

Mapping the Opioid Epidemic in Rhode Island: Where Are We Missing Resources?

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ABSTRACT

Opioid overdose deaths have been rising steadily over the past decade in Rhode Island (RI), and although deaths have decreased slightly over the past year, there were 314 deaths in 2018 and there have been 208 deaths in the first 9 months of 2019.¹ The objective of this spatial study is to identify the RI regions with the greatest need for opioid emergency response and rehabilitation resources. Using geographic information systems (GIS), we identify areas in RI with high overdose rates and that are far from emergency departments, and areas with high rates of treatment admissions that are far away from Centers of Excellence (COEs) which provide effective medication-assisted treatment (MAT). Ultimately, we identified Burrillville, Coventry, Bristol, and Portsmouth as towns needing more emergency resources and Western Hopkinton, Western Richmond, and Western Scituate as areas needing more high-quality rehabilitation resources. These findings should inform future decisions when considering new locations for COEs or emergency resources to respond to the Rhode Island opioid epidemic.

KEYWORDS: opioid, overdose, MAT, GIS

INTRODUCTION

Even with a recent modest decrease in overdoses, opioids remain the leading cause of death in RI.² Policy makers and healthcare workers are working hard to combat the epidemic by increasing the availability and quality of resources for people with opioid addictions. People with opioid use disorders can seek chronic addiction treatment at behavioral health organizations (BHOs) and acute treatment at emergency departments (EDs). Some BHOs provide MAT, a treatment regimen with FDA medications approved for use in opioid disorders, including methadone, buprenorphine products and naltrexone. MAT has been proven to increase retention in treatment, improve social functioning, and decrease risk of fatal overdose by 50% among patients.³ Even though MAT has proven to be effective, fewer than 1 million of the 2.5 million people in the US with opioid use disorders receive MAT.⁴ Appropriately, providing access to MAT is a key objective of RI Governor Gina Raimondo's plan to

tackle the RI opioid epidemic.⁵ For acute treatment, opioid overdoses are treated by the administration of naloxone, a drug that binds to opioid receptors in the brain.⁶ Naloxone can be administered by emergency medical technicians or by anyone who purchases it at a pharmacy, but patients who have received naloxone during an overdose should be subsequently evaluated in an emergency department. To address the opioid epidemic, it is important to consider both the accessibility of treatment for addiction and accessibility of emergency response for overdose. The aim of this spatial study is to determine areas which may need more rehabilitation or emergency resources for resource allocation planning: areas which have high BHO usage and high distance from COEs providing MAT, and areas which have high distance from EDs with high overdose rates.

METHODS

Opioid Emergency Response Needed Resources

Needed opioid emergency response was assessed by: 1) mapping overdose rates per 100,000 RI population, and 2) mapping emergency treatment resources. Overdose rates by town from 2014–2017 were taken from Rhode Island Department of Health (RIDOH) data published online.⁷ Population estimates for zip codes in RI from 2012–2016 were taken from the National Historical GIS Database.⁸ Addresses of emergency departments were provided by Rhode Island Geographic Information System (RIGIS) and verified by Google Earth.^{9,10} Because anyone treated for an overdose should be evaluated in an emergency department, we defined access to treatment for overdoses as access to an emergency department, not access to naloxone. Behavioral Healthcare Link (BH Link) is a new facility in East Providence offering care to people with substance or behavioral healthcare emergencies and was created in partnership with the RI Department of Behavioral Healthcare, Developmental Disabilities and Hospitals (BHDDH). Since BH Link is open 24/7 and has the capacity for clinical assessment, emergency medication prescription, and crisis management, we included it in the emergency resources for people with opioid use disorders.¹¹ Between BH Link and various EDs, we identified 13 emergency treatment facilities in RI. Distance to the nearest ED in miles is shown in **Figure 1**, and overdose rates by town are shown in **Figure 2**.

Figure 1. Distance to the nearest ED in miles

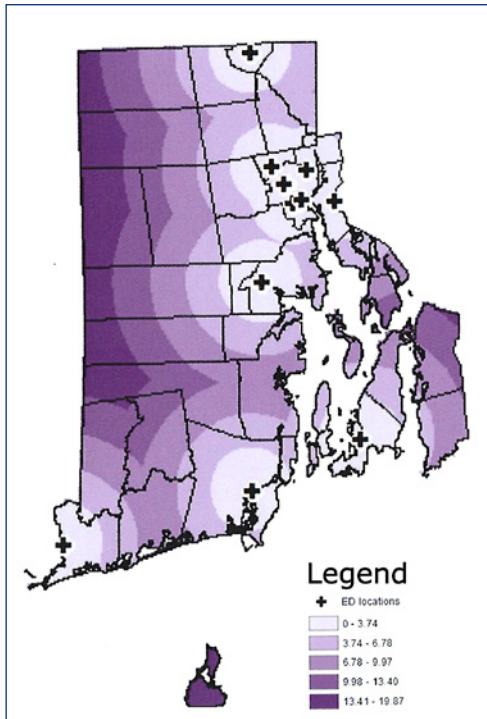


Figure 2. Overdose rates by town

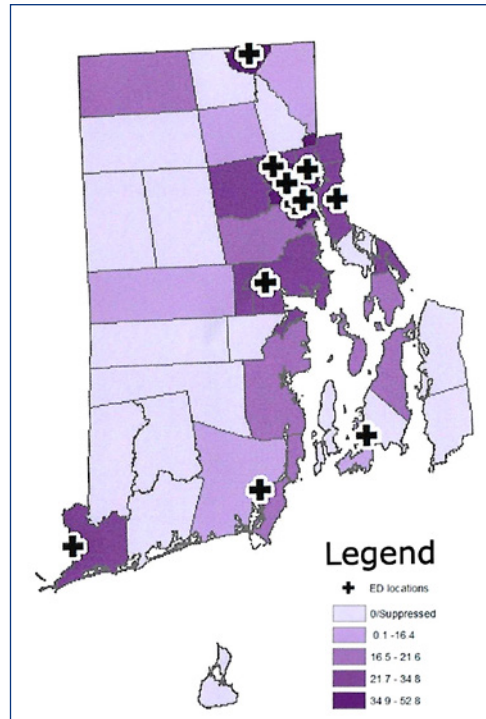
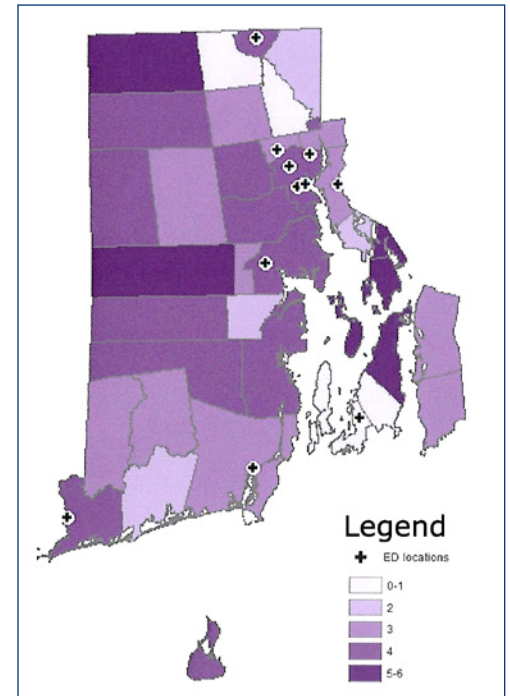


Figure 3. Risk score by town based on distance to the nearest ED and overdose rate



To address emergency resources, we calculated the maximum distance to an emergency department from each town by using an ArcMap “zonal statistics” tool and divided these maximum distances into quintiles. We numbered these quintiles to create a distance “score” for each town for 0–4, with 4 being the highest distance category. We then assigned each town a score of 0–4 based on quintiles of overdose rates, with 4 being the highest category of overdose rate. To obtain an overall risk score, we summed the distance scores and the overdose scores for each town, so that towns with the highest risk score had the largest distances from emergency departments and highest overdose rate to create a map which approximated need for additional emergency resources by town. Risk score by town based on distance to the nearest ED and overdose rate is shown in **Figure 3**.

Needed Opioid Treatment Resources

Needed opioid treatment resources were assessed by: 1) mapping opioid use disorder treatment rates per 100,000 RI population, and 2) mapping COE treatment resources. Data for BHO usage for opioid use disorder was obtained from BHO data in files provided by the Rhode Island Department of Behavioral Healthcare, Developmental Disabilities, and Healthcare (BHDDH).¹² BHO usage was calculated as unique individuals served for opioid use disorder by zip code during 2012–2016 fiscal years. Rates in each zip code were calculated based on population estimates for RI in 2012–2016.⁸ When evaluating access to high quality care, we chose to use only rehabilitation centers designated to be Centers of

Excellence (COEs) by the BHDDH. For a BHO to be certified as a COE by the BHDDH, it must offer MAT, individualized care for patients with a range of treatment options, low wait times, and comprehensive patient and family education programs as well as support resources for patients who are referred into the community.² Currently, there are 14 COEs offering MAT in RI, and this project aims to identify areas where more COEs may be needed. Addresses of COEs were provided by BHDDH in a word file.¹² Distance to the nearest COEs in miles is shown in **Figure 4**, and rates of BHO usage per zip code are demonstrated in **Figure 5**.

To address rehabilitation resources, we followed a similar procedure as for emergency resources. We calculated the maximum distance to the nearest COE from within each zip code using the “zonal statistics” tool and divided this into quintiles to give each zip code a distance score from 0–4 with 4 being the highest distance. Finally, we assigned each zip code a BHO usage rate of 0–4 based off quintile rates of BHO usage, with 4 being the highest rate category. We added the distance scores and the BHO usage scores to create an overall “risk score” where zip codes with high-risk scores have high distances to COEs and high BHO-usage rates to create a map which identifies zip codes that would be ideal for new COE locations. Risk scores per zip code based on BHO usage and distance to COEs are shown in **Figure 6**.

All data analyses were performed in Microsoft Excel version 5.3, Google Earth, ArcMap version 10.6.1, and Stata version 14.^{10,13,14}

Figure 4. Distance to the nearest COEs in miles

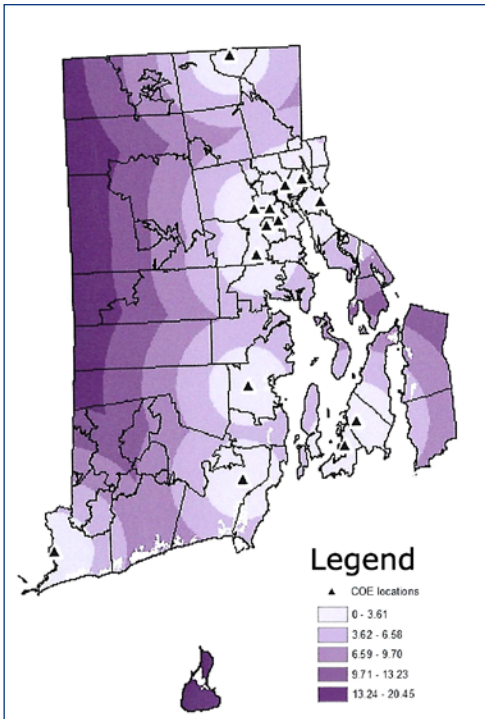


Figure 5. Rates of BHO usage per zip code

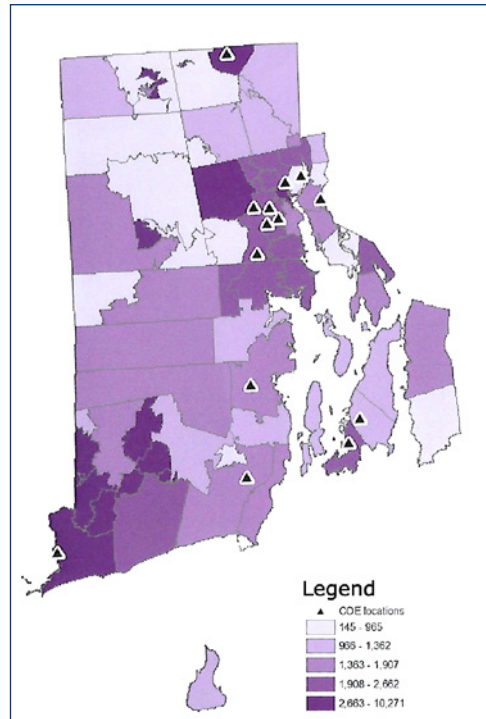
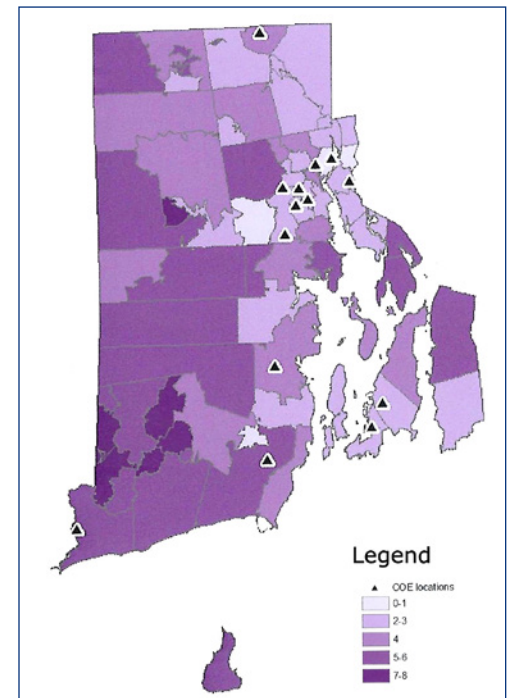


Figure 6. Risk scores per zip code based on BHO usage and distance to COEs



RESULTS

After analyzing overdose data from 2014–2017, the towns with the highest risk scores based on distance to emergency departments and overdose rates are Burrillville, Coventry, Bristol, and Portsmouth. When analyzing BHO usage rates for individuals served by BHOs in 2012–2016, the areas with the highest risk scores based on BHO usage rates and distance to COEs are Western Hopkinton, Western Richmond, and Western Scituate. Specifically, these are zip codes 02804, 02808, 02894, 02898 and 02815.

DISCUSSION

There has been an influx of funding and resources allocated in the RI state budget to combat the opioid epidemic: Gov. Raimondo's Overdose Prevention and Intervention Action Plan includes \$4 million in funding to expand access to MAT, and her 2017 executive order aims to improve the rescue and treatment action recommendations by the Overdose Prevention and Intervention Task Force.⁵ Although motivation and funding to fight the epidemic is clear at the state level, besides publishing overdose rates by town there has been minimal spatial analysis of the crisis to show where resources would be best implemented. Identifying areas which have the greatest need for resources can help guide the allocation of funds dedicated to the opioid crisis. For example, in Providence there are currently 12 "safe stations," which are fire departments specially designated as resources to connect people with opioid use disorders to care.¹⁵ If these

safe stations are used as intended and function as effective emergency resources for people using opioids, more fire stations could be designated as safe stations in areas lacking emergency resources such as Burrillville, Coventry, Bristol, and Portsmouth. However, more evaluation of the efficacy of safe stations is needed before their potential expansion. Additionally, in areas like Western Hopkinton, Western Richmond, and Western Scituate where BHO usage rates and distance to COEs are high, it would be beneficial to begin the process of upgrading BHOs in those areas to COEs.

There are several reasons why spatial analysis is important in fighting the opioid epidemic in RI. First, RI is geographically diverse and contains rural, suburban and urban areas. Rural and urban communities can have vastly different health-risk profiles for residents and accessibility of health-care resources, so when offering solutions for health crises in RI it is important to keep these differences in mind. On average, people with opioid use disorders residing in rural areas need to travel farther to emergency resources, have lower incomes, and are less likely to be insured when compared to people who use opioid disorders in urban areas.¹⁶

Secondly, distance to both emergency and rehabilitation resources affects outcomes in patients with opioid use disorders. With opioid overdose, brain damage due to hypoxia can occur after just five minutes, so administration of naloxone in this time period is critical.¹⁷ Even though naloxone can be administered outside of an emergency department, naloxone has a short half-life of 60–90 minutes and is metabolized faster than almost all opioids, so re-overdose is possible

after the administration of naloxone.¹⁸ Due to the possibility of re-overdose and possible complications from initial overdoses, being seen at an emergency department immediately after an overdose is essential and high distances to emergency departments can increase the risk of death from an overdose.

Studies show retention in treatment is an essential determinant in recovery from substance abuse, and additionally show correlation between the distance a patient needs to travel to a rehabilitation center and retention. Patients who travel less than 1 mile to their rehabilitation center are 50% more likely to complete treatment when compared to patients who need to travel more than one mile, and patients needing to travel more than 4 miles have significantly shorter length-of-stay in treatment when compared to patients who travel less than 1 mile.¹⁹

This study is by no means exhaustive, and further research is needed. As discussed in the limitations, using addresses where people overdosed or addresses where people who use BHOs live would provide a more accurate measure of the proximity of resources because distances could be measured as minutes spent driving or proximity to a bus route. However, using addresses of patients would require special permission as to not violate HIPAA. Additionally, it is unclear why certain areas have high overdose rates and relatively low BHO usage rates or vice versa. This could potentially be due to low socio-economic status or high numbers of uninsured residents causing poor access to rehabilitation care in certain areas, despite high opioid usage rates. However, more research is warranted. With better understanding of the reasons behind these differences, future research could combine rehabilitation center usage and overdose rates in a way that estimates overall opioid usage in different areas in RI which would be useful for planning prevention efforts. Finally, this analysis did not consider the availability of naloxone by town or neighborhood as an emergency resource. If future research demonstrated an association between higher availability of naloxone and lower overdose rates, spatial analysis could identify areas which would benefit from additional naloxone availability.

DISCUSSION OF LIMITATIONS

It is important to note that when calculating distance to the nearest facility, we used the maximum distance in each town or zip code from an emergency department or COE. Thus, this point is not equivalent to the population center of the zip code or town. Additionally, when calculating the distance to emergency departments and COEs, the distance tool used in ArcMap calculates the distance directly from one point to another and does not consider road and traffic patterns. These two factors decreased the sensitivity of measurement in this assessment of access to these resources based on distance. Additionally, due to the sensitivity of

patient records, patient overdose data is limited to the town level, while patient BHO usage data is limited to the zip-code level. Spatial analyses of need would be much more specific if we had overdose and patient data by address. Finally, because BHO usage data from BHDDH were used, informal treatment, treatment facility data that were not BHDDH-licensed, and hospital-based treatment was not included.

CONCLUSION

By using GIS, we have been able to identify 4 towns which may need more emergency resources and 3 towns which may need more rehabilitation resources. Spatial analysis can contribute to our knowledge about opioid abuse, and GIS should be included in the tools used to analyze and fight the opioid epidemic in RI.

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Disclaimer

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