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Community-based Naloxone Coverage Equity for the Prevention of Opioid Overdose Fatalities in Racial/Ethnic Minority Communities in Massachusetts and Rhode Island

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Abstract

Background and aims: Opioid-related overdose death rates continue to rise in the United States, especially in racial/ethnic minority communities. Our objective was to determine if US municipalities with high percentages of non-white residents have equitable access to the overdose antidote naloxone distributed by community-based organizations.

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Methods: We used community-based naloxone data from the Massachusetts Department of Public Health and the Rhode Island Non-Pharmacy Naloxone Distribution program for 2016–2018. We obtained publicly available opioid-related overdose death data from Massachusetts and the Office of the State Medical Examiners in Rhode Island. We defined the naloxone coverage ratio as the number of community-based naloxone kits received by a resident in a municipality divided by the number of opioid-related overdose deaths among residents, updated annually. We used a Poisson regression with generalized estimating equations to analyze the relationship between the municipal racial/ethnic composition and naloxone coverage ratio. To account for the potential nonlinear relationship between naloxone coverage ratio and race/ethnicity, we created B-splines for the percentage of non-white residents; and for a secondary analysis examining the percentage of African American/Black and Hispanic residents. The models were adjusted for the percentage of residents in poverty, urbanicity, state, and population size.

Results: Between 2016–2018, the annual naloxone coverage ratios range was 0–135. There was no difference in naloxone coverage ratios among municipalities with varying percentages of non-white residents in our multivariable analysis. In the secondary analysis, municipalities with higher percentages of African American/Black residents had higher naloxone coverage ratios, independent of other factors. Naloxone coverage did not differ by percentage of Hispanic residents.

Conclusions: There appear to be no municipal-level racial/ethnic inequities in naloxone distribution in Rhode Island and Massachusetts, USA.

Keywords

Naloxone; overdose deaths; accessibility; racial disparity

INTRODUCTION

The opioid overdose crisis continues to affect the lives of millions of people worldwide, with approximately 40.5 million people dependent on opioids and over 100,000 opioid-related overdose deaths in 2017 (1). The United States (US) is most highly impacted by the opioid overdose crisis (2–5). Over the past two decades, the opioid-related overdose death rate has increased by more than five-fold, from 2.9 per 100,000 in 1999 to 15.5 per 100,000 in 2019 (6), corresponding to a ten percent annual growth (7). Currently, New England is one of the most highly affected regions (8). In 2018, Massachusetts and Rhode Island had significantly greater opioid-related overdose death rates (29.3 per 100,000 and 25.9 per 100,000, respectively) than the national average of 15.5 per 100,000 (8).

Naloxone is a potent opioid antagonist that reverses the effects of an opioid-related overdose when administered by a bystander or health care professional (9). Federal, state, and local policies have been enacted to increase the distribution and availability of naloxone in communities across the US (10,11). However, there is significant heterogeneity in the penetration of naloxone into communities and evidence of racial disparities in access (12–14). This is partly due to healthcare facilities such as pharmacies and treatment centers being the primary distributor of naloxone in certain states (15,16). Compared to whites, non-white people who use drugs are less likely to have access to substance use

treatment services due to economic and other structural barriers, and are more likely to reside in neighborhoods with limited access to pharmacies and pharmacies with an insufficient stock of naloxone (17–20). These factors—legacies of racist policies—result in decreased access to naloxone within non-white communities (19,21,22). Examples of these policies are the Anti-Drug Abuse Acts of 1986 and 1988 that disproportionately imprisoned African American/Black and Hispanic people, and mandated significantly longer sentences for crack/cocaine use as opposed to powder cocaine use (21). A 2016 study evaluated participant engagement in a community-based opioid overdose education and naloxone distribution (OEND) program and found that naloxone reversals were least likely to happen in census tracts with high proportions of African American residents, even though counts of opioid-related overdose deaths were highest in these same neighborhoods (12). Other studies have corroborated these findings, demonstrating that racially diverse neighborhoods have higher rates of overdose deaths yet do not have correspondingly high rates of naloxone utilization (13,14,23,24). The high rates of overdose deaths observed within non-white communities across the US demonstrate a need for increased coverage of and equitable access to naloxone in these settings. Thus, we aimed to determine if municipalities (cities, towns, or divisions of a place with its own local government) in Massachusetts and Rhode Island with relatively high proportions of non-white residents have inequitable access to naloxone distributed through community-based OEND programs.

METHODS

To analyze the relationship between naloxone coverage equity and racial/ethnic composition of communities, we utilized health department naloxone data from Massachusetts and community-based naloxone data from Rhode Island from January 1st, 2016 to December 31st, 2018. Collectively, these data represent a census of all naloxone kits distributed through OEND organizations in both states. Based on an analysis conducted by one of the study's co-authors (AC), annually, over 70% of naloxone dispensed in the study period was distributed from community-based OEND programs. The remaining amount were distributed through pharmacies. A recent study that evaluated the association between community characteristics and pharmacy-based naloxone distribution found that community racial/ethnic composition was not associated with naloxone dispensing outcomes in Rhode Island and Massachusetts (25). Due to the majority of naloxone being dispensed through OEND programs and the prior study's finding of no difference in distribution by the racial composition of a community, we decided not to include pharmacy-based naloxone for this analysis. In Massachusetts, the major types of community-based OEND programs distributing naloxone are syringe service programs, which often collaborate with addiction treatment programs, and a statewide network of family support groups. As for Rhode Island, the major types are community education programs, treatment programs and syringe service programs.

Massachusetts' OEND data is collected in collaboration with the Bureau of Infectious Disease and Laboratory Sciences and the Bureau of Substance Addiction Services. Twenty-seven medical and non-medical sites distribute naloxone funded through the Massachusetts Department of Public Health overdose prevention program (26,27). Rhode Island's data collection process for naloxone distributed through community-based OEND organizations

occurs through the Rhode Island Non-Pharmacy Naloxone Distribution program, centrally managed by the Rhode Island Department of Health (28). Before 2020, one of the largest OEND organizations in the state, Preventing Overdose and Naloxone Intervention, collected their own data on naloxone distributed from the organization. Thus, we used these two sources for naloxone data in Rhode Island for our study. Using these data sources, we calculated the annual counts of naloxone kits received by residents of each city/town.

We obtained opioid-related overdose deaths in each state (categorized by year and resident municipality of the person who died due to an opioid-related overdose) from the Office of State Medical Examiners and a publicly available report on opioid-related overdose deaths by municipality in Massachusetts (29). In each state, medical examiners determine drug type of overdose through toxicological analyses, death scene investigation, autopsy, and prior history of illegal drug use. An overdose death was determined as opioid-related if at least one of the following drugs were present: heroin, illicitly manufactured fentanyl, opioid-based prescription pain medications, and/or other unspecified opioids. In Rhode Island, only unintentional drug-related overdoses are reported and included in the analysis, whereas both intentional and unintentional overdoses were included in Massachusetts. Although Massachusetts included both types of overdoses, intentional cases accounted for less than five percent of all deaths; therefore, we do not believe this difference impacts the findings of the study in a meaningful way. Finally, both states have a single, centralized statewide medical examiner system (30,31). This results in all deaths being investigated in a consistent manner, which creates a highly reliable reporting system in both states.

The American Community Survey (ACS) was used to obtain percentage estimates of the population that self-identified as a race/ethnicity other than white (non-white) in each municipality (32). Racial/ethnic groups that were not white were collapsed into one category for the primary analysis due to many municipalities having less than one percent of residents identifying as either African American/Black, Hispanic, American Indian and Alaska Native, Asian, Native Hawaiian and Other Pacific Islander, or another race. Although there were concerns of small percentages of residents for various racial/ethnic sub-groups, we decided to conduct premeditated secondary analyses where we examined the percentage of African American/Black residents and the percentage of Hispanic/Latino residents as the independent variables of interest. We used the 5-year estimates released, for the year 2018, from ACS and assumed that the racial makeup of each jurisdiction was constant throughout the study period. Alongside race/ethnicity, we used the percentage of residents in poverty and urbanicity for each municipality from the ACS. The percentage of residents in poverty was determined by a threshold based on the household income and number of people in the family unit (33). If a household was under the threshold, they were considered to be in poverty. Due to the large range in population size (48–692,600) across municipalities, which impacts population density, we included urbanicity as a covariate in our models (32). For urbanicity, we used the US Census Bureau’s 2010 definition. A jurisdiction was considered urban if it had at least 1,000 people per square mile; everywhere else was considered non-urban (34,35). Those covariates were also assumed to be constant throughout the study period.

Descriptive & Geospatial Analyses

We used geospatial methods to calculate naloxone coverage ratios for each municipality in both states. For each year, naloxone coverage was defined as the ratio of the number of naloxone kits distributed through community-based OEND programs and received by residents in the jurisdiction to the number of opioid-related overdose deaths among its residents (36). We used the number of opioid-related overdose deaths as the denominator because all deaths in the US are required to be reported and are defined using a standardized classification from the International Classification of Diseases (37). Therefore, opioid-related overdose death is more reliable as a metric in comparison to the number of people at risk of experiencing an overdose due to the underreporting of illicit drug use and non-fatal overdoses in surveillance systems (38,39).

Next, we used the percentage of non-white residents and naloxone coverage ratios to create annual scatter plots for each state. As a benchmark for minimum and optimal naloxone coverage, we used a threshold of 9 and 20 naloxone kits received for every opioid-related overdose death per year, respectively. The threshold was chosen based on a 2015 study, which estimated the number of naloxone kits per heroin overdose death that would need to be distributed for naloxone to be present at most overdoses (36). In the study, Bird et al. estimated that the minimum number of annual naloxone kits received by 9–20 times the number of opioid-related overdose deaths. Using these two benchmarks for coverage, we constructed scatter plots to compare a municipality's racial/ethnic composition and naloxone coverage ratio in each state by year.

We also constructed maps to visualize naloxone coverage ratios for each municipality per year. For the maps, we dichotomized race/ethnicity composition for each municipality according to the mean percentage of non-white residents from the ACS, 0–12.99% and ≥13.0%. We created additional maps to operationalize the percentage of non-white residents into quartiles (0–5.99%, 6–11.99%, 12–17.99% and 18% and above). The additional maps can be found in the Supplementary Appendix.

To describe how municipalities were resourced with respect to naloxone distribution, we stratified the municipalities into four groups to characterize the distribution of naloxone for each municipality/year on a relative scale. Updated annually, the first two categories were no overdose deaths and no naloxone kits received. Municipalities categorized as "no naloxone kits received" had to report at least one overdose death and received no naloxone kits, whereas those in the "no overdose deaths" category only had to report no overdose deaths in order to be sorted into that group. Municipalities with at least one overdose death occurrence and at least one naloxone kit received by a resident were categorized in one of the two remaining groups. Specifically, these categories were created using the naloxone coverage ratios to compare naloxone distribution across and within municipalities over time. Before creating the naloxone coverage groups, we analyzed the distribution of naloxone coverage ratios and found it was skewed. Thus, we used a log transformation to obtain a normal distribution of the naloxone coverage ratio: the annual $\log_{10}$(ratio) was calculated for each municipality with at least one naloxone kit distributed and one opioid-related overdose death. Using the transformed mean and standard deviation (SD), municipalities/year were divided into two categories: poorly resourced and relatively well-resourced.

For each year, municipalities that were more than −1 SD below the mean log naloxone coverage ratio were placed in the poorly resourced category. All others were placed in the relatively well-resourced category. Each municipality was then coded based on racial/ethnic composition. We mapped racial/ethnic composition and naloxone coverage categories by jurisdiction using ArcGIS 10 software. The analysis was not pre-registered and the results should therefore be considered exploratory.

Statistical Analysis

We analyzed the association between the racial/ethnic composition of a municipality and the naloxone coverage ratio. First, we conducted a Moran's I test and found no spatial autocorrelation was present with naloxone coverage ratios within our data (32). For our analysis, we used a robust Poisson regression with a generalized estimating equation (GEE) to model the number of naloxone kits distributed per opioid-related overdose death. In the model, the number of kits received by residents per municipality per year was considered the outcome, with the number of opioid-related overdose deaths per municipality per year as an offset. Due to the relationship between naloxone coverage and the percentage of minority residents being nonlinear, splines, a piece-wise polynomial function, were included in the model. The splines are used as a mechanism to divide the polynomial shape of the distribution for the percentage of non-white residents into subsets where each subset has a linear distribution. These subsets represent an individual spline that is modeled separately. Each of the subsets is divided at a specific cut point, i.e., a knot, where the direction of the distribution changes. For our model, we included two knots that were used to create three splines. We chose two knots because of the cubic shape of the distribution of the percentage of non-white residents.

Next, in a multivariable model, we included state, year, population size, urbanicity, and percentage of residents in poverty as covariates. An autoregressive correlation structure was used to account for within-municipality clustering by year. For analyzing the association between racial/ethnic composition and naloxone coverage, we used the percentage of non-white residents in a municipality as the primary independent variable. We used R version 3.5.2 in this analysis. This study was approved by Brown University School of Public Health, Rhode Island Department of Health, and Boston University Medical Campus Institutional Review Boards.

RESULTS

Three-hundred ninety municipalities were included in the analysis, with 351 in Massachusetts and 39 in Rhode Island. Across the two states, there were 26,616 kits distributed in 2016, 31,565 in 2017, and 35,965 in 2018. We excluded 4.8% (N=1,274) of naloxone kits in 2016 and 6 kits in 2017 due to missing data regarding the residing municipality of naloxone recipients. Over the study period, the naloxone coverage ratio among municipalities with at least one opioid-related overdose death varied between 0 and 135 with an annual mean municipality-level naloxone coverage ratio between 10.3 and 12.3 (Table 1). The scatter plots depicting the relationship between the naloxone coverage ratio and the percentage of non-white residents are shown in Figures 1 and 2. Each year

of the study period, approximately 30% of the municipalities in Massachusetts surpassed the minimum. Of those exceeding the minimal threshold, 45–50 municipalities in the study period had an above-average (>13%) percentage of residents identifying as non-white. More municipalities crossed the minimum threshold over time in Rhode Island, with 8 in 2016 and increased to 27 in 2018. Of those with a ratio over 9, three municipalities had over 13% non-white residents in 2016, 8 in 2017, and 22 in 2018. Similar trends were observed when examining the relationships between naloxone coverage ratios and the percentage of African American/Black and Hispanic residents (see Supplemental Appendix).

The spatiotemporal distribution of naloxone coverage categories is summarized in Table 1 and visualized in Figures 3 and 4. In Massachusetts, most poorly resourced municipalities tended to be in the eastern region of the state (Figure 3). Wayland, MA was the only municipality that was consistently poorly resourced throughout the study period, with 18.8% non-white residents. We did not identify any consistently poorly resourced municipalities across all three years of the study in Rhode Island (Figure 4). Results were similar when the percentage of non-white residents was operationalized as quartiles.

The results of the bivariable analyses and multivariable models are summarized in Table 2. In the bivariable analysis, we found that urban municipalities, those with a higher poverty level, and higher percentages of African American/Black residents had greater naloxone coverage ratios, indicating increased naloxone distribution relative to overdose deaths. In the primary multivariable model (Model 1), there was no significant relationship between the percentage of non-white residents and the number of naloxone kits received by residents per opioid-related overdose death. In the secondary models (Model 2 and Model 3), the spline terms related to the percentage of African American/Black residents were found to be statistically significant, indicating that municipalities with higher percentages of African American/Black residents might have greater naloxone distribution relative to disease burden, after accounting for other community-level covariates.

DISCUSSION

In this multi-state study, we did not observe a relationship between naloxone coverage and municipality-level percentage of non-white residents. However, we observed a positive association between naloxone coverage and the percentage of African American/Black residents and residents in poverty. Moreover, of the 390 municipalities included in this study, only one was identified as being consistently poorly resourced relative to the state's average naloxone coverage over the three-year study period. However, in both states, of the municipalities with a naloxone coverage ratio over 9 kits per overdose death, 43–50% of municipalities in Massachusetts and 37–40% in Rhode Island had a municipality-level percentage of non-white residents above the state average.

We found that municipalities with higher proportions of African American/Black residents had high numbers of naloxone kits distributed per opioid-related overdose death after accounting for other community-level characteristics. This is in contrast to recent studies that examined the geographic distribution of community-based naloxone reversals in San Francisco, California, where overdose reversals were least likely to occur in predominantly

African American/Black neighborhoods (12) which could suggest poorer availability of naloxone in those communities. One likely explanation for our finding is that municipalities with high overdose rates in Massachusetts and Rhode Island also have above-average percentages of African American/Black residents (12,13,40–43). Because of the high overdose rates, more OEND organizations such as syringe service programs are likely located in these communities. This may result in higher naloxone distribution in these municipalities compared to other regions of the states. However, as this study is ecological, further research is needed to determine the extent to which naloxone is distributed equitably to racial/ethnic minorities residing in these municipalities.

Municipalities with higher percentages of residents in poverty also had higher rates of naloxone distribution through treatment and community programs supporting OEND. Like our findings for the percent of African American/Black residents, the association was in a different direction than other studies. A 2020 study using pharmacy-based naloxone distribution data found neighborhoods in New York City with lower income were least likely to have residents carrying naloxone (17). One of the likely causes of our differing findings is the type of distribution activity and the geographic scale. Early studies of pharmacy naloxone access found that pharmacies are least likely to have a sufficient supply of and stock naloxone in neighborhoods that are low-income, majority-minority, and have higher overdose death rates (17,18). In addition, in Massachusetts, a representative pharmacy purchase trial demonstrated that 81% of pharmacies provide naloxone access, but the study did not examine this access by race or ethnicity (44). In contrast, using data from state community-based naloxone distribution programs, we were able to examine how OEND organizations have increased naloxone distribution in low-income communities, particularly those with high opioid-related overdose deaths. In this manner, community-based OEND organizations may be effective at providing naloxone to higher-risk populations in communities with more non-white and low-income residents who continue to experience barriers while attempting to access naloxone from pharmacies and hospitals (12,17,19,22,45). As such, our findings suggest that OEND organizations potentially fill an important gap that is present for pharmacy naloxone distribution alone.

The study has several limitations. First, the measure we used to determine naloxone coverage equity may not accurately represent true access, particularly across communities of varying population sizes. Municipalities with low opioid-related overdose counts might be defined as poorly resourced due to the low demand for naloxone within the community. An example is Wayland, MA (with a population of less than 15,000), which was categorized as poorly resourced perhaps because the need for naloxone in the municipality was low, as evidenced by the fact that there were only two opioid-related overdose deaths that occurred during the entire study period. Second, while annualized naloxone coverage ratios permitted us to determine changes in distribution patterns over time, we were unable to assess the precise temporality of naloxone distribution activities compared to opioid-related overdose deaths. Another limitation is the geographic unit chosen for the analysis. There might be a difference in outcomes if we used a smaller geographic unit such as zip codes or census tracts that may be more highly correlated with specific racial and ethnic populations. Also, our study does not consider the impact of pharmacy distribution of naloxone. Both pharmacies and community-based organizations are increasing their naloxone distribution

among people at risk of experiencing an overdose. This leads to an interconnected impact on the overdose rates that were used in the study. Lastly, our data did not permit the determination of whether a naloxone kit was used for a reversal. Therefore, we have no knowledge of how many of the naloxone kits that were distributed were used and where they were used.

In conclusion, after taking into account opioid-related overdose mortality burden and other factors, we did not identify municipal-level racial/ethnic inequities in naloxone distribution in Rhode Island and Massachusetts. While this finding is encouraging, we were unable to assess the racial/ethnic identity of people within those municipalities who are receiving naloxone kits and whether it reflects the racial makeup of persons who are most likely to experience an overdose. Future studies should be conducted to evaluate individual- and structural-level barriers to naloxone access, particularly those experienced by racial/ethnic minority residents in municipalities with high opioid overdose burden.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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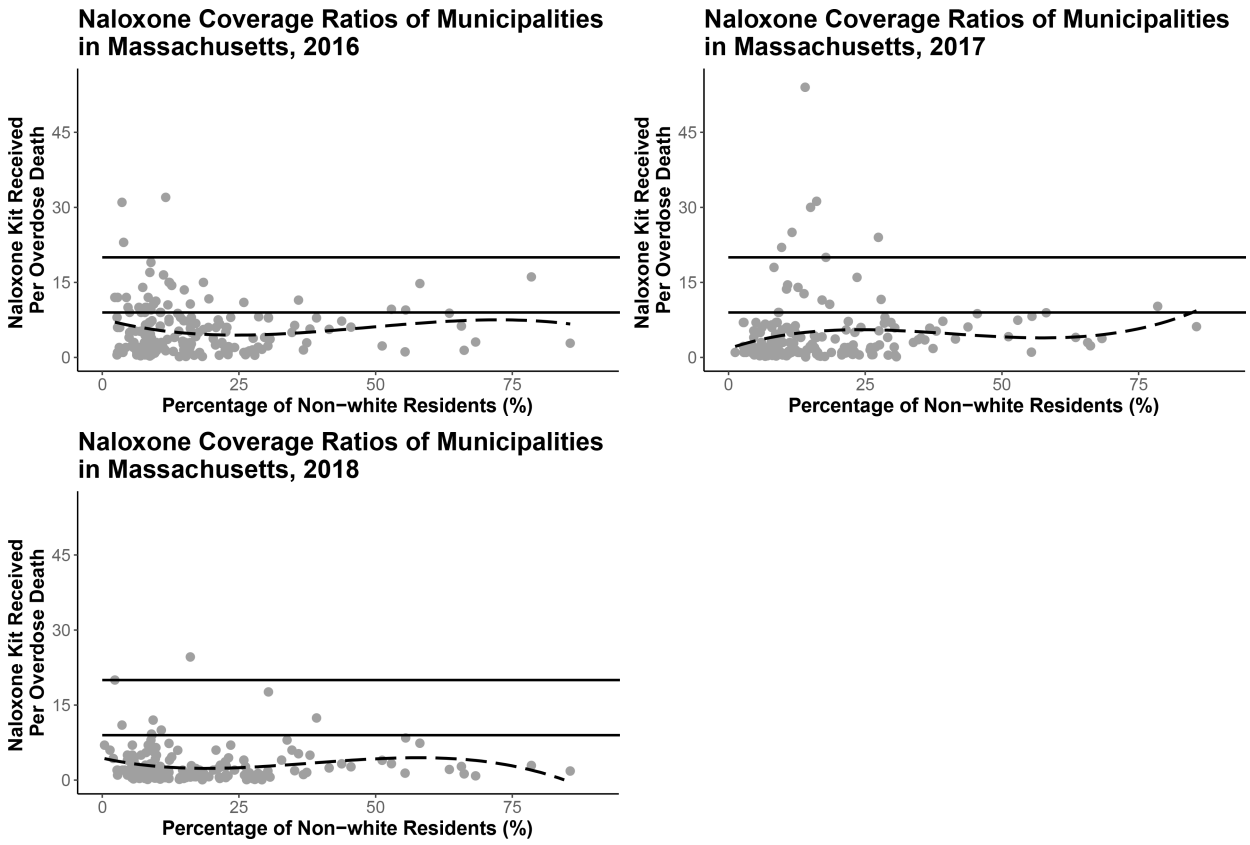

Figure 1. Naloxone coverage equity trends by percentage of non-white residents per municipality in Massachusetts, 2016–2018.

The solid horizontal lines represent the minimal coverage threshold of 9 naloxone kits per opioid-related overdose death and the ultimate coverage threshold of 20 naloxone kits per opioid-related overdose death. The dashed black line is the trend line.

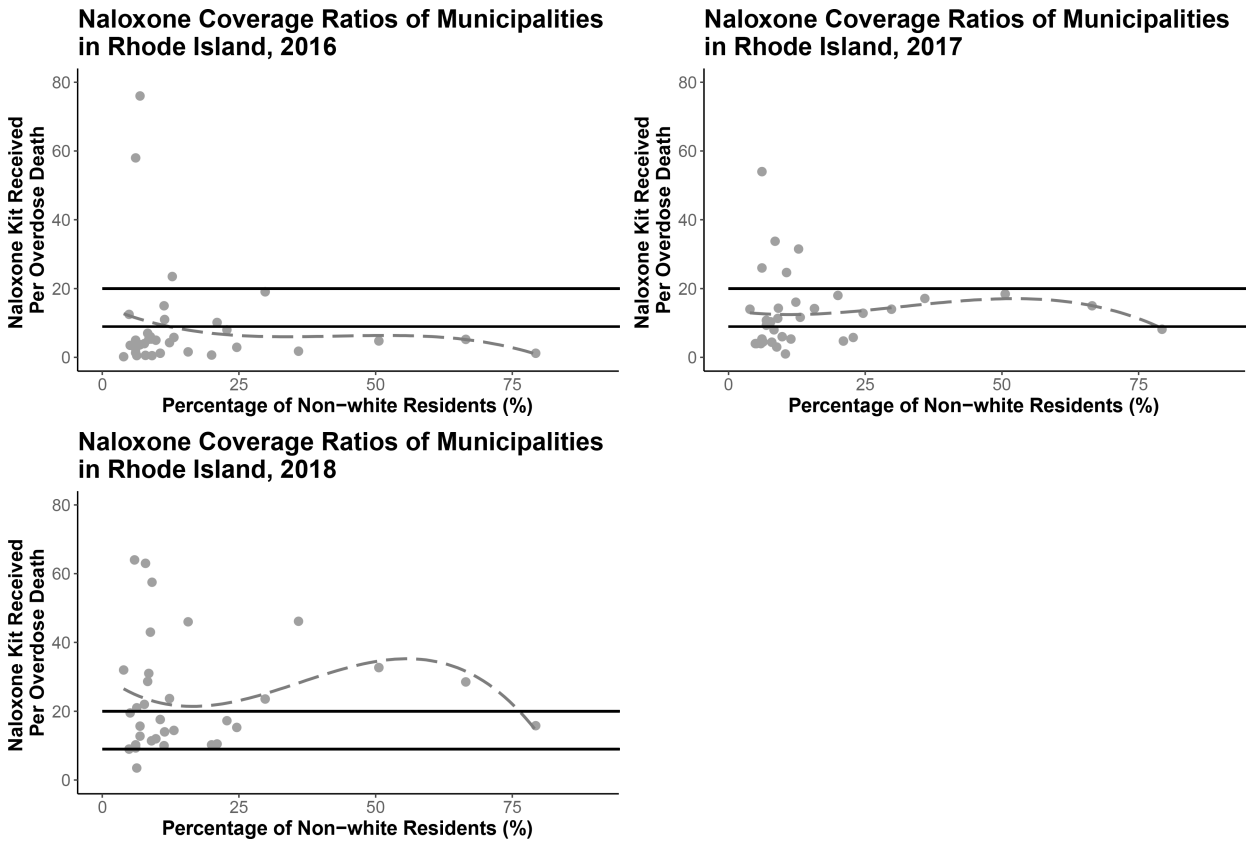

Figure 2. Naloxone coverage equity trends by percentage of non-white residents per municipality in Rhode Island, 2016–2018.

The solid horizontal lines represent the minimal coverage threshold of 9 naloxone kits per opioid-related overdose death and the ultimate coverage threshold of 20 naloxone kits per opioid-related overdose death. The dashed black line is the trend line.

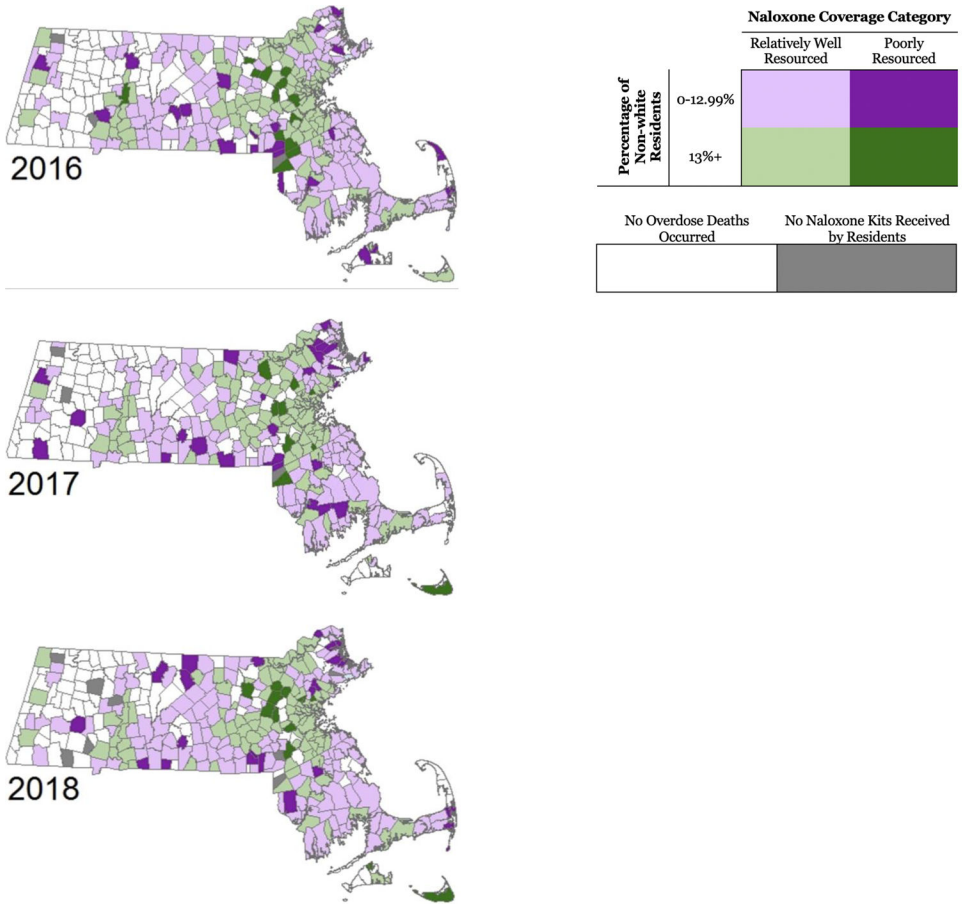

Figure 3. Naloxone coverage equity by distribution of non-white residents per municipality in Massachusetts, 2016–2018.

The green and purple areas represent municipalities with higher and lower than mean percentages of non-white residents, respectively. The white areas represent the municipalities/year that experienced no opioid-related overdose deaths, and the gray areas are the municipalities/year that had no residents receive analoxone kit but had at least one opioid-related overdose death.

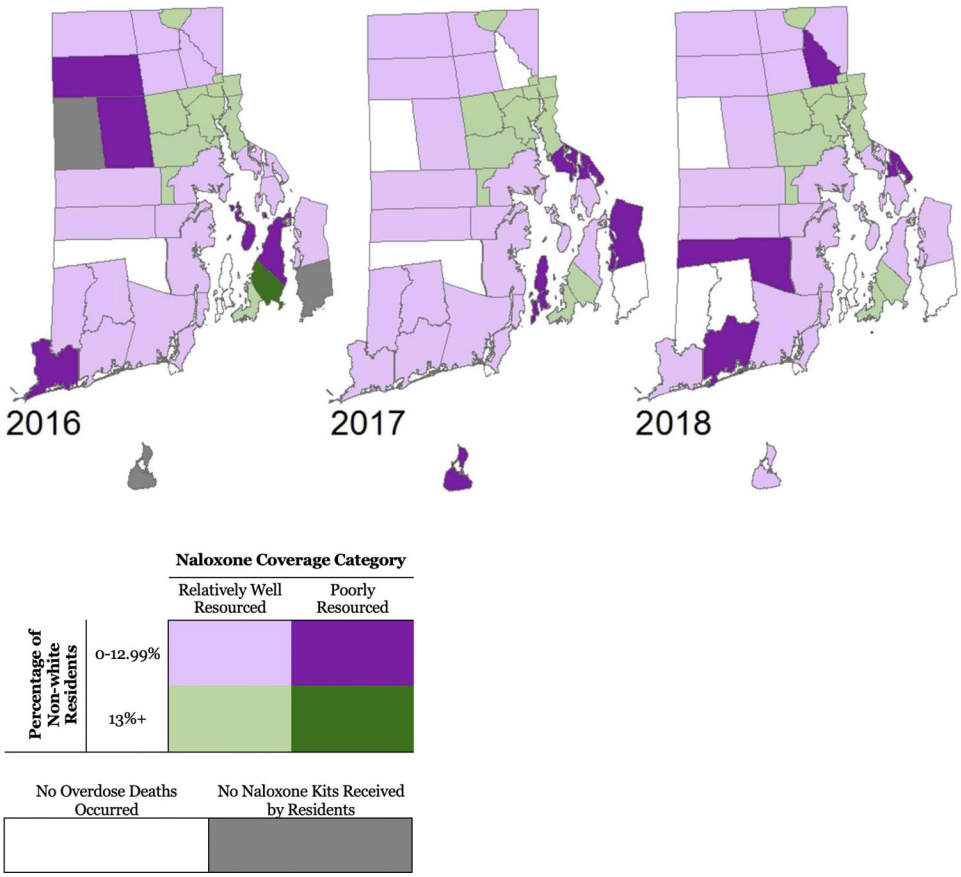

Figure 4. Naloxone coverage equity by distribution of non-white residents per municipality in Rhode Island, 2016–2018.

The green and purple areas represent municipalities with higher and lower than mean percentages of non-white residents, respectively. The white areas represent the municipalities/year that experienced no opioid-related overdose deaths, and the gray areas are the municipalities/year that had no residents a receive analoxone kit but had at least one opioid-related overdose death

Table 1.

Community-level naloxone coverage equity characteristics in 2016–2018, stratified by state, N=390 municipalities (including 351 in Massachusetts and 39 in Rhode Island)

	Total Mean (SD.)	Massachusetts Mean (SD.)	Rhode Island Mean (SD.)	p-value[a]
Naloxone coverage ratio [b]				
2016	10.3 (9.8)	10.4 (9.2)	8.9 (13.8)	0.396
2017	12.3 (18.7)	11.6 (17.9)	16.7 (23.0)	0.130
2018	11.9 (12.8)	10.1 (10.2)	28.1 (19.9)	<0.001
		Number of Municipalities (%)		
2016 naloxone resource groups				0.037
Relatively well-resourced[c]	243 (62.3)	215 (61.3)	28 (71.8)	
Poorly resourced[c]	41 (10.5)	36 (10.3)	5 (12.8)	
No overdose deaths observed[d]	100 (25.6)	96 (27.4)	4 (10.3)	
No naloxone kits received[d]	6 (1.5)	4 (1.1)	2 (5.1)	
2017 naloxone resource groups				0.048
Relatively well-resourced[c]	236 (60.5)	206 (58.7)	30 (76.9)	
Poorly resourced[c]	38 (9.7)	33 (9.4)	5 (12.8)	
No overdose deaths observed[d]	113 (29.0)	109 (31.1)	4 (10.3)	
No naloxone kits received[d]	3 (0.8)	3 (0.9)	0 (0.0)	
2018 naloxone resource groups				0.811
Relatively well-resourced[c]	244 (62.6)	219 (62.4)	25 (64.1)	
Poorly resourced[c]	36 (9.2)	32 (9.1)	4 (10.3)	
No overdose deaths observed[d]	102 (26.2)	92 (26.2)	10 (25.6)	
No naloxone kits received[d]	8 (2.1)	8 (2.3)	0 (0.0)	

[a] A *t*-test was performed for the naloxone resource ratios, and a Chi-squared test was used for evaluating the distribution of naloxone resource groups by state

[b] Excluded municipalities that did not have at least one opioid-related overdose death and/or one naloxone kit distributed to residents in the year.

[c] Poorly resourced is defined as municipalities that are more than −1 SD below the annual mean log of the naloxone coverage ratio in the state, and all others were placed in the relatively well-resourced category

[d] No naloxone kits received is defined as reporting at least one overdose death and received no naloxone kits, whereas those in the no overdose deaths category only had to report no overdose deaths in order to be included in that category.

Table 2.

Multivariable modified Poisson model[a] of the association between geographical and sociodemographic characteristics of the residing municipality and the number of naloxone kits received by residents per opioid-related overdose death, Rhode Island and Massachusetts, 2016–2018.

		Adjusted		
Characteristic	**Unadjusted Coef (SE)**	**Model 1 (non-white residents) Coef (SE)**	**Model 2 (African American/Black residents) Coef (SE)**	**Model 3 (Hispanic residents) Coef (SE)**
X_1 (B-spline for % of non-white residents)	−0.07 (0.57)	0.61 (0.60)	-	-
X_2 (B-spline for % of non-white residents)	2.48 (0.63) *	0.75 (0.55)	-	-
X_3 (B-spline for % of non-white residents)	0.10 (0.39)	−0.08 (0.39)	-	-
X_1 (B-spline for % of African American/Black residents)	1.21 (0.46) *	-	2.33 (0.70) *	-
X_2 (B-spline for % of African American/Black residents)	1.62 (0.63) *	-	−2.95 (0.81) *	-
X_3 (B-spline for % of African American/Black residents)	1.07 (0.18) *	-	0.96 (0.22) *	-
X_1 (B-spline for % of Hispanic residents)	2.63 (0.96) *	-	-	−0.04 (0.72)
X_2 (B-spline for % of Hispanic residents)	0.14 (0.77)	-	-	−0.54 (0.76)
X_3 (B-spline for % of Hispanic residents)	0.66 (0.22) *	-	-	−0.57 (0.37)
% of residents in poverty	0.05 (0.01) *	0.03 (0.01) *	0.03 (0.01) *	0.04 (0.01) *
Population size per 10,000 residents State	0.02 (0.001) *	0.01 (0.002) *	0.03 (0.004) *	0.01 (0.001) *
Massachusetts	ref	ref	ref	ref
Rhode Island Urbanicity	0.09 (0.27)	0.19 (0.13)	0.25 (0.11) *	0.16 (0.15)
Non-urban	ref	ref	ref	ref
Urban	0.66 (0.19) *	−0.11 (0.17)	−0.21 (0.1615 *	0.05 (0.14)

Coef = coefficient; CI = confidence interval; ref = reference level

* p-value <0.05

[a] The number of opioid-related overdose deaths among residents was used as the offset of the model.

X_1-X_3 variables are B-splines basis variables for the percentage of non-white, African American, and Hispanic residents that flexibly model the relationship between municipal-level racial/ethnic composition and naloxone kits received by residents