OVERDOSE AND DRUG USE INDICATORS

MAPPING DISCARDED NEEDLE PICKUPS AND POLICE "SICK ASSISTS"

IN RELATION TO THE

CareZONE TREATMENT & HARM REDUCTION PROGRAM

BOSTON MASSACHUSETTS: 2016 TO 2019

Background

In the last decade, opioid-related deaths in Massachusetts roughly quadrupled, rising from 560 deaths in 2010 to a peak of 2,100 deaths in 2016 (MDPH 2017 Opioid Data Brief) Recognizing the high human costs of this opioid epidemic in Boston, the City of Boston and local healthcare organizations have joined those stepping forward to address opiate use disorder among Boston citizens.

Using a mobile van to increase patient access, and thus increase retention of patients receiving treatment for opiate use disorder (OUD), has been successfully tested in Baltimore (Greenfield et al.) and a mobile van treatment program reduced barriers of stigmatization and cost in New Jersey (Hall et al.) However, the concept of combining mobile treatment, primary care, and harm reduction services was not found in a literature search and may be novel. On January 16, 2018, CareZONE, a program of the Kraft Center for Community Health at Massachusetts General Hospital, initiated just such a mobile-health service in partnership with the Boston Public Health Commission's AHOPE harm reduction program, Boston Health Care for the Homeless, and the GE Foundation.

CareZONE is designed to be easy access and barrier free for persons-who-inject-drugs (PWIDs), a highly-at-risk population. Having started at locations near North Station in Boston's West End as well as Nubian Square in Roxbury in January 2018, the program expanded in May 2018 to Downtown Crossing and a site in the Fenway. These four locations were served by the van, clinician, and harm reduction/outreach specialists once-per-week for the remainder of 2018-2019.

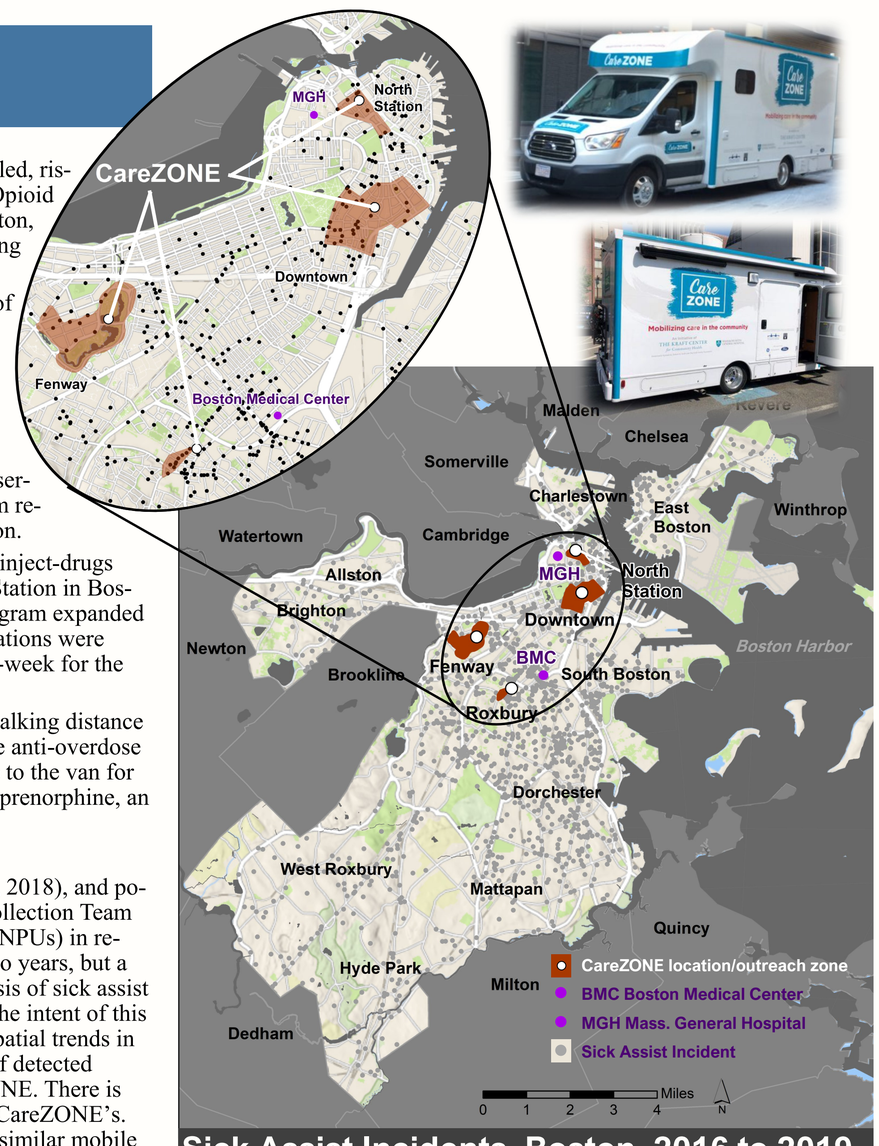
For each site visit, the harm reduction team searches an area within easy walking distance of the CareZONE van. When PWIDs are found, they are offered free naloxone anti-overdose kits and clean syringes (Stopka et al., 2017). Contacts are encouraged to come to the van for medical services, referrals, and counseling. The van clinician can prescribe buprenorphine, an OUD treatment; make methadone referrals; and provide free primary care.

Study motivation

Discarded syringes are an indicator of injectable opioid use (Bearnot et al., 2018), and police "sick assist" calls are indicators of drug overdoses. The Mobile Sharps Collection Team was created by the City of Boston in 2015 to make discarded needle pickups (NPUs) in response to Boston 311 reports. Bearnot et al. studied this program in its first two years, but a literature search does not reveal analysis of NPUs for 2017/2018 or any analysis of sick assist incident (SAI) reports in the 4-1/2 years since the new system was initiated. The intent of this study is to use these NPUs and SAIs to visually describe and analyze recent spatial trends in intravenous drug use and likely overdoses in Boston. Further, the study asks if detected trends could have any spatial-temporal relationship to the presence of CareZONE. There is little published evidence on the effectiveness and benefits of a model such as CareZONE's. The results of these analyses could help CareZONE, and others considering a similar mobile service, evaluate the program's response to community needs and plan future deployments.

Research questions

1. What trends in opioid use and misuse and opioid injection, as measured in SAIs and NPUs, can be seen in the past four years?
2. Are there any spatial-temporal relationships between CareZONE-delivered services and trends in SAIs or NPUs since CareZONE started on 16 January 2018?



Sick Assist Incidents, Boston, 2016 to 2019

Methods

Data Sources

1. Analyze Boston, the City of Boston's open data hub: Crime Incident Reports (new system as of Summer, 2015; includes latitude and longitude). This analysis employs data from 2016 through 1019. Until September 29, 2019 these data were coded:

   1830: Drugs – Sick Assist – Heroin (66.0%)

   1831: Drugs – Sick Assist – Other Narcotic (13.9%)

   1832: Drugs – Sick Assist – Other Harmful Drug (27.9%)

   On September 29, 2019 these three codes were consolidated, and, going forward, all sick assist incidents were reported as "1832: Sick Assist – Drug Related Illness." Given that these codes are all reported by responding police officers without the benefit of medical diagnoses or drug testing, none of the pre- or post-September 2019 codes are considered here either exclusive or confirmative of opioid overdosing and all are included as general indicators of opioid trends and likely overdose locations for the purpose of this analysis.
2. Analyze Boston: 311 NPU requests, 2016 through 2019.

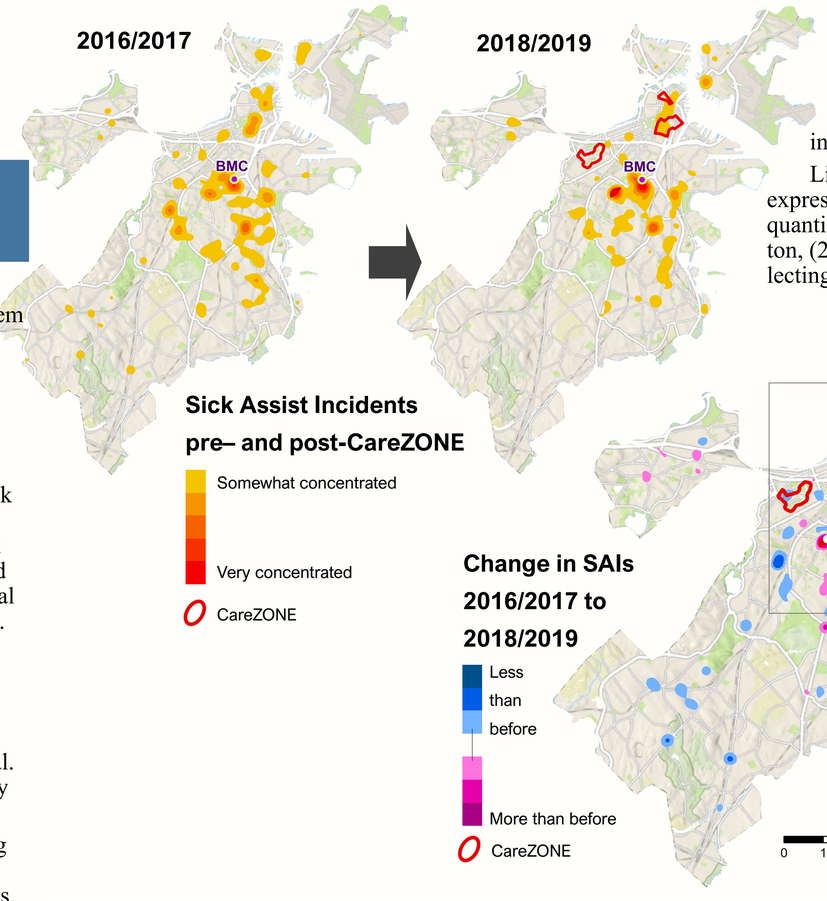
   The Sharps Collection Team is dispatched based on 311 reports via smartphone app (66%) or voice calls (33%), picking up used syringes from public places. Latitudes and longitudes are currently provided in this database for all NPUs, 2016 to 2019. This is in contrast to when, in a mapping analysis of these data through August 2017, Bearnot et al. found that 22% of the latitudes and longitudes for NPUs were missing but could be fully geocoded with street addresses provided in the database.
3. Isabel Plakes, Outreach Coordinator, CareZONE: CareZONE parking spots and walking outreach zones for all four locations. Recorded in Google MyMaps and transcribed by hand to ArcGIS Desktop 10.7.1 (ESRI, Redlands CA), which was used for all final maps.

Data procedures and analyses

The SAI data were plotted for all four years in a dot density map. SAIs were then aggregated for the two years prior and the two years following CareZONE's start. These data were processed with a Kernel density algorithm to show hot spots before and after CareZONE. The density scales were manually controlled to show true comparative effects between the two maps. In a third map, map algebra was used to subtract the pre-CareZONE map from the post-CareZONE map to show spatial trends across the two time periods. Cell size was set at 2 square feet and search radii at 500 feet for all maps.

The NPU data were plotted in a dot density map for 2019 and with a Kernel density algorithm for each year, 2016 to 2019. The density scales were manually controlled to show true comparative effects across all four maps. Cell size was set at 2 SF and search radii at 1,000 feet. In contrast, Bearnot et al. used a census cluster/Moran's I analysis with the data to 2017.

CareZONE outreach zones were visually superimposed on all maps for periods after the start of CareZONE. Individual SAI and NPU events were visually examined to estimate if further analysis to detect potentially significant effects of CareZONE would be possible.



Results

Examining the dot density maps for four years of SAIs and the 2019 NPUs, it is apparent that both SAIs and NPUs are widespread and occur in every area of Boston.

The Kernel density maps for both indicators show hot spots which are consistent over time and with each other. However, while aggregated two-year totals decreased 18% from 1,124 SAIs in 2016/2017 to 921 SAIs in 2018/2019, the spatial trend was for Nubian Square/Roxbury (a CareZONE location) and Boston Medical Center loci to become "hotter", as the CareZONE locations at the Fenway, Downtown Crossing, and North Station/West End grew "cooler." These trends can be seen in comparing the 2016/2017 and 2018/2019 yellow/orange SAI maps as well as in the combined map showing the pre-/post-CareZONE trends of SAIs in blue and magenta.

The NPU Kernel density maps reflect the quadrupling of NPUs in Boston over four years, rising from 1,990 needle pickups in 2016 to 8,070 in 2019. The area with the most NPUs spread through the city over time in a wide swath bounded somewhat by Nubian Square/Roxbury and North Station/West End. Within this area both the Boston Medical Center neighborhood and Downtown between the North End and Downtown Crossing showed the most increase.

Very close visual examination of the four mapped CareZONE walking zones (in red shading or outline) did not reveal enough data for reliable temporal analysis of possible trends relative to those zones.

Discussion

The quadrupling of NPUs over the four years from 2016 to 2019 may be attributable to a combination of factors including an increase in use of injected drugs; the high and increased rate of fentanyl use in Massachusetts, which, due to fentanyl pharmacology (CDC), may lead to many more injections per day than is average for people who inject heroin alone; resources or efficiency of the Boston Mobile Sharps Collection Team; and, finally, less reuse of syringes, and, thus, more discards, as programs like CareZONE and over-the-counter sales make clean syringes easier to obtain.

Data for SAIs show an 18% decline during the same four years. This is surprising data, given the rapid increase of discarded syringe pickups. With the rise of fentanyl, the use of which can easily lead to overdose (CDC), an increase in SAIs would be expected. A possible explanation for this discrepancy is greatly increased distribution by CareZONE, and many others, of naloxone to PWIDs, and their contacts, with a consequent reduction in overdoses. During this period of declining SAIs, their concentration around Nubian Square/Roxbury and Boston Medical Center has increased, which is consistent with the increase of NPUs around these areas.

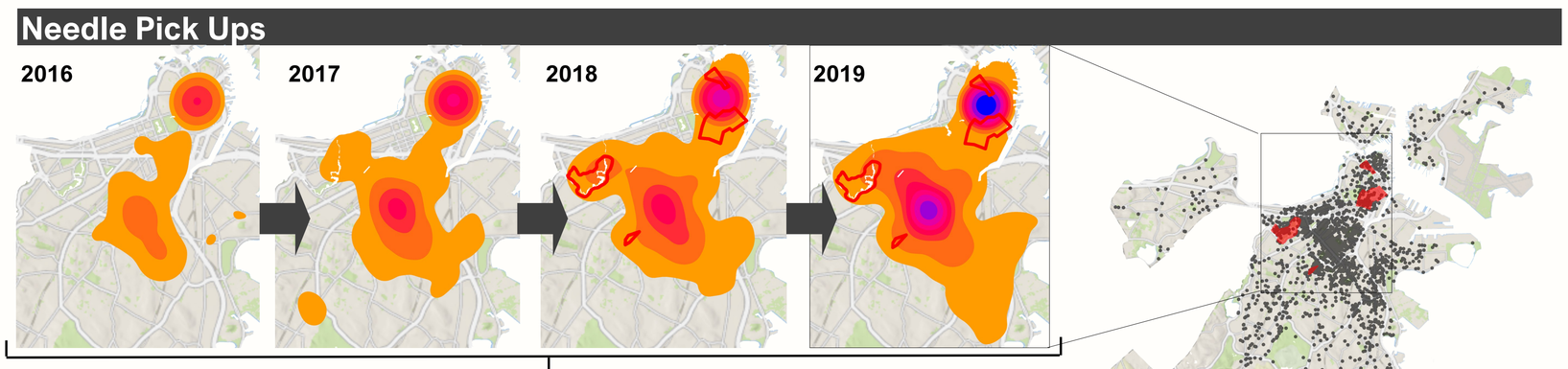
No conclusion can be drawn about the association of CareZONE with the trends seen in NPUs and SAIs. SAIs declined in three CareZONE areas but increased around Nubian Square/Roxbury. NPUs increased slightly in the Nubian Square area and much more in the other three CareZONE areas. However, it is clear that CareZONE, in selecting sites for outreach in 2018 and since, has accessed the most intense zones of opioid use and misuse and injection.

Limitations of this analysis include the lack of certainty regarding overdose diagnoses expressed, or not expressed, in the police codes for sick assist incidents. No data exists to quantify the increase in NPUs due to a possible increase in (1) the number of PWIDs in Boston, (2) fentanyl, which might be injected more frequently, (3) City of Boston syringe collecting resources, or (4) other factors. Analysis of the potential effect of a mobile source of intervention such as CareZONE is limited by the challenges of shifting and mobile populations of PWIDs, limited weekly presence, and shifting intervention locations, which take advantage of the mobility and adaptability of CareZONE.

The strength of this study resides in the quantity, accuracy, and timespan of data for both SAIs and NPUs and the mapping of both of these indicators for comparison.

Future work could address why NPUs have rapidly increased in Boston and why SAIs, which are likely overdoses, have decreased. More information on the effect of naloxone distribution on the rate of overdoses in Boston would be valuable.

Needle Pick Ups



All needle pickups for 2019

Credits

Cartographer/author: Ric Bayly

May 1, 2020

PH262 GIS for Public Health (Spring, 2020) / Thomas Stopka, PhD, MHS
Tufts University School of Medicine
Public Health Professional Development

Thanks to Craig Regis, MPH, Program Manager, Kraft Center for Community Health, and Isabel Plakes, Outreach Coordinator, CareZONE.

Projection: Web Mercator Auxiliary Sphere with WGS 1984 coordinate system.
Data:
Analyze Boston, 311 Service Requests, City of Boston
Analyze Boston, Crime Incident Reports (for "Sick Assists") , City of Boston
ESRI: World Map
MassGIS: Massachusetts Political Boundaries Map

Tufts Institutional Review Board approval, March 2020.

References

Bearnot B, Pearson JF, Rodriguez JA. Using Publicly Available Data to Understand the Opioid Overdose Epidemic: Geospatial Distribution of Discarded Needles in Boston, Massachusetts. *Am J Public Health*. 2018;108(10):1355-1357. doi:10.2105/AJPH.2018.304583

Greenfield L, Brady JV, Besteman KJ, De Smet A. Patient retention in mobile and fixed-site methadone maintenance treatment. *Drug Alcohol Depend*. 1996;42(2):125-131. doi:10.1016/0376-8716(96)01273-2

Hall, G., Neighbors, C. J., Iheoma, J., Dauber, S., Adams, M., Culleton, R., Muench, F., Borys, S., Mcdonald, R., & Morgenstern, J. (2014). Mobile opioid agonist treatment and public funding expands treatment for disenfranchised opioid-dependent individuals. *Journal of Substance Abuse Treatment*, *46*(4), 511–515. https://doi.org/10.1016/j.jsat.2013.11.002

Stopka TJ, Donahue A, Hutcheson M, Green TC. Nonprescription naloxone and syringe sales in the midst of opioid overdose and hepatitis C virus epidemics: Massachusetts, 2015. *Journal of the American Pharmacists Association*. 2017;57(2, Supplement):S34-S44. doi:10.1016/j.japh.2016.12.077

Massachusetts Department of Public Health. *Data Brief: Opioid-Related Overdose Deaths Among Massachusetts Residents*. Boston MA; 2018:4.

Centers for Disease Control and Prevention. Fentanyl. https://www.cdc.gov/drugoverdose/opioids/fentanyl.html. Published March 19, 2020. Accessed May 1, 2020.

Tufts UNIVERSITY