HIV and Hepatitis C in Rural Areas: Prevalence, Service Availability, and Challenges

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Rural Health Research & Policy Centers
Funded by the Federal Office of Rural Health Policy
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UNIVERSITY OF SOUTHERN MAINE
Muskie School of Public Service

Maine Rural Health Research Center

Overview

Project 1: Maternal hepatitis C prevalence by county in the US

- Katherine Ahrens

Project 2:

HIV prevalence by county-level rurality in the US

HIV service availability by county-level rurality in the US

- Katherine Ahrens

Project 3: Challenges and promising practices of rural public health in addressing HIV and hepatitis C

- Amanda Burgess

These projects were funded by a cooperative agreement between the University of Southern Maine and the US Federal Office of Rural Health Policy, Health Resources and Services Administration, Department of Health and Human Services (CA#U1CRH03716)

Project 1: Maternal HCV Prevalence

Recent CDC guidelines recommended all pregnant women be screened for hepatitis C (HCV) during each pregnancy, except in settings where the prevalence of HCV infection is <0.1%; therefore, local prevalence data are needed

Research questions:

- What is the prevalence of maternal HCV by county across the US?
- Is maternal HCV prevalence higher in rural counties as compared to urban counties?

Ahrens KA, Rossen LR, Burgess A, Palmsten K, Ziller E. Rural-urban residence and maternal hepatitis C infection, United States: 2010-2018. American Journal of Preventive Medicine. March 2021

Methods- Data source

- Maternal HCV prevalence
  - National birth certificate data for the US, 2010-2018
  - Revised 2003 version of birth certificate added a checkbox for maternal HCV infection
  - Staggered adoption of the revised birth certificate over time, with most states adopting by 2010, and all states by 2016
  - Restricted use data on county of residence
  - Data use agreement stipulates no presentation of estimates based on <10 observations (in practice, <20 observations not reliable)
- County-level rurality
  - National Center for Health Statistics (NCHS) 6-level Urban-Rural Classification Scheme for Counties (2013 version)

Methods- Spatial modeling

- Small area estimation modeling
  - Previously used for modeling other outcomes with small number of observations in low population counties (e.g., suicide mortality, teen births)
  - Hierarchical Bayesian models with spatiotemporal random effects
  - Estimated smoothed county-level HCV prevalence
  - Borrowed strength from adjacent counties and years to stabilize estimates
  - R INLA package

Maternal characteristics by rurality, 2010-2018

	6-Level Urban-Rural classification scheme						
	Total	Large central metro	Large fringe metro	Medium metro	Small metro	Micro-politan	Non-core
All births in the US, n	35,397,658	33.0	23.4	21.0	9.0	8.2	5.4
Births in reporting states, n	32,555,153	33.8	22.9	20.8	8.9	8.3	5.3
Among reporting states:							
Maternal characteristics at delivery							
Maternal age at birth (years)	32,555,153	28.9	29.3	27.8	27.3	26.8	26.6
Under 20	2,147,632	6.0	4.9	7.3	7.7	9.0	9.3
20-24	7,083,520	19.2	17.5	23.9	26.0	28.7	30.0
25-29	9,383,286	26.9	28.0	30.2	31.4	31.0	31.3
30-34	8,721,104	28.7	30.6	25.1	23.5	21.0	20.0
35-39	4,229,385	15.4	15.4	11.1	9.5	8.5	7.8
40 or greater	990,226	3.8	3.6	2.4	2.0	1.8	1.7
Maternal race/ethnicity							
Hispanic	7,696,290	32.7	19.1	24.7	15.9	14.3	9.6
non-Hispanic white	17,174,129	35.3	57.9	55.9	66.7	72.0	75.9
non-Hispanic Black	4,683,992	19.0	14.1	12.6	11.6	8.0	8.3
Other	2,992,797	13.1	8.9	6.8	5.9	5.6	6.2

Maternal characteristics by rurality, 2010-2018

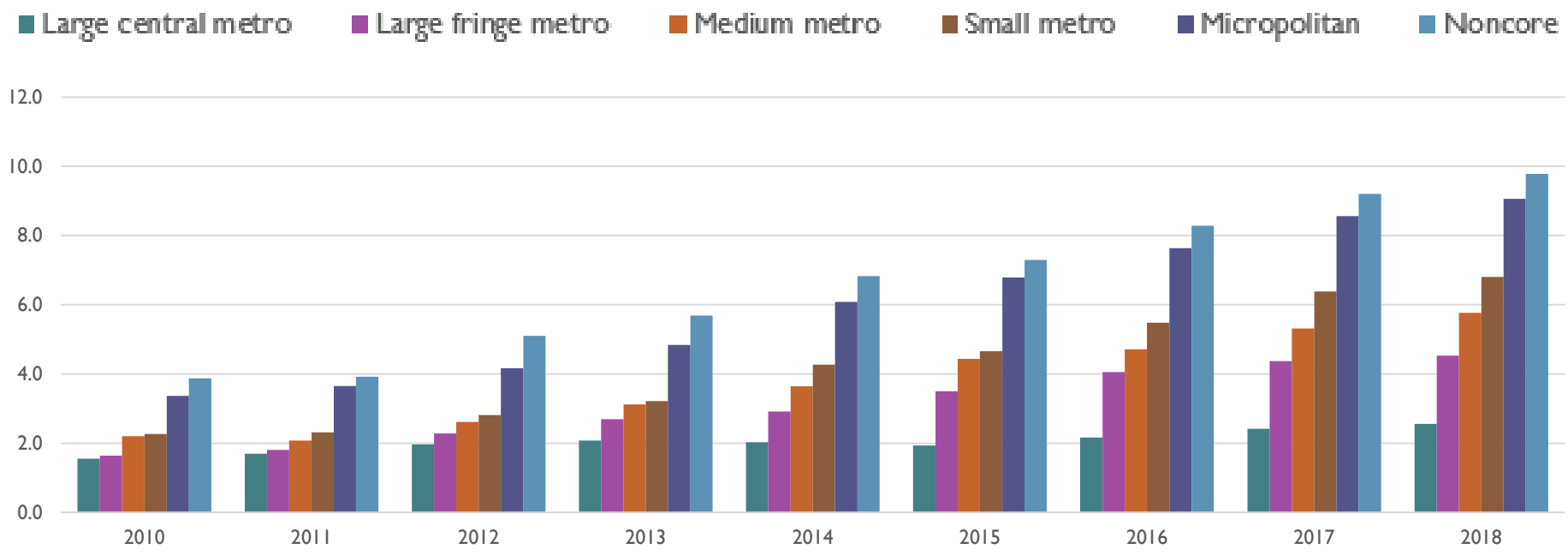
	6-Level Urban-Rural classification scheme						
	Total	Large central metro	Large fringe metro	Medium metro	Small metro	Micro-politan	Non-core
Maternal educational attainment							
No high school diploma or GED	4,970,573	16.7	11.4	16.1	14.8	17.1	17.6
High school diploma or GED	8,122,282	23.7	21.6	25.7	27.7	30.0	31.9
Some college	9,284,067	25.0	27.7	30.8	32.1	32.5	32.9
Bachelor's degree or higher	9,720,068	32.6	37.7	26.4	24.6	19.7	16.8
Expected source of payment for delivery							
Medicaid	13,997,365	44.6	34.2	44.7	45.1	49.0	51.2
Private	15,413,565	46.2	57.8	44.1	44.3	40.3	38.4
Self-pay	1,333,698	4.6	3.3	3.8	3.7	4.9	5.3
Other	1,410,035	3.7	3.1	6.2	5.6	4.7	3.8
Pregnancy smoking status							
No	28,788,307	93.6	88.2	88.1	83.6	80.5	78.5
Yes	2,477,793	3.5	6.2	8.5	11.7	15.5	17.3
Unknown/not stated	1,289,053	3.0	5.6	3.4	4.7	4.0	4.2

County characteristics by rurality, 2010-2018

	6-Level Urban-Rural classification scheme						
	Total	Large central metro	Large fringe metro	Medium metro	Small metro	Micro-politan	Non-core
County of residence (percentage below poverty threshold)							
Mean	32,555,136	16.7	10.7	16.2	16.3	17.3	18.3
Less than 10%	5,339,614	4.7	48.7	9.5	8.4	7.4	6.4
10-19%	22,148,658	80.5	48.7	71.0	72.4	65.1	58.2
20-29%	4,520,261	13.7	2.6	16.6	18.4	23.7	30.1
30% or greater	544,435	1.2	0.0	2.9	0.9	3.8	5.1
County overdose death rate per 100,000 population (mean)	32,555,153	15.8	16.7	17.4	15.8	16.9	17.3

Observed data: HCV prevalence over time

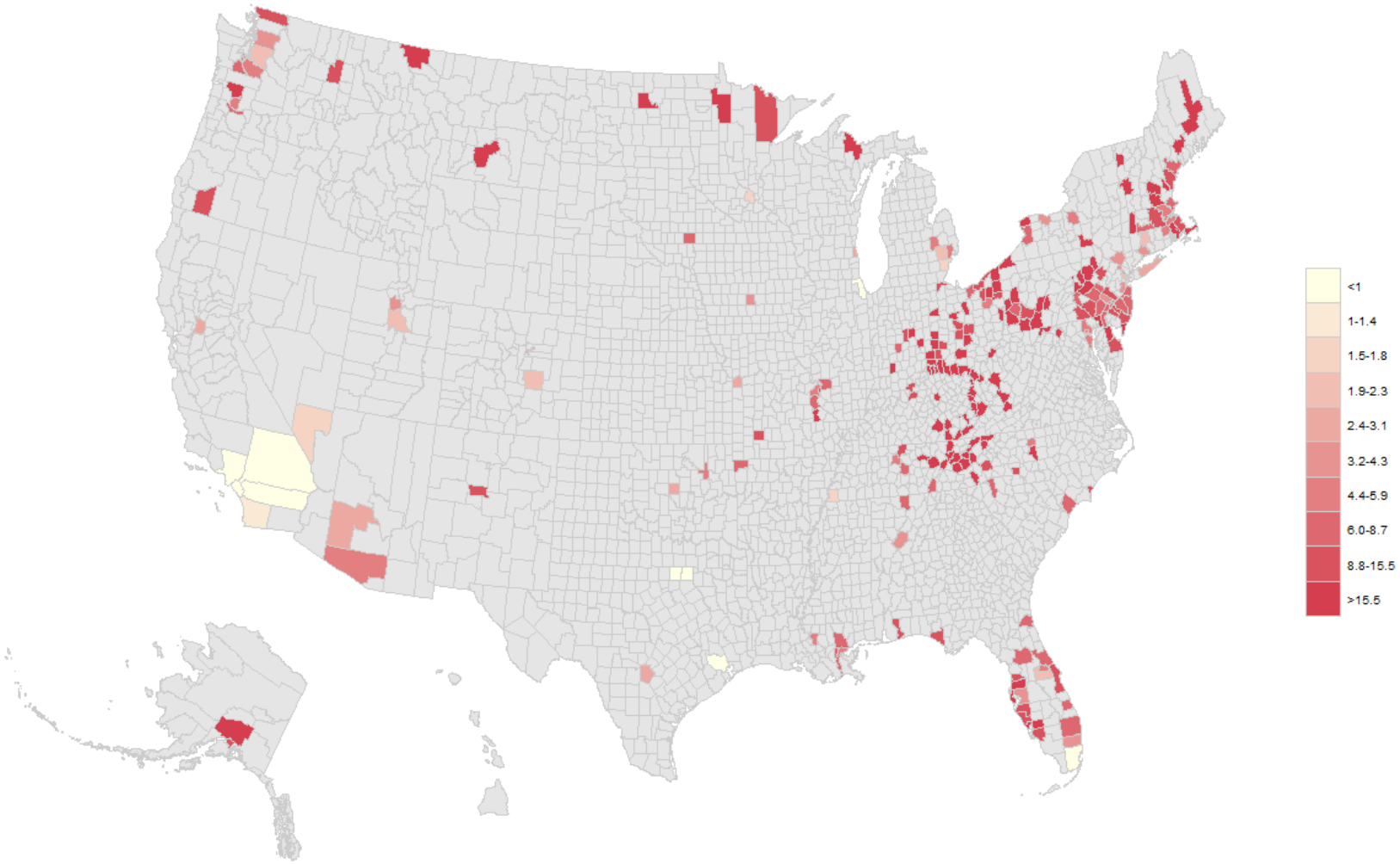
The overall prevalence of maternal hepatitis C virus infection was 3.5 per 1,000 births (increased from 2.0 in 2010 to 5.0 in 2018).



Mean prevalence (per 1,000 births)

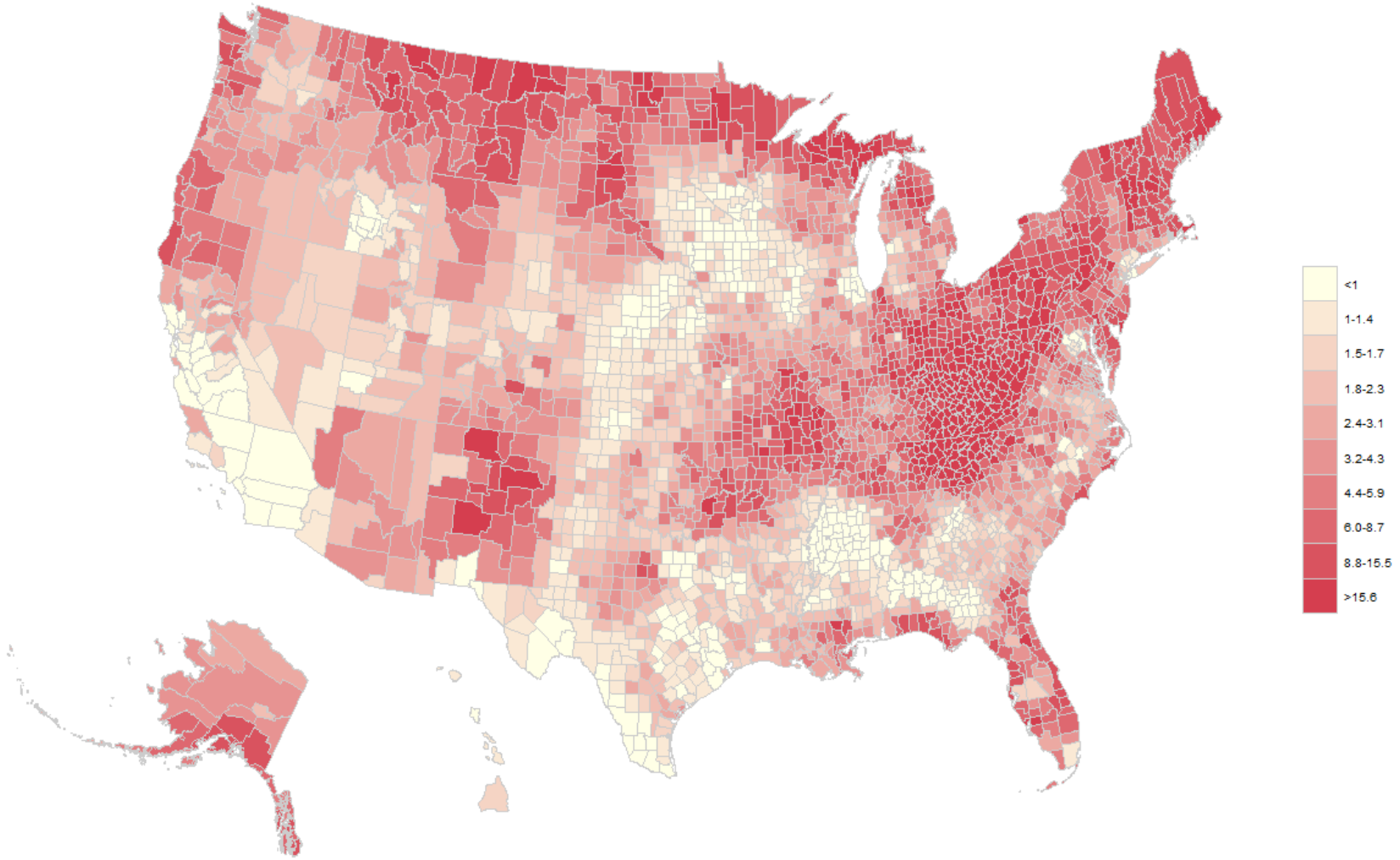
Observed maternal HCV prevalence, >20 counts

Crude estimates 20+ of the HCV infection per 1,000 births, 2018



Modeled maternal HCV prevalence, 2016

Model-based estimates of the HCV infection per 1,000 births, 2016



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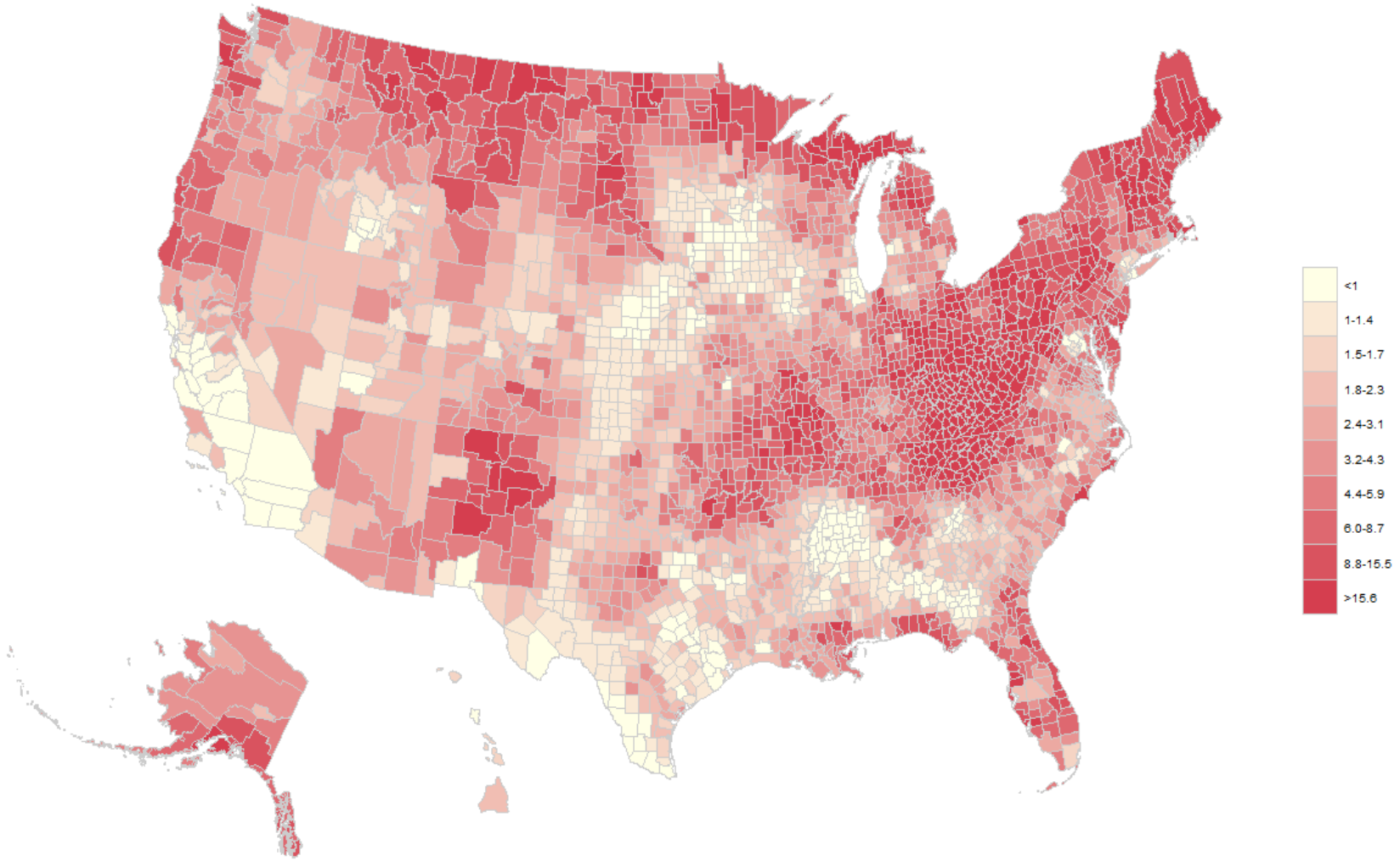

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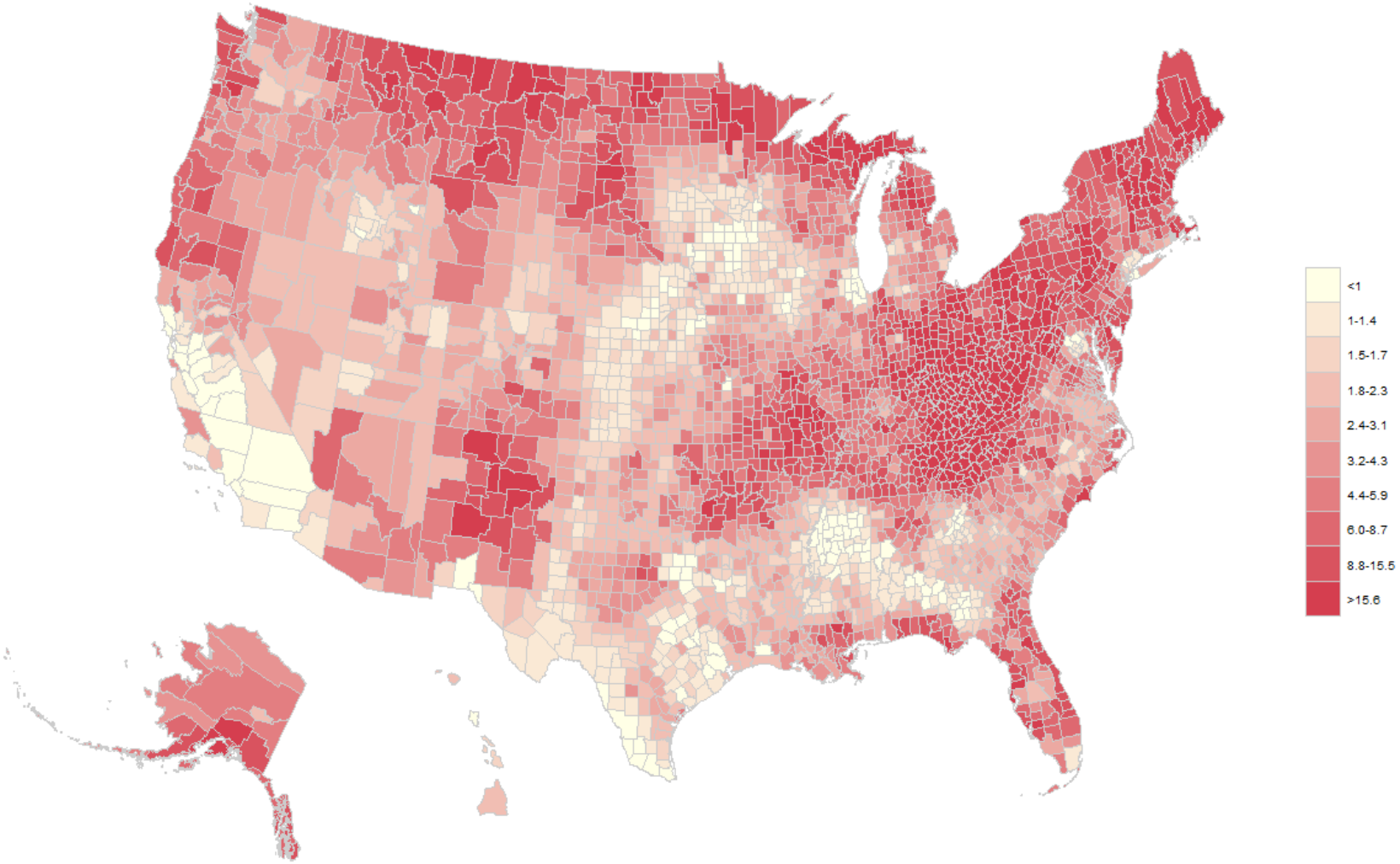
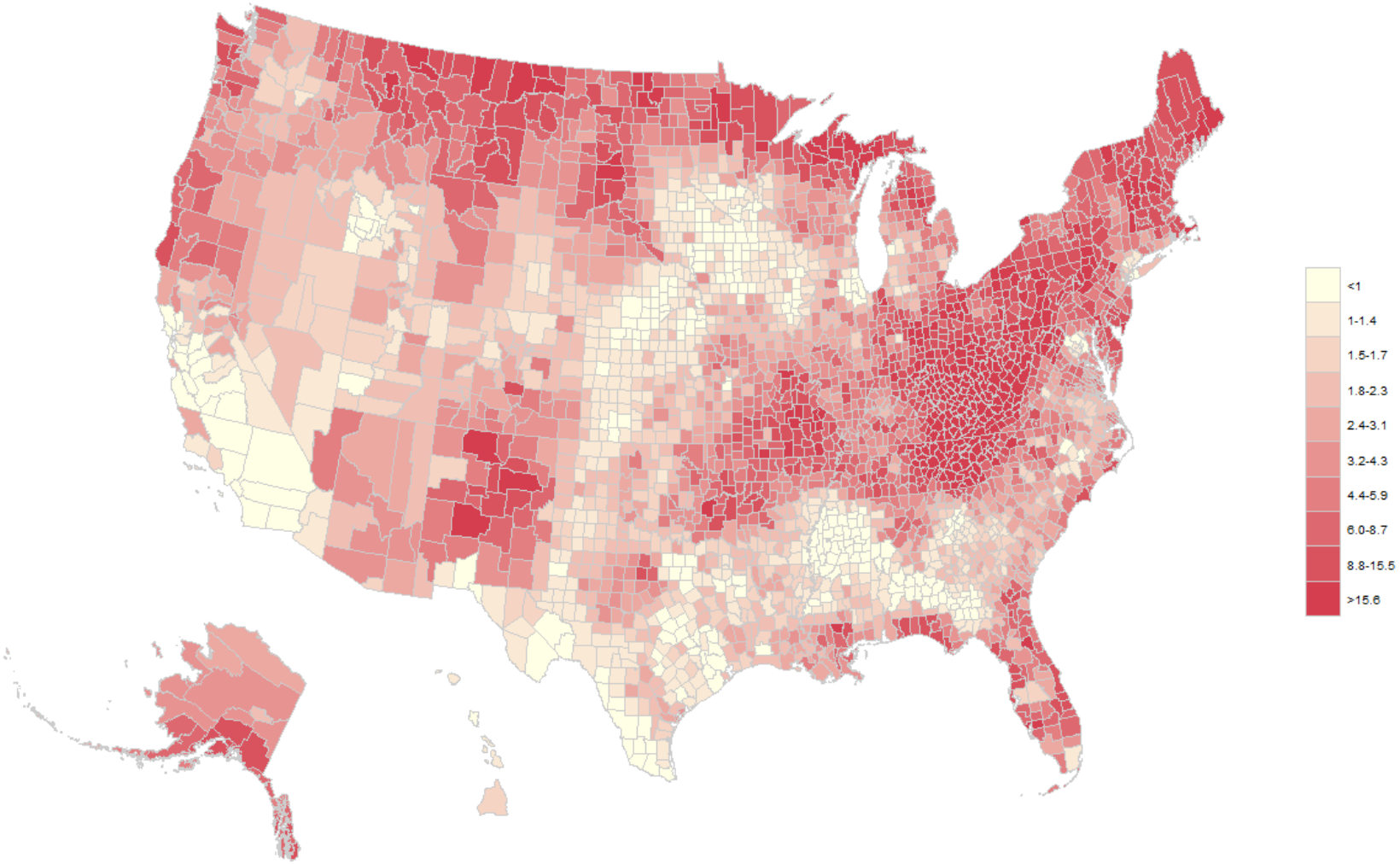


AGAIN…

Modeled maternal HCV prevalence, 2016

Model-based estimates of the HCV infection per 1,000 births, 2016



Modeled maternal HCV prevalence, 2017

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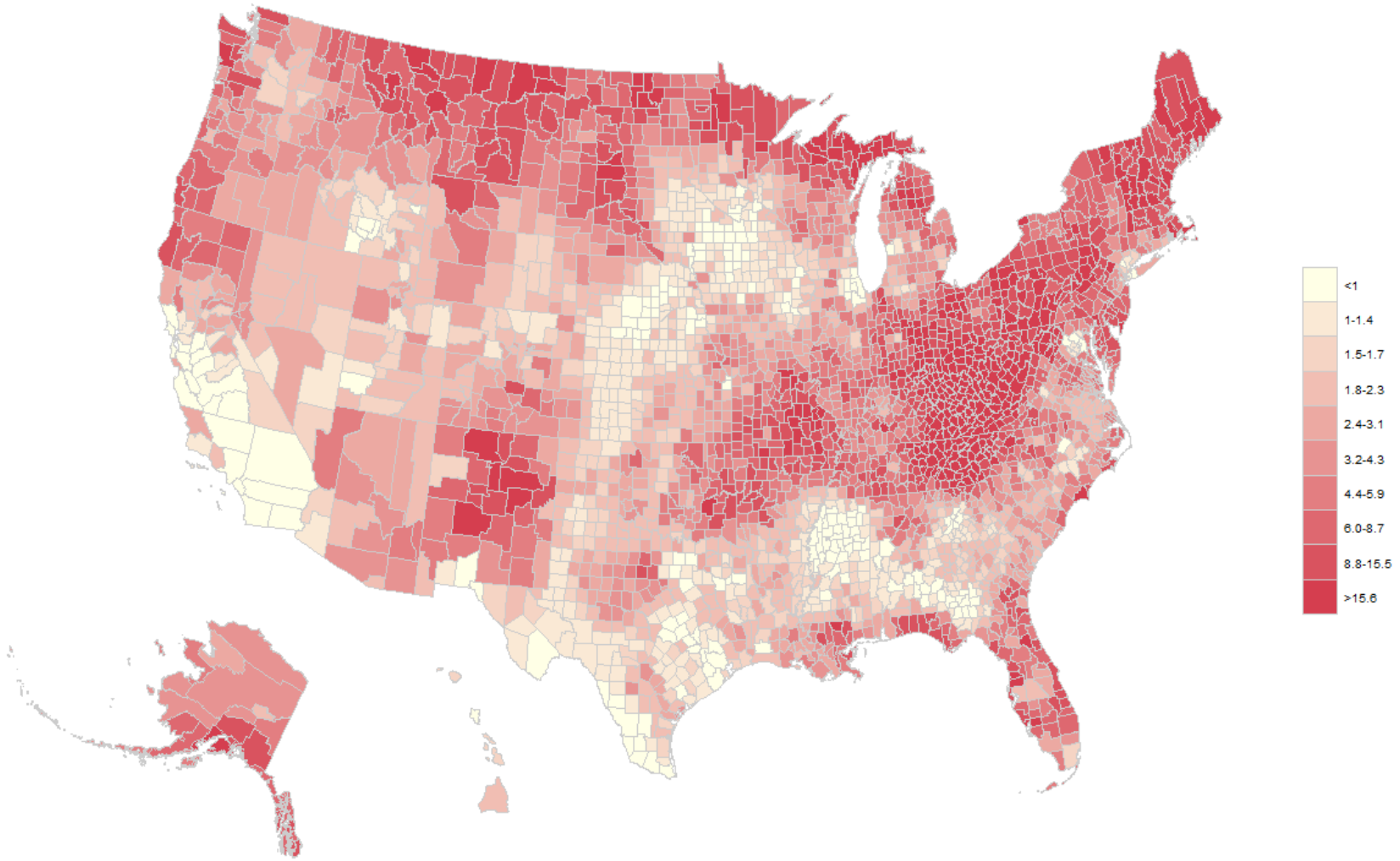
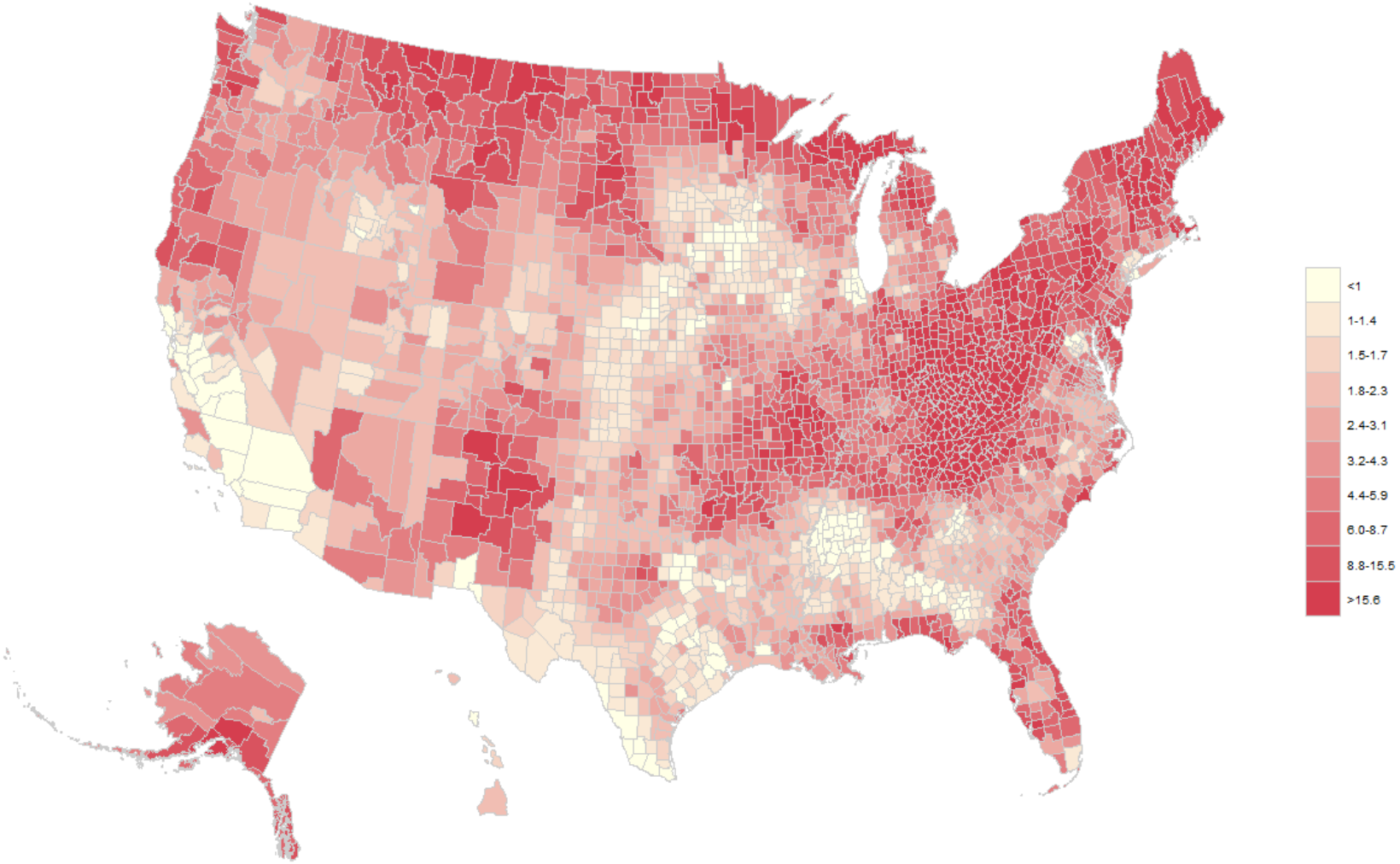


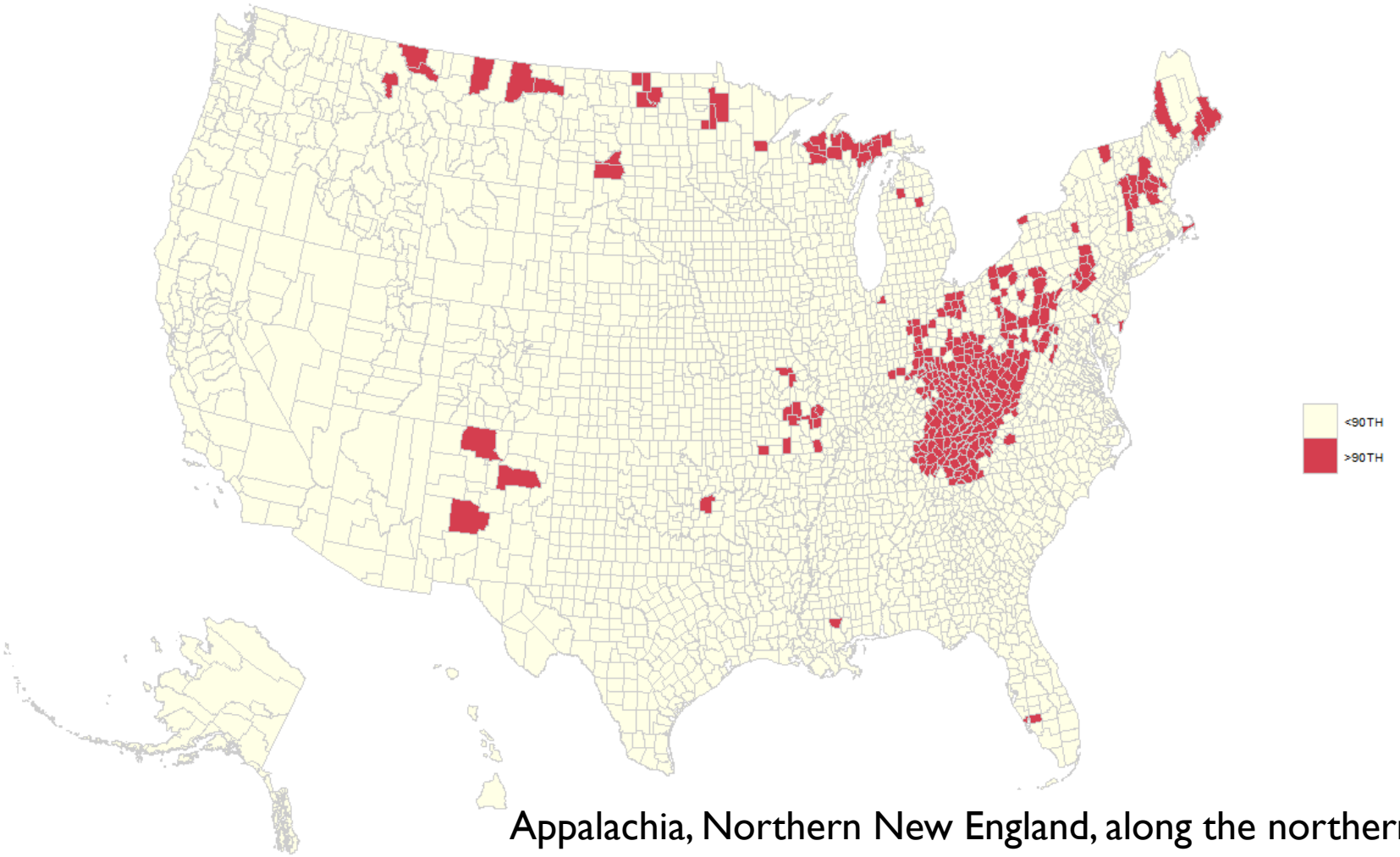
Modeled maternal HCV prevalence, 2018

Model-based estimates of the HCV infection per 1,000 births, 2018



Top 10th percentile HCV prevalence, 2018

Model-based estimates of the HCV infection per 1,000 births, 2018



Appalachia, Northern New England, along the northern border in the Upper Midwest, and New Mexico

Rural-urban maternal HCV prevalence, 2016-2018

	Observed prevalence			Modeled median prevalence		
6-Level urban-rural county classification scheme	Mean prevalence of HCV infection (per 1,000 births)	Prevalence ratio	95% confidence interval	Mean prevalence of HCV infection (per 1,000 births)	Prevalence ratio	95% confidence interval
Urban-1 Large central metro	2.4	Reference		2.4	Reference	
Urban-2 Large fringe metro	4.3	1.82	(1.77, 1.87)	4.3	1.81	(1.77, 1.86)
Urban-3 Medium metro	5.3	2.21	(2.16, 2.28)	5.2	2.21	(2.15, 2.27)
Urban-4 Small metro	6.2	2.62	(2.54, 2.70)	6.2	2.61	(2.52, 2.69)
Rural-5 Micropolitan	8.4	3.54	(3.44, 3.65)	8.3	3.52	(3.41, 3.62)
Rural-6 Noncore	9.1	3.82	(3.70, 3.95)	8.9	3.76	(3.63, 3.89)

Conclusions

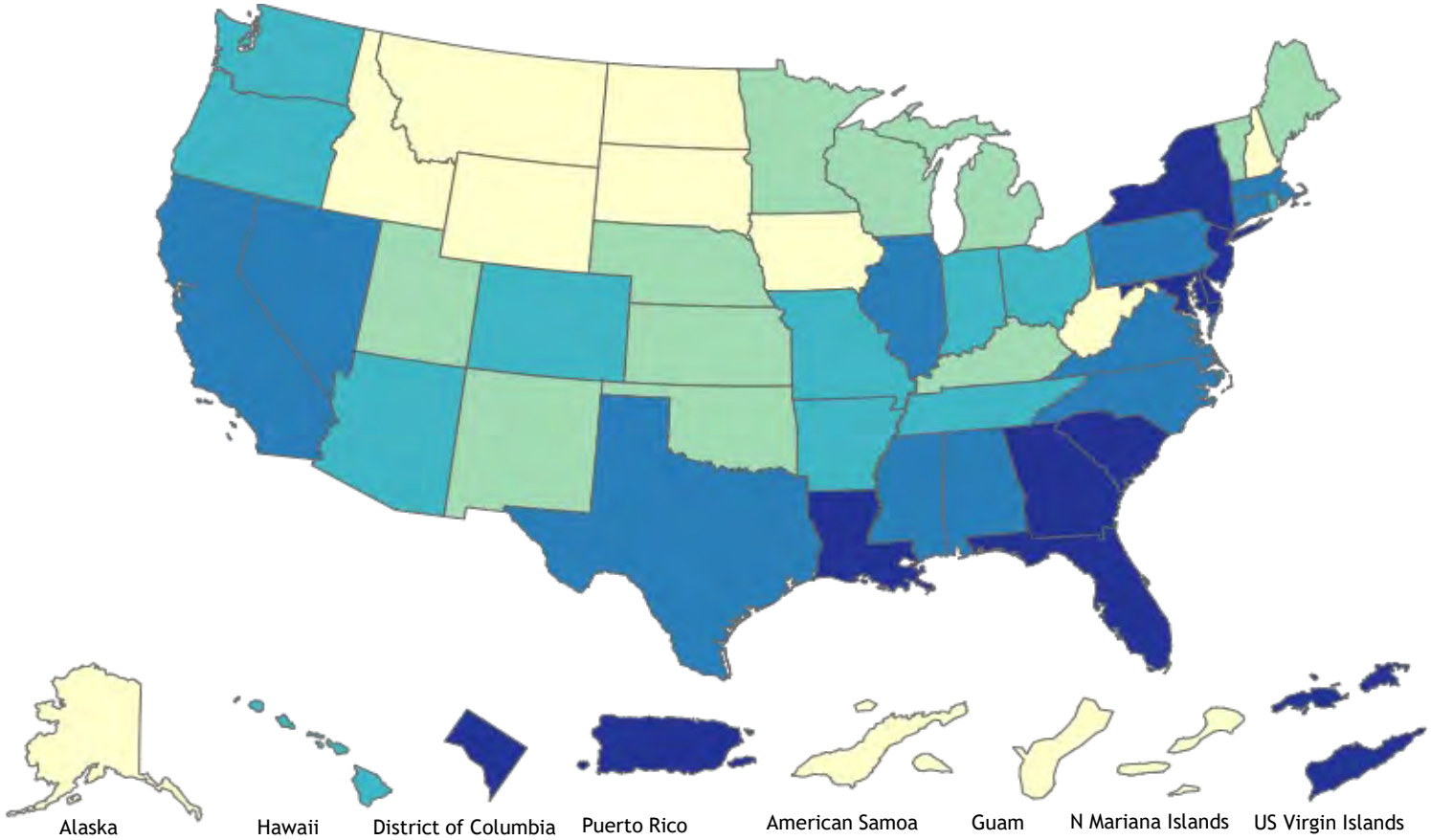
- Modeled maternal HCV prevalence estimates for every county in the country
- Can be used to help inform which areas need universal testing of pregnant women
  - However, birth certificate data on maternal HCV infection most likely underreported
  - Unknown what type of HCV test was used for birth certificate reporting; CDC recommendations based on HCV RNA test positivity rates

Project 2: HIV Prevalence

- Estimating county-level HIV prevalence
  - Centers for Disease Control and Prevention, AtlasPlus
    - State and county level estimates for 2016
  - National HIV Surveillance System, aggregates data from all 50 states, the District of Columbia, and six US dependent areas
  - HIV prevalence: persons aged 13 and older living with diagnosed HIV or AIDS at the end of 2016
  - Most recent known address as of December 31, 2016

Ahrens KA, Burgess A, Munk L, Ziller E. Rural HIV Prevalence and Service Availability in the United States: a Chartbook.

HIV prevalence | 2016 | Ages 13 years and older | All races/ethnicities | Both sexes | All transmission categories | US Map-State Level

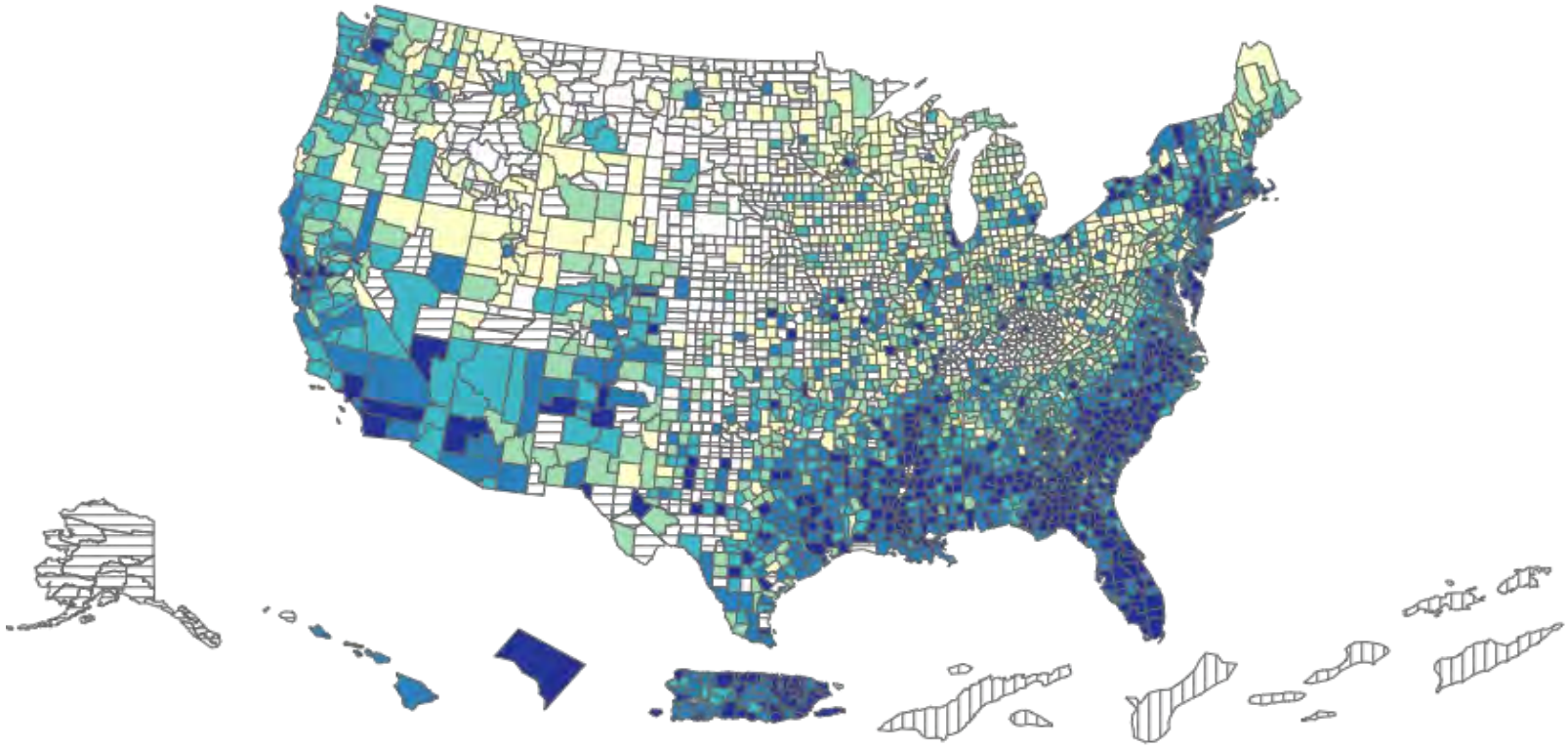


Rate per 100,000 among selected population

2.6 - 113.7	113.8 - 188.5	192.8 - 290.8	306.3 - 383.2	389.9 - 2435.2

Footnotes: Prevalence data for the year 2018 are preliminary and based on death data received by CDC as of December 2019.

HIV prevalence | 2016 | Ages 13 years and older | All races/ethnicities | Both sexes | All transmission categories | US Map-County Level

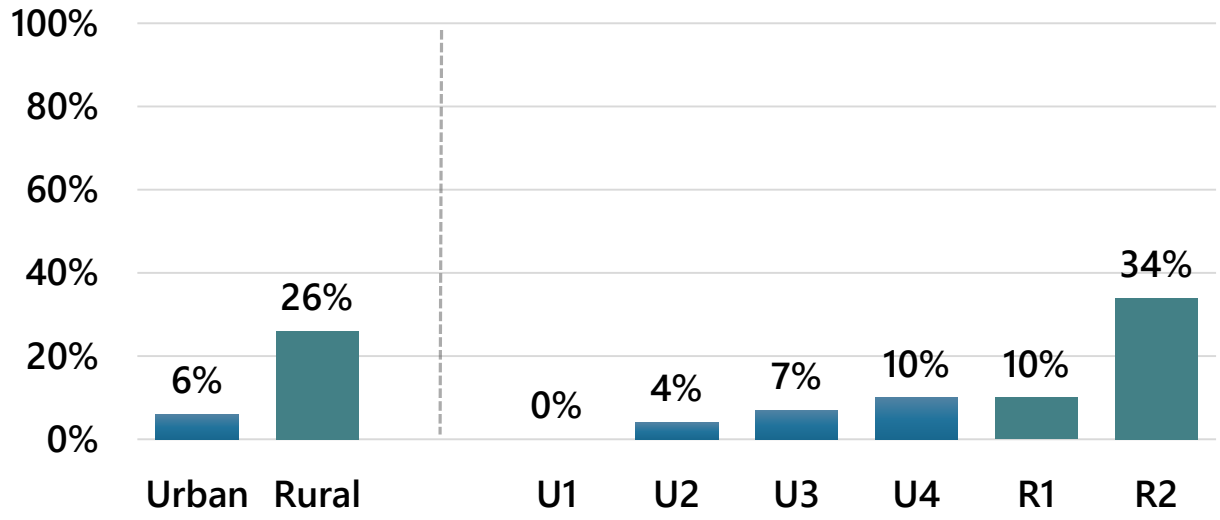


Rate per 100,000 among selected population

Data not available	Data suppressed	0	3.7 - 68	68.2 - 104.7	104.8 - 160.3	160.4 - 275.3	275.4 - 2435.2

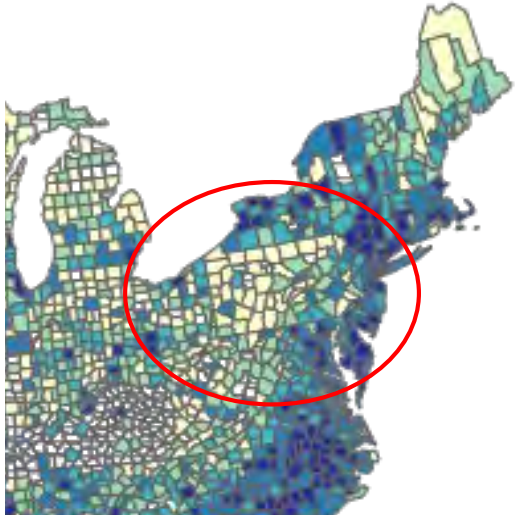
Footnotes: Prevalence data for the year 2018 are preliminary and based on death data received by CDC as of December 2019.

Percentage of counties with suppressed HIV prevalence data in Atlas, by level of rurality, NCHS 6-level classification (n=3142)



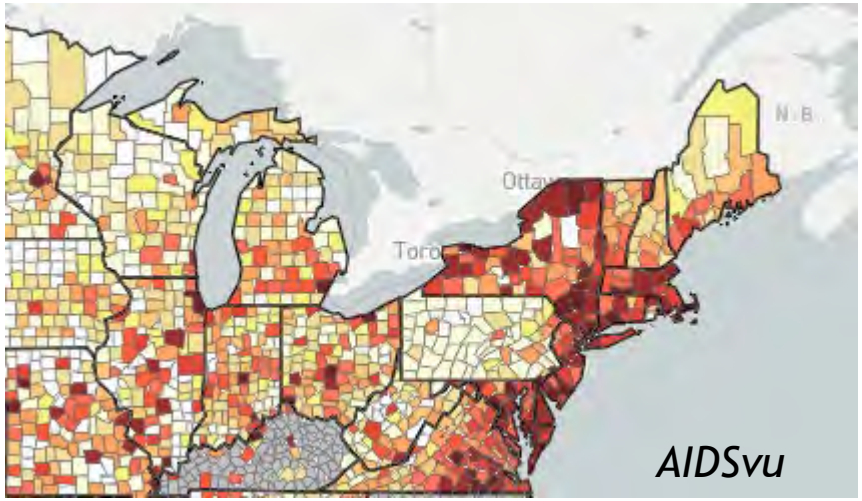
In Atlas, a data suppression rule is applied if:
The population denominator is less than 100 or total case count is 1–4.
Also based on data re-release agreements between CDC and local HIV surveillance programs

Additional issue: missing HIV cases



Example: Pennsylvania

Total HIV cases in state=35,617
Total HIV cases that could be attributed to a county of residence=22,337 (63%)



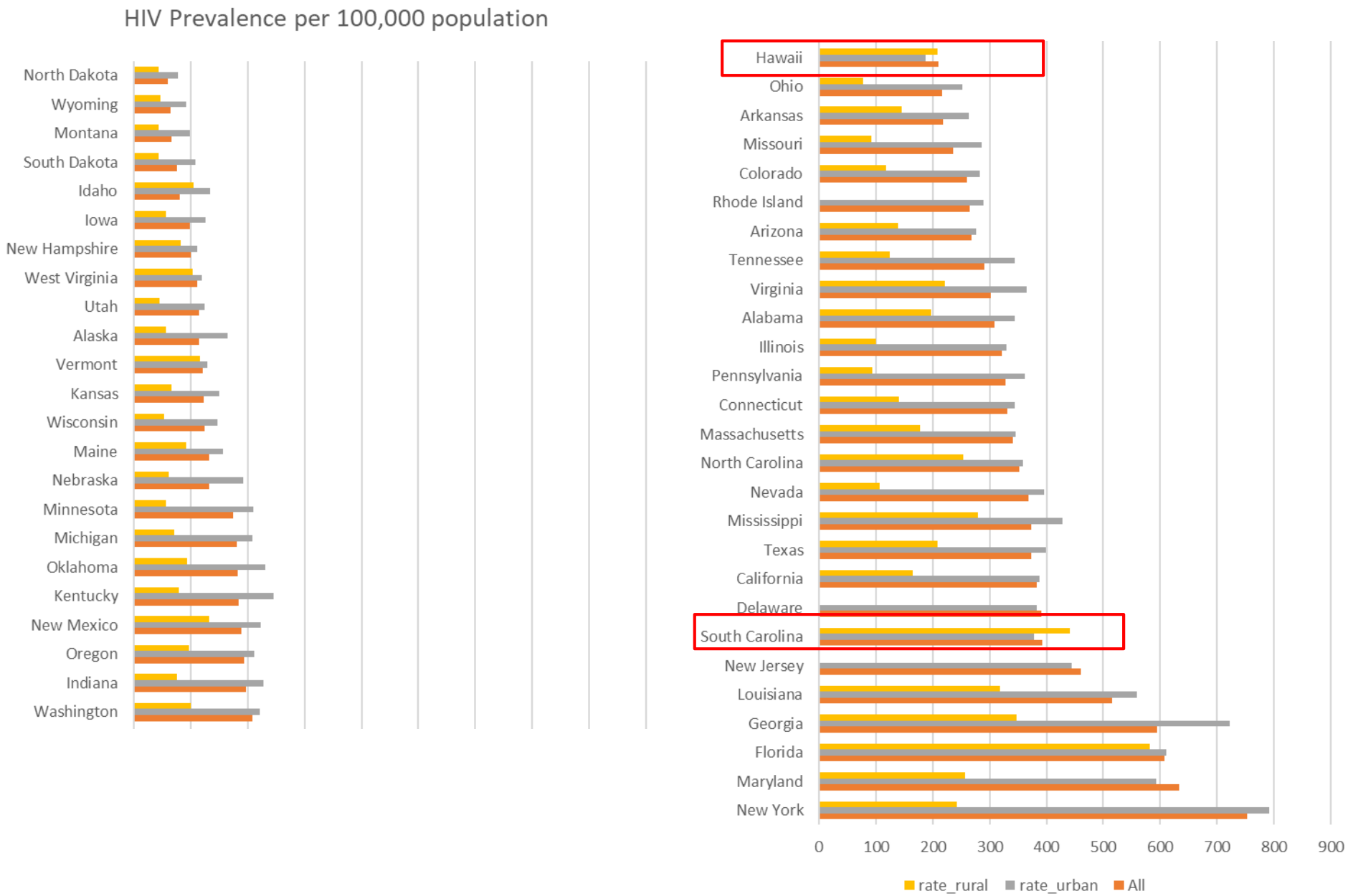
Even though data are released for a county, they are not accurate

Therefore, county-level HIV prevalence for PA is a severe undercount

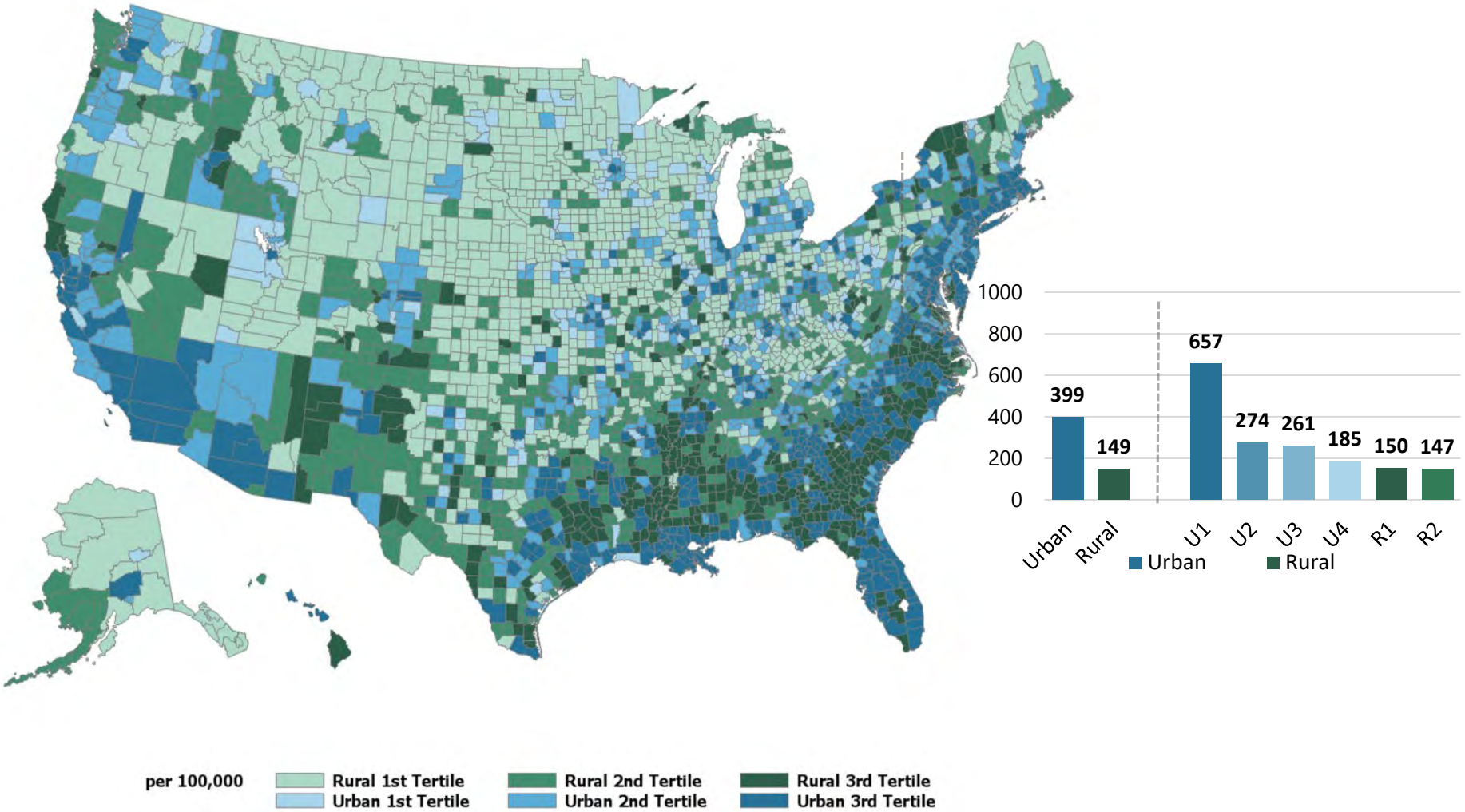
"prevalence data from 2010 to present are based on most recent known address"

HIV Prevalence: Methods

- To estimate county-level HIV prevalence (2016)
  - Supplemented Atlas data with state-produced HIV surveillance reports
  - Sequentially, used 5 different methods to fill in missing data
  - For some counties, imputed counts of one when counts 1-4 suppressed
  - Our goal was to obtain county-level estimates for each state that summed to within +/-10% of the total AtlasPlus HIV case counts for that state for 2016


HIV Prevalence per 100,000 population
North Dakota
Wyoming
Montana
South Dakota
Idaho
Iowa
New Hampshire
West Virginia
Utah
Alaska
Vermont
Kansas
Wisconsin
Maine
Nebraska
Minnesota
Michigan
Oklahoma
Kentucky
New Mexico
Oregon
Indiana
Washington
Hawaii
Ohio
Arkansas
Missouri
Colorado
Rhode Island
Arizona
Tennessee
Virginia
Alabama
Illinois
Pennsylvania
Connecticut
Massachusetts
North Carolina
Nevada
Mississippi
Texas
California
Delaware
South Carolina
New Jersey
Louisiana
Georgia
Florida
Maryland
New York
0
100
200
300
400
500
600
700
800
900
rate_rural
rate_urban
All

County-level HIV prevalence per 100,0000 population, by rurality



Conclusions

- Urban HIV prevalence was higher than rural county-level HIV prevalence in all but two states: South Carolina and Hawaii
- Suppressed data for rural counties can be addressed by a variety of methods:
  - Using state-reported estimates if national data suppressed
  - Imputing suppressed counts (1-4) with values of 1

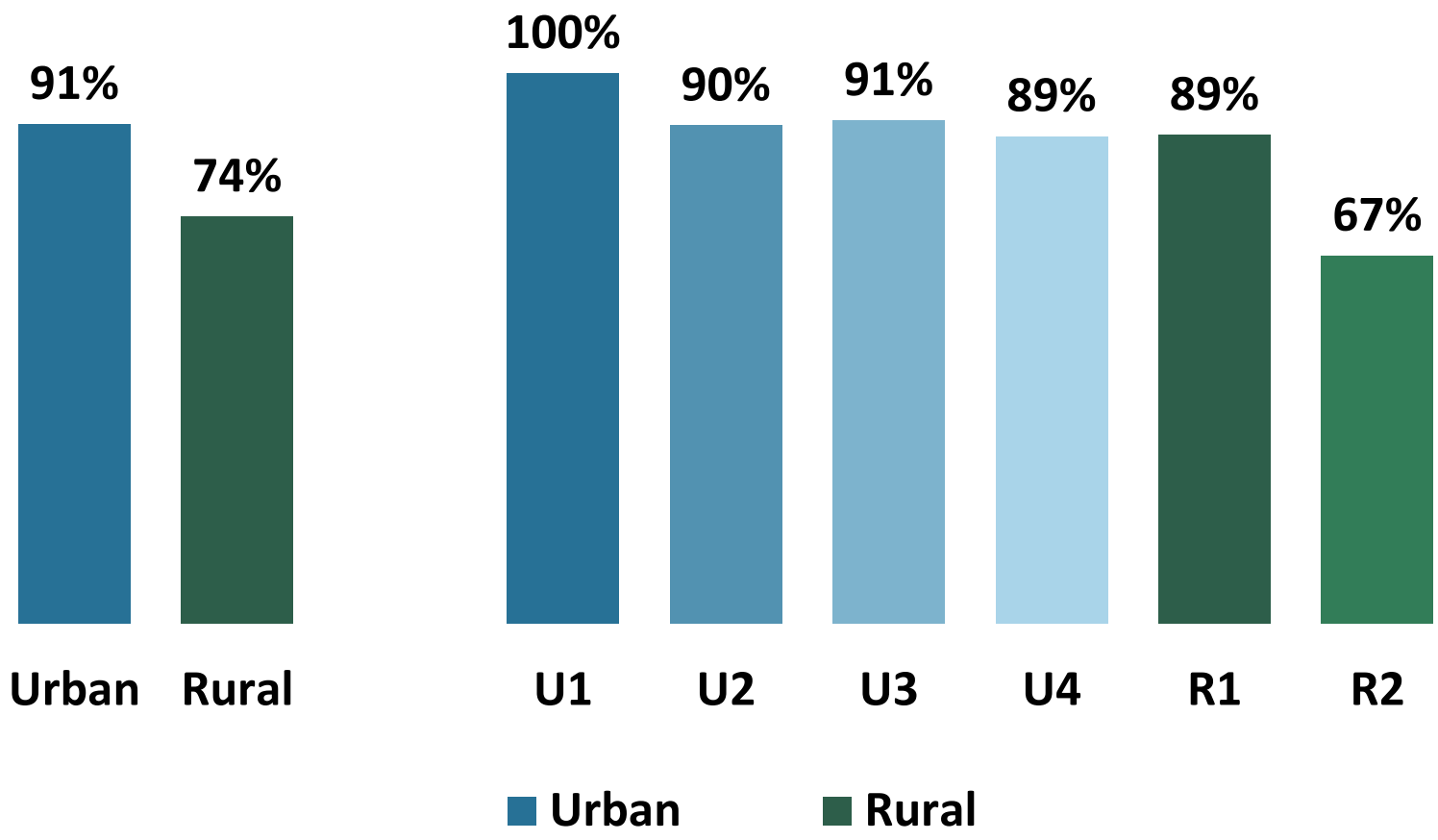
Project 2: HIV service availability

- What is the availability of HIV prevention, testing, and treatment services by rurality of county and US Census region?

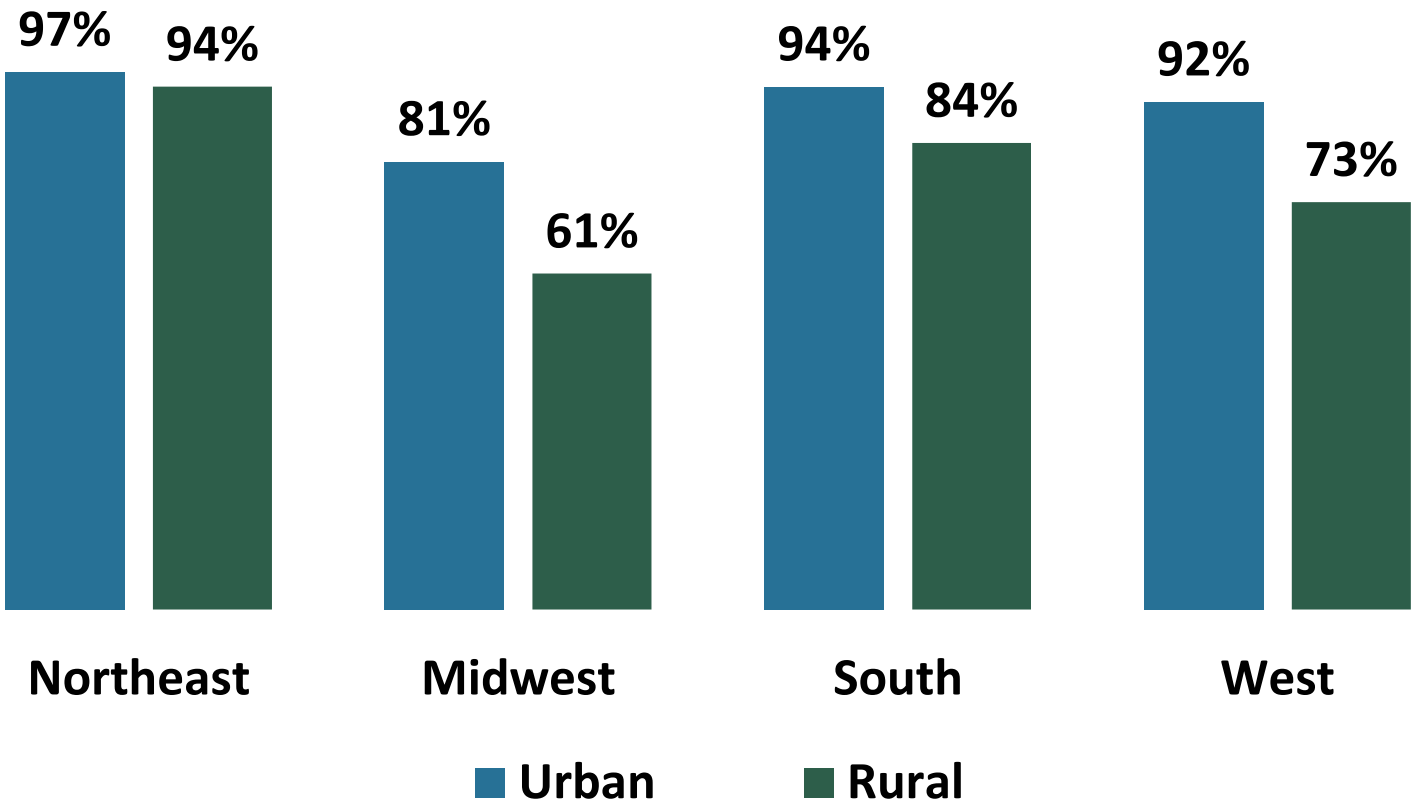
HIV Service Availability: Methods

- Service availability (2019)
  - Geocoded data from the National Prevention Information Network (NPIN) Organizations Database
  - 11,813 organizations that provide services related to HIV/AIDS, viral hepatitis, and/or STDs
  - Organizations must offer specific programs focused on one or more of these diseases
  - Linked to NCHS county classifications
- Differences are significant at $p < .05$

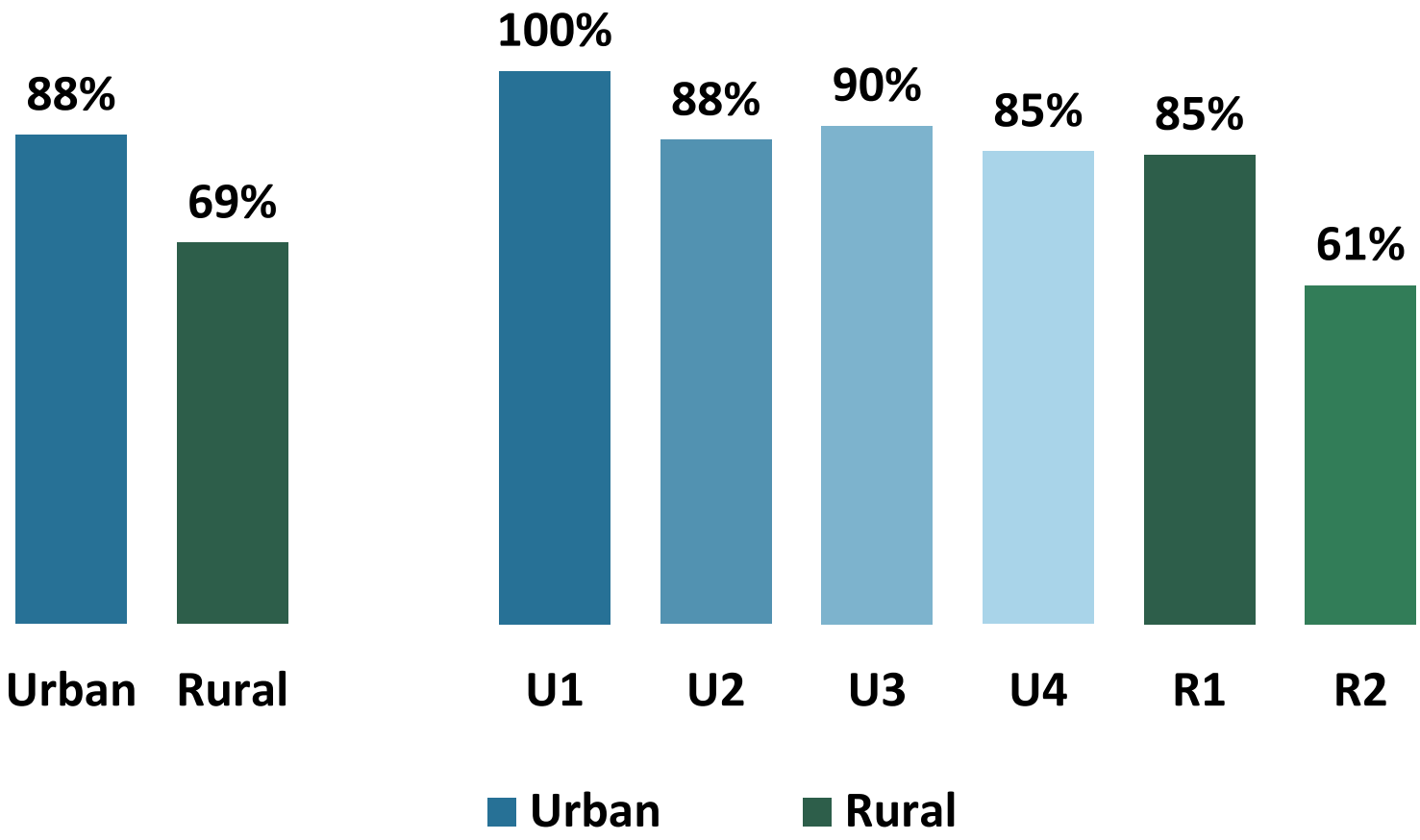
Percentage of counties with any of select HIV services, by rurality



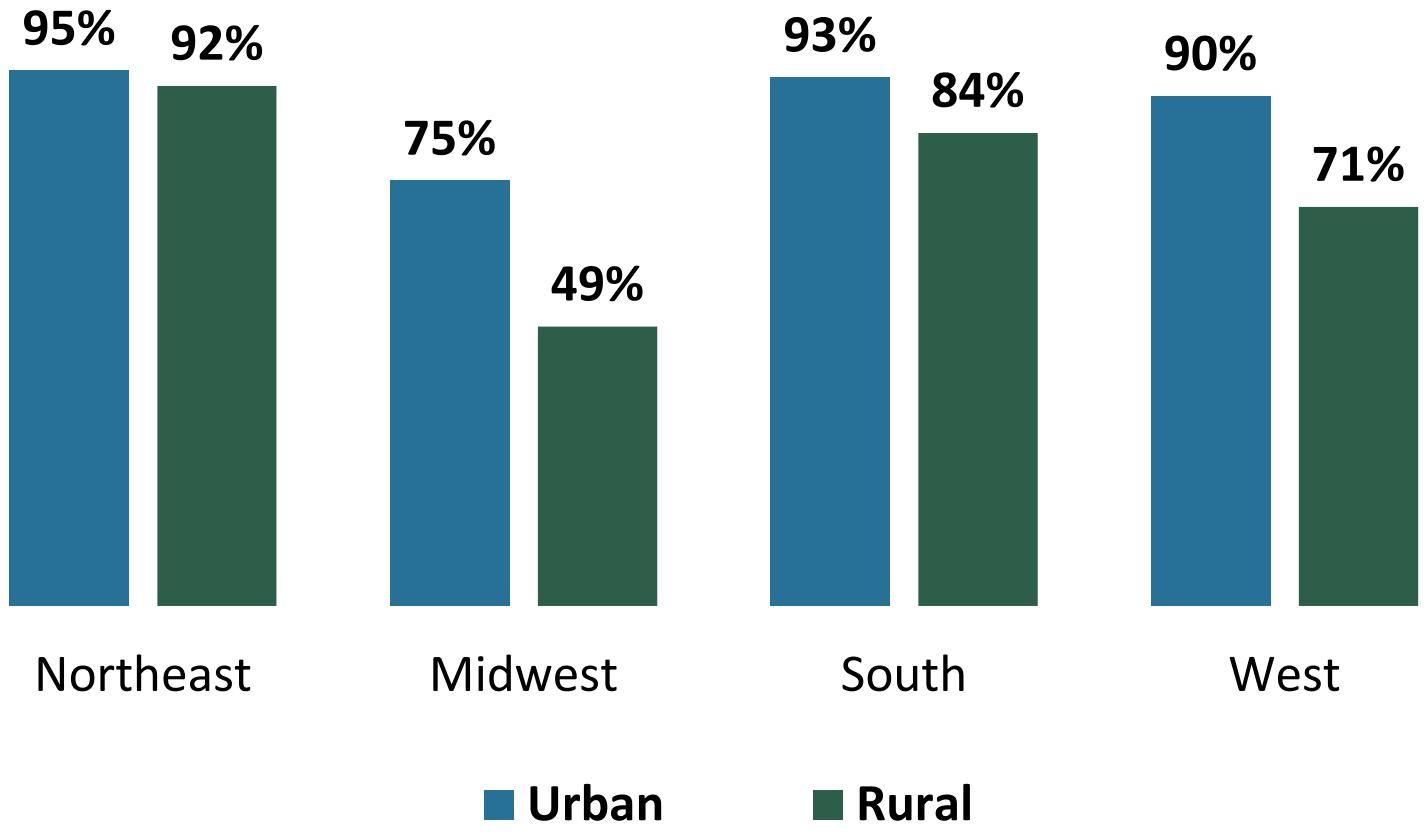
Percentage of counties with any of select HIV services, by Census region



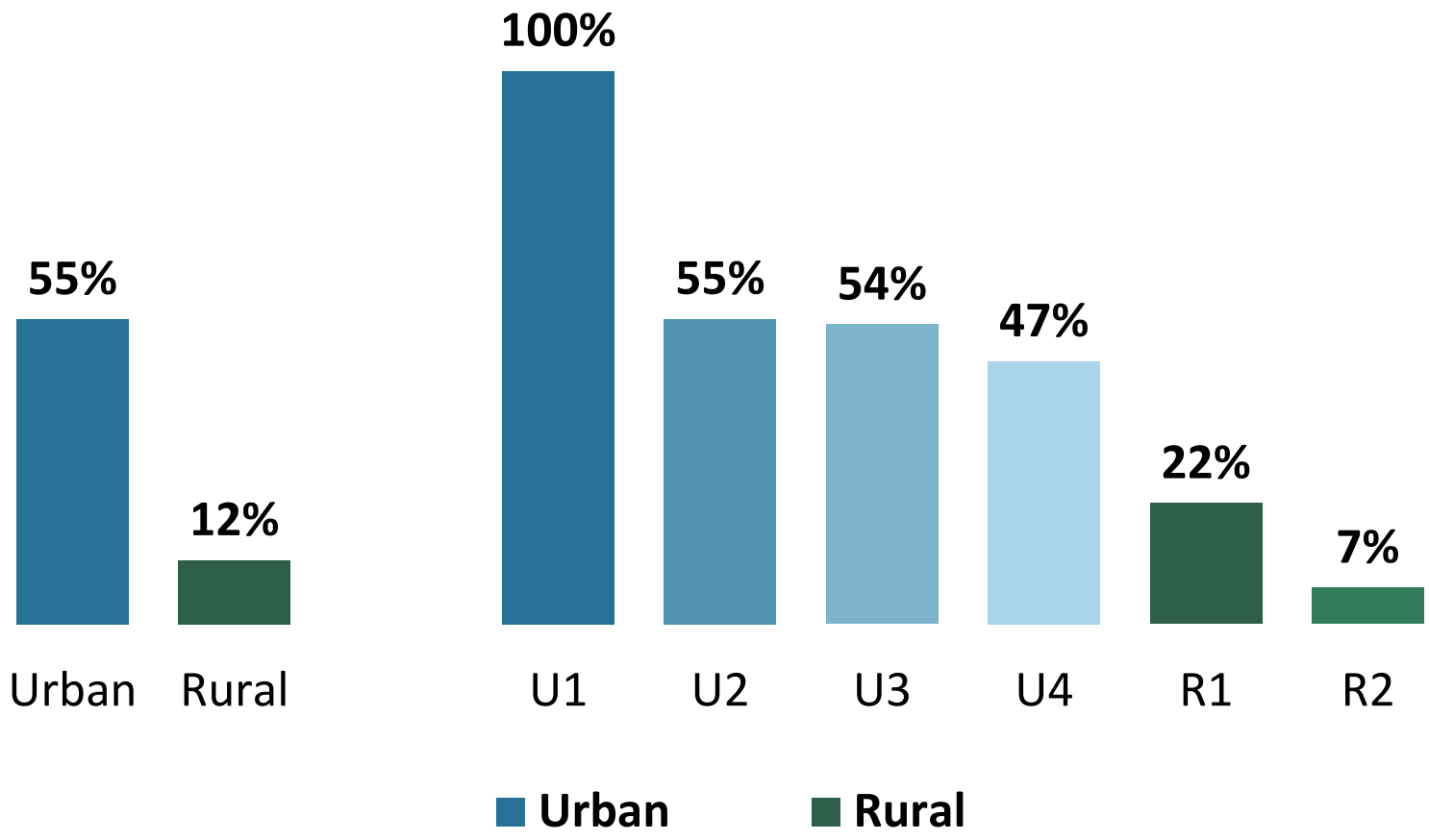
Percentage of counties with an organization providing HIV testing services, by rurality



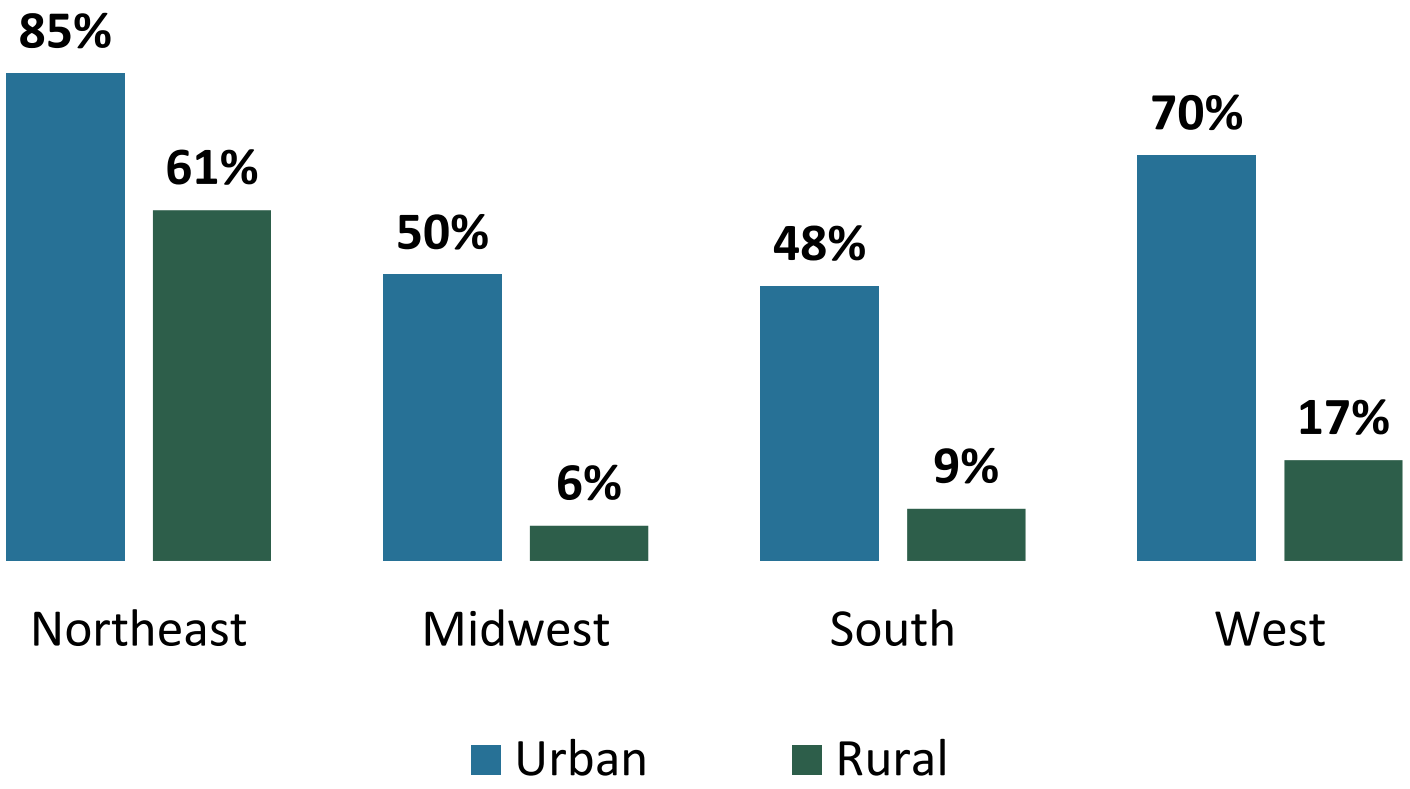
Percentage of counties with an organization providing HIV testing services, by Census region



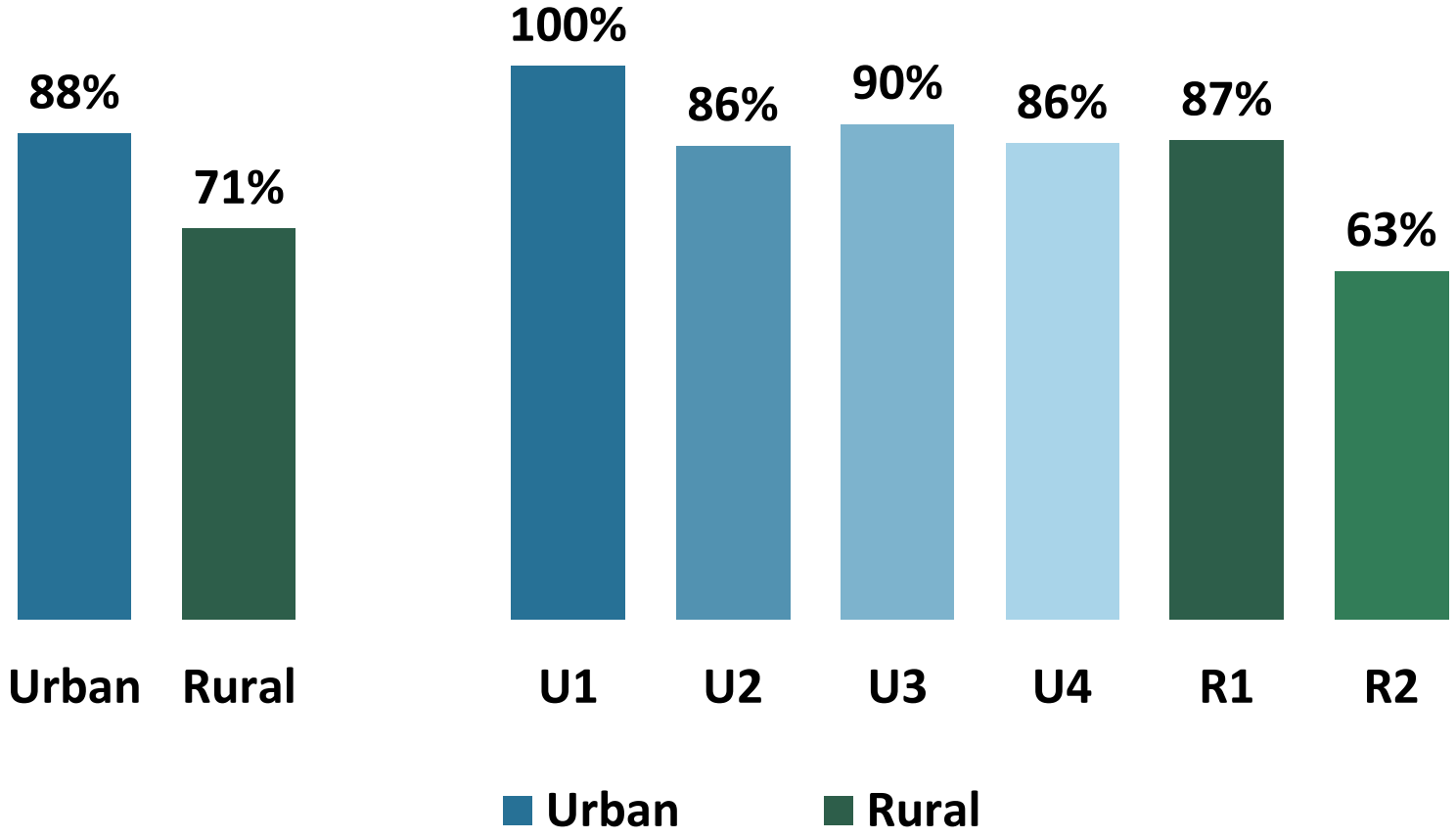
Percentage of counties with an organization providing PrEP, by rurality



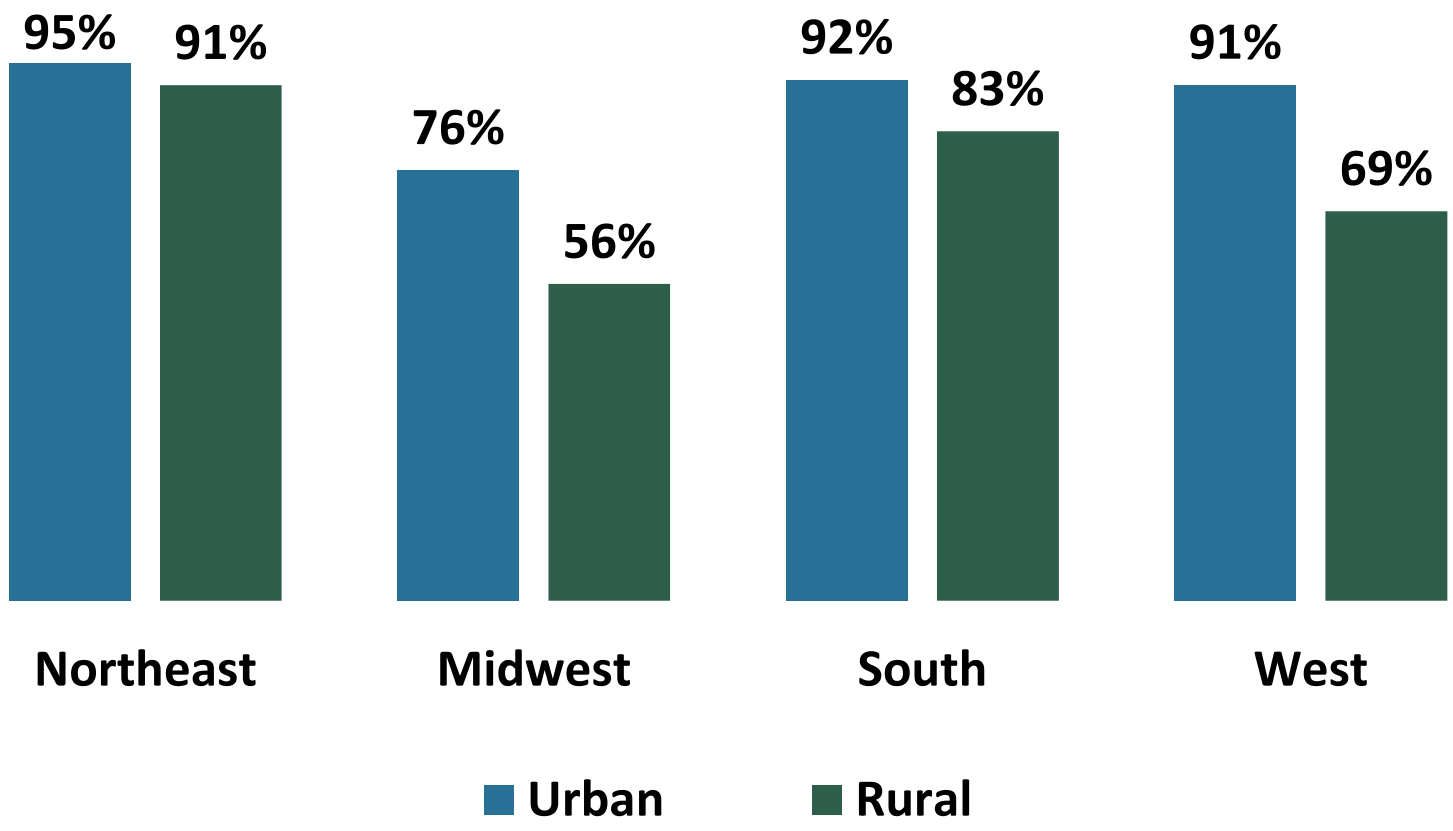
Percentage of counties with an organization providing PrEP, by Census region



Percentage of counties with an organization providing HIV prevention education, by rurality



Percentage of counties with an organization providing HIV prevention education, by Census region



Conclusions

- HIV prevalence and the availability of HIV-related services varied across the rural-urban continuum and US Census regions
- Compared with urban counties, a smaller proportion of rural counties had organizations that provide HIV prevention, testing, and treatment services

Project 3: Challenges and promising practices of rural public health in addressing HIV and hepatitis C

Research Questions:

- What is the capacity of rural counties to prepare for, identify, and respond to an HIV or HCV outbreak?
- What challenges do rural communities face in addressing a potential outbreak? What strategies are used to address those challenges?

Methods

- Identification of target states
  - Potentially at risk for HIV or HCV outbreak
  - 20%+ rural population
  - Geographic diversity
  - Diversity of public health governance structures
    - Centralized, decentralized, shared, mixed
  - Six states selected

Methods

- Key informants
  - Key informants recruited from state health departments, rural local health departments (LHDs), and rural community-based organizations (CBOs)
  - Purposive and snowball sampling
  - 36 key informants interviewed in May-August 2019
- Semi-structured interviews
- NVivo v.12 for coding and thematic analysis

Key challenges

- **Funding and funding allocation**
- Staffing
- Surveillance
- **Access to testing and treatment**
- **Resistance to harm reduction services**

Funding and funding allocation

- Declining public health funding

"The state chose to, in balancing the budget, take [more than 20%] of the income from all the local health departments. To take that much of a cut and still try to provide services has been very challenging."

Funding and funding allocation

- Funding favoring population centers

"Prevention dollars have been siphoned away from agencies in smaller, more rural communities and those dollars have been sent to more urban areas."

- Funding disparities between HCV and HIV programs

Addressing funding limitations

- Soliciting funds from the local community

"As much as we're challenged with some of our rurality, I do think that some of the community that comes with the rurality can be a powerful part of the solution."

- Integrating HCV response into existing, more robust HIV programs and infrastructure

Access to testing and treatment

- Limited health infrastructure and clinician shortages

"The rural areas that have hospitals and/or FQHCs [federally qualified health centers] are in a much better situation if they've got good working relationships to be able to draw on those assets so they can be testing for hepatitis C, they can be testing for HIV, they can be vaccinating for hepatitis A. Unfortunately, in many rural areas they have neither."

"A lot of people simply do not have the gas money or a vehicle capable of driving them 60 miles and sometimes more to the nearest place where they can get HIV or hepatitis C treatment."

Access to testing and treatment

- Stigma

"People feel like if they can go over to [a different] county nobody's going to know them and they can get a test. Remember, we are a very small community."

- Medicaid and clinician-specific requirements for HCV treatment

Expanding access to testing and treatment

- Telehealth

"Folks in more rural areas can still get access to specialty or primary care without needing to physically travel two or three hours to see them."

Expanding access to testing and treatment

- Community outreach and mobile clinics

"It's basically meeting the people where they really are, literally and figuratively."

- Service integration
- Patient navigation

Resistance to harm reduction services

- Process for establishing harm reduction programs, including syringe service programs (SSPs), varied by location and governance structure

"Our county commissioners—they're not experts in health, or rural health, or disease intervention, so a lot of education has to be done and sometimes you're just not going to change people's mind."

- Law enforcement resistance

Increasing acceptance of harm reduction services

- Educate the community and stakeholders about services provided by SSPs and the impact of stigma
- Provide harm reduction trainings for law enforcement

"You pretty much have to have buy-in with law enforcement. We work with a lot of retired police officers that help with the promotion of harm reduction in the state."

Increasing acceptance of harm reduction services

- Include community stakeholders from different sectors in the planning process
- Centralized public health governance structures

"Given that we can provide [harm reduction] services in our health offices, we can operate regardless of [a location's political] environment."

Conclusions

- Rural public health organizations faced funding challenges, limited access to local HIV and HCV testing and treatment, and stakeholder and/or community resistance to evidence-based public health approaches.
- Rural communities were using a variety of innovative approaches to prepare for and address the threat of infectious disease outbreaks.

Co-authors

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This work was supported by the Federal Office of Rural Health Policy, Health Resources and Services Administration, Grant U1CRH03716

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