Care management reduced infant mortality for Medicaid managed care enrollees in Ohio

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September 2019

Abstract

Objectives: In 2012, the Ohio Department of Medicaid introduced requirements for enhanced care management to be delivered by Medicaid managed care organizations (MCOs). This study evaluated the impact of care management on reducing infant mortality in the largest Medicaid MCO in Ohio.

Study Design: Observational study using infant and maternal individual-level enrollment and claims data (2009-2015), which used a quasi-experimental research design built upon a sibling-comparison approach that controls for within-family confounders.

Methods: Using individual-level data from the largest MCO in Ohio, we estimated linear probability models to examine the effect of infant engagement in care management on infant mortality. We used a within-family fixed-effects research design to determine if care management reduced infant mortality and estimated models separately for healthy infants and non-healthy infants.

Results: Infant engagement in care management was associated with a 7.4 ($p<.001$) percentage point reduction in infant mortality among the most vulnerable infants, those identified as not well at birth (95% confidence interval (CI)= -10.7, -4.1). This effect was larger in recent years and was likely driven by new statewide enhanced care management requirements. Infant mortality was unchanged for healthy infants engaged in care management (coefficient=0.03, 95% CI= -0.01, 0.08).

Conclusions: This study provides evidence that care management can be effective in reducing infant mortality among Medicaid MCO-enrollees, a population at high-risk of mortality. Few infants were engaged in care management, suggesting to policy makers that there is room for many additional infants to benefit from this intervention.

Key Words: Managed care programs, Medicaid, Infant mortality, Care management

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Introduction

Despite a 15% decline in the U.S. infant mortality rate (IMR)—from 6.86 deaths per 1,000 live births in 2004 to 5.82 in 2014—rates remain high for many vulnerable subpopulations.[1] One particularly vulnerable group is the Medicaid population, whose IMR is twice the non-Medicaid population. One study reported the IMR of Indiana newborns enrolled in Medicaid was 7.16 compared to 4.19 in the non-Medicaid population.[2] Elevated IMR among Medicaid enrollees is of particular importance since over 40% of births in the U.S. in 2016 are covered by Medicaid.[3] Moreover, nationally, 70% of Medicaid participants are enrollees in managed care organizations (MCOs),[4] an alternative payment model where there are financial incentives to reduce costs. Thus, any successful intervention focused on Medicaid MCO-enrollees has the potential to avoid a large number of infant deaths and to serve as a model for both the fee-for-service and non Medicaid populations.[5]

Many state Medicaid programs have implemented care management requirements for MCOs or designed care management interventions to improve birth outcomes. While care management has no strict definition, it is loosely described as a patient centered, team-based approach to coordinating medical care with an emphasis on chronic conditions.[6] Prior studies suggest that care management for pregnant women may lead to fewer preterm births,[7] fewer low birth weight births,[8,9] and reduced infant mortality.[10] In 2012, the Ohio Department of Medicaid introduced requirements for enhanced care management to be delivered by Medicaid MCOs, including: a minimum staff/member ratio; quarterly face-to-face contact with members; and multidisciplinary teams to care for high-risk members.[11] For high-risk infants in the intensive care unit, the teams included nurses and social workers and were designed to manage unique infant needs (e.g. connection to specialists). Although care management guidelines were not specific to

infants, these changes provide a unique opportunity to conduct a case study examining the potential for care management to reduce infant mortality. As such, we conducted a quasi-experimental study to determine if enhanced care management reduced infant mortality among Medicaid managed care enrollees in an Ohio MCO.

Methods

We obtained individual-level enrollment and claims data from CareSource, a large Ohio Medicaid MCO that covers 60% of Ohio Medicaid enrollees. We combined these data with county characteristics from the Area Health Resources File from 2009-2015. In our preferred model, we studied 61,560 infants born from 2009-2015, enrolled in CareSource at birth, that had at least one sibling enrolled since birth in the MCO. Infant mortality within the first year of life was measured as a dichotomous variable. Infants were linked to mothers and siblings using a maternal identifier. Care management was offered to infants predicted to be high-cost using a proprietary algorithm or that were identified as high-risk pregnancies. Infant engagement in care management was defined as a dichotomous variable indicating any engagement beginning in the first month of life.

We used linear probability models to examine the relationship between infant engagement in care management and infant mortality. We first used a cross-sectional approach, estimating models controlling for infant, maternal, and community characteristics reported in Exhibit 1, including infant sex, race/ethnicity, maternal age at birth, a multiple birth indicator, the number of primary care providers in the county, and the unemployment rate. Indicators of maternal health conditions were constructed from claims data using Expanded Diagnosis Clusters to identify mothers that ever had a maternal substance use disorder or serious mental health issue. These models also controlled for time-invariant county-level characteristics (e.g., rural/urban county

status) and birth-year-cohort invariant characteristics (e.g., recessions) through the inclusion of county and birth-year fixed-effects.

We also used a within-family approach, which adds controls for family-invariant characteristics (e.g., genetic predisposition or parental education) through the addition of maternal fixed-effects. The within-family model is our preferred design since it minimizes the potential for selection bias to impact our treatment effect estimates. The simple difference between the mortality rate of those infants engaged in care management and those not engaged cannot be considered the true effect of care management because engagement was not randomly assigned. To overcome concerns related to non-random assignment, we use a quasi-experimental sibling-comparison research design and examine the sub-population of siblings that have the same health status at birth. For a detailed explanation of the sibling-comparison research design, see D'Onofrio et al. (2013), who used this approach to remove confounding factors when estimating the effect of preterm birth on infant mortality and morbidity.[12] Importantly, the sibling-comparison approach removes confounding variables and risk factors common to siblings, such as the material genetic environment and any time-invariant maternal characteristics.

Since this approach cannot remove confounders that are unique to any single infant, there still exists the possibility that the non-random assignment of care management could lead to biased estimates if those infants engaged in care management are healthier than those not engaged. If this were the case, then the estimated effect would confound differences in underlying health with the true treatment effect. However, this is of limited concern for our analysis as infants engaged in care management (2,524) were less healthy at birth (17.94% considered well-at-birth) than those not engaged in care management (161,193 with 78.00% considered well-at-birth). To mitigate this concern, we re-estimate our preferred model on the sub-population of those infants considered not

well at birth. This specification compares siblings that were both designated as not well at birth by the MCO. "Well at birth" is a designation constructed by the MCO using a proprietary algorithm that identified those infants diagnosed as a healthy newborn (e.g. absence of serious diagnoses or an explicit diagnosis normal newborn), who are not admitted to a non-general room (e.g. ICU), transferred to another facility, and who stay in the hospital less than their mother and less than seven days.

Finally, we examine our specification of interest excluding time-periods to assess if the effect of care management is driven by the period after 2012, when Ohio implemented regulations for enhanced care management.

Analyses were conducted using Stata 14 (College Station, TX). Significance tests were 2-sided with $p<0.05$ indicating statistical significance. Standard errors were clustered at the birth-county for all models. RAND's institutional review board approved the study. The study used deidentified, observational data, thus patient consent was neither required nor obtainable.

Results

In our cross-sectional design we examined 163,717 infants, where 77% were considered well at birth. We also estimated the treatment effect using the within-family design for those with siblings (61,562) as well as the sample where all siblings were born well at birth (64.45% of all infants with siblings) and the sample where all siblings were not well at birth (11.4% of all infants with siblings).

Both the cross-sectional and within-family research designs illustrated that enhanced care management was associated with reduced mortality among high-risk infants considered not well at birth (Exhibit 2). The cross-sectional results using the full study period (2009-2015) suggest that

infant engagement in care management is associated with a significant reduction in mortality for all (coefficient=-2.0, 95% confidence interval (CI)= -2.3, -1.7, P<.001), which is driven by the effect on infants considered not well at birth (coefficient= -2.5, 95% CI=-3.0, -2.1, P<.001).

Our preferred model uses the within-family design to ensure that our findings are not driven by unmeasured differences across families. Across the full study period, we find that infant engagement in care management was associated with a significant reduction in mortality for infants considered not well at birth (coefficient=-7.4, 95% CI= -10.7, -4.1, P<0.001), but not for infants considered well at birth. This is a large reduction in mortality as the predicted (i.e., regression adjusted) mortality rate for this group in the absence of care management is 7.5%.

We also estimated the preferred model for different time-periods, one before enhanced care management (2009-2011) and another after (2012-2015). We find that the significant effect of care management on infants not well at birth was driven by the time period after enhanced care management was introduced.

Discussion

Nationally, most Medicaid recipients are enrolled in MCOs, a payment model that utilizes care management to reduce costs and promote health. Prior research has documented the benefits of care management for pregnant women,[7-10,13,14] and our case study demonstrates that care management directed at high-risk infants can reduce infant mortality.

In our study population, few infants were engaged in care management, suggesting potential for many infants to benefit from it. Extending care management to more infants and strengthening existing care management activities by requiring minimum staffing ratios, in-person encounters, and specialized teams for high-risk members, may also help to reduce infant mortality. Although not the focus of this study, MCOs could also consider maternal health when

making decisions about engaging infants in care management. A prior study of a similar population of infants in an Ohio Medicaid MCO found increased odds of maternal mortality among healthy-weight infants born to mothers with severe mental illness or substance use.[15]

The MCO changed a number of care management strategies over the time period we studied, thus we cannot identify the exact components of care management that contributed to the mortality decline. However, through extensive conversations with the MCO, we hypothesize that a key driver of the decline may have been better management of specialist care for those infants admitted to the Neonatal Intensive Care Unit. Due to enhanced care management, the managed care organization we studied began connecting infants to specialists, ensuring appropriate and timely specialist follow up visits, assessing need for specialist care, and encouraging collaboration and communication between specialists and/or the primary care physician. While we do not have data that allow us to evaluate this hypothesis, we believe the results presented here are still of importance as they highlight the potential mortality reductions that could occur if care management was extended to more infants who are not well at birth and if existing care management activities were strengthened.

Furthermore, because Medicaid-enrolled mothers and infants are highly vulnerable and may struggle with food insecurity, lack of stable housing, and other challenges related to poverty and discrimination, research is needed to determine the extent to which case management services may reduce infant mortality by addressing medical and/or nonmedical needs. While this care management program was not specifically focused on addressing non-medical social determinants of health, a systematic review of activities undertaken by Medicaid MCOs to address nonmedical needs found several studies focused on pregnant women and infants, but little information about key characteristics of care management programs.[16] Future studies should seek to identify the

specific characteristics of care management programs that are most effective at reducing infant mortality.

This study has several limitations. First, it is not a nationwide analysis, but a case-study examining the effects of one large MCO in a single state. It is possible that the results here are not generalizable to other settings. Second, participation in care management was not randomly assigned. While we use a quasi-experimental design and sought to minimize bias, it is still possible that selection into care management may be biasing our estimates. Third, the exact features of care management driving the large mortality reductions are unknown. While we speculate that the primary driver is the connection to specialist care, this may not be the case. The effects could be driven by another feature of care management or by a combination of efforts –and this remains an important area for future research. Finally, the MCO's use of proprietary software to help identify infants to be offered care management may make it challenging for other organizations to replicate this intervention. We encourage organizations to consider use of open source algorithms or seek approval to share details about proprietary algorithms in order to facilitate the adoption of effective interventions.

Conclusion

Care management reduced infant mortality among the sickest infants enrolled in a Medicaid MCO in Ohio. This finding is of importance as an increasing number of births in U.S. are covered by Medicaid MCOs and currently only a small number of infants are enrolled in care management. State regulations should follow the best available evidence and incentivize care management participation for those most likely to benefit. Moreover, this result is of general

interest to the entire population as best-practices in care management can be applied to those births not covered by an MCO, helping to reduce the US infant mortality rate.

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Exhibit 1: Maternal and infant characteristics for infants enrolled in care management since birth

A. Infants in cross-sectional sample

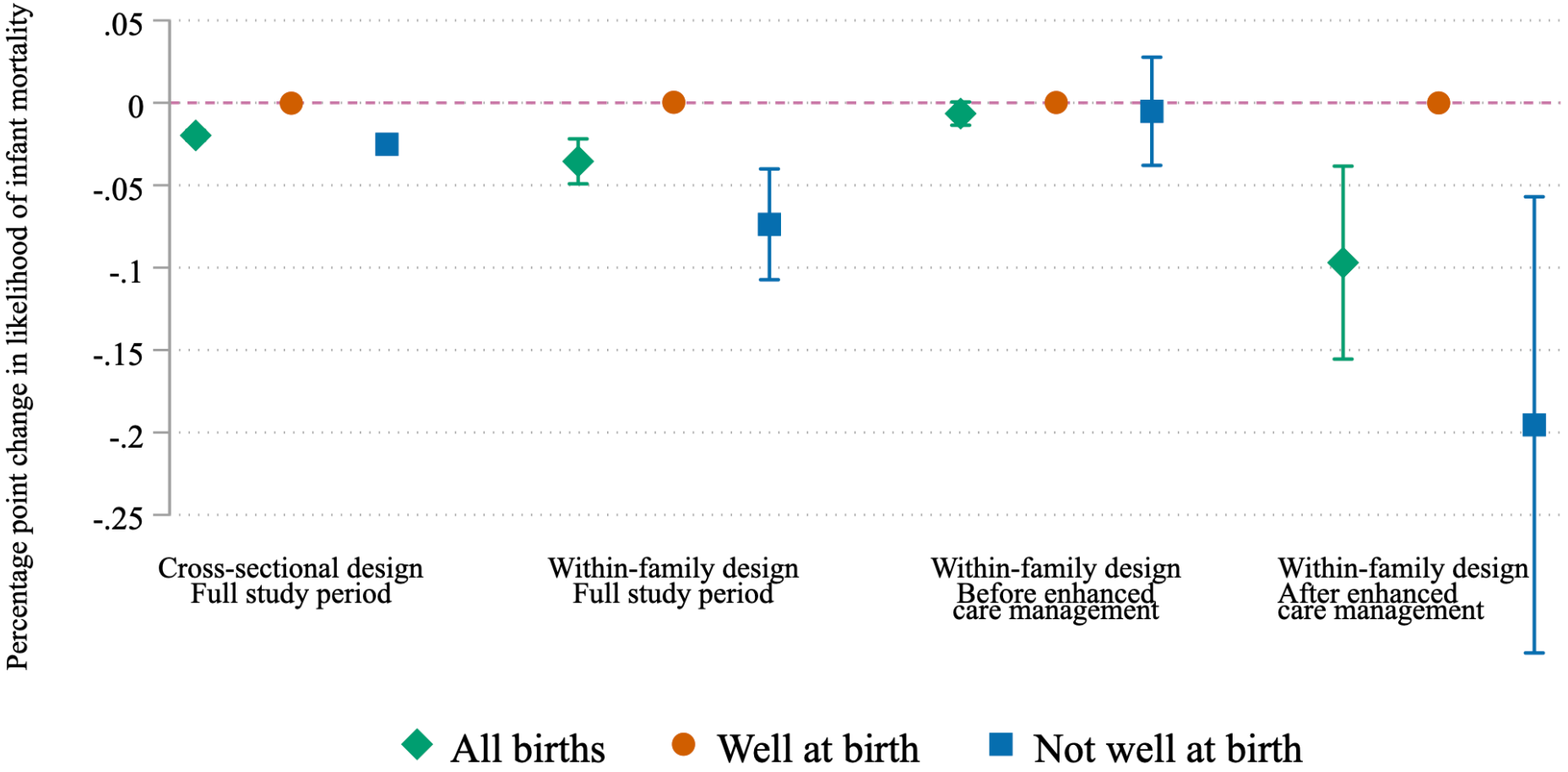
	All infants in sample		Those healthy at birth		Those sick at birth	
	In care management N=2,524	Not in care management N=161,193	In care management N=453	Not in care management N=125,737	In care management N=2,071	Not in care management N=35,453
Infant Characteristics						
Died in first year of life, No. (%)	9, (0.36)	1,079, (0.67)	0, (0.00)	46, (0.04)	9, (0.43)	1,033, (2.91)
Race/Ethnicity						
Black, No. (%)	914, (36.21)	48,339, (29.99)	148, (32.67)	36,966, (29.40)	766, (36.99)	11,373, (32.08)
Hispanic, No. (%)	9, (0.36)	592, (0.37)	0, (0.00)	469, (0.37)	9, (0.43)	123, (0.35)
Other race, No. (%)	427, (16.92)	27,406, (17.00)	52, (11.48)	21,152, (16.82)	375, (18.11)	6,254, (17.64)
Male, No. (%)	1,376, (54.52)	82,510, (51.19)	255, (56.29)	63,732, (50.69)	1,121, (54.13)	18,776, (52.96)
Well-at-birth indicator, No. (%)	453, (17.95)	125,737, (78.00)	453, (100)	125,737, (100)	0, (0.00)	0, (0.00)
Multiple birth indicator, No. (%)	393, (15.57)	4,542, (2.82)	9, (1.99)	1,727, (1.37)	384, (18.54)	2,815, (7.94)
Maternal Characteristics						
Ever SUD, No. (%)	276, (10.94)	13,734, (8.52)	47, (10.38)	9,493, (7.55)	229, (11.06)	4,241, (11.96)
Ever SMI, No. (%)	223, (8.84)	10,528, (6.53)	44, (9.71)	7,833, (6.23)	179, (8.64)	2,695, (7.60)
Ever engaged in care management, No. (%)	304, (12.04)	6,642, (4.12)	45, (9.93)	4,722, (3.76)	259, (12.51)	1,920, (5.42)
Age at birth, mean (SD)	25.93, (5.73)	25.51, (5.46)	24.46, (5.07)	25.38, (5.38)	26.25, (5.82)	25.96, (5.69)
Community Characteristics						
PCP per 100k, mean (SD)	83.93, (53.76)	78.74, (53.26)	95.26, (51.10)	77.99, (53.14)	81.46, (54.03)	81.39, (53.57)
Unemployment rate, mean (SD)	0.08, (0.02)	0.08, (0.02)	0.09, (0.02)	0.08, (0.02)	0.08, (0.02)	0.08, (0.02)
% in poverty, mean (SD)	16.85, (3.22)	16.71, (3.31)	16.66, (2.97)	16.67, (3.32)	16.89, (3.27)	16.85, (3.28)
% non-white, mean (SD)	0.21, (0.12)	0.19, (0.12)	0.19, (0.12)	0.18, (0.12)	0.21, (0.12)	0.19, (0.12)
% smokers, mean (SD)	21.66, (3.57)	22.17, (3.80)	22.22, (3.38)	22.20, (3.80)	21.53, (3.60)	22.06, (3.80)

B. Infants in within-family design

	All infants with siblings		All siblings well at birth		All siblings not well at birth	
	In care management N=1129	Not in care management N=60,433	In care management N=158	Not in care management N=39,522	In care management N=594	Not in care management N=6,426
Infant Characteristics						
Died in first year of life, No. (%)	3, (0.27)	514, (0.85)	0, (0.00)	15, (0.04)	1, (0.17)	251, (3.91)
Race/Ethnicity						
Black, No. (%)	426, (37.73)	19,932, (32.98)	52, (32.91)	12,660, (32.03)	228, (38.38)	2,332, (36.29)
Hispanic, No. (%)	4, (0.35)	148, (0.24)	0, (0.00)	93, (0.24)	3, (0.51)	12, (0.19)
Other race, No. (%)	175, (15.50)	9,548, (15.80)	18, (11.39)	6,163, (15.59)	94, (15.82)	1,000, (15.56)
Male, No. (%)	635, (56.24)	30,825, (51.01)	98, (62.03)	20,031, (50.68)	317, (53.37)	3,307, (51.46)
Well-at-birth indicator, No. (%)	189, (16.74)	46,615, (77.14)	158, (100)	39,522, (100)	0, (0.00)	0, (0.00)
Multiple birth indicator, No. (%)	388, (34.37)	4,477, (7.41)	5, (3.16)	1,502, (3.80)	370, (62.29)	2,502, (38.94)
Maternal Characteristics						
Ever SUD, No. (%)	114, (10.10)	5,339, (8.83)	16, (10.13)	2,893, (7.32)	62, (10.44)	840, (13.07)
Ever SMI, No. (%)	91, (8.06)	4,020, (6.65)	14, (8.86)	2,508, (6.35)	55, (9.26)	502, (7.81)
Ever engaged in care management, No. (%)	129, (11.43)	2,682, (4.44)	13, (8.23)	1,528, (3.87)	89, (14.98)	484, (7.53)
Age at birth, mean (SD)	25.71, (5.45)	25.12, (4.98)	23.77, (4.86)	24.98, (4.87)	26.31, (5.52)	26.13, (5.37)
Community Characteristics						
PCP per 100k, mean (SD)	82.00, (53.86)	79.22, (53.56)	96.43, (50.05)	78.19, (53.13)	77.74, (53.98)	82.55, (55.01)
Unemployment rate, mean (SD)	0.08, (0.02)	0.08, (0.02)	0.09, (0.02)	0.08, (0.02)	0.08, (0.02)	0.08, (0.02)
% in poverty, mean (SD)	16.93, (3.18)	16.79, (3.23)	16.29, (3.33)	16.74, (3.24)	17.04, (3.14)	16.98, (3.18)
% non-white, mean (SD)	0.21, (0.12)	0.19, (0.12)	0.19, (0.12)	0.19, (0.11)	0.21, (0.12)	0.20, (0.12)
% smokers, mean (SD)	21.65, (3.67)	22.18, (3.79)	21.67, (3.06)	22.24, (3.80)	21.65, (3.83)	22.01, (3.74)

Source: Author calculations using claims data. SUD indicator represents substance use disorder, SMI represents serious mental illness, and PCP abbreviates primary care providers. For summaries of binary (0,1) variables, both the count and percent are provided. For continuous variables both the mean and the standard deviation are reported. The first panel (A) contains summary statistics for all infants in our cross-sectional research design. The second panel (B) contains those infants in our within-family research design.

Care management reduced infant mortality for high risk infants for a large Managed Medicaid Organization in Ohio



Note: All point estimates and 95% confidence intervals (reported in brackets) come from separate regressions. The cross-sectional regression include all infants whose mother is an MCO member. The within-family design includes all infants with siblings whose mother is an MCO member. Results are robust to changing the sample to include all observed infants regardless of sibling or maternal MCO membership. The cross-sectional design includes controls for time invariant county-level confounders and birth-year invariant confounders. The cross-sectional design also controls for infant, maternal and community characteristics reported in Exhibit 1. The within-family design includes all of the controls from the cross-sectional design and additionally controls for family-invariant characteristics (e.g., genetic predisposition, parental education, and health behaviors). Standard errors were clustered at the birth county-level. The first two sets of results use data from all years available, 2009 to 2015. The last two sets of results examine two different sets of years; 2009-2011, which is the period before the enhanced care management program was introduced and 2013-2015, which is the time period after enhanced care management was introduced. Well at birth is a designation based on diagnosis-related groups that indicates the infant was considered well when discharged from the hospital after birth.