The Impact of Medicaid Managed Care on Pregnant Women in Ohio: A Cohort Analysis

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Objective. To examine the impact of mandatory HMO enrollment for Medicaid-covered pregnant women on prenatal care use, smoking, Cesarean section (C-section) use, and birth weight.

Data Sources/Study Setting. Linked birth certificate and Medicaid enrollment data from July 1993 to June 1998 in 10 Ohio counties, 6 that implemented mandatory HMO enrollment, and 4 with low levels of voluntary enrollment (under 15 percent). Cuyahoga County (Cleveland) is analyzed separately; the other mandatory counties and the voluntary counties are grouped for analysis, due to small sample sizes.

Study Design. Women serve as their own controls, which helps to overcome the bias from unmeasured variables such as health beliefs and behavior. Changes in key outcomes between the first and second birth are compared between women who reside in mandatory HMO enrollment counties and those in voluntary enrollment counties. County of residence is the primary indicator of managed care status, since, in Ohio, women are allowed to "opt out" of HMO enrollment in mandatory counties in certain circumstances, leading to selection. As a secondary analysis, we compare women according to their HMO enrollment status at the first and second birth.

Data Collection/Extraction Methods. Linked birth certificate/enrollment data were used to identify 4,917 women with two deliveries covered by Medicaid, one prior to the implementation of mandatory HMO enrollment (mid-1996) and one following implementation. Data for individual births were linked over time using a scrambled maternal Medicaid identification number.

Principal Findings. The effects of HMO enrollment on prenatal care use and smoking were confined to Cuyahoga County, Ohio's largest county. In Cuyahoga, the implementation of mandatory enrollment was related to a significant deterioration in the timing of initiation of care, but an improvement in the number of prenatal visits. In that county also, women who smoked in their first pregnancy were less likely to smoke during the second pregnancy, compared to women in voluntary counties. Women residing in all the mandatory counties were less likely to have a repeat C-section. There were no effects on infant birth weight. The effects of women's own managed care status were inconsistent depending on the outcome examined; an interpretation of these results is hampered by selection issues. Changes over time in outcomes, both positive and negative, were more pronounced for African American women.

Conclusions. With careful implementation and attention to women's individual differences as in Ohio, outcomes for pregnant women may improve with Medicaid

managed care implementation. Quality monitoring should continue as Medicaid managed care becomes more widespread. More research is needed to identify the types of health maintenance organization activities that lead to improved outcomes.

Key Words. Managed care, Medicaid, birth outcomes, prenatal care

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Two converging trends in the l980s and l990s—the Medicaid expansions for pregnant women and the rapid expansion in the use of managed care approaches in Medicaid—have led to a greatly expanded role for managed care in the pregnancies of low income women. The Medicaid program covered a substantial proportion of all births in the United States, from 20 percent to 55 percent depending on the state in the late l990s (Schwalberg et al. 2001; Tai-Seale et al. 2001), and 48 percent of Medicaid enrollees in the childbearing years were enrolled in health maintenance organizations (HMOs) by 2000 (National Center for Health Statistics 2002).

Pregnant women and their infants are an important population that could either benefit from managed care—through potentially improved access to high-quality, continuous preventive care—or could suffer from a restriction in the number and type of services provided in the managed care system. Some studies have examined this major change in Medicaid financing of maternity care, but all have had some methodological flaws, and no consensus has emerged on managed care's effects on pregnant women.

LITERATURE REVIEW

Table 1 shows ten published studies all conducted on data from the mid-l980s to the mid-l990s—classified according to three broad categories of research

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Table 1: Overview of Studies of the Impact of Medicaid Managed Care on Prenatal Care and Birth Outcomes

Design	*Citation*	*Location/Date(s)*	*Key Findings*
Comparison of Medicaid Pregnant Women in Fee-for-Service Areas to Those in Managed Care Areas	Carey, Weis, and Homer 1991	California and Missouri, 1985	Rates of prenatal care use and low birth weight did not differ significantly between fee-for-service and managed care counties.
	Conover, Rankin, and Sloan 2001	North Carolina and Tennessee, 1993 and 1995	Women in the managed care state (Tennessee) were more likely to have late or no prenatal care than in North Carolina. There was no effect on infant mortality.
	Oleske et al. 1998	California, 1993	Women in managed care counties were less likely to deliver low birth weight infants. There were no differences in prenatal care, C-section, or other outcomes.
	Tai-Seale et al. 2001	California, 1987 and 1992	The number of prenatal care visits and length of delivery hospital stay were lower under managed care.
Comparison between Medicaid Pregnant Women Prior to Managed Care Implementation and Those after Implementation in the Same Area	Griffin et al. 1999	Rhode Island, 1993–1995	Adequacy of prenatal care improved after implementing managed care, and more care was received from private physicians.
	Moreno 1999	Tennessee, 1993–1996	Women were more likely to have late prenatal care after the implementation of managed care.

continued

Table 1: *Continued*

Design	*Citation*	*Location/Date(s)*	*Key Findings*
Comparisons between Medicaid Pregnant Women Who Do and Do Not Enroll in Managed Care within the Same Area	Goldfarb et al. 1991	Philadelphia, PA 1988	There were no significant differences between fee-for-service and managed care enrollees in the number of prenatal visits and birth weight.
	Krieger, Connell, and LoGerfo 1992	Washington State, 1993–1996	Managed care enrollees were more likely to receive late prenatal care, but this result was confined to one of the three studied plans. There was no difference in the rate of low birth weight.
	Levinson and Ullman 1998	Wisconsin 1994	Women enrolled in managed care were more likely to receive adequate prenatal care; there was no difference between the groups in the rate of low birth weight.
	Koroukian, Bush, and Rimm 2001	Ohio, 1992–1997	Managed care enrollees had significantly lower rates of repeat C-section; rates of primary C-section did not differ between the two groups.

designs. In the first group, four studies compare Medicaid pregnant women in fee-for-service (FFS) areas to those in managed care areas. In the second group, two studies compare Medicaid pregnant women before managed care implementation to those after implementation in the same area. In the final group, four studies compare Medicaid pregnant women who did not enroll in managed care to those who did enroll within the same area.

The studies examine three types of outcomes: prenatal care utilization (either the timing of the first visit, the number of visits, or overall adequacy of care), rates of Cesarean section (C-section), and infant birth outcomes (birth weight or mortality), all of which could hypothetically be affected by managed care enrollment. Results vary considerably from study to study, especially the findings concerning prenatal care use. Two studies report better prenatal care use under managed care (Levinson and Ullman 1998; Griffin et al. 1999) and four studies (Conover, Rankin, and Sloan 2001; Tai-Seale et al. 2001; Moreno 1999; Krieger, Connell, and LoGerfo 1992) report poorer care.

These variations in findings concerning the impact of Medicaid managed care could be due to study methodology, the location or timing of the study, or variations across health plans in how pregnant women are treated. The cited studies also suffer from various methodological weaknesses that could bias the findings. In the first set of studies, women in managed care counties may be different than those in fee-for-service (FFS) counties in ways that are unobserved and correlated with study outcomes. For example, women in managed care counties may have greater access to prenatal care or neonatal intensive care; be more likely to be substance abusers or smokers; or have other characteristics that cannot easily be controlled for in regression analyses. In the second set of studies, lack of a comparison group results in no control for unmeasured secular trends in the composition of the Medicaid population. For example, if prenatal care use declines after managed care implementation, this could be due to other changes in the geographic area such as improved health care services, or to shifts in the composition of the population (e.g., more Hispanic residents). The third set of studies is subject to selection bias, whereby women who enroll in managed care are different from those who choose not to enroll (for example, lower-risk women may enroll).

Our study introduces a new way of addressing these biases. Here we compare a woman's prenatal care use and birth outcomes for two of her pregnancies, rather than comparing her results to those of a different person with different unmeasured characteristics. We control for secular trends (for example changes that naturally occur over women's lifetimes, as well as

changes in the health care system) by comparing the changes in her outcomes to those of other women outside her geographic area who are not subject to mandatory Medicaid managed care.

Medicaid Managed Care in Ohio

Data for this study are from Ohio, where managed care was gradually implemented on a county-by-county basis beginning in 1989. The first county to implement mandatory managed care was Montgomery County (Dayton) in 1989. The state also encouraged voluntary enrollment in HMOs throughout the early 1990s, primarily in selected urban areas that had a sufficient number of health plans. Then—with the "OhioCare" Medicaid waiver in 1996—six additional counties were moved to mandatory Medicaid managed care. These counties (and their main cities) were: Butler (just north of Cincinnati), Cuyahoga (Cleveland), Franklin (Columbus), Hamilton (Cincinnati), Lucas (Toledo), and Summit (Akron). These are all counties that had previously implemented voluntary HMO enrollment. Eleven counties continued to have voluntary HMO enrollment, although HMO penetration was low, below 10 percent, in most counties, and never rose above 30 percent in any of the voluntary counties in any time period. All other counties remained under fee-for-service.

There was considerable turmoil in the early implementation period, especially in Cuyahoga County. Because the state took the position that any plan that agreed to the state's conditions and accepted the premiums could participate, initially many more plans entered the market than could survive given the number of Medicaid enrollees. Eventually a number of plans left the market, and implementation proceeded more smoothly. More detail on the implementation of Medicaid managed care in Ohio, including information on some of the difficulties the state faced in recruiting and retaining high-quality plans, is contained in another document (Howell and Sommers 2003).

One important aspect of Ohio's implementation of managed care was considerable flexibility in how a woman's individual managed care status was assigned. If a woman enrolled in Medicaid in the third trimester of her pregnancy she generally remained under FFS reimbursement. This could also happen with a problem pregnancy, when a woman's physician did not participate in a health plan. The most common reason for remaining in FFS was late enrollment in Medicaid.

METHODS

The study uses an innovative research design to address the problems that have troubled previous studies of Medicaid managed care's impact on pregnant women. Using linked data from Medicaid eligibility and birth certificate files, we examine changes in prenatal care use, smoking, C-section, and birth weight for women who had two deliveries covered by Medicaid, one before the implementation of mandatory managed care and one after implementation. In such a design, a woman serves as her own control, so that underlying unmeasured characteristics such as health attitudes and behaviors are less likely to confound the results.

To control for secular trends and changes that naturally occur between pregnancies as women age, we compare change between pregnancies in the study outcomes for women who were subject to managed care to women who were not. The previously mentioned flexibility in whether women were assigned to HMOs could lead to selection bias in comparisons between HMO enrollees and nonenrollees at the individual level. Consequently, our primary analysis concentrates on comparisons between women residing in different types of counties. Cuyahoga County is classified separately because of its large size and somewhat different history of managed care implementation as described above. The remaining five mandatory managed care counties are grouped for analysis, because of relatively small sample sizes (Butler, Franklin, Hamilton, Lucas, and Summit). Outcomes for women in mandatory managed care counties are compared to women residing in four comparison counties (Marion, Miami, Stark, and Wood), grouped for analysis. These counties had low levels of voluntary enrollment in HMOs—less than 15 percent—during the study period. They were considered to be more suitable as comparison counties than, for example, entirely FFS counties, because they had a managed care infrastructure and other important characteristics, such as access to neonatal intensive care. A separate analysis, not shown in this paper, compared women in mandatory counties to women in selected FFS counties. Results were essentially the same as those shown here. (See Kenney, Sommers, and Dubay 2003 for more discussion of the selection of comparison counties.)

A secondary analysis focuses on differences between types of enrollees within county types. Women who were enrolled in fee-for-service during their first pregnancy and an HMO during the second (FFS/HMO) are distinguished from, for example, those in fee-for-service for both pregnancies (FFS/FFS).

Beginning in l992, the state of Ohio routinely has linked its birth certificates to Medicaid eligibility files using a methodology that is described more thoroughly elsewhere (Koroukian, Bush, and Rimm 2001). We used this linked file to identify a sample of women who had one delivery between July l993 and June l996 (before mandatory HMO enrollment in the six mandatory counties) and another delivery under Medicaid between April 1997 and June 1998 (following implementation of mandatory enrollment). Thus, women in the study population have a maximum birth interval of five years; the median birth interval is 33 months, with a range from 10 to 60 months. To be included in the study a woman must have delivered two (and only two) infants covered by the Ohio Medicaid program, one before the implementation of mandatory HMO enrollment in the six counties that began in mid-1996, and one at least 9 months following implementation.

To construct the analysis file we began with all Medicaid deliveries in the five year time period and eliminated births that did not meet the study criteria. First, individual births were linked by mother's Medicaid identification number (confirmed by matching race and age). The major exclusion (64 percent of all excluded births) was births to women who delivered only once in the time period. Other exclusions are shown in Table 2.

The final sample includes 4,917 mothers (9,834 births). The unit of analysis is the mother. Table 3 shows the study sample and the mother's characteristics at the time of her second delivery, compared to all Medicaid births during the time period. Mothers in the study group were older, less likely to be married, more often African American, and more likely to be on Medicaid through attachment to welfare than through the "Healthy Start" program that provides Medicaid coverage for other low-income pregnant women not receiving welfare. Consequently, the results from this study can be viewed as reflective of managed care's impact on mothers who remain attached to the Medicaid program for a substantial part of their childbearing years, but not necessarily reflective of its impact on young women or women who have, for example, a single birth while on Medicaid.

Classifying women according to their own managed care status led to the following designations: FFS/FFS (fee-for-service for the majority of months in both pregnancies—1,391 women), FFS/HMO (2,539 women), HMO/FFS (187 women), and HMO/HMO (692 women). Because of the small sample size, results for the HMO/FFS women are excluded from tables, although they were included in the regression analysis.

We examined five outcomes: prenatal care timing, number of prenatal visits (for women with full term pregnancies), smoking, C-section delivery, and

Table 2: Study Exclusions

Total Medicaid Births, July 1993–June 1998	*254,658*
Exclusions:	
1. Blind/disabled mother	9,580
2. Plural birth	6,890
3. Only one birth in study period	155,943
4. More than two births in study period	16,249
5. Unconfirmed matches	
• Different race	5,420
• Different age	362
6. Birth interval less than 9 months	954
7. Did not meet date criteria (one birth before implementation/one birth after)	21,186
8. Outside study counties or mother moved between births	28,240
Total Exclusions	244,824
Study Population: 9,834 births/4,917 mothers	

Table 3: Characteristics of Total Medicaid Births and Study Cohort Ohio: 1994–1998

Maternal Characteristics	*All Medicaid Births (n = 254,658)* %	*Study Cohort/Second Birth (n = 4,917 births)* %
% Aged <20	34.2	22.1
% Married	36.0	25.8
% Less than high school education	34.7	34.2
% African American	28.7	51.4
% Healthy Start*	33.8	23.5
Average birth interval between study births	Not Applicable	2.7 years

*Healthy Start is Ohio's program to provide Medicaid coverage to women who are not attached to the welfare system.

birth weight. The definitions for them are shown in Table 4 and basic descriptive statistics are shown in Table 5. Since we are interested in change in these variables from the first delivery to the second, in each case we measure that change. For example, for prenatal care, if a woman initiated care in the second trimester of her first pregnancy, but the first trimester of her second pregnancy, her care is classified as "improved."

To estimate the relative risks of worsening or improving prenatal care use relative to no change, we estimated separate multinomial logit models for

Table 4: Definitions of Study Outcome Variables

Variable	*Underlying Measure*	*Analysis Variable (Change)*
Prenatal Care Initiation	Mothers Began Prenatal Care in: • First Trimester • Second Trimester • Third Trimester • No Care	Change in Prenatal Care Initiation from First to Second Pregnancy: • Improved • No Change • Care Worsened
Number of Prenatal Visits (Only women who were full term at both births)	Number of Prenatal Visits: • 13+ Visits • 7–12 Visits • 1–6 Visits • No Visits	Change in Number of Visits from First to Second Pregnancy • Improved • No Change • Care Worsened
Smoking (Only women who smoked during first pregnancy)	Mother Smoked during Pregnancy	Second Pregnancy: • Smoked • Did Not Smoke
C-section (Only women who had C-section at first birth)	C-section Delivery	Second Delivery: • Had C-section • No C-section
Birth Weight	Birth Weight (in grams)	Difference between birth weight of second and first infant

changes in the initiation of care and visits. The multinomial logit approach allows us to determine whether the chance of both improvement and worsening of prenatal care use could occur with the implementation of Medicaid managed care. We report relative risk ratios for both improvement in and worsening of prenatal care use relative to no change in prenatal care use. Our models for smoking and C-section are estimated as logistic regression models, and we report the relative risks of continuing to smoke and having a repeat C-section in the postperiod relative to not continuing smoking and not having a repeat C-section, respectively. Ordinary least squares regression was used to model change in infant birth weight. Control variables in the models were indicators for county of residence (Cuyahoga or other mandatory, with voluntary serving as the reference category) and race (African American, with white women serving as the reference category). Additional analyses used other control variables (such as parity, marital status, and education), but none were found to be important to the key findings.

The quality of birth certificate data, while not perfect, is generally good for the variables used in this analysis (DiGiuseppe et al. 2002). Other

Table 5: Descriptive Outcomes for Study Cohort Ohio Medicaid: 1994–1998

	County of Residence			
	Mandatory Counties			
	Cuyahoga	*Other*	*Voluntary Counties*	*Total Study Cohort*
Sample Size (Number of Women)	1,748	2,650	519	4,917
Prenatal Care Initiation (%)				
Improved	19%	16%	18%	17%
Worsened	24	21	17	21
Prenatal Visits (%)				
Improved	29	22	21	25
Worsened	29	28	27	28
Smoking (%)				
Second Delivery	23	37	39	32
C-section (%)				
Second Delivery	10	11	16	11
Birthweight (Grams)				
Second Delivery	3,220g	3,227g	3,294g	3,231g

Note: Other mandatory counties: Butler, Franklin, Hamilton, Lucas, Summit.
Voluntary counties: Marion, Miami, Stark, Wood.

researchers have observed an increase in missing data on Ohio birth certificates during our study period (Kids Count 2002). However, in separate analyses not shown here, we recoded missing values to "no care" and found no major differences in the findings that are presented.

FINDINGS

Medicaid and HMO Enrollment

Women can be affected by their Medicaid HMO only for the time that they are both enrolled in Medicaid and enrolled in an HMO. We first examine the degree to which women in the several types of Ohio counties were in HMOs and the length of their Medicaid enrollment. Table 6 can be used to illustrate several important points. First, in the period before mandatory MMC implementation only about a quarter of women were enrolled in HMOs at delivery in those counties that implemented mandatory enrollment. Following mandatory managed care implementation, 76.9 percent of women in mandatory managed care counties were enrolled in HMOs at delivery,

Table 6: Managed Care and Medicaid Enrollment of Study Cohort Ohio Medicaid: 1994–1998

	County Managed Care Status			
	Preperiod (First Pregnancy)		*Postperiod (Second Pregnancy)*	
	Mandatory	*Voluntary*	*Mandatory*	*Voluntary*
Woman's Managed Care Status				
In HMO at Delivery	24.3%	5.8%	76.9%	14.5%
Mean Months of Pregnancy Enrolled in Medicaid	8.5	8.2	8.2	8.7
In FFS at Delivery	75.7%	94.2%	23.1%	85.6%
Mean Months of Pregnancy Enrolled in Medicaid	7.1	7.1	5.9	7.1
Total Number of Women in Study Cohort	4,398	519	4,398	519

Note: Mandatory counties: Butler, Cuyahoga, Franklin, Hamilton, Lucas, Summit. Voluntary counties: Marion, Miami, Stark, Wood.

leaving the remaining 23.1 percent in FFS at the time of delivery. Thus, living in a mandatory managed care county did not necessarily mean being subject to the direct influence of an HMO throughout pregnancy, although there could be indirect effects due to changes in provider practice patterns and other health system changes. The table also shows that the average length of time enrolled in Medicaid during pregnancy was at least a month longer for women enrolled in HMOs at the time of delivery than for FFS women. This reflects the fact that women who enroll in Medicaid late in pregnancy in Ohio are frequently exempted from HMO enrollment.

Prenatal Care

We studied whether women's care improved or worsened after the implementation of mandatory Medicaid managed care and the degree to which this varied by the type of managed care in her county of residence and her own HMO status. Tables 7 and 8 show results from two types of regression analyses: (1) those that include only type of county of residence, and (2) those that also include mother's HMO status during pregnancy.

Table 7 shows results from multinomial logistic regressions that predict both a woman's relative risk of improved prenatal care use and of worsened use, according to her residence in a particular type of managed care county and her race.

Table 7: Relative Risk of Improved or Worse Prenatal Care Use by County of Residence and Race, Ohio Medicaid Study Cohort: 1994–1998

	Initiation of Care		*Number of Visits**	
	RRR	*95% Confidence Interval*	*RRR*	*95% Confidence Interval*
Outcome Improved				
County of Residence				
Cuyahoga	1.09	.83–1.43	1.60	1.18–2.16
Other mandatory	.91	.70–1.18	1.06	.80–1.42
Voluntary	1.00	—	1.00	—
Race				
African American	1.24	1.05–1.45	1.20	1.01–1.43
White	1.00	—	1.00	—
Outcome Worsened				
County of Residence				
Cuyahoga	1.34	1.02–1.76	1.15	.86–1.52
Other mandatory	1.13	.88–1.47	1.01	.78–1.32
Voluntary	1.00	—	1.00	—
Race				
African American	1.49	1.28–1.73	1.42	1.21–1.68
White	1.00	—	1.00	—
Total Number of Women	4,806		3,500	

*Only women with full-term pregnancies for both births.
RRR: Relative Risk Ratio estimated from multinomial logistic regression.

As shown, there were no significant improvements in initiation of care for women residing in mandatory managed care counties compared to those in voluntary counties. Indeed, in Cuyahoga County (Cleveland) women were significantly more likely to have the timing of initiation of their care worsen according to this measure. On the other hand, in Cuyahoga County women with full-term pregnancies were more likely to show an improvement in their number of prenatal care visits. There were no significant findings on prenatal care use in the other mandatory counties.

African American women were differentially affected by trends in prenatal care use. The initiation of prenatal care for African American women, in contrast to care for white women, was more likely both to improve and to become worse during the period of managed care implementation. The tables show only the contrast between non-Hispanic African American and non-Hispanic white women. (There was a very small number [31] of Hispanic and "other race/ethnicity" women who are included in the regressions, but whose data are not shown separately due to the small sample size.)

Table 8: Relative Risk of Improved or Worse Prenatal Care Use by Residence in Managed Care County and Maternal HMO Enrollment, Ohio Medicaid Study Cohort: 1994–1998

	Relative Risk of Outcome			
	Initiation of Care		*Number of Visits**	
	RRR	*95% Conf. Interval*	*RRR*	*95% Conf. Interval*
Outcome Improved				
County of Residence and Maternal HMO Status				
Mandatory				
Cuyahoga				
FFS/FFS	1.70	1.18–1.50	1.57	1.04–2.39
FFS/HMO	.79	.57–1.10	1.61	1.14–2.27
HMO/HMO	1.15	.76–1.74	1.84	1.18–2.86
Other Mandatory Counties				
FFS/FFS	1.26	.91–1.74	1.20	.81–1.76
FFS/HMO	.80	.60–1.08	1.17	.84–1.62
HMO/HMO	.70	.47–1.03	.85	.55–1.31
Voluntary Counties				
FFS/FFS	1.00	—	1.00	—
Outcome Worsened				
County of Residence and Maternal HMO Status				
Cuyahoga				
FFS/FFS	1.43	.98–2.09	1.09	.73–1.62
FFS/HMO	1.18	.86–1.61	1.10	.80–1.53
HMO/HMO	1.69	1.15–2.48	1.34	.88–2.05
Other Mandatory Counties				
FFS/FFS	1.33	.96–1.86	1.44	1.02–2.03
FFS/HMO	1.13	.85–1.52	.89	.66–1.21
HMO/HMO	.78	.53–1.15	1.01	.69–1.47
Voluntary Counties				
FFS/FFS	1.00	—	1.00	—
Total Number of Women		4,786		3,486

Notes: 1. RRR: Relative Risk Ratio estimated from multinomial logistic regression.
2. FFS/FFS: In fee-for-service for both pregnancies.
3. FFS/HMO: In fee-for-service for the first pregnancy and in an HMO for the second pregnancy.
4. HMO/HMO: In an HMO for both pregnancies.

In separate regressions we examined whether married women, young or older women, women with lower education, women with longer birth intervals, or Healthy Start (nonwelfare) women were different in the changes in their outcomes during the managed care implementation period. Most differences were nonsignificant and those data are not presented in the paper.

Table 8 shows results from regressions that, in addition to county of residence, include maternal HMO status. Within each county type, a woman is classified according to HMO status in her first and second pregnancy. The comparison group for this table is those women in voluntary counties who remained in FFS throughout the period.

The interactions between county status and maternal HMO status show that women who remained in fee-for-service enrollment throughout the time period in Cuyahoga County and the other mandatory counties were significantly more likely to improve the timing of their initiation of prenatal care relative to those in the voluntary counties. Perhaps women in mandatory counties had health problems that kept them in FFS in the postmandatory managed care period, and these health problems led them to seek a doctor's care earlier. Note also that women who remained in HMOs throughout the period of implementation had a higher chance of worse timing of prenatal care initiation, and that this finding was also very close to significance for FFS/FFS women. Again, selection could be a reason for this finding, since women who enrolled late in pregnancy (and therefore remained in FFS) may have delayed care related to women who enrolled early.

In Cuyahoga County all groups, regardless of mother's HMO status, showed significant improvement in the number of prenatal care visits compared to women in voluntary counties. This leads to questions about whether it was Medicaid managed care, or it was other changes in Cuyahoga County over the same period, that led to improved prenatal care utilization. One possibility is that the National Healthy Start Initiative (different from the state's Medicaid insurance program for pregnant women), a program to improve prenatal care and birth outcomes for low-income women in Cuyahoga County, during the early 1990s (Howell et al. 1997; Devaney et al. 2000) was responsible for some of the observed changes. However, Healthy Start was first implemented early in the decade, before mandatory managed care, so this is unlikely to be the primary explanation for the significant changes observed here for women in Cuyahoga County.

In summary, it appears that the effects of Ohio's managed care program on prenatal care use for this cohort of women were confined to Cuyahoga County. Women with full-term pregnancies in Cuyahoga County were more likely to receive a greater number of prenatal visits in their second pregnancy than in their first after implementation of mandatory managed care, as compared to the change for women in voluntary counties. All women in Cuyahoga, regardless of their own managed care status, benefited from these changes, whether from changed practice patterns in the county, improved

access to a wider range of providers under Medicaid, or other factors in Cuyahoga County.

The fact that, in Cuyahoga County, the initiation of prenatal care also deteriorated under managed care is perhaps not surprising. As noted, the implementation of mandatory HMO enrollment was difficult in that county, with a large number of plans competing intensely and with varied quality among plans. In addition, many women do not enroll in Medicaid early in pregnancy, instead waiting until later at which point they then must be assigned to an HMO, resulting in long delays. These mixed findings from Ohio—improvements in some circumstances and deterioration in others—may explain the mixed findings from previous research regarding managed care's impact on prenatal care use.

Smoking

Women who are enrolled in managed care may receive smoking cessation counseling or other interventions that affect smoking behavior. Our case study of managed care implementation showed that, to varying degrees, plans in Ohio do screen for smoking status and refer women to smoking cessation classes. Table 5 shows that the rate of smoking during pregnancy was very high for Medicaid pregnant women in Ohio during the study period.

Table 9 shows odds ratios for smoking at the time of the second delivery, given that a woman smoked during her first pregnancy. The table shows both the odds of smoking by county of residence, and also interactions with mother's HMO status. We also examined data for women who did not smoke during their first pregnancy; there were no significant findings regarding their smoking status at their second delivery (data not shown).

Women in Cuyahoga County were, as with prenatal care, different from women in voluntary counties, in this case being less likely to smoke in their second pregnancy if they had smoked in their first pregnancy. This favorable result applied only to women who were in FFS during their first pregnancy and became enrolled in an HMO during their second pregnancy. This gives some confidence to the interpretation of a managed care impact on smoking in Cuyahoga County. Women in other mandatory counties were not similarly affected.

As with the prenatal care results, African American women were differentially affected by the changes in Ohio during this time period, in this case positively. Their relative risk of continuing smoking was 54 percent of those of white women.

Table 9: Relative Risk of Smoking or C-Section at Second Delivery by Status at First Delivery, County of Residence, Race, and Maternal HMO Status, Ohio Medicaid Study Cohort: 1994–1998

	Smoker at Second Delivery for Smokers at First Delivery		*C-section at Second Delivery for Women with C-section at First Delivery*	
	RRR	*95% CI*	*RRR*	*95% CI*
County of Residence				
Cuyahoga	.62	.41–.94	.51	.27–.94
Other Mandatory	1.24	.84–1.83	.58	.33–1.02
Voluntary County	1.00	—	1.00	—
Race				
African American	.54	.41–.70	.75	.52–1.08
White	1.00	—	1.00	—
County and Maternal HMO Status				
Cuyahoga				
FFS/FFS	.74	.41–1.35	.42	.18–.78
FFS/HMO	.59	.37–.95	.58	.45–1.57
HMO/HMO	.67	.36–1.26	.19	.09–.54
Other Mandatory				.18–.78
FFS/FFS	1.38	.84–2.28	.38	.45–1.57
FFS/HMO	1.26	.82–1.95	.84	.09–.54
HMO/FFS	2.86	.94–8.67	.22	.18–.78
HMO/HMO	1.31	.72–2.39	.38	.45–1.57
Voluntary				
FFS/FFS	1.00	—	1.00	—
Total Number of Women	1,467		520	

Notes: 1. RRR: Relative Risk Ratio estimated from logistic regression.

2. FFS/FFS: In fee-for-service for both pregnancies.

3. FFS/HMO: In fee-for-service for the first pregnancy and in HMO for the second pregnancy.

4. HMO/HMO: In an HMO for both pregnancies.

We might consider what type of other initiative or secular trend would affect women's smoking behavior in Cuyahoga County, but not in the other managed care counties of the state. It is possible that other public education or public health campaigns (such as the previously mentioned National Healthy Start Initiative) were more prominent in Cleveland, the biggest city in the state. The consistency of these results with the prenatal care visit results—smoking education is likely to go hand-in-hand with prenatal care—gives some confidence that at least some of the effect is due to improved prenatal care use and enhanced smoking cessation initiatives within managed care plans.

C-section

A C-section delivery is considered an undesirable outcome, if it can be avoided safely. Since C-sections are more costly than vaginal deliveries, there is a possibility that managed care provides an incentive to avoid C-section delivery.

Table 9 shows the odds of repeat C-section for women who had a C-section at their first delivery. We also examined data for women who did not deliver by C-section the first time, and there were no significant differences in the odds of a C-section at the second delivery (data not shown).

Mirroring to some extent the results for prenatal care use and smoking, managed care's effect on C-section was most prominent in Cuyahoga County, where women were significantly less likely to have a repeat C-section. This was not true for the other counties, although the lower odds in other mandatory counties was close to significant, and the small sample sizes for this analysis suggest that it is very possible that a larger sample would have yielded a significant result there as well.

In examining the interaction between county and a mother's HMO status, we find results that are somewhat puzzling, but consistent between Cuyahoga County and the other mandatory counties. Women who remained in the same status for both their deliveries (i.e., either FFS/FFS or HMO/HMO) in mandatory counties were significantly less likely to have a repeat C-section, in comparison to FFS/FFS women in the voluntary counties. This perhaps means that the incentives to reduce C-section delivery were in place system-wide in these mandatory counties, but that doctors were more comfortable making a decision against C-section for a woman whose care they had overseen previously. When managed care is implemented, there is a loss of continuity of care for some women who change providers, and this may affect their likelihood of repeat C-section.

Birth Weight

Using ordinary least squares regression, we modeled change in birth weight between the first and second deliveries, according to a mother's race and her county of residence. On average, birth weight increased across all women between their first and second births, but there was no evidence of an impact of managed care on this trend (data not shown).

DISCUSSION

When Medicaid managed care was implemented in many parts of the country in the l990s there was substantial policy concern that low-income people might be adversely affected by managed care's incentives to limit care. In this paper we provide an analysis of data for a subgroup of those affected by Medicaid managed care, pregnant women in Ohio who delivered a baby under Medicaid once before mandatory managed care was implemented in six counties, and once afterward. This group is unique, but important, since it includes women who are likely to be more disadvantaged, and to have a longer-term connection to the Medicaid program than the majority of pregnant Medicaid managed care enrollees. Thus findings that such women are positively (or negatively) affected by managed care may be viewed as more important than effects on women who remain enrolled in Medicaid for only a brief part of their lives.

Previous studies of Medicaid managed care's impact on pregnant women have provided conflicting results, possibly because women under managed care have been compared to other women who are not enrolled, who may have different underlying health status, health attitudes, or other unmeasured characteristics. Certainly women can change throughout their lives, and the health status and health attitudes of a young mother may change before she delivers again. However, we feel that the results presented here, where women serve as their own controls, is a clear improvement over past analyses in the control for such unmeasured characteristics.

The data we present are still subject to selection problems, particularly when comparisons are made between women within managed care counties who do and do not enroll in HMOs. Certainly women who remain in FFS in a mandatory enrollment county have unique characteristics such as late Medicaid enrollment and possible health problems. The state used considerable flexibility in waiving mandatory enrollment in certain circumstances. For this reason we have confined the analysis primarily to county-level comparisons.

In addition, the findings that we here attribute to changes in Medicaid managed care could certainly be due to changes that would have occurred during the period, regardless of Medicaid managed care implementation. While we control for secular trends in the design to some extent, there could be changes that differentially affect the managed care counties such as special health education campaigns that would affect prenatal care use or smoking behavior, or changes in health care practice patterns that would affect prenatal

care use or C-section rates. However, we discovered in our case study of implementation that Medicaid managed care did have a major effect on many aspects of the health care system, especially in Cuyahoga County. Consequently, we feel that changes in practice patterns in mandatory Medicaid managed care counties during the period can be attributed, at least in part, to managed care implementation.

With these caveats in mind, the data provide new insights into questions surrounding Medicaid managed care for pregnant women. As it was implemented in Ohio—where women were able to opt out of HMOs in several circumstances—Medicaid managed care did not appear to make women worse off in most of the ways examined here. It is important to remember that these results apply to a small, but important, subset of pregnant women, those who have more than one of their deliveries covered by the Medicaid program.

Change, both positive and negative, was more pronounced in Cuyahoga County, the largest of Ohio's counties (containing 27 percent of all Medicaid pregnant women and 38 percent of African American Medicaid pregnant women in the study population). In a somewhat puzzling finding, we found that Cuyahoga County was significantly more likely to have the initiation of prenatal care use worsen under managed care, but it also experienced an improvement in the number of prenatal visits for women with full-term pregnancies; reductions in smoking; and reductions in repeat C-sections. In the other mandatory counties, results were not always in the same direction as those for Cuyahoga County, and did not achieve statistical significance. This is possibly due to more mixed effects from county to county, but those could not be detected in this analysis due to smaller sample sizes in those counties. A parallel paper (Kenney, Sommers, and Dubay 2003) found improvements in prenatal care use and smoking behavior for white women covered by Medicaid in other mandatory counties using a somewhat different methodology.

African American women were significantly more likely to show improvement in prenatal care use and smoking during this period, when compared to white women, regardless of the county in which they resided. They also were more likely to have their prenatal care use worsen. There are no such consistent patterns for other demographic subgroups. This suggests that one group of vulnerable women was affected differentially by changes occurring in Ohio in this period.

We conclude that, with careful implementation and attention to women's individual differences as was done in Ohio, most pregnant women

will not be disadvantaged by Medicaid managed care implementation, but some may be. Several projects have focused attention on quality monitoring for the Medicaid managed care population more generally (Felt-Lisk 2001) and for pregnant women in particular (Oehlmann 2001). Such efforts should be continued as Medicaid managed care becomes more widespread, so that lessons from positive successes (such as Ohio's apparent success in affecting smoking behavior for some pregnant women) can be widely disseminated, and the potential problems (such as the experience of some women in Cuyahoga County and some African American women in accessing prenatal care) can be avoided. Finally, more research is needed to better identify how women are selected into health plans, and the activities of health plans that lead to better or worse outcomes for pregnant women.

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