Does Managed Care Hurt Health?
Evidence from Medicaid Mothers

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Abstract

Most Americans are now in some form of managed care plan. These plans typically restrict access to providers and services in order to reduce costs. But it has been difficult to determine whether these restrictions affect necessary as well as unnecessary services, and whether they affect health. The primary empirical difficulty is that individuals and firms self select into managed care plans. We investigate the effect of managed care using a California policy change that required some pregnant women on Medicaid to enter managed care plans. California phased in the adoption of Medicaid managed care (MMC) creating variation in the timing that we exploit. We use a unique longitudinal data base of California births in which the effects of MMC are identified using changes in the regime faced by individual mothers between births. We find that MMC reduced the quality of prenatal care and increased low birth weight, prematurity, and neonatal death.

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By the mid 1990s, most Americans with health insurance were in some form of managed care (Glied, 2000). More recently, with the Medicare Modernization Act of 2003, the federal government seeks to increase the number of Medicare beneficiaries enrolled in managed care, particularly among the disabled. Other countries are considering managed care as a possible way to control costs.[1] In addition, evidence presented by Baker (1999) suggests important spillover effects from managed care to the traditional "fee-for service" (FFS) sector. Thus developing a better understanding of the impact of managed care on utilization of care, costs and health has implications beyond those subject to managed care.

Unlike traditional fee-for-service (FFS) health plans that reimburse care provided by any doctor the patient wishes to see, managed care plans restrict access to providers and services. Moreover, managed care providers often face capitated fees -- that is, they receive a lump sum payment per patient independent of the services they provide. This fee structure creates clear incentives to provide fewer services. Restrictions on services and on reimbursements are intended to reduce costs by discouraging the inappropriate use of care. But what happens to the quality of care and to patients' health? So far, it has been difficult to establish whether the adoption of managed care reduces the use of appropriate medical care and ultimately affects actual health outcomes.

A priori, the expected effect of the introduction of managed care on health outcomes is ambiguous. On the one hand, we generally think that less choice is bad for consumers. By limiting the discipline of the market, and the freedom of choice on the part of patients, the restrictions imposed by managed care plans may ultimately reduce health.[2] On the other hand, managed care could in theory improve health, particularly in vulnerable populations. First, it has been argued that patients do not always know what health care is really desirable, or who the best doctors are. If some patients have only limited information, linking patients to providers could improve health by increasing access to care, the continuity of care and the match between patient and doctor. Second, capitated plans have the incentive to provide effective *preventive* care in order to keep future costs low. Both of these effects could be particularly important for

[1] For example, there are already several quasi-managed care initiatives in Australia, and some recent government initiatives intended to expand them (Marcus, 2000).

[2] Arlen and MacLeod (2003) discuss an additional reason that managed care organizations may provide substandard care which is that the organization is not liable for errors made by affiliated physicians.

poor and uneducated patients.[3]

Ultimately, how managed care affects health care utilization and health is an *empirical* question. Despite its enormous policy implications, it is a question that has been difficult to answer given self-selection into managed care plans. Workers, given their preferences and health, choose the employer with the optimal combination of salary, health care plans and other job characteristics. It is likely that individuals who are in managed care plans differs from those in traditional plans in many unobservable ways. Given the nature of the data that are available, it is difficult to account for this self-selection. For example, it is generally difficult to follow the same person in and out of a managed care plan.

In this paper, we try to inform the debate on how managed care affects health care use and patients' health by examining the effects of a California policy that required women enrolled in Medicaid to switch from FFS to managed care plans. In the U.S., Medicaid is the main public health insurance program for low income women and children. Beginning in 1994, California phased in Medicaid managed care (MMC) on a county-by-county basis, creating a great deal of variation in the timing of implementation which we exploit.

We construct a unique longitudinal data base of California births in order to examine the impact of switching from FFS to MMC on pregnant women and their infants. This file is formed by using the confidential birth records to link mothers between births. We control for individual heterogeneity using mother fixed effects and focusing on changes in the Medicaid regime faced by a mother between births. For example, we compare the change in birth outcomes for a mother whose first birth happened under FFS and whose second birth happened under MMC to the change in birth outcomes of a mother who did not experience a policy change.

[3] See Culyer and Newhouse, 2000 and Glied, 2000 for discussions of imperfections in the health care market that managed care is designed to address. Finally, managed care may benefit patients if it reduces costs. Presumably, the lower cost of health care is split between workers and firms. Higher salaries for workers may result in more money available for out of pocket expenditures, better food, more leisure, etc.

This strategy allows us to deal with two serious selection issues. First, patients in managed care may differ from those who are not in managed care. Second, Medicaid patients may differ from other patients in unobserved ways, and changing the nature of the Medicaid program could change the way that Medicaid patients are selected.

We find large negative effects on the utilization of care. Given the idea that managed care should promote the use of recommended preventive care, it is especially striking that the probability that a woman started prenatal care in the first trimester fell by 4 to 8 percentage points when she was required to enroll in managed care. This is a large effect. While there is debate about some aspects of prenatal care (e.g. how many visits are really necessary for healthy women), there is consensus that prenatal care should commence early in pregnancy in order to prevent complications and improve health outcomes.

Having addressed the issue of how managed care affects care utilization, we turn to the arguably more important question of how managed care affects actual health outcomes. In contrast to previous examinations of MMC which have found some evidence of effects on health care utilization but little evidence of effects on health outcomes, we find that MMC plans were associated with increases in the probability of low birth weight, prematurity, and neonatal death relative to FFS Medicaid. These negative outcomes may be linked to the decline in prenatal care usage, as well as to shifts in the quality of hospitals used and changes in delivery care.

Our estimates are robust to several changes in specification including: a "regression discontinuity" design in which we focus only on women who had a birth in the three years before or after a change in MMC; an "intent-to-treat" design in which we assign MMC status based on the state's original plan for each county (disregarding changes in MMC which were not in the state plan); controlling for the endogeneity of location by assigning MMC status to each woman based on the first county in which she is observed only; and including both county-specific time

trends and time trends interacted with the mother's demographic characteristics. We also show that while MMC has strong effects on the target group, it had no effect on other similar groups who were not subject to MMC.

These results indicate that the incentive to reduce utilization of care is strong in managed care and that necessary care is also affected. Notably, these reductions in care appear to have negative consequences for health. While these results apply directly to the population of Medicaid mothers, they may generalize to less disadvantaged population. Among these Medicaid mothers, we noted above that the incentives to reduce care might be counter-balanced by improvements in the matching of patients and doctors. But this potential benefit of managed care is likely to be smaller for better educated and less disadvantaged populations. Hence, it is possible that the net effects of reducing access to care among relatively well-informed patients are even more negative among these patients than among the Medicaid mothers.

The rest of the paper is organized as follows: Section 1 provides background about the implementation of MMC in California. Section 2 describes our data sources, and section 3 lays out our methods. Results are discussed in section 4, and section 5 concludes.

1. Background

a) The Implementation of Medicaid Managed Care in California

Until 1994, the vast majority of California's Medicaid recipients were in fee-for-service plans in which recipients could choose any provider who would accept them, and providers would then seek reimbursement from Medi-Cal, California's Medicaid agency. Several counties had managed care plans available to Medi-Cal recipients on a voluntary basis prior to the implementation of MMC.[4] In a voluntary system, enrollees can leave the plan and return to fee-for-service care if they wish so only people satisfied with the care they are receiving will stay

[4] In most counties, the fraction of people voluntarily enrolled was low, but Duggan (2004) points out that a

enrolled. The move to mandatory managed care required all eligibles in certain categories to enroll in order to receive services. Although two California counties (Santa Barbara and San Mateo) were allowed to implement experimental mandatory plans, it was not until the early 1990s that the state made definitive moves to implement mandatory MMC on a broader scale.[5]

First, a plan for MMC adoption was laid out in "The Department of Health Services' Plan for Expanding Medi-Cal Managed Care" (DHS, 1993). The stated goal of the plan was cost savings and improving quality of care.[6] From our point of view, it is important that the impetus for the change came from the state rather than from individual counties.

The planning document discusses several models of MMC. In one, the County Organized Health System (COHS) there is one public, county-run managed care provider. In the other models, the county contracts with at least some private vendors and offers enrollees a choice of plans. Private plans involved in MMC are selected by competitive bidding, and must offer a minimum bundle of services.

The planning document specified that three counties would adopt the COHS (Orange, Santa Cruz and Solano) while 14 of California's 58 counties would adopt a model with two or more vendors including at least one private vendor. The main criteria for determining which counties would get which plan were the county's population (there had to be a minimum of 45,000 Medi-Cal beneficiaries) and the extent of private managed care infra-structure that already existed in the county at the time of the planning document.

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few counties had larger numbers of voluntary enrollees.

[5] Tai-Seale et al. (2001) find that these two counties had lower utilization of prenatal care, and a higher number of one-day stays compared to a third county with FFS care.

4 In the cover letter to this document, the director of the Department of Health Services, Molly Joel Coye, laid out the case for an expansion of mandatory managed care in California as follows: "The care our patients receive is fragmented, patchwork, and out-dated. Instead of being cared for in a doctor's office or a clinic, our patients wind up waiting hours in emergency rooms for simple problems like a child's ear infection. Thousands of Medi-Cal beneficiaries are hospitalized each year for serious health conditions that could have been prevented by primary care...There is an alternative that makes sense: organized health care...Because the state is in such a severe budget crisis, many people assume that we are speeding up the transition to managed care in order to save money. But the purpose of our accelerated transition–designed to double managed care enrollments by April 1995 and to take nearly half of all Medi-Cal beneficiaries into managed care arrangements by the year 1996 "is to improve quality and access" (Coye, 1993).

The state plan inspired a great deal of controversy about what type of plan would best serve Medi-Cal recipients and other indigents. The state held that competition between at least two plans would offer patients choice and assure quality. However, in federal Congressional hearings held to discuss the state's plans, many stakeholders expressed skepticism (Committee on Energy and Commerce, 1994).

It was feared that commercial plans would place new burdens on safety net providers by identifying the low-cost patients and leaving the rest for the safety net to serve, and by denying services to people so that they ended up in emergency rooms. For example, Michele Melden, an attorney with the National Health Law Program discussed one managed care organization that routinely "emergency disenrolled" members who were brought into the San Bernardino trauma unit, with the disenrollment being effective the date of injury (Committee on Energy and Commerce, page 44).

Witnesses also raised the possibility that diverting paying Medi-Cal patients from traditional safety-net providers to private plans would reduce the ability of these providers to care for non-paying, indigent patients, and that it would threaten the "disproportionate share" payments that these providers received from the federal government.7 One study in Sacramento found that community clinics experienced 40 to 45 percent declines in usage after the introduction of MMC (Korenbrot, Miller and Green, 1998). These arguments imply that the movement to MMC could well have adverse effects on other low-income people by attacking the safety net of clinics that both Medi-Cal and non-Medi-Cal patients rely on. Baker and Brown (1997) discuss these type of spillover effects and find that increases in the fraction of the population enrolled in managed care has broad effects on the services provided and prices

7 The disproportionate share program or DSH is a federal program created in the late 1980's to provide financial subsidies to those hospitals that serve a disproportionate share of poor people. DSH was implemented in California in late 1990. DSH accounted for 19 percent of the total Medi-Cal budget by 1995.

charged by health care providers.

In the end, events unfolded more or less according to the state's plan: The 14 counties designated to accept a model with at least two plans did so. The three counties earmarked for COHS also adopted it, as did two other counties, Napa and Monterey. (Yolo county also adopted COHS, but after our sample period). By June 2001, some 2.8 million people, half of those enrolled in Medi-Cal, were in managed care (Klein and Donaldson, 2002). Moreover, counties had been asked to have their new plans in place by April 1996 at the latest, and 15 of the 17 originally designated counties had implemented a plan by April 1997 (the two laggards were San Diego and Tulare). In general then, it appears that counties cooperated remarkably closely with the master plan that had been laid out by the state.[8]

Table 1 lists the counties that adopted MMC, the type of plan that they adopted, the date at which enrollment began, the fraction of the caseload enrolled in a privately-run plan as of July 2000, the size of the county as proxied by the number of births in 2000, and median household income in the county. Table 1 shows that the counties that adopted MMC were much larger on average than those that did not, as one would expect given the state's rationale for selecting counties. COHS counties were somewhat wealthier than "Two Plan" counties, which in turn were wealthier than those that did not adopt. These differences suggest that it will be important to control for heterogeneity when examining the effects of MMC adoption on outcomes. Table 1 also shows that in a typical Two Plan county, between 20 to 40 percent of the caseload was enrolled in the private MMC plan, so that the private plans were important, and might have been

[8] Some delay may have been difficult for counties to avoid. For example, Los Angeles county began planning to set up their Two-Plan model in February 1993, before the state plan had even been officially released. In Sept. 1994, the governor signed legislation enabling the creation of the county-managed plan. Creation of the plan was completed by Dec. 1995 and it was licensed to serve Medi-Cal eligibles in April 1997. However, it did not receive permission from the Health Care Financing Administration to move FFS beneficiaries into managed care untilSept.1997(www.lacare.org/lacare/lacare01.nsf/0/9ef4e855697f82f68825688d005a4fb1?OpenDocument).

expected to provide some competition for the publicly-run plans.

Adult women who are not pregnant are generally eligible for Medicaid coverage only if they are on welfare or disabled. But many pregnant women who have incomes higher than the cutoff for welfare are eligible for Medicaid coverage of their pregnancies (and of their infants post-partum) because of special federal legislation mandating coverage of pregnant women that was implemented over the late 1980s and early 1990s.[9] Specifically, women with incomes below 200% but above the cutoff for cash welfare (about 100% of poverty) may receive Medicaid coverage of their pregnancies.

These women, who are covered only because they are pregnant, are not required to enroll in managed care. The logic seems to be that they will only be eligible for Medicaid for a short period and that it would be beneficial for them to use their regular providers. Also, it could take several months for them to enroll with a managed care plan and this could delay the receipt of prenatal care. By the same logic, undocumented women are not required to enroll in managed care plans. These women are not eligible for Medicaid services other than coverage of their pregnancies (and emergency care). In 2000, 11.6% of Medi-Cal deliveries were of women in the first category, while 38.9% of California Medicaid deliveries were of undocumented women (Rains, 2002).[10] Hence, only about half of the Medi-Cal deliveries were to women who, as regular Medicaid recipients, were required to enroll in managed care plans.

Unfortunately, we cannot tell from our data whether women were eligible through welfare or whether they are undocumented. In order to focus on women likely to be subject to MMC, we restrict our analysis sample to unmarried native-born women with a high school

[9] Currie and Gruber (1996) discuss extensions of Medicaid eligibility to pregnant women who were not on cash assistance over the late 1980s and early 1990s.

[10] There are many small categories of Medi-Cal patients, such as SSI recipients, who were subject to MMC in some counties but not in others. However, according to Rains (2002) deliveries to people who were "aged, blind, or disabled" accounted for only 1.53 percent of Medi-Cal covered deliveries in 2000.

education or less. These criteria remove the undocumented (who by definition are foreign-born) and also remove better-educated and/or married women who are unlikely to be on welfare. We show below (in Table 2) that a very high fraction of our sample women had Medicaid deliveries.

It is unfortunate that we also lose births to foreign-born women who are legal residents and who are therefore potentially subject to the MMC mandates. However, the numbers suggest that this is a relatively small group. Over the 1990s, 65 percent of all California births were to Hispanic women, and about two thirds of these women were foreign born. According to Rains (2002), 38.89 percent of Medi-Cal births in 2000 were to undocumented women who were not subject to mandates. Assuming that most undocumented women are Hispanic suggests that the majority of Medi-Cal births to foreign-born Hispanic women were in this category.

b) Previous Examinations of the Effects of Medicaid Managed Care

Kaestner, Dubay, and Kenney (2002) provide an overview of the literature on the effects of MMC on the utilization of care and on health. They point out that most of the previous literature deals with effects on utilization of care rather than health outcomes, and that even the conclusions regarding utilization are mixed. Infants are the one group for whom there has been an attempt to link MMC to health outcomes, but the evidence here too is mixed, clouded by difficulties in controlling for potentially important unobserved characteristics of the women in MMC plans.[11]

[11] For example, Levinson and Ullman (1998) analyze a cross section from three Wisconsin counties and find that MMC increases both the utilization of prenatal care and birth weight compared to FFS. Moreno (1999) examined prenatal care and outcomes in Tennesee before and after the implementation of managed care, and find declines in some measures of prenatal care utilization, but there is no control group. Conover, Rankin and Sloan (2001) re-examine the impact of managed care in Tennessee using North Carolina as a control group and conclude that MMC may have reduced the utilization of high tech procedures without affecting outcomes. Other studies which suffer from similar limitations, and come to similarly mixed conclusions include Krieger et al. (1992), Goldfarb, Hillman, and Eisenberg (1991), Carey, Weis, and Homer (1991), Oleske, Brana and Schmidt (1998), and Griffin (1999). Sommers, Kenney and Dubay (2002) and Kenney, Sommers and Dubay (2003) use difference-in-difference methods to examine MMC in Missouri and Ohio respectively, while Kaestner, Dubay and Kenney (2002)

Two previous studies of the switch to MMC in California have shown that it was not cost saving. Baker, Schmitt, and Phibbs (2003) use Medicaid claims data to examine the impact of the introduction of MMC on utilization of care, costs, and outcomes. Because they are using claims data, they focus only on Medicaid mothers, and do not examine possible effects of MMC on the selection of mothers into Medicaid.[12] They use the fraction of 15 to 44 year old Medi-Cal women who are enrolled in managed care as the key independent variable measuring the effect of MMC. This variable includes women on Medi-Cal who were not pregnant (e.g. welfare recipients and the disabled), and does not adjust for the fact that many pregnant Medi-Cal recipients were not required to enroll in managed care, as discussed above. In Orange county in 2000, Baker et al. report that 75% of Medi-Cal women 15-44 were in MMC; however, in the same year, only 27% of deliveries were in aid categories subject to MMC (Rains, 2002).[13]

Still, variations in both series after the implementation of MMC are smaller than the sharp jump that occurred when MMC was implemented, suggesting that the Baker et al. measure

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examine a national sample drawn from the Vital Statistics Detail Natality files, and look at whether being in a county with a MMC plan affects birth outcomes among women likely to be on Medicaid (these women are identified using maternal education and marital status). These three studies generally find little effect on birth outcomes, though the Ohio study finds a positive impact on prenatal care. Barham, Gertler, and Raube (2003) is a preliminary study of the impact of MMC in California using a difference-in-difference-in-differences design. In COHS counties, they compare the before/after MMC change in outcomes among Medi-Cal mothers to the change in outcomes among self-pay (uninsured) mothers. In Two-Plan counties, they compare the change in outcomes among Medi-Cal mothers to the change in outcomes among privately insured mothers. However, the choice of different control groups in the two set of counties is not well justified, and the paper does not exploit the longitudinal aspect of the data.

[12] This may be an important omission in view of evidence that women may decline to take up private health insurance coverage available through their employment in order to use Medicaid (Cutler and Gruber, 1996); and that many women eligible for Medicaid coverage of their pregnancies do not take up the coverage until relatively late in pregnancy (Ellwood and Kenney, 1995).

[13] Given the growing share of Medi-Cal deliveries accounted for by undocumented women, the fraction of Medi-Cal deliveries subject to MMC often actually moves in the opposite direction to the fraction of all 15 to 44 year old Medi-Cal women subject to managed care. For example, Baker et al. show that in Alameda county, the fraction of 15 to 44 year old Medi-Cal women who were in managed care rose from 60 to 70 percent between 1998 and 2000. However, the fraction of Medi-Cal deliveries that were in aid categories subject to mandatory managed care in Alameda fell from 63% to 48% over the same two year interval because of a drop in the number of AFDC/TANF families that was offset by an increase in the number of births to undocumented women (Rains, 2002).

should capture large changes associated with the introduction of MMC. Baker et al. conclude that the adoption of MMC did not reduce Medicaid spending, and may have increased it. They also find some differences in the utilization of health services after the adoption of MMC, including, for example, increases in access to high-level NICUs among low birth weight infants.

Duggan (2004) also examines the effect of the switch to MMC in California using Medicaid claims data. He focuses on the population who were eligible for Medicaid because they participated in welfare (In 2000, 41.2% of Medi-Cal deliveries were to people eligible through AFDC/TANF) since these people were subject to mandates. This population includes welfare mothers and older children as well as infants born to AFDC/TANF mothers.

Duggan estimates models of costs that include individual fixed effects and concludes that the switch to MMC actually raised Medicaid spending in California. Duggan is unable to examine the impact of the switch on health outcomes using the claims data (since this data does not include outcomes). Hence, he uses cross-sectional hospital discharge data to examine the effect of the switch on infant health outcomes. As we point out above, the infant population differs from the AFDC/TANF population he used to examine spending in that many pregnant women/infants were not subject to MMC. Using the entire population of Medi-Cal births, Duggan finds little impact of the switch to MMC on prematurity, in-hospital infant mortality rates, or average length of stay. Thus, he argues that the switch increased costs without producing benefits, at least for the subset of infant Medicaid recipients.

We believe that these null results for infant health outcomes reflect heterogeneity in whether or not pregnant/women infants were actually subject to mandates. This study focuses on the group most likely to be subject to mandates: pregnant women who are native born, have a high school education or less, and who are unmarried. Moreover, by estimating models of outcomes using mother fixed effects, we control for potential selection effects in a more rigorous

way than other studies that have examined outcomes. For comparison, we also estimate our models using groups unlikely to be subject to mandates, including college educated women, and married women with a high school education or less. We show that the switch to MMC had no effect on these groups, as one would expect. Hence, estimating the effects of the switch on the entire population of infants is likely to obscure the true effects of mandates on affected infants.

Our results are consistent with those of Baker et al. and Duggan in that we find increases in procedure use during labor and delivery which likely raised costs, and like Baker et al. we also find an increase in NICU access (in COHS counties only). We find that the implementation of MMC reduced the utilization of timely prenatal care and had negative effects on the health of infants subject to the mandates. Taken as a whole, these studies suggest that the switch to MMC increased costs, reduced access to care, and worsened infant health outcomes in California.

2. Data

The main sources of information on birth outcomes are the California Birth Statistical Master File 1990-2000, and the Birth Cohort files for the same period. Both files have information about all of the births in California over the period, drawn from individual birth records. These files have maternal age, education, marital status, race/ethnicity, parity, county and zip code of residence, whether or not the delivery was paid for by Medicaid or a private payer, and a hospital code. In addition, they report outcomes including birth weight, as well as information about some procedures of labor and delivery. The Master file has confidential information including the mother's name and birth date, which has enabled us to link records for siblings, which allows us to estimate models with mother fixed effects. The Birth Cohort files link birth and death certificates. Hence, by using the common information about births in the Master files and the Birth Cohort files, we have created a longitudinal data base that has

information about both births and deaths.

We focus on two measures of hospital quality: the presence/type of neo-natal intensive care unit (NICU) and rates of neo-natal mortality. Information about the type of NICU available in each hospital was generously supplied by Cairan Phibbs. For the second measure, we generate hospital-level information from the Vital Statistics records about the neo-natal infant mortality rate (i.e. deaths in the first 28 days divided by the number of births). We focus on neo-natal mortality as it is arguably more likely to be affected by hospital quality and the type of medical care received than infant mortality (death in the first year) which could reflect factors such as SIDS (Sudden Infant Death Syndrome) and accidental deaths. Since hospital-level mortality rates are likely to vary with the patient case-mix, we focus on case-mix adjusted neonatal mortality rates from residuals of regressions of the rates on maternal and child characteristics.[14]

We start with data about all births. We dropped data from the 15 smallest counties, since these are very rural, and not at risk for managed care adoption.[15] We also dropped multiple births, since these have a much higher incidence of negative outcomes, and differences in outcomes between multiples cannot be due to changes in the managed care environment.

The first two columns of Table 2a show sample statistics from a random 30 percent sample of this group of births in 1990, and 2000. The Table shows that about 40 percent of all deliveries in the state were covered by Medicaid, and that this fraction was relatively constant

[14] We estimate linear probability models for the probability of neonatal death controlling for the following maternal characteristics (all dummies): black, white, hispanic, asian, other race, teen mom, mom 20-29, mom 30-34, mom 35+, < high school, high school, some college, college or more, single, foreign-born, no pregnancy complications; the following child characteristics: first born, lbw, vlbw, twin, male, and the year. We then take the residuals from these regressions and aggregate them to the hospital level. This procedure identifies hospitals that were good or bad on average over the period, so that we can interpret our estimates as the effect of shifting between hospitals of different average quality. These measures are imperfect because it may still be the case that some hospitals have sicker patients, even conditional on observables.

[15] We dropped Alpine, Amador, Calaveras, Colusa, Del Norte, Glenn, Inyo, Lassen, Mariposa, Modoc, Mono, Plumas, Sierra, Siskiyou, and Trinity counties.

over time. Turning to prenatal care, the state saw a large improvement in the fraction of women beginning prenatal care in the first trimester. This is an important indicator of the quality of prenatal care, and is also an indicator of the ease with which the newly pregnant women can get access to care.

In terms of hospital characteristics, there was a small increase in the fraction of infants born in hospitals with a NICU of level 3 or higher. This increase in access to high-level NICUs might be expected to improve outcomes. Raw hospital-level neonatal death rates (i.e. deaths in the first month of life) decline from about 4.5 per 1,000 to 3.7 per 1,000. The comparison of the 1990 and 2000 caseload adjusted rates suggest that over time, births shifted to better hospitals. We set rates for hospitals with fewer than 500 births per year to missing, in order to avoid unreliable rate calculations for small cells.

Delivery care became more high-tech over time, with a doubling of the probability that labor was induced or stimulated, and a 37 percent increase in the use of fetal monitors. However, the use of Cesarian sections increased only 3.6 percent, perhaps because of efforts by hospitals and health insurers to monitor unnecessary use of this procedure. It is not clear whether these changes would be expected to lead to any improvement in average infant outcomes, because many of these procedures may be medically unnecessary, and conducted more for the convenience of the mother or doctor than for the benefit of the infant. More intensive care during delivery would be expected to be associated with higher costs.

Consistent with other research, there was little state-wide trend in the incidence of low birth weight (defined as birth weight less than 2,500 grams), a widely used indicator of the health of the infant at birth. Nor is there much trend in the incidence of short gestation (gestation less than or equal to 258 days). This can be contrasted with the decline in the probability of neonatal death. The fact that the underlying health of infants delivered was stable, while the probability

of death declined suggests that the decline was due to interventions at the time of delivery and in the first month. Thus, to the extent that the change to MMC affected the quality of hospital used, it could have a large impact on mortality.

The next two columns provide a comparison with our "analysis sample" of 255,000 births. This sample consists of all births to native-born, unmarried women with high school or less, who had two or more singleton births over our sample period. Of these women, the majority (216,591) were in a county that eventually adopted Two Plan, with the rest equally divided between non-adopters and COHS counties.[16]

These women had a much higher than average probability of having a Medicaid delivery, although this probability fell by approximately 8 percentage points over time. Conversely, it is striking to note that even in this very disadvantaged group, 19 percent had private insurance for delivery, and that this proportion had increased to 27 percent by 2000.

The data on hospital characteristics show that the analysis sample's probability of delivering in a hospital with a high level NICU started much lower, but converged towards that of the whole sample. The data on neonatal mortality rates indicate that sample women moved to hospitals with lower raw death rates over time, but at a slower rate than among other women.

It is striking that in contrast to the overall trends, the analysis sample showed a decrease in the incidence of low birth weight and short gestation over time. These means reflect the way that the sample is selected. For example, Table 2b, which shows means for the control variables that we include in our regressions, indicates that there are virtually no first born children in the analysis sample in 2000. This is because women had to have two or more children in order to be included. This criteria affects the rate of low birth weight and short gestation because first born

[16] Deleting small counties and multiple birth yields 5,433,975 births. Of these, 2,998,635 are to native born women, and 1,563,640 are to native born women with more than one child in the sample. Thus, our sample of single, unmarried women represents about 16% of the women eligible for inclusion in our fixed effects models.

children tend to be at higher risk. For similar reasons, in 2000 women in our analysis sample are older than the average mother, and much less likely to be teenage mothers. It is striking that neonatal mortality also falls, but much less than in the overall population.

The fifth column of Table 2a shows the number of mothers experiencing a change in the outcome variable in question during the sample period. This information is important given that models that include mother fixed effects are identified by these changers. For all but very rare outcomes, such as deaths, there is a large sample with changes. The last column shows the mean change. If equal numbers experienced positive and negative changes in these largely dichotomous variables, then the mean would be zero. A positive number indicates that on average mothers moved from zero to one. These means indicate that for all our variables of interest, there are many changes in either direction.

Table 2b indicates that the analysis sample is more likely to be African-American than the whole sample. The restriction to native-born mothers reduces the proportion of Hispanics slightly, though it is still 50 percent in 2000. The greatest effect of this restriction appears to be the elimination of most Asian mothers.

The last three columns of Table 2b show changes in the characteristics of women delivering in the sample as a whole, over the 1990 to 2000 period, by whether the county eventually adopted COHS, Two-Plan, or no MMC. These columns suggest that the populations of women giving birth were evolving somewhat differently in the three types of counties. For example, the fraction of women who were black or Hispanic grew more rapidly in the Two-Plan counties than in the other types of counties, as did the fraction of mothers with less than a high school education, and the fraction of single mothers. Given these changes in the characteristics of mothers, we might expect outcomes to deteriorate in Two-Plan counties relative to other counties. Thus, the Table illustrates the importance of controlling adequately for maternal

characteristics when assessing the effect of MMC.

3. Methods

We estimate models of the following form:

$$(1)\ Outcome_{it} = b_0 + b_1 X_{it} + b_2 year_t + b_3 COHS_t + b_4 TwoPlan_t + b_5 county\_trend_t + b_6 FE + e_{it},$$

where *Outcome* is one of the variables listed in the first 5 panels of Table 2a, *X* is the vector of maternal and child characteristics included in Table 2b, *year* is a vector of year dummies, and *county_trend* is a county-specific time trend which accounts for under-lying trends in the variables that we consider. Standard errors are clustered at the county-year level in order to account for factors that might affect all the observations in a particular county and year.[17]

FE refers to a vector of fixed effects, and we estimate two versions of (1) which include different types of fixed effects. The first model controls only for county level fixed effects. This model is in the same spirit as earlier work that has controlled for county fixed effects. The second model includes mother-specific fixed effects, which has not been done before. These models control for unobserved characteristics associated with the same mother, and identify the effects of MMC by using mothers who became subject to it between pregnancies. These models can be compared to those that control only for county fixed effects in order to gauge the importance of controlling for unobserved characteristics of mothers.

Note that these fixed effects estimates are likely to be biased towards zero by random measurement error (caused, for example, by different nurses recording things more or less carefully, or by different hospital reporting practices). On the other hand, to the extent that

[17] Clustering by county only does not change our results.

measurement errors are associated with maternal reporting, and such reporting is constant over time, including fixed effects could help to deal with such errors and increase the precision of our estimates.

In addition to these basic models, we report the results of several specification checks. First, we re-estimate all of our models using less educated, native-born *married* women. While these women may be quite similar to our sample mothers in many respects, they are highly unlikely to be on welfare, and thus quite unlikely to be subject to MMC. As we show below, county MMC adoption had no impact on these mothers.

Second, mothers may experience a change in MMC either because they change counties, or because the law changed in the county that they were in. This observation raises the possibility that mobility between counties could be affected by the MMC environment. (Note that MMC status is determined by county of residence, not county of delivery, so we focus on county of residence). In order to deal with this possibility, we also estimate models in which we use the MMC environment the mother would have experienced had she remained in the county in which we first observe her, and ignore subsequent moves. While the county of the first (in our sample) birth is also a choice, factors influencing this choice can be controlled for via the inclusion of mother fixed effects. As we show below, this change also has no effect on our findings.

Third, readers may be concerned that the estimated effects of MMC reflect a time trend of some kind, given that the MMC indicators turn "on" over time but generally do not turn "off". We approach this problem in two ways. The first is to examine only counties that eventually adopted MMC, and adopt a "regression discontinuity design" in which we eliminate any births that occurred more than three years before adoption, or more than three years after adoption. In this design the effect of MMC is identified by changes between births that took place over a

relatively short interval, so the estimated effects are unlikely to be driven by trends. While this reduces our sample size considerably, it generally strengthens our results as shown below. Note that focusing only on births within three years of a change also eliminates births in counties such as Santa Barbara that had long-standing Medicaid managed care programs.

Fourth, we added interactions between a time trend and indicators for whether the mother was black, Hispanic, teen-aged, aged 20 to 29, aged 30 to 39, or had less than a high school education. If, for example, blacks were more likely than others to be subject to MMC, and the coefficient on "black" in the outcome equations was changing over time, then these trends would help to pick up any spurious correlation between MMC and outcomes that could result. However, since the results of this exercise produced estimates very similar to those shown below, we do not report them.

Fifth, some readers may be concerned that the adoption of MMC was not really an exogenous event, since some counties took actions that were not in the original state plan. In particular, Napa and Monterey adopted COHS even though they were not mandated to do so. We have estimated alternative "intent-to-treat" models in which we assign MMC status on the basis of the state's planning document and ignore deviations. That is, we treat Napa and Monterey as though they never adopted COHS. Since Napa and Monterey are relatively small counties (as shown in Table 1) this has little impact on our estimates, and we do not report this specification below.

Sixth, we have estimated models similar to (1) except that they focus only on Medi-Cal women. In the absence of spillover effects, one would expect the effects of the managed care mandates to be greater for the Medi-Cal women than for other low income women. In practice, since most women in the group we examine are covered by Medi-Cal we find that the point estimates are generally somewhat larger in absolute value for the Medi-Cal women than for the

whole sample, but that the differences are not statistically significant.

Finally, because we find similar results for some outcomes whether or not we include mother fixed effects, we re-estimate our models using the full sample of less educated, native-born, unmarried mothers. That is, we relax the requirement that the mother have at least two births over the sample period. We also estimate our models using the sample of first born children.

4. Results

a) Effects on Insurance Coverage

We begin the empirical analysis by asking whether the imposition of MMC had any effect on the probability that a woman was enrolled in Medi-Cal for the delivery. Note that very few California women were uninsured at delivery during the 1990s, so if women did not have Medi-Cal, then they generally had private health insurance. One might expect that in our very disadvantaged population, the scope for leaving Medi-Cal and gaining private coverage would be rather small.

Still, the estimated effects of MMC implementation on insurance coverage shown in Table 3 indicate that in Two Plan counties, women were 3 percent less likely to have Medicaid covered deliveries, and 3 percent more likely to have privately covered deliveries following the implementation of MMC. The results are virtually identical when mother fixed effects are included. Although Table 1 indicated that a sizeable fraction of these mothers did have private coverage, it is possible that these estimates are contaminated by reporting bias. For example, if the private MMC plan is Blue Cross, then perhaps women or providers identify the payor as a private plan rather than as Medi-Cal.

The second panel of Table 3 offers another look at the selection issue by asking whether

the characteristics of mothers on Medi-Cal change after the implementation of MMC. Columns (1) and (2) show that Hispanic women became less likely to be covered by Medi-Cal following the introduction of MMC, especially in COHS counties, while black women became more likely to be covered in COHS counties. On average, black women tend to have poorer birth outcomes than similar whites, while Hispanic women tend to have better birth outcomes. On the whole then, the second half of Table 3 suggests that the Medi-Cal caseload became more negatively selected, in that the women covered by Medi-Cal after the implementation of MMC were more likely to have bad birth outcomes. Hence, these results emphasize the importance of adequately controlling for maternal characteristics when examining the effects of MMC.[18] In addition, our finding that those most at risk for poor birth outcomes have the least access to alternative coverage underscores the importance of developing appropriate oversight of managed care plans, especially in light of the federal government's policy of subjecting more disabled Medicare beneficiaries to managed care.

b) Effects on Prenatal Care, Hospital Quality, Delivery Care, and Outcomes

Table 4 explores the effect of MMC on prenatal care, hospital quality, delivery care and outcomes. Panel A shows county-fixed effects models, while mother-fixed effects models are shown in Panel B. In general, the addition of mother fixed effects reduces the estimated effects somewhat, which is consistent with the negative selection into MMC that was suggested in the previous section. The biggest exceptions are induction/stimulation of labor and fetal monitoring, where COHS is only statistically significant in models with mother fixed effects. In what follows, we will focus on the mother fixed effects models.

[18] We have estimated similar models for Medicaid coverage of prenatal care, and private coverage of prenatal care (since coverage of prenatal and delivery care are distinguished on the California birth certificate). The results were similar although slightly stronger for prenatal care than for deliveries.

In view of the state's goals and the idea that managed care organizations promote preventive care, it is surprising that MMC implementation was associated with large decreases in the probability that disadvantaged women started prenatal care in the first trimester. The estimates suggest that this probability declined by 4 to 6 percentage points in both COHS and Two Plan counties. It is remarkable that the decline occurred against the backdrop of large overall increases in the early initiation of prenatal care as documented in Table 2a.

The next two columns of Table 4 explore the effects of MMC on hospital quality. Column (3) shows an 11.2 percentage point increase in the probability that disadvantaged women in COHS counties delivered in a hospital with a high-level NICU. In Two Plan counties, there were no gains in NICU availability. Perhaps more important, in Two Plan counties disadvantaged women were shifted to hospitals with higher residual neonatal mortality rates, indicating hospitals of worse quality. (Note that the coefficients and standard errors on hospital death rates are multiplied by 1,000).

Columns (4) through (6) examine effects of MMC on delivery care. The estimates indicate that MMC had no effect on the probability of Cesarian delivery, but was associated with a shift towards higher-tech births in COHS counties: In these counties, the use of induction/stimulation of labor increased by 3.9 percentage points, and the use of fetal monitors increased by 11.9 percentage points following the introduction of MMC. In contrast, in Two Plan counties, there was a slight decline in the use of fetal monitors. As discussed above, it is not clear what implications these findings are likely to have for infant health, but the increased intensity of delivery services in COHS counties could well have increased costs. It is possible that these predominantly public-sector plans were under less pressure to cut costs than the private sector managed care organizations involved in the Two Plan counties.[19]

[19] Similarly, Duggan's (2000) work on the way that hospitals reacted to the incentives provided by the federal "disproportionate share" program suggests that public hospitals did not respond to these incentives while

The last three columns of Table 4 indicate that the incidence of low birth weight, short gestation, and neonatal death all increased among Medi-Cal women following the introduction of MMC. Moreover, we cannot reject the null hypothesis that the effects were similar in COHS and Two Plan counties. Changes in the incidence of low birth weight and short gestation may reflect inadequacies in prenatal care, while changes in the neonatal death rate reflect the effects of prenatal care as well as care that is received during and after the delivery. While prenatal care has been shown to affect the incidence of low birth weight in full-term infants, there is some controversy about whether it is possible for prenatal care to affect the incidence of short gestation. On the one hand, until very recently, there were no known medical interventions that could affect the incidence of prematurity. On the other hand, factors such as infections, poor diet, and smoking are all thought to contribute to prematurity, so that holistic care that emphasized better health habits could have an impact. In any case, the estimates in Table 4 suggest that MMC had a larger proportional impact on neonatal death than on either low birth weight or short gestation. Relative to the means in Table 2, the incidence of low birth weight and short gestation are estimated to have increased by about 15 percent, while the incidence of neonatal death increased by about 50 percent.

In summary, Table 4 shows that MMC implementation was associated with reductions in the quality of prenatal care. There were some potentially off-setting improvements in hospital quality in COHS counties, while the quality of hospitals used by Medi-Cal mothers declined in Two Plan counties. However, infant health outcomes deteriorated in both COHS and Two Plan counties, to a roughly equal extent.

c) Specification Checks

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private hospitals did.

Table 5 presents several sets of alternative estimates. Panel A shows estimates using married (rather than single) native-born less-educated women. These women have a much lower probability of being subject to MMC than the single, unmarried women that we focus on in Table 4. In the state as a whole in 2000, 65% of deliveries to native-born, less educated, single women were covered by Medi-Cal, while the comparable figure for similar married women was 28%. Moreover, because married women are generally not eligible for welfare, the married women would have been much more likely to be in an aid category that was not subject to MMC.[20] On the other hand, if our estimates were picking up a trend among less-educated women, then one would expect the trend to show up here also. Table 5 shows, however, that MMC had no effect on this sample of women. Panel B shows estimates for native-born women with more than a high school education, with similar (null) results. These estimates suggest that we must focus specifically on the group of women likely to be subject to the mandates in order to see their effects.

The third panel of Table 5 presents estimates in which the woman's MMC status is calculated using her initial county of residence only. As discussed above, these estimates are purged of any bias due to endogenous mobility, at the cost of introducing some measurement error in MMC status. The results are remarkably similar to those shown in Table 4, except that the COHS coefficient on induction/stimulation of labor becomes statistically insignificant, and the MMC coefficients in the models of short gestation and neonatal death are now significant at the 90% rather than the 95% level of confidence.

Panel D presents estimates based on births that occurred within plus or minus 3 years of MMC implementation. In these models, the MMC coefficients are identified using the sample of

[20] Recall that in 2000, 11.6% of Medi-Cal deliveries were not subject to MMC because the women were eligible due to low-income only. Births to married, less-educated, native-born women constituted only 3.4% of the Medi-Cal caseload in 2000, so in principal, all of these women could have been in this non-MMC category.

women who had one birth just prior to MMC implementation, and one birth just afterwards. Although the sample size is considerably reduced by this procedure, the estimates remain qualitatively similar, and in most cases the point estimates are larger. Standard errors also increase, however, with the result that the estimated effects of COHS on infant outcomes are no longer statistically significant, although Two Plan is still estimated to increase low birth weight, short gestation, and neonatal death (the t-statistics are 1.83, 2.00, and 1.81, respectively), and we cannot reject the null hypothesis of equal coefficient estimates in the two types of counties.

Panel E shows estimates using only Medi-Cal women. As discussed above, the point estimates are higher than those for the full sample of native-born, less-educated, unmarried women, although the possibility of spillover effects suggests that managed care can influence care for similar women who are not on Medicaid as well (see Baker, 1994 and Baker and Brown 1999 for an analysis of spillover effects of managed care on the FFS sector).

Table 4 suggested that in many cases, we obtained similar results with and without mother fixed effects. Hence, in Panel F we show estimates based on the full sample of less educated, native-born, unmarried women. These models include county fixed effects and county-specific time trends. Relaxing the requirement that women have more than one child in the sample almost triples the sample size. The estimated effects of MMC on prenatal care and infant health outcomes are very similar to those obtained in the restricted sample, but are more precisely estimated. Including the additional children (many of whom are first borns) does weaken the estimated effects of COHS on NICU access, suggesting that decisions about the hospital of delivery may be different for first borns than for subsequent children.

Panel G investigates this possibility by estimating the model using only first born children. The estimated effects of MMC on prenatal care and hospital quality, and delivery care are very similar to those in Panel F. The main difference between the two sets of estimates is

that while Two Plan has adverse effects on birth weight, gestation, and neonatal death in both models, COHS has adverse effects only in the larger sample. In these models MMC has no significant effect on delivery care, but in Table 4, significant effects on these outcomes emerged only when maternal fixed effects were added to control for unobserved heterogeneity. Hence, on the whole, the results are remarkably similar to those obtained using the more restrictive sample.

We have also estimated models that include interactions between a time trend and indicators for whether the mother was black, hispanic, teen-aged, aged 20 to 29, aged 30 to 39, or had less than a high school education. However, since the results of this exercise produced estimates very similar to those shown in Table 4, we do not report them.[21]

5. Discussion and Conclusions

One of our most striking findings is that MMC was associated with large declines in the utilization of prenatal care in the disadvantaged population we examine. These declines are especially disturbing because the stated goal of MMC was to improve access to medical care, and because in general, utilization of prenatal care was improving over this time period. We also find that the introduction of MMC was associated with increases in the incidence of low birth weight, short gestation, and neonatal death among the population of very disadvantaged women who were subject to the law. These deteriorations in prenatal care and infant health occurred despite a generally stable or improving picture in the state as a whole, and are robust to changes in specification.[22]

[21] We also estimated models including interactions of mother and county fixed effects. These models are identified using mothers who stayed in the same county and experienced a change in MMC regime. The results were the same as those reported above with the important exception that the MMC variables were no longer jointly significant at the 90% level of confidence in the models for neonatal mortality. Since the point estimates are stable, we believe that this loss of statistical significance is a reflection of the smaller effective sample size, and the fact that neonatal mortality is a rare outcome.

[22] Whether the deterioration in utilization of prenatal care is the most probable cause of the deterioration in outcomes is not clear. Prenatal care in the general population has been shown to increase birth weight in full term

In COHS counties, the quality of hospitals where women delivered, and the intensity of delivery care increased, but not enough to offset the other negative effects of MMC. In Two Plan counties, declines in access to prenatal care were reinforced by a shifting of disadvantaged women to hospitals of worse quality.

These results provide strong evidence that health care providers responded to managed care incentives to reduce costs by limiting care, and suggest that these limitations in care had negative effects on infant health. These negative effects may have been especially pronounced in this population because the plans' incentive to provide preventive care was effectively removed. Managed care plans in Two Plan counties and most COHS counties are not responsible for paying the costs of high cost newborns and so have little financial incentive to improve birth outcomes (Medi-Cal Policy Institute, March 2000).[23] Hence, our results demonstrate the importance of countering the tendency of managed care plans to ration care by having them internalize the longer-term costs of reductions in utilization. As other vulnerable populations such as the elderly on Medicare are shifted into managed care, it will be important to determine whether plans have sufficient incentive to safeguard the health of their enrollees.

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infants, but to have little impact on the probability of pre-term birth (Goldenberg and Rouse, 1998). There are however, medical interventions such as treatment with antibiotics that can delay birth in specific groups of high-risk women (Gibbs and Eschenbach, 1997), and it is only a small number of women whose infants are at risk of neo-natal death. Hence, it is possible that proper prenatal care in this disadvantaged population makes a difference in terms of the prevention of pre-term birth and infant death.

[23] These costs are paid by a different program, the California Children's Services Program. According to the state director of Children's Medical Services, newborns account for one third of all CCS costs (personal communication with Marian Dalsey, Acting Chief, California Children's Medical Services Branch).

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Table 1: The Adoption of Medicaid Managed Care

County	Type	Date Began	2000, %MMC Enrollment Private Plan	# births, 2000	Median HH Income, 1999
Santa Barbara	COHS	Sep-83		5601	46,677
San Mateo	COHS	Dec-87		10343	70,819
Solano	COHS	May-94		5831	54,099
Orange	COHS	Oct-95		46654	58,820
Santa Cruz	COHS	Jan-96		3382	53,998
Napa	COHS	Mar-98		1474	51,738
Monterey	COHS	Oct-99		6835	48,305
Average for COHS:				11,446	54,922
Sacramento	2-Plan*	Apr-94	100%	17987	43,816
Alameda	2-Plan	Jan-96	27.80%	21825	55,946
San Joaquin	2-Plan	Feb-96	19.60%	9515	41,282
Kern	2-Plan	Jul-96	36.20%	11542	35,446
San Bernardino	2-Plan	Sep-96	23.40%	28329	42,066
Riverside	2-Plan	Sep-96	23.60%	24633	42,887
Santa Clara	2-Plan	Oct-96	38.40%	27388	74,335
Fresno	2-Plan	Nov-96	18.00%	14141	34,725
San Francisco	2-Plan	Jul-96	39.00%	8525	55,221
Contra Costa	2-Plan	Feb-97	11.20%	13065	63,675
Los Angeles	2-Plan	Apr-97	39.90%	156006	42,189
Stanislaus	2-Plan	Oct-97	42.00%	7200	40,101
San Diego	2-Plan*	Jul-98	100%	43759	47,067
Tulare	2-Plan	Feb-99	11.50%	7194	33,983
Average for 2Plan:				27,936	46,624
Avg. for 22 included counties that did not adopt:				1089	41,859
Avg. for 15 counties excluded from our sample:				187	35,324

Notes: Counties that did not adopt, but are included in our sample include: Butte, El Dorado, Humboldt, Imperial, Kings, Lake, Madera, Marin, Mendocino, Merced, Nevada, Placer, San Benito San Luis Obispo, Shasta, Sonoma, Sutter, Tehema, Tuolumne, Ventura, Yuba & Yolo. Yolo county implemented a managed care plan in 2001. Percent enrollments are for July 2000, except for Stanislaus county where the commercial plan ended in March 2000, so we use enrollments for July 1999. * indicates that the county had two or more private plans but no public plan in contrast to most 2-Plan counties.

Source: Klein and Donaldson, 2002 and authors' tabulations from Vital Statistics and 2000 U.S. Census.

Table 2: Means for All Births and for Analysis Sample

Insurance Coverage	All 1990	All 2000	Sample 1990	Sample 2000	# Mothers with any Changes	Mean Change
Medicaid for Delivery	0.389	0.404	0.775	0.697	39131	-0.064
Private Ins. for Delivery	0.518	0.553	0.191	0.271	36370	0.097
Hospital Characteristics						
Level 3 or higher NICU	0.484	0.529	0.430	0.517	47260	0.077
Public	0.217	0.115	0.229	0.156	22108	-0.142
Neonatal Mort. Rate*100	0.449	0.372	0.458	0.413	196786	-0.015
Adjusted NMR*100	0.009	-0.005	0.001	-0.006	89606	-0.002
Prenatal Care						
Began in 1st Trimester	0.722	0.834	0.553	0.704	62714	0.051
Delivery Care						
Induction/Stimulation Labor	0.107	0.212	0.089	0.176	45768	0.035
Fetal Monitor	0.488	0.668	0.458	0.644	60753	0.161
Cesarian	0.221	0.229	0.201	0.211	23675	0.073
Infant Outcomes						
Low Birth Weight	0.052	0.055	0.078	0.061	18512	-0.058
Gestation < 37 weeks	0.095	0.097	0.135	0.127	31332	0.035
Neonatal Death*100	0.424	0.344	0.313	0.301	1222	0.026

Mother&Child Characteristics	All 1990	All 2000	Sample 1990	Sample 2000	1990-2000 Change in COHS	1990-2000 Change in 2Plan/GMC	1990-2000 Change in No MMC
Black	0.079	0.065	0.296	0.237	0.017	0.044	0.009
White	0.416	0.321	0.321	0.241	0.061	0.027	0.066
Hispanic	0.408	0.490	0.367	0.500	-0.024	-0.016	-0.064
Asian	0.060	0.081	0.002	0.006	-0.037	-0.040	-0.006
Mother < High School	0.339	0.297	0.530	0.409	0.101	0.145	0.105
Mother High School	0.313	0.287	0.470	0.591	0.061	0.043	0.056
Mother Some College	0.195	0.200	0	0	-0.041	-0.076	-0.058
Foreign Born	0.413	0.456	0	0	-0.045	-0.024	-0.041
Mother Single	0.304	0.324	1	1	0.159	0.223	0.157
Teen Mother	0.114	0.105	0.417	0.123	0.042	0.060	0.043
Mother 20-29	0.561	0.494	0.511	0.716	0.105	0.062	0.057
Mother 30-34	0.219	0.241	0.060	0.112	-0.062	-0.053	-0.037
Child First Born	0.401	0.386	0.461	0.002	0.038	0.012	0.008
Child Male	0.513	0.512	0.511	0.512	-0.001	0.002	-0.002
#Obs	175564	155112	25945	17762			

Notes: "All" is a 30% sample of singleton births excluding the 15 counties with the fewest births in 2000
The analysis sample is all native born mothers with >=2 births in the sample, who had <=highschool, and who were unmarried at each point at which they were observed.

Table 3: Effect of MMC on Enrollments in Medi-Cal/Private Insurance

Panel A	**[1] MediCal Delivery**	**[2] MediCal Delivery**	**[3] Private Delivery**	**[4] Private Delivery**
Mother FE	no	yes	no	yes
COHS	-0.026	-0.01	0.015	0.017
	[0.017]	[0.023]	[0.019]	[0.021]
2Plan	-0.027	-0.025	0.026	0.023
	[0.006]**	[0.006]**	[0.006]**	[0.006]**
#Obs.	255018	255018	255018	255018
R-squared	0.060	0.7	0.070	0.71
Test COHS=2Plan/	10.21	8.06	11.27	7.21
=0	*0.000*	*0.000*	*0.000*	*0.001*
Test COHS=2Plan	0.01	0.44	0.34	0.07
	0.034	*0.506*	*0.558*	*0.785*

Panel B: Mother Fixed Effects Models of Prob(Medi-Cal Delivery)
Include Interactions of Indicated Maternal Characteristics with MMC

Characteristic:	**Hispanic**	**Black**
COHS*Characteristic	-0.065	0.048
	[0.022]**	[0.023]*
2Plan*Characteristic	-0.024	0.011
	[0.008]**	[0.008]
COHS	0.022	-0.016
	[0.026]	[0.021]
2Plan	-0.015	-0.028
	[0.007]*	[0.007]**
Main Effect	0.004	0.012
Characteristic	[0.013]	[.017]
#Obs.	255018	255018
R-squared	0.7	0.7

Notes: Robust standard errors in brackets are clustered at county-year level. P-values for F-statistics in italics. Panel A regressions included all of the mother and child characteristics in Table 2.
All regressions also included year fixed effects and county-specific
time trends. Regressions without mother fixed effects include county fixed effects.

Table 4: Effects of MMC on Prenatal Care, Hospital of Delivery, Delivery Care, and Birth Outcomes

	[1] Prenatal 1st tri.	[2] NICU	[3] Residual NMR	[4] Induction Stim.Labor	[5] Fetal Monitor	[6] Cesarian	[7] Low Birth Weight	[8] Short Gestation	[9] Neonatal Death
Panel A: County FE									
COHS	-0.075	0.103	0.151	-0.006	0.016	0.019	0.022	0.022	0.295
	[0.021]**	[0.047]*	[0.096]	[0.011]	[0.029]	[0.012]	[0.009]*	[0.012]	[0.206]
2Plan	-0.078	0.005	0.1	-0.002	-0.025	-0.006	0.024	0.024	0.19
	[0.012]**	[0.010]	[0.040]*	[0.007]	[0.012]*	[0.003]	[0.003]**	[0.006]**	[0.056]**
Observations	255018	255018	248438	255018	255018	255018	255007	242314	255018
R-squared	0.04	0.19	0.08	0.06	0.14	0.01	0.01	0.01	0
Test COHS=2Plan=0	26.29	2.74	4.29	0.17	2.13	2.98	44.92	8.29	6.34
	0.000	*0.065*	*0.014*	*0.842*	*0.112*	*0.051*	*0.000*	*0.000*	*0.002*
Test COHS=2Plan	0.02	4.01	0.25	0.08	1.62	3.82	0.02	0.01	0.25
	0.891	*0.045*	*0.618*	*0.782*	*0.203*	*0.051*	*0.880*	*0.918*	*0.616*
Panel B: Mother FE									
COHS	-0.058	0.112	0.088	0.039	0.119	-0.003	0.014	0.025	0.308
	[0.019]**	[0.032]**	[0.095]	[0.017]*	[0.037]**	[0.008]	[0.007]*	[0.012]*	[0.160]
2Plan	-0.044	0.005	0.082	0.002	-0.023	0.001	0.013	0.015	0.16
	[0.008]**	[0.009]	[0.034]*	[0.007]	[0.009]*	[0.003]	[0.003]**	[0.007]*	[0.070]*
Observations	255018	255018	248438	255018	255018	255018	255007	242314	255018
R-squared	0.6	0.76	0.72	0.6	0.69	0.82	0.61	0.59	0.54
Test COHS=2Plan=0	15.52	7.02	3.12	2.73	7.68	0.19	12.11	3.74	3.65
	0.000	*0.001*	*0.044*	*0.065*	*0.001*	*0.829*	*0.000*	*0.024*	*0.026*
Test COHS=2Plan	0.58	9.64	0.00	4.55	13.36	0.31	0.02	0.73	0.86
	0.448	*0.002*	*0.948*	*0.033*	*0.000*	*0.577*	*0.876*	*0.394*	*0.354*

Notes: Robust standard errors in brackets are clustered at the county-year level. P-values for F-tests in italics. All regressions also include indicators for maternal race abd ethnicity, maternal education, mother age, whether the child was first born, and whether the child was male as well as year dummies and county-specific time trends. Coefficients and standard errors on hospital death rates are multiplied by 1,000. Coefficients and standard errors on neonatal death are multiplied by 100.

Table 5: Alternate Specifications

	[1] Medical Delivery	[2] Prenatal 1st tri.	[3] NICU	[4] Residual NMR	[5] Induction Stim.Labor	[6] Fetal Monitor	[7] Cesarian	[8] Low Birth Weight	[9] Short Gestation	[10] Neonatal Death
Panel A: Married Native-Born Mothers with Highschool or Less										
COHS	-0.001	-0.046	0.026	0.052	0.045	0.082	-0.019	0.002	0.005	0.118
	[0.036]	[0.037]	[0.060]	[0.127]	[0.064]	[0.060]	[0.028]	[0.020]	[0.025]	[0.405]
2Plan	-0.008	-0.032	-0.037	0.027	-0.003	-0.016	0.009	0.005	-0.007	0.441
	[0.022]	[0.025]	[0.033]	[0.123]	[0.029]	[0.030]	[0.016]	[0.014]	[0.023]	[0.319]
#Obs.	134023	134023	134023	128890	134023	134023	134023	134015	129032	134023
R-squared	0.96	0.91	0.95	0.94	0.9	0.93	0.96	0.92	0.91	0.9
Panel B: Native-born Mothers with More than Highschool										
COHS	-0.010	-0.018	0.008	0.002	0.083	0.015	0.008	-0.007	-0.006	-0.238
	[0.011]	[0.018]	[0.045]	[0.090]	[0.033]*	[0.038]	[0.015]	[0.012]	[0.018]	[0.289]
2Plan	-0.013	-0.018	-0.035	0.065	-0.020	-0.029	0.009	0.009	0.013	0.198
	[0.010]	[0.011]	[0.032]	[0.097]	[0.021]	[0.024]	[0.011]	[0.007]	[0.014]	[0.156]
#Obs.	219349	219349	219349	212548	219349	219349	219349	219342	213335	219349
R-squared	0.950	0.890	0.940	0.940	0.880	0.920	0.950	0.910	0.900	0.870
Panel C: MMC Classification Based on Initial County Only										
COHS	-0.015	-0.059	0.103	0.108	0.024	0.096	0	0.014	0.017	0.258
	[0.022]	[0.018]**	[0.029]**	[0.086]	[0.016]	[0.029]**	[0.007]	[0.006]*	[0.010]	[0.151]
2Plan	-0.026	-0.044	0.006	0.081	0.004	-0.021	0.001	0.012	0.011	0.13
	[0.006]**	[0.008]**	[0.009]	[0.034]*	[0.007]	[0.009]*	[0.003]	[0.003]**	[0.006]	[0.068]
#Obs.	255018	255018	255018	248438	255018	255018	255018	255007	242314	255018
R-squared	0.7	0.6	0.76	0.72	0.6	0.69	0.82	0.61	0.59	0.54
Panel D: Births Within +/- 3 years of Implementation of MMC Only										
COHS	-0.011	-0.083	0.079	0.087	0.006	0.128	0.003	0.016	0.039	0.208
	[0.039]	[0.027]**	[0.016]**	[0.116]	[0.017]	[0.056]*	[0.013]	[0.010]	[0.028]	[0.232]
2Plan	-0.026	-0.042	0.012	0.136	0.000	0.006	-0.004	0.011	0.026	0.235
	[0.010]**	[0.014]**	[0.015]	[0.054]*	[0.008]	[0.012]	[0.006]	[0.006]	[0.013]*	[0.130]
#Obs.	115035	115035	115035	112517	115035	115035	115035	115034	109118	115035
R-squared	0.83	0.77	0.87	0.85	0.78	0.84	0.9	0.77	0.76	0.72

Table 5: Alternate Specifications

	[1] Medical Delivery	[2] Prenatal 1st tri.	[3] NICU	[4] Residual NMR	[5] Induction Stim.Labor	[6] Fetal Monitor	[7] Cesarian	[8] Low Birth Weight	[9] Short Gestation	[10] Neonatal Death
Panel E: Unmarried Native-born Mothers with Highschool or Less, Medi-Cal Only										
COHS		-0.066	0.077	0.133	0.041	0.144	-0.006	0.018	0.019	0.256
		[0.022]**	[0.033]*	[0.127]	[0.022]	[0.051]**	[0.010]	[0.011]	[0.014]	[0.235]
2Plan		-0.049	0.023	0.097	0.000	-0.018	-0.002	0.013	0.013	0.145
		[0.010]**	[0.011]*	[0.041]*	[0.009]	[0.011]	[0.004]	[0.004]**	[0.009]	[0.085]
#Obs.		196616	196616	191324	196616	196616	196616	196608	186869	196616
R-squared		0.65	0.80	0.77	0.65	0.74	0.84	0.65	0.63	0.59
Panel F: All Unmarried Native-born Mothers with Highschool or Less, including those with One Child in Sample - OLS										
COHS	-0.018	-0.065	0.053	0.172	-0.010	0.003	0.010	0.022	0.017	0.250
	[0.011]	[0.017]**	[0.040]	[0.063]**	[0.009]	[0.024]	[0.007]	[0.006]**	[0.010]	[0.109]*
2Plan	-0.023	-0.082	0.006	0.108	-0.003	-0.025	0.000	0.028	0.026	0.261
	[0.005]**	[0.012]**	[0.009]	[0.040]**	[0.007]	[0.011]*	[0.003]	[0.002]**	[0.006]**	[0.046]**
#Obs.	627027	627027	627027	608983	627027	627027	627027	627001	595863	627027
R-squared	0.070	0.040	0.190	0.070	0.060	0.130	0.020	0.010	0.010	0.000
Panel G: First Born Children of Unmarried Native-born Mothers with Highschool or Less - OLS										
COHS	-0.022	-0.059	0.045	0.174	-0.009	0.017	0.009	0.011	0.009	0.027
	[0.013]	[0.015]**	[0.041]	[0.066]**	[0.012]	[0.022]	[0.007]	[0.006]	[0.012]	[0.113]
2Plan	-0.023	-0.07	0.004	0.108	-0.004	-0.024	0.003	0.022	0.022	0.289
	[0.006]**	[0.014]**	[0.010]	[0.040]**	[0.007]	[0.012]*	[0.003]	[0.002]**	[0.006]**	[0.064]**
#Obs.	301503	301503	301503	292699	301503	301503	301503	301490	288478	301503
R-squared	0.06	0.04	0.18	0.07	0.05	0.12	0.02	0.01	0.01	0

Notes: See Table 4.