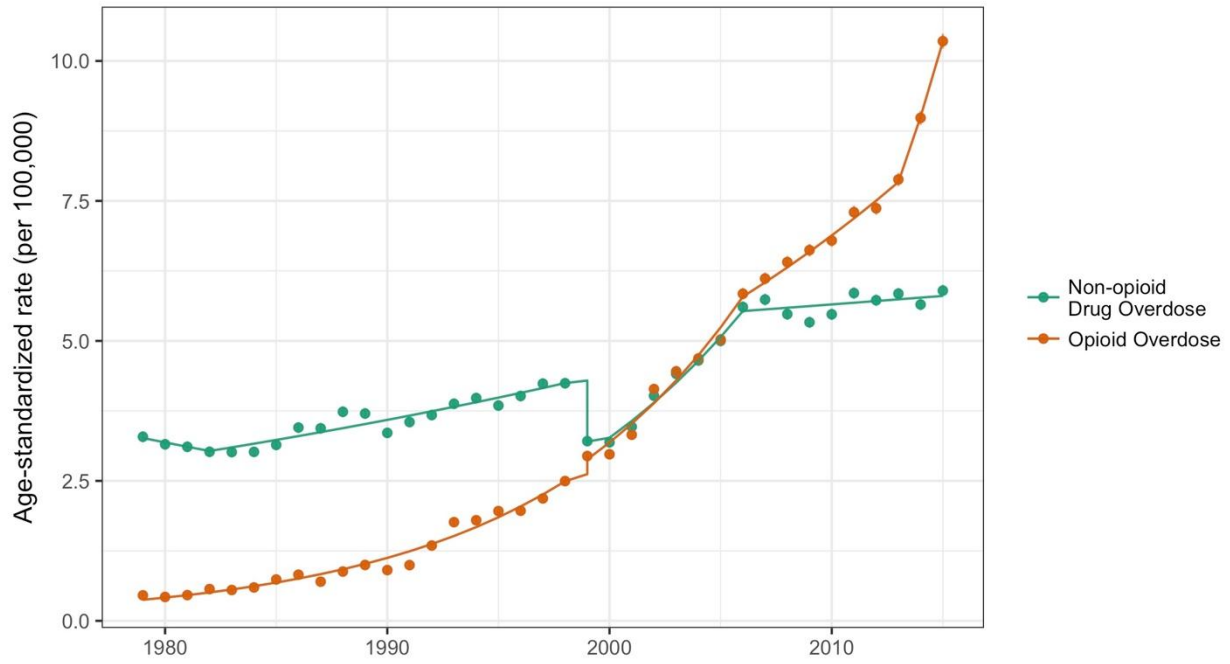


Supplement for Trends in Black and White Opioid Mortality in the United States, 1979–2015

1. eFigure 1: Non-opioid drug vs opioid mortality, 1979–2015, total population
2. eTable 1: Joinpoint results of drug and opioid mortality in the total population, 1979–2015
3. eTable 2: ISW7 definition for opioid and drug deaths for ICD-9 and ICD-10.
4. eTable 3: Joinpoint results for all opioids for the white population, 1979–2015
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10. eText 1: Location of the public repository of all code to reproduce plots and tables

Web Figure 1. Drug vs Opioid Mortality, 1979–2015, Total Population



Circles represent the observed age-standardized rate of non-opioid drug overdoses (green) and opioid overdoses (orange). Vertical lines are the 95% confidence intervals. Lines are joinpoint regression model lines.

Web Table 1: Joinpoint Results of Non-Opioid and Opioid Mortality in the Total Population, 1979–2015

Web Table 1a: Opioid Drug Deaths, Total Population, 1979-2015

Average APC

Time period	Race	Outcome	Average APC (95% CI)	P value
1979-2015	All	Opioid drug deaths	9.50 (8.81, 10.20)	< 0.001

Joinpoint Summary (Jump model)

Time period	Race	Outcome	APC (95% CI)	P value
1979-2006	All	Opioid drug deaths	10.47 (9.99, 10.95)	< 0.001
2006-2013	All	Opioid drug deaths	4.42 (2.65, 6.23)	< 0.001
2013-2015	All	Opioid drug deaths	14.88 (5.62, 24.96)	< .01

Joinpoint Model Estimates

Estimates

Year (95% CI)	Intercept (SE)	Intercept P Value	Slope (SE)	Slope P Value	Change in Slope (SE)	Slope Change P Value
1979 (Starting year)	-198.01 (4.26)	< 0.001	0.10 (0.00)	< 0.001	NA	NA
2006 (2004, 2008)	-85.08 (16.83)	< 0.001	0.04 (0.01)	< 0.001	-0.06 (0.01)	< 0.001
2013 (2011, 2013)	-277.30 (82.79)	< .01	0.14 (0.04)	< .01	0.10 (0.04)	< .05

Summary

Outcome	Race	Obs. (N)	Parameters	Degrees of Freedom	Sum of squared errors	Mean squared error
Opioid deaths	All	37	6	31	712.537	22.98506

Web Table 1b: Non-Opioid Drug Deaths, Total Population, 1979-2015

Average APC

Time period	Race	Outcome	Average APC (95% CI)	P value
1979-2015	All	Non-opioid drug deaths	2.47 (1.30, 3.65)	< 0.001

Joinpoint Summary (Jump model)

Time period	Race	Outcome	APC (95% CI)	P value
1979-1982	All	Non-opioid drug deaths	-2.42 (-12.77, 9.15)	= 0.66
1982-2000	All	Non-opioid drug deaths	2.12 (1.43, 2.83)	< 0.001
2000-2006	All	Non-opioid drug deaths	9.16 (5.26, 13.20)	< 0.001
2006-2015	All	Non-opioid drug deaths	0.53 (-0.70, 1.78)	= 0.39

Joinpoint Model Estimates

Estimates

Year (95% CI)	Intercept (SE)	Intercept P Value	Slope (SE)	Slope P Value	Change in Slope (SE)	Slope Change P Value
1979 (Starting year)	49.75 (108.00)	= 0.65	-0.02 (0.05)	= 0.66	NA	NA
1982 (1981, 2001)	-40.55 (6.64)	< 0.001	0.02 (0.00)	< 0.001	0.05 (0.05)	= 0.41
2000 (1996, 2007)	-173.82 (35.42)	< 0.001	0.09 (0.02)	< 0.001	0.07 (0.02)	< .01
2006 (2004, 2013)	-8.64 (12.09)	= 0.48	0.01 (0.01)	= 0.39	-0.08 (0.02)	< 0.001

Summary

Outcome	Race	Obs. (N)	Parameters	Degrees of Freedom	Sum of squared errors	Mean squared error
Non-opioid drug deaths	All	37	8	29	366.5493	12.63963

Web Table 2: Definition of Opioid and Drug Deaths for ICD-9 and ICD-10

ICD-9^a		
	External Injury Code	Nature of Injury Code
Drugs	E850–E858 , E950(.0–.5), E962.0, E980(.0–.5)	909(.0,–.5), 960–979, 995 (.2, .4, .86, .89), 999(.4–.7)
Opioids	E850(.0–.2)	965.0
ICD-10^b		
	Underlying Cause	Contributory Cause
Drugs		T36–T50.9
Opioids	X40–X44, X60–X64, X85, Y10–Y14	T40(.0–.4, .6)
^a ICD-9 definitions need only one of the codes from either column to be classified as a drug or opioid death ^b ICD-10 definitions require one code from each column to be classified as a drug or opioid death		

Web Table 3: Joinpoint Results for all Opioids for the White Population, 1979–2015

Average APC

Race	Outcome	Time period	Average APC (95% CI)	<i>P</i> value
White	Opioid deaths	1979-2015	9.90 (8.77, 11.05)	< 0.001

Joinpoint Summary (Jump model)

Race	Outcome	Time period	APC (95% CI)	<i>P</i> value
White	Opioid deaths	1979-1989	8.32 (4.98, 11.77)	< 0.001
White	Opioid deaths	1989-2006	12.53 (11.73, 13.33)	< 0.001
White	Opioid deaths	2006-2013	4.63 (2.91, 6.39)	< 0.001
White	Opioid deaths	2013-2015	14.81 (5.75, 24.65)	< .01

Joinpoint Model Estimates

Estimates

Year (95% CI)	Intercept (SE)	Intercept <i>P</i> Value	Slope (SE)	Slope <i>P</i> Value	Change in Slope (SE)	Slope Change <i>P</i> Value
1979 (Starting year)	-159.14 (30.27)	< 0.001	0.08 (0.02)	< 0.001	NA	NA
1989 (1981, 2007)	-234.84 (6.93)	< 0.001	0.12 (0.00)	< 0.001	0.04 (0.02)	< .05
2006 (2004, 2010)	-88.93 (16.26)	< 0.001	0.05 (0.01)	< 0.001	-0.07 (0.01)	< 0.001
2013 (2011, 2013)	-275.89 (80.58)	< .01	0.14 (0.04)	< .01	0.09 (0.04)	< .05

Summary

Outcome	Race	Obs. (N)	Parameters	Degrees of Freedom	Sum of squared errors	Mean squared error
Opioid deaths	White	37	8	29	558.3175	19.25233

Web Table 4: Joinpoint Results for all Opioids for the Black Population, 1979–2015

Average APC

Race	Outcome	Time period	Average APC (95% CI)	P value
Black	Opioid deaths	1979-2015	6.22 (5.13, 7.31)	< 0.001

Joinpoint Summary (Jump model)

Race	Outcome	Time period	APC (95% CI)	P value
Black	Opioid deaths	1979-1994	10.88 (8.82, 12.98)	< 0.001
Black	Opioid deaths	1994-2011	0.10 (-0.79, 1.00)	= 0.81
Black	Opioid deaths	2011-2015	16.31 (10.26, 22.69)	< 0.001

Joinpoint Model Estimates

Estimates

Year (95% CI)	Intercept (SE)	Intercept P Value	Slope (SE)	Slope P Value	Change in Slope (SE)	Slope Change P Value
1979 (Starting year)	-204.91 (18.25)	< 0.001	0.10 (0.01)	< 0.001	NA	NA
1994 (1992, 1996)	-1.03 (8.78)	= 0.91	0.00 (0.00)	= 0.82	-0.10 (0.01)	< 0.001
2011 (2009, 2013)	-302.77 (52.58)	< 0.001	0.15 (0.03)	< 0.001	0.15 (0.03)	< 0.001

Summary

Outcome	Race	Obs. (N)	Parameters	Degrees of Freedom	Sum of squared errors	Mean squared error
Opioid deaths	Black	37	6	31	156.1592	5.037392

Web Table 5: Joinpoint Results by Opioid Type for the White Population, 1979–2015

Average APC

Race	Outcome	Time period	Average APC (95% CI)	P value
White	Heroin	1979-2015	11.86 (9.96, 13.80)	< 0.001
White	Methadone	1979-2015	1.68 (-0.46, 3.87)	= 0.12
White	Non-heroin, non-methadone opioid	1979-2015	9.33 (3.91, 15.04)	< .01

Joinpoint Summary (Jump model)

Race	Outcome	Time period	APC (95% CI)	P value
White	Heroin	1979-1998	11.49 (9.97, 13.05)	< 0.001
White	Heroin	1998-2005	0.55 (-4.64, 6.03)	= 0.83
White	Heroin	2005-2010	12.38 (3.20, 22.37)	< .01
White	Heroin	2010-2015	30.88 (26.32, 35.59)	< 0.001
White	Methadone	1979-1988	-1.78 (-6.27, 2.93)	= 0.43
White	Methadone	1988-1998	-9.20 (-14.53, -3.53)	< .01
White	Methadone	1998-2003	43.04 (37.05, 49.28)	< 0.001
White	Methadone	2003-2006	20.34 (11.60, 29.76)	< 0.001
White	Methadone	2006-2011	-5.37 (-7.41, -3.28)	< 0.001
White	Methadone	2011-2015	-8.19 (-10.57, -5.75)	< 0.001
White	Non-heroin, non-methadone opioid	1979-1990	7.54 (1.68, 13.75)	< .05
White	Non-heroin, non-methadone opioid	1990-1993	23.22 (-30.37, 118.07)	= 0.46
White	Non-heroin, non-methadone opioid	1993-2010	9.09 (7.88, 10.32)	< 0.001
White	Non-heroin, non-methadone opioid	2010-2013	-1.03 (-17.17, 18.25)	= 0.91
White	Non-heroin, non-methadone opioid	2013-2015	18.38 (0.94, 38.84)	< .05

Joinpoint Model Estimates

Estimates

Outcome	Year (95% CI)	Intercept (SE)	Intercept P Value	Slope (SE)	Slope P Value	Change in Slope (SE)	Slope Change P Value
Heroin	1979 (Starting year)	-217.34 (13.38)	< 0.001	0.11 (0.01)	< 0.001	NA	NA
Heroin	1998 (1994, 2003)	-10.95 (51.60)	= 0.83	0.01 (0.03)	= 0.83	-0.10 (0.03)	< 0.001
Heroin	2005 (2000, 2010)	-233.86 (83.21)	< .01	0.12 (0.04)	< .01	0.11 (0.05)	< .05
Heroin	2010 (2008, 2013)	-540.15 (34.67)	< 0.001	0.27 (0.02)	< 0.001	0.15 (0.04)	< .01
Methadone	1979 (Starting year)	32.54	= 0.47	-0.02	= 0.43	NA	NA

	year)	(44.50)		(0.02)			
Methadone	1988 (1981, 2000)	188.61 (57.80)	< .01	-0.10 (0.03)	< .01	-0.08 (0.04)	< .05
Methadone	1998 (1984, 2004)	-719.31 (40.99)	< 0.001	0.36 (0.02)	< 0.001	0.45 (0.04)	< 0.001
Methadone	2003 (1995, 2007)	-373.23 (72.42)	< 0.001	0.19 (0.04)	< 0.001	-0.17 (0.04)	< 0.001
Methadone	2006 (2001, 2010)	108.82 (21.00)	< 0.001	-0.06 (0.01)	< 0.001	-0.24 (0.04)	< 0.001
Methadone	2011 (2005, 2013)	169.73 (25.36)	< 0.001	-0.09 (0.01)	< 0.001	-0.03 (0.02)	= 0.08
Non-heroin, non-methadone opioid	1979 (Starting year)	-145.49 (53.82)	< .05	0.07 (0.03)	< .05	NA	NA
Non-heroin, non-methadone opioid	1990 (1981, 1992)	-416.28 (549.57)	= 0.46	0.21 (0.28)	= 0.46	0.14 (0.28)	= 0.63
Non-heroin, non-methadone opioid	1993 (1991, 2003)	-173.59 (10.80)	< 0.001	0.09 (0.01)	< 0.001	-0.12 (0.28)	= 0.66
Non-heroin, non-methadone opioid	2010 (2007, 2010)	22.21 (173.05)	= 0.90	-0.01 (0.09)	= 0.91	-0.10 (0.09)	= 0.27
Non-heroin, non-methadone opioid	2013 (2012, 2013)	-338.32 (155.22)	< .05	0.17 (0.08)	< .05	0.18 (0.12)	= 0.13

Summary

Outcome	Race	Obs. (N)	Parameters	Degrees of Freedom	Sum of squared errors	Mean squared error
Heroin	White	37	8	29	580.29124	20.010043
Methadone	White	37	12	25	80.12523	3.205009
Non-heroin, non-methadone opioid	White	37	10	27	246.14265	9.116394

Web Table 6: Joinpoint results by opioid type for the black population, 1979–2015

Average APC

Race	Outcome	Time period	Average APC (95% CI)	P value
Black	Heroin	1979-2015	7.32 (6.01, 8.64)	< 0.001
Black	Methadone	1979-2015	-1.06 (-5.05, 3.10)	= 0.61
Black	Non-heroin, non-methadone opioid	1979-2015	7.18 (4.84, 9.56)	< 0.001

Joinpoint Summary (Jump model)

Race	Outcome	Time period	APC (95% CI)	P value
Black	Heroin	1979-1995	7.60 (5.56, 9.69)	< 0.001
Black	Heroin	1995-2010	-0.44 (-1.99, 1.13)	= 0.57
Black	Heroin	2010-2015	33.28 (26.73, 40.16)	< 0.001
Black	Methadone	1979-1987	1.98 (-8.99, 14.27)	= 0.72
Black	Methadone	1987-1999	-12.56 (-20.04, -4.38)	< .01
Black	Methadone	1999-2006	23.62 (18.11, 29.39)	< 0.001
Black	Methadone	2006-2009	-9.43 (-25.11, 9.55)	= 0.29
Black	Methadone	2009-2015	-1.91 (-5.17, 1.46)	= 0.25
Black	Non-heroin, non-methadone opioid	1979-1994	14.52 (10.31, 18.89)	< 0.001
Black	Non-heroin, non-methadone opioid	1994-2013	-0.66 (-1.93, 0.62)	= 0.30
Black	Non-heroin, non-methadone opioid	2013-2015	34.13 (1.58, 77.11)	< .05

Joinpoint Model Estimates

Estimates

Outcome	Year (95% CI)	Intercept (SE)	Intercept P Value	Slope (SE)	Slope P Value	Change in Slope (SE)	Slope Change P Value
Heroin	1979 (Starting year)	-146.05 (18.64)	< 0.001	0.07 (0.01)	< 0.001	NA	NA
Heroin	1995 (1993, 2002)	8.94 (15.36)	= 0.57	-0.00 (0.01)	= 0.57	-0.08 (0.01)	< 0.001
Heroin	2010 (2009, 2011)	-577.34 (49.60)	< 0.001	0.29 (0.02)	< 0.001	0.29 (0.03)	< 0.001
Methadone	1979 (Starting year)	-41.85 (109.05)	= 0.70	0.02 (0.06)	= 0.72	NA	NA
Methadone	1987 (1981, 2001)	263.87 (86.12)	< .01	-0.13 (0.04)	< .01	-0.15 (0.07)	< .05
Methadone	1999 (1984, 2007)	-428.36 (44.14)	< 0.001	0.21 (0.02)	< 0.001	0.35 (0.05)	< 0.001
Methadone	2006 (1993, 2009)	195.63	= 0.30	-0.10	= 0.29	-0.31 (0.09)	< .01

	2010)	(184.55)		(0.09)			
Methadone	2009 (2004, 2013)	35.46 (32.84)	= 0.29	-0.02 (0.02)	= 0.25	0.08 (0.09)	= 0.40
Non-heroin, non- methadone opioid	1979 (Starting year)	-269.81 (36.40)	< 0.001	0.14 (0.02)	< 0.001	NA	NA
Non-heroin, non- methadone opioid	1994 (1992, 1996)	13.83 (12.58)	= 0.28	-0.01 (0.01)	= 0.30	-0.14 (0.02)	< 0.001
Non-heroin, non- methadone opioid	2013 (2009, 2013)	-590.71 (273.79)	< .05	0.29 (0.14)	< .05	0.30 (0.14)	< .05

Summary

Outcome	Race	Obs. (N)	Parameters	Degrees of Freedom	Sum of squared errors	Mean squared error
Heroin	Black	37	6	31	96.48112	3.112294
Methadone	Black	37	10	27	32.05168	1.187099
Non-heroin, non- methadone opioid	Black	37	6	31	195.46617	6.305360

Web Table 7: Joinpoint results by ICD-10 opioid type for the white population, 1979–2015

Average APC

Race	Outcome	Time period	Average APC (95% CI)	P value
White	Heroin	1999-2015	13.05 (10.20, 15.96)	< 0.001
White	Methadone	1999-2015	9.19 (6.62, 11.82)	< 0.001
White	Natural	1999-2015	8.90 (7.80, 10.01)	< 0.001
White	Other	1999-2015	-0.23 (-0.81, 0.36)	= 0.42
White	Synthetic	1999-2015	17.06 (13.20, 21.06)	< 0.001

Joinpoint Summary (Jump model)

Race	Outcome	Time period	APC (95% CI)	P value
White	Heroin	1999-2005	0.55 (-3.82, 5.12)	= 0.79
White	Heroin	2005-2010	12.38 (4.62, 20.70)	< .01
White	Heroin	2010-2015	30.88 (27.05, 34.82)	< 0.001
White	Methadone	1999-2003	42.72 (33.78, 52.26)	< 0.001
White	Methadone	2003-2006	21.39 (8.30, 36.05)	< .01
White	Methadone	2006-2015	-6.42 (-7.40, -5.43)	< 0.001
White	Natural	1999-2010	12.81 (11.51, 14.12)	< 0.001
White	Natural	2010-2015	0.76 (-1.78, 3.37)	= 0.53
White	Other	1999-2015	-0.23 (-0.81, 0.36)	= 0.42
White	Synthetic	1999-2006	17.68 (11.30, 24.44)	< 0.001
White	Synthetic	2006-2013	3.19 (-1.66, 8.28)	= 0.17
White	Synthetic	2013-2015	78.70 (50.42, 112.29)	< 0.001

Joinpoint Model Estimates

Estimates

Outcome	Year (95% CI)	Intercept (SE)	Intercept P Value	Slope (SE)	Slope P Value	Change in Slope (SE)	Slope Change P Value
Heroin	1979 (Starting year)	-11.38 (39.35)	= 0.78	0.01 (0.02)	= 0.79	NA	NA
Heroin	2005 (2001, 2008)	-234.28 (63.45)	< .01	0.12 (0.03)	< .01	0.11 (0.04)	< .05
Heroin	2010 (2008, 2012)	-540.58 (26.43)	< 0.001	0.27 (0.01)	< 0.001	0.15 (0.03)	< .01
Methadone	1979 (Starting year)	-712.28 (57.22)	< 0.001	0.36 (0.03)	< 0.001	NA	NA
Methadone	2003 (2001, 2005)	-387.96 (101.09)	< .01	0.19 (0.05)	< .01	-0.16 (0.06)	< .05

Methadone	2006 (2005, 2008)	133.87 (9.37)	< 0.001	-0.07 (0.00)	< 0.001	-0.26 (0.05)	< 0.001
Natural	1979 (Starting year)	-240.83 (10.67)	< 0.001	0.12 (0.01)	< 0.001	NA	NA
Natural	2010 (2007, 2011)	-13.79 (23.59)	= 0.57	0.01 (0.01)	= 0.53	-0.11 (0.01)	< 0.001
Other	1979 (Starting year)	4.56 (5.50)	= 0.42	-0.00 (0.00)	= 0.42	NA	NA
Synthetic	1979 (Starting year)	-326.76 (49.42)	< 0.001	0.16 (0.02)	< 0.001	NA	NA
Synthetic	2006 (2003, 2010)	-63.07 (42.77)	= 0.17	0.03 (0.02)	= 0.17	-0.13 (0.03)	< .01
Synthetic	2013 (2012, 2013)	-1168.50 (153.40)	< 0.001	0.58 (0.08)	< 0.001	0.55 (0.08)	< 0.001

Summary

Outcome	Race	Obs. (N)	Parameters	Degrees of Freedom	Sum of squared errors	Mean squared error
Heroin	White	17	6	11	179.42790	16.311627
Methadone	White	17	6	11	78.36266	7.123878
Natural	White	17	4	13	195.82764	15.063665
Other	White	17	2	15	104.10104	6.940070
Synthetic	White	17	6	11	178.63099	16.239181

Web Table 8: Joinpoint results by ICD-10 opioid type for the black population, 1979–2015

Average APC

Race	Outcome	Time period	Average APC (95% CI)	P value
Black	Heroin	1999-2015	9.02 (6.83, 11.25)	< 0.001
Black	Methadone	1999-2015	6.21 (4.14, 8.33)	< 0.001
Black	Natural	1999-2015	8.16 (7.66, 8.67)	< 0.001
Black	Other	1999-2015	-8.21 (-9.13, -7.29)	< 0.001
Black	Synthetic	1999-2015	15.36 (0.67, 32.18)	< .05

Joinpoint Summary (Jump model)

Race	Outcome	Time period	APC (95% CI)	P value
Black	Heroin	1999-2010	-0.56 (-2.86, 1.79)	= 0.61
Black	Heroin	2010-2015	33.46 (26.90, 40.37)	< 0.001
Black	Methadone	1999-2006	21.81 (16.69, 27.14)	< 0.001
Black	Methadone	2006-2015	-4.52 (-6.43, -2.56)	< 0.001
Black	Natural	1999-2015	8.16 (7.66, 8.67)	< 0.001
Black	Other	1999-2015	-8.21 (-9.13, -7.29)	< 0.001
Black	Synthetic	1999-2013	6.09 (-5.68, 19.32)	= 0.29
Black	Synthetic	2013-2015	107.34 (-14.65, 403.72)	= 0.10

Joinpoint Model Estimates

Estimates

Outcome	Year (95% CI)	Intercept (SE)	Intercept P Value	Slope (SE)	Slope P Value	Change in Slope (SE)	Slope Change P Value
Heroin	1979 (Starting year)	11.06 (21.51)	= 0.62	-0.01 (0.01)	= 0.61	NA	NA
Heroin	2010 (2009, 2011)	-580.48 (46.59)	< 0.001	0.29 (0.02)	< 0.001	0.29 (0.03)	< 0.001
Methadone	1979 (Starting year)	-395.89 (39.43)	< 0.001	0.20 (0.02)	< 0.001	NA	NA
Methadone	2006 (2004, 2007)	92.54 (18.71)	< 0.001	-0.05 (0.01)	< 0.001	-0.24 (0.02)	< 0.001
Natural	1979 (Starting year)	-157.40 (4.42)	< 0.001	0.08 (0.00)	< 0.001	NA	NA
Other	1979 (Starting year)	172.09 (9.45)	< 0.001	-0.09 (0.00)	< 0.001	NA	NA
Synthetic	1979	-119.62	= 0.29	0.06	= 0.30	NA	NA

	(Starting year)	(108.31)		(0.05)			
Synthetic	2013 (2010, 2013)	-1468.59 (820.77)	= 0.10	0.73 (0.41)	= 0.10	0.67 (0.41)	= 0.13

Summary

Outcome	Race	Obs. (N)	Parameters	Degrees of Freedom	Sum of squared errors	Mean squared error
Heroin	Black	17	4	13	45.26414	3.481857
Methadone	Black	17	4	13	22.19573	1.707364
Natural	Black	17	2	15	11.75447	0.783631
Other	Black	17	2	15	53.40062	3.560041
Synthetic	Black	17	4	13	589.08946	45.314574

eText 1: Location of the public repository of all code to reproduce plots and tables

A public repository of all code to reproduce the tables and figures in the text and supplement can be found at https://github.com/mkiang/opioid_trends. Note that joinpoint analyses were conducted using the Joinpoint Regression Program GUI (i.e., not the command line interface) and thus are not a part of the reproducible pipeline. However, the data and input file for the joinpoint analyses are included in the repo and can be performed independently of the pipeline.