presentation.) It significantly raises the probability of c-section for fetal distress. These results may be seen more clearly in the first column of Table 3, which reports the partial derivatives of cesarean delivery with respect to HMO.

In Table 4, these partial derivatives are applied to diagnosis rates from Table 1 to provide estimates of the effects of HMO and IPA on cesarean section rates, by diagnosis. For example, the first derivative for dystocia (Table 3) is −0.177; the proportion of deliveries diagnosed with dystocia is 0.133 (line 6 of Table 1); so Table 4 reports that dystocia in HMOs accounts for −0.0235 (−0.177 times 0.133) change in the cesarean rate. Adding up the effects of all diagnoses gives an implied reduction in the c-section rate of approximately 2.5 percentage points, as shown in Table 4. This 2.5 percentage point estimate is somewhat lower than the 3.0 percentage point estimate of Equation 1.1. These two estimates are reasonably close to each other, when one considers that they are calculated rather differently.

Table 2: Probit Regression of Method of Delivery, Cesarean versus Vaginal, and of Cesarean for Dystocia and Cesarean for Fetal Distress, on HMO and IPA Variables, New York State, 1986 (Absolute values of *t* in parentheses beneath parameter estimates)

	Eq. 1.1	*Eq. 1.2*	*Eq. 1.3*	*Eq. 1.4*
DEPENDENT VARIABLE:	*Cesarean*	*Cesarean*	*Cesarean for Dystocia†*	*Cesarean for Fetal Distress‡*
VERSION:	*No Diagnosis Interactions*	*With Diagnosis Interactions*	*With No Diagnosis Interactions*	*With No Diagnosis Interactions*
Main diagnoses indicating cesarean				
Dystocia	1.887*** (106.22)	1.914*** (104.05)		
Fetal distress	0.968*** (56.65)	0.970*** (55.19)		
Breech	1.841*** (80.23)	1.850*** (78.41)		
Previous cesareans	2.838*** (136.80)	2.850*** (133.45)		
Setting HMO				
HMO	−0.0758** (1.99)	0.0972* (1.95)	−0.0294 (0.66)	0.0224 (0.43)
HMO interactions with				
• Dystocia		−0.540*** (6.00)		
• Fetal distress		0.200** (2.00)		
• Breech		−0.442*** (3.64)		
• Previous cesareans		−0.411*** (3.72)		
Setting IPA				
IPA	−0.0970 (1.28)	−0.0274 (0.029)	0.180** (2.22)	−0.0337 (0.32)
IPA pays more for cesarean	0.178** (1.97)	0.145 (1.57)	−0.112 (1.15)	0.0196 (0.09)
IPA interactions with				
• Dystocia		−0.158 (1.55)		

Continued

Table 2: Continued

	Eq. 1.1	*Eq. 1.2*	*Eq. 1.3*	*Eq. 1.4*
DEPENDENT VARIABLE:	*Cesarean*	*Cesarean*	*Cesarean for Dystocia†*	*Cesarean for Fetal Distress‡*
VERSION:	*No Diagnosis Interactions*	*With Diagnosis Interactions*	*With No Diagnosis Interactions*	*With No Diagnosis Interactions*
• Fetal distress		−0.278*** (2.58)		
• Breech		0.386*** (2.38)		
• Previous cesarean		0.111 (0.816)		
County HMO/IPA Penetration				
HMO deliveries as % of total	−0.0249*** (9.86)	−0.0247*** (9.76)	−0.0109*** (3.57)	0.00114 (0.32)
IPA deliveries as % of total	−0.0322*** (12.95)	−0.0323*** (12.98)	0.00517* (1.82)	0.000978 (0.28)
−2 Log Likelihood Ratio	49,561.99***	49,643.05***	3,106.53***	1,485.94***
Number of observations	85,288	85,288	75,932†	76,124‡

Significance:

*$p \leq .10$.

**$p \leq .05$.

***$p \leq .01$.

†The dependent variable is equal to 1 where dystocia is diagnosed and a c-section is performed. Cases with fetal distress = 1 excluded.

‡The dependent variable is equal to 1 where fetal distress is diagnosed and a c-section is performed. Cases with dystocia = 1 excluded.

Data discussed earlier (see Table 1) suggest that HMO physicians may use the dystocia and fetal distress diagnostic labels differently from non-HMO/IPA physicians, and these differences may account in part or whole for the results of the HMO parameters in Equations 1.1 and 1.2, and of the interaction variables in Equation 1.2. Equations 1.3 and 1.4 are intended to resolve this issue; see points 8 and 9.

Point 3. The IPA variable in Equation 1.1 is not significant, suggesting that this type of setting per se does not affect the probability of a c-section.

Table 3: Partial Derivatives of Cesarean Method of Delivery, with Respect to HMO and IPA; Derived from Linear Probability Transformations of Probit Regression 1.2 in Table 2

Diagnosis	*HMO*	*IPA**
Dystocia	−0.177	−0.017
Fetal distress	+0.119	−0.064
Breech	−0.138	+0.201
Previous cesarean	−0.126	+0.092
All other deliveries	+0.039	+0.047

*IPA values assume IPA pays more for cesarean than vaginal delivery; that is, the transformed coefficient of variable, "IPA pays more for a cesarean delivery," is included in the calculation above. (If it is assumed that IPA pays the same for both methods of delivery, the sign of "All other deliveries" becomes negative.)

Table 4: Estimated Effect of HMO Setting on Cesarean Rate, by Diagnosis; Derived from First Derivatives, Table 3 and Rates of Diagnoses, Table 1†

	HMO	*IPA*
Dystocia	−.0235***	−.0022
Fetal Distress	+.0115*	−.0099***
Dystocia Plus Fetal Distress	−.0120	−.0122
Breech/Abnormal Presentation	−.0095***	+.0056***
Previous Cesarean	−.0127***	−.0147
All Other Diagnoses‡	+.0091**	+.0127
Breech Plus Previous Cesarean Plus All Other	−.0131	+.0036
Overall Total	−.0251	−.0086

Significance of regression coefficients on which estimates are based:

* $p \leq .10$.

** $p \leq .05$.

*** $p \leq .01$.

†First derivatives from Table 3 multiplied by lines 6, 9, 12, and 3 of HMO and IPA columns under "New York State," Table 1. For all other diagnoses, first derivatives in Table 3 multiplied by .233 for HMO and .270 for IPA. See note ‡.

‡All other diagnoses indicating cesarean, including abruptio placentae, placenta previa, umbilical cord prolapse, maternal medical conditions, and others. These estimates are based on the HMO and IPA variables, respectively, in equation 1.2.

Point 4. When we interact IPA with diagnosis in Equation 1.2, we find that IPAs do affect the probability of a c-section for certain diagnoses. Evidently, these effects are such as to cancel each other when the effect of IPA is gauged in a single variable, as in Equation 1.1. IPA significantly reduces the probability of a c-section for fetal distress, but raises it for breech and other abnormal presentation—effects opposite to those of HMO. As with HMO, the results for IPAs may reflect different uses of the labels dystocia and fetal distress.

Point 5. Where IPAs pay physicians more for a cesarean than a vaginal delivery, as they do in most cases, that increases the c-section rate, regardless of model specification.

Point 6. The partial derivatives for IPA in Table 3 are based on the assumption that the IPA pays physicians more for a cesarean delivery. The same is true of the diagnosis-by-diagnosis estimates of the effect of IPA on the c-section rate. The overall downward effect of IPA on the c-section rate is estimated in Table 4 to be less than 1 percentage point.

Point 7. In Equations 1.1 and 1.2 of Table 2, the county HMO and IPA penetration variables are consistently negative and very significant, and they persist with little change regardless of model specification. The results in Equation 1.2 imply that every one percentage point increase in either HMO or IPA share of obstetric deliveries is associated with a fall of approximately one percentage point (0.99 percent and 1.29 points, respectively, for HMO and IPA) in the probability of a c-section. These results, the indirect effects of HMOs and IPAs, pertain to every delivery in an area, not just HMO/IPA deliveries.

Point 8. In Equation 1.3, the dependent variable is c-section for dystocia, the interaction between diagnosis dystocia and method of delivery cesarean section. In Equation 1.4, the dependent variable is c-section for fetal distress. In both cases HMO is statistically insignificant. This result is consistent with Table 1, where a high rate of diagnosis of dystocia and a low rate of diagnosis of fetal distress in HMOs are offset by respectively low and high cesarean section rates for these diagnoses. This result casts some doubt on whether, with respect to dystocia and fetal distress, our main hypothesis has been sustained, namely, that given mothers with particular given backgrounds, illnesses, and complications, HMOs have lower probabilities of delivery by cesarean section.

This concern does not affect other diagnoses. Table 4 indicates that the probability of a c-section for breech presentation, previous cesarean section, and all other diagnoses (other than dystocia and fetal distress) is changed in HMO settings by −.0131, i.e., reduced by approximately 1.3 percentage points.

Point 9. The finding in Equations 1.3 and 1.4 for IPAs is only slightly different from that for HMOs. IPAs do appear to have a significantly higher rate of cesarean section for dystocia, while the IPA coefficient for c-section for fetal distress is statistically insignificant.

DISCUSSION

In this section we discuss four principal findings of this article: (1) that HMO setting reduces the probability of a cesarean section by 2.5 to 3.0 percentage points; (2) that this result is likely to be partly an artifact of offsetting diagnostic labeling and of choice of method of delivery, given diagnosis, and that a better estimate of the effect of HMO setting is −1.3 percentage points; (3) that IPA setting appears to affect the probability of a cesarean section even less, and perhaps not at all; and (4) that HMO and IPA penetration in a region, as measured by the HMO and IPA deliveries, respectively, as a percent of total deliveries, has a relatively large depressing effect on the probability of a cesarean section, not only in HMO/IPA settings, but throughout the area. We conclude with a review of policy implications.

We are unable to observe or control for health consciousness or previous medical care utilization, apart from previous deliveries, live births, and c-sections. Our results should be interpreted with the caveat that these and other unobserved variables could influence the c-section rates of HMO patients relative to others.

HMO setting does appear to reduce c-section rates, by approximately 2.5 points (Table 4) to about 3.0 percentage points (Equation 1.1, Table 2). The effect of HMO is significantly negative in Equation 1.2 for every one of the four main diagnoses indicating cesarean section, except for fetal distress, where the effect is positive.

If HMOs do in fact lower c-section rates for dystocia and raise them for fetal distress, as our results indicate, that would be consistent with our earlier discussion. Compared with FFS physicians, HMO physicians have less need to perform c-sections for slow labor (a major category of dystocia) in order to manage time more effectively. On the other hand, if HMOs are more impersonal and clinic-like than FFS settings, and/or if HMO physicians are less skilled, they may tend to choose c-section more for fetal distress, where physicians are less certain of their diagnoses and of the progress of labor.

However, one should recall that HMO physicians evidently use the dystocia and fetal distress labels in ways different from those of their FFS counterparts. They are more likely to diagnose dystocia and less likely to deliver by c-section when they do; they are less likely to diagnose fetal distress and more likely to select c-section when they do. This difference in use of diagnostic labels, rather than differences in methods of delivery, appears to account for the observed differences in cesarean section behavior, in so far as dystocia and fetal distress are concerned.

This interpretation can be illustrated by referring to Equation 1.2

in Table 2. We know from Table 1 that HMO physicians are less likely to diagnose fetal distress when compared to other physicians. Assuming the underlying patient populations of HMO and non-HMO settings to be similar (i.e., that the true incidence of fetal distress is about the same across these settings), this suggests that HMO physicians are more conservative with the fetal distress label and thus that HMO patients labeled as such are likely to have more serious problems when compared with non-HMO patients who are similarly labeled. One would expect higher c-section rates for HMO patients diagnosed with fetal distress than for non-HMO patients similarly diagnosed. The significant positive coefficient for the interaction term between HMO and fetal distress in Equation 1.2, Table 2, bears this out.

Similarly, HMO physicians use the dystocia label more often, suggesting that they might tend more often to label less severe patients with dystocia than their non-HMO counterparts. One might expect c-section of these patients by HMO physicians less often. That surmise is borne out by the significant negative coefficient for the interaction term between HMO and dystocia in Equation 1.2, Table 2.

In each case, the difference in diagnostic behavior is so closely offset by a corresponding but opposite difference in method of delivery as to produce no significant difference between the fraction of all their patients that HMO and non-HMO physicians section for either of these two diagnoses. This is shown by the fact that the coefficient for HMO is not significantly different from zero in Equations 1.3 and 1.4 in Table 2.

Our main hypothesis was that with given mothers—with particular given backgrounds, illnesses, and complications—HMOs and IPAs will have lower probabilities of delivery by cesarean section. If we conclude that this hypothesis is *not* sustained for the two most important (and most subjective) diagnoses indicating cesarean, namely dystocia and fetal distress, we are still left with the conclusion that physicians perform c-section deliveries less for the other, more objective diagnoses. Table 4 reports an estimate that HMO reduces the c-section rate by 1.3 percentage points for previous c-section, breech and other abnormal presentation, and other diagnoses. This is our minimum estimate of the effect of HMO on cesarean rates. The maximum estimate includes dystocia and fetal distress, and lies between 2.5 and 3.0 percentage points. Whichever value one accepts, these effects of HMO on method of delivery appear small, compared with the previously reported effects of HMOs on other types of inpatient hospital utilization.

Turning to IPAs, we cannot say with confidence that they tend to reduce c-section rates. Their effect depends on diagnosis, but there is little if any overall effect.

On the other hand, the indirect effects of HMO and IPA can be substantial and do warrant our attention. These consist of the influence on every delivery, irrespective of setting, of HMO and IPA penetration. These effects are large, negative, and very significant. Assuming that these variables reflect competitiveness of obstetrics markets, these results suggest that competition per se brings down cesarean section rates, a finding consistent with results we report elsewhere. We have found the area ratio of obstetricians to fertile females to relate negatively to the probability that a given delivery is by cesarean; this result is inconsistent with the familiar supplier-induced demand hypothesis, but it is consistent with an argument that competition brings down cesarean section rates (Tussing and Wojtowycz 1991; Tussing and Wojtowycz 1993).

In sum, while the direct effects of HMO (and maybe IPA) are in the direction expected, they are relatively small; but the indirect effects are large and important.

Taken together, these results have implications for public policy respecting both c-sections and HMOs. With regard to c-sections, it is interesting that the HMOs (and IPAs) in our study appear not to behave differently from other settings in terms of the proportions of all their patients they tend to give the subjective diagnoses of dystocia and fetal distress and then to deliver by c-section. Given the strong incentives these plans face to avoid unnecessary costly utilization, this may mean that HMOs see little opportunity for cost savings in this area. They evidently conclude that it is appropriate to perform c-sections for dystocia and fetal distress as often as FFS physicians do.

By contrast, it would appear that HMOs are significantly less likely to perform c-sections for the objective diagnoses, and particularly for previous cesarean. This appears to be the main area where HMOs see an opportunity to save money in method of obstetric delivery, as compared with non-HMO settings. It is interesting that, since 1986, the national cesarean rate has peaked and fallen slightly, and that the reductions are almost exclusively derived from increased VBAC rates, in effect following the HMO lead (Placek, Taffel, and Moien 1988). Perhaps a promising strategy for further reductions in c-section rates is to focus on VBACs, and perhaps breech.

The result regarding HMO and IPA penetration, when viewed against the background of the small reduction in c-section rates found in HMOs and IPAs, is consistent with a picture of a market in which HMOs and perhaps IPAs stay a step ahead of their FFS competitors in finding ways to reduce c-section rates, but where FFS physicians respond by finding ways to reduce their own c-section rates. This finding, which concerns a little explored avenue of HMO/IPA influence, would appear to have important implications for the current discussions of reforms in the U.S. health care system. If increased competition, or penetration per se of prepaid plans, is capable of affecting the practice styles and clinical judgments not only of HMO/IPA physicians but in fact of physicians in general, that suggests a potentially powerful lever for achieving cost control. It is a prospect worth further study.

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NOTES

1. Dystocia is abnormal (usually slow) progress of labor, and includes fetopelvic disproportion and failure to progress.
2. Fetal distress results from inadequate fetal oxygen supply and carbon dioxide removal, producing fetal acidosis.
3. In our data set, 84 percent of cesareans are accounted for by these indications. Using the hierarchy of indications suggested by Stafford (1990), 36 percent had previous cesareans, perhaps with other indications; 16 percent had breech or other abnormal presentation, possibly with other indications but not previous cesareans; 22 percent had dystocia and possibly other indications but not previous cesareans or breech or other abnormal presentation; 10 percent had fetal distress but none of the other indications.
4. The five boroughs of New York City are excluded because New York City maintains its own vital records department; the New York State Office of Biostatistics in Albany handles the remaining 57 countries.
5. Method of payment was recoded on the basis of payer name.
6. Plural birth, placenta previa, cord prolapse, abruptio placenta, and so forth all constitute indications for cesarean, but the numbers are small compared with the four indications specifically discussed.
7. For S_i, variables are included for self-pay and Medicaid, while commercial insurance/Blue Cross is included in the constant term.

8. Only the results pertinent to the present study are shown in Table 3. Full results are available from the authors.

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