Supplement A: Full Results

Table A1. Summary statistics by state Medicaid expansion status, 2010-2017

	All States		Non-Expansion States		Expansion States	
	Mean	SD	Mean	SD	Mean	SD
Percent of Medicare MA beneficiaries	22.0	14.2	21.2	13.7	26.4	15.6
Percent Medicare beneficiaries dually eligible	21.8	8.83	21.8	8.96	21.8	8.35
Percent female Medicare beneficiaries	54.0	2.40	54.2	2.35	53.35	2.47
Average age of Medicare beneficiaries	71.2	1.94	71.3	1.94	71.1	1.91
Number of inpatient stays, per 1,000 beneficiaries	284.9	58.3	291.1	58.6	263.1	51.7

Number of ED visits, per 1,000 beneficiaries	678.8	150.9	675.2	152.2	691.6	145.5
Average HCC score	0.94	0.097	0.95	0.098	0.94	0.094
Median household income, per 10,000 county pop.	4.68	1.23	4.54	1.15	5.17	1.35
Unemployment rate	6.81	2.90	7.16	2.99	5.53	2.11
Percent African-American	8.91	14.36	10.16	15.42	4.49	8.26
Percent Hispanic	8.86	13.40	9.04	13.72	8.21	12.16
Percent Asian or other race	4.85	8.40	4.71	8.31	5.36	8.70
Poverty rate	16.0	5.96	16.4	5.99	14.4	5.59

Log of county population	10.3	1.44	10.2	1.42	10.5	1.51
Naloxone distribution law	0.37	0.48	0.26	0.44	0.77	0.42
Must-access PDMP law	0.13	0.34	0.08	0.27	0.32	0.47
Pain management clinic law	0.26	0.44	0.27	0.44	0.20	0.40
Medical cannabis dispensary	0.15	0.36	0.08	0.28	0.39	0.49
Recreational cannabis dispensary	0.02	0.14	0	0	0.09	0.28

Source: Authors' analysis of spillover of Medicaid expansion to prescribing of opioid use disorder treatment medications in Medicare Part D using data from the Medicare Part D Prescription Public Use File, Medicare Geographic Variation Files, and other publicly available sources, 2010-2017.
Notes: The unit of analysis is the county-year. Number of observations 24,850.

Table A2. Difference-in-differences linear regression results estimating the effect of Medicaid expansion on the probability of a county having at least one provider serving Medicare Part D for a given opioid use disorder medication, 2010-2017

	(1) Any provider b (SE)	(2) Any buprenorphine provider b (SE)	(3) Any injectable naltrexone provider b (SE)
Expanded Medicaid	0.0092 (0.01)	0.016 (0.01)	0.036*** (0.01)
Log(Number of Medicare Beneficiaries)	0.25*** (0.06)	0.26*** (0.07)	0.079 (0.05)
Percent of Medicare beneficiaries in MA plan	-0.14 (0.09)	-0.041 (0.09)	-0.059 (0.06)
Percent Medicare beneficiaries dually eligible	0.0018 (0.00)	0.0028 (0.00)	-0.0022 (0.00)
Average age of Medicare beneficiaries	0.0047 (0.01)	0.0054 (0.01)	-0.0036 (0.00)
Percent female Medicare beneficiaries	0.0016 (0.00)	0.0030 (0.00)	-0.00095 (0.00)
Number of inpatient stays, per 1,000 beneficiaries	0.000059 (0.00)	-0.000020 (0.00)	-0.000071 (0.00)
Number of ED visits, per 1,000 beneficiaries	-0.000075 (0.00)	-0.000052 (0.00)	-0.0000077 (0.00)
Average HCC score	0.17** (0.08)	0.12 (0.09)	0.0026 (0.06)
Median household income, per 10,000 county population	-0.016+ (0.01)	-0.012 (0.01)	0.019*** (0.01)
Unemployment rate	0.00064 (0.00)	0.000061 (0.00)	-0.0020 (0.00)
Percent African-American	-0.0045 (0.01)	0.00098 (0.01)	-0.0025 (0.01)

Percent Hispanic	-0.0087**	-0.0034	0.0022
	(0.00)	(0.00)	(0.00)
Percent Asian or other race	-0.015+	-0.021***	0.015+
	(0.01)	(0.01)	(0.01)
Poverty rate	0.00092	0.0014	0.000098
	(0.00)	(0.00)	(0.00)
Log of total population	0.11	-0.0074	0.083
	(0.10)	(0.11)	(0.08)
Naloxone distribution law	0.0062	0.00099	0.0039
	(0.01)	(0.01)	(0.01)
Must-access PDMP law	0.00051	0.0085	0.011
	(0.01)	(0.01)	(0.01)
Pain management clinic law	0.026**	0.024+	0.0024
	(0.01)	(0.01)	(0.01)
Medical cannabis dispensary	0.018	0.021	0.034
	(0.02)	(0.02)	(0.02)
Recreational cannabis dispensary	0.023	0.010	-0.060***
	(0.02)	(0.02)	(0.02)
Constant	-3.18***	-2.34**	-1.27
	(1.08)	(0.98)	(0.84)
Number of Observations	24376	24376	24376

Source: Authors' analysis of spillover of Medicaid expansion to prescribing of opioid use disorder treatment medications in Medicare Part D using data from the Medicare Part D Prescription Public Use File, Medicare Geographic Variation Files, and other publicly available sources, 2010-2017.
Notes: Models include county and year fixed effects, and standard errors are clustered at the state level;
*** p<.01, ** p<.05, + p<.10.

Table A3. Difference-in-differences linear regression results estimating the effect of Medicaid expansion on the number of opioid use disorder medication providers serving the Medicare Part D population, 2010-2017 (Log Transformation)

	(1) Number of providers	(2) Number of buprenorphine providers	(3) Number of injectable naltrexone providers
	b (SE)	b (SE)	b (SE)
Expanded Medicaid	0.056+ (0.03)	0.056** (0.03)	0.033*** (0.01)
Log(Number of Medicare Beneficiaries)	0.75*** (0.14)	0.65*** (0.13)	0.058 (0.04)
Percent of Medicare beneficiaries in MA plan	0.081 (0.17)	0.095 (0.16)	-0.061 (0.06)
Percent Medicare beneficiaries dually eligible	0.00019 (0.00)	0.00027 (0.00)	-0.0022 (0.00)
Average age of Medicare beneficiaries	0.0057 (0.01)	0.0080 (0.01)	-0.0048 (0.00)
Percent female Medicare beneficiaries	-0.00063 (0.01)	0.0014 (0.01)	-0.0014 (0.00)
Number of inpatient stays, per 1,000 beneficiaries	-0.000081 (0.00)	-0.00015+ (0.00)	-0.000044 (0.00)
Number of ED visits, per 1,000 beneficiaries	-0.00013+ (0.00)	-0.000085+ (0.00)	-0.000033 (0.00)
Average HCC score	0.055 (0.14)	0.023 (0.14)	-0.0038 (0.06)
Median household income, per 10,000 county population	0.022+ (0.01)	0.020+ (0.01)	0.028** (0.01)
Unemployment rate	-0.0018 (0.01)	-0.0032 (0.00)	-0.0023 (0.00)
Percent African-	0.018+	0.016+	-0.0029

American	(0.01)	(0.01)	(0.01)
Percent Hispanic	-0.0067	-0.00036	0.0041
	(0.01)	(0.01)	(0.01)
Percent Asian or other race	0.065***	0.055***	0.022**
	(0.01)	(0.01)	(0.01)
Poverty rate	0.0016	0.0020	0.00052
	(0.00)	(0.00)	(0.00)
Log of total population	0.88***	0.68***	0.061
	(0.20)	(0.20)	(0.07)
Naloxone distribution law	-0.0032	-0.0013	0.0040
	(0.02)	(0.02)	(0.01)
Must-access PDMP law	0.033	0.037	0.018
	(0.03)	(0.03)	(0.02)
Pain management clinic law	0.015	0.023	-0.0025
	(0.03)	(0.03)	(0.01)
Medical cannabis dispensary	0.061**	0.067**	0.046
	(0.03)	(0.03)	(0.03)
Recreational cannabis dispensary	0.00024	0.0036	-0.061***
	(0.04)	(0.05)	(0.02)
Constant	-15.9***	-13.3***	-0.85
	(2.22)	(2.27)	(0.72)
Number of Observations	24376	24376	24376

Source: Authors' analysis of spillover of Medicaid expansion to prescribing of opioid use disorder treatment medications in Medicare Part D using data from the Medicare Part D Prescription Public Use File, Medicare Geographic Variation Files, and other publicly available sources, 2010-2017. Outcome variables are specified as log(number of providers + 1).
*Notes: Models include county and year fixed effects, and standard errors are clustered at the state level. Number of Observations 24,376; *** p<.01, ** p<.05, + p<.10.*

Table A4. Difference-in-differences linear regression results estimating the effect of Medicaid expansion on number of opioid use disorder medication daily doses serving the Medicare Part D Population, 2010-2017 (Log transformation)

	(1) Number of daily doses b (SE)	(2) Number of daily doses of buprenorphine b (SE)	(3) Number of daily doses of injectable naltrexone b (SE)
Expanded Medicaid	0.12 (0.09)	0.16 (0.10)	0.23*** (0.08)
Log(Number of Medicare Beneficiaries)	2.71*** (0.51)	2.73*** (0.57)	0.50 (0.31)
Percent of Medicare beneficiaries in MA plan	-0.47 (0.81)	0.20 (0.78)	-0.40 (0.38)
Percent Medicare beneficiaries dually eligible	0.018 (0.02)	0.023 (0.02)	-0.014 (0.01)
Average age of Medicare beneficiaries	0.047 (0.05)	0.052 (0.05)	-0.025 (0.02)
Percent female Medicare beneficiaries	0.015 (0.03)	0.027 (0.03)	-0.0073 (0.01)
Number of inpatient stays, per 1,000 beneficiaries	-0.000042 (0.00)	-0.00046 (0.00)	-0.00038 (0.00)
Number of ED visits, per 1,000 beneficiaries	-0.00054 (0.00)	-0.00037 (0.00)	-0.00010 (0.00)
Average HCC score	1.11+ (0.63)	0.73 (0.71)	-0.0041 (0.37)
Median household income, per 10,000 county population	-0.10+ (0.06)	-0.084 (0.05)	0.13*** (0.05)
Unemployment rate	0.0017 (0.03)	-0.0033 (0.03)	-0.012 (0.01)
Percent African-American	-0.011 (0.05)	0.024 (0.05)	-0.016 (0.03)

Percent Hispanic	-0.058	-0.018	0.018
	(0.04)	(0.04)	(0.03)
Percent Asian or other race	-0.0045	-0.048	0.11+
	(0.04)	(0.05)	(0.06)
Poverty rate	0.0072	0.010	0.0013
	(0.01)	(0.01)	(0.00)
Log of total population	2.26***	1.37	0.51
	(0.72)	(0.85)	(0.52)
Naloxone distribution law	0.048	0.026	0.031
	(0.05)	(0.06)	(0.06)
Must-access PDMP law	0.056	0.10	0.084
	(0.12)	(0.12)	(0.08)
Pain management clinic law	0.23**	0.23+	0.0060
	(0.11)	(0.13)	(0.06)
Medical cannabis dispensary	0.18	0.19+	0.23
	(0.11)	(0.11)	(0.15)
Recreational cannabis dispensary	0.065	0.0040	-0.40***
	(0.14)	(0.15)	(0.11)
Constant	-47.9***	-40.7***	-7.79
	(7.95)	(8.20)	(5.43)
Number of Observations	24376	24376	24376

Source: Authors' analysis of spillover of Medicaid expansion to prescribing of opioid use disorder treatment medications in Medicare Part D using data from the Medicare Part D Prescription Public Use File, Medicare Geographic Variation Files, and other publicly available sources, 2010-2017. Outcome variables are specified as log(number daily doses + 1).
Notes: Models include county and year fixed effects, and standard errors are clustered at the state level. Number of Observations 24,376; *** p<.01, ** p<.05, + p<.10.

Supplement B: Alternative Outcome Variable Specifications

Table B1. Difference-in-differences logistic regression results estimating the effect of Medicaid expansion on the probability of a county having at least one provider serving Medicare Part D for a given opioid use disorder medication, 2010-2017

	(1) Any provider OR [95% CI]	(2) Any buprenorphine provider OR [95% CI]	(3) Any injectable naltrexone provider OR [95% CI]
Expanded Medicaid	0.18 [-0.20,0.56]	0.39 [-0.08,0.86]	1.03*** [0.32,1.74]
Log(Number of Medicare Beneficiaries)	5.71** [1.36,10.06]	5.16+ [-0.80,11.12]	2.50 [-7.82,12.83]
Percent of Medicare beneficiaries in MA plan	-2.81 [-6.18,0.55]	-1.21 [-5.39,2.97]	-3.78 [-10.42,2.86]
Percent Medicare beneficiaries dually eligible	0.012 [-0.07,0.10]	0.040 [-0.06,0.14]	-0.048 [-0.19,0.09]
Average age of Medicare beneficiaries	0.11 [-0.14,0.36]	-0.021 [-0.34,0.30]	-0.25 [-0.70,0.21]
Percent female Medicare beneficiaries	-0.035 [-0.24,0.17]	0.0027 [-0.27,0.27]	-0.28 [-0.84,0.28]
Number of inpatient stays, per 1,000 beneficiaries	0.00034 [-0.01,0.01]	-0.0019 [-0.01,0.01]	-0.013+ [-0.03,0.00]
Number of ED visits, per 1,000 beneficiaries	-0.0014 [-0.00,0.00]	-0.0017 [-0.00,0.00]	0.0048 [-0.00,0.01]
Average HCC score	2.58 [-1.99,7.15]	2.10 [-3.59,7.78]	9.84+ [-1.65,21.32]
Median household income, per 10,000 county population	-0.35+ [-0.76,0.06]	-0.27 [-0.76,0.23]	0.46 [-0.35,1.27]
Unemployment rate	0.040 [-0.06,0.14]	0.035 [-0.09,0.16]	-0.14 [-0.38,0.09]

Percent African-American	-0.17 [-0.58,0.25]	-0.083 [-0.52,0.35]	-0.45 [-1.21,0.31]
Percent Hispanic	-0.25+ [-0.52,0.02]	-0.079 [-0.46,0.30]	-0.052 [-0.66,0.56]
Percent Asian or other race	0.041 [-0.44,0.52]	-0.19 [-0.83,0.44]	-0.40 [-1.17,0.38]
Poverty rate	0.021 [-0.03,0.08]	0.041 [-0.02,0.10]	-0.040 [-0.17,0.09]
Log of total population	3.23 [-2.69,9.16]	-1.09 [-8.85,6.67]	-5.26 [-21.32,10.79]
Naloxone distribution law	0.18 [-0.11,0.47]	0.084 [-0.26,0.42]	-0.027 [-0.54,0.48]
Must-access PDMP law	0.0051 [-0.40,0.41]	-0.024 [-0.50,0.45]	0.21 [-0.40,0.81]
Pain management clinic law	0.56** [0.08,1.04]	0.54** [0.01,1.07]	0.38 [-0.54,1.29]
Medical cannabis dispensary	0.55+ [-0.06,1.16]	1.24*** [0.32,2.17]	0.73+ [-0.04,1.50]
Recreational cannabis dispensary	0.36 [-0.60,1.31]	-0.10 [-1.23,1.03]	-1.96** [-3.89,-0.04]
Constant	-79.0*** [-132.92,-25.08]	-27.5 [-96.20,41.25]	56.9 [-58.26,172.11]
Number of Observations	6760	5520	2528

Source: Authors' analysis of spillover of Medicaid expansion to prescribing of opioid use disorder treatment medications in Medicare Part D using data from the Medicare Part D Prescription Public Use File, Medicare Geographic Variation Files, and other publicly available sources, 2010-2017.
*Notes: Models include county and year fixed effects; *** p<.01, ** p<.05, + p<.10.*

Table B2. Difference-in-differences linear regression results predicting the number of opioid use disorder medication providers and number of opioid use disorder medication daily doses serving Medicare Part D, 2010-2017 (Inverse Hyperbolic Sine Transformation)

	(1) Number of providers	(2) Number of buprenorphine providers	(3) Number of injectable naltrexone providers	(4) Number of daily doses	(5) Number of daily doses of buprenorphine	(6) Number of daily doses of injectable naltrexone
	b (SE)	b (SE)	b (SE)	b (SE)	b (SE)	b (SE)
Expanded Medicaid	0.063+ (0.03)	0.064+ (0.03)	0.042*** (0.02)	0.12 (0.10)	0.17 (0.11)	0.26*** (0.09)
Log(Number of Medicare Beneficiaries)	0.94*** (0.17)	0.82*** (0.16)	0.075 (0.06)	2.88*** (0.55)	2.90*** (0.61)	0.55 (0.34)
Percent of Medicare beneficiaries in MA plan	0.085 (0.21)	0.12 (0.20)	-0.078 (0.08)	-0.56 (0.87)	0.17 (0.84)	-0.44 (0.42)
Percent Medicare beneficiaries dually eligible	0.00088 (0.00)	0.00095 (0.00)	-0.0028 (0.00)	0.020 (0.02)	0.025 (0.02)	-0.016 (0.01)
Average age of Medicare beneficiaries	0.0074 (0.01)	0.010 (0.01)	-0.0063 (0.00)	0.050 (0.05)	0.056 (0.05)	-0.028 (0.02)
Percent female Medicare beneficiaries	0.000072 (0.01)	0.0025 (0.01)	-0.0018 (0.00)	0.016 (0.03)	0.029 (0.03)	-0.0079 (0.01)

Number of inpatient stays, per 1,000 beneficiaries	-0.00010 (0.00)	-0.00019+ (0.00)	-0.000056 (0.00)	-0.0000019 (0.00)	-0.00047 (0.00)	-0.00042 (0.00)
Number of ED visits, per 1,000 beneficiaries	-0.00014+ (0.00)	-0.000093 (0.00)	-0.000044 (0.00)	-0.00059 (0.00)	-0.00041 (0.00)	-0.00011 (0.00)
Average HCC score	0.089 (0.17)	0.045 (0.17)	-0.0049 (0.07)	1.23+ (0.69)	0.81 (0.77)	-0.0024 (0.40)
Median household income, per 10,000 county population	0.020 (0.01)	0.019 (0.01)	0.036** (0.01)	-0.11+ (0.07)	-0.092 (0.06)	0.15*** (0.05)
Unemployment rate	-0.0016 (0.01)	-0.0036 (0.01)	-0.0030 (0.00)	0.0022 (0.03)	-0.0033 (0.03)	-0.014 (0.01)
Percent African-American	0.022** (0.01)	0.020+ (0.01)	-0.0039 (0.01)	-0.014 (0.05)	0.025 (0.06)	-0.018 (0.04)
Percent Hispanic	-0.0099 (0.01)	-0.0014 (0.01)	0.0053 (0.01)	-0.064 (0.04)	-0.021 (0.04)	0.019 (0.03)
Percent Asian or other race	0.067*** (0.01)	0.056*** (0.01)	0.028** (0.01)	-0.015 (0.05)	-0.062 (0.05)	0.12+ (0.06)
Poverty rate	0.0017 (0.00)	0.0022 (0.00)	0.00065 (0.00)	0.0078 (0.01)	0.011 (0.01)	0.0013 (0.00)
Log of total population	1.01*** (0.24)	0.77*** (0.24)	0.079 (0.09)	2.33*** (0.78)	1.37 (0.92)	0.56 (0.58)

Naloxone distribution law	-0.0029 (0.02)	-0.00084 (0.02)	0.0050 (0.01)	0.053 (0.06)	0.027 (0.06)	0.034 (0.06)
Must-access PDMP law	0.040 (0.03)	0.046 (0.03)	0.024 (0.02)	0.056 (0.13)	0.11 (0.13)	0.091 (0.09)
Pain management clinic law	0.019 (0.03)	0.028 (0.04)	-0.0034 (0.01)	0.25** (0.12)	0.24+ (0.13)	0.0076 (0.06)
Medical cannabis dispensary	0.067** (0.03)	0.078** (0.03)	0.058 (0.04)	0.19 (0.12)	0.20+ (0.12)	0.26 (0.16)
Recreational cannabis dispensary	0.0053 (0.06)	0.0099 (0.06)	-0.079*** (0.03)	0.081 (0.15)	0.011 (0.17)	-0.44*** (0.12)
Constant	-18.9*** (2.63)	-15.9*** (2.74)	-1.08 (0.92)	-50.1*** (8.62)	-42.3*** (8.82)	-8.67 (6.01)
Number of Observations	24376	24376	24376	24376	24376	24376

Source: Authors' analysis of spillover of Medicaid expansion to prescribing of opioid use disorder treatment medications in Medicare Part D using data from the Medicare Part D Prescription Public Use File, Medicare Geographic Variation Files, and other publicly available sources, 2010-2017. Outcome variables are specified as the inverse hyperbolic sine.

*Notes: Models include county and year fixed effects, and standard errors are clustered at the state level. Number of Observations 24,376; *** p<.01, ** p<.05, + p<.10.*

Table B3. Difference-in-differences linear regression results predicting the number of opioid use disorder medication providers and number of opioid use disorder medication daily doses serving Medicare Part D per 1,000 Medicare beneficiaries, 2010-2017 (Log Transformation)

	(1) Number of providers per 1,000 beneficiaries	(2) Number of buprenorphine providers per 1,000 beneficiaries	(3) Number of injectable naltrexone providers per 1,000 beneficiaries	(4) Number of daily doses of any medication per 1,000 beneficiaries	(5) Number of daily doses of buprenorphine per 1,000 beneficiaries	(6) Number of daily doses of injectable naltrexone per 1,000 beneficiaries
	b (SE)	b (SE)	b (SE)	b (SE)	b (SE)	b (SE)
Expanded Medicaid	0.014+ (0.01)	0.014** (0.01)	0.0022** (0.00)	11.7 (11.59)	13.5 (10.67)	0.61 (0.55)
Percent of Medicare beneficiaries in MA plan	-0.00098 (0.05)	0.00055 (0.04)	-0.0074 (0.01)	157.6 (138.10)	214.2 (131.96)	-6.56 (4.21)
Percent Medicare beneficiaries dually eligible	0.00069 (0.00)	0.00032 (0.00)	-0.00014 (0.00)	4.54 (3.62)	4.09 (3.56)	-0.0048 (0.08)
Average age of Medicare beneficiaries	0.0054 (0.00)	0.0055+ (0.00)	-0.00026 (0.00)	18.1 (11.65)	16.7 (11.30)	-0.24 (0.15)
Percent female Medicare beneficiaries	-0.0017 (0.00)	0.0011 (0.00)	-0.000054 (0.00)	4.50 (5.01)	6.19 (4.75)	-0.25 (0.28)
Number of inpatient stays, per 1,000 beneficiaries	-0.0000081 (0.00)	-0.000026 (0.00)	0.0000044 (0.00)	-0.12 (0.09)	-0.14+ (0.08)	0.011 (0.01)

Number of ED visits, per 1,000 beneficiaries	-0.000059** (0.00)	-0.000045** (0.00)	0.0000023 (0.00)	-0.13+ (0.07)	-0.13+ (0.07)	-0.0023 (0.01)
Average HCC score	0.074 (0.05)	0.057 (0.05)	-0.000016 (0.01)	144.0+ (85.59)	85.4 (77.27)	-4.34 (4.73)
Median household income, per 10,000 county population	0.0035 (0.01)	0.0029 (0.00)	0.00092 (0.00)	-7.03 (10.14)	-5.23 (9.31)	0.50+ (0.30)
Unemployment rate	0.0019 (0.00)	0.0014 (0.00)	-0.000020 (0.00)	8.20 (5.29)	7.11 (5.25)	-0.025 (0.08)
Percent African-American	-0.00067 (0.00)	-0.0016 (0.00)	-0.00029 (0.00)	-5.28 (5.61)	-3.82 (5.53)	-0.23 (0.28)
Percent Hispanic	-0.0041 (0.00)	-0.0020 (0.00)	-0.00047 (0.00)	-9.91+ (5.31)	-6.89 (5.37)	-0.30 (0.24)
Percent Asian or other race	0.014*** (0.01)	0.0072** (0.00)	-0.00041 (0.00)	24.6** (10.65)	7.96 (5.65)	0.32 (0.72)
Poverty rate	0.0011+ (0.00)	0.00069 (0.00)	0.000028 (0.00)	1.37 (1.02)	1.54 (0.94)	0.051 (0.07)
Log of total population	0.14+ (0.08)	0.042 (0.06)	-0.0034 (0.00)	176.6 (201.38)	92.3 (197.11)	-7.12 (6.23)
Naloxone distribution law	0.0046 (0.00)	0.0052 (0.00)	0.00014 (0.00)	11.7 (11.35)	10.8 (10.61)	0.62 (0.43)

Must-access PDMP law	0.025*** (0.01)	0.020** (0.01)	0.00053 (0.00)	54.0** (22.06)	45.3** (22.09)	0.10 (0.50)
Pain management clinic law	0.0052 (0.01)	0.011 (0.01)	0.00044 (0.00)	52.1+ (27.51)	58.3+ (29.30)	0.18 (0.34)
Medical cannabis dispensary	0.019+ (0.01)	0.018** (0.01)	0.0012 (0.00)	27.2 (22.65)	24.9 (20.97)	0.35 (0.83)
Recreational cannabis dispensary	0.024 (0.02)	0.017 (0.02)	-0.0022+ (0.00)	13.9 (24.61)	17.2 (23.87)	-1.35** (0.54)
Constant	-1.79** (0.67)	-0.88 (0.54)	0.063 (0.04)	-3405.5*** (1245.07)	-2459.3** (1194.65)	109.7 (88.50)
Number of Observations	24376	24376	24376	24376	24376	24376

Source: Authors' analysis of spillover of Medicaid expansion to prescribing of opioid use disorder treatment medications in Medicare Part D using data from the Medicare Part D Prescription Public Use File, Medicare Geographic Variation Files, and other publicly available sources, 2010-2017. Outcome variables are specified as log(number providers + 1) and log(number of daily doses + 1).

*Notes: Models include county and year fixed effects, and standard errors are clustered at the state level. Number of Observations 24,376; *** $p<.01$, ** $p<.05$, + $p<.10$.*

Table B4. Difference-in-differences linear regression results predicting the number of opioid use disorder medication providers and number of opioid use disorder medication daily doses serving Medicare Part D per 1,000 in the county population, 2010-2017 (Log Transformation)

	(1) Number of providers per 1,000 county pop	(2) Number of buprenorphine providers per 1,000 county pop	(3) Number of injectable naltrexone providers per 1,000 county pop	(4) Number of daily doses of any medication per 1,000 county pop	(5) Number of daily doses of buprenorphine per 1,000 county pop	(6) Number of daily doses of injectable naltrexone per 1,000 county pop
	b (SE)	b (SE)	b (SE)	b (SE)	b (SE)	b (SE)
Expanded Medicaid	0.0029+ (0.00)	0.0030** (0.00)	0.00041** (0.00)	2.79 (2.56)	3.16 (2.43)	0.10 (0.13)
Percent of Medicare beneficiaries in MA plan	0.0024 (0.01)	0.00084 (0.01)	-0.0016 (0.00)	40.9 (30.63)	51.1+ (29.41)	-1.71 (1.16)
Percent Medicare beneficiaries dually eligible	0.00019 (0.00)	0.00013 (0.00)	-0.000028 (0.00)	1.13 (0.87)	1.06 (0.86)	0.0023 (0.02)
Average age of Medicare beneficiaries	0.0011 (0.00)	0.0013+ (0.00)	-0.000064 (0.00)	4.78+ (2.79)	4.61+ (2.75)	-0.066 (0.04)
Percent female Medicare beneficiaries	0.00022 (0.00)	0.00061 (0.00)	-0.000013 (0.00)	1.84 (1.16)	2.07+ (1.11)	-0.073 (0.08)
Number of inpatient stays, per 1,000 beneficiaries	0.0000072 (0.00)	-0.00000057 (0.00)	0.0000014 (0.00)	-0.016 (0.02)	-0.022 (0.02)	0.0028 (0.00)

Number of ED visits, per 1,000 beneficiaries	-0.000015** (0.00)	-0.000011** (0.00)	0.00000039 (0.00)	-0.032+ (0.02)	-0.030+ (0.02)	-0.00063 (0.00)
Average HCC score	0.013 (0.01)	0.010 (0.01)	-0.00039 (0.00)	26.6 (20.34)	16.4 (19.13)	-1.20 (1.18)
Median household income, per 10,000 county population	0.00059 (0.00)	0.000029 (0.00)	0.00011 (0.00)	-2.36 (1.83)	-2.34 (1.75)	0.020 (0.07)
Unemployment rate	0.00025 (0.00)	0.00016 (0.00)	-0.00000034 (0.00)	1.79 (1.30)	1.59 (1.29)	-0.0051 (0.02)
Percent African-American	-0.00028 (0.00)	-0.00065 (0.00)	-0.000059 (0.00)	-1.28 (1.38)	-1.16 (1.40)	-0.077 (0.08)
Percent Hispanic	-0.0011** (0.00)	-0.00083+ (0.00)	-0.00013+ (0.00)	-2.95** (1.26)	-2.48+ (1.25)	-0.11 (0.08)
Percent Asian or other race	0.0015 (0.00)	0.00068 (0.00)	-0.000096 (0.00)	2.30 (2.25)	-0.58 (1.39)	0.088 (0.18)
Poverty rate	0.00030** (0.00)	0.00020** (0.00)	0.0000071 (0.00)	0.39 (0.32)	0.42 (0.30)	0.014 (0.02)
Naloxone distribution law	0.0015 (0.00)	0.0013 (0.00)	0.000013 (0.00)	3.12 (2.41)	2.70 (2.26)	0.14 (0.10)
Must-access PDMP law	0.0051** (0.00)	0.0043** (0.00)	0.000097 (0.00)	12.0** (5.09)	10.5** (5.07)	-0.0029 (0.11)

Pain management clinic law	0.0015 (0.00)	0.0025 (0.00)	0.000067 (0.00)	12.0+ (6.68)	13.0+ (7.01)	0.027 (0.08)
Medical cannabis dispensary	0.0052+ (0.00)	0.0044** (0.00)	0.00022 (0.00)	6.78 (5.22)	5.98 (4.82)	0.046 (0.18)
Recreational cannabis dispensary	0.0053 (0.00)	0.0037 (0.00)	-0.00051** (0.00)	2.60 (5.32)	3.03 (5.16)	-0.35** (0.15)
Constant	-0.086 (0.08)	-0.11 (0.07)	0.0077 (0.00)	-429.8 (270.85)	-416.6 (263.98)	10.8 (8.25)
Number of Observations	24376	24376	24376	24376	24376	24376

*Notes: Models include county and year fixed effects, and standard errors are clustered at the state level. Number of Observations 24,376; *** $p<.01$, ** $p<.05$, + $p<.10$.*

Supplement C: Alternate Specification: Proportion of Medicare Beneficiaries in the County

Table C1. Difference-in-differences linear regression results predicting the probability of a county having at least one provider serving Medicare Part D for a given opioid use disorder medication, 2010-2017

	(1) Any provider	(2) Any buprenorphine provider	(3) Any injectable naltrexone provider
	b (SE)	b (SE)	b (SE)
Expanded Medicaid	0.0091 (0.01)	0.016 (0.01)	0.036*** (0.01)
Percentage of Medicare beneficiaries in county	0.011*** (0.00)	0.0078** (0.00)	0.0014 (0.00)
Percent of Medicare beneficiaries in MA plan	-0.13 (0.09)	-0.038 (0.09)	-0.058 (0.06)
Percent Medicare beneficiaries dually eligible	0.0017 (0.00)	0.0028 (0.00)	-0.0022 (0.00)
Average age of Medicare beneficiaries	0.0049 (0.01)	0.0058 (0.01)	-0.0035 (0.00)
Percent female Medicare beneficiaries	0.0014 (0.00)	0.0030 (0.00)	-0.00085 (0.00)
Number of inpatient stays, per 1,000 beneficiaries	0.000063 (0.00)	-0.0000052 (0.00)	-0.000064 (0.00)
Number of ED visits, per 1,000 beneficiaries	-0.000078 (0.00)	-0.000057 (0.00)	-0.0000098 (0.00)
Average HCC score	0.17** (0.08)	0.10 (0.09)	-0.0034 (0.05)
Median household income, per 10,000 county population	-0.016 (0.01)	-0.012 (0.01)	0.019*** (0.01)
Unemployment rate	0.00052 (0.00)	-0.00046 (0.00)	-0.0022 (0.00)
Percent African-	-0.0038	0.0010	-0.0027

American	(0.01)	(0.01)	(0.01)
Percent Hispanic	-0.0091**	-0.0049	0.0014
	(0.00)	(0.00)	(0.00)
Percent Asian or other race	-0.013	-0.019**	0.015+
	(0.01)	(0.01)	(0.01)
Poverty rate	0.0011	0.0017	0.00018
	(0.00)	(0.00)	(0.00)
Log of total population	0.39***	0.27***	0.16**
	(0.11)	(0.10)	(0.08)
Naloxone distribution law	0.0060	0.0010	0.0040
	(0.01)	(0.01)	(0.01)
Must-access PDMP law	0.00098	0.0093	0.011
	(0.01)	(0.01)	(0.01)
Pain management clinic law	0.026**	0.024+	0.0027
	(0.01)	(0.01)	(0.01)
Medical cannabis dispensary	0.018	0.022	0.034
	(0.02)	(0.02)	(0.02)
Recreational cannabis dispensary	0.026	0.016	-0.057***
	(0.02)	(0.02)	(0.02)
Constant	-4.16***	-3.10***	-1.44
	(1.22)	(1.04)	(0.87)
Number of Observations	24376	24376	24376

Source: Authors' analysis of spillover of Medicaid expansion to prescribing of opioid use disorder treatment medications in Medicare Part D using data from the Medicare Part D Prescription Public Use File, Medicare Geographic Variation Files, and other publicly available sources, 2010-2017.
Notes: Models include county and year fixed effects, and standard errors are clustered at the state level;
*** p<.01, ** p<.05, + p<.10.*

Table C2. Difference-in-differences linear regression results predicting the number of opioid use disorder medication providers serving Medicare Part D, 2010-2017 (Log Transformation)

	(1) Number of providers	(2) Number of buprenorphine providers	(3) Number of injectable naltrexone providers
	b (SE)	b (SE)	b (SE)
Expanded Medicaid	0.055+ (0.03)	0.055+ (0.03)	0.033*** (0.01)
Percentage of Medicare beneficiaries in county	0.024*** (0.01)	0.019*** (0.01)	0.00080 (0.00)
Percent of Medicare beneficiaries in MA plan	0.088 (0.17)	0.10 (0.16)	-0.060 (0.06)
Percent Medicare beneficiaries dually eligible	0.00024 (0.00)	0.00033 (0.00)	-0.0022 (0.00)
Average age of Medicare beneficiaries	0.0067 (0.01)	0.0088 (0.01)	-0.0047 (0.00)
Percent female Medicare beneficiaries	-0.00052 (0.01)	0.0016 (0.01)	-0.0013 (0.00)
Number of inpatient stays, per 1,000 beneficiaries	-0.000044 (0.00)	-0.00011 (0.00)	-0.000038 (0.00)
Number of ED visits, per 1,000 beneficiaries	-0.00014** (0.00)	-0.000097+ (0.00)	-0.000035 (0.00)
Average HCC score	0.022 (0.14)	-0.0093 (0.14)	-0.0088 (0.06)
Median household income, per 10,000 county population	0.023+ (0.01)	0.021+ (0.01)	0.028** (0.01)
Unemployment rate	-0.0031 (0.01)	-0.0046 (0.01)	-0.0026+ (0.00)
Percent African-	0.018+	0.016	-0.0030

American	(0.01)	(0.01)	(0.01)
Percent Hispanic	-0.011	-0.0041	0.0035
	(0.01)	(0.01)	(0.01)
Percent Asian or other race	0.071***	0.060***	0.022**
	(0.01)	(0.01)	(0.01)
Poverty rate	0.0022	0.0026	0.00058
	(0.00)	(0.00)	(0.00)
Log of total population	1.68***	1.37***	0.12+
	(0.20)	(0.19)	(0.06)
Naloxone distribution law	-0.0031	-0.0012	0.0040
	(0.02)	(0.02)	(0.01)
Must-access PDMP law	0.035	0.039	0.019
	(0.03)	(0.03)	(0.02)
Pain management clinic law	0.017	0.025	-0.0022
	(0.03)	(0.03)	(0.01)
Medical cannabis dispensary	0.063**	0.069**	0.046
	(0.03)	(0.03)	(0.03)
Recreational cannabis dispensary	0.015	0.017	-0.059***
	(0.04)	(0.04)	(0.02)
Constant	-18.2***	-15.1***	-0.95
	(2.38)	(2.41)	(0.75)
Number of Observations	24376	24376	24376

Source: Authors' analysis of spillover of Medicaid expansion to prescribing of opioid use disorder treatment medications in Medicare Part D using data from the Medicare Part D Prescription Public Use File, Medicare Geographic Variation Files, and other publicly available sources, 2010-2017. Outcome variables are specified as log(number providers + 1).
*Notes: Models include county and year fixed effects, and standard errors are clustered at the state level. Number of Observations 24,376; *** $p<.01$, ** $p<.05$, + $p<.10$.*

Table C3. Difference-in-differences linear regression results predicting the number of opioid use disorder medication daily doses serving Medicare Part D, 2010-2017 (Log Transformation)

	(1) Number of daily doses	(2) Number of daily doses of buprenorphine	(3) Number of daily doses of injectable naltrexone
	b (SE)	b (SE)	b (SE)
Expanded Medicaid	0.12	0.16	0.23***
	(0.09)	(0.10)	(0.08)
Percentage of Medicare beneficiaries in county	0.10***	0.087**	0.0099
	(0.03)	(0.03)	(0.02)
Percent of Medicare beneficiaries in MA plan	-0.45	0.23	-0.39
	(0.81)	(0.79)	(0.38)
Percent Medicare beneficiaries dually eligible	0.018	0.024	-0.014
	(0.02)	(0.02)	(0.01)
Average age of Medicare beneficiaries	0.050	0.055	-0.024
	(0.05)	(0.05)	(0.02)
Percent female Medicare beneficiaries	0.014	0.027	-0.0067
	(0.03)	(0.03)	(0.01)
Number of inpatient stays, per 1,000 beneficiaries	0.000042	-0.00032	-0.00033
	(0.00)	(0.00)	(0.00)
Number of ED visits, per 1,000 beneficiaries	-0.00058	-0.00042	-0.00011
	(0.00)	(0.00)	(0.00)
Average HCC score	1.03	0.61	-0.040
	(0.63)	(0.71)	(0.36)
Median household income, per 10,000 county population	-0.097	-0.080	0.13***
	(0.06)	(0.05)	(0.05)
Unemployment rate	-0.0012	-0.0082	-0.014
	(0.03)	(0.03)	(0.01)
Percent African-American	-0.0059	0.026	-0.017
	(0.05)	(0.06)	(0.04)

Percent Hispanic	-0.068+	-0.033	0.014
	(0.04)	(0.04)	(0.03)
Percent Asian or other race	0.018	-0.027	0.11+
	(0.05)	(0.05)	(0.06)
Poverty rate	0.0091	0.013	0.0018
	(0.01)	(0.01)	(0.00)
Log of total population	5.25***	4.29***	1.01**
	(0.81)	(0.76)	(0.50)
Naloxone distribution law	0.047	0.026	0.031
	(0.05)	(0.06)	(0.06)
Must-access PDMP law	0.062	0.11	0.086
	(0.11)	(0.12)	(0.08)
Pain management clinic law	0.24**	0.23+	0.0078
	(0.11)	(0.12)	(0.06)
Medical cannabis dispensary	0.18	0.20+	0.24
	(0.11)	(0.11)	(0.15)
Recreational cannabis dispensary	0.11	0.059	-0.39***
	(0.12)	(0.14)	(0.11)
Constant	-57.6***	-49.1***	-8.87
	(9.14)	(8.80)	(5.59)
Number of Observations	24376	24376	24376

Source: Authors' analysis of spillover of Medicaid expansion to prescribing of opioid use disorder treatment medications in Medicare Part D using data from the Medicare Part D Prescription Public Use File, Medicare Geographic Variation Files, and other publicly available sources, 2010-2017. Outcome variables are specified as log(number daily doses + 1).
Notes: Models include county and year fixed effects, and standard errors are clustered at the state level. Number of Observations 24,376; *** p<.01, ** p<.05, + p<.10.
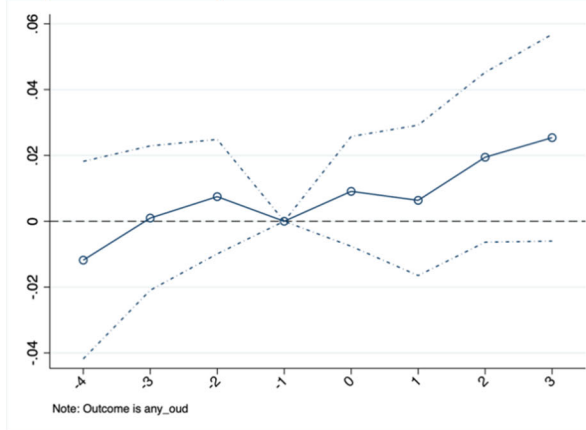
Supplement D: Event Study Analyses

Description of Event Study Models

For the event study models, we replace the single post indicator variable with a set of indicator variables that capture years relative to implementation (from 6 years prior to 3 years post Medicaid expansion), with the year prior to adoption as the omitted period. Coefficient estimates for 6 and 5 years prior to adoption are excluded from the figure, as they are only identified off of the few late adopting states. In all figures, the dashed lines represent 95% confidence intervals, and standard errors are clustered at the state level.
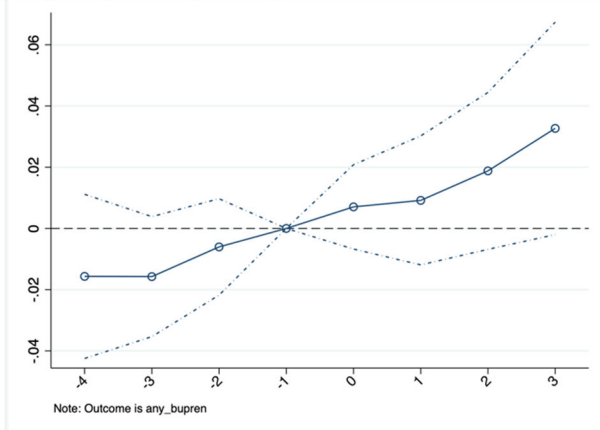
For all outcome variables the estimated coefficients for the periods prior to Medicaid expansion are not statistically different from zero, which provides support for the identifying assumption that in the absence of Medicaid expansion the outcomes in adopting and non-adopting states would have evolved along similar trends. We note, however, that for the buprenorphine-related outcomes, examination of the point estimates suggests that this outcome *was* potentially evolving along a different trend for expanding and non-expanding states in the periods prior to expansion. Therefore, these results should be interpreted with caution.

Figure D1. Event study results for the probability of a county having at least one provider serving Medicare Part D for a given opioid use disorder medication
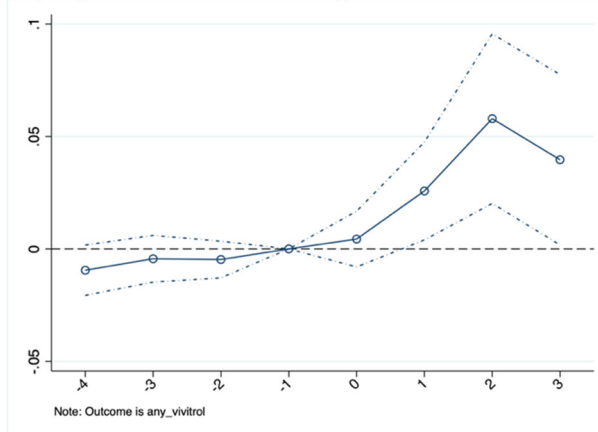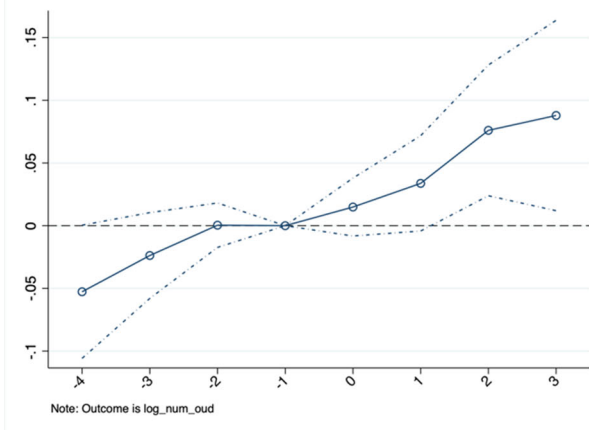
Any medication providers:

Note: Outcome is any_oud

Any buprenorphine providers:

Note: Outcome is any_bupren

Any injectable naltrexone providers:
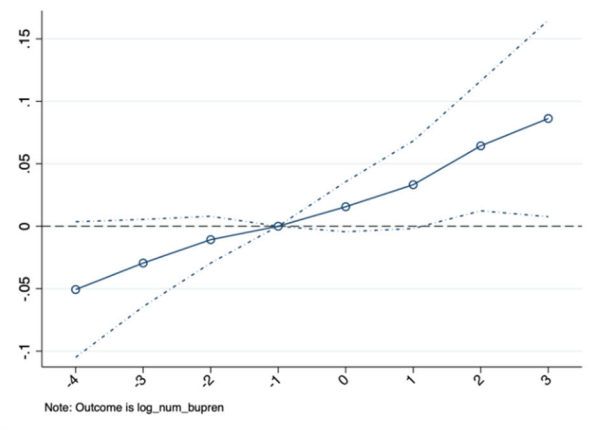

Note: Outcome is any_vivitrol

Figure D2: Event study results for the log(number of opioid use disorder medication providers) serving Medicare Part D

Log number of any medication providers:
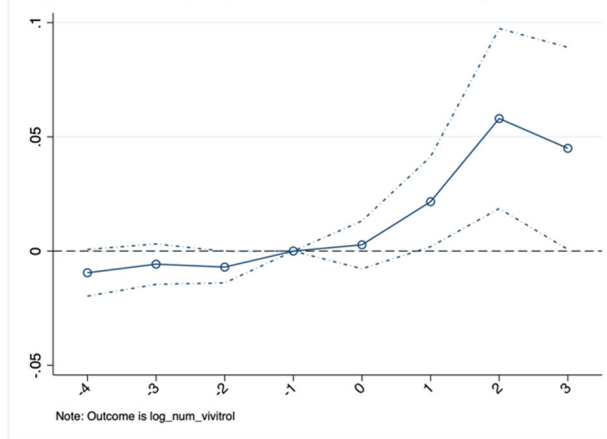

Note: Outcome is log_num_oud

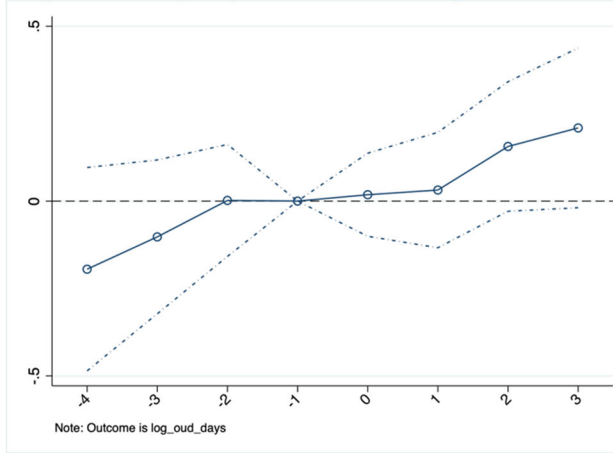*Log number of buprenorphine providers:*

Note: Outcome is log_num_bupren

Log number of injectable naltrexone providers:
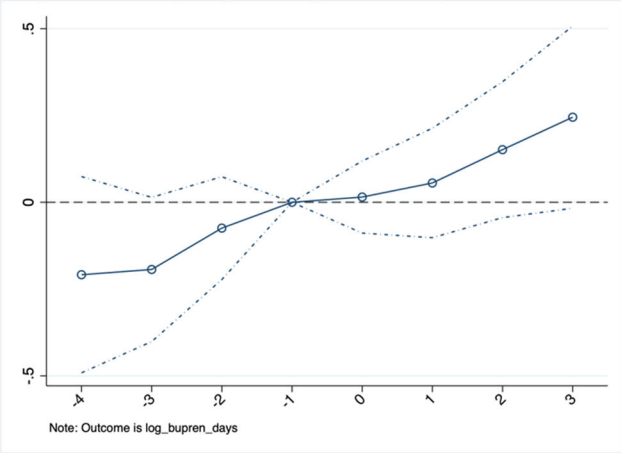

Note: Outcome is log_num_vivitrol

Figure D3: Event study results for the log(number of opioid use disorder medication daily doses) serving Medicare Part D

Log number of any medication daily doses:

Note: Outcome is log_oud_days

Log number of buprenorphine daily doses:

Note: Outcome is log_bupren_days

Log number of injectable naltrexone daily doses:

Note: Outcome is log_vivitrol_days