



HHS Public Access

Author manuscript

J Rural Health. Author manuscript; available in PMC 2025 January 01.

Published in final edited form as:

J Rural Health. 2024 January ; 40(1): 26–63. doi:10.1111/jrh.12775.

Rural/urban differences in health care utilization and costs by perinatal depression status among commercial enrollees

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Abstract

Purpose: To understand differences in health care utilization and medical expenditures by perinatal depression (PND) status during pregnancy and 1-year postpartum overall and by rural/urban status.

Methods: We estimated differences in health care utilization and medical expenditures by PND status for individuals with an inpatient live-birth delivery in 2017, continuously enrolled in commercial insurance from 3 months before pregnancy through 1-year postpartum (study period), using MarketScan Commercial Claims data. Multivariable regression was used to examine differences by rurality.

Findings: Ten percent of commercially insured individuals had claims with PND. A smaller proportion of rural (8.7%) versus urban residents (10.0%) had a depression diagnosis ($p < 0.0001$). Of those with PND, a smaller proportion of rural (5.5%) versus urban residents (9.6%) had a depression claim 3 months before pregnancy ($p < 0.0001$). Compared with urban residents, rural residents had greater differences by PND status in total inpatient days (rural: 0.7, 95% confidence interval [CI]: 0.6–0.9 vs. urban: 0.5, 95% CI: 0.5–0.6) and emergency department (ED) visits

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CONFLICT OF INTEREST STATEMENT

No conflict of interest or financial disclosures were reported by the authors of this paper.

FINANCIAL DISCLOSURES

Lisa M. Pollack, Jiajia Chen, Shanna Cox, Feijun Luo, Cheryl L. Robbins, Heather Tevendale, Rui Li, and Jean Y. Ko have no financial disclosures.

(rural: 0.7, 95% CI: 0.6–0.9 vs. urban: 0.5, 95% CI: 0.4–0.5), but a smaller difference by PND status in the number of outpatient visits (rural: 9.2, 95% CI: 8.2–10.2 vs. urban: 13.1, 95% CI: 12.7–13.5). Differences in expenditures for inpatient services by PND status differed by rural/urban status (rural: \$2654; 95% CI: \$1823–\$3485 vs. urban: \$1786; 95% CI: \$1445–\$2127).

Conclusions: Commercially insured rural residents had more utilization for inpatient and ED services and less utilization for outpatient services. Rural locations can present barriers to evidence-based care to address PND.

INTRODUCTION

Perinatal depression (PND) affects one of seven pregnant and postpartum individuals in the United States.^{1,2} PND is defined as depression during pregnancy and after childbirth up to 12-month postpartum.³ It is an important issue because of its association with adverse health outcomes for the mother^{4,5} and child.^{6–9}

Prior research studies of comparisons of PND by rural/urban status are limited to self-reported PND¹⁰ or smaller local studies.¹¹ Risk factors for PND include obesity,^{12,13} type 2 diabetes,^{13,14} low socioeconomic status,^{13,15} and low social support,^{13,15} all of which are more prevalent among rural residents (i.e., obesity,^{16–18} type 2 diabetes,^{17,19} low socioeconomic status,¹⁸ and low social support²⁰), potentially contributing to higher risk for PND. One study using self-reported data found that residents of rural areas have a greater risk for PND than their urban counterparts (21% higher), adjusting for race, ethnicity, and maternal age; however, the association was no longer significant after further adjustment for maternal education, health insurance coverage, and Women, Infants, and Children Special Supplemental Nutrition Program (WIC) participation.¹⁰ Rural residents have less access to specialized health care than their urban counterparts (e.g., obstetric and mental health services),¹⁸ which could contribute to rural/urban health inequality in maternal and child health. Additional barriers to health care access among rural populations include lower rates of insurance coverage, health care workforce shortages, and transportation-related barriers.¹⁴ However, little is known about health care utilization patterns by rural and urban residence during the perinatal period.

Building on our previous analysis using Medicaid claims data to understand differences in health care utilization by PND status and inequities by race/ethnicity,²¹ this paper examines commercial claims data to assess inequities by rurality. The objective of this study is to estimate differences in health care utilization and medical expenditures by PND status overall and by rural/urban residence to better understand patterns of care and identify potential rural/urban inequities.

METHODS

Data

The 2016–2018 IBM MarketScan Commercial Claims and Encounters Database was used. It includes employer-sponsored private-sector health plan claims data for employees and their beneficiaries for over 150 million persons from all US states.²² It contains individual-level medical utilization, expenditures, and enrollment across inpatient, outpatient, and

prescription drug services and uses a unique identifier to follow individuals over time.²² MarketScan data are de-identified; thus, this study was not considered human subjects research by the Centers for Disease Control and Prevention and did not require Institutional Review Board approval.

Analytic cohort

We created an analytical cohort of individuals aged 15–44 years with an inpatient live-birth delivery in 2017. We excluded individuals who were not continuously enrolled in commercial insurance from 3 months before pregnancy through 1-year postpartum. Individuals with missing or unspecified gestational age information, gestational age <20 or >42 weeks at delivery, or without prescription drug coverage were also excluded from the cohort (Appendix Figure 1). Delivery hospitalizations were identified using ICD-10-CM diagnosis and procedure codes and diagnosis-related group codes, as previously described.²¹

Measures

Pregnancy episode—In alignment with our prior work,²¹ the pregnancy episode was defined from the start of the pregnancy through the delivery hospitalization discharge date. The start of pregnancy was defined as the difference between the delivery hospitalization discharge date and days of gestation, which was obtained from ICD-10-CM gestational age codes recorded during the delivery hospitalization.

Perinatal depression—PND was defined as 1 inpatient admission or 2 outpatient health care encounters 30 days apart with a diagnosis of depression based on ICD-10-CM codes during pregnancy through 1-year postpartum.^{21,23} The first documented depression diagnosis during pregnancy (by trimester) or postpartum (early postpartum [up to 6-week postpartum] or late postpartum [>6-week to 1-year postpartum]) was identified. Prevalence of depression during the 3 months prior to pregnancy was identified but not included in the definition for PND.

Outcome measures—Patient-level health care utilization and medical expenditures were measured during pregnancy through 1-year postpartum. Health care utilization included a number of inpatient admissions (including direct hospitalizations and emergency department [ED] visits resulting in hospitalization), total inpatient days from all inpatient admissions (including the delivery episode), outpatient visits (including visits to a doctor's office, hospital outpatient facility, or other outpatient facilities), ED visits not ending in inpatient admission, and weeks of drug therapy covered by a prescription (drug therapy). Inpatient claims were grouped into the same admission if individuals had 2 inpatient claims with a start date on the second claim before or equal to the end date on the earlier claim. Outpatient and ED visit claims incurred on the same day were counted as 1 outpatient and 1 ED visit.

Medical expenditures were measured by service type (inpatient, outpatient, ED, outpatient pharmaceutical) and as the sum of those services (total medical expenditures). Inpatient expenditures included the total paid to providers for patient services provided while in the hospital, payments for ED visits resulting in hospitalization, and pharmaceuticals given in a hospital setting. Outpatient or ED visits not resulting in inpatient admission

included the total paid to the provider for a service that did not occur during a period of hospitalization. Outpatient pharmaceutical payments included the total paid to the pharmacy for the prescription filled by the pharmacy (retail/mail order). All payments included the patient's deductible, coinsurance, copay, and coordination of benefit amounts. The share of the difference in the expenditure of each service type among total difference in expenditure by PND status was also reported. The medical care component of the Consumer Price Index was used to adjust all expenditures to 2018 US dollars.²⁴

Patient characteristics

Patient characteristics at the time of delivery included age (15–18, 19–24, 25–29, 30–34, 35–39, and 40–44 years), rural/urban residence (rural [nonmetropolitan statistical area, based on National Center for Health Statistics' definition for nonmetropolitan counties], urban [metropolitan/micropolitan statistical area],²⁵ and missing metropolitan statistical area), and census region as defined by MarketScan (Northeast, North Central, South, West, Unknown). Race/ethnicity data were not available in the MarketScan Commercial Claims and Encounters Database. Comorbidities were defined using ICD-10-CM codes^{21,26–28} and included diabetes (with and without complications and gestational diabetes), hypertension (chronic hypertension, maternal hypertension, gestational hypertension, preeclampsia, and eclampsia), obesity, alcohol use disorder, substance use disorder, and tobacco use. All comorbidities were identified from 3 months prior to the end of pregnancy, with the exception of comorbidities that only occur during pregnancy (hypertension with preeclampsia, hypertension complicating the puerperium, maternal hypertension, gestational hypertension, preeclampsia, eclampsia, and gestational diabetes), which were only identified during the pregnancy episode. Comorbidity was indicated when patients had 1 comorbidity diagnosis in the inpatient setting or 2 comorbidity diagnoses in the outpatient setting 30 days apart.^{26–28}

Statistical analysis

Chi-square tests were used to compare differences in proportions for categorical variables by rural/urban status. We used multivariable negative binomial regression models to estimate differences in health care utilization by PND status. We used multivariable generalized linear models with log link and gamma distribution to estimate differences in medical expenditures by PND status. For each outcome measure, we estimated both a specification that includes PND, rural/urban categories, and the interaction terms between those two variables (basic model), and a specification that further adjusts for age, comorbidities, and census region (adjusted model). All models were adjusted for age, rural/urban status, comorbidities, and census region. We used interaction terms between PND status and rural/urban categories to estimate rural-/urban-specific differences. We defined per person differences in health care utilization (or medical expenditures) by PND status as estimated differences in adjusted mean utilization (or medical expenditures) between individuals with and without PND. All expenditure analyses were restricted to individuals with fee-for-service (subsample analysis) because MarketScan does not capture capitation payments.²⁴ Health care utilization restricted to this subsample was also estimated. All statistical analyses were performed using SAS, version 9.4 or Stata, version 14.

RESULTS

Patient characteristics

A total of 254,610 commercially insured individuals aged 15–44 years had an inpatient delivery hospitalization between January 1, 2017 and December 31, 2017. The analytical cohort included 96,868 individuals after applying the exclusion criteria (Appendix Figure 1). In the descriptive analysis, most individuals lived in an urban (79%) versus rural area (11%). About 10% of the analytical cohort had been diagnosed with PND (Table 1). A smaller proportion of rural (8.7%) versus urban residents (10.0%) had been diagnosed with PND ($p < 0.0001$) (Table 1). Compared with urban residents, a greater proportion of rural residents were in the younger age groups (15–18–, 19–24–, and 25–29–year age ranges) and had hypertension, obesity, or tobacco use (Table 1). A smaller proportion of rural residents had managed care (9%) than urban residents (17%). In addition, a smaller proportion of rural versus urban residents resided in the Northeast (5.5% vs. 15.3%) or West (9.3% vs. 18.3%) regions (Table 1).

Of those with diagnosed PND, a smaller proportion of rural (5.5%) versus urban residents (9.6%) had a depression claim 3 months before pregnancy ($p < 0.0001$) (Table 2). Compared with urban residents with PND, a larger proportion of rural residents with PND had their first claim of PND during the second trimester (11.8% vs. 8.9%; $p = 0.0055$); however, no significant differences were found during other trimesters or postpartum periods (Table 2).

Adjusted estimates of differences in per person health care utilization by PND status

Compared with individuals without PND, individuals with PND had higher numbers of inpatient admissions (0.1, 95% confidence interval [CI]: 0.1–0.1), total inpatient days (0.5, 95% CI: 0.5–0.6), outpatient visits (12.6, 95% CI: 12.2–12.9), ED visits (0.5, 95% CI: 0.5–0.6), and weeks of drug therapy covered by a prescription (42.8, 95% CI: 40.8–44.8) (Table 3A; Appendix Table 1 [A2, B2, C2, D2, E2] provide multivariable regression results).

By rural/urban residence, rural residents (0.7, 95% CI: 0.6–0.9) had a greater difference by PND status in the number of total inpatient days than urban residents (0.5, 95% CI: 0.5–0.6) (Table 3B; Appendix Table 1 [A2, B2, C2, D2, E2] provides multivariable regression results). Rural residents (0.7, 95% CI: 0.6–0.9) had a greater difference by PND status in the number of ED visits than urban residents (0.5, 95% CI: 0.4–0.5). Rural residents (9.2, 95% CI: 8.2–10.2) had a smaller difference by PND status in the number of outpatient visits than urban residents (13.1, 95% CI: 12.7–13.5). (Table 3B; Appendix Table 1 [A2, B2, C2, D2, E2] provides multivariable regression results). Findings were similar in the subsample restricted to individuals with fee-for-service (Appendix Table 2). Appendix Table 1 (A3, B3, C3, D3, E3) provides the multivariable regression results.

Adjusted estimates of differences in per person medical expenditures by PND status in the subsample restricted to individuals with fee-for-service

Compared to individuals without PND, individuals with PND had higher total expenditures (\$7129; 95% CI: \$6538–\$7720) (Table 4A; Appendix Table 3 [A2, B2, C2, D2, E2] provides multivariable regression results). By service type, compared to individuals without

PND, individuals with PND had higher expenditures for inpatient services (\$1818; 95% CI: \$1525–\$2110), outpatient visits (\$3445; 95% CI: \$3057–\$3834), ED visits (\$1038; 95% CI: \$888–\$1189), and outpatient pharmaceuticals (\$878; 95% CI: \$626–\$1130).

By rural/urban residence, rural residents (\$2654; 95% CI: \$1823–\$3485) had a greater difference by PND status in inpatient expenditures than urban residents (\$1786; 95% CI: \$1445–\$2127) (Table 4B; Appendix Table 3 [A2, B2, C2, D2, E2] provides multivariable regression results).

Percent share of greater differences by PND status in medical expenditures

Overall, ignoring rural/urban residence, outpatient expenditures accounted for 48% of greater differences by PND status in total expenditures, followed by inpatient (25%), ED (15%), and prescription drug expenditures (12%) (Figure 1). By rural/urban status, inpatient expenditures accounted for 24% of greater differences by PND status in total expenditures for urban residents, whereas they accounted for 37% for rural residents. Outpatient expenditures accounted for 50% of greater differences by PND status in total expenditures for urban residents, whereas they accounted for 35% for rural residents. ED expenditures accounted for 14% of the greater differences by PND status in total expenditures for urban residents, whereas they accounted for 18% for rural residents. Prescription drug expenditures accounted for 12% of greater differences by PND status in total expenditures for urban residents and 10% for rural residents.

DISCUSSION

Principal findings

In this large, longitudinal cohort of individuals continuously enrolled in commercial insurance across the United States, individuals with diagnosed PND during pregnancy and 1-year postpartum had more health care utilization (greater numbers of inpatient admissions, total inpatient days, outpatient visits, ED visits, and weeks of drug therapy) compared with individuals without diagnosed PND, and 29% more total medical expenditures. The differences by PND status in the numbers of total inpatient days and ED visits among rural residents were higher than those among urban residents. The difference by PND status in the number of outpatient visits among rural residents was smaller than that among urban residents. Inpatient and ED expenditures accounted for greater differences by PND status in total expenditures for rural residents compared with urban residents. Outpatient and prescription drug expenditures accounted for a lesser percentage of greater differences by PND status in total expenditures for rural residents compared with urban residents.

Results of the study in the context of other observations

Prevalence of PND, overall—In our study, 10% of individuals with commercial insurance had been diagnosed with PND, in line with previously reported prevalence estimates,¹ but smaller than our estimate of PND among Medicaid recipients (17%).²¹

Prevalence of PND, by rural-urban status—The prevalence of diagnosed depression during pregnancy and 12-month postpartum was slightly higher among urban (10.0%)

versus rural residents (8.7%). This is in contrast with an older cross-sectional analysis of National Health Interview Survey (NHIS) data (1999) that found depression in the general population (in men and women) to be slightly higher among rural (6.1%) versus urban residents (5.2%). Another study among perinatal women also found a higher percentage of PND among rural residents.¹⁰ The differences in our study can be due to the use of administrative data to assess depression as compared to a validated instrument²⁹ or self-report,¹⁰ and difference in population, that is, the general population²⁹ or women with recent live birth¹⁰ as compared to a cohort of commercially insured women during the perinatal period as in our study.

In our study, we found that among individuals with diagnosed PND, a smaller proportion of rural versus urban residents had a depression claim 3 months before pregnancy. This may be due to underdiagnosis/late diagnosis of depression/health conditions in rural areas.¹⁰ Mental health/depression is underdiagnosed,³⁰ which may vary by rural status. Reduced access to mental health services, providers, and specialists are challenged to the receipt of mental health care in rural communities.^{31,32} If patients experience cost barriers, they could be less likely to seek care in general or seek consistent care for preventive services such as counseling for depression.³³

Health care utilization among those with and without PNDs—Similar to our analysis of Medicaid recipients,²¹ commercially insured individuals with PND had greater numbers of inpatient admissions, total inpatient days, outpatient visits, ED visits, and weeks of drug therapy compared with individuals without PND.

Rural versus urban residents had greater differences by PND status in the numbers of total inpatient days (42% greater) and ED visits (49% greater), and a smaller difference by PND status in the number of outpatient visits (30% smaller). These differences could suggest less access/availability to low-acuity mental health or specialty health care services as previous studies have found^{18,34} or a higher level of illness. Although a difference of less than 1 day in the hospital appears small, 1 day of inpatient care in the United States is estimated to cost nearly \$3000.³⁵ In line with our findings, authors of a study of Medicare beneficiaries, who used the Medicare Current Beneficiary Survey, Cost, and Use files from 2000 to 2010, found that compared with beneficiaries living in an urban setting, beneficiaries living in a rural setting had a greater risk of an ED visit and a lower rate of follow-up care post discharge, where follow-up care is somewhat similar to our examination of outpatient visits.³⁶ Although our analysis was not specific to mental health service use, analogous to Ziller et al., who found lower office-based mental health use among rural versus urban residents using 2003 and 2004 Medical Expenditure Panel Survey data, we found a smaller difference by PND status in the number of outpatient visits for rural versus urban residents.³⁷

Medical expenditures among those with and without PNDs—This study also measured inpatient, outpatient, ED, and outpatient pharmaceutical payments among individuals with commercial insurance during pregnancy and 1-year postpartum and found that individuals with PND had 29% more total medical expenditures than those without

PND. Similarly, in our previous study, we found that Medicaid recipients with PND had more (54%) total medical expenditures than those without PND.²¹

By residential status, rural residents had a greater difference by PND status in inpatient expenditures than urban residents (49% greater). In terms of the percent share of greater differences by PND status in total expenditures by service type, compared with urban residents, rural residents had a greater percent share for inpatient and ED services and a smaller percent share for outpatient and prescription drug services. Multiple factors may affect the differences in costs noted in our study. Increased inpatient expenditures for rural residents could be attributable to the more total inpatient days in rural areas seen in our study, including ED visits resulting in hospital admission. Rural areas have a higher percentage of maternity care deserts (counties with no hospitals/birth centers offering obstetric care and no obstetric providers), presenting barriers to perinatal care,³⁸ which could result in individuals seeking care in higher acuity settings (e.g., EDs). Increased inpatient expenditures for rural residents could also be due to rural residents being on average in poorer health than their urban counterparts (e.g., having more chronic conditions and being less physically active).³⁹ Rural areas could also lack provider plan competition, which is associated with increased costs overall compared with urban areas.^{40–42} Another possible explanation could be due to the fact that the expenditure analyses were restricted to individuals with fee-for-service (individuals with capitation payments were excluded for the expenditure analyses). A higher proportion of rural (91.3%) versus urban residents (82.7%) had fee-for-service and in general patients with fee-for-service have higher expenditures recorded in claims than patients with capitation payments. Thus, the total costs may be skewed higher in rural areas.

Addressing barriers and expanding mental health care in rural areas and opportunity to improve outcomes—These findings have implications for mental health care delivery in rural areas. Depression screening is recommended across the life course, including among the general adult population⁴³ and pregnant and postpartum women.^{3,43} Screening for depression and provision of appropriate mental health care are important for preventing and managing PND.^{3,44} To address the availability of care in rural settings, if broadband capabilities exist, telehealth offers an option to provide trained specialists who can screen, refer, and treat depression in low-resourced areas.^{18,45} Other ways to address mental health conditions in rural communities include focusing on preventive measures in community settings and educating the community about the importance of treatment and prevention⁴⁶; recruiting and retaining a quality workforce⁴⁷; engaging nontraditional mental health professionals⁴⁸; integrating mental health services into primary care⁴⁹; and providing community-based supports and services.⁵⁰ Improved screening and treatment and expanded access to health care for women who reside in rural areas could help address PND and reduce rural/urban health inequities in mental health outcomes.⁵¹

Strengths and limitations

Strengths of this study include the use of a large, claims-based database of commercially insured individuals to examine rural/urban differences in health care utilization and medical expenditure patterns by PND status. The longitudinal nature of the data, detailed health

care utilization and cost data, and focus on diagnosed depression during the perinatal period add to the existing literature of rural/urban differences in health care utilization and expenditures. Our study should be interpreted in the context of several limitations, many of which limit the generalizability of our findings. This study includes delivery hospitalizations only among commercially insured individuals and includes a subset of these individuals whose insurers have consented to be included in MarketScan data. Rural individuals are more likely to be publicly insured,⁵² and our results only apply to the segment of the rural population with commercial insurance. Other limitations include the potential misclassification of conditions based on ICD-10-CM/diagnosis-related group coding (e.g., delivery hospitalization, PND, and comorbidities). The prevalence of PND is likely underestimated in our study because more patients have depression than are diagnosed,^{30,53} even when they meet current Diagnostic and Statistical Manual criteria for major depression.³⁰ Thus, estimates for PND are likely underestimated. Because of the continuous enrollment restriction imposed from 3 months before pregnancy to the end of pregnancy, we excluded those with gaps in employment, which could potentially represent a more vulnerable group of individuals whose utilization and expenditures were unaccounted for in this analysis. In addition, comorbidities were likely underidentified because of the continuous enrollment restriction, and because some comorbidities are not well coded in administrative claims data (i.e., obesity and tobacco use). Further, we were unable to control for other important sociodemographic characteristics for which there is variation in health care utilization and cost, such as race/ethnicity because the database did not provide it. Because this analysis examined all health care utilization and expenditures by PND status versus mental health, PND-specific utilization and expenditure estimates reflect services for conditions other than depression. However, health care utilization and expenditure estimates for conditions other than depression are relevant because individuals with depression seek more medical care than others without depression.⁵⁴ Finally, this study only examined differences in medical expenditures by PND status and did not account for lower quality of life or decreased workplace productivity associated with PND.

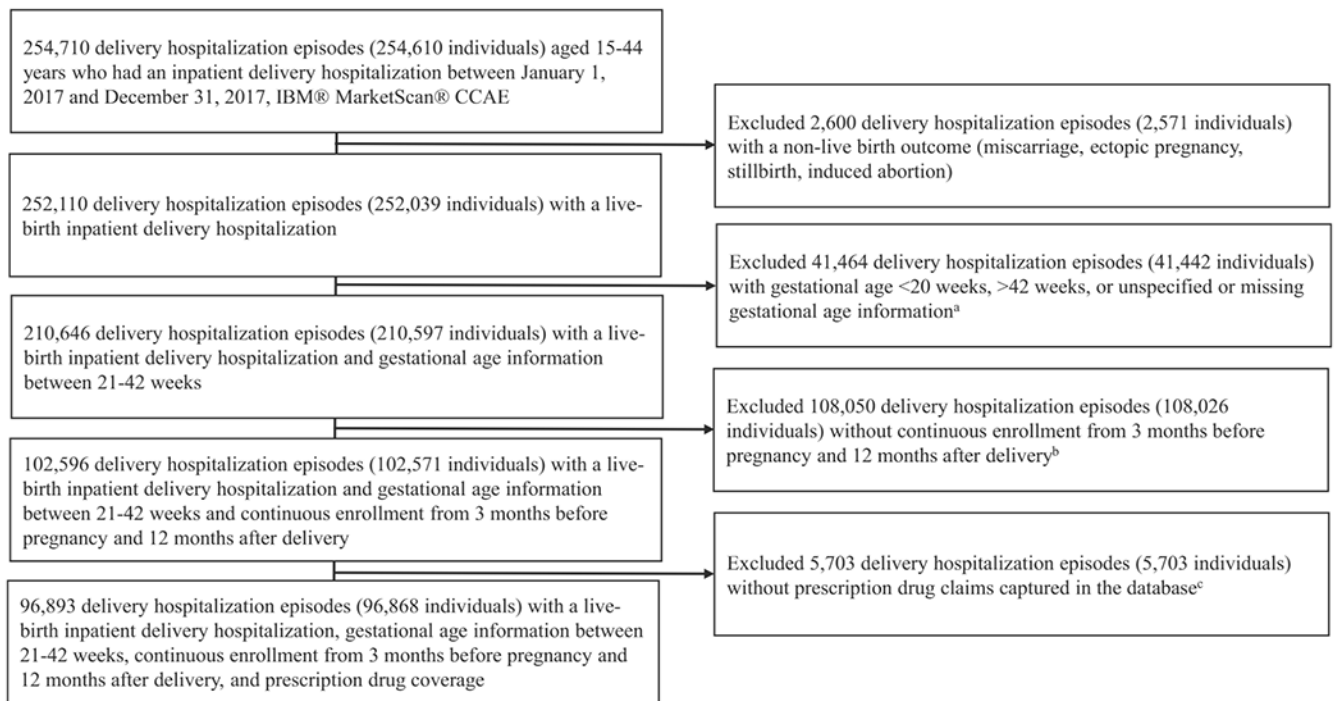
CONCLUSION

In this large, longitudinal cohort of commercially insured individuals, differences in utilization for inpatient and ED services by PND status were greater among rural versus urban residents, and differences in utilization for outpatient services by PND status were smaller among rural versus urban residents. In addition, differences in inpatient expenditures by PND status were greater among rural versus urban residents. The findings contribute to our understanding of rural/urban differences in treatment and medical expenditures by PND status. Expanding care in rural settings could potentially reduce more costly forms of health care such as inpatient and ED visits.

ACKNOWLEDGMENTS

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention, Health Resources and Services Administration, or US Department of Health and Human Services.

APPENDIX



APPENDIX FIGURE 1.

Data attrition diagram.

^aBecause the pregnancy episode was defined by gestational age, individuals with missing/unspecified ICD-10-CM codes for gestational age or individuals with gestational age information <20 or >42 weeks were excluded.

^bTo reduce measurement error from loss of follow-up, a sampling restriction was imposed of continuous enrollment in commercial insurance from at least 3 months before the beginning of the pregnancy episode through 12 months after the end of the pregnancy episode.

^cIndividuals whose insurance coverage excluded prescription drugs were excluded because outcome measures included drug therapy utilization and outpatient pharmaceutical expenditures.

TABLE 1.A1

Multivariable regression coefficients (log-scale) and 95% confidence intervals for health care utilization: Inpatient admissions (analytic cohort [basic model estimates]).

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
PND				
With PND	0.09	<0.001	0.07	0.11
Without PND	Reference	-	-	-
Metropolitan statistical area				
Rural residence	0.00	0.651	-0.03	0.02

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
Missing	0.00	0.828	-0.02	0.02
Urban residence	Reference	-	-	-
PND and metropolitan statistical area				
PND and rural residence	0.03	0.309	-0.03	0.10
PND and missing residence	-0.02	0.503	-0.08	0.04
No PND and urban residence	Reference	-	-	-
Constant	0.06	<0.001	0.05	0.07

Note: Multivariable negative binomial regression models were used to estimate differences in health care utilization by PND status.

The basic model includes PND status, rural/urban categories, and the interaction between PND status and rural/urban categories. The adjusted model further includes age, comorbidities, and region. Interaction terms between PND status and rural/urban categories were used to calculate rural-/urban-specific estimates.

Abbreviations: LCL, lower confidence limit; PND, perinatal depression; UCL, upper confidence limit.

TABLE 1.A2

Multivariable regression coefficients (log-scale) and 95% confidence intervals for health care utilization: Inpatient admissions (analytic cohort [adjusted model estimates]).

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
PND				
With PND	0.08	<0.001	0.06	0.10
Without PND	Reference	-	-	-
Metropolitan statistical area				
Rural residence	-0.01	0.244	-0.03	0.01
Missing	0.00	0.762	-0.02	0.02
Urban residence	Reference	-	-	-
PND and metropolitan statistical area				
PND and rural residence	0.03	0.356	-0.04	0.10
PND and missing residence	-0.02	0.520	-0.08	0.04
No PND and urban residence	Reference	-	-	-
Age				
15–18	0.08	0.009	0.02	0.15
19–24	0.04	<0.001	0.02	0.06
25–29	0.00	0.623	-0.01	0.02
30–34	Reference	-	-	-
35–39	0.00	0.675	-0.01	0.02
40–44	0.01	0.479	-0.02	0.04
Comorbidities				
Diabetes	0.04	0.001	0.02	0.06
Hypertension	0.05	<0.001	0.04	0.07
Obesity	0.02	0.011	0.01	0.04

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
Alcohol use disorder	0.28	<0.001	0.13	0.44
Substance use disorder	0.16	<0.001	0.09	0.22
Tobacco use	0.04	0.074	0.00	0.09
Region				
Northeast	Reference	-	-	-
North Central	-0.01	0.241	-0.03	0.01
South	0.00	0.956	-0.02	0.02
West	-0.01	0.650	-0.03	0.02
Missing	-0.01	0.947	-0.26	0.24
Constant	0.04	<0.001	0.02	0.06

Note: Multivariable negative binomial regression models were used to estimate differences in health care utilization by PND status.

The basic model includes PND status, rural/urban categories, and the interaction between PND status and rural/urban categories. The adjusted model further includes age, comorbidities, and region. Interaction terms between PND status and rural/urban categories were used to calculate rural-/urban-specific estimates.

Abbreviations: LCL, lower confidence limit; PND, perinatal depression; UCL, upper confidence limit.

TABLE 1.A3

Multivariable regression coefficients (log-scale) and 95% confidence intervals for health care utilization: Inpatient admissions (subsample restricted to individuals with fee-for-service [adjusted model estimates]).

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
PND				
With PND	0.08	<0.001	0.06	0.11
Without PND	Reference	-	-	-
Metropolitan statistical area				
Rural residence	-0.01	0.231	-0.04	0.01
Missing	0.00	0.764	-0.03	0.02
Urban residence	Reference	-	-	-
PND and metropolitan statistical area				
PND and rural residence	0.03	0.378	-0.04	0.10
PND and missing residence	-0.02	0.548	-0.08	0.04
No PND and urban residence	Reference	-	-	-
Age				
15–18	0.08	0.013	0.02	0.15
19–24	0.04	<0.001	0.02	0.07
25–29	0.01	0.573	-0.01	0.02
30–34	Reference	-	-	-
35–39	0.00	0.672	-0.01	0.02
40–44	0.01	0.660	-0.03	0.04

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
Comorbidities				
Diabetes	0.04	0.004	0.01	0.06
Hypertension	0.05	<0.001	0.03	0.07
Obesity	0.02	0.022	0.00	0.04
Alcohol use disorder	0.32	<0.001	0.16	0.48
Substance use disorder	0.15	<0.001	0.08	0.23
Tobacco use	0.03	0.174	-0.01	0.08
Region				
Northeast	Reference	-	-	-
North Central	-0.01	0.377	-0.03	0.01
South	0.00	0.947	-0.02	0.02
West	0.00	0.762	-0.03	0.02
Missing	0.03	0.856	-0.28	0.34
Constant	0.04	<0.001	0.02	0.06

Note: Multivariable negative binomial regression models were used to estimate differences in health care utilization by PND status.

The basic model includes PND status, rural/urban categories, and the interaction between PND status and rural/urban categories. The adjusted model further includes age, comorbidities, and region. Interaction terms between PND status and rural/urban categories were used to calculate rural-/urban-specific estimates.

Abbreviations: LCL, lower confidence limit; PND, perinatal depression; UCL, upper confidence limit.

TABLE 1.B1

Multivariable regression coefficients (log-scale) and 95% confidence intervals for health care utilization: Total inpatient days (analytic cohort [basic model estimates]).

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
PND				
With PND	0.21	<0.001	0.19	0.22
Without PND	Reference	-	-	-
Metropolitan statistical area				
Rural residence	-0.06	<0.001	-0.08	-0.05
Missing	-0.01	0.508	-0.02	0.01
Urban residence	Reference	-	-	-
PND and metropolitan statistical area				
PND and rural residence	0.08	0.001	0.04	0.13
PND and missing residence	-0.05	0.030	-0.09	0.00
No PND and urban residence	Reference	-	-	-
Constant	1.00	<0.001	1.00	1.01

Note: Multivariable negative binomial regression models were used to estimate differences in health care utilization by PND status.

The basic model includes PND status, rural/urban categories, and the interaction between PND status and rural/urban categories. The adjusted model further includes age, comorbidities, and region. Interaction terms between PND status and rural/urban categories were used to calculate rural-/urban-specific estimates.

Abbreviations: LCL, lower confidence limit; PND, perinatal depression; UCL, upper confidence limit.

TABLE 1.B2

Multivariable regression coefficients (log-scale) and 95% confidence intervals for health care utilization: Total inpatient days (analytic cohort [adjusted model estimates]).

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
PND				
With PND	0.17	<0.001	0.15	0.18
Without PND	Reference	-	-	-
Metropolitan statistical area				
Rural residence	-0.07	<0.001	-0.09	-0.06
Missing	-0.01	0.257	-0.02	0.01
Urban residence	Reference	-	-	-
PND and metropolitan statistical area				
PND and rural residence	0.08	0.002	0.03	0.13
PND and missing residence	-0.05	0.041	-0.09	0.00
No PND and urban residence	Reference	-	-	-
Age				
15-18	0.22	<0.001	0.17	0.26
19-24	0.08	<0.001	0.06	0.09
25-29	0.00	0.415	-0.02	0.01
30-34	Reference	-	-	-
35-39	0.04	<0.001	0.03	0.05
40-44	0.13	<0.001	0.11	0.16
Comorbidities				
Diabetes	0.15	<0.001	0.13	0.16
Hypertension	0.34	<0.001	0.33	0.35
Obesity	0.11	<0.001	0.10	0.13
Alcohol use disorder	0.64	<0.001	0.53	0.74
Substance use disorder	0.36	<0.001	0.31	0.40
Tobacco use	0.01	0.390	-0.02	0.05
Region				
Northeast	Reference	-	-	-
North Central	-0.10	<0.001	-0.12	-0.08
South	-0.06	<0.001	-0.08	-0.05
West	-0.09	<0.001	-0.11	-0.07
Missing	-0.13	0.166	-0.32	0.05
Constant	0.96	<0.001	0.94	0.97

Note: Multivariable negative binomial regression models were used to estimate differences in health care utilization by PND status.

The basic model includes PND status, rural/urban categories, and the interaction between PND status and rural/urban categories. The adjusted model further includes age, comorbidities, and region. Interaction terms between PND status and rural/urban categories were used to calculate rural-/urban-specific estimates.

Abbreviations: LCL, lower confidence limit; PND, perinatal depression; UCL, upper confidence limit.

TABLE 1.B3

Multivariable regression coefficients (log-scale) and 95% confidence intervals for health care utilization: Total inpatient days (subsample restricted to individuals with fee-for-service [adjusted model estimates]).

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
PND				
With PND	0.19	<0.001	0.17	0.21
Without PND	Reference	-	-	-
Metropolitan statistical area				
Rural residence	-0.07	<0.001	-0.09	-0.06
Missing	0.00	0.852	-0.01	0.02
Urban residence	Reference	-	-	-
PND and metropolitan statistical area				
PND and rural residence	0.07	0.007	0.02	0.12
PND and missing residence	-0.06	0.015	-0.10	-0.01
No PND and urban residence	Reference	-	-	-
Age				
15-18	0.18	<0.001	0.14	0.23
19-24	0.08	<0.001	0.07	0.10
25-29	0.00	0.928	-0.01	0.01
30-34	Reference	-	-	-
35-39	0.03	<0.001	0.02	0.05
40-44	0.11	<0.001	0.09	0.14
Comorbidities				
Diabetes	0.15	<0.001	0.13	0.17
Hypertension	0.33	<0.001	0.32	0.35
Obesity	0.12	<0.001	0.10	0.13
Alcohol use disorder	0.69	<0.001	0.58	0.79
Substance use disorder	0.36	<0.001	0.31	0.41
Tobacco use	-0.01	0.774	-0.04	0.03
Region				
Northeast	Reference	-	-	-
North Central	-0.09	<0.001	-0.11	-0.07
South	-0.07	<0.001	-0.08	-0.05
West	-0.11	<0.001	-0.13	-0.09
Missing	-0.02	0.875	-0.24	0.21
Constant	0.96	<0.001	0.94	0.97

Note: Multivariable negative binomial regression models were used to estimate differences in health care utilization by PND status.

The basic model includes PND status, rural/urban categories, and the interaction between PND status and rural/urban categories. The adjusted model further includes age, comorbidities, and region. Interaction terms between PND status and rural/urban categories were used to calculate rural-/urban-specific estimates.

Abbreviations: LCL, lower confidence limit; PND, perinatal depression; UCL, upper confidence limit.

TABLE 1.C1

Multivariable regression coefficients (log-scale) and 95% confidence intervals for health care utilization: Outpatient visits (analytic cohort [basic model estimates]).

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
PND				
With PND	0.48	<0.001	0.46	0.49
Without PND	Reference	-	-	-
Metropolitan statistical area				
Rural residence	-0.11	<0.001	-0.12	-0.10
Missing	0.02	0.005	0.01	0.03
Urban residence	Reference	-	-	-
PND and metropolitan statistical area				
PND and rural residence	-0.08	<0.001	-0.12	-0.04
PND and missing residence	-0.04	0.027	-0.07	0.00
No PND and urban residence	Reference	-	-	-
Constant	3.12	<0.001	3.12	3.13

Note: Multivariable negative binomial regression models were used to estimate differences in health care utilization by PND status.

The basic model includes PND status, rural/urban categories, and the interaction between PND status and rural/urban categories. The adjusted model further includes age, comorbidities, and region. Interaction terms between PND status and rural/urban categories were used to calculate rural-/urban-specific estimates.

Abbreviations: LCL, lower confidence limit; PND, perinatal depression; UCL, upper confidence limit.

TABLE 1.C2

Multivariable regression coefficients (log-scale) and 95% confidence intervals for health care utilization: Outpatient visits (analytic cohort [adjusted model estimates]).

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
PND				
With PND	0.46	<0.001	0.44	0.47
Without PND	Reference	-	-	-
Metropolitan statistical area				
Rural residence	-0.05	<0.001	-0.06	-0.04
Missing	0.03	<0.001	0.02	0.04
Urban residence	Reference	-	-	-
PND and metropolitan statistical area				
PND and rural residence	-0.08	<0.001	-0.12	-0.05
PND and missing residence	-0.04	0.018	-0.07	-0.01
No PND and urban residence	Reference	-	-	-

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
Age				
15-18	-0.15	<0.001	-0.19	-0.12
19-24	-0.16	<0.001	-0.17	-0.15
25-29	-0.08	<0.001	-0.09	-0.07
30-34	Reference	-	-	-
35-39	0.10	<0.001	0.10	0.11
40-44	0.23	<0.001	0.21	0.24
Comorbidities				
Diabetes	0.29	<0.001	0.27	0.30
Hypertension	0.13	<0.001	0.13	0.14
Obesity	0.12	<0.001	0.11	0.13
Alcohol use disorder	0.37	<0.001	0.28	0.46
Substance use disorder	0.29	<0.001	0.25	0.32
Tobacco use	0.02	0.054	0.00	0.05
Region				
Northeast	Reference	-	-	-
North Central	-0.12	<0.001	-0.13	-0.11
South	-0.19	<0.001	-0.20	-0.18
West	-0.13	<0.001	-0.14	-0.12
Missing	-0.15	0.020	-0.28	-0.02
Constant	3.19	<0.001	3.19	3.20

Note: Multivariable negative binomial regression models were used to estimate differences in health care utilization by PND status.

The basic model includes PND status, rural/urban categories, and the interaction between PND status and rural/urban categories. The adjusted model further includes age, comorbidities, and region. Interaction terms between PND status and rural/urban categories were used to calculate rural-/urban-specific estimates.

Abbreviations: LCL, lower confidence limit; PND, perinatal depression; UCL, upper confidence limit.

TABLE 1.C3

Multivariable regression coefficients (log-scale) and 95% confidence intervals for health care utilization: Outpatient visits (subsample restricted to individuals with fee-for-service [adjusted model estimates]).

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
PND				
With PND	0.47	<0.001	0.46	0.48
Without PND	Reference	-	-	-
Metropolitan statistical area				
Rural residence	-0.05	<0.001	-0.06	-0.04
Missing	0.02	0.006	0.00	0.03
Urban residence	Reference	-	-	-

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
PND and metropolitan statistical area				
PND and rural residence	-0.10	<0.001	-0.14	-0.06
PND and missing residence	-0.05	0.003	-0.08	-0.02
No PND and urban residence	Reference	-	-	-
Age				
15-18	-0.16	<0.001	-0.19	-0.12
19-24	-0.16	<0.001	-0.17	-0.15
25-29	-0.08	<0.001	-0.09	-0.07
30-34	Reference	-	-	-
35-39	0.11	<0.001	0.10	0.12
40-44	0.23	<0.001	0.21	0.25
Comorbidities				
Diabetes	0.29	<0.001	0.28	0.31
Hypertension	0.13	<0.001	0.12	0.14
Obesity	0.12	<0.001	0.11	0.13
Alcohol use disorder	0.40	<0.001	0.31	0.50
Substance use disorder	0.28	<0.001	0.24	0.32
Tobacco use	0.03	0.045	0.00	0.05
Region				
Northeast	Reference	-	-	-
North Central	-0.13	<0.001	-0.14	-0.11
South	-0.19	<0.001	-0.20	-0.18
West	-0.14	<0.001	-0.15	-0.13
Missing	-0.05	0.555	-0.21	0.11
Constant	3.19	<0.001	3.18	3.20

Note: Multivariable negative binomial regression models were used to estimate differences in health care utilization by PND status.

The basic model includes PND status, rural/urban categories, and the interaction between PND status and rural/urban categories. The adjusted model further includes age, comorbidities, and region. Interaction terms between PND status and rural/urban categories were used to calculate rural-/urban-specific estimates.

Abbreviations: LCL, lower confidence limit; PND, perinatal depression; UCL, upper confidence limit.

TABLE 1.D1

Multivariable regression coefficients (log-scale) and 95% confidence intervals for health care utilization: Emergency department visits (analytic cohort [basic model estimates]).

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
PND				
With PND	0.62	<0.001	0.58	0.67
Without PND	Reference	-	-	-
Metropolitan statistical area				

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
Rural residence	0.05	0.031	0.00	0.09
Missing	-0.21	<0.001	-0.25	-0.16
Urban residence	Reference	-	-	-
PND and metropolitan statistical area				
PND and rural residence	0.19	0.004	0.06	0.32
PND and missing residence	-0.03	0.570	-0.15	0.08
No PND and urban residence	Reference	-	-	-
Constant	-0.32	<0.001	-0.34	-0.31

Note: Multivariable negative binomial regression models were used to estimate differences in health care utilization by PND status.

The basic model includes PND status, rural/urban categories, and the interaction between PND status and rural/urban categories. The adjusted model further includes age, comorbidities, and region. Interaction terms between PND status and rural/urban categories were used to calculate rural-/urban-specific estimates.

Abbreviations: LCL, lower confidence limit; PND, perinatal depression; UCL, upper confidence limit.

TABLE 1.D2

Multivariable regression coefficients (log-scale) and 95% confidence intervals for health care utilization: Emergency department visits (analytic cohort [adjusted model estimates]).

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
PND				
With PND	0.51	<0.001	0.47	0.55
Without PND	Reference	-	-	-
Metropolitan statistical area				
Rural residence	-0.18	<0.001	-0.22	-0.14
Missing	-0.21	<0.001	-0.26	-0.17
Urban residence	Reference	-	-	-
PND and metropolitan statistical area				
PND and rural residence	0.14	0.018	0.02	0.26
PND and missing residence	-0.02	0.740	-0.13	0.09
No PND and urban residence	Reference	-	-	-
Age				
15-18	1.47	<0.001	1.37	1.57
19-24	1.12	<0.001	1.08	1.15
25-29	0.33	<0.001	0.30	0.36
30-34	Reference	-	-	-
35-39	-0.07	<0.001	-0.10	-0.04
40-44	0.01	0.805	-0.05	0.07
Comorbidities				
Diabetes	0.22	<0.001	0.18	0.26
Hypertension	0.29	<0.001	0.25	0.32

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
Obesity	0.43	<0.001	0.40	0.46
Alcohol use disorder	0.70	<0.001	0.41	1.00
Substance use disorder	0.43	<0.001	0.31	0.55
Tobacco use	0.64	<0.001	0.56	0.71
Region				
Northeast	Reference	-	-	-
North Central	0.06	0.003	0.02	0.10
South	0.16	<0.001	0.13	0.20
West	-0.17	<0.001	-0.22	-0.13
Missing	-0.02	0.933	-0.49	0.45
Constant	-0.83	<0.001	-0.87	-0.79

Note: Multivariable negative binomial regression models were used to estimate differences in health care utilization by PND status.

The basic model includes PND status, rural/urban categories, and the interaction between PND status and rural/urban categories. The adjusted model further includes age, comorbidities, and region. Interaction terms between PND status and rural/urban categories were used to calculate rural-/urban-specific estimates.

Abbreviations: LCL, lower confidence limit; PND, perinatal depression; UCL, upper confidence limit.

TABLE 1.D3

Multivariable regression coefficients (log-scale) and 95% confidence intervals for health care utilization: Emergency department visits (subsample restricted to individuals with fee-for-service [adjusted model estimates]).

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
PND				
With PND	0.53	<0.001	0.49	0.58
Without PND	Reference	-	-	-
Metropolitan statistical area				
Rural residence	-0.19	<0.001	-0.23	-0.15
Missing	-0.23	<0.001	-0.27	-0.19
Urban residence	Reference	-	-	-
PND and metropolitan statistical area				
PND and rural residence	0.14	0.031	0.01	0.26
PND and missing residence	-0.06	0.333	-0.18	0.06
No PND and urban residence	Reference	-	-	-
Age				
15-18	1.45	<0.001	1.34	1.55
19-24	1.09	<0.001	1.05	1.13
25-29	0.32	<0.001	0.29	0.35
30-34	Reference	-	-	-
35-39	-0.09	<0.001	-0.12	-0.05

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
40-44	-0.03	0.397	-0.10	0.04
Comorbidities				
Diabetes	0.23	<0.001	0.18	0.27
Hypertension	0.29	<0.001	0.26	0.32
Obesity	0.45	<0.001	0.42	0.49
Alcohol use disorder	0.76	<0.001	0.45	1.06
Substance use disorder	0.44	<0.001	0.31	0.57
Tobacco use	0.62	<0.001	0.54	0.70
Region				
Northeast	Reference	-	-	-
North Central	0.08	<0.001	0.03	0.12
South	0.15	<0.001	0.11	0.18
West	-0.15	<0.001	-0.19	-0.10
Missing	-0.01	0.981	-0.62	0.60
Constant	-0.81	<0.001	-0.85	-0.77

Note: Multivariable negative binomial regression models were used to estimate differences in health care utilization by PND status.

The basic model includes PND status, rural/urban categories, and the interaction between PND status and rural/urban categories. The adjusted model further includes age, comorbidities, and region. Interaction terms between PND status and rural/urban categories were used to calculate rural-/urban-specific estimates.

Abbreviations: LCL, lower confidence limit; PND, perinatal depression; UCL, upper confidence limit.

TABLE 1.E1

Multivariable regression coefficients (log-scale) and 95% confidence intervals for health care utilization: Number of weeks of drug therapy covered by a prescription (analytic cohort [basic model estimates]).

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
PND				
With PND	0.70	<0.001	0.67	0.72
Without PND	Reference	-	-	-
Metropolitan statistical area				
Rural residence	0.06	<0.001	0.03	0.08
Missing	0.07	<0.001	0.05	0.10
Urban residence	Reference	-	-	-
PND and metropolitan statistical area				
PND and rural residence	-0.05	0.201	-0.14	0.03
PND and missing residence	0.00	0.959	-0.07	0.08
No PND and urban residence	Reference	-	-	-
Constant	3.76	<0.001	3.75	3.78

Note: Multivariable negative binomial regression models were used to estimate differences in health care utilization by PND status.

The basic model includes PND status, rural/urban categories, and the interaction between PND status and rural/urban categories. The adjusted model further includes age, comorbidities, and region. Interaction terms between PND status and rural/urban categories were used to calculate rural-/urban-specific estimates.

Abbreviations: LCL, lower confidence limit; PND, perinatal depression; UCL, upper confidence limit.

TABLE 1.E2

Multivariable regression coefficients (log-scale) and 95% confidence intervals for health care utilization: Number of weeks of drug therapy covered by a prescription (analytic cohort [adjusted model estimates]).

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
PND				
With PND	0.69	<0.001	0.67	0.72
Without PND	Reference	-	-	-
Metropolitan statistical area				
Rural residence	0.08	<0.001	0.06	0.11
Missing	0.06	<0.001	0.04	0.09
Urban residence	Reference	-	-	-
PND and metropolitan statistical area				
PND and rural residence	-0.05	0.236	-0.13	0.03
PND and missing residence	-0.01	0.722	-0.09	0.06
No PND and urban residence	Reference	-	-	-
Age				
15-18	-0.38	<0.001	-0.45	-0.30
19-24	-0.30	<0.001	-0.33	-0.28
25-29	-0.12	<0.001	-0.14	-0.10
30-34	Reference	-	-	-
35-39	0.07	<0.001	0.05	0.09
40-44	0.16	<0.001	0.12	0.20
Comorbidities				
Diabetes	0.54	<0.001	0.52	0.57
Hypertension	0.33	<0.001	0.31	0.35
Obesity	0.15	<0.001	0.13	0.17
Alcohol use disorder	0.21	0.058	-0.01	0.42
Substance use disorder	0.31	<0.001	0.22	0.40
Tobacco use	0.04	0.129	-0.01	0.10
Region				
Northeast	Reference	-	-	-
North Central	0.02	0.155	-0.01	0.04
South	0.04	<0.001	0.02	0.06
West	-0.16	<0.001	-0.19	-0.14
Missing	-0.09	0.554	-0.38	0.21

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
Constant	3.66	<0.001	3.64	3.68

Note: Multivariable negative binomial regression models were used to estimate differences in health care utilization by PND status.

The basic model includes PND status, rural/urban categories, and the interaction between PND status and rural/urban categories. The adjusted model further includes age, comorbidities, and region. Interaction terms between PND status and rural/urban categories were used to calculate rural-/urban-specific estimates.

Abbreviations: LCL, lower confidence limit; PND, perinatal depression; UCL, upper confidence limit.

TABLE 1.E3

Multivariable regression coefficients (log-scale) and 95% confidence intervals for health care utilization: Number of weeks of drug therapy covered by a prescription (subsample restricted to individuals with fee-for-service [adjusted model estimates]).

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
PND				
With PND	0.71	<0.001	0.68	0.74
Without PND	Reference	-	-	-
Metropolitan statistical area				
Rural residence	0.07	<0.001	0.05	0.10
Missing	0.07	<0.001	0.05	0.10
Urban residence	Reference	-	-	-
PND and metropolitan statistical area				
PND and rural residence	-0.04	0.337	-0.13	0.04
PND and missing residence	-0.02	0.569	-0.10	0.05
No PND and urban residence	Reference	-	-	-
Age				
15-18	-0.37	<0.001	-0.45	-0.28
19-24	-0.31	<0.001	-0.33	-0.28
25-29	-0.13	<0.001	-0.15	-0.11
30-34	Reference	-	-	-
35-39	0.07	<0.001	0.05	0.09
40-44	0.17	<0.001	0.13	0.21
Comorbidities				
Diabetes	0.54	<0.001	0.51	0.57
Hypertension	0.34	<0.001	0.31	0.36
Obesity	0.15	<0.001	0.13	0.18
Alcohol use disorder	0.24	0.040	0.01	0.46
Substance use disorder	0.31	<0.001	0.21	0.40
Tobacco use	0.05	0.108	-0.01	0.11
Region				
Northeast	Reference	-	-	-

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
North Central	0.02	0.141	-0.01	0.05
South	0.05	<0.001	0.03	0.08
West	-0.15	<0.001	-0.18	-0.12
Missing	0.01	0.943	-0.36	0.38
Constant	3.65	<0.001	3.63	3.67

Note: Multivariable negative binomial regression models were used to estimate differences in health care utilization by PND status.

The basic model includes PND status, rural/urban categories, and the interaction between PND status and rural/urban categories. The adjusted model further includes age, comorbidities, and region. Interaction terms between PND status and rural/urban categories were used to calculate rural-/urban-specific estimates.

Abbreviations: LCL, lower confidence limit; PND, perinatal depression; UCL, upper confidence limit.

APPENDIX TABLE 2

Adjusted estimates of differences in mean predicted health care utilization by PND status for the subsample restricted to individuals with fee-for-service.

Predicted utilization	Overall Estimate (95% CI)	Urban Estimate (95% CI)	Rural Estimate (95% CI)
Inpatient admissions			
With PND	1.15 (1.13-1.18)	1.15 (1.13-1.18)	1.18 (1.10-1.25)
Without PND	1.06 (1.05-1.07)	1.06 (1.06-1.07)	1.05 (1.03-1.07)
Difference ^a	0.09 (0.07-0.12)^c	0.09 (0.06-0.12)	0.13 (0.05-0.21)
Total inpatient days			
With PND	3.28 (3.24-3.33)	3.30 (3.25-3.36)	3.30 (3.15-3.45)
Without PND	2.71 (2.70-2.73)	2.73 (2.72-2.75)	2.54 (2.50-2.58)
Difference ^a	0.57 (0.52-0.62)^c	0.57 (0.51-0.63)	0.76 (0.61-0.92)^c
Outpatient visits			
With PND	35.41 (35.03-35.79)	36.10 (35.66-36.54)	31.04 (29.96-32.11)
Without PND	22.46 (22.38-22.55)	22.54 (22.44-22.63)	21.45 (21.22-21.69)
Difference ^a	12.95 (12.56-13.34)^c	13.66 (13.21-14.12)	9.11 (8.07-10.15)^c
Emergency Department visits			
With PND	1.28 (1.23-1.32)	1.32 (1.27-1.38)	1.26 (1.12-1.40)
Without PND	0.74 (0.73-0.75)	0.78 (0.76-0.79)	0.64 (0.62-0.67)
Difference ^a	0.54 (0.49-0.59)^c	0.53 (0.48-0.59)	0.76 (0.59-0.94)
Drug therapy ^b			
With PND	87.77 (85.58-89.96)	86.95 (84.48-89.42)	89.60 (82.50-96.71)
Without PND	43.65 (43.28-44.02)	42.91 (42.50-43.32)	46.16 (45.03-47.29)
Difference ^b	44.12 (41.90-46.33)^c	44.11 (41.61-46.61)	42.34 (35.35-49.33)

Note: Data are presented as mean-predicted utilization (95% confidence interval). Multivariable negative binomial regression models were used to estimate differences in health care utilization by PND status, controlling for age, rural/urban, and comorbidities. Interaction terms between PND status and rural/urban categories were used to calculate urban-rural-specific estimates.

Abbreviations: CI, confidence interval; PND, perinatal depression.

^aDifference in utilization for those with PND compared with those without PND.

^bNumber of weeks of drug therapy covered by a prescription.

^cFor the overall column, boldface indicates statistical significance ($p < 0.05$) for the difference between individuals with and without PNDs (statistical significance determined from regression output for PND in Appendix Table 1). For the rural column, boldface indicates the statistical significance ($p < 0.05$) for the association of PND and utilization differing between rural and urban statuses (statistical significance determined from regression output for the interaction term between PND status and rural/urban categories in Appendix Table 1).

Source: 2016–2018 IBM MarketScan Commercial Claims and Encounters Database, restricted to individuals with fee-for-service ($N = 86,335$).

TABLE 3.A1

Multivariable regression coefficients (log-scale) and 95% confidence intervals for medical expenditures for the subsample restricted to individuals with fee-for-service: Total expenditures (basic model estimates).

Variable	Coefficient (log-scale)	<i>p</i> -Value	LCL	UCL
PND				
With PND	0.29	<0.001	0.27	0.31
Without PND	Reference	-	-	-
Metropolitan statistical area				
Rural residence	-0.19	<0.001	-0.21	-0.17
Missing	-0.10	<0.001	-0.12	-0.08
Urban residence	Reference	-	-	-
PND and metropolitan statistical area				
PND and rural residence	0.05	0.115	-0.01	0.12
PND and missing residence	-0.06	0.068	-0.11	0.00
No PND and urban residence	Reference	-	-	-
Constant	10.15	<0.001	10.15	10.16

Note: Multivariable generalized linear models with log link and gamma distribution were used to estimate differences in medical expenditures by PND status.

The basic model includes PND status, rural/urban categories, and the interaction between PND status and rural/urban categories. The adjusted model further includes age and comorbidities. Interaction terms between PND status and urban/rural categories were used to calculate urban–rural-specific estimates.

Abbreviations: LCL, lower confidence limit; PND, perinatal depression; UCL, upper confidence limit.

TABLE 3.A2

Multivariable regression coefficients (log-scale) and 95% confidence intervals for medical expenditures for the subsample restricted to individuals with fee-for-service: Total expenditures (adjusted model estimates).

Variable	Coefficient (log-scale)	<i>p</i> -Value	LCL	UCL
PND				
With PND	0.25	<0.001	0.23	0.27
Without PND	Reference	-	-	-
Metropolitan statistical area				
Rural residence	-0.12	<0.001	-0.14	-0.10
Missing	-0.11	<0.001	-0.12	-0.09

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
Urban residence	Reference	-	-	-
PND and metropolitan statistical area				
PND and rural residence	0.03	0.273	-0.03	0.10
PND and missing residence	-0.04	0.164	-0.09	0.02
No PND and urban residence	Reference	-	-	-
Age				
15-18	0.04	0.179	-0.02	0.10
19-24	0.00	0.864	-0.02	0.02
25-29	-0.05	<0.001	-0.07	-0.04
30-34	Reference	-	-	-
35-39	0.10	<0.001	0.08	0.11
40-44	0.22	<0.001	0.19	0.24
Comorbidities				
Diabetes	0.21	<0.001	0.19	0.23
Hypertension	0.18	<0.001	0.16	0.20
Obesity	0.14	<0.001	0.13	0.16
Alcohol use disorder	0.40	<0.001	0.24	0.56
Substance use disorder	0.37	<0.001	0.30	0.43
Tobacco use	0.08	<0.001	0.04	0.12
Region				
Northeast	Reference	-	-	-
North Central	-0.32	<0.001	-0.34	-0.30
South	-0.31	<0.001	-0.33	-0.30
West	-0.11	<0.001	-0.13	-0.09
Missing	0.06	0.655	-0.20	0.32
Constant	10.30	<0.001	10.27	10.30

Note: Multivariable generalized linear models with log link and gamma distribution were used to estimate differences in medical expenditures by PND status.

The basic model includes PND status, rural/urban categories, and the interaction between PND status and rural/urban categories. The adjusted model further includes age and comorbidities. Interaction terms between PND status and urban/rural categories were used to calculate urban-rural-specific estimates.

Abbreviations: LCL, lower confidence limit; PND, perinatal depression; UCL, upper confidence limit.

TABLE 3.B1

Multivariable regression coefficients (log-scale) and 95% confidence intervals for medical expenditures for the subsample restricted to individuals with fee-for-service: Inpatient expenditures (basic model estimates).

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
PND				
With PND	0.13	<0.001	0.11	0.15

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
Without PND	Reference	-	-	-
Metropolitan statistical area				
Rural residence	-0.21	<0.001	-0.23	-0.19
Missing	-0.08	<0.001	-0.10	-0.06
Urban residence	Reference	-	-	-
PND and metropolitan statistical area				
PND and rural residence	0.09	0.007	0.02	0.15
PND and missing residence	-0.04	0.125	-0.10	0.01
No PND and urban residence	Reference	-	-	-
Constant	9.67	<0.001	9.66	9.68

Note: Multivariable generalized linear models with log link and gamma distribution were used to estimate differences in medical expenditures by PND status.

The basic model includes PND status, rural/urban categories, and the interaction between PND status and rural/urban categories. The adjusted model further includes age and comorbidities. Interaction terms between PND status and urban/rural categories were used to calculate urban-rural-specific estimates.

Abbreviations: LCL, lower confidence limit; PND, perinatal depression; UCL, upper confidence limit.

TABLE 3.B2

Multivariable regression coefficients (log-scale) and 95% confidence intervals for medical expenditures for the subsample restricted to individuals with fee-for-service: Inpatient expenditures (adjusted model estimates).

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
PND				
With PND	0.11	<0.001	0.09	0.13
Without PND	Reference	-	-	-
Metropolitan statistical area				
Rural residence	-0.14	<0.001	-0.15	-0.12
Missing	-0.09	<0.001	-0.10	-0.07
Urban residence	Reference	-	-	-
PND and metropolitan statistical area				
PND and rural residence	0.08	0.006	0.02	0.14
PND and missing residence	-0.03	0.306	-0.08	0.02
No PND and urban residence	Reference	-	-	-
Age				
15-18	-0.02	0.453	-0.07	0.03
19-24	-0.04	<0.001	-0.05	-0.02
25-29	-0.05	<0.001	-0.06	-0.04
30-34	Reference	-	-	-
35-39	0.04	<0.001	0.02	0.05
40-44	0.11	<0.001	0.08	0.13

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
Comorbidities				
Diabetes	0.09	<0.001	0.07	0.11
Hypertension	0.17	<0.001	0.16	0.19
Obesity	0.10	<0.001	0.08	0.12
Alcohol use disorder	0.35	<0.001	0.20	0.50
Substance use disorder	0.19	<0.001	0.12	0.25
Tobacco use	0.00	0.988	-0.04	0.04
Region				
Northeast	Reference	-	-	-
North Central	-0.37	<0.001	-0.39	-0.35
South	-0.32	<0.001	-0.33	-0.30
West	-0.06	<0.001	-0.08	-0.05
Missing	0.10	0.397	-0.14	0.35
Constant	9.85	<0.001	9.83	9.86

Note: Multivariable generalized linear models with log link and gamma distribution were used to estimate differences in medical expenditures by PND status.

The basic model includes PND status, rural/urban categories, and the interaction between PND status and rural/urban categories. The adjusted model further includes age and comorbidities. Interaction terms between PND status and urban/rural categories were used to calculate urban-rural-specific estimates.

Abbreviations: LCL, lower confidence limit; PND, perinatal depression; UCL, upper confidence limit.

TABLE 3.C1

Multivariable regression coefficients (log-scale) and 95% confidence intervals for medical expenditures for the subsample restricted to individuals with fee-for-service: Outpatient expenditures (basic model estimates).

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
PND				
With PND	0.47	<0.001	0.42	0.51
Without PND	Reference	-	-	-
Metropolitan statistical area				
Rural residence	-0.14	<0.001	-0.18	-0.10
Missing	-0.13	<0.001	-0.17	-0.09
Urban residence	Reference	-	-	-
PND and metropolitan statistical area				
PND and rural residence	-0.06	0.374	-0.21	0.08
PND and missing residence	-0.08	0.193	-0.21	0.04
No PND and urban residence	Reference	-	-	-
Constant	8.89	<0.001	8.87	8.90

Note: Multivariable generalized linear models with log link and gamma distribution were used to estimate differences in medical expenditures by PND status.

The basic model includes PND status, rural/urban categories, and the interaction between PND status and rural/urban categories. The adjusted model further includes age and comorbidities. Interaction terms between PND status and urban/rural categories were used to calculate urban–rural-specific estimates.

Abbreviations: LCL, lower confidence limit; PND, perinatal depression; UCL, upper confidence limit.

TABLE 3.C2

Multivariable regression coefficients (log-scale) and 95% confidence intervals for medical expenditures for the subsample restricted to individuals with fee-for-service: Outpatient expenditures (adjusted model estimates).

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
PND				
With PND	0.41	<0.001	0.37	0.46
Without PND	Reference	-	-	-
Metropolitan statistical area				
Rural residence	-0.03	0.113	-0.07	0.01
Missing	-0.12	<0.001	-0.16	-0.08
Urban residence	Reference	-	-	-
PND and metropolitan statistical area				
PND and rural residence	-0.08	0.231	-0.20	0.05
PND and missing residence	-0.05	0.339	-0.17	0.06
No PND and urban residence	Reference	-	-	-
Age				
15-18	-0.15	0.014	-0.26	-0.03
19-24	-0.14	<0.001	-0.17	-0.10
25-29	-0.12	<0.001	-0.15	-0.09
30-34	Reference	-	-	-
35-39	0.21	<0.001	0.18	0.24
40-44	0.40	<0.001	0.34	0.46
Comorbidities				
Diabetes	0.33	<0.001	0.29	0.37
Hypertension	0.19	<0.001	0.15	0.22
Obesity	0.18	<0.001	0.14	0.21
Alcohol use disorder	0.54	0.001	0.20	0.87
Substance use disorder	0.55	<0.001	0.41	0.69
Tobacco use	0.11	0.008	0.03	0.20
Region				
Northeast	Reference	-	-	-
North Central	-0.28	<0.001	-0.32	-0.25
South	-0.43	<0.001	-0.47	-0.40
West	-0.19	<0.001	-0.24	-0.15
Missing	-0.12	0.647	-0.66	0.41
Constant	9.04	<0.001	9.00	9.07

Note: Multivariable generalized linear models with log link and gamma distribution were used to estimate differences in medical expenditures by PND status.

The basic model includes PND status, rural/urban categories, and the interaction between PND status and rural/urban categories. The adjusted model further includes age and comorbidities. Interaction terms between PND status and urban/rural categories were used to calculate urban–rural-specific estimates.

Abbreviations: LCL, lower confidence limit; PND, perinatal depression; UCL, upper confidence limit.

TABLE 3.D1

Multivariable regression coefficients (log-scale) and 95% confidence intervals for medical expenditures for the subsample restricted to individuals with fee-for-service: Emergency department visits expenditures (basic model estimates).

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
PND				
With PND	0.67	<0.001	0.60	0.74
Without PND	Reference	-	-	-
Metropolitan statistical area				
Rural residence	-0.10	0.001	-0.16	-0.04
Missing	-0.40	<0.001	-0.46	-0.34
Urban residence	Reference	-	-	-
PND and metropolitan statistical area				
PND and rural residence	0.19	0.072	-0.02	0.40
PND and missing residence	-0.04	0.654	-0.22	0.14
No PND and urban residence	Reference	-	-	-
Constant	7.25	<0.001	7.23	7.27

Note: Multivariable generalized linear models with log link and gamma distribution were used to estimate differences in medical expenditures by PND status.

The basic model includes PND status, rural/urban categories, and the interaction between PND status and rural/urban categories. The adjusted model further includes age and comorbidities. Interaction terms between PND status and urban/rural categories were used to calculate urban–rural-specific estimates.

Abbreviations: LCL, lower confidence limit; PND, perinatal depression; UCL, upper confidence limit.

TABLE 3.D2

Multivariable regression coefficients (log-scale) and 95% confidence intervals for medical expenditures for the subsample restricted to individuals with fee-for-service: Emergency department visits expenditures (adjusted model estimates).

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
PND				
With PND	0.55	<0.001	0.47	0.62
Without PND	Reference	-	-	-
Metropolitan statistical area				
Rural residence	-0.25	<0.001	-0.31	-0.18
Missing	-0.40	<0.001	-0.46	-0.34
Urban residence	Reference	-	-	-
PND and metropolitan statistical area				

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
PND and rural residence	0.12	0.262	-0.09	0.34
PND and missing residence	0.02	0.814	-0.17	0.21
No PND and urban residence	Reference	-	-	-
Age				
15-18	1.33	<0.001	1.13	1.52
19-24	1.04	<0.001	0.98	1.10
25-29	0.29	<0.001	0.24	0.34
30-34	Reference	-	-	-
35-39	-0.03	0.309	-0.08	0.03
40-44	0.03	0.596	-0.07	0.13
Comorbidities				
Diabetes	0.23	<0.001	0.16	0.30
Hypertension	0.28	<0.001	0.22	0.33
Obesity	0.44	<0.001	0.38	0.49
Alcohol use disorder	0.82	0.003	0.27	1.37
Substance use disorder	0.49	<0.001	0.26	0.72
Tobacco use	0.58	<0.001	0.44	0.73
Region				
Northeast	Reference	-	-	-
North Central	-0.10	0.004	-0.16	-0.03
South	0.10	0.001	0.04	0.15
West	0.03	0.377	-0.04	0.10
Missing	-0.02	0.970	-0.92	0.89
Constant	6.80	<0.001	6.74	6.85

Note: Multivariable generalized linear models with log link and gamma distribution were used to estimate differences in medical expenditures by PND status.

The basic model includes PND status, rural/urban categories, and the interaction between PND status and rural/urban categories. The adjusted model further includes age and comorbidities. Interaction terms between PND status and urban/rural categories were used to calculate urban-rural-specific estimates.

Abbreviations: LCL, lower confidence limit; PND, perinatal depression; UCL, upper confidence limit.

TABLE 3.E1

Multivariable regression coefficients (log-scale) and 95% confidence intervals for medical expenditures for the subsample restricted to individuals with fee-for-service: Outpatient pharmaceutical expenditures (basic model estimates).

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
PND				
With PND	0.50	<0.001	0.37	0.63
Without PND	Reference	-	-	-
Metropolitan statistical area				

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
Rural residence	-0.23	<0.001	-0.35	-0.12
Missing	0.03	0.652	-0.09	0.14
Urban residence	Reference	-	-	-
PND and metropolitan statistical area				
PND and rural residence	0.10	0.593	-0.28	0.48
PND and missing residence	0.08	0.647	-0.26	0.41
No PND and urban residence	Reference	-	-	-
Constant	7.16	<0.001	7.12	7.20

Note: Multivariable generalized linear models with log link and gamma distribution were used to estimate differences in medical expenditures by PND status.

The basic model includes PND status, rural/urban categories, and the interaction between PND status and rural/urban categories. The adjusted model further includes age and comorbidities. Interaction terms between PND status and urban/rural categories were used to calculate urban-rural-specific estimates.

Abbreviations: LCL, lower confidence limit; PND, perinatal depression; UCL, upper confidence limit.

TABLE 3.E2

Multivariable regression coefficients (log-scale) and 95% confidence intervals for medical expenditures for the subsample restricted to individuals with fee-for-service: Outpatient pharmaceutical expenditures (adjusted model estimates).

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
PND				
With PND	0.51	<0.001	0.37	0.65
Without PND	Reference	-	-	-
Metropolitan statistical area				
Rural residence	-0.18	0.003	-0.30	-0.06
Missing	0.02	0.784	-0.10	0.14
Urban residence	Reference	-	-	-
PND and metropolitan statistical area				
PND and rural residence	0.05	0.811	-0.36	0.45
PND and missing residence	0.08	0.658	-0.28	0.44
No PND and urban residence	Reference	-	-	-
Age				
15-18	-0.90	<0.001	-1.27	-0.53
19-24	-0.47	<0.001	-0.59	-0.36
25-29	-0.13	0.005	-0.23	-0.04
30-34	Reference	-	-	-
35-39	0.20	<0.001	0.11	0.30
40-44	0.47	<0.001	0.29	0.66
Comorbidities				
Diabetes	0.82	<0.001	0.68	0.95

Variable	Coefficient (log-scale)	p-Value	LCL	UCL
Hypertension	0.15	0.004	0.05	0.25
Obesity	0.21	<0.001	0.10	0.32
Alcohol use disorder	0.49	0.353	-0.55	1.53
Substance use disorder	0.68	0.002	0.25	1.11
Tobacco use	0.02	0.894	-0.25	0.29
Region				
Northeast	Reference	-	-	-
North Central	-0.17	0.007	-0.29	-0.05
South	-0.05	0.369	-0.16	0.06
West	-0.32	<0.001	-0.45	-0.20
Missing	0.63	0.468	-1.07	2.33
Constant	7.11	<0.001	7.01	7.22

Note: Multivariable generalized linear models with log link and gamma distribution were used to estimate differences in medical expenditures by PND status.

The basic model includes PND status, rural/urban categories, and the interaction between PND status and rural/urban categories. The adjusted model further includes age and comorbidities. Interaction terms between PND status and urban/rural categories were used to calculate urban-rural-specific estimates.

Abbreviations: LCL, lower confidence limit; PND, perinatal depression; UCL, upper confidence limit.

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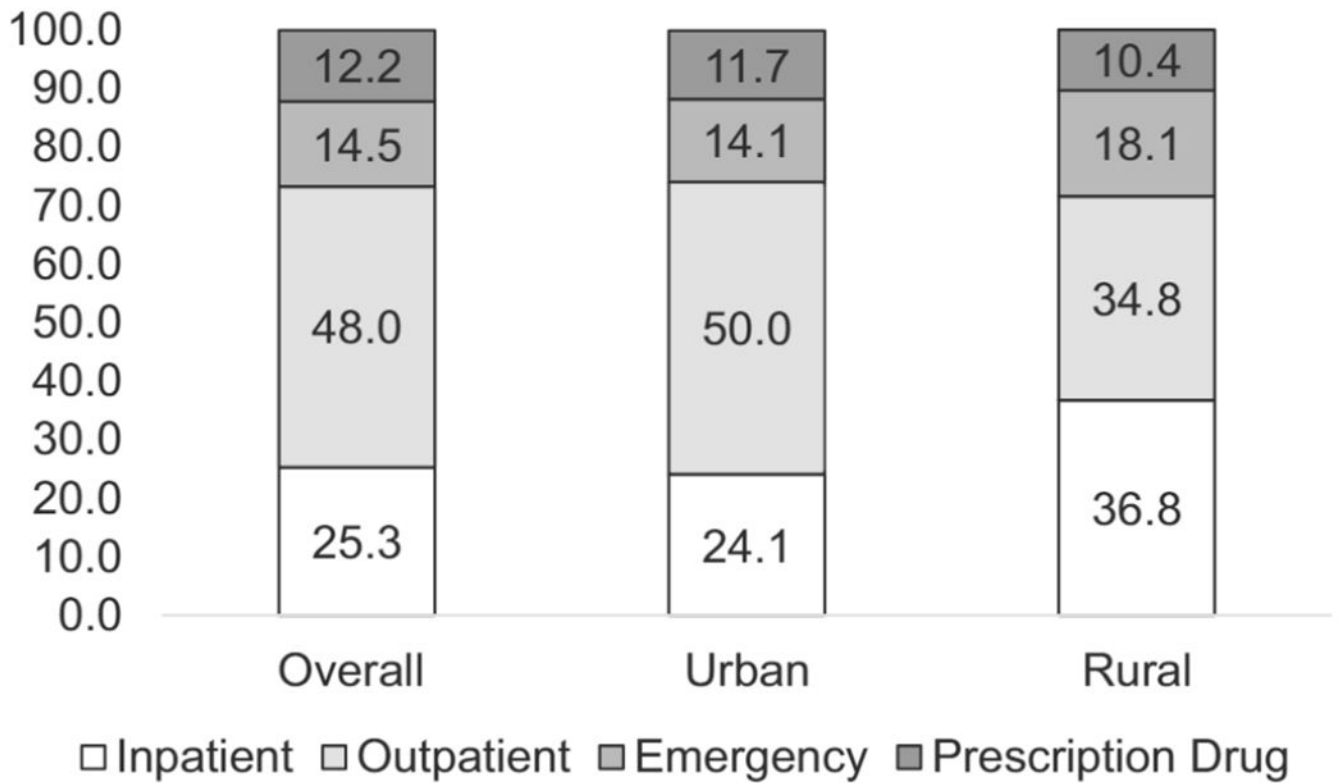


FIGURE 1. Percent share of greater differences in medical expenditures by PND status. PND, perinatal depression. *Source:* 2016–2018 IBM MarketScan Commercial Database, restricted to individuals with fee-for-service ($N = 81,926$).

Characteristics of individuals who had a live-birth inpatient delivery hospitalization in 2017 by rural/urban residence, 2016–2018 IBM MarketScan CCAE.

TABLE 1

Characteristics	<u>All^a N = 96,868</u>		<u>Urban n = 76,114</u>		<u>Rural n = 10,221</u>		p-Value ^b
	N	%	N	%	N	%	
Perinatal depression	9685	10.0	7607	10.0	884	8.7	<0.0001
Age (years)							
15–18	886	0.9	645	0.9	173	1.7	<0.0001
19–24	12,510	12.9	9170	12.1	2322	22.7	<0.0001
25–29	22,897	23.6	16,835	22.1	3217	31.5	<0.0001
30–34	36,648	37.8	29,395	38.6	3054	29.9	<0.0001
35–39	19,910	20.6	16,628	21.9	1250	12.2	<0.0001
40–44	4017	4.2	3441	4.5	205	2.0	<0.0001
Comorbidity							
Diabetes	7490	7.7	5965	7.8	721	7.1	0.0054
Hypertension	14,222	14.7	10,752	14.1	1814	17.8	<0.0001
Obesity	12,450	12.9	9726	12.8	1377	13.5	0.0491
Alcohol use disorder	108	0.1	82	0.1	11	0.1	0.9974
Drug use disorder	679	0.7	525	0.7	83	0.8	0.1650
Tobacco use	1685	1.7	1151	1.5	361	3.5	<0.0001
Payment plan							
Fee-for-service	81,926	84.6	62,952	82.7	9328	91.3	<0.0001
Managed care	14,942	15.4	13,162	17.3	893	8.7	
Region ^c							
Northeast	13,810	14.3	11,632	15.3	557	5.5	<0.0001
North Central	21,308	22.0	16,976	22.3	2826	27.7	<0.0001
South	45,483	47.0	33,580	44.1	5885	57.6	<0.0001
West	16,210	16.7	13,925	18.3	953	9.3	<0.0001

Abbreviation: CCAE, Commercial Claims and Encounters.

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^aIncludes cases that were missing rural/urban status.

^bComparing those by rural/urban status (comparison excludes missing metropolitan statistical area status; $n = 10,533$, 10.9%).

^cUnknown category for region ($n = 57$) not reported in Table 1.

TABLE 2

Prior depression diagnosis and first PND claim among individuals with diagnosed PND by rural/urban residence.

	<u>All N = 8491</u>		<u>Urban n = 7607</u>		<u>Rural n = 884</u>		<i>p</i> -Value ^b
	N	%	N	%	N	%	
Prior depression ^a	779	9.2	730	9.6	49	5.5	<0.0001
First PND claim							
First trimester	2040	24.0	1832	24.1	208	23.5	0.7153
Second trimester	782	9.2	678	8.9	104	11.8	0.0055
Third trimester	3285	38.7	2964	39.0	321	36.3	0.1254
Early postpartum	455	5.4	408	5.4	47	5.3	0.9534
Late postpartum	1929	22.7	1725	22.7	204	23.1	0.7880

Note: Subsample restricted to individuals with PND and without missing rural/urban residence.

^aDepression claim noted in the 3 months before pregnancy.

^bComparing those with PND by rural/urban status.

^cSingle joint chi-square test for first PND claim.

TABLE 3A

Estimates from the basic model and adjusted model of mean predicted health care utilization among individuals with and without diagnosed PND: Overall.

Predicted utilization	Overall	
	Basic model estimate (95% CI)	Adjusted model estimate (95% CI)
Inpatient admissions		
With PND	1.2 (1.1–1.2)	1.2 (1.1–1.2)
Without PND	1.1 (1.1–1.1)	1.1 (1.1–1.1)
Difference ^a	0.1 (0.1–0.1)^c	0.1 (0.1–0.1)^c
Total inpatient days		
With PND	3.3 (3.3–3.4)	3.2 (3.2–3.3)
Without PND	2.7 (2.7–2.7)	2.7 (2.7–2.7)
Difference ^a	0.6 (0.6–0.7)^c	0.5 (0.5–0.6)^c
Outpatient visits		
With PND	35.8 (35.4–36.1)	35.1 (34.8–35.4)
Without PND	22.5 (22.4–22.6)	22.5 (22.5–22.6)
Difference ^a	13.3 (12.9–13.7)^c	12.6 (12.2–12.9)^c
Emergency department visits		
With PND	1.4 (1.3–1.4)	1.3 (1.2–1.3)
Without PND	0.7 (0.7–0.7)	0.8 (0.8–0.8)
Difference ^a	0.7 (0.6–0.7)^c	0.5 (0.5–0.6)^c
Drug therapy ^b		
With PND	86.6 (84.6–88.6)	86.3 (84.3–88.2)
Without PND	43.4 (43.1–43.8)	43.5 (43.1–43.8)
Difference ^a	43.1 (41.1–45.1)^c	42.8 (40.8–44.8)^c

TABLE 3B

Estimates from the basic model and adjusted model of mean predicted health care utilization among individuals with and without diagnosed PND: By rural/urban residence.

Predicted utilization	Urban		Rural	
	Basic model estimate (95% CI)	Adjusted model estimate (95% CI)	Basic model estimate (95% CI)	Adjusted model estimate (95% CI)
Inpatient admissions				
With PND	1.2 (1.1–1.2)	1.2 (1.1–1.2)	1.2 (1.1–1.3)	1.2 (1.1–1.2)
Without PND	1.1 (1.1–1.1)	1.1 (1.1–1.1)	1.1 (1.0–1.1)	1.1 (1.0–1.1)
Difference ^a	0.1 (0.1–0.1)	0.1 (0.1–0.1)	0.1 (0.1–0.2)	0.1 (0.1–0.2)
Total inpatient days				
With PND	3.3 (3.3–3.4)	3.21 (3.2–3.3)	3.4 (3.3–3.6)	3.3 (3.1–3.4)
Without PND	2.7 (2.7–2.7)	2.7 (2.7–2.8)	2.6 (2.5–2.6)	2.6 (2.5–2.6)
Difference ^a	0.6 (0.6–0.7)	0.5 (0.5–0.6)	0.9 (0.7–1.0)	0.7 (0.6–0.9)^c
Outpatient visits				
With PND	36.5 (36.1–36.9)	35.6 (35.2–36.0)	30.2 (29.2–31.2)	31.2 (30.2–32.2)
Without PND	22.7 (22.6–22.8)	22.6 (22.5–22.7)	20.4 (20.2–20.6)	21.5 (21.3–21.7)
Difference ^a	13.8 (13.4–14.3)	13.1 (12.7–13.5)	9.8 (8.8–10.9)^c	9.2 (8.2–10.2)^c
Emergency department visits				
With PND	1.4 (1.3–1.4)	1.3 (1.2–1.3)	1.7 (1.5–1.9)	1.2 (1.1–1.4)
Without PND	0.7 (0.7–0.7)	0.8 (0.8–0.8)	0.8 (0.7–0.8)	0.6 (0.6–0.7)
Difference ^a	0.6 (0.6–0.7)	0.5 (0.4–0.5)	1.0 (0.8–1.2)^c	0.7 (0.6–0.9)^c
Drug therapy ^b				
With PND	85.8 (83.6–88.1)	85.5 (83.3–87.7)	86.0 (79.5–92.5)	88.3 (81.8–94.9)
Without PND	42.8 (42.5–43.2)	42.8 (42.4–43.1)	45.3 (44.3–46.4)	46.5 (45.4–47.5)
Difference ^a	43.0 (40.8–45.3)	42.7 (40.5–44.9)	40.7 (34.0–47.3)	41.0 (34.5–47.5)

Note: Data are presented as mean-predicted utilization (95% confidence interval). Multivariable negative binomial regression models were used to estimate differences in health care utilization by PND status. The basic model includes PND status, rural/urban categories, and the interaction between PND status and rural/urban categories. The adjusted model further includes age, comorbidities, and region. Interaction terms between PND status and rural/urban categories were used to calculate rural-/urban-specific estimates.

Abbreviations: CI, confidence interval; PND, perinatal depression.

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β_2 Difference in utilization for those with PND compared with those without PND.

q Number of weeks of drug therapy covered by a prescription.

γ_1 For panel A, boldface indicates statistical significance ($p < 0.05$) for the difference between individuals with and without PNDs (statistical significance determined from regression output for PND in Appendix Table 1). For panel B, boldface indicates the statistical significance ($p < 0.05$) for the association of PND and utilization differing between rural and urban statuses (statistical significance determined from regression output for the interaction term between PND status and rural/urban categories in Appendix Table 1).

Source: 2016–2018 IBM MarketScan Commercial Claims and Encounters Database ($N = 96,868$).

Subsample analysis of estimates from the basic model and adjusted model of mean-predicted medical expenditures (2018 US Dollars) among individuals with and without diagnosed PND: Overall.

TABLE 4A

Predicted expenditure	Overall	
	Basic model estimate (95% CI)	Adjusted model estimate (95% CI)
Total		
With PND	33,238 (32,605–33,870)	32,140 (31,569–32,712)
Without PND	24,917 (24,762–25,073)	25,011 (24,863–25,159)
Difference ^a	8321 (7669–8972)^b	7129 (6538–7720)^b
Inpatient		
With PND	17,482 (17,173–17,791)	17,173 (16,892–17,453)
Without PND	15,329 (15,240–15,418)	15,355 (15,272–15,438)
Difference ^a	2153 (1831–2475)^b	1818 (1525–2110)^b
Outpatient visits		
With PND	10,954 (10,516–11,391)	10,469 (10,089–10,848)
Without PND	6983 (6892–7075)	7023 (6937–7110)
Difference ^a	3970 (3523–4417)^b	3445 (3057–3834)^b
Emergency department visits		
With PND	2681 (2522–2839)	2410 (2261–2559)
Without PND	1342 (1316–1367)	1372 (1339–1404)
Difference ^a	1339 (1178–1500)^b	1038 (888–1189)^b
Outpatient pharmaceutical		
With PND	2122 (1895–2349)	2148 (1898–2397)
Without PND	1264 (1219–1308)	1269 (1217–1322)
Difference ^a	858 (627–1089)^b	878 (626–1130)^b

TABLE 4B

Subsample analysis of estimates from the basic model and adjusted model of mean-predicted medical expenditures (2018 US Dollars) among individuals with and without diagnosed PND: By rural/urban residence.

Predicted expenditure	Urban		Rural	
	Basic model estimate (95% CI)	Adjusted model estimate (95% CI)	Basic model estimate (95% CI)	Adjusted model estimate (95% CI)
Total				
With PND	34,318 (33,577–35,060)	32,956 (32,291–33,621)	30,072 (28,249–31,894)	30,262 (28,551–31,973)
Without PND	25,715 (25,532–25,898)	25,628 (25,457–25,800)	21,346 (20,955–21,738)	22,725 (22,330–23,121)
Difference ^a	8603 (7839–9367)	7384 (6691–8077)	8725 (6861–10,590)	7140 (5482–8797)
Inpatient				
With PND	17,971 (17,609–18,333)	17,500 (17,176–17,824)	15,841 (14,947–16,735)	16,522 (15,665–17,379)
Without PND	15,818 (15,713–15,922)	15,726 (15,630–15,823)	12,793 (12,575–13,011)	13,709 (13,490–13,928)
Difference ^a	2154 (1777–2530)	1786 (1445–2127)	3048 (2128–3968)^b	2654 (1823–3485)^b
Outpatient visits				
With PND	11,456 (10,936–11,975)	10,783 (10,340–11,226)	9341 (8154–10,529)	9678 (8566–10,791)
Without PND	7196 (7088–7303)	7139 (7040–7237)	6256 (6015–6496)	6925 (6678–7171)
Difference ^a	4260 (3730–4790)	3699 (3239–4159)	3086 (1874–4297)	2508 (1475–3541)
Emergency department visits				
With PND	2767 (2584–2951)	2541 (2364–2718)	3027 (2464–3590)	2244 (1809–2679)
Without PND	1412 (1381–1443)	1470 (1432–1509)	1277 (1205–1349)	1148 (1080–1217)
Difference ^a	1356 (1169–1542)	1046 (872–1221)	1749 (1182–2317)	1305 (781–1829)
Outpatient pharmaceutical				
With PND	2124 (1865–2383)	2149 (1866–2432)	1863 (1226–2500)	1887 (1196–2579)
Without PND	1290 (1239–1342)	1289 (1230–1348)	1020 (915–1126)	1078 (955–1200)
Difference ^a	834 (569–1098)	866 (577–1155)	842 (196–1488)	747 (102–1392)

Note: Data are presented as mean predicted expenditure (95% confidence interval). Multivariable generalized linear models with log link and gamma distribution were used to estimate differences in medical expenditures by PND status. The basic model includes PND status, rural/urban categories, and the interaction between PND status and rural/urban categories. The adjusted model further includes age and comorbidities. Interaction terms between PND status and urban/rural categories were used to calculate urban-rural specific estimates.

Abbreviations: CI, confidence interval; PND, perinatal depression.

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^gDifference in utilization for those with PND compared with those without PND.

^hFor panel A, boldface indicates statistical significance ($p < 0.05$) for the difference between individuals with and without PND (statistical significance determined from regression output for PND in Appendix Table 3). For panel B, boldface indicates the statistical significance ($p < 0.05$) for the association of PND and utilization differing between rural and urban status (statistical significance determined from regression output for the interaction term between PND status and rural/urban categories in Appendix Table 3).

Source: 2016–2018 IBM MarketScan Commercial Claims and Encounters Database, subsample restricted to individuals with fee-for-service ($N = 81,926$).