

Supplemental Online Content

Xuan Z, Yan S, Formica SW, et al. Association of implementation of postoverdose outreach programs with subsequent opioid overdose deaths among Massachusetts municipalities. *JAMA Psychiatry*. Published online March 15, 2023. doi:10.1001/jamapsychiatry.2023.0109

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This supplemental material has been provided by the authors to give readers additional information about their work.

eTable 1. Baseline Difference in Opioid Fatality Rate Level and Slope between the Series of Non-implementing Municipalities and the Pre-implementation Series of the Implementing Municipalities

	Opioid fatality rates before implementation		Opioid fatality rates after implementation	
	Baseline level (95% CI)	Baseline slope (95% CI) (per quarter)	Baseline level (95% CI)	Baseline slope (95% CI) (per quarter)
Model 1^a				
Municipalities with program (N=58)	5.23 (4.61, 5.93)	0.15 (0.11, 0.19)	0.28 (-0.39, 1.05)	-0.12 (-0.21, -0.03)
Municipalities without program (N=35)	5.08 (4.50, 5.74)	0.13 (0.08 to 0.19)	No change	No change
Difference between municipalities with and without programs	0.15 (-0.69, 1.15)	0.02 (-0.04, 0.07)	0.28 (-0.39, 1.05)	-0.12 (-0.21, -0.03)
Model 2^b				
All 93 municipalities	4.94 (4.38, 5.49)	0.19 (0.15, 0.24)	0.53 (-0.52, 1.58)	-0.16 (-0.29, -0.03)

^a Linear generalized estimating equations (GEE) regression model with a normal link function was used to estimate the average level and slope (per quarter) of opioid fatality rate at baseline, and the rate difference of level change and slope change (per quarter) between the non-implementing municipalities and implementing municipalities, without adjusting for municipal-level covariates.

^b Given the baseline equivalence in Model 1 with respect to level (level difference=0.15, 95% CI [-0.69, 1.15]) and trend (slope difference=0.02, 95% CI [-0.04, 0.07]), Model 2 only evaluated the baseline level and slope, and the changes of level and slope among all 93 municipalities without explicitly modeling the terms on municipalities' program status and its interaction with baseline slope due to the lack of statistical significance of these two terms.

eTable 2. Post hoc Sensitivity Analyses of the Associations of Post-overdose Programs With the Outcomes of Opioid Fatality Rate, and Opioid Emergency Response Rate, in Massachusetts, From January 2013 to June 2019

	Adjusted analysis 3: Removing potential mediators^b	Adjusted analysis 4: Controlling for state-wide standing order mandate	Adjusted analysis 5: Excluding 7 municipalities without program inception information
Primary outcome: Opioid fatality rate	Rate ratio (95% CI), p-value	Rate ratio (95% CI), p-value	Rate ratio (95% CI), p-value
Level change	1.05 (0.94, 1.16), p=0.39	1.06 (0.95, 1.19), p=0.28	1.10 (0.99, 1.23), p=0.09
Slope change (annualized per year)	0.94 (0.90, 0.98), p=0.005	0.94 (0.90, 0.98), p=0.008	0.94 (0.90, 0.98), p=0.007
Secondary outcome: Opioid emergency responses rate	Rate ratio (95% CI), p-value	Rate ratio (95% CI), p-value	Rate ratio (95% CI), p-value
Level change	1.07 (0.97, 1.18), p=0.18	1.07 (0.97, 1.18), p=0.17	1.08 (0.97, 1.20), p=0.15
Slope change (annualized per year)	0.93 (0.88, 0.99), p=0.02	0.95 (0.90, 0.99), p=0.03	0.95 (0.91, 0.99), p=0.02

^a These sensitivity analyses models were based on the main model (adjusted model 1) using generalized estimating equations Poisson model with municipality-quarters as unit of analysis assessing the pre-post level change in the outcome and the slope change after program implementation while accounting for the trend of pre-intervention period and a variety of municipal-level covariates, including age group (<25, 25-44, 45-54, 55-64, and ≥65 years), male sex, race and ethnicity (African American/Black, American Indian/Alaska Native, Asian, Hispanic/Latinx, Pacific Islander, White, and other), high school education or less, vacancy units, naloxone kits distributed by Massachusetts’ opioid education and naloxone distribution (OEND) program, public safety equipped with naloxone, presence of a drug court or jail diversion program, drug arrests, releases from incarceration, Massachusetts Bureau of Substance Addition Services methadone treatment admissions and residential admissions, Massachusetts Prescription Monitoring Program patient rate of buprenorphine prescriptions indicated for opioid use disorder (OUD), presence of Massachusetts Opioid Abuse Prevention Collaborative, and proportion of fentanyl-related death, and without accounting for municipal-level fixed effects. Robust standard errors were used to account for the clustering of repeated quarterly measures at municipal level.

^b Naloxone kits rate by OEND program, methadone admissions rate, residential admissions rate, and patients rate of buprenorphine prescription for opioid use disorder

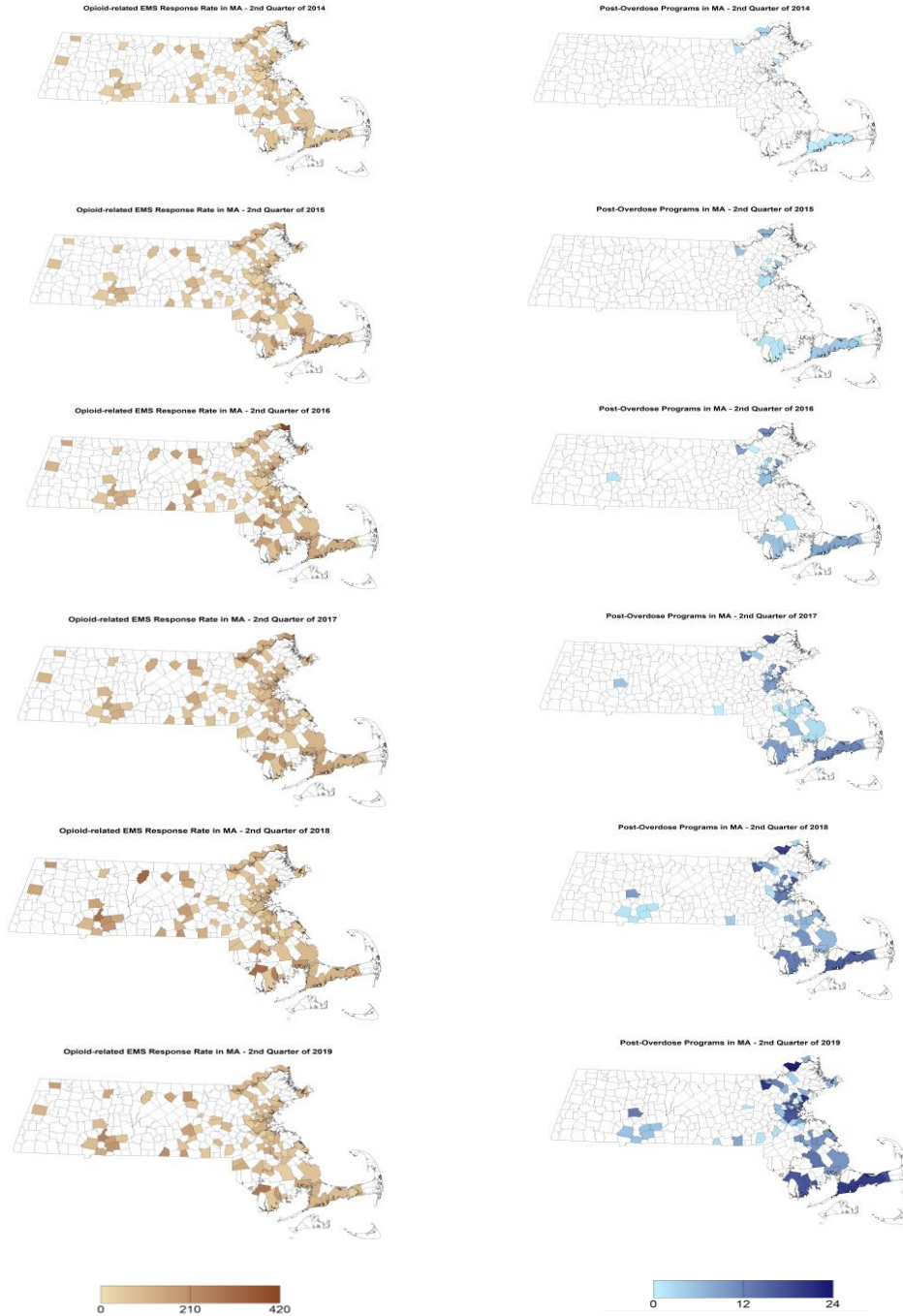
^c Statewide pharmacy naloxone standing order mandate effective in October, 2018

eFigure 1. Change of Opioid Overdose Fatality Rate and Uptake of Post-overdose Outreach Programs among 93 Municipalities in Massachusetts



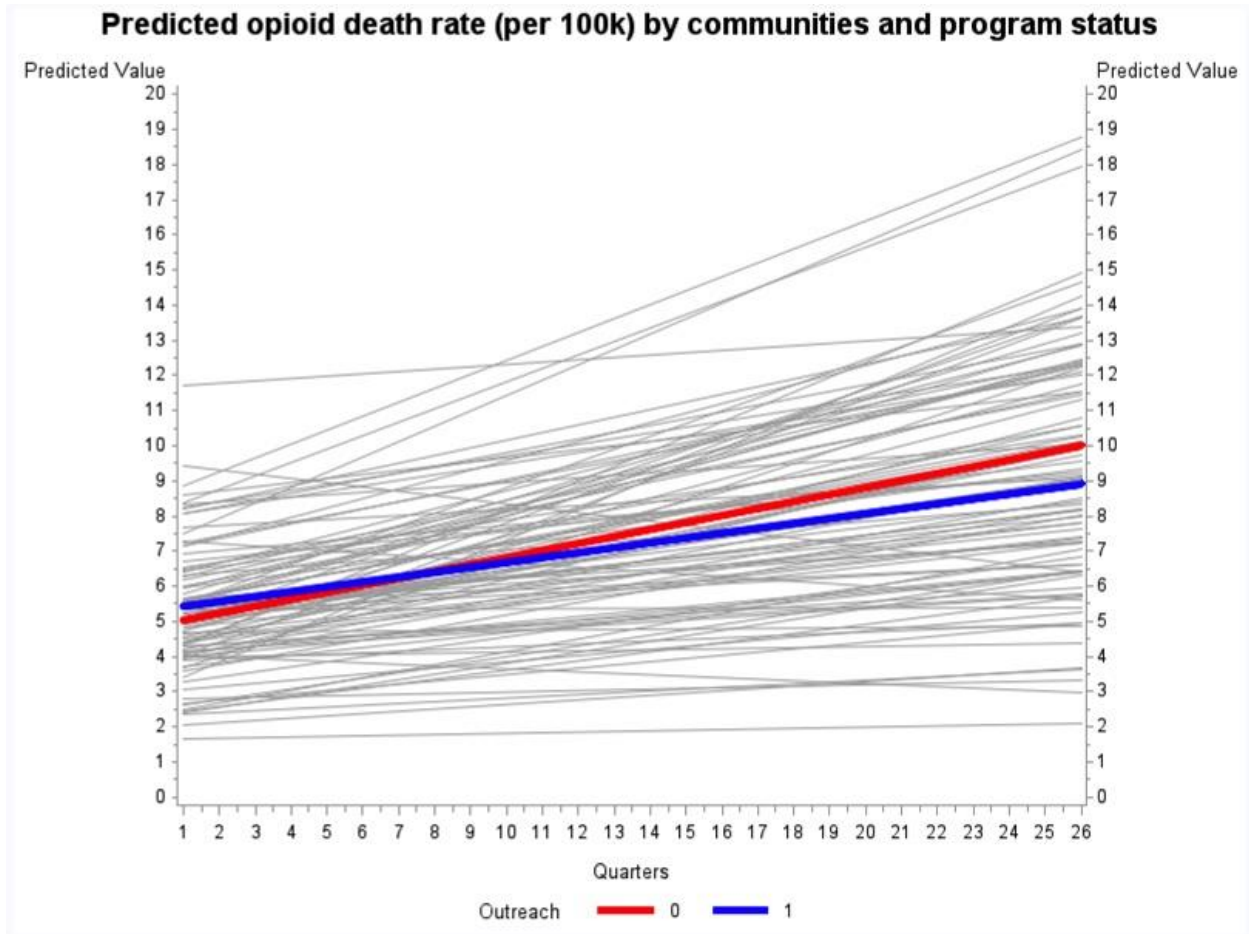
Note: The gradient of red color represents the overdose fatality rate. Blue color represents the municipalities that have outreach programs by the specified quarter-year. The gradient of blue color represents the number of quarters that the outreach programs have been established.

eFigure 2. Change of Opioid Emergency Response Rate and Uptake of Post-overdose Outreach Programs among 93 Municipalities in Massachusetts



Note: The gradient of brown color represents the opioid-related emergency medical service response rate. Blue color represents the municipalities that have outreach programs by the specified quarter-year. The gradient of blue color represents the number of quarters that the outreach programs have been established.

eFigure 3. Predicted Quarterly Opioid Fatality Rate among 93 Municipalities and Aggregated by Outreach Program Status



Note: 93 communities were eligible based on a threshold of 30 overdose-related emergency encounters in the year of 2015. The predicted quarterly opioid death rates were based on the main model (Adjusted model 1) which used log-linear Poisson model for the interrupted time-series design and also controlled for a variety of municipality-level characteristics. Grey lines represent the time trend of the predicted opioid death rates in each of the 93 municipalities across the study period. Red line represents the aggregate time trend of the predicted quarterly opioid death rates across the 35 non-implementing municipalities. Blue line represents the aggregate time trend of the predicted opioid death rates across the 58 implementing municipalities.