RURAL-URBAN DISPARITIES IN LATE HIV DIAGNOSES IN THE SOUTHEASTERN UNITED STATES

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AETC AIDS Education & Training Center Program
Southeast

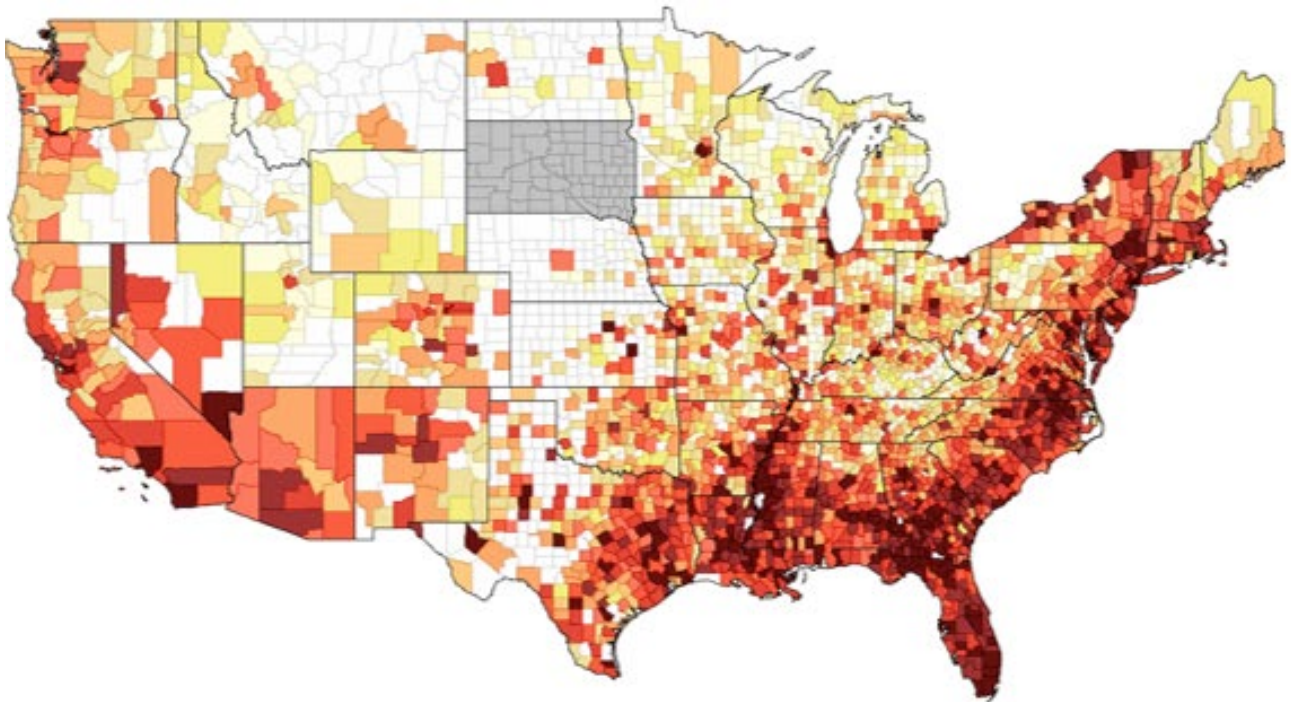# Acknowledgments, Funding, & Disclosures

Acknowledgments & Funding

TENNESSEE CENTER FOR AIDS RESEARCH

Disclosures

I have no conflicts of interest or financial disclosures to disclose.
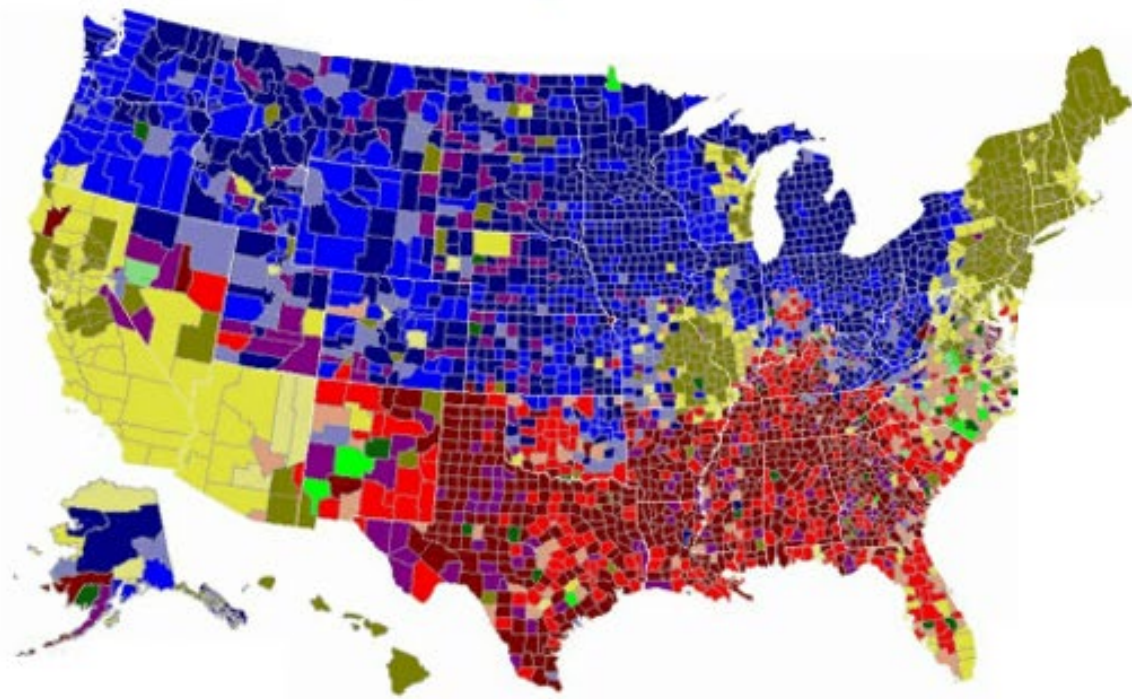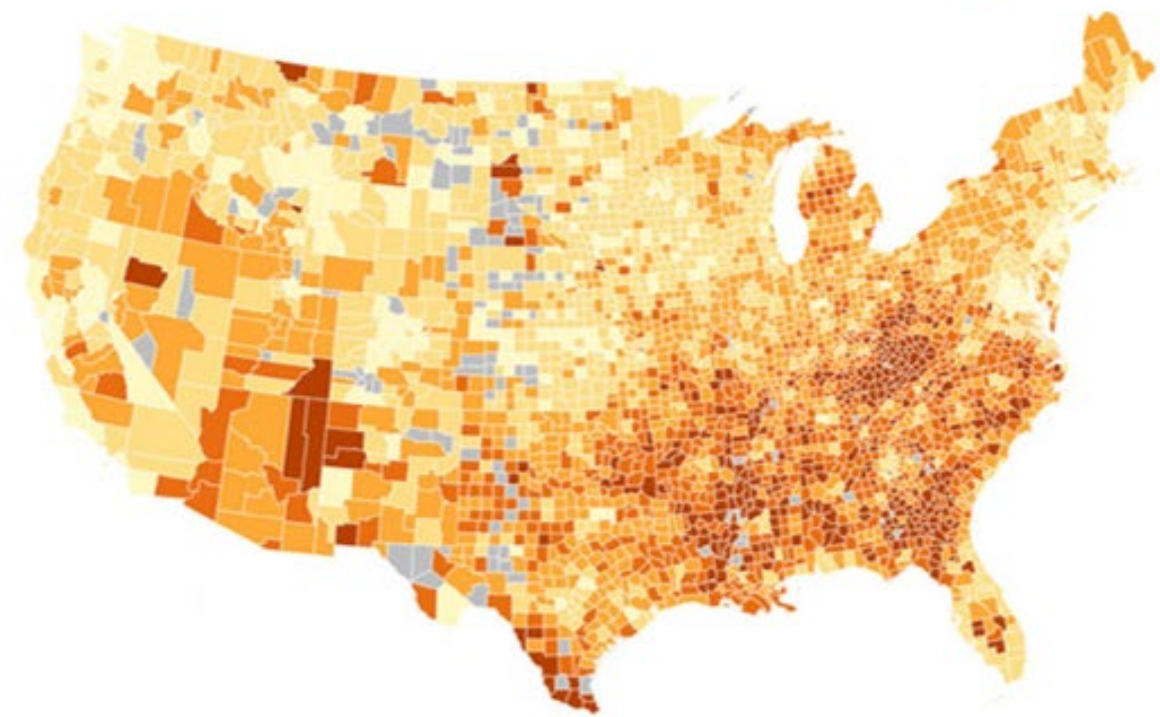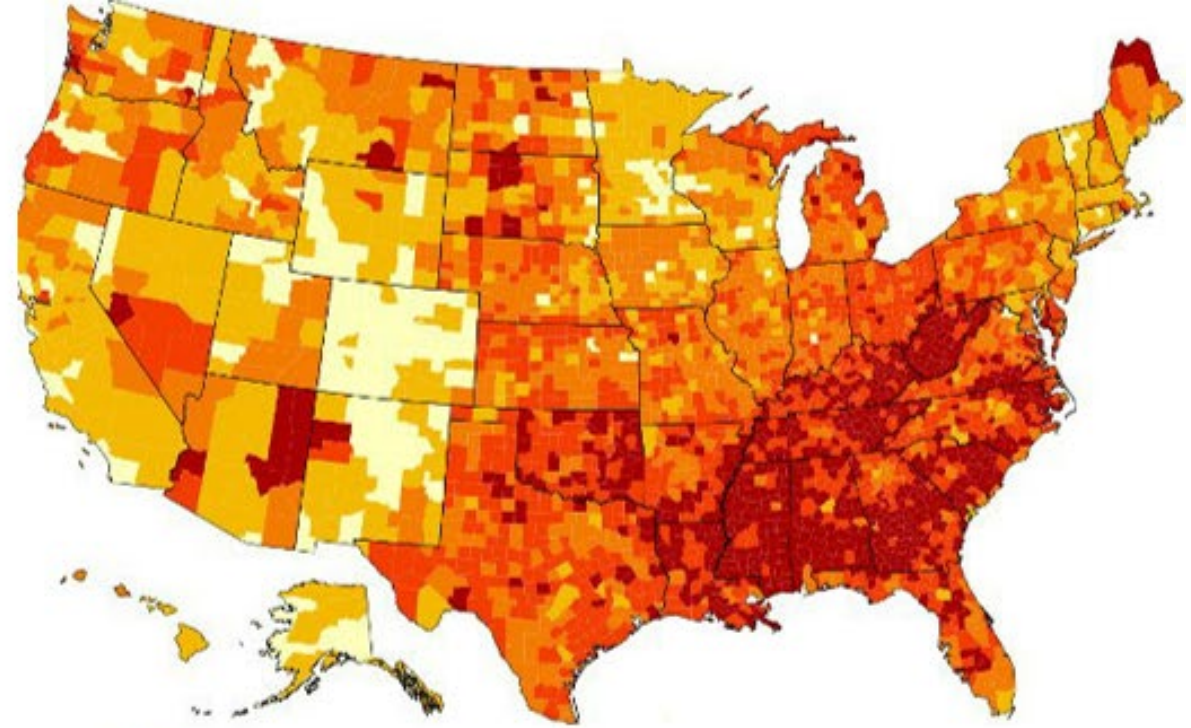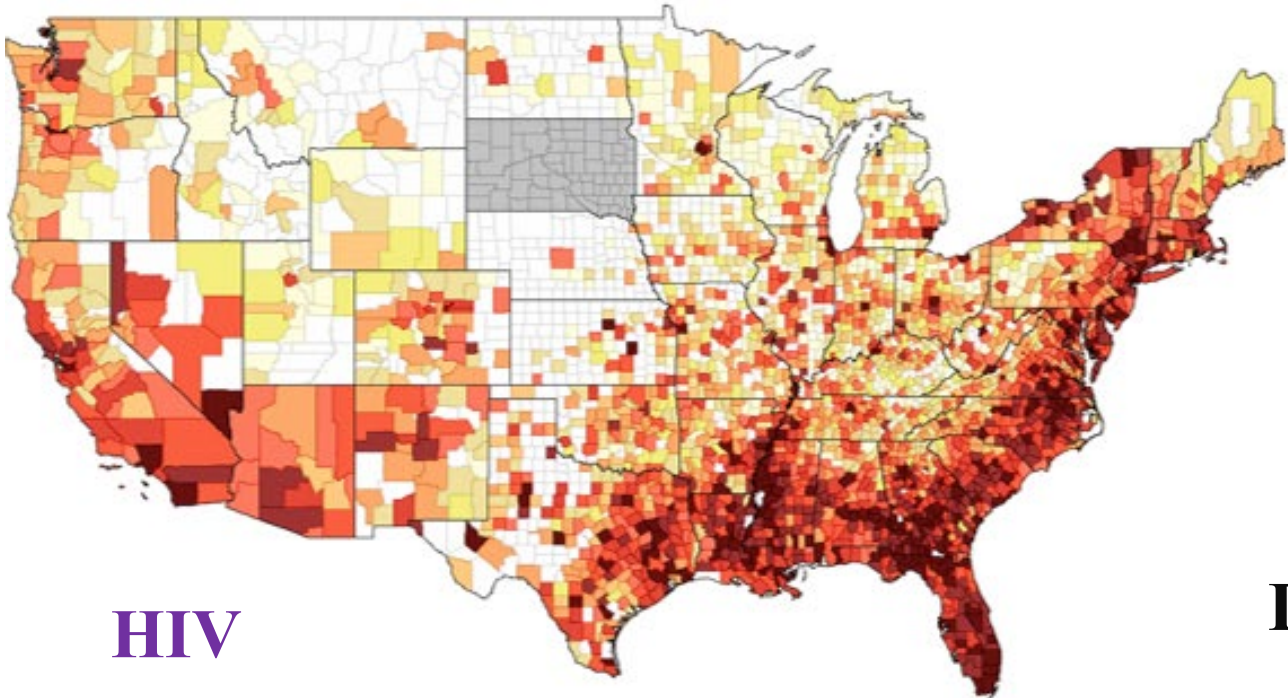
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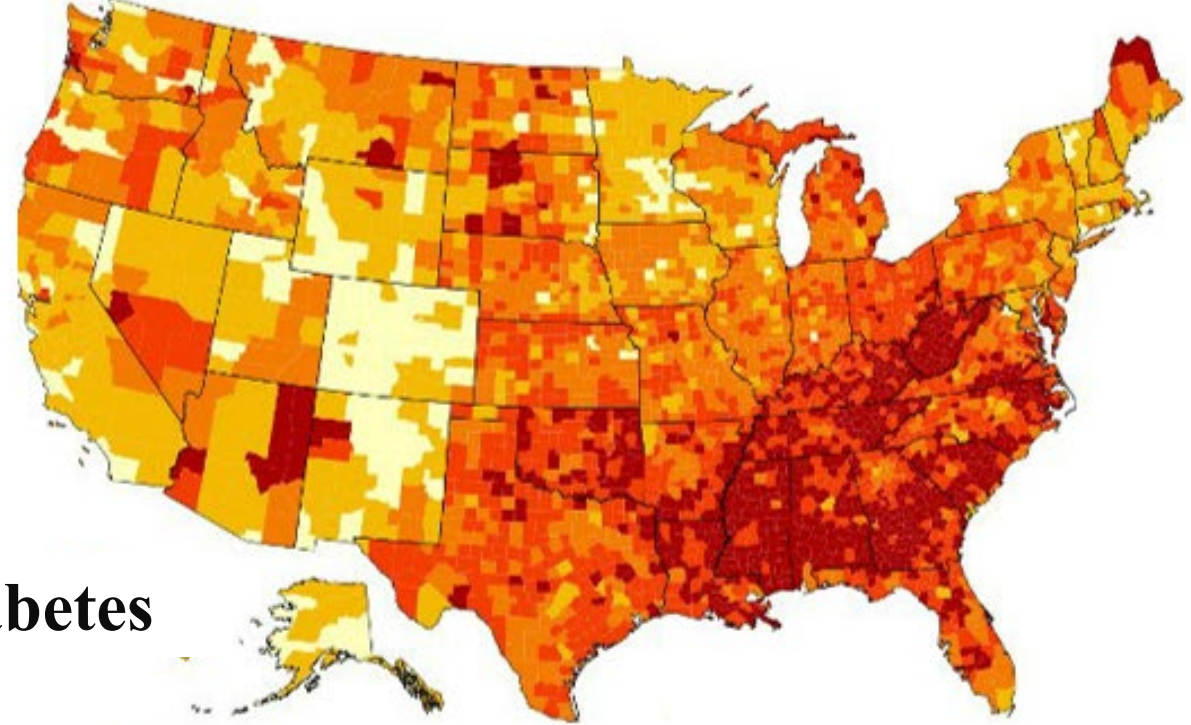
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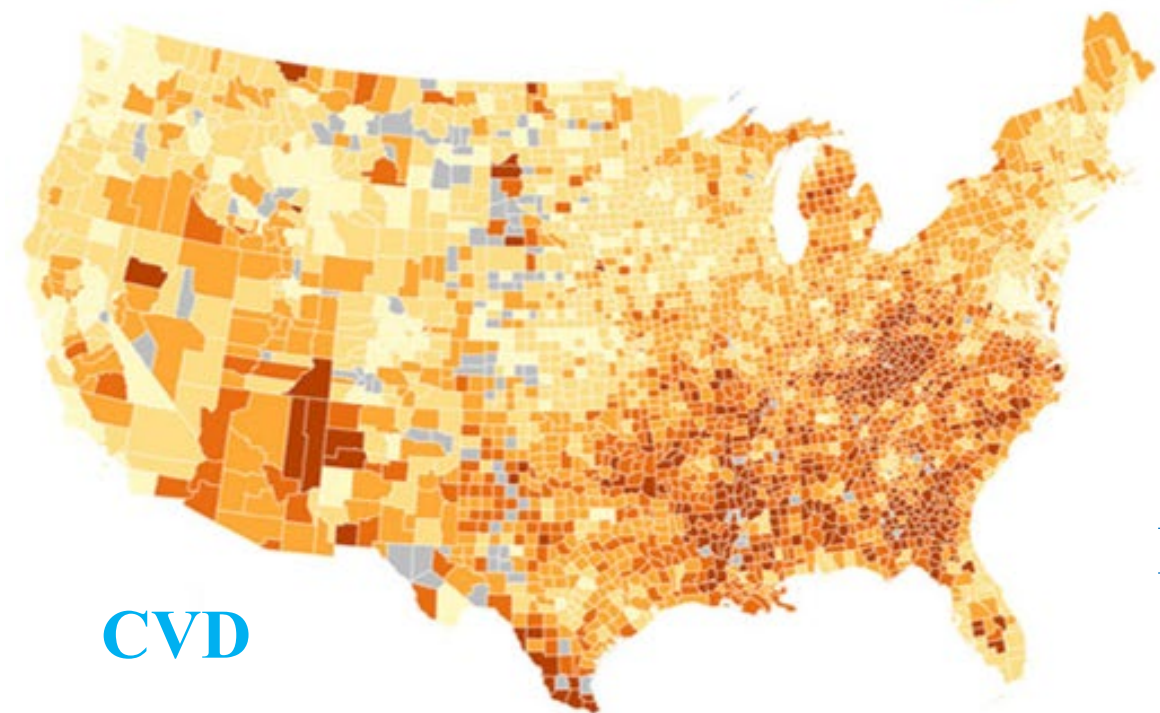
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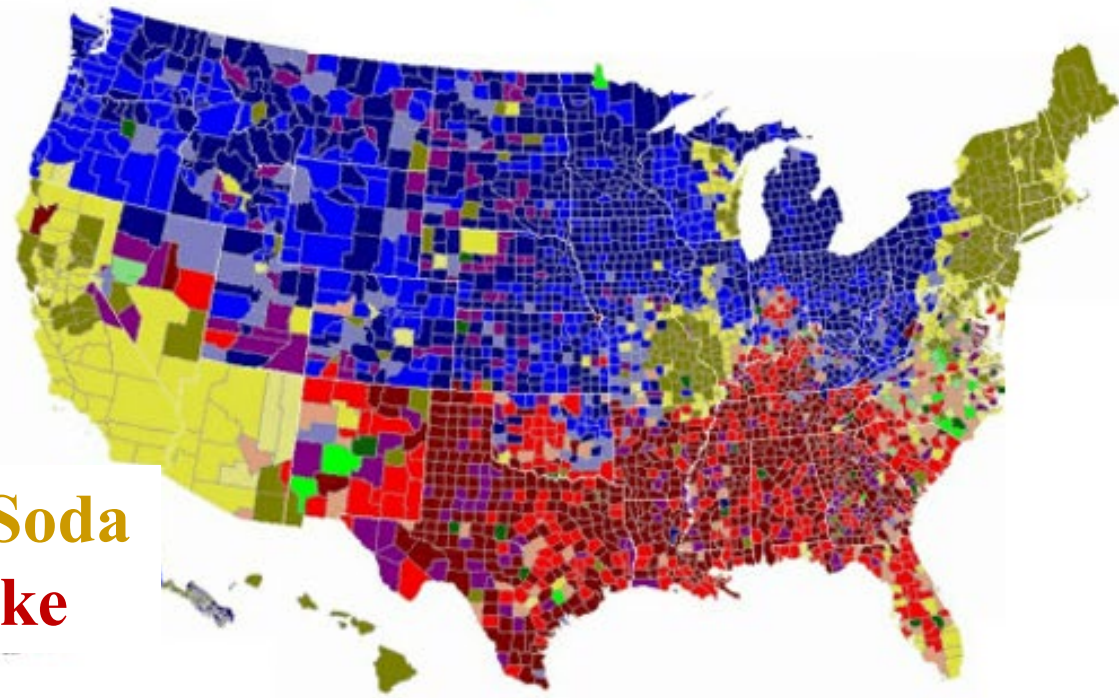
Pop vs. Soda vs. Coke

The South is Disproportionately Affected by HIV
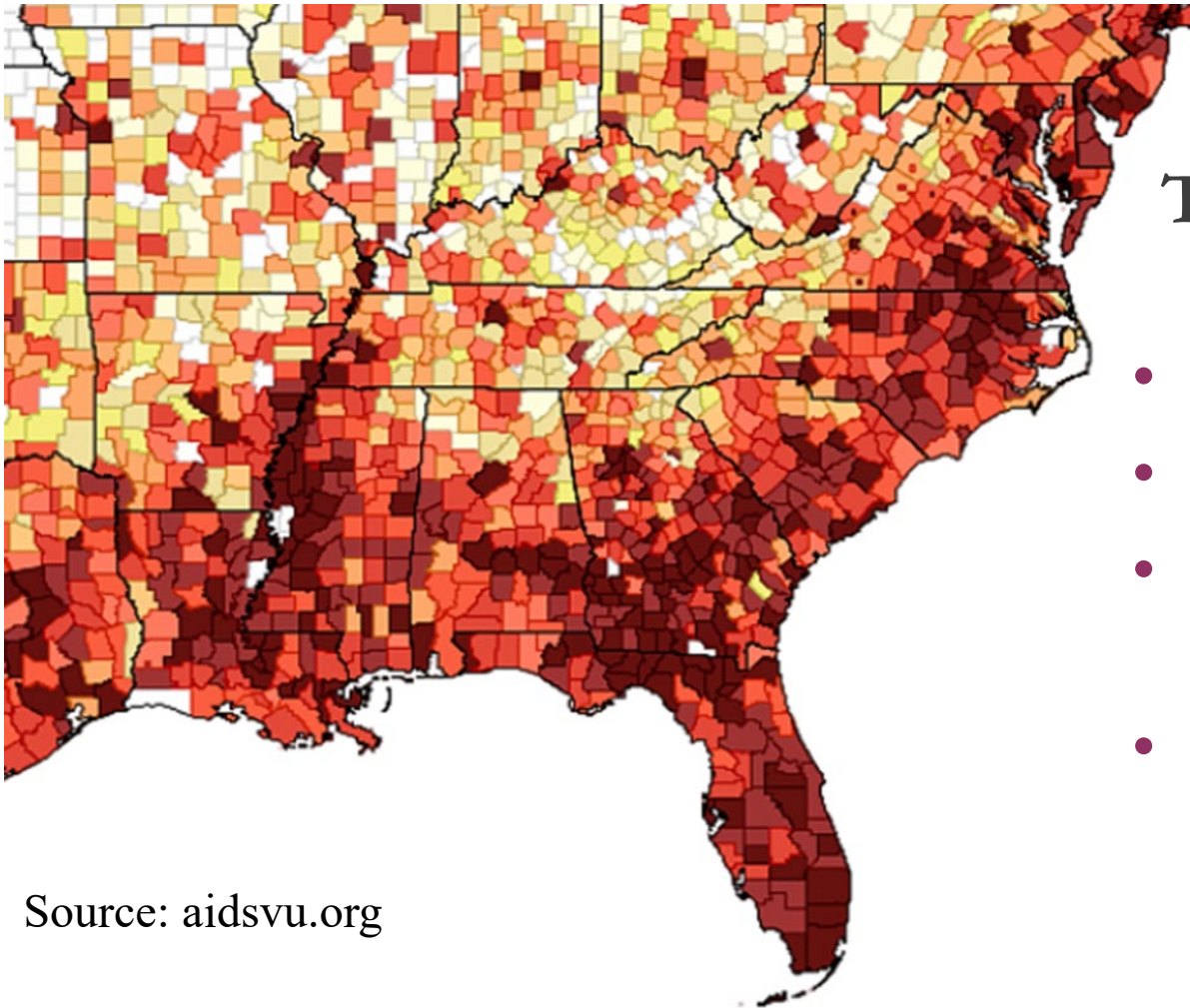
The Southeast accounts for **38%** of the U.S. population, but…

- **51%** of new HIV cases
- **47%** of HIV-related deaths
- **24%** of HIV diagnoses that are non-urban **(highest in the U.S.)**
- **20.4%** of HIV diagnoses in the Southeast are classified as **"late"**

Source: aidsvu.org

Tennessee Specifics

Tennessee Data (2019)

- **17,667** PWH in TN (307/100,000)
  - 54.7%Black, 5.9% Hispanic/Latinx, 34.7% White
  - 75.2% Male, 24.8% Female
- **773** new HIV diagnoses in 2019 (average over last 5 years has been ~750/year)
  - **~17.3%** were diagnosed late
- **307** PWH died in 2019

Source: aidsvu.org
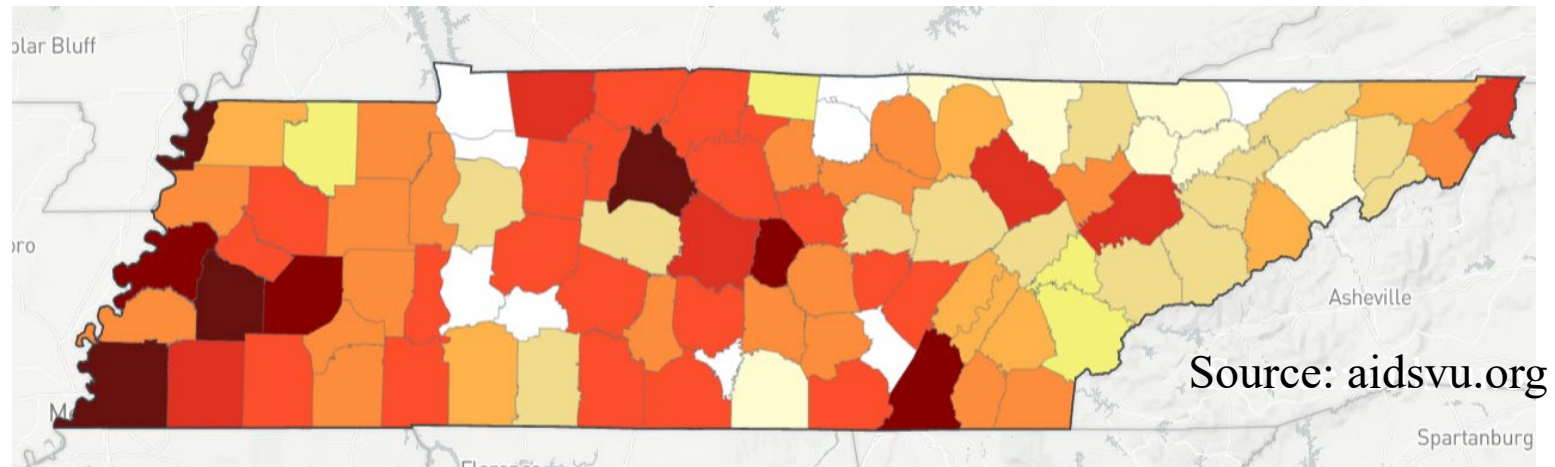
Number of New HIV Diagnoses, 2008-2019
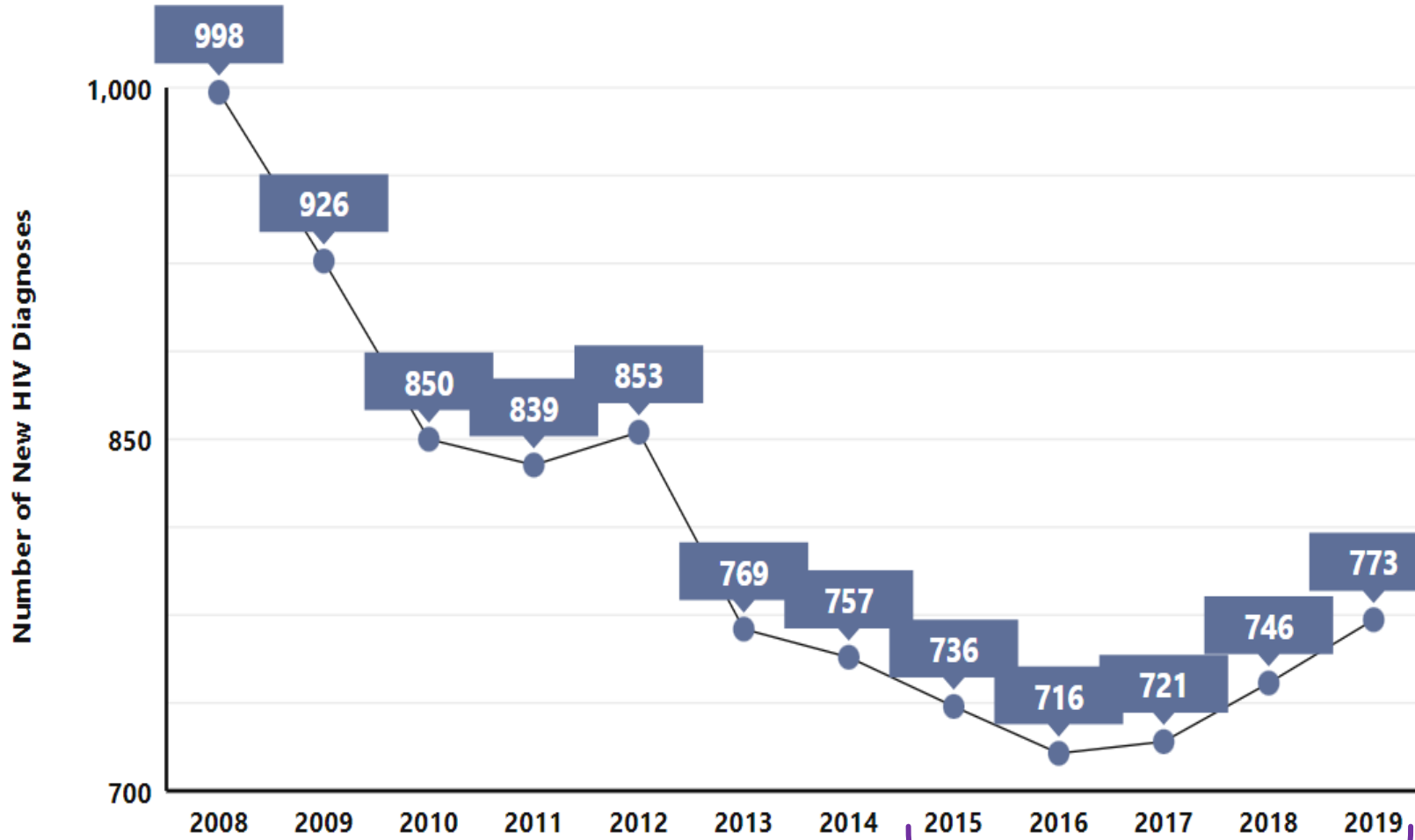
TN Specifics:
New Diagnoses

Knowledge Gaps

Limited studies suggest the following risk factors for receiving a late HIV diagnosis:

- Older age at diagnosis
- Racial minority status (particularly Hispanic MSM)
- Non-metropolitan residence
- Uninsured status
- Female sex/gender identification

Very few studies have examined predictors of late HIV in the southeast

- Most data comes from Northeast/West

No studies have utilized statewide surveillance data in the Southeast to comprehensively examine disparities & geographic factors that impact delays in HIV diagnoses!

Addressing Knowledge Gaps

Study Premise:
- Incident HIV remains an important public health problem, especially in the southeast
- Late/delayed HIV diagnoses are an important driver of incident HIV
- Identifying factors associated with late diagnosis is vital to improving HIV-related health outcomes, decreasing HIV transmission, and ending the HIV epidemic.

Study Goal:
- Evaluate factors associated with late HIV diagnoses in Tennessee
- Specific focus on **rural vs. urban disparities**

End Outcome:
- Results will inform TDH HIV testing and prevention programming

Research Goals & Aims

- *Goal/Aim 1:* To identify disparities associated with late HIV diagnoses* with a specific focus on differences on disparities based on urban vs. rural residence in Tennessee utilizing TDH HIV surveillance data and U.S. Census Bureau data from January 1, 2015 to December 31, 2019.
    - **Late HIV Diagnosis Definition:** CDC Stage 3 (AIDS) diagnosis (CD4 count <200 cells/μL, CD4% <14, or opportunistic illness) ≤3 months after HIV diagnosis

- *Impact:* Results will identify specific populations in rural & urban areas in Tennessee which will benefit from intensified HIV testing activities & will inform TDH programming around HIV testing.

Study Question

Research Question

- Does the proportion of late HIV diagnoses* differ based on urban vs. rural residence residence** at the time of HIV diagnosis for persons newly diagnosed with HIV in Tennessee between January 1, 2015 and December 31, 2019; and what sociodemographic characteristics predict late HIV diagnosis in these areas?

    * First-reported CD4 <200 cells/µL, CD4% <14, or AIDS-defining illness w/in 3 months of HIV diagnosis
    ** U.S. census bureau definitions for rural and urban

Hypothesis

- There will be disparities in the proportion of HIV diagnoses which are late based on rural vs. urban residence.

Clinical & Public Health Implications

- **Important implications for funding public health agencies/public health programs**

- **Important for designing effective new HIV testing, treatment, prevention, and care retention programs**
  - *Identifying locality-specific factors contributing late/delayed diagnoses despite existing resources will help in designing new HIV testing and prevention services & guide resource allocation*

Study Design

Retrospective cohort study utilizing:

- Individual-level surveillance data from the Tennessee Department of Health (TDH) enhanced HIV/AIDS Reporting System (eHARS) to capture demographics and HIV outcomes

- US Census Bureau data to measure majority-rural ("rural") vs. majority-urban ("urban") county of residence

Who, What, Where, When, Why, & How?

Who, Where, & When

- **Study Population (who):** Adults ≥18 years old newly diagnosed with HIV in Tennessee

- **Study Period (when):** January 1, 2015 & December 31, 2019

- **Source (where):** Tennessee→ Data obtained from the TDH enhanced HIV/AIDS Reporting System (eHARS) about all new HIV diagnoses

Who, What, Where, When, Why, & How?

What did the study examine:

- *Exposure:* Rural vs. urban county residence at HIV diagnosis
  - Majority-rural status defined using census definition
    - ≥50% of housing clusters in areas w/ <2,500 individuals or sub-urban population density of <1,000 people/sq mile
  - Census provides "proportion rural" and "proportion urban" data for every county:
    - "Majority rural"= county w/ "proportion rural" of >/= 0.05

- *Outcome:* Receiving a late HIV diagnosis
  - *Definition:* CDC Stage 3 (AIDS) diagnosis (CD4 count <200 cells/μL, CD4% <14, or opportunistic illness) ≤3 months after HIV diagnosis

Who, What, Where, When, Why, & How?

- *Additional outcomes evaluated:*
  - All cause mortality for persons receiving a late HIV diagnosis
  - All cause mortality for all PWH living in rural areas vs. PWH living in urban areas
  - Time from HIV diagnosis to CDC stage 3 (AIDS) diagnosis

- *Why:* To further investigate rural-urban disparities in HIV diagnoses

- *How:* Utilizing TDH eHARS data to capture demographics and HIV outcomes and US Census Bureau data to measure rural-urban status on the county level

Results: Baseline Characteristics by Urban-Rural Classification (all HIV cases)

HIV CASES (n=3652)	Urban n=3244 (88.8%)	Rural n=408 (11.2%)	Test Statistic
Median Age at HIV Diagnosis	30 (IQR: 25, 42)	33 IQR: 25, 46)	P=0.0003 Kruskal–Wallis equality- of-populations rank test
Gender			
Cisgender male	2582 (79.5%)	327 (80.5%)	
Cisgender female	595 (18.3)	71 (17.45)	P= 0.801 Person chi2=0.4450
Transgender person*	67 (2.1%)	10 (2.5%)	
Race/Ethnicity			
Black/African American	1946 (60.0%)	111 (27.2%)	
White/Caucasian	979 (30.2%)	262 (64.2%)	P=0.000
Hispanic/Latino	220 (6.8%)	26 (6.4%)	Pearson chi2=193.6713
Other	99 (3.1%)	9 (2.2%)	
HIV Exposure Risk Factor(s)			
MSM	1746 (53.8%)	239 (58.5%)	
Injection Drug Use	757 (23.3)	104 (25.4%)	P=0.017
Heterosexual Contact	241 (7.4%)	23 (5.6%)	Pearson Chi2(3)=10.23
Other/Unknown	500 (15.4%)	42 (10.3%)	

HIV CASES (n=3652)	Urban n=3244 (88.8%)	Rural n=408 (11.2%)	Test Statistic
Vital Status (End of Follow Up)			
Alive	3080 (94.9%)	377 (92.4%	**P=0.031**
Deceased	164 (5.1%)	31 (7.6%)	Pearson Chi2(3)=4.6353
CD4 Count at HIV Diagnosis			
<200	666 (20.5%)	113 (27.7%)	**P=0.000**
200-499	1195 (36.8%)	115 (28.2%)	Pearson Chi2(2)=16.6595
>500	1130 (34.8%)	151 (37.0%)	
Missing/Unknown	253 (7.9%)	29 (7.1%)	
Enrolled in Ryan White Part B the Year of HIV Diagnosis			
Yes	1621 (50.0%)	223 (54.7%)	P=0.074
No	1623 (50.0%)	185 (45.3%)	Pearson Chi2(1)=3.1859
Diagnosis of AIDS During Study Follow Up			
Yes	792 (24.4%)	123 (30.2%)	**P=0.012**
No	2452 (75.6%)	285 (69.8%)	Pearson Chi2(1)=6.3431
Late/Delayed Diagnosis of AIDS (AIDS Defining Event w/in 90 days of HIV Diagnosis)			
Yes	539 (16.6%)	103 (25.2%)	**P=0.000**
No	2705 (83.4%)	305 (74.8%)	Pearson Chi2(1)=18.6283

Late HIV Diagnoses by Rural-Urban Residence & Tennessee Public Health Region
January 1, 2015—December 31, 2019

Nashville/Davidson
Urban: 13.1%

Sullivan/Blountville
Urban: 26.5%

Mid-Cumberland
Urban: 17.4%
Rural: 23.1%

East
Urban: 17.7%
Rural: 38.8%

Upper-Cumberland
Urban: 29.4%
Rural: 27.7%

Northeast
Urban: 33.3%
Rural: 28.6%

West
Urban: 25.0%
Rural: 16.4%

South Central
Urban: 22.2%
Rural: 22.0%

Southeast
Urban: 20.0%
Rural: 27.8%

Knoxville/Knox
Urban: 17.9%

Memphis/Shelby
Urban: 15.9%

Jackson/Madison
Urban: 16.2%

Chattanooga/Hamilton
Urban: 19.5%

Key

Public health region where the percentage of both rural & urban late HIV diagnoses was <20% of all HIV diagnoses

Public health region where the percentage of either rural or urban late HIV diagnoses was between 20-30% of all HIV diagnoses

Public health region where the percentage of either rural or urban late HIV diagnoses was >30% of all HIV diagnoses

Baseline Characteristics by Urban-Rural Classification (Stage 3 (AIDS) Cases Only)

AIDS CASES ONLY (n=915)	Urban n=792 (86.6%)	Rural n=123 (13.4%)	Test Statistic
Median Age at HIV Diagnosis	36 (IQR: 21)	44 (IQR: 20)	P=0.0003 Kruskal–Wallis equality-of-populations rank test
Gender			
Cisgender male	632 (79.8%)	98 (79.7%)	
Cisgender female	147 (18.6%)	22 (17.9%)	Fischer Exact= 0.747
Transgender person*	13 (1.6%)	3 (2.4%)	
Race/Ethnicity			
Black/African American	462 (58.3%)	28 (22.7%)	P=0.000
White/Caucasian	235 (30.0%)	82 (66.7%)	Pearson chi2=67.42
Hispanic/Latino	71 (9.0%)	10 (8.1%)	
Other	24 (3.0%)	3 (2.4%)	Fischer Exact = 0.000
HIV Exposure Risk Factor(s)			
MSM	424 (53.5%)	76 (61.8%)	P=0.146
Injection Drug Use	195 (24.6%)	31 (25.2%)	Pearson chi2=5.3800
Heterosexual Contact	51 (6.4%)	5 (4.1%)	
Other/Unknown	122 (15.4%)	11 (8.9%)	

Tennessee Public Health Region of at Time of AIDS Diagnosis

Memphis/Shelby	317 (40.1%)	0 (0.0%)	
Nashville/Davidson	143 (18.1%)	3 (2.4%)	
Mid-Cumberland	76 (9.6%)	18 (14.6%)	
Knoxville/Knox	58 (7.3%)	1 (0.81%)	**P=0.000**
Chattanooga/Hamilton	62 (7.8%)	0 (0.0%)	**Pearson Chi2(12)=299.7263**
Jackson/Madison	17 (2.2%)	0 (0.0%)	
Sullivan/Blountville	10 (1.3%)	0 (0.0%)	
Out of State	2 (3.3%)	1 (0.81%)	
Other	82 (10.4%)	100 (81.3%)	

Vital Status (End of Follow Up)

Alive	**698** (88.1%)	**108** (83.7%)	**P=0.813**
Deceased	**94** (11.9%)	**21** (16.3%)	Pearson chi2=0.413

CD4 Count at AIDS Diagnosis

<200	**694** (87.6%)	**99** (80.5%)	**P=0.585**
≥200	**2** (0.25%)	**0** (0%)	Pearson chi2=0.2981
			Fischer Exact= 0.758
Missing/Unknown	**96** (12.1%)	**24** (19.5%)	

First HIV Viral Load Following AIDS Diagnosis

Virally Suppressed	**696** (87.9%)	**108** (87.8%)	**P=0.824**
Not Virally Suppressed	**63** (7.9%)	**9** (7.3%)	Pearson chi2=0.0497
Missing/Unknown	**33** (4.2%)	**6** (4.9%)	

AIDS Cases Diagnosed Late

Yes	**539** (68.1%)	**103** (83.7%)	**P=0.000**
No	**253** (31.9%)	**20** (16.3%)	Pearson chi2=12.5107

Enrolled in Ryan White Part B the Year of HIV Diagnosis

|			
Yes	**405** (51.1)	**65** (52.8%)	**P=0.724**
No	**387** (48.9)	**58** (48.2%)	Pearson chi2=0.1245

Primary Outcome:

Late Diagnoses by Rural-urban Status

Main Findings:

- Increased risk of late HIV diagnosis in individuals diagnosed in **rural counties** (vs. urban counties)

- Increased risk of late HIV diagnosis in **Hispanic individuals** (vs. non-Hispanic Black individuals)

Primary Outcome: Late HIV diagnoses by rural vs. urban residence at HIV diagnosis
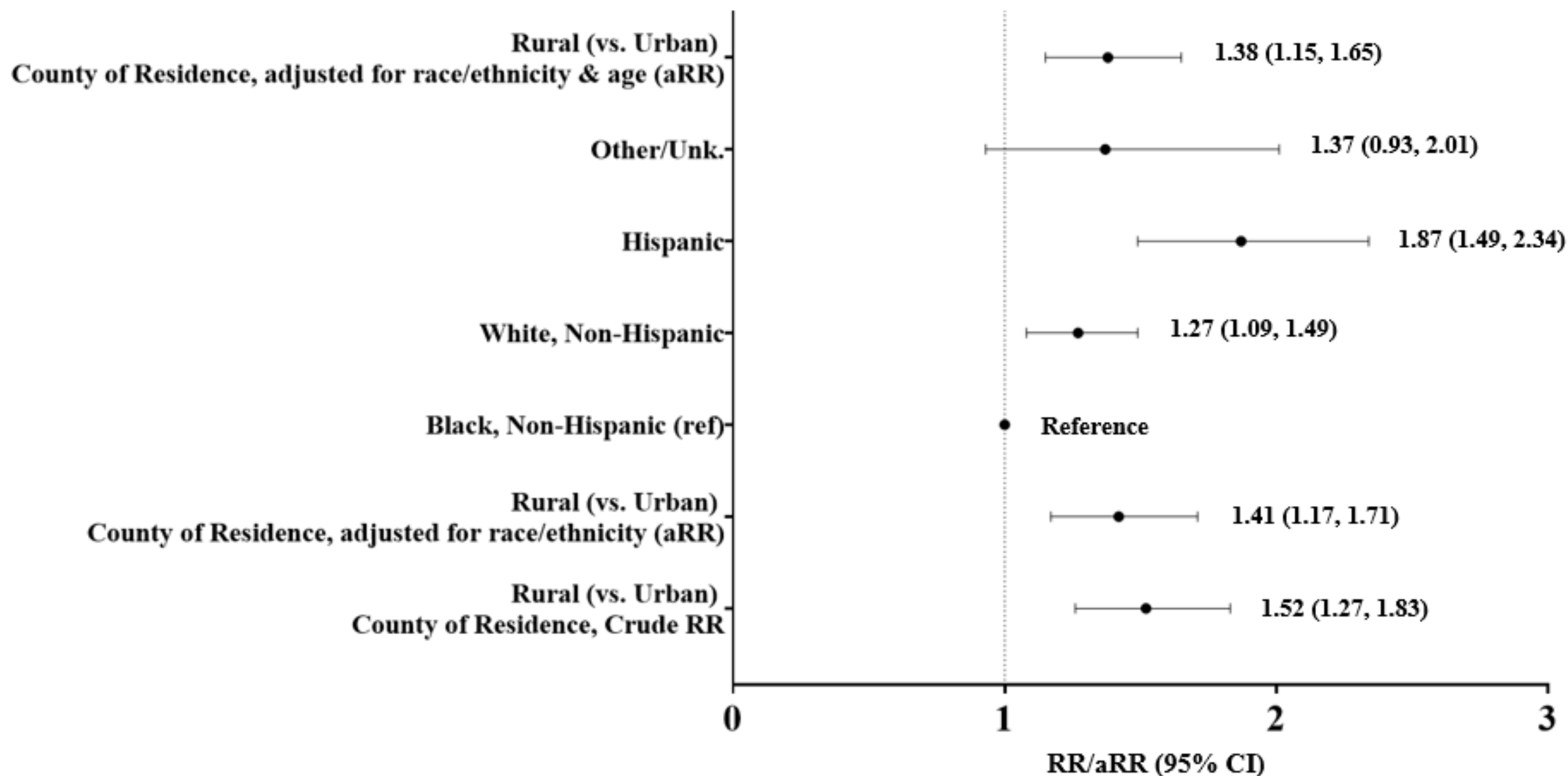
Secondary Outcomes Examined

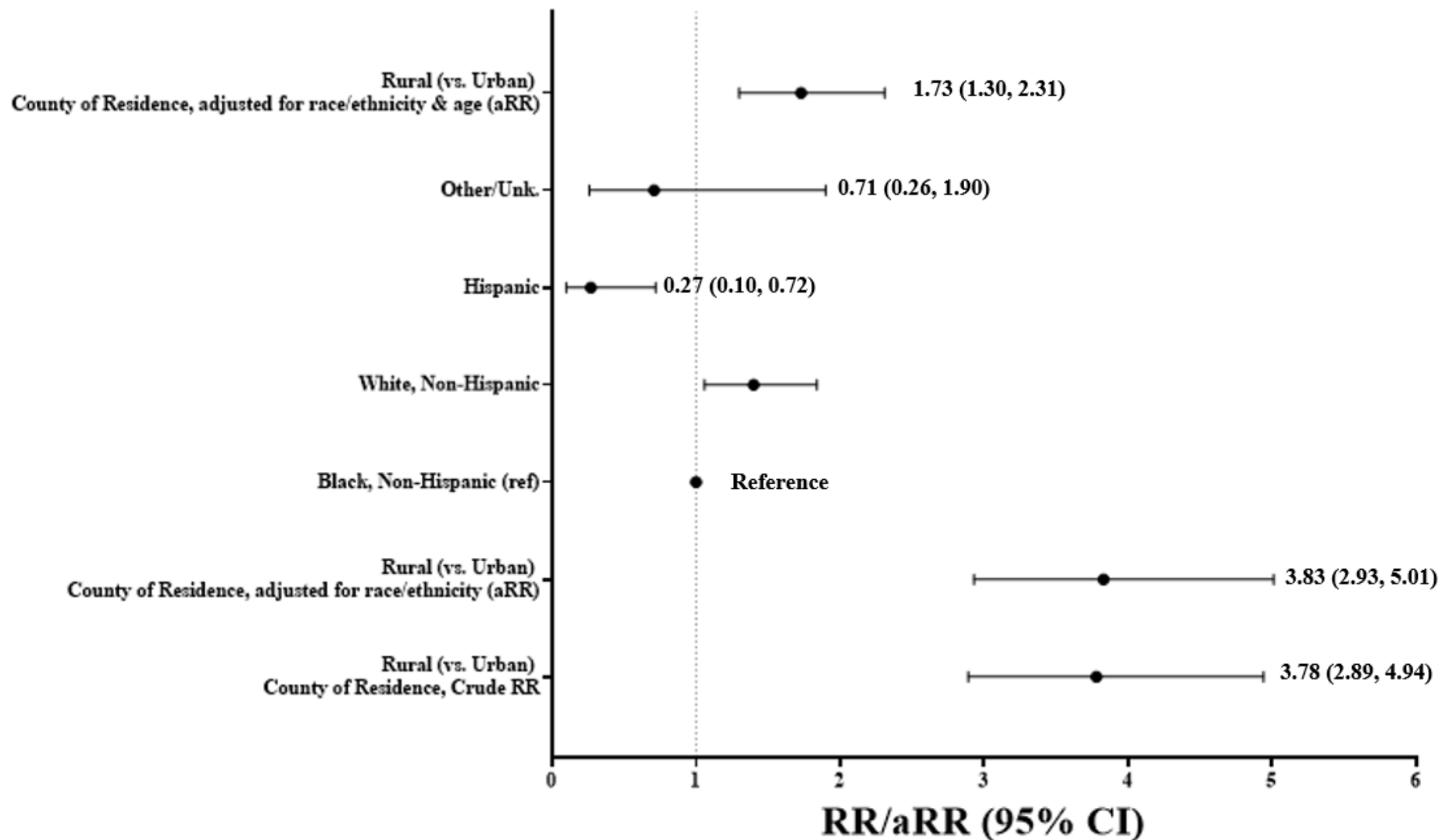- **All-cause mortality by late vs. not-late HIV diagnosis**

- **All-cause mortality by rural vs. urban county of residence at time HIV diagnosis**

Secondary Outcome # 1

All-cause mortality by late vs. not-late HIV diagnosis

Main Findings: Significantly increased unadjusted all cause mortality among those receiving late HIV diagnoses as well as those in rural counties at HIV diagnosis (next slide).

Secondary Outcome: All-cause mortality by late vs. not-late HIV diagnosis

Rural (vs. Urban)
County of Residence, adjusted for race/ethnicity & age (aRR) — 1.73 (1.30, 2.31)

Other/Unk. — 0.71 (0.26, 1.90)

Hispanic — 0.27 (0.10, 0.72)

White, Non-Hispanic

Black, Non-Hispanic (ref) — Reference

Rural (vs. Urban)
County of Residence, adjusted for race/ethnicity (aRR) — 3.83 (2.93, 5.01)

Rural (vs. Urban)
County of Residence, Crude RR — 3.78 (2.89, 4.94)

RR/aRR (95% CI)

Secondary Outcome # 2

All-cause mortality by rural vs. urban county of residence at time HIV diagnosis

Secondary Outcome: All-cause mortality by rural vs. urban residence at HIV diagnosis

Rural (vs. Urban)
County of Residence, adjusted for race/ethnicity & age (aRR) — 1.26 (0.88, 1.80)

Other/Unk. — 0.83 (0.31, 2.17)

Hispanic — 0.34 (0.13, 0.99)

White, Non-Hispanic — 1.12 (0.85, 1.49)

Black, Non-Hispanic (ref) — Reference

Rural (vs. Urban)
County of Residence, adjusted for race/ethnicity (aRR) — 1.23 (0.86, 1.78)

Rural (vs. Urban)
County of Residence, Crude RR — 1.50 (1.03, 2.17)

RR/aRR (95% CI)
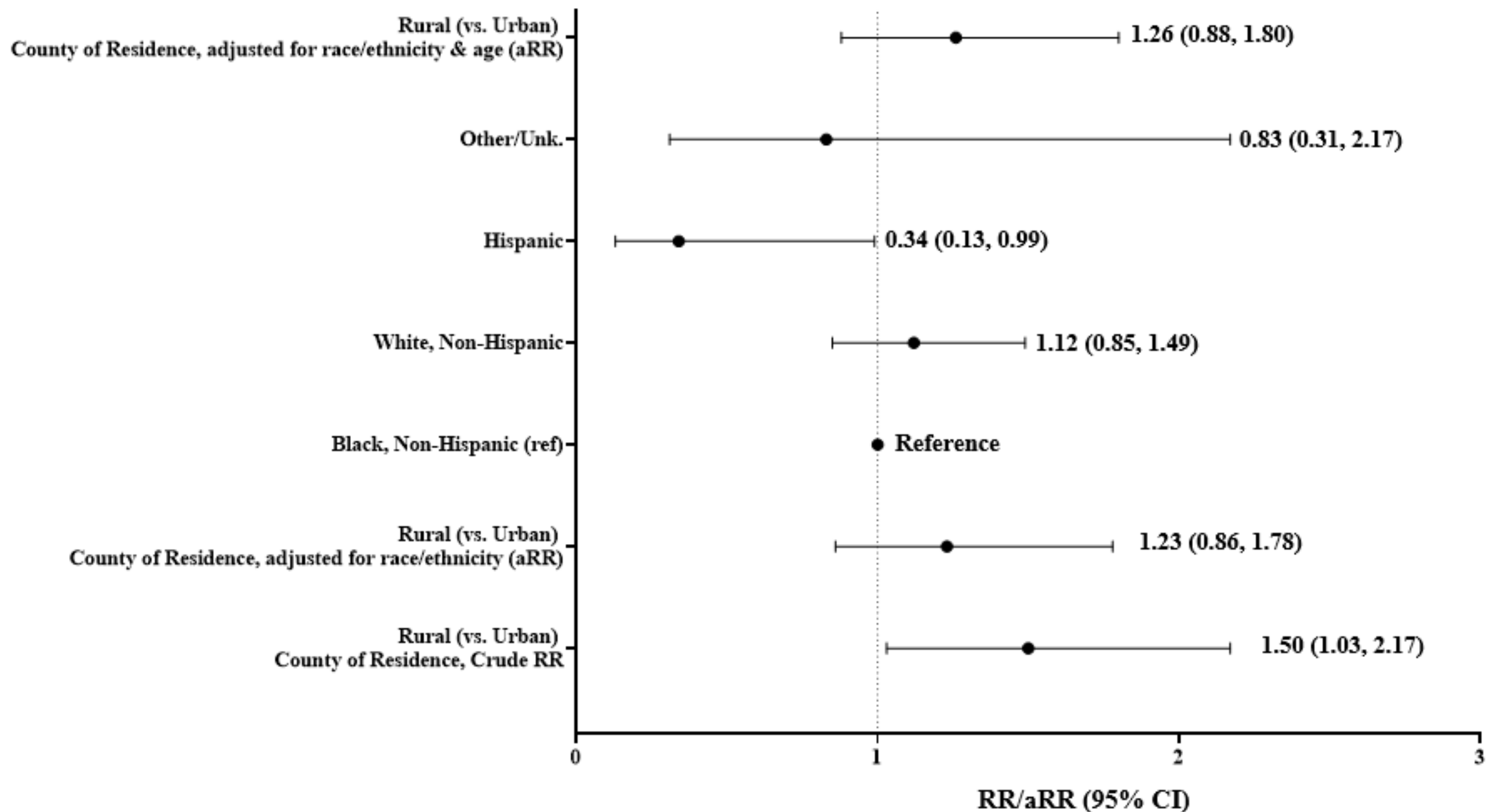
Additional Analyses

Time from HIV diagnosis to CDC stage 3 (AIDS) diagnosis

- By majority rural vs. majority urban county of residence at time of HIV diagnosis

- By race/ethnicity

Figure 1: Kaplan-Meier Estimates:
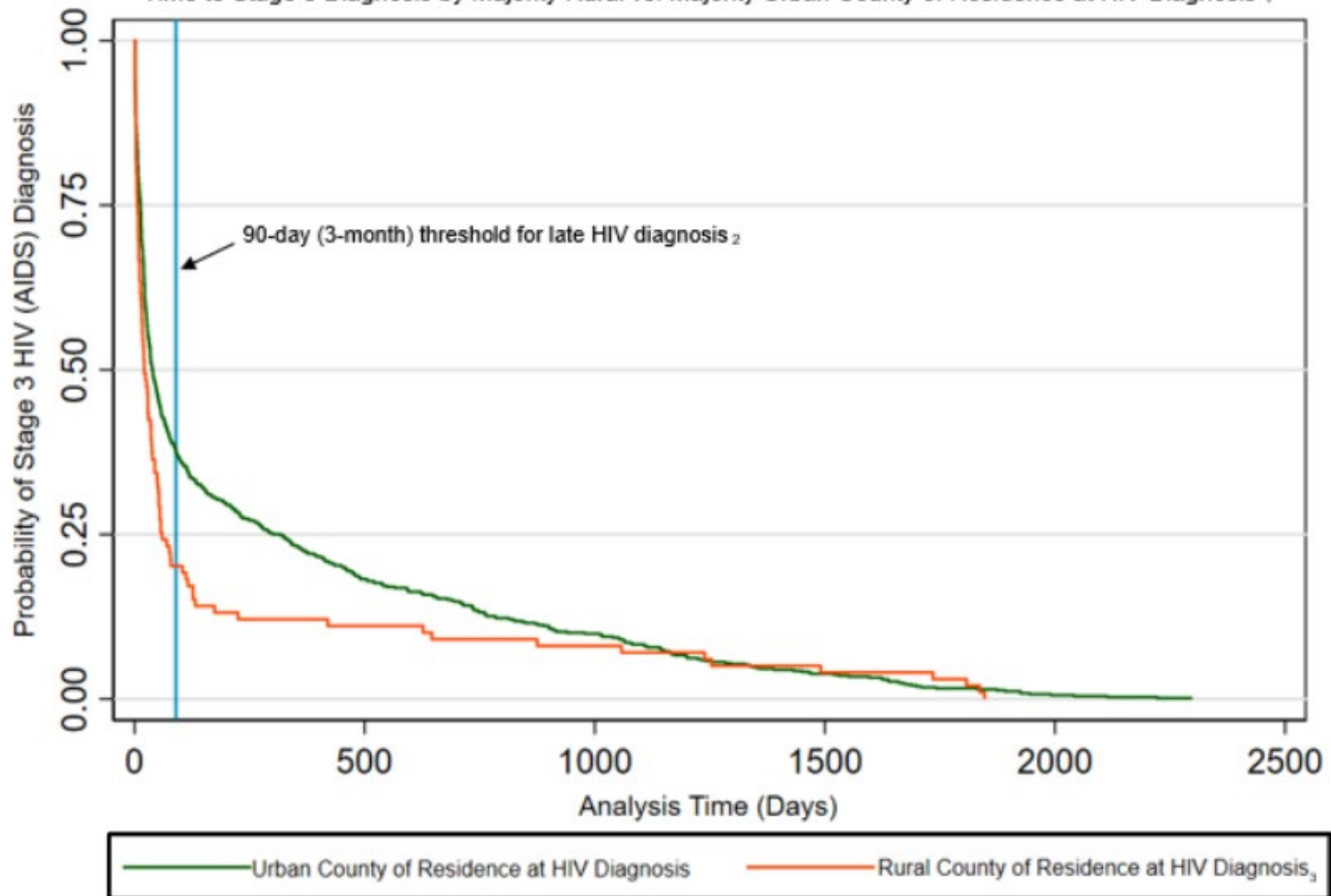Time to Stage 3 Diagnosis by Majority Rural vs. Majority Urban County of Residence at HIV Diagnosis [1]
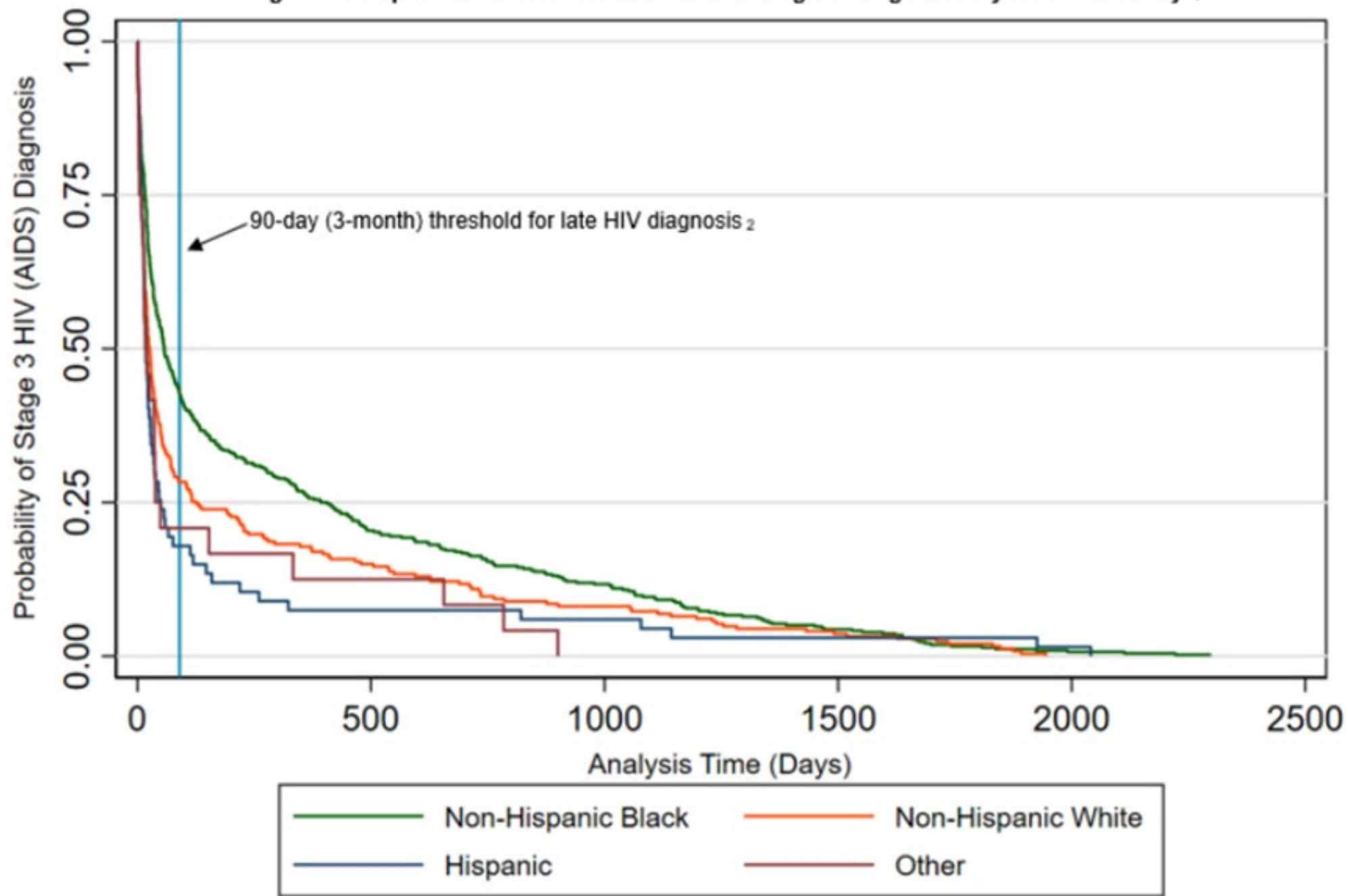
90-day (3-month) threshold for late HIV diagnosis [2]

Urban County of Residence at HIV Diagnosis —— Rural County of Residence at HIV Diagnosis [3]

Figure 2: Kaplan-Meier Estimates: Time to Stage 3 Diagnosis by Race/Ethnicity [1]

Main Points & Discussion

- **Rural residence and Hispanic race/ethnicity in Tennessee is associated with an increased risk of receiving a late HIV diagnosis**

  - Increased risk remains even after accounting for potential rural-urban age and race/ethnicity distribution differences.

- **Rural residence and Hispanic race/ethnicity in Tennessee are associated with a shorter time to Stage 3 HIV (AIDS) diagnosis**

  - Indicates these populations are being diagnosed late in the disease process.

Main Points & Discussion

- **Efforts to increase the uptake of early HIV testing should be focused on the needs of these vulnerable populations**

- **These results are important for identifying factors contributing late/delayed diagnoses despite existing resources**
  - This will help in designing effective new HIV testing, treatment, prevention, and care retention programs

- **Future studies are required to identify factors driving these observed disparities**

Limitations

- **Definitions & cut-offs used for "rural" and "urban":**
  - Limited data & lack of a consensus definition for "rural"/"urban" in HIV research
  - Use of rural proportion of >0.50 to define a county as "rural"– somewhat arbitrary

- **Use of 2010 census data:**
  - Urban/Rural data are only available for the decennial census data; until the full 2020 data tables are released, our analyses is based on 2010 census data
  - Both total population and numbers of housing units will likely have increased substantially since 2010; however, it is unclear if/how the proportion urban/rural for each county have shifted

- **Lack of insurance and income data at the time of HIV diagnosis:** Both may have effects on HIV-related outcomes & potentially testing practices

Future Analyses & Directions

- **Utilize community level data from the American Community Survey to adjust for community level variables**

- **Conduct a qualitative study consisting of semi-structured in-depth interviews of HIV testing providers and clients across Tennessee**
  - *Objective:* to further elucidate the determinants of HIV testing, the unique challenges in different geographic regions, and potential strategies to improve early HIV diagnosis among groups identified as being at highest risk for late HIV diagnoses in the present study

Thank you!

Primary Mentor: April Pettit, MD, MPH
Project Mentors: Peter Rebeiro, PhD, MHS, Meredith Brantley, PhD, MPH, April Pettit, MD, MPH
Additional Committee Members: C. William "Bill" Wester, M.D., MPH, Christianne Roumie, MD, MPH
TDH Epidemiologists: Laurie Maurer, PhD, Samantha Mathieson, MPH

Comments, Feedback, & Questions

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- **National Coordinating Resource Center –** serves as the central web –based repository for AETC Program training and capacity building resources; its website includes a free virtual library with training and technical assistance materials, a program directory, and a calendar of trainings and other events. Learn more: https://aidsetc.org/

- **National Clinical Consultation Center –** provides free, peer-to-peer, expert advice for health professionals on HIV prevention, care, and treatment and related topics. Learn more: https://nccc/ucsf.edu

- **National HIV Curriculum –** provides ongoing, up –to-date HIV training and information for health professionals through a free, web –based curriculum; also provides free CME credits, CNE contact hours, CE contact hours, and maintenance of certification credits. Learn more: www.hiv.uw.edu