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Title: Utilizing public health data to geotarget hepatitis C virus elimination approaches in urban and rural Michigan

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ABSTRACT

Using Michigan public health data, we assessed geographical access to specialist providers for hepatitis C virus (HCV) treatment in urban and rural areas in Michigan and explored correlates of HCV in these areas to help inform HCV elimination planning and resource allocations. We found higher HCV incidence in urban areas, lower treatment specialist access in rural areas, but few correlates of HCV across adult populations in both areas. State and local HCV elimination planning should include population-based screening among all adults and address geographical barriers to care.

Key Words: Hepatitis C elimination; Hepatitis C policy; rurality; treatment access

INTRODUCTION

The number of new hepatitis C virus (HCV) cases has risen dramatically in the U.S. over the past decade, driven by acute HCV infections related to the ongoing opioid epidemic. The result is a demographic shift in new HCV cases from baby boomers to younger adults with histories of injection drug use (IDU), and an increasing number of cases in rural areas.[1,2] However, few studies have evaluated potential differences in HCV burden, demographics and access to treatment between urban and rural areas.

Currently, the U.S. is not projected to meet the World Health Organization's targets for HCV elimination by 2030.[3] The changing demographics of HCV presents unique challenges in HCV screening and treatment. HCV evaluation and treatment often relies heavily on infectious disease or hepatology specialist availability, which is often lacking in rural areas. Moreover, treatment barriers may include payer restrictions on medication access at the patient-level (e.g., requiring advanced liver fibrosis or sobriety documentation) and/or provider-level (e.g., limiting prescribers to hepatology, gastroenterology and infectious disease physicians). Fortunately, many payers are loosening their restrictions – either voluntarily or as the result of legal recourse – suggesting the potential to expand treatment to more patients. Thus, the local and state

infrastructure must be poised to target resources to meet the unique needs of their HCV population.

The aim of this study was to assess geographical access to specialist providers in urban and rural areas in Michigan and explore correlates of HCV in these areas to help inform HCV elimination planning and resource allocations.

METHODS

For geospatial analyses, newly reported cases of chronic HCV for 2017 in adults ≥18 years at the Zip Code Tabulation Areas (ZCTA)-level were obtained from the Michigan Disease Surveillance System (see Supplementary Materials for case definitions). Data are suppressed in ZCTAs with 1 to 5 reported cases. Because heroin treatment admission and opioid prescription rates were only available at the county-level, all data for regression analyses were obtained and analyzed at this level. County-level HCV incidence rates and heroin treatment admission rates were obtained from the Michigan Department of Health and Human Service's 2017 Hepatitis B and C Annual Surveillance Report.[4] Opioid prescription rates were obtained from the Michigan Substance Use Data Repository.[5]

We used 2010 U.S. Census Survey data to obtain demographics. Rurality designations were obtained from the Michigan Department of Community Health, which uses the U.S. Census Urban and Rural Classification and Urban Area Criteria to classify counties as urban or rural.

The location and number of specialist providers (gastroenterologists, hepatologists, and infectious disease physicians) in Michigan were extracted from the 2016 American Medical Association Physician Masterfile. Locations of federally qualified health centers (FQHC) and substance use disorder (SUD) clinics were also obtained from HRSA's Health Professional Shortage Area tool and the Substance Abuse and Mental Health Services Administration provider locator tool, respectively. Provider and clinic data were obtained as of June 1, 2019.

Maps of HCV incidence rates at the ZCTA-level in relation to specialist and clinic locations were constructed using ArcGIS. Minimum driving distance was determined from the centroid of each ZCTA to the nearest specialty provider, FQHC and SUD clinic location. The longitude and latitude for each ZCTA centroid and clinical locations were determined and an R-interface was used to access OpenStreetMap to calculate driving distances.

For descriptive statistics, all rates are expressed per 100,000 residents, unless otherwise stated. Minimum driving distances are expressed as median (interquartile range, IQR) and analyzed using paired t-tests. For ZCTAs with suppressed HCV case counts, HCV cases

were estimated by finding the discrepancy between county-level and zip-level counts and using total populations as a weight. To identify correlates of HCV in urban and rural areas, a multiple linear regression analysis was performed separately for urban and rural counties, weighted by total population, with the following variables: opioid prescription rates, heroin treatment admission rates, proportion male, proportion white, proportion no high school diploma or equivalent, proportion uninsured, and proportion living below the poverty level. All statistical analyses were performed using R. Statistical significance was determined at $p<0.05$.

RESULTS

Eighty-two percent (n=8,511) of HCV cases were in urban areas whereas only 18% (n=1,904) were in rural areas. Figure 1 depicts the spatial distribution of specialist provider, FQHC and SUD clinic locations in relation to HCV rates across Michigan. Specialist provider density (number of providers per HCV case) of counties are depicted in Supplementary Figure 1. Twenty-one (95%) of the 22 urban counties had >1 specialist provider. Conversely, only 15 (25%) of the 61 rural counties had ≥1 specialist provider and 46 (75%) had no specialist providers. At the ZCTA level, the median minimum driving distance to a specialist provider was 26.62 (IQR 16.28–45.97) miles in rural ZCTAs (n=503), compared to only 3.46 (IQR 1.54–8.69) miles in urban ZCTAs (n=414; $p<0.001$). On the other hand, the median minimum driving distance to a FQHC or SUD clinic in rural ZCTAs was shorter than specialists at 11.79 (IQR 6.92–17.06; $p<0.001$) and 8.92 (IQR 5.33–12.74; $p<0.001$) miles, respectively. Median driving distances to FQHCs and SUDs in urban ZCTAs were statistically different than specialists, but were under 5 miles (FQHC: 4.91, IQR 2.16–8.59 ,$p<0.001$; SUD: 2.22, IQR 0.76–5.53, $p<0.001$).

Few correlates of HCV incidence were identified for either urban or rural counties. In urban counties (n=22), poverty level was positively associated with HCV rates; for every 1% increase in the proportion of the population living below the poverty level, there was a 7.16 increase in HCV incidence per 100.000 (β=7.16, 95% CI 1.58–12.75, p=0.016). Heroin treatment admission per 1,000 residents trended towards significance (β=9.50, 95% CI 1.04–20.04, p=0.074). In rural counties (n=60; demographics unavailable for Keweenaw County), opioid prescription rates per 10 residents trended towards significant (β=4.98; 95% CI -0.37–10.33; p=0.067).

DISCUSSION

Despite reported increasing rurality of HCV infections in the U.S, we found over 80% of cases in Michigan still occurred in urban areas. However, we found significant differences in specialist access between rural and urban areas, with significantly less access and longer driving distances in rural areas. These differences may result in differential access to treatment, in light of current treatment restrictions, which could have notable implications for geographic disparities in HCV-related mortality. While poverty was correlated with HCV in urban areas and may present a barrier to care, the lack of demographic correlates in urban and rural areas reinforces the new U.S. Centers for Disease Control and Prevention (CDC) universal screening recommendations that all adults aged 18 years and older and pregnant women in the U.S. should be screened at least once in a lifetime, in addition to traditional risk-guided screening.

Concurrent with the nation's opioid crisis, opioid prescription and heroin treatment admissions were correlated with HCV rates in rural and urban areas, respectively. While these associations were weak, they support the need for comprehensive programs for HCV elimination that pair HCV screening and treatment with interventions that directly address the opiate epidemic, including syringe service programs and substance use counseling. Accumulating data demonstrating safety and efficacy in patients with recent or active IDU highlight that sobriety requirements are outdated and should be eliminated.[6]

To more efficiently and effectively deliver HCV care to rural counties, treatment restrictions based on provider type should be removed. Many rural counties had no qualifying specialists and others only had one for the entire area. Moreover, the 18% of reported cases in rural Michigan areas may underestimate the true HCV burden as rural areas often have lower testing rates.[7] Expanding HCV treatment to FQHCs or co-localizing treatment at SUD clinics may help remove geographical barriers and expand access for a large number of patients. These sites often have established, on-going relationships with their patients, which may help improve patient testing, linkage to care, and treatment adherence. Telehealth modalities should also be explored.

The CDC recently endorsed new screening recommendations that advises all adults and pregnant women be tested for HCV, expanding screening recommendations beyond persons born between 1945–1965 and those with risk factors.[1] This expanded scope was based on a CDC report that found the number of newly reported chronic infections was approximately equal among younger and older adults.[2] Although we did not find a correlation between the proportion of young adults and HCV rates in urban or rural areas, Michigan did see a bimodal distribution of chronic HCV cases overall, with the highest proportions among persons aged 18–29 years and baby boomers in 2017.[4] These findings, and the lack of demographic correlates of HCV

rates in urban and rural areas, support the continued need for policies to promote universal testing among adults, particularly as 40% of Americans with HCV continue to remain unaware of their infection. Although, given the potential cost of increased testing, resource-limited health systems and payers may need to prioritize individuals based on risk factors (i.e., IDU) and/or age group (i.e., baby boomers).

Findings from the present study are limited in that we were unable to assess HCV prevalence and treatment rates. In Michigan, negative HCV antibody, RNA, and genotype results were not reportable until 2019. Negative results would allow State and local public health departments to normalize new diagnoses by the rate of HCV testing. The incident disease surveillance paradigm used for HCV surveillance in the U.S. is limited in its ability to measure longitudinal outcomes and therefore has inherit limitations (Supplementary Table 2).[8] Funding for more robust surveillance systems are imperative for data driven HCV prevention and care efforts. This information would be used to better identify patients who could benefit from patient navigation services, including HCV treatment.

In conclusion, the majority of HCV cases continue to occur in urban areas, although we found few correlates for HCV incidence rates across all adult populations within both rural and urban areas. There are notable geographic differences in specialist availability between urban and rural areas, which can result in geographic disparities in treatment access and liver-related mortality. State HCV elimination planning and resource allocations should include a population-based approach to HCV screening among all adults and treatment approaches that address geographical barriers to care in rural areas.

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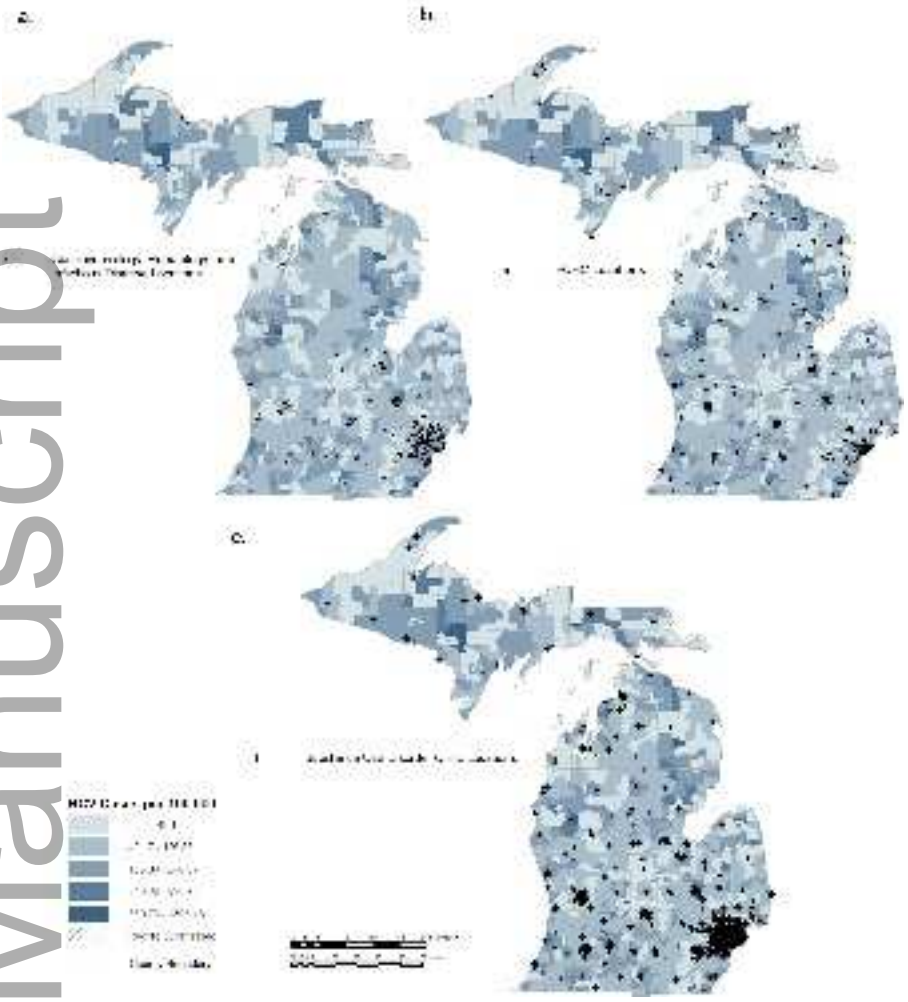
FIGURE LEGENDS

Figure 1. Spatial distribution of specialist provider (n=902), federally qualified health center (FQHC, n=246) and substance use disorder clinic (SUD, n= 1194) locations in relation to hepatitis C virus (HCV) rates by Zip Code Tabulation Areas (ZCTA; n=917), 2017. Non-residential ZCTAs were removed prior to analyses (i.e., those assigned to a single high-volume address). HCV rates are presented as provided by MDHHS with no further processing and include potential outliers.

Figure 1.



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