Identifying, Entering, and Characterizing, HCV Hotspots: A Mixed Methods Approach

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  - Finding, Characterizing, and Preventing Hepatitis C Hot Spot Clusters in Massachusetts (PI: Stopka)

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Overview: HCV Hotspots in Massachusetts (MA)

- Background: HCV; Opioid syndemic
- Methods
  - Data
  - Mixed methods
- Results: Identifying, Entering, Characterizing Hotspots
- Discussion
- Next steps: Future steps

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Background: HCV in Massachusetts

- Change in age distribution of HCV
- Reported HCV cases among 15-29 year olds increased by 137% between 2002-2013
- 9,000 HCV cases reported annually
- >2,000 cases reported among 15-29 year olds
- Opioid Syndemic: Prescription opioids, heroin use, fentanyl, HCV, endocarditis, STIs
  - Singer M., Clair S. Syndemics and Public Health: Reconceptualizing disease in bio-social context. Med Anthropology Quarterly. 2003

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Age distribution of newly reported confirmed cases of HCV infection --- Massachusetts, 2002 and 2009

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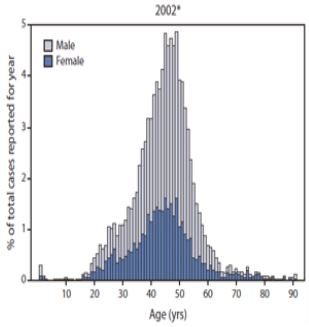
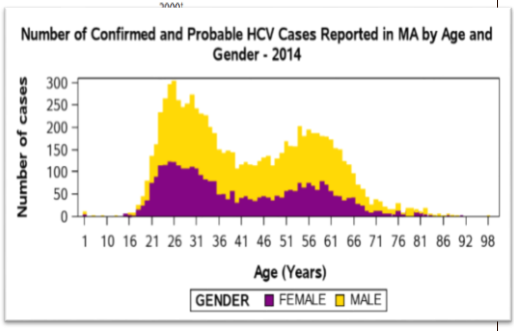
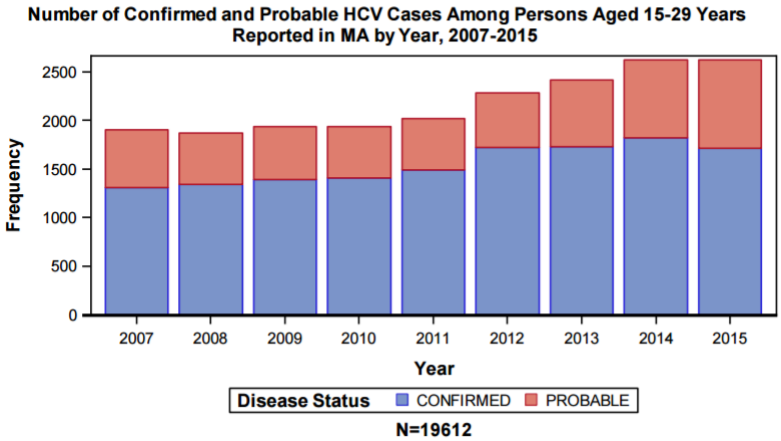




Source: Onofrey et al MMWR: **May 6, 2011 / 60(17);537-541**

Massachusetts Department of Public Health
Bureau of Infectious Disease and Laboratory Sciences
Division of Epidemiology and Immunization



Methods

1) **Identify HCV Hotspots:** GIS and spatial epidemiological methods
2) **Enter HCV Hotspots:** In-depth interviews
3) **Characterize HCV Hotspots:** Statistical and qualitative analyses

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Identifying Hotspots: GIS and Spatial Epidemiology

- Data: MA Department of Public Health
  - HCV Surveillance Data, 2002-2013
  - MA Virtual Epidemiologic Network (MAVEN)
- Descriptive GIS Mapping
  - To assess initial geospatial distributions of HCV
  - To map ACASI survey data
- Spatial Epidemiological Analyses
  - Kernel density estimates (heat maps)
  - Incremental spatial autocorrelations
  - Hotspot cluster analysis (Getis-Ord Gi*); ArcGIS 10.4.1
  - Spatiotemporal analyses (SatScan)

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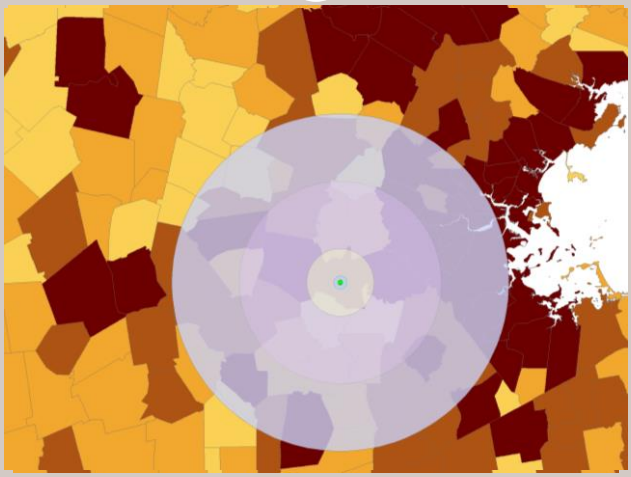
Exemplar Sphere of Spatial Influence (1km, 5 km, 15km, 25km?)



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Hotspot Analysis Output

- Clusters pinpointed
  - Statistically significant clusters across **state**
  - Significant clusters within concerning **regions**
- Results
  - **Z-scores,** P-values, and Moran's *I*
    - Larger Z-score, more intense the clustering of high values (**a hotspot**)
    - Smaller Z-score, more intense the clustering of low values (**a coldspot**)

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Entering Hotspots: Qualitative Interviews

- 60 minute in-depth interviews
  - Public health officials, harm reduction staff, clinicians
  - Context within HCV hotspots
- Audio-recorded interviews
- Coding and context analysis in NVivo
- Identify salient themes and quotes
- Results
  - Context surrounding HCV hotspots
  - Inform survey development and recruitment

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Characterizing Hotspots: Statistical Analyses

- Data
  - Secondary: MDPH surveillance data; U.S. Census: ACS Data
  - Primary: Audio computer assisted survey instrument (ACASI)
- Descriptive Statistics
- Statistical Analyses
  - Logistic regression: Factors associated with HCV hotspots
  - Comparison across sites

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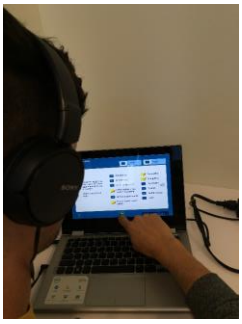
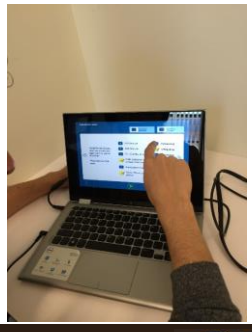
ACASI Surveys in HCV Hotspots

PRELIMINARY FINDINGS





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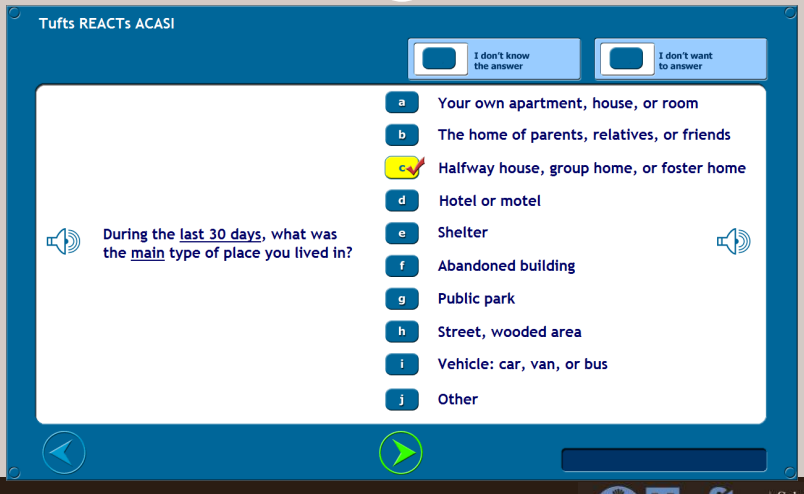
Screen Shots – ACASI Survey



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Results:
Identifying HCV hotspots

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Stopka et al (2017)
BMC ID. PMID: 28427355

Stopka *et al. BMC Infectious Diseases* (2017) 17:294
DOI 10.1186/s12879-017-2400-2

BMC Infectious Diseases

RESEARCH ARTICLE Open Access

Identifying and characterizing hepatitis C virus hotspots in Massachusetts: a spatial epidemiological approach

Thomas J. Stopka[1*], Michael A. Goulart[1], David J. Meyers[1,2], Marga Hutcheson[1], Kerri Barton[3], Shauna Onofrey[3], Daniel Church[3], Ashley Donahue[1] and Kenneth K. H. Chui[1]

Abstract

Background: Hepatitis C virus (HCV) infections have increased during the past decade but little is known about geographic clustering patterns.

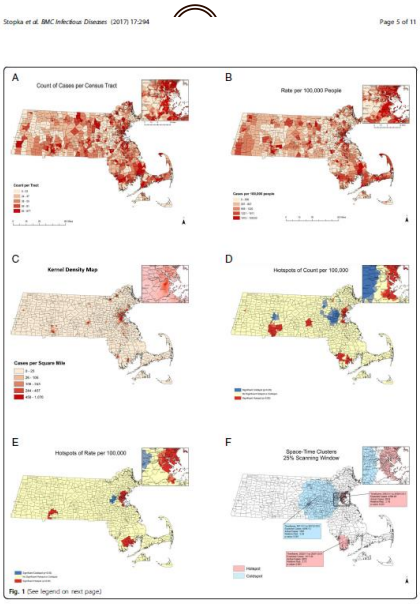
Methods: We used a unique analytical approach, combining geographic information systems (GIS), spatial epidemiology, and statistical modeling to identify and characterize HCV hotspots, statistically significant clusters of census tracts with elevated HCV counts and rates. We compiled sociodemographic and HCV surveillance data (n = 99,780 cases) for Massachusetts census tracts (n = 1464) from 2002 to 2013. We used a five-step spatial epidemiological approach, calculating incremental spatial autocorrelations and Getis-Ord Gi* statistics to identify clusters. We conducted logistic regression analyses to determine factors associated with the HCV hotspots.

Results: We identified nine HCV clusters, with the largest in Boston, New Bedford/Fall River, Worcester, and Springfield ($p < 0.05$). In multivariable analyses, we found that HCV hotspots were independently and positively associated with the percent of the population that was Hispanic (adjusted odds ratio [AOR]: 1.07; 95% confidence interval [CI]: 1.04, 1.09) and the percent of households receiving food stamps (AOR: 1.83; 95% CI: 1.22, 2.74). HCV hotspots were independently and negatively associated with the percent of the population that were high school graduates or higher (AOR: 0.91; 95% CI: 0.89, 0.93) and the percent of the population in the "other" race/ethnicity category (AOR: 0.88; 95% CI: 0.85, 0.91).

Conclusion: We identified locations where HCV clusters were a concern, and where enhanced HCV prevention, treatment, and care can help combat the HCV epidemic in Massachusetts. GIS, spatial epidemiological and statistical analyses provided a rigorous approach to identify hotspot clusters of disease, which can inform public health policy and intervention targeting. Further studies that incorporate spatiotemporal cluster analyses, Bayesian spatial and geostatistical models, spatially weighted regression analyses, and assessment of associations between HCV clustering and the built environment are needed to expand upon our combined spatial epidemiological and statistical methods.

Keywords: Getis-Ord Gi*, Spatial clusters, GIS, Surveillance, Infectious diseases

Identifying Geospatial Patterns…



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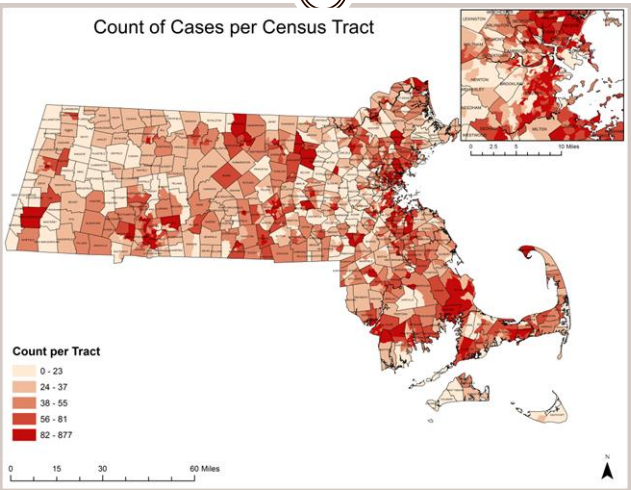
Descriptive Maps: HCV Counts, 2002-2013



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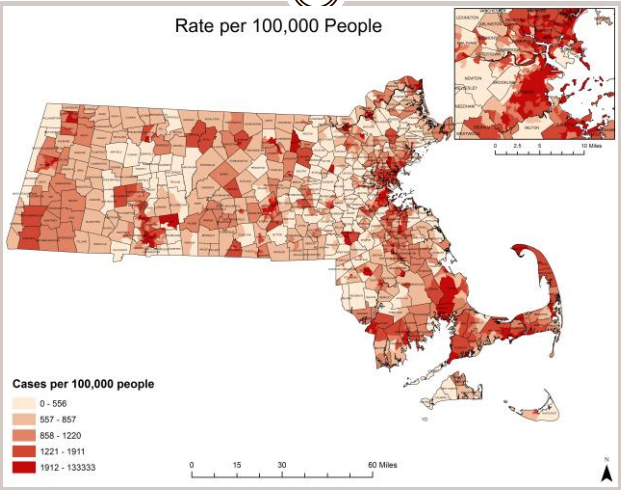
HCV Rates by Census Tract, 2002-2013



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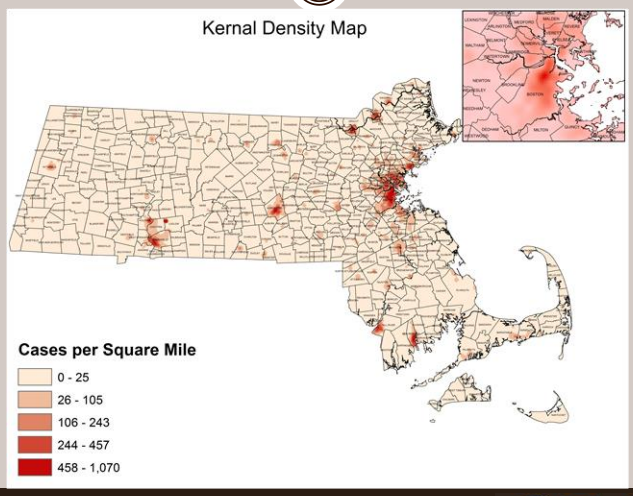
Kernel Density Estimates: "Heat Maps"



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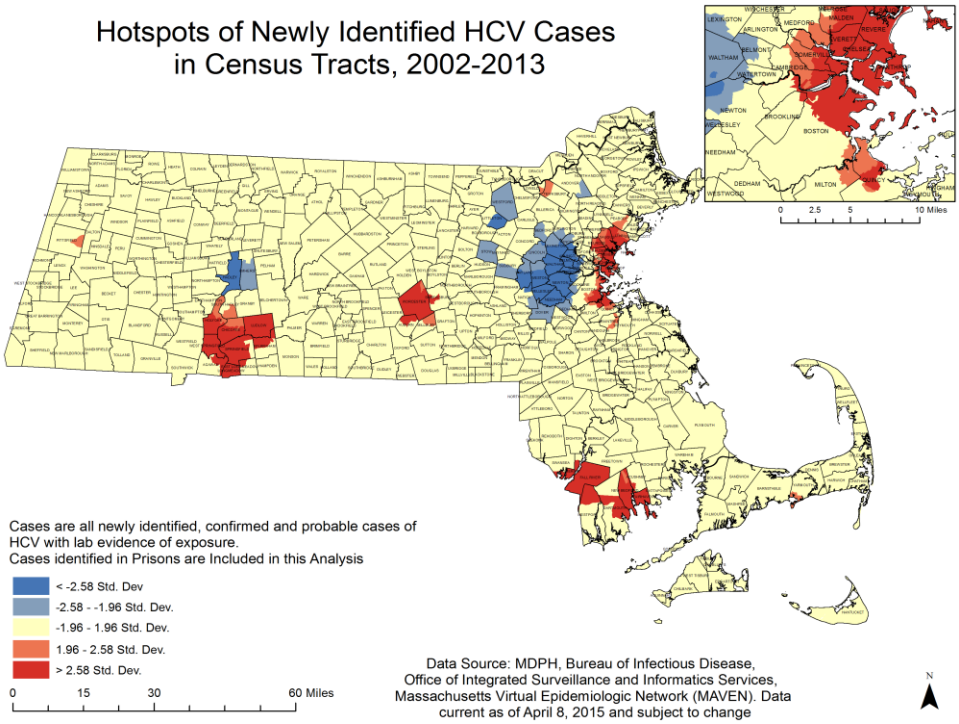
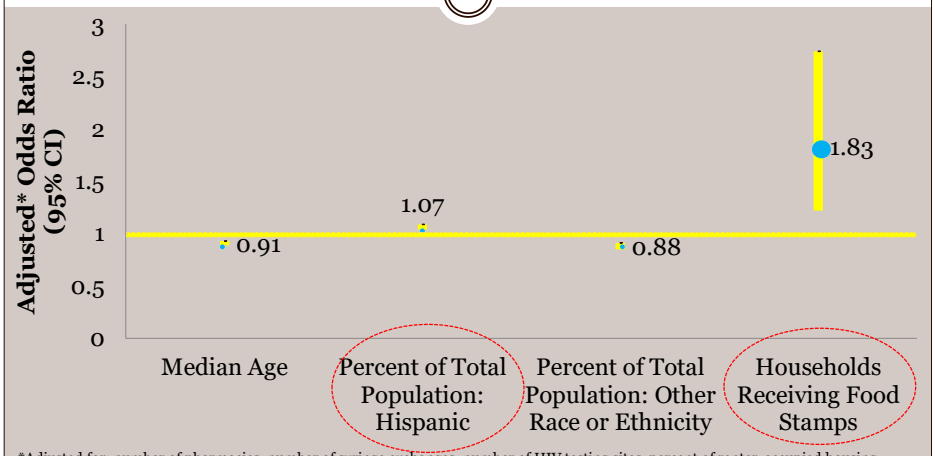


Validating Across Spatial Methods

TABLE 1 Comparison of Geostatistical Findings Highlighting Locations with High and Low Reported HCV Infections, Massachusetts, 2002-2013

Location	Kernel Density Analysis (Heat Maps)	Getis-Ord GI* Hotspot Test (Count)	Getis-Ord GI* Hotspot Test (Rate)	Poisson Space-time Cluster Test
Greater Boston Area	Higher Caseload per Square Mile	Statistically Significant Hot Spot	Statistically Significant Hot Spot	Statistically Significant Hot Spot
South Shore of Massachusetts	Higher Caseload per Square Mile	Statistically Significant Hot Spot	Statistically Significant Hot Spot	Statistically Significant Hot Spot
Springfield	Higher Caseload per Square Mile	Statistically Significant Hot Spot	Statistically Significant Hot Spot	No Significant Cluster
Worcester	Higher Caseload per Square Mile	Statistically Significant Hot Spot	No Significant Cluster	No Significant Cluster
Pittsfield	Higher Caseload per Square Mile	Statistically Significant Hot Spot	No Significant Cluster	No Significant Cluster
Cape Cod	Higher Caseload per Square Mile	Statistically Significant Hot Spot	No Significant Cluster	No Significant Cluster
North Shore of Massachusetts	Higher Caseload per Square Mile	No Significant Cluster	No Significant Cluster	No Significant Cluster
Merrimack Valley	Higher Caseload per Square Mile	No Significant Cluster	No Significant Cluster	No Significant Cluster
Metro West	No Discernable Difference from State Average	Statistically Significant Cold Spot	Statistically Significant Cold Spot	Statistically Significant Cold Spot

Sociodemographic Factors Associated with HCV Hotspots (MA Census Tracts; n=1472)



*Adjusted for: number of pharmacies, number of syringe exchanges, number of HIV testing sites, percent of renter-occupied housing units, percent of households with one worker, and percent of households with two or more workers

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Entering & Characterizing HCV Hotspots: In-Depth Interviews

PRELIMINARY QUALITATIVE RESULTS: WORCESTER AND BOSTON

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Qualitative Interviews

- **Young generation feels invincible**
- **Lots of services for HIV, but not for HCV**
- **More focus on epidemic now because of demographics –middle class whites**
- **Stigma, Guilt, Shame**
  - To see medical providers
  - To go to a place called "AIDS Project Worcester"
  - Mention of "IDU", many barriers appear
- **Adherence**
  - Some interviewees believe that drug users will adhere to medications because they are used to being on a schedule
  - Others believe they would not be adherent because of their lifestyles (homeless, other more important things to deal with)

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Qualitative Interviews (2)

- **Need for expansion of treatment and programs to treat addiction AND disease**
  - Piloting drug and HCV treatment together (Suboxone + HCV meds)
  - Need for treatment beds, detox services– multi-week wait times
- **Worcester as a Hotspot**
  - Economic climate – difficult to find employment
  - Nothing to do
  - Laid back attitude of law enforcement
  - Many highways converge in Worcester – contributes to it being a heroin hub
- **Insurance/cost barrier to HCV treatments**
- **Many people still don't know about new HCV medications**
- **Huge need for more SSPs that serve the at risk-population**
  - Needles everywhere in Worcester
  - Users have to get needles from pharmacies

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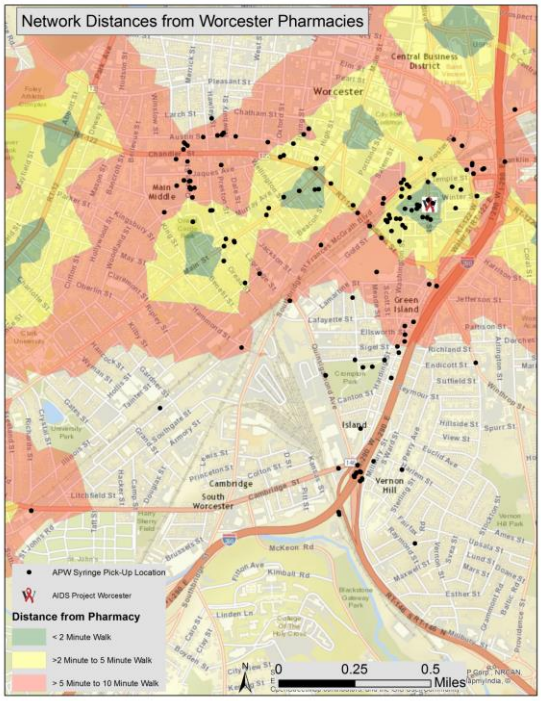

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Characterizing HCV Hotspots: Statistical Results

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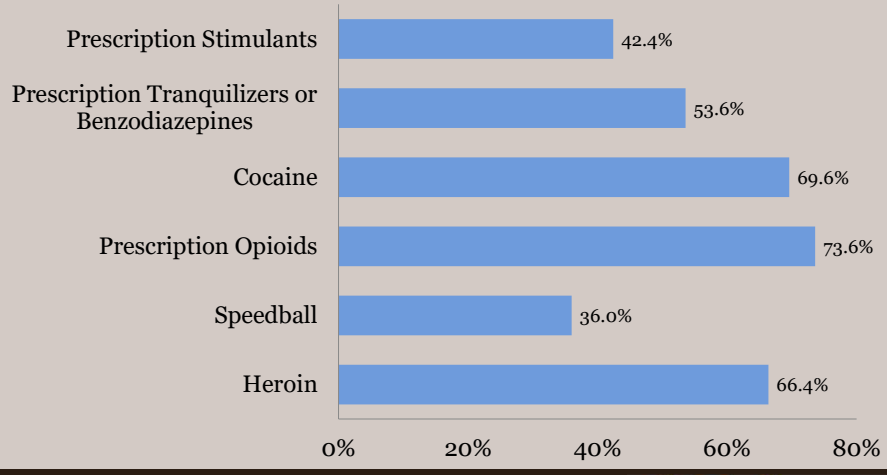
ACASI Results: Drugs Participants Have Ever Used in HCV Hotspots



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ACASI Results: Overdose and Drug Treatment in HCV Hotspots

In the Past 12 Months:

- 49.6% Witnessed an overdose
- 24% Rescued someone with Naloxone
- 33.6% Have been in a drug treatment program
- 24% Attempted to enter a drug treatment program but could not

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Preliminary ACASI Results: Healthcare Access

Variable	Boston (n=137) n, %	Worcester (n=125) n, %	P-value
Saw medical provider (Last 12 mos)	124 (91%)	94 (75%)	<0.001
Has health insurance	132 (96%)	109 (87%)	0.01
Tested for HIV	125 (91%)	103 (82%)	0.03
Tested for HCV	121 (88%)	94 (75%)	0.01
Heard about HCV Tx	63 (77%)	25 (54%)	0.01
Interested in HCV Tx	68 (83%)	33 (72%)	0.20

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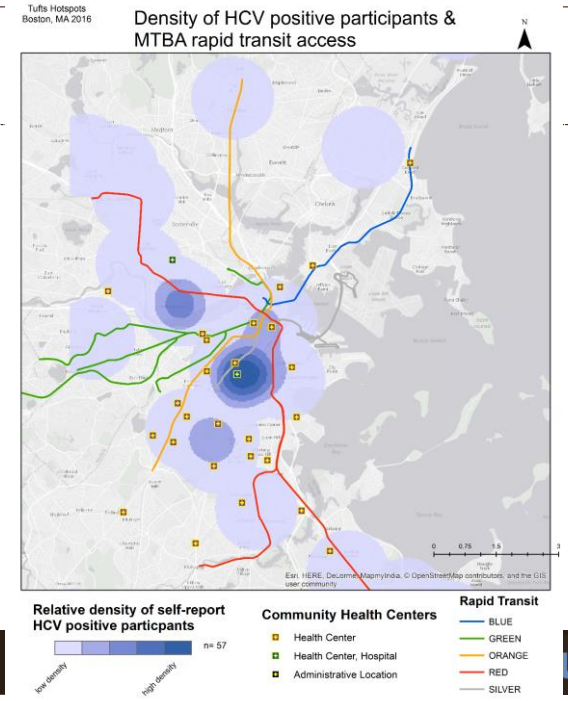
Preliminary ACASI Results: Disease Prevalence

Variable	Boston (n=137) n, %	Worcester (n=125) n, %	P-value
HCV infection	121 (88%)	94 (75%)	0.01
HIV infection	17 (14%)	10 (10%)	0.37
HBV infection	18 (13%)	6 (5%)	0.02
STI ever	42 (33%)	24 (19%)	0.01
Opioid overdose	65 (47%)	44 (35%)	0.045
Treated for last OD	53 (82%)	33 (75%)	NS
Had abscess	55 (40%)	32 (26%)	0.03
Treated for abscess	45 (82%)	29 (91%)	0.04
Mental illness	107 (78%)	91 (73%)	NS
Depression	57 (42%)	49 (39%)	NS
Bipolar disorder	23 (17%)	29 (21%)	NS



Discussion

- Limitations
  - Not all HCV cases captured in surveillance system (MAVEN)
  - Time lag: Capture HCV report years after infection
  - Place of residence at time of HCV report; not place of infection
  - Spontaneous viral clearance (25%)
  - Small sample for survey results
- Strengths
  - Mapped/analyzed >80,000 cases (80% geocode rate)
  - Used systematic, objective, rigorous approach to identify and characterize HCV hotspots
  - Findings can help inform policymakers and public health officials

Next Steps

- Syndemic approach to precision public health
- Entering and intervening in HCV hotspots among young adults (18-30 year olds)
  - Qual, quant, social network, spatial, phylogenetic analyses
  - Intervene with highest risk transmission networks in local-level hotspots
- ID hotspots within hotspots
- Enhance HCV linkage to care and CasP

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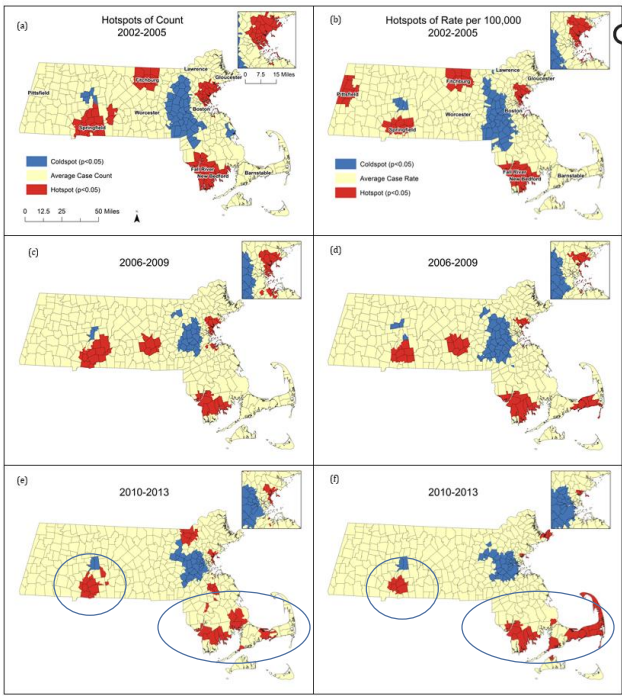
Shifting HCV in 15-30 year olds

2002-2013



Overview: HCV Hotspots in Massachusetts (MA)

- Background: Syndemic
- Methods
  - Data
  - Mixed methods
- Results: Identifying, Entering, Characterizing Hotspots
- Discussion
- Next steps: Future research

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Thank you! Questions?

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