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Pre-pregnancy and Early Prenatal Care are Associated with Lower Risk of Ectopic Pregnancy Complications in the Medicaid Population: 2004–08

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Abstract

Background—Ectopic pregnancy causes significant maternal morbidity and mortality.

Complications are more common among women with Medicaid or no insurance compared to those with private insurance. It is unknown whether preventive care prior to pregnancy and prenatal care, which are covered by Medicaid, would decrease complications if they were more fully utilised.

Methods—Medicaid claims were used to identify a clinical cohort of women who experienced an ectopic pregnancy during 2004–08 among all female Medicaid enrollees from a large 14-state population, ages 15–44. Diagnosis and procedure codes were used to identify ectopic pregnancies and associated complications. The primary outcomes were complications associated with ectopic pregnancy: blood transfusion, sterilisation, or hospitalisation with length of stay greater than 2 days. Independent variables were documentation of preventive care within 1 year prior to the ectopic pregnancy and prenatal care within 4 months prior.

Results—Controlling for race, age, and state of residence, women's risks of any ectopic pregnancy complication were independently higher among those who did not receive any Medicaid-covered preventive care within 1 year before the ectopic pregnancy compared to those who did (RR 1.12, 95% confidence interval (CI) 1.09, 1.16), and among those who did not receive any Medicaid-covered prenatal care within 4 months prior, compared to those who did (RR 1.89, 95% CI 1.83, 1.96).

Conclusions—Pre-pregnancy and prenatal care are independently associated with decreased risk of ectopic pregnancy complications among Medicaid beneficiaries.

Keywords

ectopic pregnancy; insurance status; preconception care; prenatal care

Ectopic pregnancy is an important cause of maternal morbidity and mortality in the US. In the most recent national surveillance, 876 deaths were attributed to ectopic pregnancy between 1980 and 2007.¹ Among women enrolled in Medicaid – the U.S. health insurance

program primarily serving people of low-income – 11% of those with an ectopic pregnancy (2004–08) experienced at least one short-term complication, including blood transfusion, hysterectomy, other sterilising procedure, or hospital length-of-stay (LOS) greater than 2 days.² These were more common among women from all racial/ethnic minority groups compared to White women.

Controlling for race/ethnicity, zip code, age, and chronic diseases, women on Medicaid are at increased risk of severe maternal morbidity at the time of delivery compared to those with private insurance.³ In the context of ectopic pregnancy, Medicaid and lack of insurance have also been associated with increased risk of adverse outcomes, such as prolonged hospitalisation⁴ and the need for surgical treatment after initiation of medical management with methotrexate.⁵

The causes of adverse maternal outcomes are complex, and we need more research to understand and deliver effective interventions that reduce maternal morbidity and mortality, especially in high-risk populations.⁶ Two related strategies that have been suggested to improve maternal outcomes are preconception care⁷ and early prenatal care.⁸ However, these interventions have not been studied specifically in relationship with ectopic pregnancy outcomes.

Clinically, it makes sense that the earlier a woman presents in the course of an ectopic pregnancy, the more options she will have for treatment (medical vs. surgical) and the lower her risk will be for complications.⁹ This intuition is supported by historical trends showing reduction in ectopic pregnancy-related mortality over time, as technology to diagnose the condition earlier in pregnancy has been developed and disseminated.^{1,10} Furthermore, women without a routine source of care are more likely to be denied timely follow-up after a diagnosis of ectopic pregnancy if they have Medicaid rather than private insurance.¹¹ A known health care provider prior to or early in pregnancy may thus improve outcomes for Medicaid beneficiaries by increasing their likelihood of getting timely care when they develop an ectopic pregnancy. Finally, care prior to pregnancy may help educate women to identify pregnancy early and to recognise symptoms of abnormal pregnancy. For these reasons, we conducted this study to test the hypothesis that women enrolled in Medicaid who developed an ectopic pregnancy would face lower risk of short-term complications if they had received preventive care in the year prior to pregnancy, or early prenatal care, or both

Methods

We received Medicaid Analytic Extract data files from the Centers for Medicare and Medicaid Services (CMS) under an approved Data Use Agreement. These data files include person-level information on Medicaid enrollees and encounter-level information for Medicaid claims from all sources of care, including inpatient, outpatient, physician services, radiology, and clinic visits. We did not examine long-term care files or pharmacy prescription claims for this study; in previous research we found these did not contribute valuable information about ectopic pregnancy.¹² The University of Chicago's Institutional

Review Board acknowledged the study as exempt from review since it constituted a secondary analysis of de-identified data.

Subjects

We analysed data from all female beneficiaries, ages 15–44 years, enrolled in Medicaid at least once during 2004–08 in Arizona, California, Colorado, Florida, Illinois, Indiana, Iowa, Louisiana, Massachusetts, Michigan, Minnesota, Mississippi, New York, or Texas. We selected these states to maximise the number of enrollees, geographic spread, and racial diversity, given that we had funding to purchase data for 14 states. Women who experienced an ectopic pregnancy during the study period were included in the study cohort. As in previous work on ectopic pregnancy complications,² we excluded women who experienced repeat ectopic pregnancies during the study period ($n = 754$, 0.8% of all ectopic pregnancy patients) to clearly delineate pre-pregnancy care for each unique episode of ectopic pregnancy.

Statistical analysis

We calculated the risk of ectopic pregnancy complication as the number of ectopic pregnancies associated with at least one complication divided by the number of total ectopic pregnancies. Ectopic pregnancies were identified as previously reported for Medicaid 2004–08 rates in these same states.¹³ For both the numerator and denominator counts, repeat ectopic pregnancy-related encounters within 9 months (270 days) were considered part of the same ectopic pregnancy. Repeat ectopic pregnancy-related encounters for the same beneficiary after 9 months were treated as a new ectopic pregnancy episode, and each ectopic pregnancy episode (in 9-month groupings of claims) was counted separately.

The primary outcome was an ectopic pregnancy with at least one of the following complications: blood transfusion, sterilisation, or hospitalisation with a length of stay greater than 2 days. Secondary outcomes were each of these complications reported individually. We identified ectopic pregnancy cases as previously described.² We searched both inpatient and outpatient claims containing the International Classification of Diseases ninth revision (ICD9) diagnosis codes and Current Procedural Terminology (CPT) codes outlined in the Table S1. Sterilisation procedures included hysterectomy, bilateral oophorectomy, bilateral salpingectomy, and bilateral salpingo-oophorectomy. Procedures commonly used for a desired end to a woman's fertility (e.g. tubal ligation and occlusion) were excluded from the complications list in an effort to minimise the risk of misclassifying desired sterilisations as complications. Hospital length-of-stay was calculated by subtracting admission dates from discharge dates.

The independent variables of interest were preventive pre-pregnancy care within 1 year before the ectopic pregnancy, and prenatal care within 4 months. We use the term “preventive pre-pregnancy care” because the data allowed us to identify preventive services and the time frame in which they occurred but did not allow us to examine whether many of the specific services recommended as part of preconception care were provided, such as counselling about healthy weight or alcohol use; however, the concept of preventive care prior to pregnancy is frequently encompassed in the term ‘preconception care’ and we do not

draw a strong distinction between these terms. The time intervals for these variables were selected based on the clinical literature showing that ectopic pregnancy presents within the first trimester of pregnancy,⁹ and on prior studies assessing yearly preventive care as a standard for routine care.¹⁴ In addition, it is clinically reasonable that preventive care and counselling within the preceding year may impact a woman's health and knowledge at the start of pregnancy. Preventive pre-pregnancy care was defined as a physical exam, Pap smear, or family planning service in the year prior to pregnancy. Prenatal care was defined as any visit coded with a diagnosis of pregnancy supervision (normal or high risk), pregnancy incidental state, or positive pregnancy test. Pre-pregnancy and prenatal care were identified using distinct ICD9 diagnosis codes with no overlap, allowing the two types of services to be assessed independently (Table S1).

We used multivariable Poisson regression models to estimate the relative risks for ectopic pregnancy complication by pre-pregnancy care and prenatal care, adjusting for demographic characteristics: age, state, and race. We used Poisson regression because the outcome was a ratio of counts: the number of ectopic pregnancies with a complication over number of total ectopic pregnancies. We examined pre-pregnancy and prenatal care in two multivariable models: first, controlling for demographic variables of race, age, and state of residence (Model 1), and second, controlling for demographic variables and also controlling for pre-pregnancy care when examining prenatal care, and for prenatal care when examining pre-pregnancy (Model 2). We also explored whether a medical history of infertility or chronic disease (diabetes, cardiovascular disease, or pulmonary disease) confounded the relationship between receiving pre-pregnancy/prenatal care and ectopic pregnancy complications. Chronic diseases and infertility were identified using ICD9 diagnosis codes (Table S1) from encounters prior to the start of the ectopic pregnancy. We constructed indicator variables to classify each beneficiary as having or not having each diagnosis (diabetes, cardiovascular disease, pulmonary disease, and infertility). We added these as independent variables to the multivariable models to assess whether they changed the direction or size of the pre-pregnancy and prenatal care effects. In a subset of beneficiaries, we also conducted exploratory analysis to assess whether the number of preventive pre-pregnancy care or prenatal care visits mattered.

Results

Among 19 135 106 women in the study population, there were 101 892 unique ectopic pregnancies, and 98 513 unique beneficiaries who experienced one ectopic pregnancy during the study period. Among all ectopic pregnancies, there were 4014 (3.9%) in which the woman required a blood transfusion, 273 in which she underwent sterilisation (0.3%), and 8729 (8.6%) involving hospitalisation longer than 2 days. Among women with one ectopic pregnancy, 28.8% (28 390) received prenatal care within 4 months prior to their ectopic pregnancy and 23.4% ($n = 23\ 037$) received pre-pregnancy care within 1-year prior (Table 1).

Women who received no preventive pre-pregnancy care within 1 year of an ectopic pregnancy were significantly more likely to experience any complication (Table 2). They were also more likely to experience a blood transfusion and a length of stay greater than 2

days than those with documentation of preventive pre-pregnancy care. They were significantly less likely to experience a sterilisation. These effects were found when controlling for race, age, and state of residence (Model 1), and also when additionally controlling for receipt of prenatal care (Model 2).

Women receiving no prenatal care within 4 months of an ectopic pregnancy were significantly more likely to experience the composite outcome (any complication) and all individual adverse outcomes (blood transfusion, sterilisation, and length of stay greater than 2 days. This effect held when controlling for race, age, and state (Model 1) and also when additionally controlling for receipt of pre-pregnancy care (Model 2).

Although women who received pre-pregnancy and prenatal care were more likely to have chronic diseases than those who did not receive these types of care, and those who received pre-pregnancy care were more likely to have an infertility diagnosis than those who did not (Table 1), these differences did not confound the relationship between receiving pre-pregnancy/prenatal care and ectopic pregnancy outcomes.

In exploratory analysis with beneficiaries from one state who experienced an ectopic pregnancy ($n = 31\,778$), the association between having any complication and receiving pre-pregnancy care was stronger for beneficiaries with 2 visits than those with just one visit. (No preventive pre-pregnancy visits vs. 2 visits RR 1.29, 95% confidence interval (CI) 1.16, 1.44. No preventive pre-pregnancy visits vs. one visit RR 1.17, 95% CI 1.09, 1.27.) Among women who received any documented preventive pre-pregnancy care in the year prior to their ectopic pregnancy, 51.5% had 2 visits. Among those who received any prenatal care within 4 months prior, 37.5% had 2 visits, and this was more strongly associated with complication risk than was receiving just one prenatal visit. (No prenatal visits vs. 2 visits RR 2.98, 95% CI 2.68, 3.32. No prenatal visits vs. one visit RR 1.88, 95% CI 1.73, 2.06).

Comment

Lack of preventive pre-pregnancy care within 1 year prior to an ectopic pregnancy, and lack of prenatal care within 4 months, were both associated with increased risk of ectopic pregnancy complication, controlling for covariates. This was true for the composite outcome (any complication) and for each individual outcome, with one exception: the relationship between pre-pregnancy care and sterilisation. In addition, the association between receiving care and reducing complications was stronger for prenatal care than for pre-pregnancy care for all outcomes, and stronger among women who had 2 visits compared to those who had just one pre-pregnancy or prenatal visit.

Previous research on the association between preconception care and pregnancy outcomes has focused on its effects on the newborn, but little has assessed effects on maternal outcomes.¹⁵ None, to our knowledge, has previously assessed its relationship with ectopic pregnancy outcomes. Models of preconception care that emphasise maternal behaviour changes such as eating nutritious foods and avoiding alcohol prior to pregnancy would not be biologically plausible to improve ectopic pregnancy outcomes. And while smoking and

sexually transmitted infections are risk factors for ectopic pregnancy, there is no evidence that in women who develop an ectopic pregnancy, reduced exposure to these risks (in response to counselling by a clinician) would improve outcomes. However, to the extent that preconception counselling includes patient education about symptoms of abnormal pregnancy such as vaginal bleeding and pelvic pain, this may prompt women to seek more timely care when complications arise and thus feasibly improve ectopic pregnancy outcomes.

Similarly, rigorous research linking prenatal care to maternal outcomes is lacking.¹⁶ While specific prenatal interventions have been shown to improve birth outcomes (such as screening for Group B streptococcus to prevent neonatal infection), in the context of ectopic pregnancy the most feasible mechanism by which prenatal care improves outcomes is likely early detection of abnormal implantation.

The strength of this study was in providing a complete picture of ectopic pregnancy in an entire 14-state population of women on Medicaid. Ectopic pregnancy is fairly rare, representing <2% of all reported pregnancies;^{13,17} and complications occur in approximately 11% of cases.² Therefore, the ability to detect factors associated with increased risk of complications requires a very large population, which this study provided. Furthermore, women on Medicaid have been identified as a population at increased risk of pregnancy-related morbidity compared to those with private insurance,³ so identifying possible opportunities to decrease their risk can provide an important public health benefit.

The study had several limitations. First, we were unable to observe the specific content of the pre-pregnancy and prenatal care. Previous research on preconception care has identified interventions that reduce risky maternal behaviours such as smoking and drinking alcohol and increase beneficial behaviours such as taking folic acid.^{18,19} Using Medicaid claims without chart review, we were unable to assess whether preventive visits prior to an ectopic pregnancy incorporated counselling on these or other factors. Second, the potential for unobserved confounding may have introduced bias. It is likely that women who do not receive preventive care have other social or biomedical risk factors for poor outcomes, and our inability to observe these and control for them may have biased the study towards overstating the relationship or even showing a relationship where none exists. However, the observed associations suggest possible mechanisms for addressing pregnancy-associated risk that deserve further study. The third limitation was our inability to observe care women received during periods when they were ineligible for Medicaid. It is possible that those we identify as receiving no pre-pregnancy or prenatal care in fact received care under private insurance or by paying out-of-pocket. However, this would likely bias our analysis towards the null hypothesis, so we do not consider it a threat to the validity of the observed association. Finally, we did not have access to data after 2008. It is possible that policy changes in recent years, including the Affordable Care Act, may have expanded the scope of preventive services that women with Medicaid receive. If these changes lead to improved pre-pregnancy health, the association between preventive care and pregnancy outcomes would likely become greater than the effect size we observed in the 2004–08 time period.

The associations we observed between lack of pre-natal and pre-pregnancy visits and increased risk of any complication, blood transfusion, and prolonged hospitalisation from an ectopic pregnancy may be due to the expected clinical benefit from these preventive visits. For example, a woman who receives pre-pregnancy or early prenatal care may be counselled by her provider about early warning signs of abnormal pregnancy, which may cause her to seek care earlier with an ectopic pregnancy and thus be less likely to haemorrhage. Access to care may also play a role in the causal pathway, with women who receive pre-pregnancy and prenatal care perhaps also more likely to have access to timely treatment for ectopic pregnancy. Other possible explanations include the confounding effects of the patient's education, family support, or other characteristics that may be associated with both receipt of pre-pregnancy/prenatal care and the risk of adverse pregnancy outcomes. Previous research has shown that women who receive preconception care are more likely to enter prenatal care early,¹⁶ so it was noteworthy that in this study, pre-pregnancy care was associated with improved outcomes even controlling for early prenatal care (Model 2). Furthermore, the strength of the association between prenatal care and improved outcomes was unanticipated. We would expect that the earlier a woman with ectopic pregnancy experiences symptoms, the less opportunity she has to seek prenatal care and also the less risk she has of bad outcomes, creating a negative bias.

The association we observed between lack of pre-pregnancy care and a *decreased* risk of sterilisation was also unexpected. In the setting of ectopic pregnancy, the procedures we identify as sterilisations – including hysterectomy, bilateral salpingectomy, etc. – are generally done only to treat severe haemorrhage and prevent the woman's death or further serious morbidity. It defies clinical reasoning to suggest that pre-pregnancy care caused women with ectopic pregnancies to experience these complications. Rather, there are several possible unobserved confounders that may play a role. For example, high-order multiparity, previous caesarean birth, and short inter-pregnancy intervals are all associated with increased risk of complications that may have necessitated a hysterectomy or salpingectomy at the time of ectopic pregnancy. These may also have caused an apparent increase in pre-pregnancy care. For example, a woman who recently gave birth may have been more likely to go to her provider for family planning, and these visits may have fallen within our broad definition of pre-pregnancy care. If these or other unobserved confounders were present, they would bias the study in favour of showing a relationship between preconception care and sterilisation that is not valid. We also cannot rule out that a portion of the procedures we identified as sterilisation complications were in fact desired sterilisations, although we excluded the common tubal ligation procedures. In general, the risk of sterilisation as an unintended complication of ectopic pregnancy deserves further study.

If pre-pregnancy and prenatal care's association with improved ectopic pregnancy outcomes can be demonstrated in future research to be causally linked, these will be among the first strategies to reduce disparities in maternal health. Given the stubborn difficulty the US has had in reducing maternal morbidity and mortality,²⁰ we believe this study provides further evidence for the importance of investing in preventive care for women.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

None of the authors have a conflict of interest

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Table 1

Characteristics of women who experienced an ectopic pregnancy, by receipt of pre-pregnancy and prenatal care

	Pre-pregnancy care within 1 year?		Prenatal care within 4 months?		Total N = 98 513
	Yes (N = 23 037)	No (N = 75 476)	Yes (N = 28 390)	No (N = 70 123)	
Race					
White, non-Hispanic	6770 (29.4%)	19 894 (26.4%)	8093 (28.5%)	18 571 (26.5%)	26 664 (27.1%)
Black, non-Hispanic	7450 (32.3%)	18 949 (25.1%)	7113 (25.1%)	19 286 (27.5%)	26 399 (26.8%)
American Indian/Alaskan Native	177 (0.8%)	474 (0.6%)	213 (0.8%)	438 (0.6%)	651 (0.7%)
Asian	590 (2.6%)	1753 (2.3%)	570 (2.0%)	1773 (2.5%)	2343 (2.4%)
Hispanic	7101 (30.8%)	30 930 (41.0%)	11 161 (39.3%)	26870 (38.3%)	38 031 (38.6%)
Native Hawaiian/Pacific Islander	131 (0.6%)	533 (0.7%)	167 (0.6%)	497 (0.7%)	664 (0.7%)
Age group					
15–24	10 361 (45.0%)	31 039 (41.1%)	13 242 (46.6%)	28 158 (40.2%)	41 400 (42.0%)
25–34	9913 (43.0%)	34 128 (45.2%)	11 948 (42.1%)	32 093 (45.8%)	44 041 (44.7%)
35–44	2763 (12.0%)	10 309 (13.7%)	3200 (11.3%)	9872 (14.1%)	13 072 (13.3%)
Chronic diseases					
Diabetes	868 (3.8%)	1740 (2.3%)	980 (3.5%)	1628 (2.3%)	2608 (2.7%)
Pulmonary	3012 (13.1%)	4784 (6.3%)	2529 (8.9%)	5267 (7.5%)	7796 (7.9%)
Cardiovascular	2000 (8.7%)	3185 (4.2%)	1685 (5.9%)	3500 (5.0%)	5185 (5.3%)
Infertility	376 (1.6%)	389 (0.5%)	240 (0.9%)	525 (0.8%)	765 (0.8%)

Table 2

The risk of ectopic pregnancy complications for those with no prenatal and no pre-pregnancy care – adjusted for race, age, and state (Model 1), and for race, age, state, and pre-pregnancy/prenatal care (Model 2)

Outcome	No pre-pregnancy care ^a		No prenatal care ^b	
	Relative Risk (95% Confidence Interval)		Relative Risk (95% Confidence Interval)	
	Model 1	Model 2	Model 1	Model 2
Any complication	1.24 (1.20, 1.29)	1.12 (1.09, 1.16)	1.93 (1.86, 2.00)	1.89 (1.83, 1.96)
Blood transfusion	1.17 (1.12, 1.21)	1.06 (1.01, 1.10)	1.87 (1.79, 1.95)	1.85 (1.77, 1.93)
Sterilisation	0.91 (0.87, 0.96)	0.85 (0.81, 0.89)	1.53 (1.45, 1.61)	1.57 (1.49, 1.66)
Length-of-stay >2 days	1.34 (1.30, 1.39)	1.21 (1.17, 1.25)	2.03 (1.95, 2.11)	1.97 (1.90, 2.05)

^aPre-pregnancy care defined as a visit with a preventive women's health service within 1 year before the ectopic pregnancy.

^bPrenatal care is defined as a visit with a prenatal care diagnosis within 4 months before the ectopic pregnancy.