Appendix

Appendix A. List of ICD Codes Used to Identify Deliveries

Normal Delivery / Single Live-Born	O80, V3000, V3900, V3400, V3001, V270, 650, 65101, 65111, 65121, 65131, 65133, 65141, 65151, 65161, 65171, 65181, 65191, V277, V276, V276, V3700, V3601, V3600, V3500, V3501, V3400, V3401, V3300, V3301, V3100, V3101, V3900, V3901, V3000, V3001, V3901, V3900, 65181, 64420, 64421, 65171, 65161, 65151, 65141, 65131, 65221, 65101
Multiple Gestation	650.xx, V3100, V3101, V3201, V3301, V311, V312, V321, V322, V331, V332, V3400, V3401, V3500, V3501, V3600, V3601, V3700, V3701, V272, V273, V274, V275, V276, V277, V279, Z37.xx, Z38.xx
Early Delivery	64421, O6012X0, O6013X0, O6014X0
Outcome of Delivery (2013 ICD-9 codes)	V301, V302, V311, V312 V391, V392, V279, V275, V271, V270, V3900, V332, V331, V322, V321, V312, V311, V392, V391, V301, 65191, V341, V361, V362, V371, V372, V391, V392, V270, V271, V272, V273, V274

Appendix B. Sample Inclusion Criteria for Analysis of Postnatal Medicaid Coverage Outcomes

Our primary analyses exclude women who deliver in the latter six months of 2015. Those who deliver in the latter six months of 2013 constitute a transitional period that spans the date of expansion in Colorado. Appendix Exhibit B1 compares the observed characteristics of those who delivered in the first six months of each year to those who delivered in the latter six months of each year. We examine area-level characteristics drawn from the American Community Survey (2013). Area-level demographics were matched to ZIP Codes in Colorado and the level of the Small, Health Area in Utah.

Only age and the percent graduating high school (at the ZIP Code level) were significantly different across the first and last half of the year in Colorado, and the magnitude of the differences were small. This comparison provides evidence that our decisions to designate those who deliver in the last six months of 2013 as a transitional group and to exclude those who deliver in the last six months of 2015 do not, on the whole, introduce bias or reduce generalizability.

Appendix Exhibit B1. Comparing demographics between women who delivered in the first six months of the year to those who delivered in the latter six months of the year

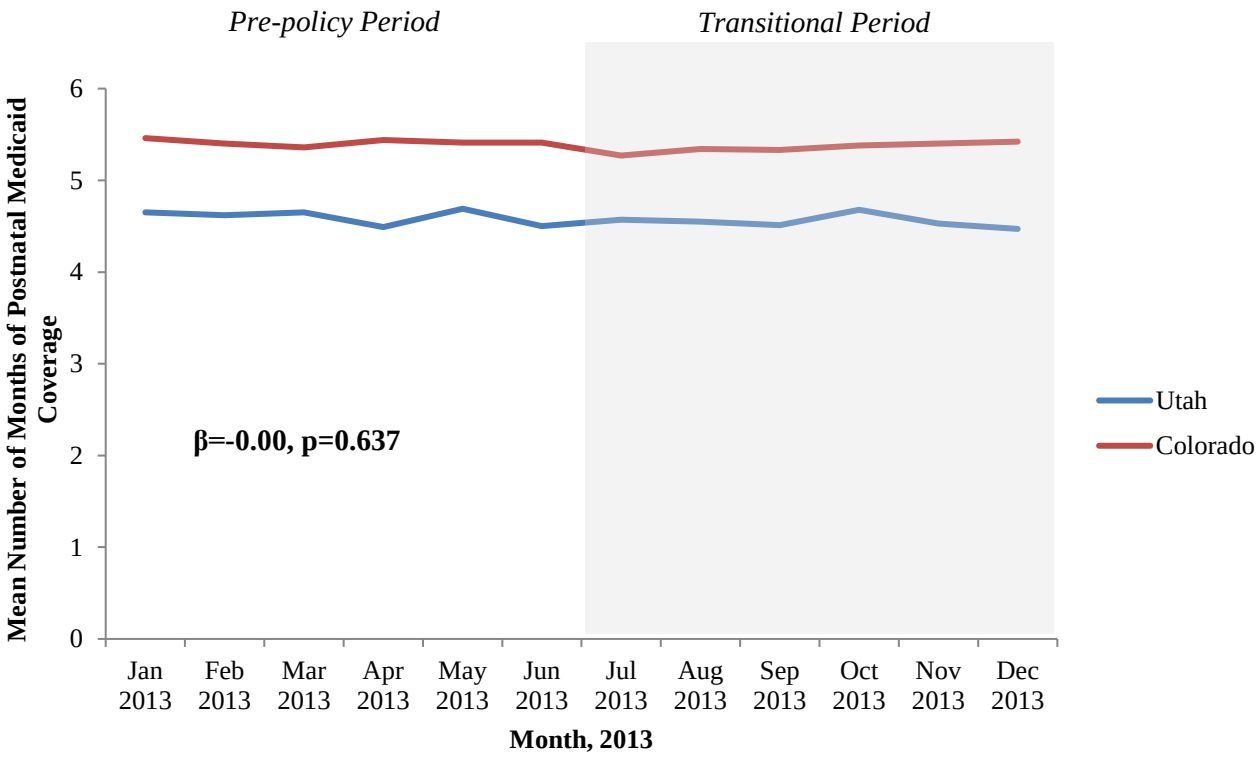
Variable	Colorado			Utah		
	Jan-Jun	Jul-Dec	P-Value	Jan-Jun	Jul-Dec	P-Value
Age (years), %						
19-24	41.5	40.8		41.3	40.5	
25-39	57.0	57.2		57.1	57.8	
40-53	1.5	2.0	<.001	1.5	1.7	.261
Area-Level Characteristics						
White, %	79.3	79.9	.089	85.2	85.1	.703
Black, %	5.7	5.4	.103	1.2	1.2	.886
Asian, %	2.6	2.5	.118	2.1	2.1	.353
Hispanic/Latino, %	29.5	29.2	.137	16.2	16.2	.729
Unemployed, %	6.6	6.5	.418	5.3	5.3	.827
Income below the Federal Poverty Level, %	12.9	12.8	.101	11.8	11.8	.825
Mean Regional Median Household Income	$52,998	$53,036	.808	$56,523	$56,230	.169
Graduated High School, %	85.3	85.5	.044	88.3	88.2	.463
Graduated College, %	27.8	27.8	.958	28.4	28.1	.062
Rural, %	11.0	11.3	.251	10.7	10.8	.929

Appendix C. Assessment of 2013 Outcome Trends in Medicaid Enrollment and Outpatient Utilization

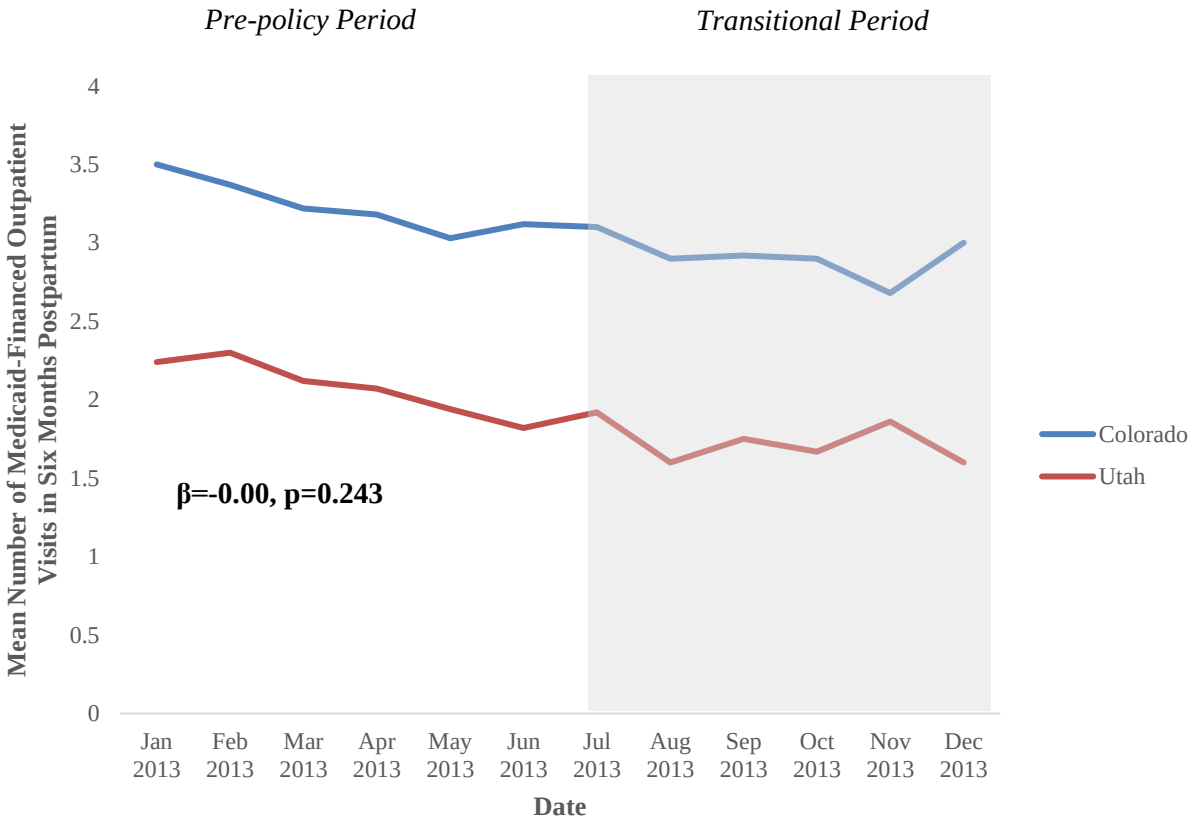
To assess whether postnatal Medicaid coverage trends were parallel during 2013, we plotted the mean number of months of postnatal coverage per delivery month over the 12 months of calendar year 2013 and tested trends in postnatal coverage over the first six months. These trends are depicted in Appendix Exhibit C1, with the transitional latter six months of 2013 highlighted in gray. A test for differential trends in postnatal coverage across states over the six months of 2013 was non-significant (β=-0.00, 95% CI: [-0.00, 0.00]).

Similarly, to assess whether trends in the number of outpatient visits in the six months after delivery were parallel prior to expansion, we plotted the mean number of outpatient visits per delivery month over the twelve months of 2013, shown in Appendix Exhibit C2. Trends in the number of postnatal visits in Colorado and Utah were not significantly different over the first six months of 2013 (β=-0.00, 95% CI: [-0.01, .00]).

Appendix Exhibit C1. Mean number of months of postnatal Medicaid coverage January-December of 2013 in Colorado and Utah



Appendix Exhibit C2. Mean number of outpatient visits during the postnatal period January-December of 2013 in Colorado and Utah



Implementing a Robustness Test Using a 2013 Placebo Policy Change

To further test the robustness of our results in response to the Medicaid expansion policy change, we implemented a sensitivity analysis by generating a placebo policy change that occurred July 1, 2013. We excluded those who delivered in the last three months of 2013 as their postnatal period spanned the actual policy change in January of 2014 and excluded those who delivered in April-June of 2013 as their postnatal period spanned the placebo policy change. We then reestimated the primary difference-in-differences models. We did not find a significant effect of the placebo policy for postnatal coverage (β=-0.01, p=.457) or utilization (β=-0.07, p=.354).

Appendix Exhibit C3. Difference-in-Differences Results of July 1, 2013 Placebo Policy Change on Postnatal Coverage and Outpatient Utilization, Colorado and Utah

	(1) Medicaid Coverage	(2) Outpatient Utilization
Colorado	0.05***	0.88***
	(.008)	(.068)
Placebo Policy Change	0.01	-0.23*
	(.019)	(.099)
Colorado * Placebo Policy Change	-0.01	-0.07
	(.014)	(.095)
Sample Size, N	13,726	13,726

Notes: Models controlled for area-level fixed effects, month of delivery, and age.

Appendix D. List of ICD Codes Used to Identify Severe Maternal Morbidity

We identified women who experienced severe maternal morbidity using ICD-9 and 10 codes present on the date of delivery. We used codes present from the date of delivery only because these conditions are more likely to be acute and not chronic. Therefore, they are less likely to be responsive to improvements in prenatal care associated with expansion, which may increase the detection of comorbid conditions.

Appendix Exhibit D1. List of ICD-9 and ICD-10 codes used to identify women who experienced severe maternal morbidity

Severe Maternal Morbidity	ICD-9	ICD-10
AMI	410.xx	I21.09, I21.19, I21.11, I21.29, I21.4, I21.3
Acute Renal Failure	584.xx, 669.3x	N170, N171, N172, N178, N179, O90.4
Adult respiratory distress syndrome	518.5x, 518.81, 518.82, 518.84,799.1	J95.821, J96.00, J95.1, J95.2, J95.3, J95.822, J96.20, J80, R09.2
Amniotic fluid embolism	673.1x: 0, 11, 12, 13, 14	O88.119, O88.111-O88.113, O88.12, O88.13
Aneurysm	441.1, 441.2, 441.3, 441.4, 441.5, 441.6, 441.7, 441.9	I71.1, I71.2, I71.3, I71.4, I71.8, I71.5, I71.6, I71.9
Cardiac Arrest/Ventricular Fibrillation	427.41, 427.42, 427.5	I49.01, I49.02, I46.9
Complications during procedure or surgery	669.4x: 40, 41, 42, 43, 44, 997.1	O75.4, I97.710, I97.790, I97.88, I97.89
Disseminated Intravascular Coagulation	286.6, 286.9, 666.3x: 30, 32, 34	D65, D68.8, D68.9, O72.3
Puerperial Cerebrovascular Disorders	430, 431, 432.0, 432.1, 432.9, 433.00, 433.01, 434.01, 434.00, 436, 437.0, 437.1, 437.2, 437.3, 437.4, 437.5, 437.6, 437.7, 437.8, 437.9, 671.50, 671.51, 671.52, 671.53, 671.54, 674.01, 674.02, 674.03, 674.04, 997.2, 999.2	I60.9, I61.9, I62.1, I62.00, I62.9, I65.1, I63.22, , I66.09, I66.19, I66.29, I63.30, I67.89, I67.2, I67.81, I67.4, I67.1, I67.7, I67.5, I67.6, G45.4, I67.89, I67.9, O22.50, O22.51, O22.52, O22.53, O22.91, O22.92, O22.93, O87.3, O99.411, O99.412, O99.413, O99.42, O99.43, T81.719A, T81.72XA, T80.1XXA
Pulmonary Edema	428.1, 518.4	I50.1, J81.0
Sepsis	038.0, 038.2, 038.3, 038.8, 038.9, 995.91, 995.92	A40.9, A40.3, A41.4, A41.89, A41.9, R65.20
Severe Anesthesia Complications	668.00, 668.01, 668.02, 668.03, 668.04, 668.10, 668.11, 668.12, 668.13, 668.14, 668.20, 668.21, 668.22, 668.23, 668.24	O74.1, O89.09, O74.2, O89.1, O74.3, O89.2
Shock	669.10, 669.11, 669.12, 669.13, 669.14, 785.50, 785.51, 785.52, 785.59, 995.0, 995.4, 998.00, 998.01, 998.02, 998.09	O75.1, R57.9, R57.0, R65.21, R57.1, R57.8, T78.2XXA, T81.10XA, T81.19XA

Sick Cell Anemia with Crisis	282.62, 282.64, 282.69	D57.00, D57.219, D57.819
Thrombotic Embolism	415.11, 415.12, 415.13, 415.19, 673.00, 673.01, 673.02, 673.03, 673.04, 673.20, 673.21, 673.22, 673.23, 673.24, 673.30, 673.31, 673.32, 673.33, 673.34, 673.80, 673.81, 673.82, 673.83, 673.84	T80.0XXA, T81.718A, T81.72XA, T82.817A, T82.818A, I26.90, I26.99, I26.92, O88.019, O88.011, O88.012, O88.013, O88.02, O88.03, O88.219, O88.22, O88.23, O88.211, O88.212, O88.213, O88.319, O88.311, O88.32, O88.312, O88.313, O88.33, O88.819, O88.811, O88.812, O88.813, O88.82, O88.83
Postpartum Hemorrhage	666.00, 666.02, 666.04, 666.10, 666.12, 666.14, 666.20, 666.22, 666.24, 666.30, 666.32, 666.34,	O72.0, O72.1, O72.2, O72.3
Infection or Wound Complications	670.10, 670.12, 670.14, 674.10, 674.12, 674.14, 674.20, 674.22, 674.24, 674.30, 674.32, 674.34	O86.12, O90.0, O90.1, O86.0
Perineal Lacerations	664.20, 664.21, 664.24, 664.30, 664.31, 664.34, 664.60, 664.61, 664.64	O70.20, O70.21, O70.22, O70.23, O70.3, O70.4
Obstetric Injury	665.30, 665.31, 665.34, 665.40, 665.41, 665.44, 665.5, 665.80, 665.81, 665.82, 665.83, 665.84, 665.70, 665.71, 665.72, 665.74	O71.3, O71.4, O71.89, O71.7

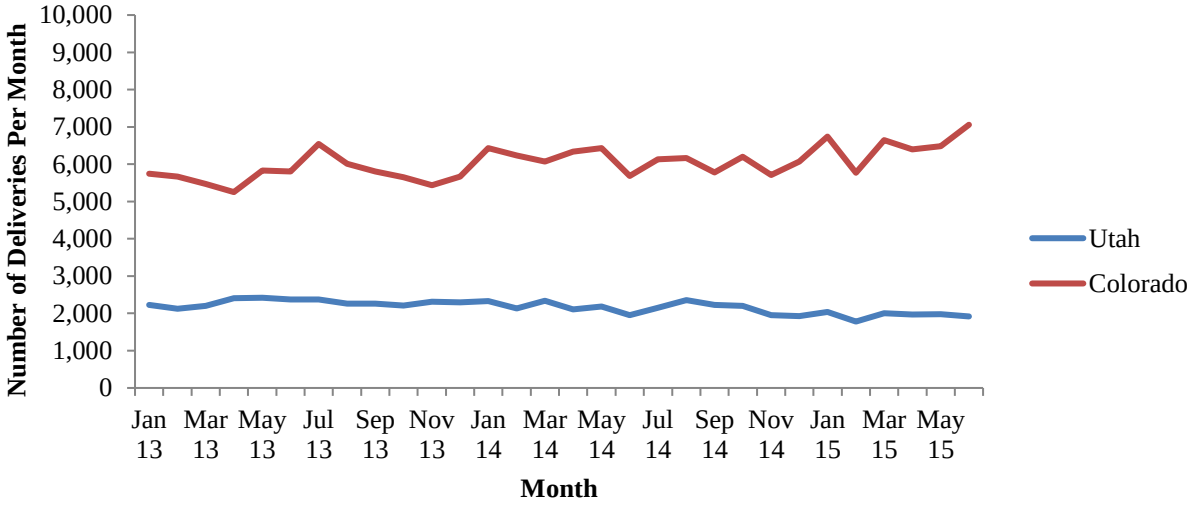
Appendix E. Assessing the Composition of Treatment and Control Groups over Time

To address the potential changing sample of women who deliver before and after expansion, we first assess the number of deliveries per month across the two states in 2013-2015 provided in Exhibit G1. While the number of Medicaid-financed births per month is more variable in Colorado than it is in Utah, there does not appear to be a strong welcome mat effect. Between 2013 and 2014-2015, there is an average relative increase in the number of Medicaid-financed births of 4.6%.

Second, in Appendix Exhibit E2, we merged ZIP code level demographic data from the 2013 American Community Survey to compare women who delivered in 2013 versus 2014-2015 in Colorado and Utah. We use area-level data because individual-level characteristics are not included in the claims data. We merged at the level of the ZIP code in Colorado and the level of the Small Health Area in Utah, an area-level measure provided by the Utah Department of Statistics that maps onto ZIP codes while limiting confidentiality risks in highly rural regions of the state.

On the observables included in Exhibit E2, the demographics of the cohort do not change significantly before and after Jan 1, 2014 in Utah. In Colorado, a few demographic characteristics are significantly different before and after expansion but the magnitudes of the changes are all less than one percentage point. While we cannot definitively rule out individual-level changes in the treatment group over time, these results suggest that based on the variables we can observe, the demographics of the treatment group are fairly stable over the study period. This may be because increased access to family planning takes time to alter the demographic characteristics of women who deliver in Colorado and we observe increases in coverage and postpartum utilization of outpatient care immediately after expansion.

Appendix Exhibit E1. Number of Deliveries per Month in Colorado and Utah, January 2013-June 2015



Appendix Exhibit E2. Comparing Composition of Medicaid Enrollees in Colorado and Utah Before and After Medicaid Expansion

Variable	Colorado			Utah		
	2013	2014-2015	P-Value	2013	2014-2015	P-Value
Sample Size						
Age (years), %						
19-24	38.7	42.0		38.4	40.9	
25-39	56.6	54.3		60.1	57.1	
40-53	2.2	1.6	<.001	1.2	1.2	0.176
Area-Level Characteristics						
White, %	79.6	79.6	.700	84.9	85.3	.116
Black, %	5.4	5.6	.011	1.2	1.2	.646
Asian, %	2.5	2.6	<.001	2.1	2.1	.726
Hispanic/Latino, %	29.9	29.1	<.001	16.5	16.2	.547
Unemployed, %	6.6	6.6	0.609	5.3	5.3	.796
Income below the Federal Poverty Level, %	13.1	12.8	<.001	11.7	11.8	.335
Mean Regional Median Household Income	$52,455	$53,477	<.001	$56,718	$55,654	.101
Graduated High School, %	85.1	85.5	<.001	88.4	88.4	.969
Graduated College, %	27.3	28.2	<.001	28.3	28.7	.374
Rural, %	11.2	11.1	.638	10.4	10.9	.111

Appendix F. Full Regression Specifications

For the continuous outcomes of enrollment and outpatient utilization, we estimated the following multivariate linear regression model:

(1) $Y_{ist} = \beta_0 + \beta_1 expansion_{st} + \beta_2\, post_t + \beta_3\, expansion_{st} * post_t + \beta_4 X_{is} + \beta_5 \gamma_{iz} + \beta_6 month_{ist} + \varepsilon_{ist}$

where *i* denotes the individual Medicaid enrollee, *s* denotes the state, *t* denotes the year, and *z* denotes the ZIP code tabulation area in Colorado and the Small Health Area in Utah. $Expansion_{st}$ is an indicator variable for state, equaling 1 for Colorado (expansion) and 0 for Utah (non-expansion). $Post_t$ is an indicator variable that equals 0 if deliveries occurred between January-June of 2013, 1 if deliveries occurred between July-December of 2013, and 2 if deliveries occurred in 2014-2015.

The interaction term $expansion_{st} * post_t$ provides the mean adjusted difference between Colorado and Utah in the change in Y_{ist} between the time periods. X_{is} captures age during the baseline year and γ_{iz} is a vector of area-level fixed effects. $\beta_6 month_{it}$ controls for month of delivery. The beta coefficients are parameters to be estimated. In the main text, we report the unadjusted rates in each state and year, as well as the main coefficient of interest, β_3, which provides the average difference in outcomes in Colorado versus Utah after Medicaid expansion compared to before, adjusting for individual and area-level characteristics. Appendix Exhibits F1-2 provide the coefficients, standard errors, sample size, and r-squared values for our primary models.

To measure the effect of Medicaid expansion stratified by health status at time of delivery, we estimated the following fully-interacted models for the continuous outcomes of enrollment and outpatient utilization:

(2) $Y_{istm} = \beta_0 + \beta_1 expansion_{st} + \beta_2\, post_t + \beta_3\, morbidity_{ist} + \beta_4\, expansion_{st} * post_t + \beta_5\, morbidity_{ist} * post_t + \beta_6\, morbidity_{ist} * expansion_{st} + \beta_7\, morbidity_{ist} * expansion_{st} * post_t + \beta_8 X_{is} + \beta_9 X_{is} * morbidity_{ist} + \beta_{10}\gamma_{iz} + \beta_{11}\gamma_{iz} * morbidity_{ist} + \beta_{12} month_{ist} + \beta_{13} month_{ist} * morbidity_{ist} + \varepsilon_{ist}$

where *i* denotes the individual Medicaid enrollee, *s* denotes the state, *t* denotes the year, *z* denotes the ZIP code tabulation area in Colorado and the Small Health Area in Utah, and *m* denotes whether women experienced severe maternal morbidity at the time of delivery. The triple interaction term $morbidity_{ist} * expansion_{st} * post_t$ provides the outcome differences in Y_{istm} between Colorado and Utah before and after expansion among women who experienced severe delivery complications and women who did not.

Appendix Exhibit F1. Results of difference-in-differences model of the effect of Medicaid expansion on coverage in the six months postpartum, Colorado and Utah 2013-2015

Variable	**Coefficient**
Colorado	0.80** (.001)
Jan-Jun 2013 (Preperiod)	(reference)
Jun-Dec 2013 (Washout Period)	-1.0** (.004)
Jan 2014-Jun 2015 (Post Period)	-0.18 (.062)
Colorado * Post Period	0.90** (.002)
Colorado * Washout Period	-0.02 (.001)
Month of Delivery	
January	(reference)
February	-0.01 (.015)
March	-0.05 (.077)
April	-0.03 (.060)
May	-0.06 (.136)
June	-0.08 (.088)
July	0.06 (.033)
August	0.10 (.007)
September	0.07 (.024)
October	0.21** (.001)
November	0.08** (.000)
December	0.04 (.094)
Age	
19-24	(reference)
25-39	-0.42* (.013)
40-53	-0.82 (.226)
Sample Size, N	70,452
Adjusted R^2	0.13

Appendix Exhibit F2. Results of difference-in-differences model of the effect of Medicaid expansion on outpatient utilization in the six months after delivery, Colorado and Utah 2013-2015

Variable	**Coefficient**
Colorado	1.5** (.007)
Jan-Jun 2013 (Preperiod)	(reference)
Jun-Dec 2013 (Washout Period)	-0.05 (.005)
Jan 2014-Jun 2015 (Post Period)	-0.17* (.002)
Colorado * Post Period	0.52** (.002)
Colorado * Washout Period	-0.42** (.001)
Month of Delivery	
January	(reference)
February	-0.03 (.017)
March	-0.13 (.035)
April	-0.18 (.020)
May	-0.09 (.018)
June	-0.16 (.008)
July	-0.22 (.041)
August	-0.07 (.081)
September	-0.22 (.041)
October	1.84** (.006)
November	-1.93 (.188)
December	-1.75 (.128)
Age	
19-24	(reference)
25-39	-0.07 (.150)
40-53	-0.21 (.108)
Sample Size, N	70,452
Adjusted R^2	0.07

Appendix G. An Alternative Approach to Standard Error Estimation Using Area-Level Models

In difference-in-difference studies with aggregate level regressors, a small number of clusters may result in overly precise effect estimates and potentially inflated p-values (see manuscript for relevant citations). Our primary model estimates standard errors and p-values via Huber-White robust variance, state-level clustering, and a t-distribution with G-1 degrees of freedom.

As a robustness check for the potential underestimation of the standard errors in our primary models, we analyzed a model aggregated to the area level (ZIP code in Colorado and the Small Health Area in Utah) to determine whether the magnitude and statistical significance of our results remained similar as in our primary models.

Clustering the standard errors at the area-level resulted in 1,843 clusters, above the threshold for concern about p-value inflation. These results are presented below in Appendix Exhibits G1-2 for the enrollment and utilization outcomes. Taken together with the magnitude of our effect estimates and the sample sizes in each state, we believe it is highly unlikely that our results are observed due to chance.

Appendix Exhibit G1. Area-level model of the effect of Medicaid expansion on postnatal Medicaid enrollment in Colorado and Utah, 2013-2015

Variable	Coefficient
Colorado	0.88***
	(.056)
Post	-0.78***
	(.052)
Colorado x Post	0.66***
	(.071)
Month of Delivery	-0.04*
	(.020)
Age	-0.01
	(.007)
Sample Size, N	1,843
R^2	0.10

Notes: Adjusting for 1,843 area-level clusters at the ZIP Code level in Colorado and the Small Health Area level in Utah, a geographic measure provided by the Utah Department of Statistics to limit the risk of identifying individuals residing in rural regions of the state. ***<.001; **<.01, *<.05

Appendix Exhibit G2. Area-level model of the effect of Medicaid expansion on utilization of outpatient care during the postpartum period in Colorado and Utah, 2013-2015

Variable	**Coefficient**
Colorado	1.7***
	(.159)
Post	-0.15*
	(.070)
Colorado x Post	0.53**
	(.199)
Month of Delivery	-0.11
	(.075)
Age	0.06*
	(.026)
Sample Size, N	1,843
R^2	.03

Notes: Adjusting for 1,843 area-level clusters at the ZIP Code level in Colorado and the Small Health Area level in Utah, a geographic measure provided by the Utah Department of Statistics to limit the risk of identifying individuals residing in rural regions of the state. ***<.001; **<.01, *<.05

Appendix H. Analysis of Commercially Financed Outpatient Postpartum Utilization

The Medicaid claims analyzed in this study are drawn from Utah and Colorado's all payer claims databases, which include commercial claims in addition to Medicaid claims. These claims are linkable to the women in our study sample via a unique identifier. Examining utilization rates of commercial coverage over the study period helps shed light on postpartum utilization beyond visits financed by Medicaid.

However, the all payer claims databases lack approximately 30% of the commercial claims. This may introduce selection bias depending on which plans are included and which are excluded. It is difficult to ascertain the extent of this potential bias since there is very limited plan information provided in the datasets. In addition, we are unable to determine whether a commercially financed visit is paid for by a Marketplace insurer or another type of private payer such as a commercial plan offered through employment. Due to these drawbacks, we incorporate these additional analyses as a sensitivity test in which we examine three types of utilization: (1) Medicaid-financed postpartum outpatient care, (2) commercially financed postpartum outpatient care, and (3) both types of utilization combined. The results of these regression models are presented below:

Appendix Exhibit H1. Changes in the Number of Commercially Financed, Medicaid-Financed, and All Postpartum Outpatient Visits in Colorado and Utah

Payer Type	Pre (Jan-Jun 2013)	Post (2014-2015)	Difference
Commercially Financed Outpatient Visits Per Delivery in Six Months Postpartum			
Colorado	0.03	0.04	0.01
Utah	0.44	0.49	0.05
Adjusted DD	-0.03*		
[95% CI]	[-0.04, -0.03]		
Medicaid-Financed Outpatient Visits Per Delivery in Six Months Postpartum			
Colorado	3.0	3.3	0.3
Utah	2.0	1.8	-0.2
Adjusted DD	0.52**		
[95% CI]	[0.50, 0.54]		
All Outpatient Visits Per Delivery in Six Months Postpartum			
Colorado	3.0	3.4	0.4
Utah	2.5	2.4	-0.1
Adjusted DD	0.49**		
[95% CI]	[0.48, 0.51]		