Opioid Overdose Deaths and Emergency Responder Rescues: A Spatial Analysis of Massachusetts

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BACKGROUND

Opioid overdose has become an epidemic in Massachusetts over the past decade. The Bureau of Substance Abuse Services (BSAS) at The Massachusetts Department of Public Health (MDPH) has been collecting data on overdose deaths and 911 rescue reports from both non-user and user by-standers in the recent years of the crisis.[1] First responders have been allowed to carry and administer Naloxone, an opioid antagonist that can reverse an overdose since 2015 in the state.[2] MDPH has overdose data starting in 2000 and rescue data from their Naloxone Pilot Sites starting in 2009, but they have never looked at the data spatially to determine if they are reaching the right areas with their programs. Using overdose data for all 351 municipalities[1] and the available rescue data from user and non-user bystanders, BSAS wants to map these data to learn more about the needs in the state. BSAS also has addresses for all their pilot sites where they distribute Naloxone and want to look at these data points in relation to overdose and rescue utilization data. These maps will fill the gap in knowledge by showing BSAS where they should focus more efforts and programs in the future. It also helps illustrate the severity of the epidemic across the state using the spatial mapping. Our main questions of interest were: 1) What is the spatial relationship between rescues and overdose death data across Massachusetts municipalities? 2) What is the geographic variation between the overdose rescue calls that were called in by a user bystander versus a non-user by-stander?

METHODOLOGY

The data used to construct the maps for this poster was provided MDPH-BSAS. Excel spreadsheets included rescues predicated by calls from user bystanders, rescues predicated by calls from non-user bystanders and overdose death data. The user bystander rescue data included total number of rescues, number of rescues where help was called/present and the rate that 911 was called/present for all years between 2009 and 2015. The non-user bystander rescue data had the same variables but the numbers were miniscule for each year so the data provided were the combined totals for all years. The overdose death data included the total number of overdose deaths between 2012 and 2015. I calculated the death rates using 2010 population data for each municipality from Census data and the resulting variable was the overdose death rate per 100,000 residents for each year and a total for all years. I excluded towns that had less than 5 overdose deaths in each year for more accurate rates. This data was cleaned and formatted in Excel so that it could be read into ArcMap for GIS processing. I also used the Pilot Sites data and was able to geocode 26 of the 30 pilot site addresses into ArcMap after downloading Massachusetts street data for each county from TIGER and merging them into a large address locator shapefile. The Excel sheets were joined with a Massachusetts municipality shapefile from MassGIS. A overdose rate map was made drawing quantities using color to show the variation between towns using total overdose rate data from 2012-2015. Dot Density maps were used to show total rescues from user and non-user by-stander calls in 2015. Lastly, a graduated symbol overlay was used to show total rescues compared to total overdoses for 2015.

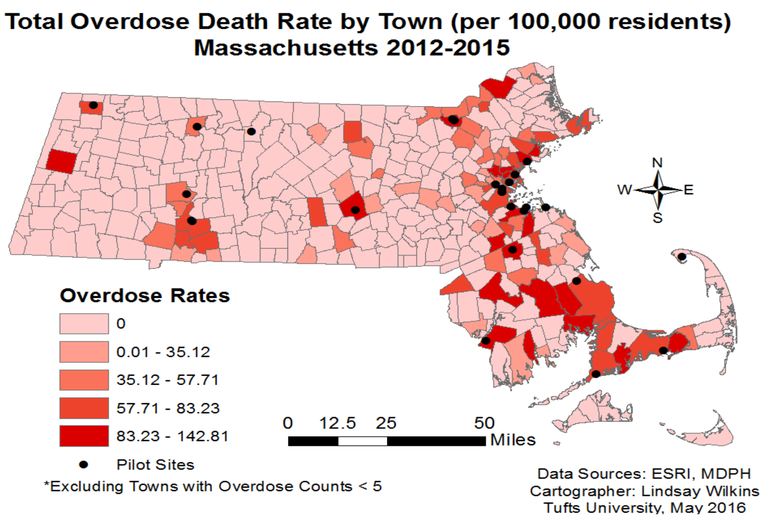


Figure 1: Total Overdose Rate by Town (per 100,000residents) - Massachusetts 2012-2015

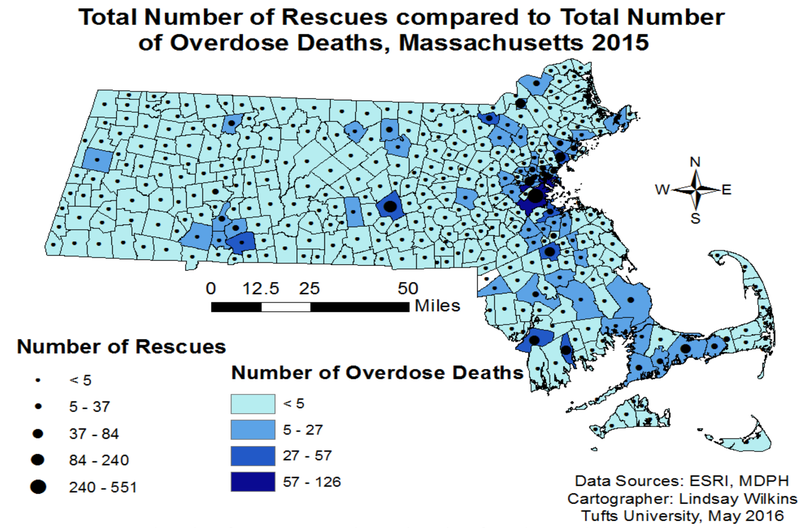
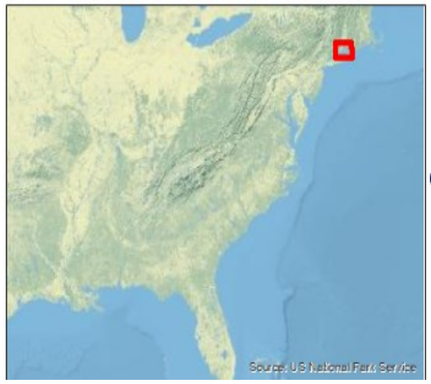


Figure 2: Total Number of Rescues compared to Total Number of Overdose Deaths—Massachusetts 2015

LOCATOR MAP



ORGANIZATION

COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF PUBLIC HEALTH

RESULTS

There are 4 maps depicting overdose rates and totals from MDPH's Overdose Statistics, and overdose rescue data from MDPH's Naloxone Bystander Pilot Programs.

Figure 1 shows the total overdose rate by town per 100,000 residents in the state between 2012 and 2015. The map excludes towns with overdose counts less than 5, and these counts then resulted in rates of 0 for those towns. The map shows increasing rates of overdose throughout the state. It also includes the MDPH Naloxone Pilot Sites. The pilot sites are mostly in the areas where the overdose rates are high.

Figure 2 shows graduated colors of total overdoses overlaid with graduated symbols in a circle shape of total rescues from the MDPH Bystander Pilot data. The symbols are proportional and get larger with more rescue incidences. Many of the towns with high total overdoses also have corresponding higher total rescue circles overlaid. The lightest blue and the smallest circles represent totals <5 to give a better view of the totals across the state.

Figures 3 and 4 are dot density maps showing total number of rescues called in by a user bystander and a non-user bystander. In each map, one dot equals 2 rescues. The non-user bystander map also includes all data from 2009-2015 because it's a small data set. The user bystander map includes total rescues from 2015 to show the most recent numbers.

PH 262: GIS for Public Health—May 11, 2016

References:

1. Massachusetts Department of Public Health: Current Statistics. (May 2016). Data Brief: Fatal Opioid-related Overdoses among Massachusetts Residents.
2. Naloxone Bystander Pilot Programs Timeline—Bureau of Substance Abuse Services (2015).

Sources:

Naloxone Bystander Pilot Site Data Sets, ESRI & MASSGIS

ArcMap was used to construct all maps shown on this poster

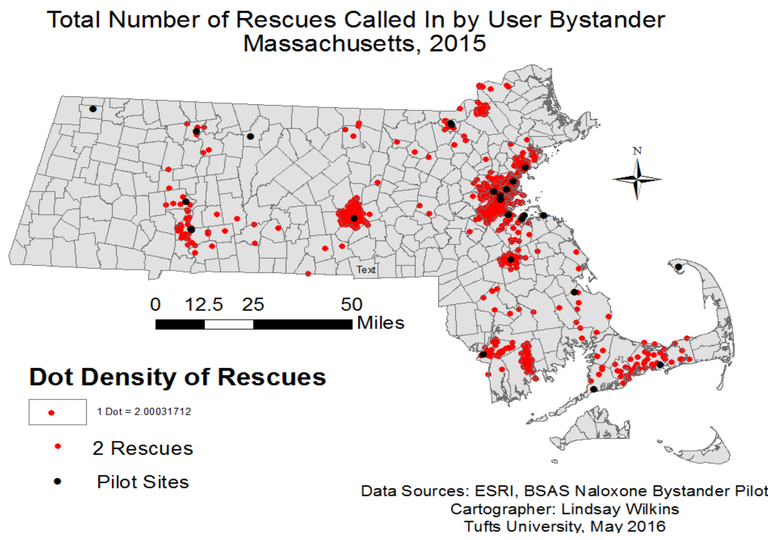


Figure 3: Total Number of Rescues Called In by User Bystander—Massachusetts 2015

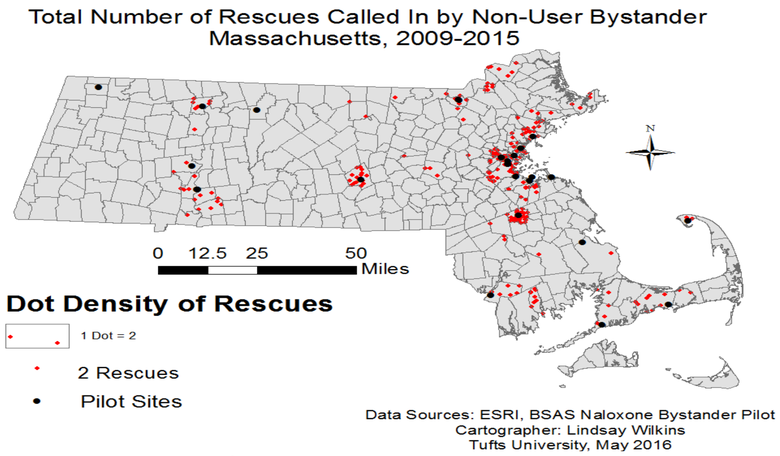


Figure 4: Total Number of Rescues Called In by Non-User Bystander—Massachusetts 2009-2015

DISCUSSION

These maps are helpful to understand if the MDPH Naloxone Bystander Pilot programs are in the right locations based on overdose rates and also to see where additional programs could be needed. The overdose rate map shows that the pilot sites are generally in or near areas with high rates of overdose deaths. Four of the pilot sites did not geocode and are located in Lawrence, Pittsfield, New Bedford and Springfield, which all have high overdose death rates in the map. Some possible areas of need for additional pilot sites could be Fitchburg, Haverhill, Gloucester, Taunton and Framingham based on their high rates of overdose deaths. Additionally the map showing total overdoses and total rescues as counts is helpful in seeing where more education might be needed for people to learn how to spot an overdose and call for 911 assistance. Some areas of the state with large overdose counts have low number of rescues and could be targeted in an education campaign. However, there are also inconsistencies with some towns with low overdose death counts and high rescue counts. This could be due to the way the data is collected at the pilot sites. These sites talk with clients and ask them for their account of rescues and if help was called during an overdose, so the data may be skewed due to recall bias. Despite this, the map gives us a glimpse at areas where rescues and overdose deaths may not align as we would expect. The dot density maps help us see the differences between rescues that are predicated by a call from a user or a non-user bystander. The user bystander map has a greater dot density than the non-user bystander map partly because we had more data for the user bystander map than the non-user map. Also, the dots showing total rescues align greatly with the pilot sites, which makes sense because the data came from the sites themselves. It is interesting to note that some pilot sites do not have any dots near them which shows that there were no rescues reported in that town. MDPH plans to review these maps as well as additional overdose rate maps to understand how these pilot sites are working in relation to the overdose data and they may be modified in the future once further data is acquired.