Preventive Medicine 128 (2019) 105740

Contents lists available at ScienceDirect

Preventive Medicine

journal homepage: www.elsevier.com/locate/ypmed

The opioid epidemic in rural northern New England: An approach to epidemiologic, policy, and legal surveillance

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ARTICLE INFO

Keywords:
Opioid epidemic
Rural
New England
Spatial epidemiology
Health policy

ABSTRACT

The opioid crisis presents substantial challenges to public health in New England's rural states, where access to pharmacotherapy for opioid use disorder (OUD), harm reduction, HIV and hepatitis C virus (HCV) services vary widely. We present an approach to characterizing the epidemiology, policy and resource environment for OUD and its consequences, with a focus on eleven rural counties in Massachusetts, New Hampshire and Vermont between 2014 and 2018. We developed health policy summaries and logic models to facilitate comparison of opioid epidemic-related polices across the three states that could influence the risk environment and access to services. We assessed sociodemographic factors, rates of overdose and infectious complications tied to OUD, and drive-time access to prevention and treatment resources. We developed GIS maps and conducted spatial analyses to assess the opioid crisis landscape. Through collaborative research, we assessed the potential impact of available resources to address the opioid crisis in rural New England. Vermont's comprehensive set of policies and practices for drug treatment and harm reduction appeared to be associated with the lowest fatal overdose rates. Franklin County, Massachusetts had good access to naloxone, drug treatment and SSPs, but relatively high overdose and HIV rates. New Hampshire had high proportions of uninsured community members, the highest overdose rates, no HCV surveillance data, and no local access to SSPs. This combination of factors appeared to place PWID in rural New Hampshire at elevated risk. Study results facilitated the development of vulnerability indicators, identification of locales for subsequent data collection, and public health interventions.

1. Introduction

New England states experienced a surge in synthetic opioid deaths with the introduction of illicit fentanyl in 2013–15 (Rudd et al., 2016; Gladden et al., 2016; Somerville et al., 2017). In 2016, Vermont (VT), New Hampshire (NH), and Massachusetts (MA), were among the top 10 states in the U.S. for opioid overdose death rates, and NH (30.3 per 100,000) and MA (23.5 per 100,000) had the 1st and 3rd highest rates for fatal overdoses attributed to fentanyl (DEA, 2018). Hepatitis C virus (HCV) infection rates have increased along similar trajectories (Thakarar et al., n.d.), and recent human immunodeficiency virus (HIV) clusters among people who inject drugs (PWID) in MA have raised concerns about widespread outbreaks (Schumaker, 2018; Cranston et al., 2019).

The devastating outbreak of HIV and HCV among PWID in Scott County, Indiana (Conrad et al., 2015), raised the alarm about injection drug use (IDU) in rural areas where geographic dispersion, poor transportation, and limited public health infrastructure constrained the

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https://doi.org/10.1016/j.ypmed.2019.05.028
Received 30 December 2018; Received in revised form 28 April 2019; Accepted 28 May 2019
Available online 31 May 2019
0091-7435/

delivery of preventive and treatment services (Conrad et al., 2015). As a result, the Centers for Disease Control and Prevention (CDC) has identified a number of rural U.S. counties vulnerable to HIV and HCV (Van Handel et al., 2016). The changing terrain with regard to prescription opioids in rural communities (Conrad et al., 2015; Broz et al., 2018; Peters et al., 2016), and the entry of fentanyl into local drug supplies (Somerville et al., 2017), have dramatically increased the risk for opioid overdose in rural communities, where access to harm reduction services is limited. Little is known about the epidemiology, service access, and policies that contribute to the local risk environment.

To address the opioid crisis, novel approaches are needed to reduce overdose deaths and infectious diseases associated with IDU. Unsafe injection practices among PWID are associated with increased infectious complications and mortality tied to HIV, HCV, the hepatitis B virus (HBV) (Prevention CfDCa, 2012; Zibbell et al., 2015; Ly et al., 2016), major bacterial infections (Gordon and Lowy, 2005; Wurcel et al., 2016), and opioid overdose (Rudd et al., 2016).

Little research has examined the epidemiology of IDU, its infectious disease and opioid overdose consequences, and service accessibility in rural New England. A better understanding of these factors is crucial to develop community and public health best practices to reach PWID in these rural communities.

This article documents our approach to studying the impact of the opioid epidemic in rural New England, the health policy and legal landscape that surrounds it, and the ability of PWID to access services that could help curb the epidemic and reduce the risk of spreading infectious diseases. Our overall objectives were to: 1) Assess the state and local policy environment and infrastructure, including access to syringe service programs (SSPs), drug treatment, naloxone, and HIV and HCV testing, prevention, and treatment services; and 2) characterize the risk environment and epidemiology of opioid overdose and infectious complications tied to IDU, as well as service needs in these counties.

2. Methods

As part of a federally-funded multisite initiative, our team conducted an epidemiological and policy assessment of opioid-related outcomes, prevention and care services, and laws in eleven contiguous rural counties in Northwestern MA (Franklin County), Eastern VT (Windham, Windsor, Orange, Caledonia, Essex and Orleans Counties), and Western NH (Cheshire, Sullivan, Grafton, and Coos Counties) located along the Interstate 91 corridor and the Connecticut River. All selected counties were defined as rural counties according to federal definitions (HRSA, 2016). Several of these rural counties, located on the border between NH and VT (Fig. 4a) (HRSA, 2016), are identified as high risk for HIV and HCV outbreaks among PWID (Van Handel et al., 2016).

Our Epidemiology, Policy and Law workgroup included state public health professionals, academicians, harm reduction experts, and field researchers. Our team met biweekly over the course of one year via videoconference. Through virtual meetings, email correspondences, and the sharing of surveillance measures, reports, and outcome data, we developed and refined definitions of key opioid epidemic measures. We came to consensus on the variables and definitions for the infectious disease and opioid overdose measures that were to be compiled and aggregated across the 11 counties in all three states. We developed data dictionaries and data table shells that collaborative team members filled. When data were available for all 11 counties across our three states, we merged the data into one dataset for GIS mapping and analysis. The team also participated in and led discussions and efforts to find new measures that could be compiled and analyzed consistently across eight federally funded rural opioid study sites.

2.1. Health policy tables and logic models

Using policy data from state statutes and regulations on-line, supplemented by inquiries to state policy experts, we characterized the legal and policy landscape in VT, NH, and MA in March–April 2018 with respect to the opioid epidemic. Policy analyses focused primarily on syringe and naloxone access, Good Samaritan laws, Prescription Drug Monitoring Programs (PDMP), HIV and HCV Surveillance and Treatment, and substance use disorder treatment access. Other components captured included: justice reinvestment, heroin trafficking, health insurance coverage, mental health care and care coordination, prescription drug disposal, opioid use disorder (OUD) treatment access, fentanyl, and medication access in prison. Salient policy landscape findings related to fatal overdose and HCV transmission were identified, summarized, and connected to their associated process points. We developed policy tables that allow a comparative assessment of salient opioid epidemic policies and laws (Table 1; Supplemental Table 1). Next, we created logic models to describe relationships and important variables in complex systems and to allow our team to understand and describe assumptions, as well as consider potential relationships between policies, laws, and health outcomes. Our logic models outline the environmental, enabling, and inhibiting factors (e.g., policies, laws, public health interventions) that influence key outcomes of the opioid epidemic in the state specific context.

2.2. Geographic Information System (GIS) mapping and spatial analysis

Using census tract level population denominators and sociodemographic data from the American Community Survey (ACS) (United States Census Bureau, n.d.), we generated thematic maps in a GIS for sociodemographic variables (e.g., unemployment rates, median income, insurance rates, percent non-white), opioid syndemic burden outcomes, as characterized by opioid overdose, HIV, and HCV rates, and availability of harm reduction, drug treatment, and overdose prevention services (SSPs, pharmacies, medication for opioid use disorder, naloxone). We aggregated disease burden rates at the county level across our 11 study counties. Infectious disease surveillance data for HIV, HCV, and sexually transmitted infections (STIs), as well as opioid overdose data, were provided by collaborating public health officials, and compiled from publicly available reports and websites. We focused on the three most current and complete years of data at the time we initiated collaborative efforts—2014 to 2016. We categorized rates by quintiles. We geocoded address-level data for prevention and treatment resources from data compiled from department of public health websites, State Boards of Pharmacy, State Epidemiologists, and other publicly available databases. We conducted drive-time analyses using a network analyst tool in a GIS that relies on street networks across MA, VT, and NH, to identify 5, 15, 30, and > 30-minute drive-sheds to assess geospatial access to key services. Drive-times were calculated from the address of the service sites, taking into consideration speed limits, terrain, and one way streets. All GIS maps and spatial analyses were completed with ArcGIS 10.6.1 and ArcGIS Pro 2.2 (Esri, Redlands, CA).

3. Results

3.1. Health policy table and logic models

The results of our health policy analysis resulted in a multi-state policy table that provides comparative details on opioid epidemic related policies across NH, VT, and MA. Our final policy analyses are summarized in logic models focused on fatal opioid overdose (Fig. 1) and HCV transmission (Fig. 2). We developed similar models for each outcome across each of our three study states, and we present two examples here.

Table 1
Policy summary for Vermont, New Hampshire and Massachusetts, 2018.*

Policy	Vermont	Massachusetts	New Hampshire
Syringe access	Permitted since 1998 Typically open only a few hours per week	Permitted since 1993 Typically open during business hours	Permitted since 2017 None in the study region
Naloxone access	Updated 2016 statewide standing order and immunity from liability	Updated 2018 to enhance access in pharmacies through required standing order	Updated 2015 to allow for standing orders and immunity from liability
Good Samaritan legal protections for people who seek medical assistance	Present 18 V.S.A. § 4254	Present M.G.L. part III, title IV, chapter 258C section 13	Present 318-B:28-b
Prescription drug monitoring program	Since 2009 18 V.S.A. § 4287	Modified in 2016 M.G.L. part I title XV chapter 94C section 24A	Since 2016 House Bill 1423
Hepatitis C surveillance	Reportable infection during study period	Reportable infection during study period	Reportable infection since 2017
Hepatitis C treatment access with Medicaid coverage	No sobriety restrictions, no fibrosis score required, requires specialist consultation	No sobriety restrictions, no fibrosis score required, primary care providers may initiate treatment without specialist consultation	No abstinence-based criteria, but screening and counseling for substance use required prior to treatment initiation, requires specialist consultation
Substance use disorder treatment access	VDH rules governing medication-assisted therapy establish minimum requirements for authorized office based opioid treatment Providers to prescribe and dispense buprenorphine, as well as Vermont-specific requirements for opioid treatment programs that are in addition to the regulatory requirements of 42 CFR, part 8.	Multiple statutes address treatment access and eliminate requirement for preauthorization, support the expansion of services, mandate evaluation within 24 h of emergency department visit for overdose, require effective discharge planning, require coverage for FDA approved drugs for opioid or alcohol dependence	Multiple statutes eliminate requirement for preauthorization for outpatient treatment, with time limits on inpatient preauthorization, expands access to treatment through drug courts

* A more detailed policy summary is provided in Supplemental Table 1, which includes links to additional statutes and law.

3.2. Fatal overdose in New Hampshire

Factors that contributed to fatal opioid overdose in NH included: 1) a minimal state tax base to fund services in the absence of income and sales taxes; 2) the absence of legal SSPs prior to June 2017; 3) primarily abstinence-based treatment; and, 4) limited access to complex co-morbid mental health and medical care. Key policies that can facilitate or inhibit OUD and overdose include: PDMP policy; access to OUD services; murder charges for fentanyl deaths; limited access to medication in corrections; growth of drug court programs; naloxone access; and the Good Samaritan law. Despite the Good Samaritan law, prosecutors have still pursued charges for fatal overdose if the caller provided fentanyl to the deceased. Prominent process points include: level of OUD, comorbidities that amplify the effect of opioids, access to street drugs, fentanyl on the street, and opioid tolerance. From a policy perspective, fatality is most related to access to naloxone and fear of criminal charges related to calling 911 if the overdose results in a fatality (Fig. 1).

3.3. HCV transmission in Vermont

Salient background factors that contributed to HCV transmission in VT (Fig. 2) included 1) stigma, 2) lack of awareness of infection status or risk, 3) legal jeopardy, and 4) drug use behaviors. The diversion of opioids in healthcare settings is a possible contributor, although little is known about how often this occurs. From a policy perspective, VT has

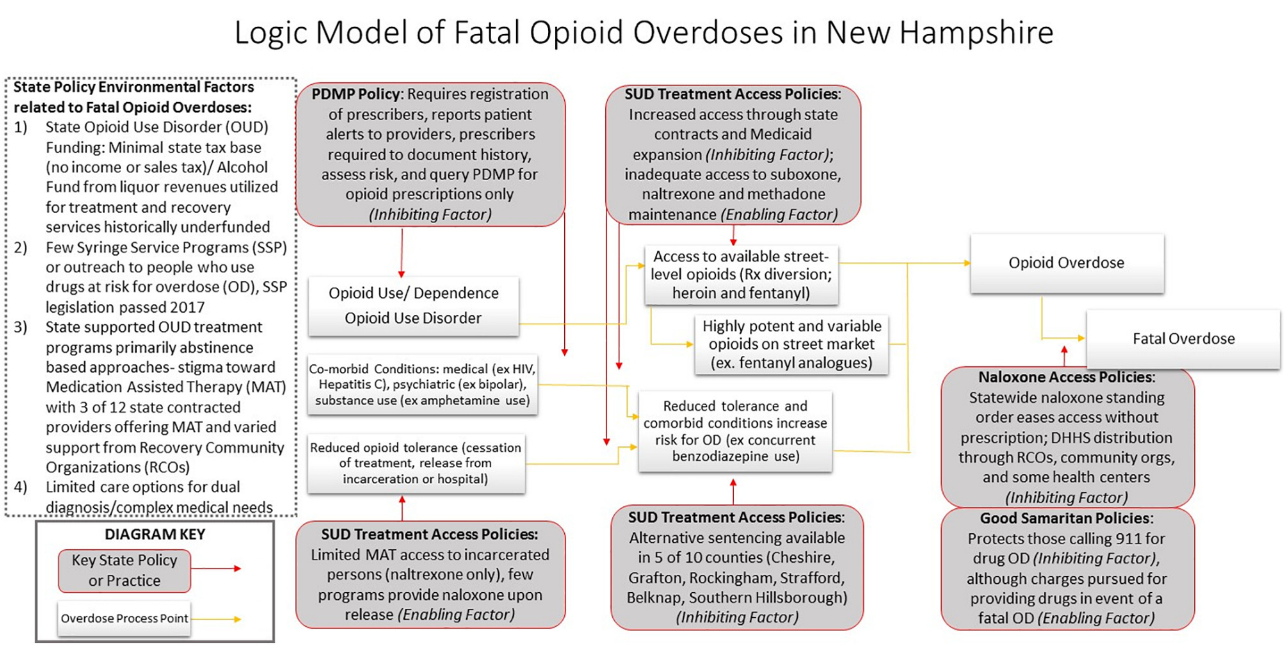

Fig. 1. Logic model for fatal opioid overdose in New Hampshire, 2018. Relevant state laws and state policies and practices are highlighted in gray boxes. Key components of the causal diagram, "overdose process points", are highlighted in white boxes in the center of the diagram. Background factors tied to opioid overdose in New Hampshire are highlighted in the box outlined with hashed lines on the left-hand side of the figure.

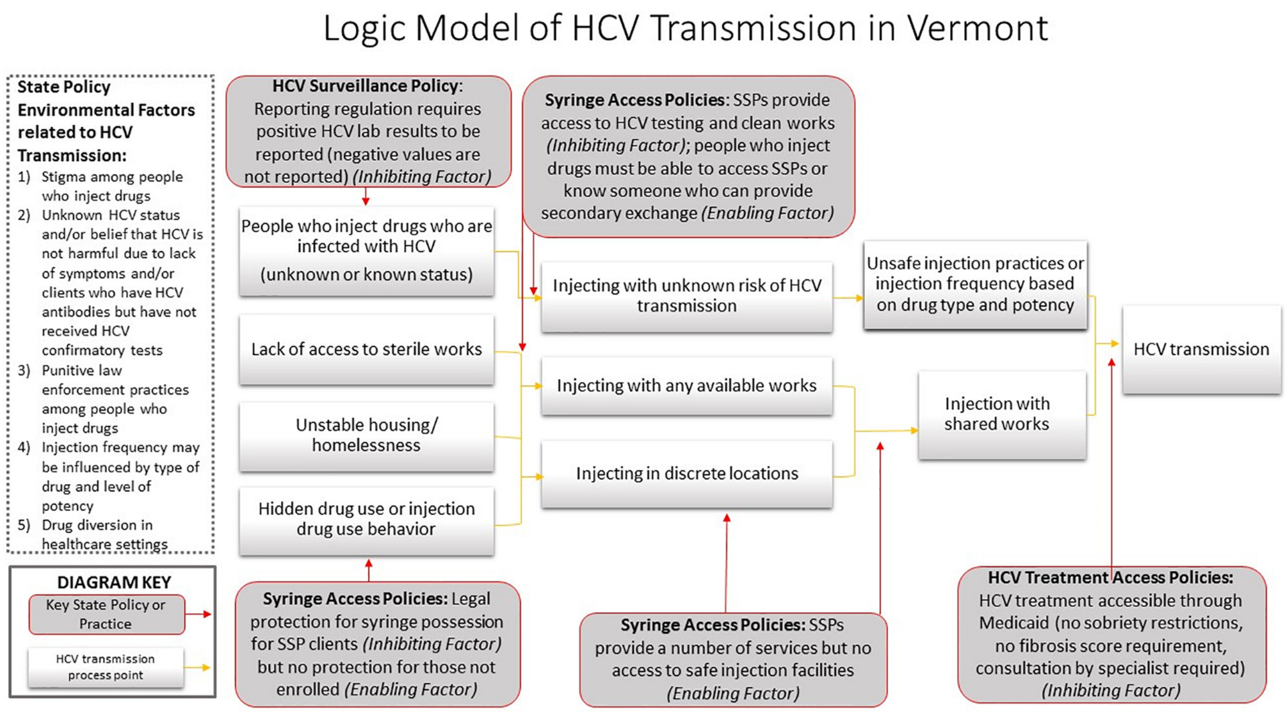

Fig. 2. Logic model for HCV transmission in Vermont, 2018. Relevant state laws, policies and practices are highlighted in gray boxes. Key components of the causal diagram, "HCV transmission process points", are highlighted in white boxes in the center of the diagram. Background factors tied to HCV transmission in VT are highlighted in the box outlined with hashed lines on the left-hand side of the figure.

robust laboratory surveillance data on HCV infections, and treatment is readily accessible for those with Medicaid. SSPs are available, although access in many rural parts of the state is limited. Possession of needles and syringes as part of an SSP is legal in VT; HCV transmission ultimately occurs due to a lack of sterile injection practices.

3.4. GIS maps and spatial analyses

In our initial GIS maps, we examined social determinants of health. NH had the highest percentage of uninsured persons, followed by VT and MA. Median income was lowest in the northern-most census tracts of Northern New England. The non-white population was higher in highly populated areas, while unemployment rates had no regular pattern. These maps highlight disparities in the region that may be associated with opioid syndemic burden and service access (Fig. 3).

Fatal opioid overdose, HIV, and HCV rates varied across the study area (Fig. 4). In 2015, opioid fatality rates were 23.3 (MA), 31.3 (NH), and 13.4 (VT) per 100,000 (Fig. 4b). While fatal opioid overdose were relatively low in Grafton County, NH and Caledonia County, VT, New Hampshire as a whole saw a 2.5-fold increase in opioid deaths between 2010 and 2015 (data not shown). NH had no SSPs until 2017, and throughout the study area, counties without SSPs before 2017 experienced relatively high opioid fatality rates. Franklin County, MA had an opioid fatality rate per 100,000 of 14.1 in 2014, 19.7 in 2015, and 21.3 in 2016. Orange County, VT saw an increase in the opioid fatality rate over three years, although the numbers of deaths were low (Fig. 4b), and rates may be less stable due to small population sizes. We also observed an increase in non-fatal opioid overdoses in Franklin County, MA and Cheshire County, NH (data not shown).

In Southern Vermont counties, rates per 100,000 for people living with HIV/AIDS increased between 2014 and 2016 (Fig. 4c). We also noted persistently high HCV rates in Windsor and Windham County, VT (Fig. 4d). Further, we identified locations where data were not readily available. In NH, for instance, HCV was not a reportable disease until 2017, so we were unable to map HCV rates in NH counties.

Mobile and brick and mortar SSPs were accessible within our rural study counties in VT and MA, but SSPs only became legal in NH in 2017. Efforts were underway to open SSPs in Sullivan and Cheshire Counties in early 2019. Drug treatment and naloxone were relatively accessible along Interstate 91 within 5, 15, and 30-minute drive-times (Fig. 5). Regions within our rural study counties that were distant from major highways had less access to drug treatment and naloxone (Essex and Orange, VT; Coos and Grafton, NH), and drive-times to pharmacies with a naloxone standing order in most regions of Franklin County, MA and Cheshire and Sullivan Counties, NH were 30 min or less, highlighting good overall access (Fig. 5).

4. Discussion

Our multi-state, interdisciplinary collaborative team developed a multifaceted approach to assess the opioid epidemic landscape across 11 rural Northern New England counties. Health policy summaries and logic models facilitated comparison of opioid epidemic-related polices and "laws on the books" across our three focal states that could influence the risk environment and access to services in our eleven study counties. GIS maps and spatial analyses provided an initial picture of the opioid crisis landscape in rural New England.

Health policy logic models assessed environmental, inhibiting, and enabling factors to opioid epidemic outcomes, as well as public health and public safety policies that could address such outcomes. Our logic models were created to understand the interrelationships between enabling environmental and legal factors related to disease risks and outcomes, and that could inform next steps in efforts to curtail the most detrimental outcomes tied to the opioid crisis.

Previous research has presented a range of geospatial approaches to assess the risk environment tied to injection drug use (Cooper et al., 2009), and mixed methods to assess the social geography of disease risk (Singer et al., 2000). In juxtaposing sociodemographic, infectious disease, and opioid overdose maps, we were able to identify locations where the social determinants of health and higher disease burdens were most concerning, helping to inform selection of locales for subsequent qualitative and quantitative primary data collection activities.

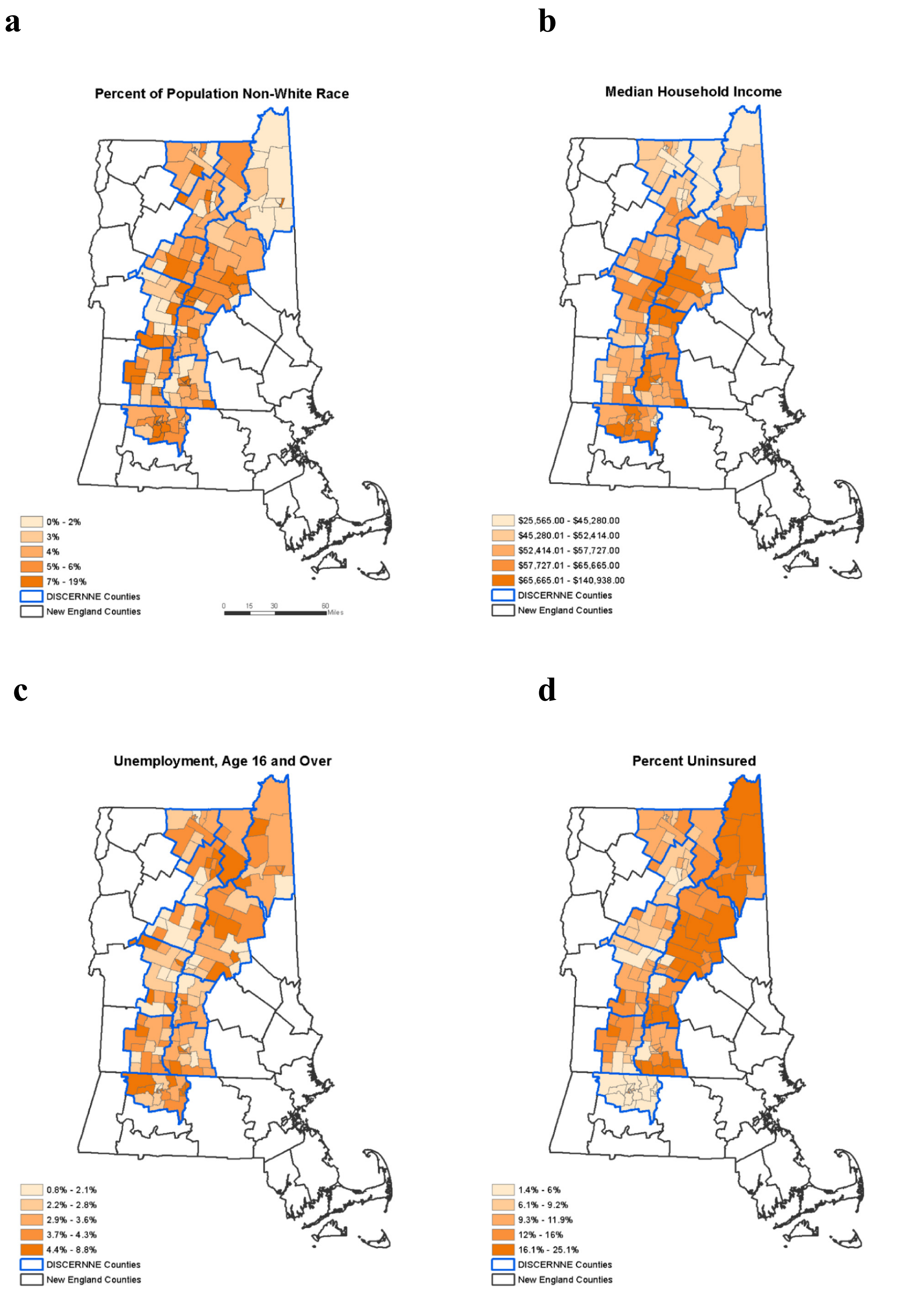

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Fig. 3. Sociodemographic characteristics of Vermont, New Hampshire, Massachusetts census tracts in 11 rural study counties, 2011–2016. a) Percent of population non-white (class breaks by quintiles); b) median household income in 2016 inflation adjusted dollars (quintiles); c) percent of population age 16 years or older who were unemployed (quintiles); d) Percent of population age 18–64 years who were uninsured (quintiles).

We were also able to obtain an early indication of regions and communities that might be at greatest need for public health and clinical interventions to curb opioid syndemic outcomes. In NH, for instance, we noted higher proportions of uninsured community members (perhaps tied to the lower tax base), some the highest opioid overdose rates, a lack of HCV surveillance data (HCV became reportable in 2017), and no local access to SSPs. This combination of factors appears to place PWID in rural New Hampshire at exceptionally high risk.

Our approach can be replicated elsewhere in the U.S. and other regions of the world where the opioid crisis has presented challenges. Work with a multidisciplinary and cross-sectoral team of state public health professionals, academic researchers, and community-based experts is essential. Inclusion of local GIS and spatial analysis experts across sites is also recommended, to facilitate development of consistent maps for cross-site comparison in an efficient manner.

Opioid surveillance measures have been recently recommended (Council of State and Territorial Epidemiologists (CSTE), 2017) in the U.S. The CDC has also recently funded 41 states to conduct opioid epidemic jurisdiction vulnerability analyses that build upon the approach developed by Van Handel et al. (2016), and aims to guide collection and analysis of consistent measures at a comparable unit of analysis (e.g., state, county, municipality) across many regions of the U.S. The results of those analyses can be supplemented by epidemiologic and policy assessments like the one described here to best inform approaches to decrease morbidity and mortality associated with substance use disorder.

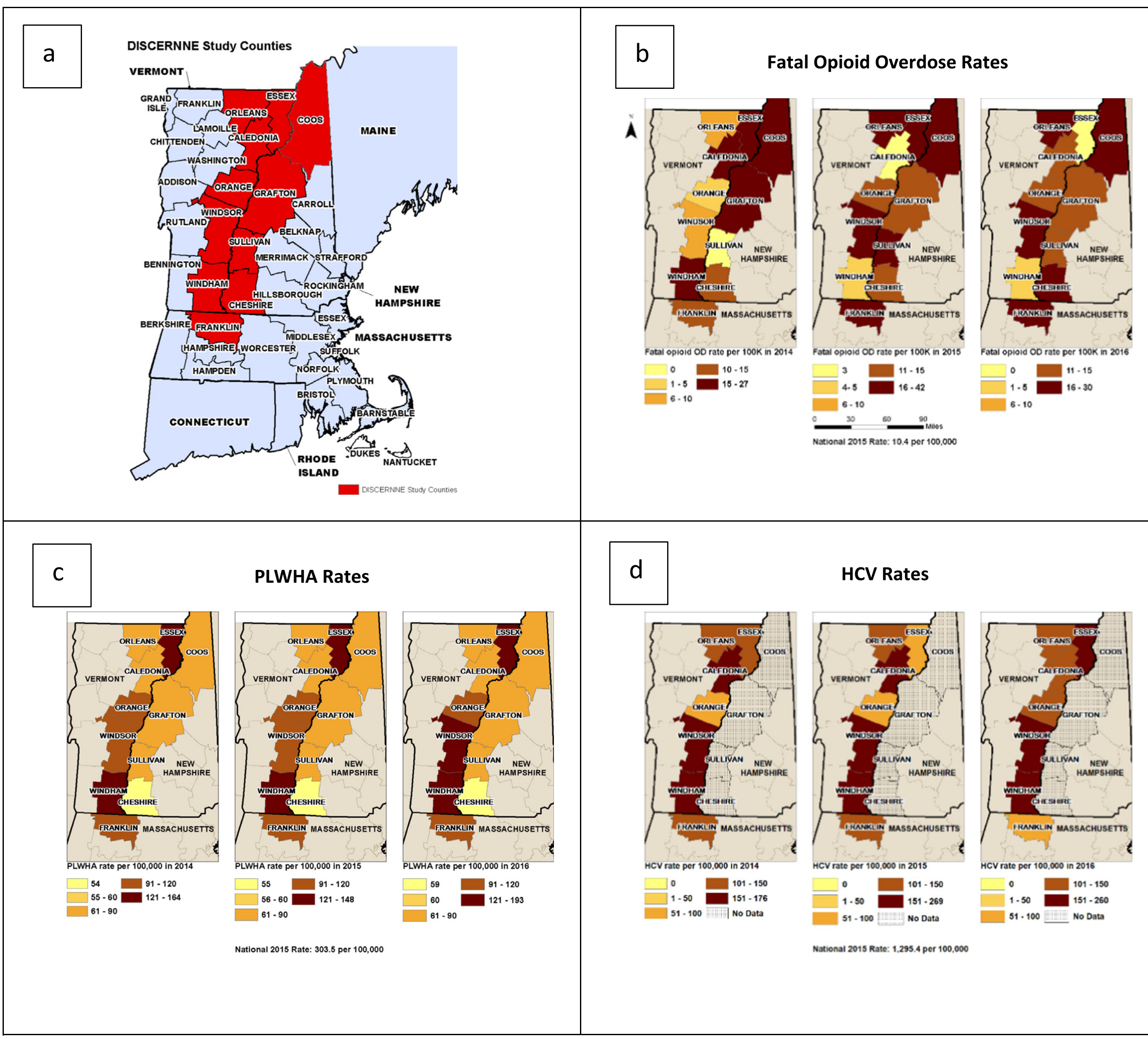

Fig. 4. Geospatial distributions of opioid syndemic outcomes in 11 rural New England counties in Massachusetts, New Hampshire, and Vermont, 2014–2016. Study counties for the Drug Injection Surveillance and Care Enhancement for Rural Northern New England (DISCERNNE) project (a); fatal opioid overdose rates per 100,000 population (b); people living with HIV/AIDS (PLWHA) rates per 100,000 (c); HCV rates per 100,000 (d).

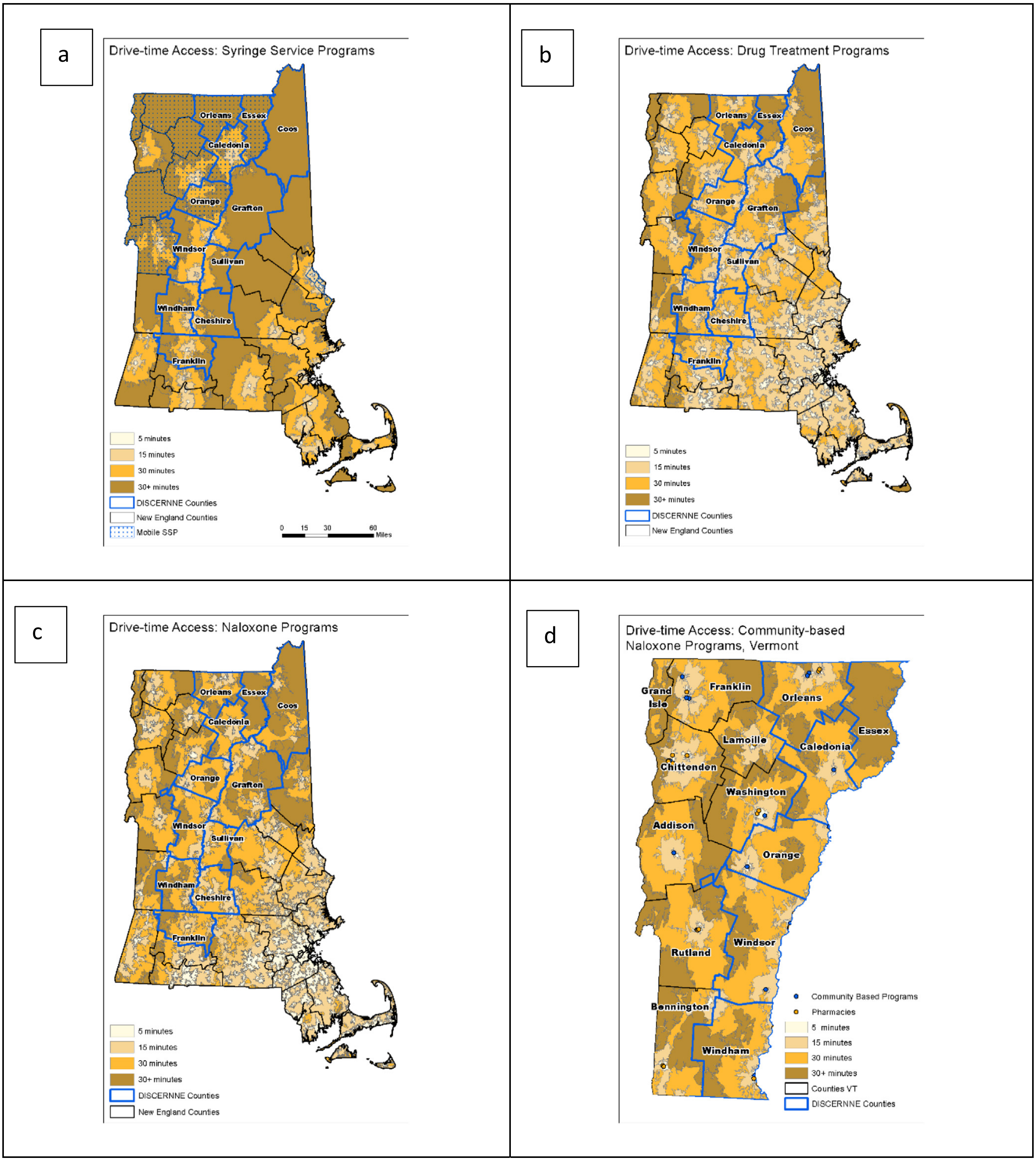

Fig. 5. Geospatial access to opioid syndemic services in Massachusetts, Vermont and New Hampshire, 2017–2018. Drive-time access (5, 15, 30, and > 30 min) to syringe service programs (a); drive-time access (5, 15, 30, > 30 min) to drug treatment programs (b); drive-time access (5, 15, 30, > 30 min) to naloxone distribution sites at pharmacies, community agencies, and health centers (c); spatial access (5, 10, 30, > 30 miles) to naloxone distribution sites at Vermont community and pharmacy sites (d).

This approach has several limitations. Data were not complete for all variables and measures of interest across all three states and all 11 counties. Through our collaborative team meetings and calls, we aimed to focus on the outcomes for which we had access to consistent surveillance data and measures in all sites. Many measures were not available across all 11 county sites, which provided limited geospatial granularity across our study region. Small numbers in the numerators and denominators can also lead to large fluctuations in rates across rural counties with small population counts. When available, we complemented such maps with maps of local measures at the sub-county level. Cross-state sharing of data (e.g., PDMP) is not typically possible. Naloxone distribution data and administration were not consistently available across all counties, and these results include only pharmacy access to naloxone. Cross-border interactions could also influence access to services. We are unable to draw causal inferences from our policy, law, and geospatial data.

4.1. Lessons learned

Through our three-state epidemiology, policy and law workgroup collaboration, we garnered several key lessons that will help inform subsequent collaborative work. We found that the composition of the work group is key to success, and the decision making process with regard to selection of measures and final aggregation of data benefitted from discussion among state public health professionals and academic partners. This multidisciplinary approach facilitated opportunities to assure that we selected measures that were available across all three states, and our eleven study counties. A range of content area expertise was also essential, with key contributions from state officials with expertise in infectious disease and opioid overdose surveillance systems and nomenclature. This range of expertise from a content, technical, and surveillance perspective, also facilitated access to relevant local, state, and federal reports and guidance documents from other jurisdictions and agencies that contributed. The work of the CSTE, which has focused on development of consistent opioid epidemic measures, provided solid resources for definition of measures and consistent data sources across states.

Regularly scheduled videoconferences and email correspondence, including document sharing, were essential to the success of our work, as we were able to consistently convene key experts in each state to continue our decision making processes with regard to selection and definitions of key measures. By leveraging existing relationships and data sources, instead of reinventing the wheel, we were able to take advantage of connections and find the right people to address key requests.

Selection of measures requires that collaborative teams pay close attention to several key issues: 1) availability of data sources; 2) consistency of measures; and 3) ease of access to data. With regard to data sources, variations in public health policy can influence whether certain surveillance systems exist. While HCV surveillance data were available in MA and VT, HCV only became a reportable disease in NH in 2017, and HCV surveillance data were not available for NH during our study timeframe. Consistency of measures, and especially rate calculations that normalize by population, were facilitated by use of consistent data sources across sites, and reliance on state or federal definitions for key outcomes (where available). Access to data was fostered by key collaborative team members who worked within local and state health departments. State epidemiologists tended to have a particularly strong understanding of the available datasets and measures across various agencies and divisions within state and federal agencies.

4.2. Recommendations

Based on the CSTE recommended measures and our own experience collaborating with a wide range of public health and clinical experts, we recommend that future opioid epidemiologic scans focus on the following data sources and measures: HIV surveillance data (rates for PLWH and for PLWH with IDU risk), hepatitis surveillance data including differentiation of acute viremia or chronic disease, fatal opioid overdose rates, naloxone distribution locales and distribution methods, STI surveillance data (syphilis, gonorrhea, and chlamydia rates), state alcohol and substance use treatment capacity and availability, and social determinants of health such as homelessness.

We also recommend formation of multidisciplinary and multi-sectorial teams that fosters collaborative work with state public health professionals, academic researchers, and community-based experts, to identify, define, and measure key outcomes in a consistent manner across state-level and multi-state regions. Inclusion of state epidemiologists, where possible, is strongly recommended for similar future efforts. Standardized surveillance indicators, such as those recommended by the CSTE, should be used across sites to allow for cross-site comparisons and analysis of trends over time. Inclusion of local GIS and spatial analysis experts across sites is also recommended, to facilitate development of consistent maps for cross-site comparison in an efficient manner.

5. Conclusion

This study provides an initial understanding of the epidemiological, legal, and policy landscape related to the opioid crisis in rural Northern New England and serves as a model on how states can form multidisciplinary teams from the public and private sectors, utilizing epidemiological and policy analyses and scans to understand the effect that social vulnerabilities and related comorbid medical conditions have on PWIDs. This approach includes the etiology, progression and maintenance of these conditions, creating demographic profiles and identifying priority areas to better target limited resources and improve intervention design, quality and outcomes. It can be replicated in other regions of the U.S., and for a range of public health issues. Study results also provided information to guide next steps in a larger project, including locations for recruitment of active opioid users and locales for future interventions.

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ypmed.2019.05.028.

Acknowledgments

We thank Carolyn Talmadge of Tufts University for assistance with drive-time access analyses. We thank Brendan Atwood of the VT DOH for assistance with development of our three state policy table. This study was supported by the National Institute on Drug Abuse, the Centers for Disease Control and Prevention, the Substance Abuse and Mental Health Services Administration (SAMSHA), and the Appalachian Health Agency (1UG3DA044830; PI: Friedmann).

Human subjects

This study was reviewed and approved by the University of Massachusetts School of Medicine-Baystate Institutional Review Board (IRB#: 1094092).

Conflict of interest statement

The authors do not have any conflicts of interest to disclose.

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