

# Care Management Reduced Infant Mortality for Medicaid Managed Care Enrollees in Ohio

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Despite a 15% decline in the US infant mortality rate (IMR)—from 6.86 deaths per 1000 live births in 2004 to 5.82 in 2014—rates remain high for many vulnerable subpopulations.<sup>1</sup> One particularly vulnerable group is the Medicaid population, whose IMR is twice that of the non-Medicaid population. One study reported that the IMR of Indiana newborns enrolled in Medicaid was 7.16 per 1000 live births compared with 4.19 in the non-Medicaid population.<sup>2</sup> Elevated IMR among Medicaid enrollees is of particular importance because more than 40% of births in the United States in 2016 were covered by Medicaid.<sup>3</sup> Moreover, nationally, 70% of Medicaid participants are enrollees in managed care organizations (MCOs),<sup>4</sup> an alternative payment model in which 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 serve as a model for both the fee-for-service and non-Medicaid populations.<sup>5</sup>

Many state Medicaid programs have implemented care management requirements for MCOs or designed care management interventions to improve birth outcomes. Although 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.<sup>6</sup> Prior studies suggest that care management for pregnant women may lead to fewer preterm births,<sup>7</sup> fewer low-birth-weight births,<sup>8,9</sup> and reduced infant mortality.<sup>10</sup> 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.<sup>11</sup> For high-risk infants in the intensive care unit (ICU), the teams included nurses and social workers and were designed to manage unique infant needs (eg, 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.

## 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 on 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 nonhealthy infants.

**RESULTS:** Infant engagement in care management was associated with a reduction of 7.4 percentage points (95% CI, -10.7 to -4.1;  $P < .001$ ) in infant mortality among the most vulnerable infants, those identified as not well at birth. This effect was larger in recent years and 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 to 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.

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TAKEAWAY POINTS

- ▶ Nearly half of US births are covered by Medicaid, and these infants are at increased risk of dying during the first year of life.
- ▶ Our study found that infant engagement in care management significantly reduced infant mortality among the sickest infants enrolled in the largest Medicaid managed care organization in Ohio.
- ▶ Care management programs that focus on the most vulnerable, least healthy infants have the potential to reduce infant mortality, particularly among populations already at high risk of infant mortality.

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 the **Table**, including infant sex, race/ethnicity,

maternal age at birth, a multiple birth indicator, number of primary care providers in the county, and unemployment rate. Indicators of maternal health conditions were constructed from claims data using Expanded Diagnosis Clusters to identify mothers who ever had a substance use disorder or serious mental health issue. These models also controlled for time-invariant county-level characteristics (eg, rural/urban county status) and birth-year-cohort invariant characteristics (eg, 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 (eg, genetic predisposition or parental education) through the addition of maternal fixed effects.

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 to 2015. In our preferred model, we studied 61,560 infants born from 2009 to 2015, enrolled in CareSource at birth, who had at least 1 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 who were identified as born from

TABLE. 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 = 2524	Not in Care Management n = 161,193	In Care Management n = 453	Not in Care Management n = 125,737	In Care Management n = 2071	Not in Care Management n = 35,453
Infant characteristics						
Died in first year of life, n (%)	9 (0.36)	1079 (0.67)	0 (0.00)	46 (0.04)	9 (0.43)	1033 (2.91)
Race/ethnicity, n (%)						
Black	914 (36.21)	48,339 (29.99)	148 (32.67)	36,966 (29.40)	766 (36.99)	11,373 (32.08)
Hispanic	9 (0.36)	592 (0.37)	0 (0.00)	469 (0.37)	9 (0.43)	123 (0.35)
Other race	427 (16.92)	27,406 (17.00)	52 (11.48)	21,152 (16.82)	375 (18.11)	6254 (17.64)
Male, n (%)	1376 (54.52)	82,510 (51.19)	255 (56.29)	63,732 (50.69)	1121 (54.13)	18,776 (52.96)
Well-at-birth indicator, n (%)	453 (17.95)	125,737 (78.00)	453 (100.00)	125,737 (100.00)	0 (0.00)	0 (0.00)
Multiple birth indicator, n (%)	393 (15.57)	4542 (2.82)	9 (1.99)	1727 (1.37)	384 (18.54)	2815 (7.94)
Maternal characteristics						
Ever SUD, n (%)	276 (10.94)	13,734 (8.52)	47 (10.38)	9493 (7.55)	229 (11.06)	4241 (11.96)
Ever SMI, n (%)	223 (8.84)	10,528 (6.53)	44 (9.71)	7833 (6.23)	179 (8.64)	2695 (7.60)
Ever engaged in care management, n (%)	304 (12.04)	6642 (4.12)	45 (9.93)	4722 (3.76)	259 (12.51)	1920 (5.42)
Age at giving birth in years, 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						
PCPs per 100,000, 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 (0-1), 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)
Percentage 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)
Nonwhite (0-1), 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)
Percentage 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)

(continued)

**TABLE.** (Continued) Maternal and Infant Characteristics for Infants Enrolled in Care Management Since Birth\*

**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 = 6426
<b>Infant characteristics</b>						
Died in first year of life, n (%)	3 (0.27)	514 (0.85)	0 (0.00)	15 (0.04)	1 (0.17)	251 (3.91)
<b>Race/ethnicity, n (%)</b>						
Black	426 (37.73)	19,932 (32.98)	52 (32.91)	12,660 (32.03)	228 (38.38)	2332 (36.29)
Hispanic	4 (0.35)	148 (0.24)	0 (0.00)	93 (0.24)	3 (0.51)	12 (0.19)
Other race	175 (15.50)	9548 (15.80)	18 (11.39)	6163 (15.59)	94 (15.82)	1000 (15.56)
Male, n (%)	635 (56.24)	30,825 (51.01)	98 (62.03)	20,031 (50.68)	317 (53.37)	3307 (51.46)
Well-at-birth indicator, n (%)	189 (16.74)	46,615 (77.14)	158 (100.00)	39,522 (100.00)	0 (0.00)	0 (0.00)
Multiple birth indicator, n (%)	388 (34.37)	4477 (7.41)	5 (3.16)	1502 (3.80)	370 (62.29)	2502 (38.94)
<b>Maternal characteristics</b>						
Ever SUD, n (%)	114 (10.10)	5339 (8.83)	16 (10.13)	2893 (7.32)	62 (10.44)	840 (13.07)
Ever SMI, n (%)	91 (8.06)	4020 (6.65)	14 (8.86)	2508 (6.35)	55 (9.26)	502 (7.81)
Ever engaged in care management, n (%)	129 (11.43)	2682 (4.44)	13 (8.23)	1528 (3.87)	89 (14.98)	484 (7.53)
Age at giving birth in years, 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)
<b>Community characteristics</b>						
PCPs per 100,000, 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 (0-1), 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)
Percentage 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)
Nonwhite (0-1), 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)
Percentage 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)

PCP indicates primary care provider; SMI, serious mental illness; SUD, substance use disorder.

\*For summaries of binary (0,1) variables, the count and percentage are provided. For continuous variables, the mean and SD are reported. The first panel (A) contains summary statistics for all infants in our cross-sectional research design. The second panel (B) contains those for infants in our within-family research design.

Source: Author calculations using claims data.

The within-family model is our preferred design because it minimizes the potential for selection bias to have an impact on 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 nonrandom assignment, we used a quasi-experimental sibling-comparison research design and examined the subpopulation of maternal siblings who have the same health status at birth. For a detailed explanation of the sibling-comparison research design, see the work of D’Onofrio et al, who used this approach to remove confounding factors when estimating the effect of preterm birth on infant mortality and morbidity.<sup>12</sup> 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.

Because this approach cannot remove confounders that are unique to any single infant, there still exists the possibility that the nonrandom 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

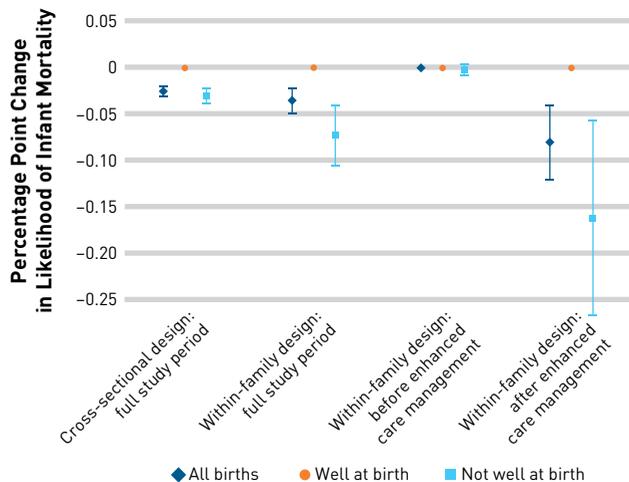
effect would confound differences in underlying health with the true treatment effect. However, this is of limited concern for our analysis because infants engaged in care management (n = 2524) were less healthy at birth (17.94% considered well at birth) than those not engaged in care management (n = 161,193, with 78.00% considered well at birth). To mitigate this concern, we reestimated our preferred model on the subpopulation of those infants considered not well at birth. This specification compares siblings who 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 identifies those infants considered a healthy newborn (eg, absence of serious diagnoses or an explicit diagnosis of normal newborn), who are not admitted to a nongeneral room (eg, ICU), who are not transferred to another facility, and who stay in the hospital for less time than their mother and less than 7 days.

Finally, we examined 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 (StataCorp; College Station, Texas). Significance tests were 2-sided, with *P* < .05 indicating

## TRENDS FROM THE FIELD

**FIGURE.** Care Management Reduced Infant Mortality for High-Risk Infants in a Large Managed Medicaid Organization in Ohio



MCO indicates managed care organization.

\*All point estimates and 95% CIs [reported in brackets] come from separate regressions. The cross-sectional regression includes 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 the Table. The within-family design includes all the controls from the cross-sectional design and additionally controls for family-invariant characteristics (eg, genetic predisposition, parental education, health behaviors). Standard errors were clustered at the birth county level. The first 2 sets of results use data from all years available, 2009 to 2015. The last 2 sets of results examine 2 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.

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, of whom 77% were considered well at birth. We also estimated the treatment effect using the within-family design for those with siblings ( $n = 61,562$ ), as well as the sample in which all siblings were well at birth (64.45% of all infants with siblings) and the sample in which 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 (Figure). 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% CI,  $-2.3$  to  $-1.7$ ;  $P < .001$ ), which is driven by the effect on infants considered not well at birth (coefficient =  $-2.5$ ; 95% CI,  $-3.0$  to  $-2.1$ ;  $P < .001$ ).

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 found 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,  $-10.7$  to  $-4.1$ ;  $P < .001$ ) but not for infants considered well at birth. This is a large reduction in mortality, as the predicted (ie, 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 found 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 uses care management to reduce costs and promote health. Prior research has documented the benefits of care management for pregnant women,<sup>7-10,13,14</sup> 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 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.<sup>15</sup>

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's leadership and staff, we hypothesize that a key driver of the decline may have been better management of specialist care for those infants admitted to the neonatal ICU. Due to enhanced care management, the MCO 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. Although we do not have data that allow us to evaluate this hypothesis, we believe that the results presented here are still of importance because they highlight the potential

