



HPV-Related Cancers and Vaccination in Appalachia: Implications for Disparities

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Outline

- HPV and HPV Vaccine
- Cancer Registry Project
- NIS-Teen Vaccination Project

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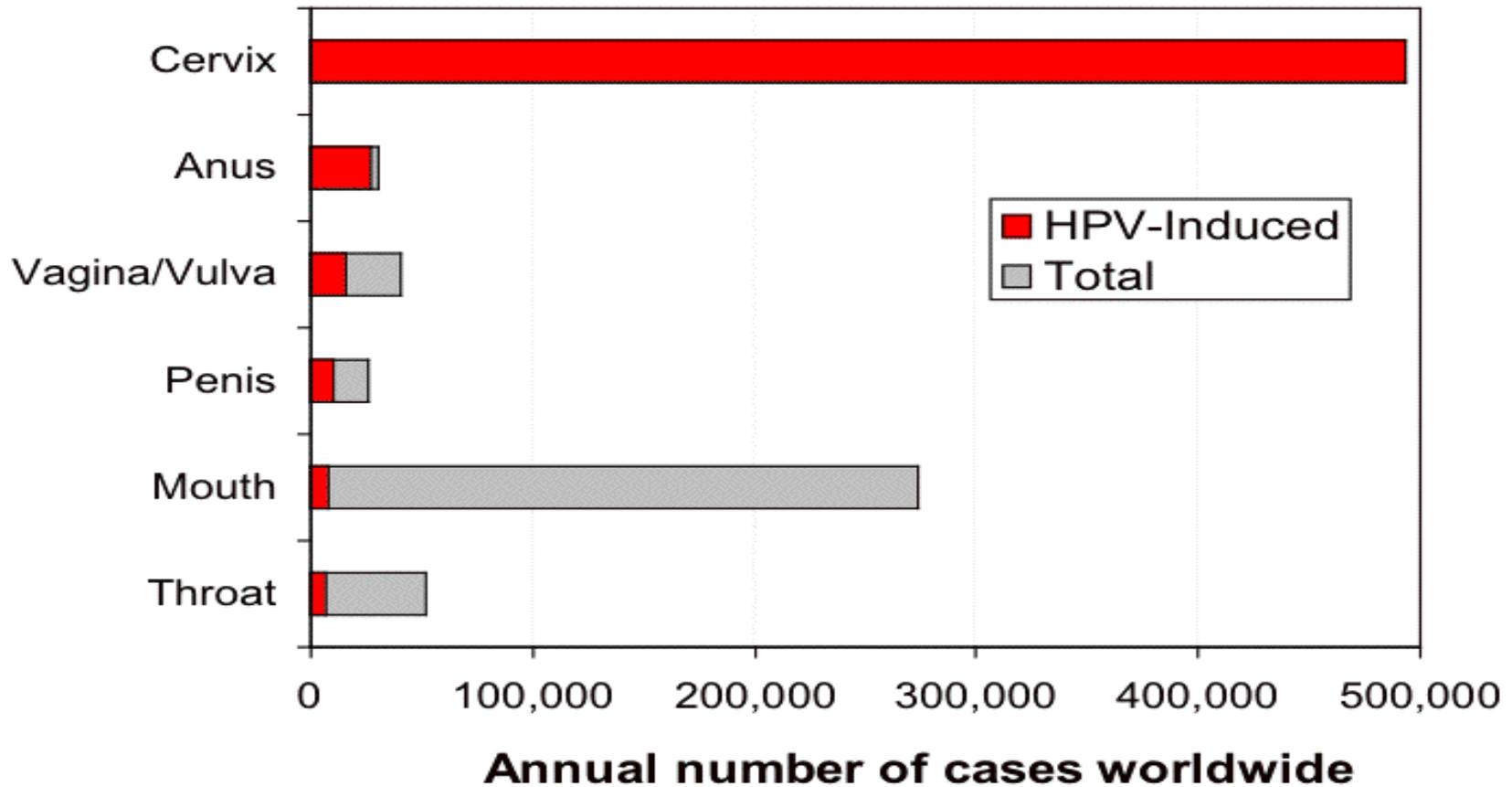
HPV

- HPV is *the* most common STI in the U.S.
 - 43% of females and >20% of males have current infection
- >30 strains cause cancer and genital warts
 - 6% of US adults report history of genital warts
- High concordance between sexual partners
 - About 38% of partners of HPV-positive individuals have 1+ types of HPV

Hariri et al. 2011, *JID*
Dunne et al. 2006, *JID*
Dinh et al. 2008, *STD*

Reiter, Pendergraft & Brewer 2010, *CEBP*

HPV Causes Cancer



HPV Cancer Burden

- HPV causes about 19,000 cases of these cancers each year in the U.S.
 - Similar to brain cancer and the most common types of leukemia
- Substantial economic burden
 - About \$400 million annually

HPV Vaccines

	HPV4	HPV2
Other Names	Gardasil, quadrivalent	Cervarix, bivalent
Dosage	3 doses (months 0, 2, 6)	3 doses (months 0, 1, 6)
Approval	2006	2009
Recommendation (Females)	Routine; ages 11-12 with catch up for ages 13-26	Routine; ages 11-12 with catch up for ages 13-25
Recommendation (Males)	Routine; ages 11-12 with catch up for ages 13-21	Not available
Types 16 & 18	Yes	Yes
Types 6 & 11	Yes	No
Approved to Prevent	Cervical, vaginal, vulvar, and anal cancers; genital warts	Cervical cancer

HPV Vaccine Coverage

- 2011 estimates (females ages 13-17)
 - Vaccine initiation: 53%
 - Vaccine completion: 35%
- Steady improvements from 2008
 - 37% and 18%
- Still much lower than other developed countries
 - Australia: >80% vaccine initiation and >70% vaccine completion



Appalachia



Source: Appalachian Regional Commission

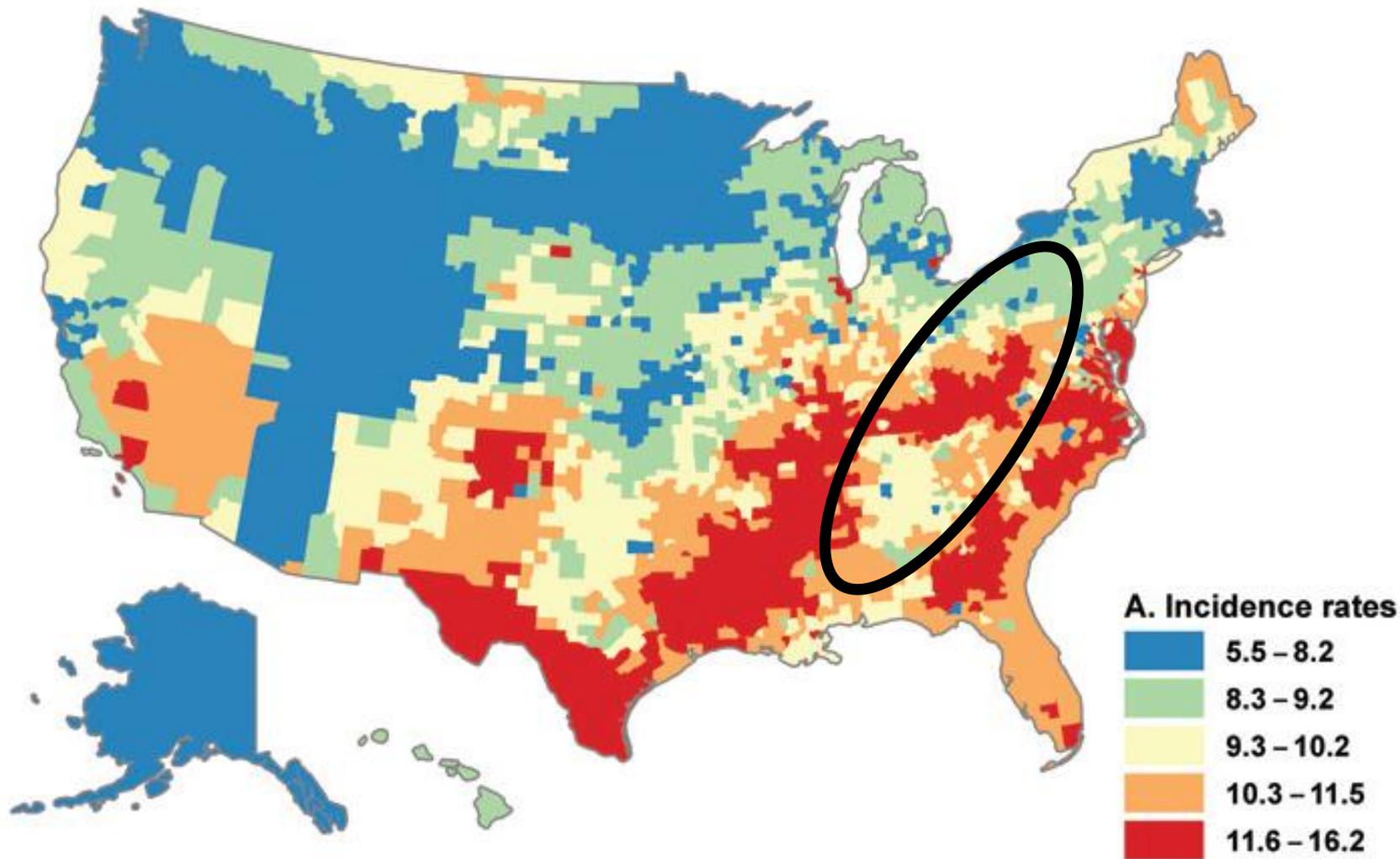
- 400+ counties in 13 states
- Mostly rural region with 70% of counties considered non-metropolitan
- Lower levels of education and higher levels of poverty
- Poorer health and health behaviors

Cancer in Appalachia

- Appalachia has a higher cancer burden compared to rest of U.S.
- All cancer sites combined
 - Males: 569 vs. 539 cases per 100,000
 - Females: 415 vs. 399 cases per 100,000
- Disparities include:
 - Lung cancer (males and females)
 - Colorectal cancer (males and females)
 - Cervical cancer

Wingo et al. 2008, *Cancer*
Hopenhayn et al. 2008, *Cancer*
Lengerich et al. 2005, *J Rural Health*

Cervical Cancer (1995-2004)



HPV Vaccine in Appalachia

- Despite high cervical cancer rates, little is known about HPV vaccine in Appalachia
 - Most adults are accepting of HPV vaccine for adolescent females (about 70%)
 - Most healthcare facilities in Appalachia offered HPV vaccine by 2008
 - Modest vaccination (initiation: <50%; completion: <5%) among adult women in Kentucky offered free vaccine

Hopenhayn et al. 2007, *Can Causes Control*

Christian et al. 2009, *JAH*

Katz et al. 2009, *Vaccine*

Huey et al. 2009, *Prev Chronic Dis*

Crosby et al. 2011, *J Rural Health*

State of Appalachian Research

What We Know

- High cervical cancer rates
- Pretty high parental acceptance of HPV vaccine for adolescent females
- Vaccine is readily available

What We Don't Know

- Burden of other HPV-related cancers among females
 - Burden of HPV-related cancers among males
 - HPV vaccine uptake among adolescent females
-
- Cancer Registry Project
- NIS-Teen Vaccination Project

Outline

- HPV and HPV Vaccine
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Goal

- To assess the total burden of HPV-related cancers among females and males in Appalachia
- To compare Appalachian areas with non-Appalachian areas

Data Sources

- Incidence data (1996-2008) from cancer registries for three Appalachian states
 - Ohio
 - Kentucky
 - West Virginia
- National data from SEER 9 cancer registries (1996-2008)
 - Represents about 10% of U.S. population

Defining Appalachia

- Ohio: 29 out of 88 counties
- Kentucky: 51 out of 120 counties
- West Virginia: all 55 counties (only state that is completely Appalachian)

Note: 3 counties in OH and KY were added to Appalachia in 2008 but were not classified as Appalachian here since 2008 was the last year of data examined

Cancer Outcomes

- Each HPV-related cancer type separately
 - Cervical, vaginal, vulvar, penile, anal, and oral cavity/pharyngeal cancers
- All HPV-related cancers combined (total burden)
 - Females: cervical, vaginal, vulvar, anal, and oral cavity/pharyngeal cancers
 - Males: penile, anal, and oral cavity/pharyngeal cancers

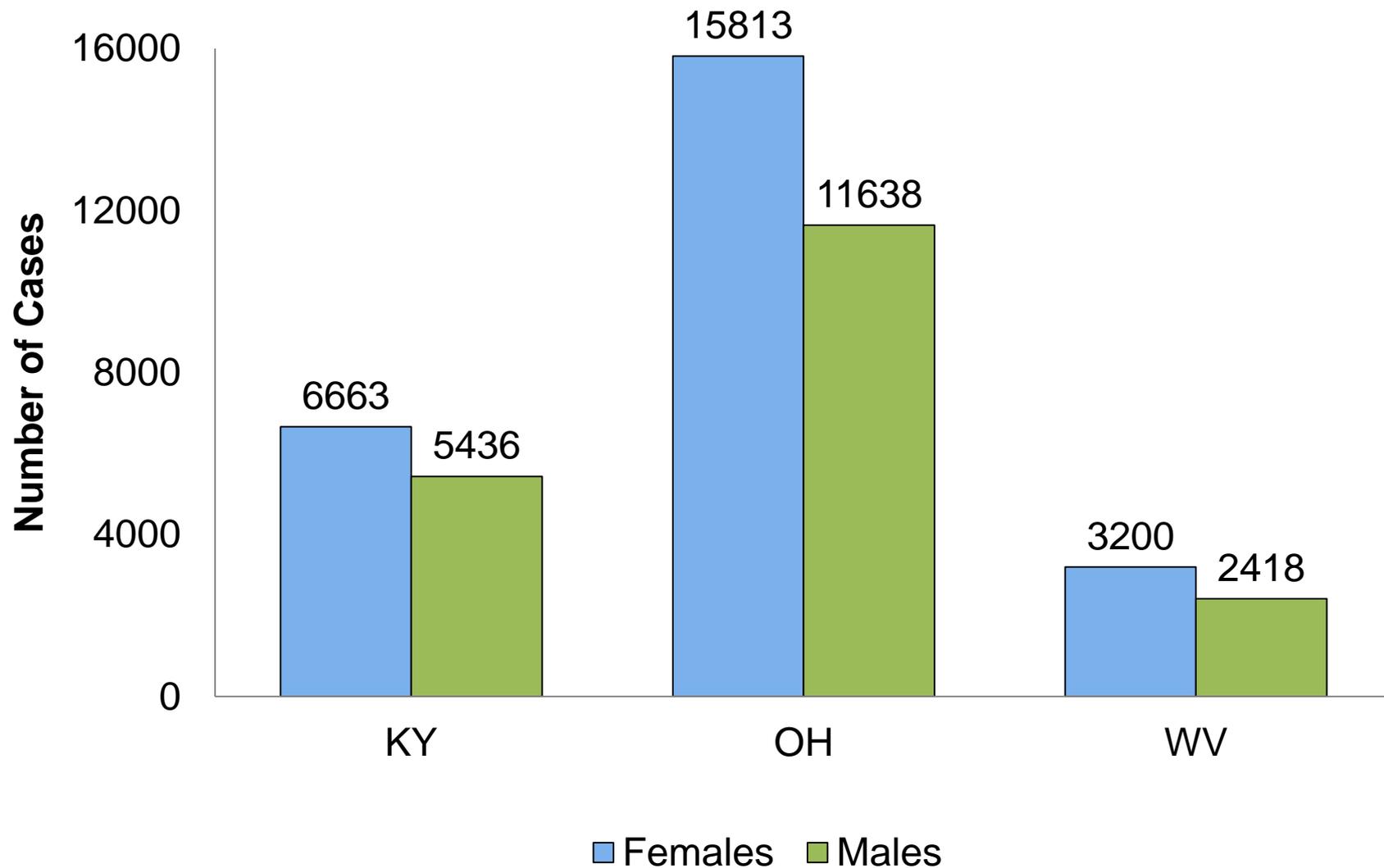
Rates

- SEER*Stat to calculate age-adjusted incidence rates
- Rates (all races included) calculated for:
 - Entire state (or SEER 9)
 - Appalachian vs. non-Appalachian regions of each state
 - Counties within states
- Statistical significance inferred by non-overlapping 95% confidence intervals (CIs)
 - Conservative approach

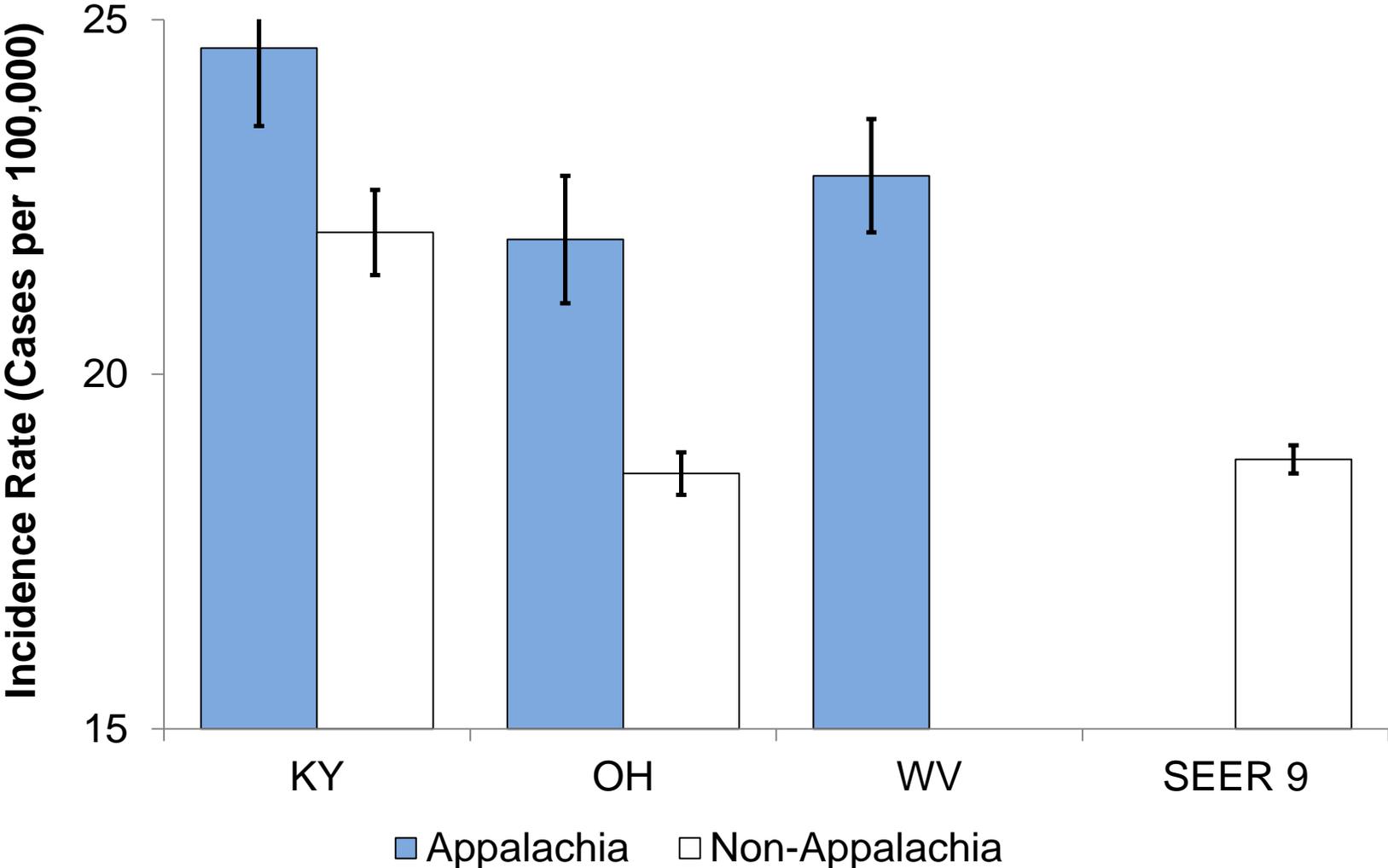
Maps

- Mapped county-level incidence rates for all HPV-related cancers combined for both females and males
- Data suppressed for counties with fewer than five cases to prevent misinterpretation of rates
- ArcGIS (ArcMap 10.0) used to generate all maps

HPV Cancer Burden (1996-2008)

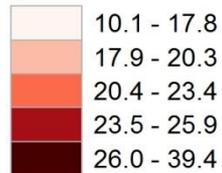


Females – All HPV Cancers



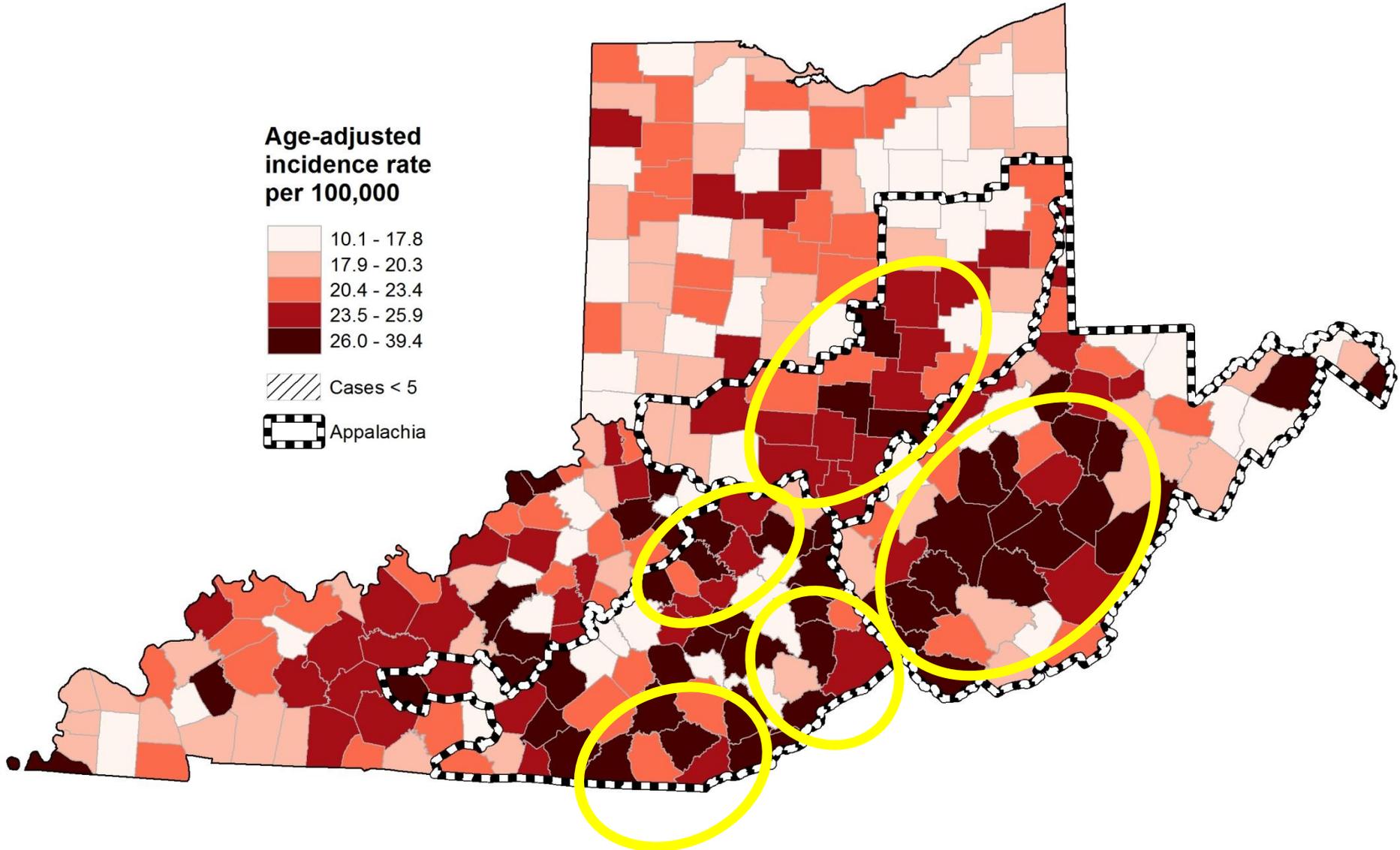
Females – All HPV Cancers

Age-adjusted
incidence rate
per 100,000



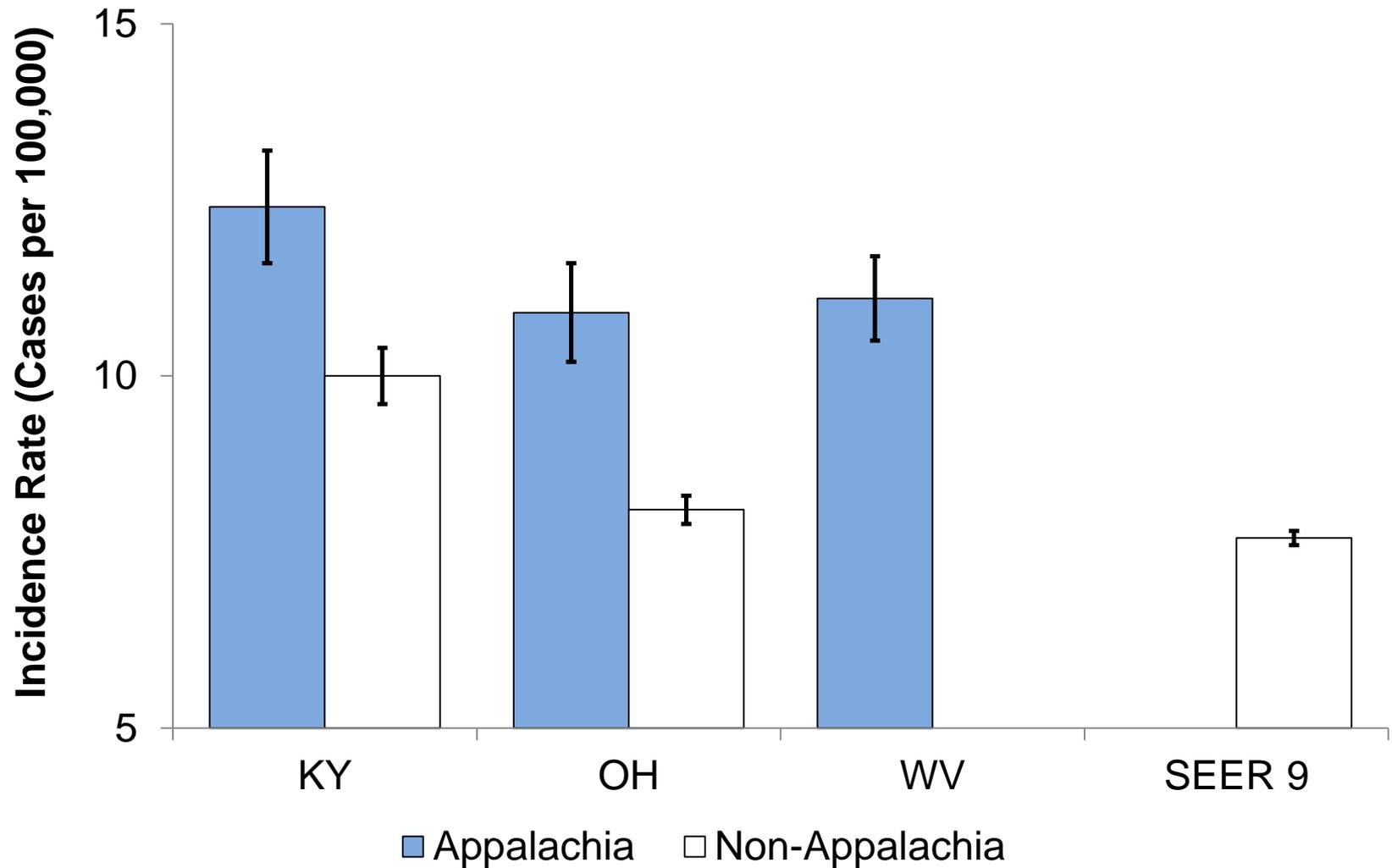
Cases < 5

Appalachia

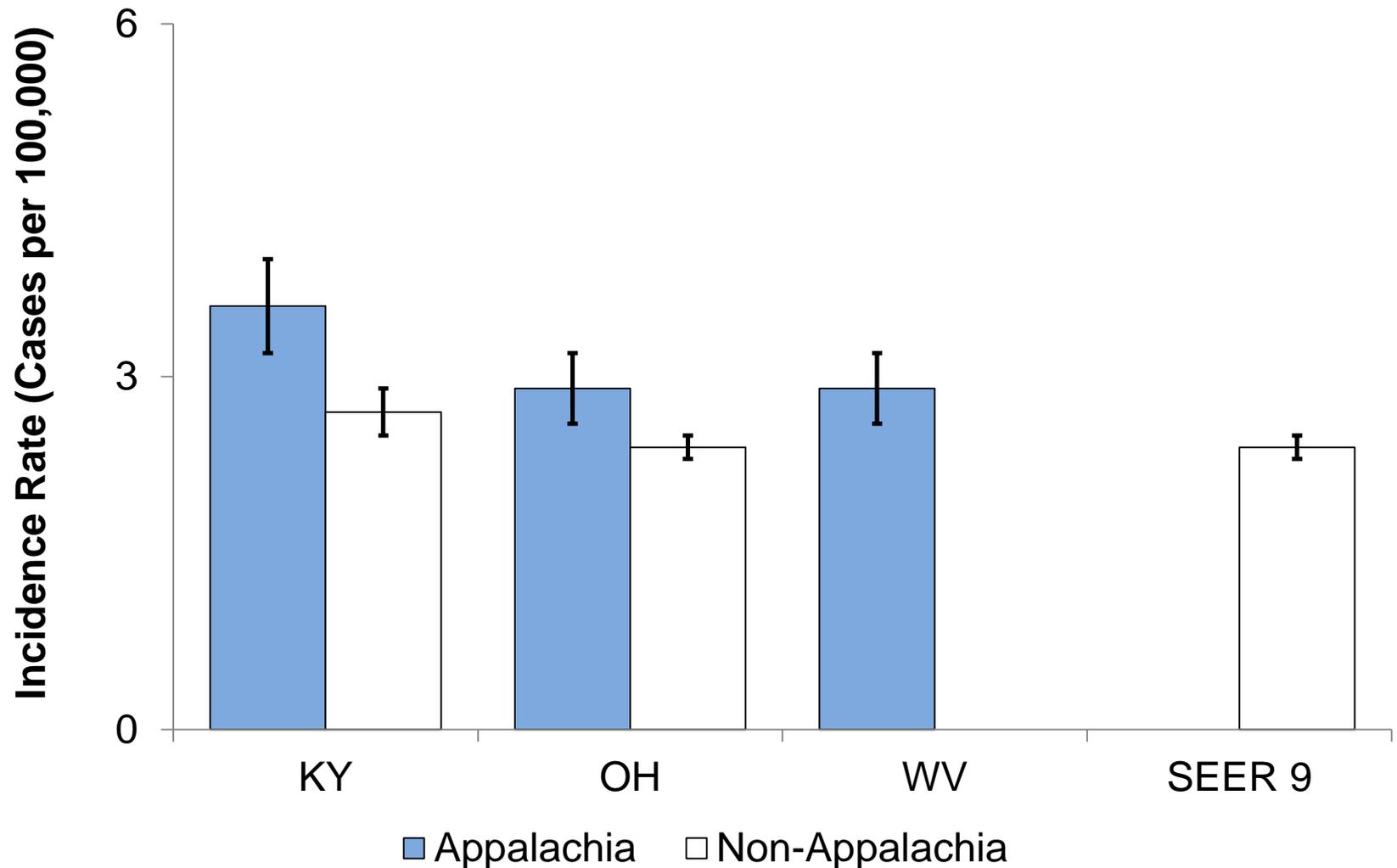


Appalachian females have higher rates of all HPV-related cancers, but what cancers are causing these disparities?

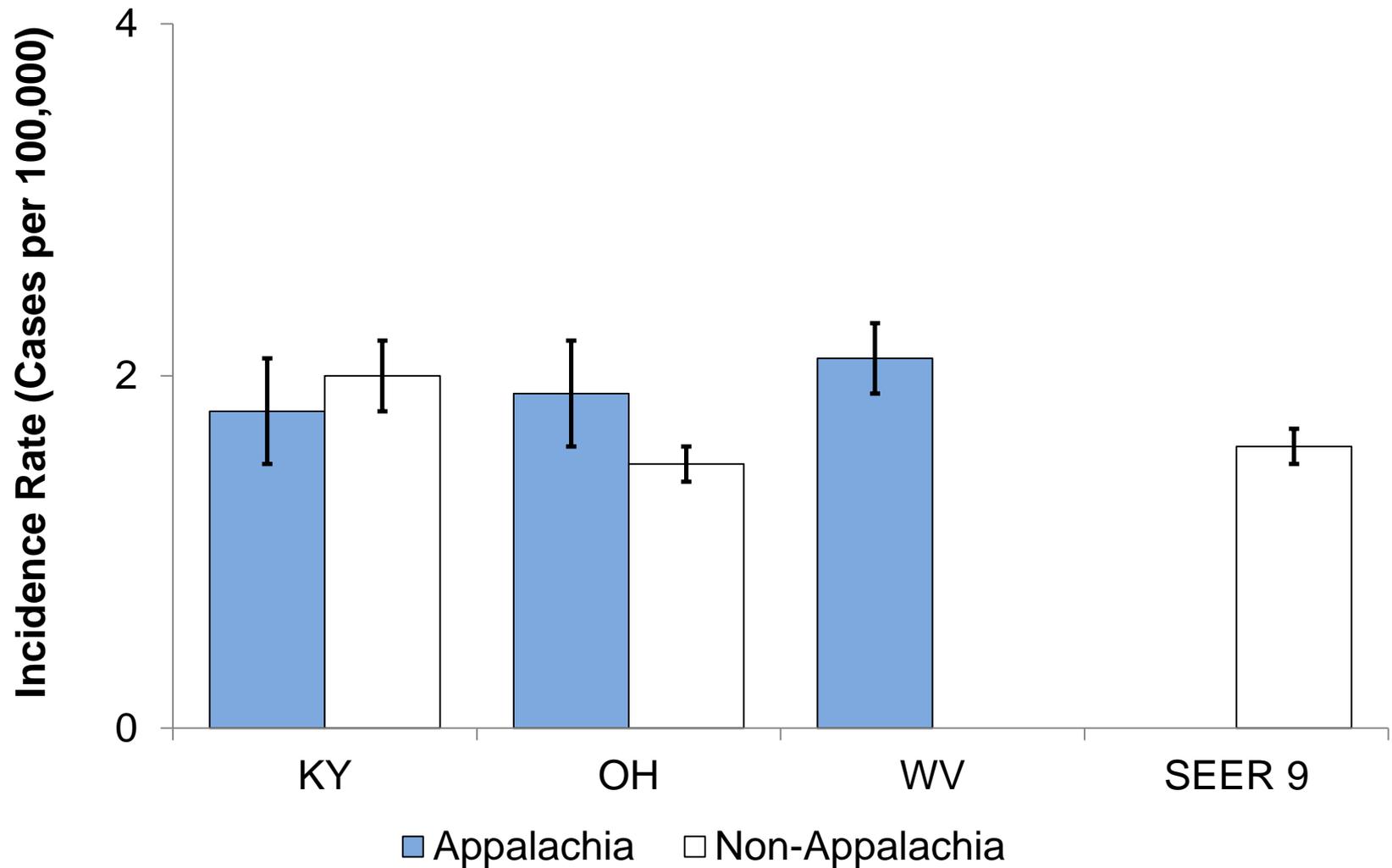
Females – Cervical Cancer



Females – Vulvar Cancer



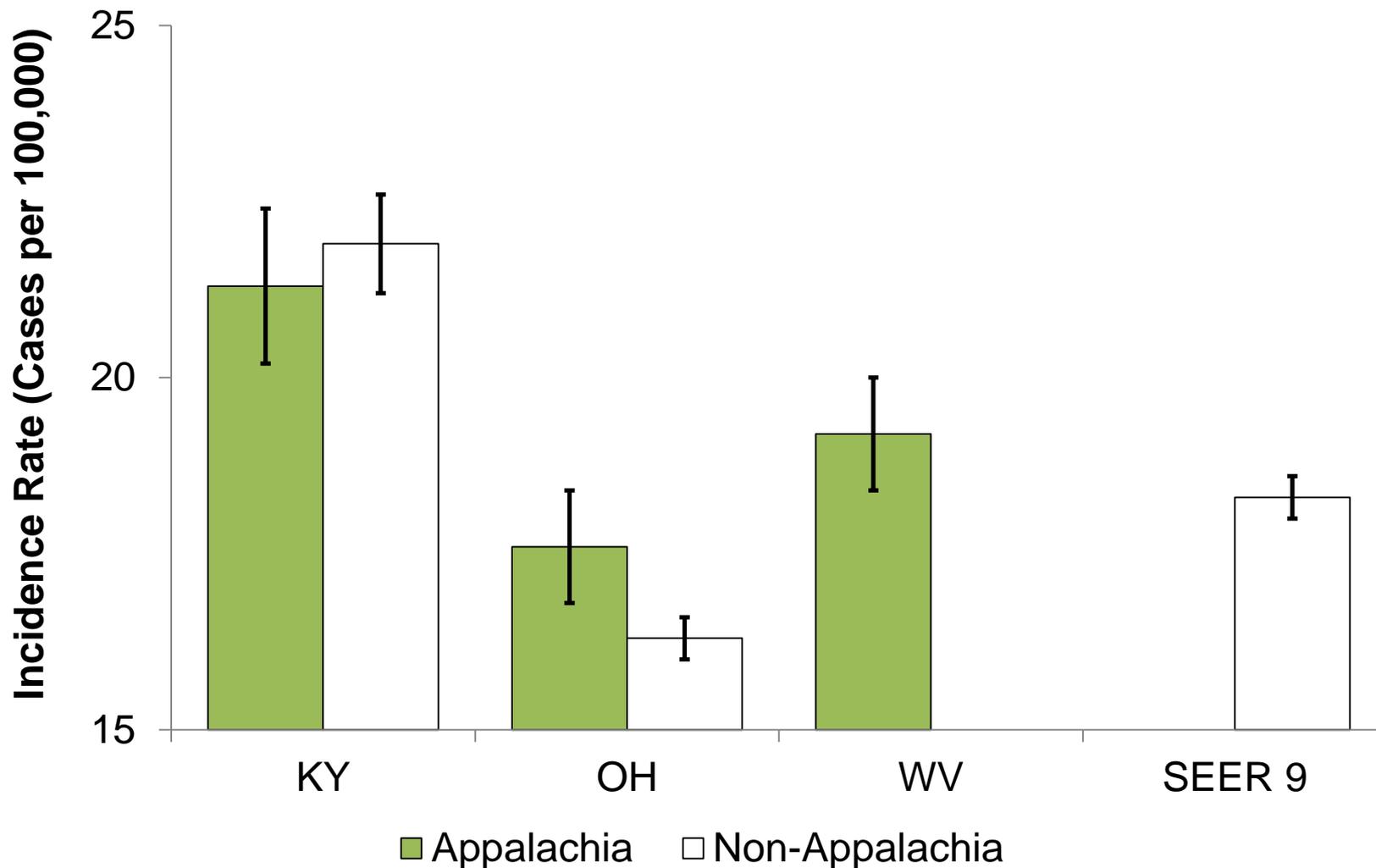
Females – Anal Cancer



Females – Other Cancers

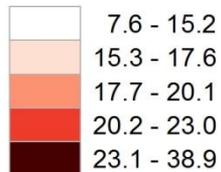
- Geographic areas did not differ greatly in terms of:
 - Vaginal cancer (all rates <1.0)
 - Oral cavity/pharyngeal cancer (all rates between 5.4 and 6.5)

Males – All HPV Cancers



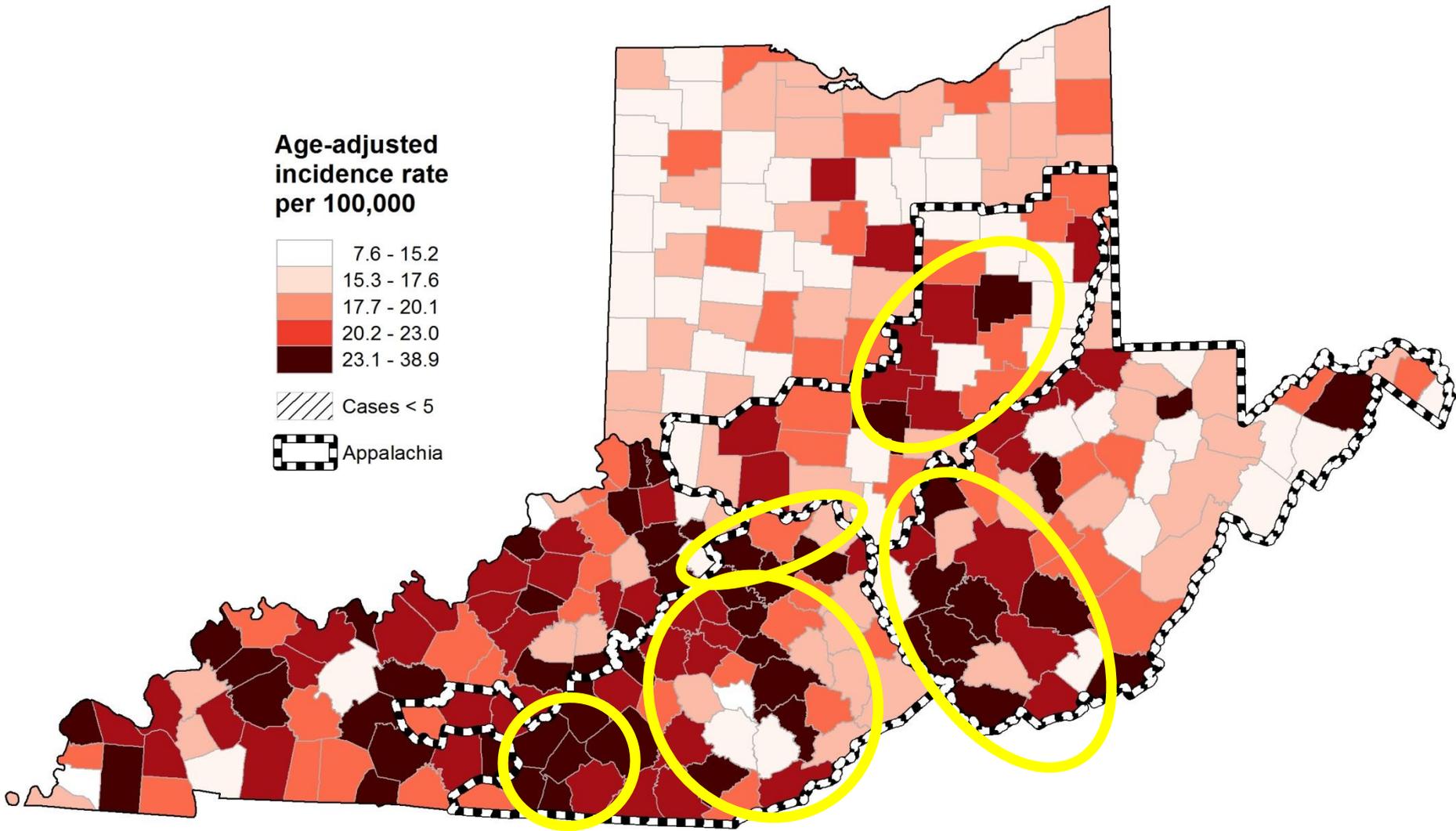
Males – All HPV Cancers

Age-adjusted
incidence rate
per 100,000

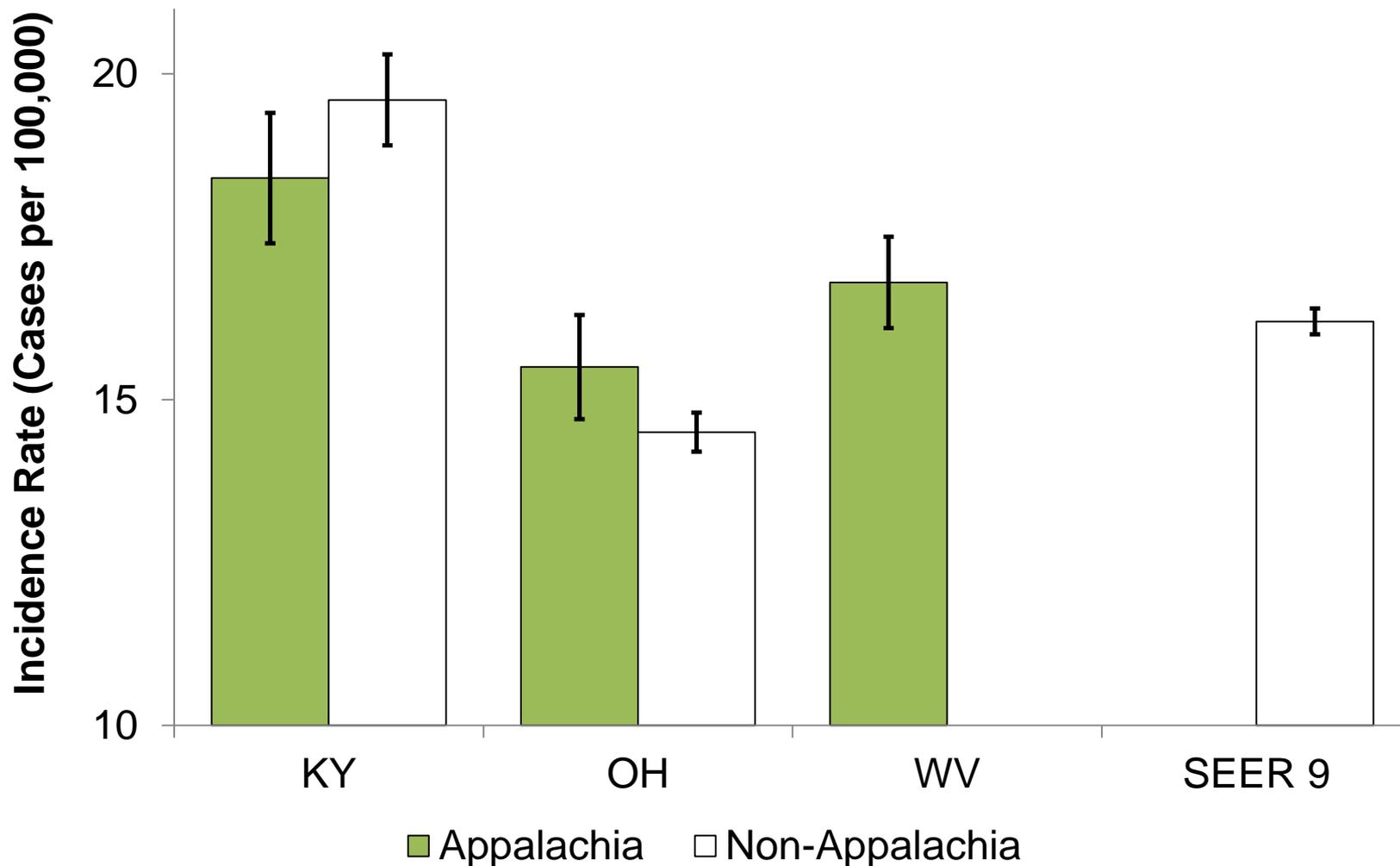


Cases < 5

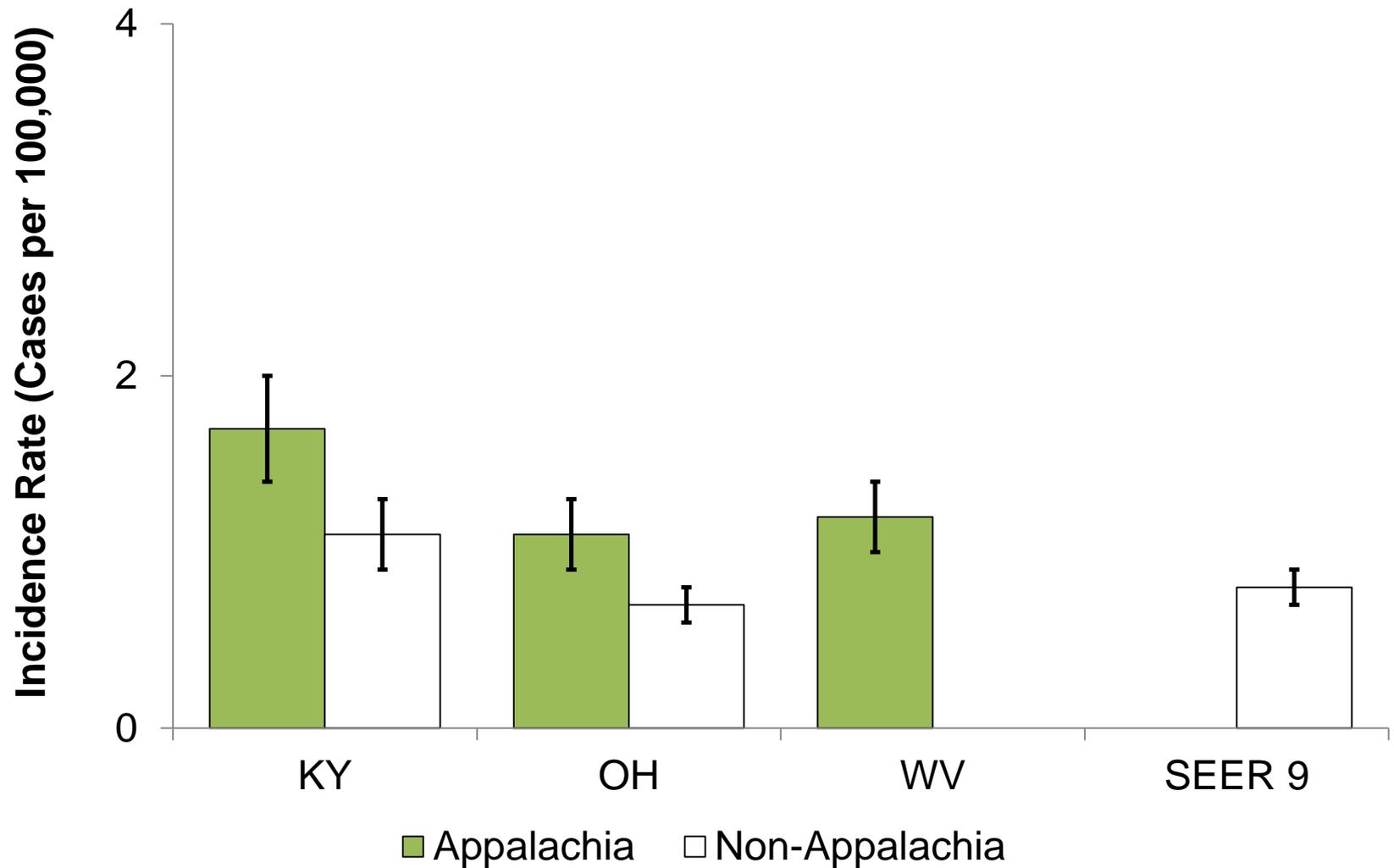
Appalachia



Males – Oral Cavity/Pharyngeal



Males – Penile Cancer

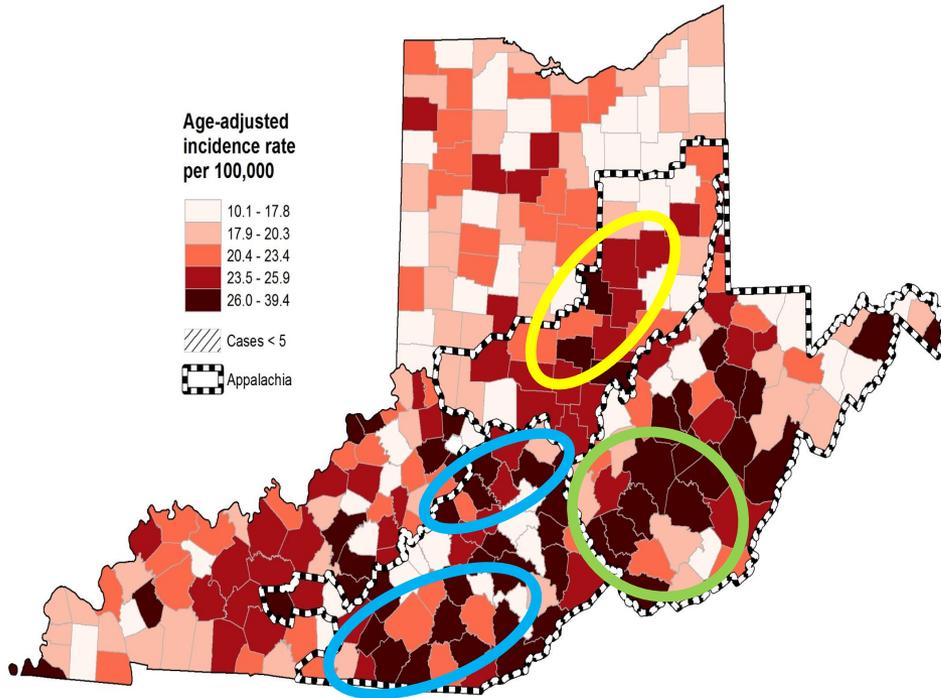


Males – Other Cancers

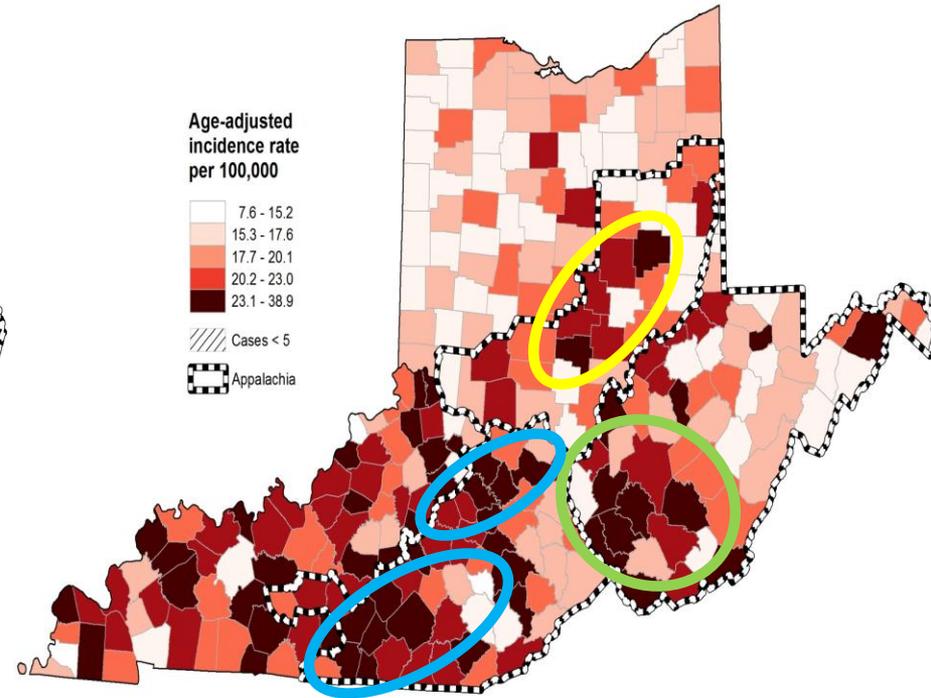
- Geographic areas did not differ greatly in terms of:
 - Anal cancer (all rates between 1.1 and 1.3)

How Do They Compare?

Females



Males



Conclusions

- Substantial burden of HPV-related cancers in Appalachia
- Disparities among females beyond cervical cancer
 - Vulvar and anal cancers
- Disparities not as present among males
 - Penile cancer
 - KY has high rates regardless; Appalachian OH has higher rates than non-Appalachian OH

Conclusions

- HPV vaccine is a potentially important public health strategy for reducing disparities
 - Currently approved to prevent cervical, vaginal, vulvar, and anal cancers
 - If vaccination is lower, disparities could worsen
- Limitations
 - Health behaviors (e.g., tobacco use)
 - Did not have HPV status of cancers

Outline

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- Cancer Registry Project
- NIS-Teen Vaccination Project

Goal

- Examine HPV vaccination among adolescent females from Appalachia
- Compare Appalachian areas with non-Appalachian areas

Data Source

- National Immunization Survey – Teen (NIS-Teen)
- National survey conducted yearly by CDC
- Examines vaccination coverage among adolescents ages 13-17
- Complex stratified sampling strategy that identifies parents through RDD
 - Parents complete survey on vaccination and demographics

Data Source

- Obtains vaccination data from adolescents' healthcare providers to produce estimates
 - Gold standard of vaccination data in the U.S.
- Examined data for 2008-2010
 - All publicly available years for HPV vaccination
 - Total of 27,419 females with provider-verified vaccination records

Disclaimer

The findings and conclusions in this paper are those of the author(s) and do not necessarily represent the views of the Research Data Center, National Center for Health Statistics, Centers for Disease Control and Prevention.

Defining Appalachia

- Most recent definition of Appalachia since all data were 2008 or more recent
 - 420 counties in 13 states
- 1,951 (7%) of all females classified as living in Appalachia based on current county of residence

Variables

- Outcomes (all yes or no)
 - HPV vaccine initiation (1 or more doses)
 - HPV vaccine completion (3 doses)
 - HPV vaccine follow-through (completion among those who initiate the series)
- Main Independent Variable
 - Appalachian residence (yes or no)
- Covariates
 - Demographics and health-related variables (awareness of HPV, HPV vaccine, etc.)

Data Analysis

- Logistic regression to determine if Appalachian residence was associated with three HPV vaccine outcomes
 - Controlled for covariates
- Examined temporal trends and differences by Appalachian subregion
- SAS Version 9.2
 - Applied sampling weights for complex design
 - Appropriate subpopulation methods

Demographics

	Appalachian (n=1951)	Non-Appalachian (n=25468)
Daughter Characteristics		
Age 13-15	60%	61%
Non-Hispanic White	81%**	58%
Mother Characteristics		
Age 45+	39%**	46%
Some College or More	56%*	60%
Married	74%	73%
Household Characteristics		
More than \$75,000	30%**	40%
Rural (Non-MSA)	37%**	15%

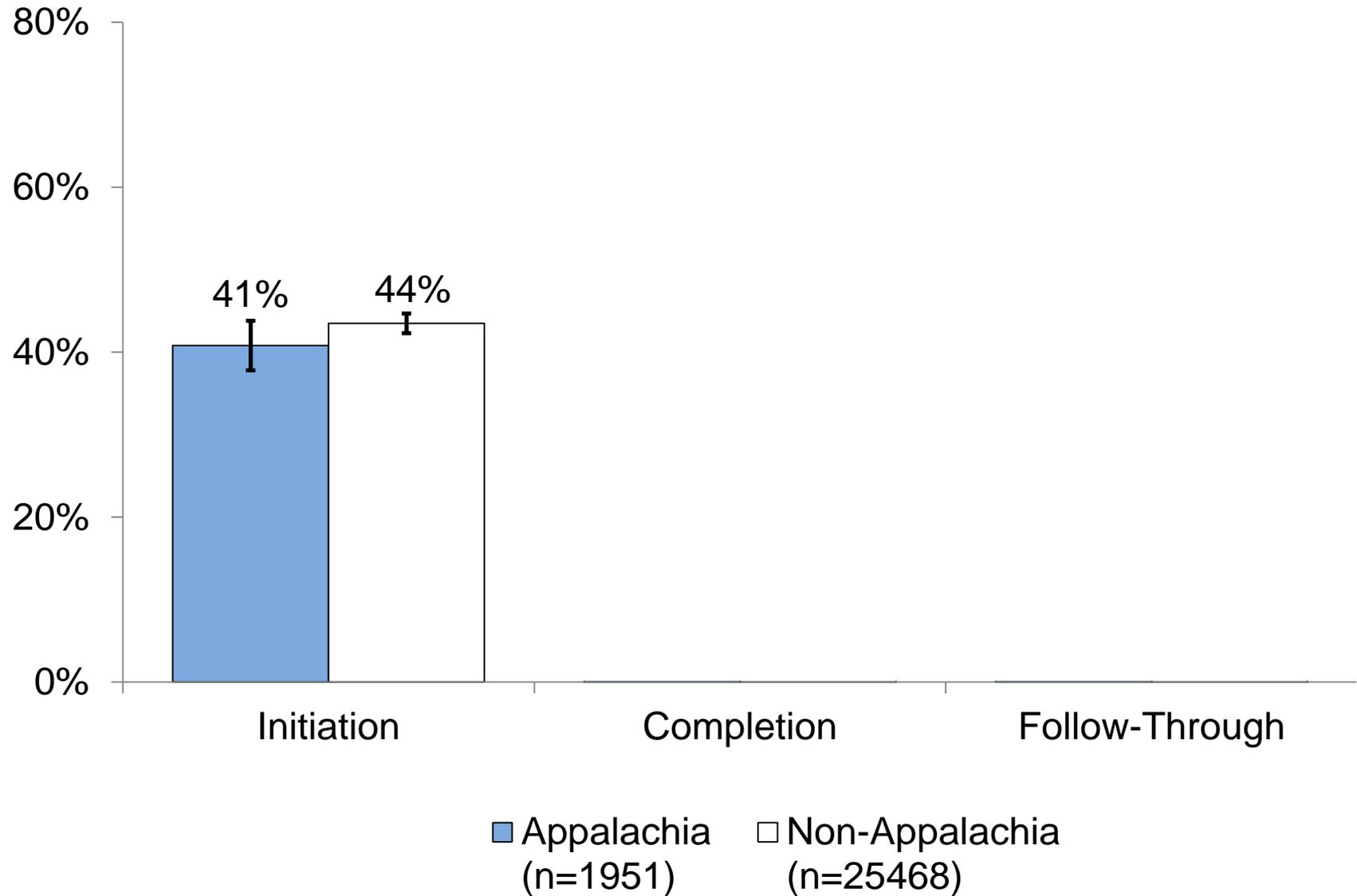
*p<0.05, **p<0.001

Health-Related Variables

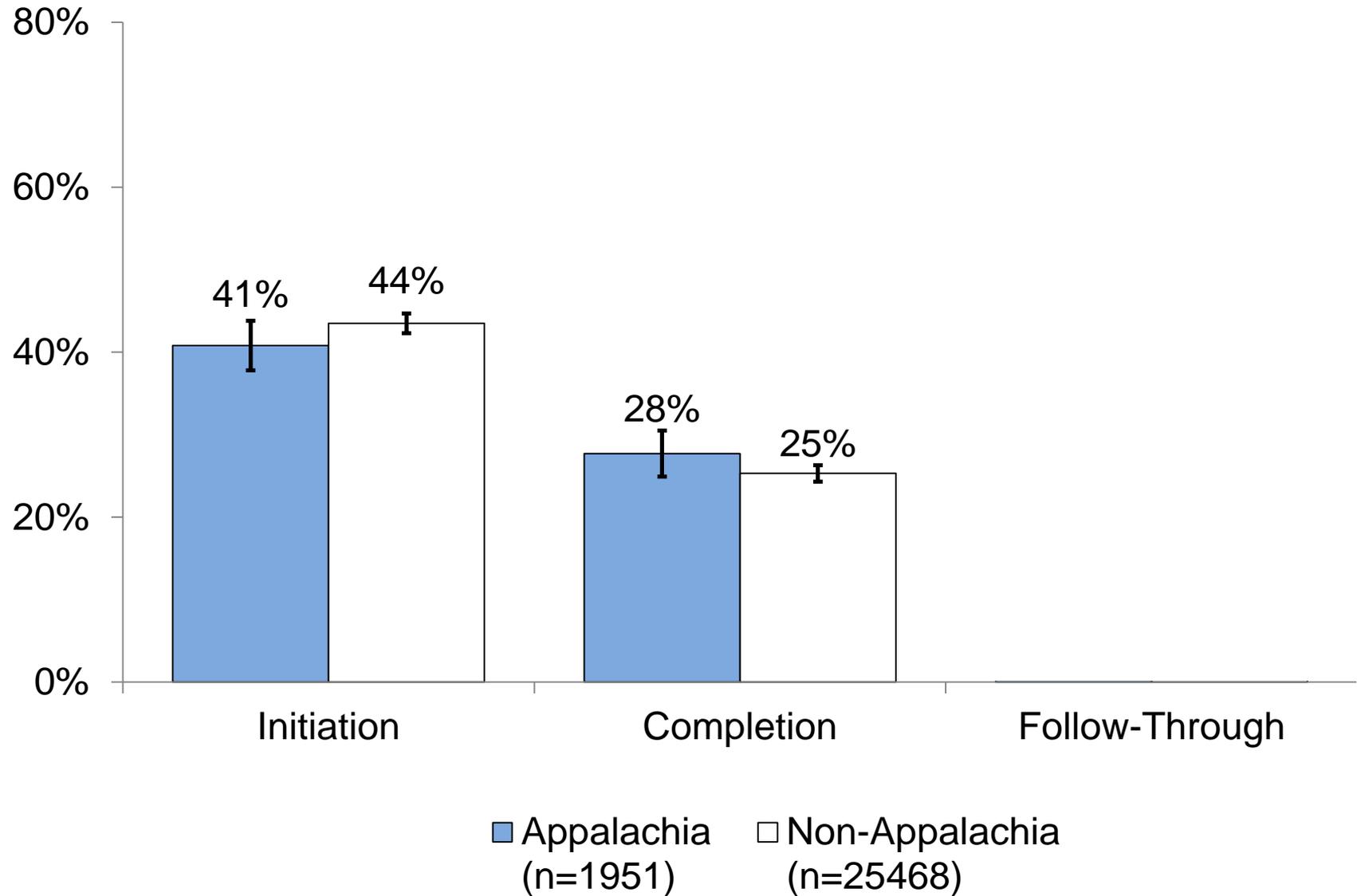
	Appalachian (n=1951)	Non-Appalachian (n=25468)
Daughter Characteristics		
Visited Doctor in Last Year	85%	84%
Covered by Private Insurance	63%	64%
Parent Characteristics		
Heard of HPV	84%	84%
Heard of HPV Vaccine	95%**	91%
Provider Recommendation for HPV Vaccine	56%	53%

*p<0.05, **p<0.001

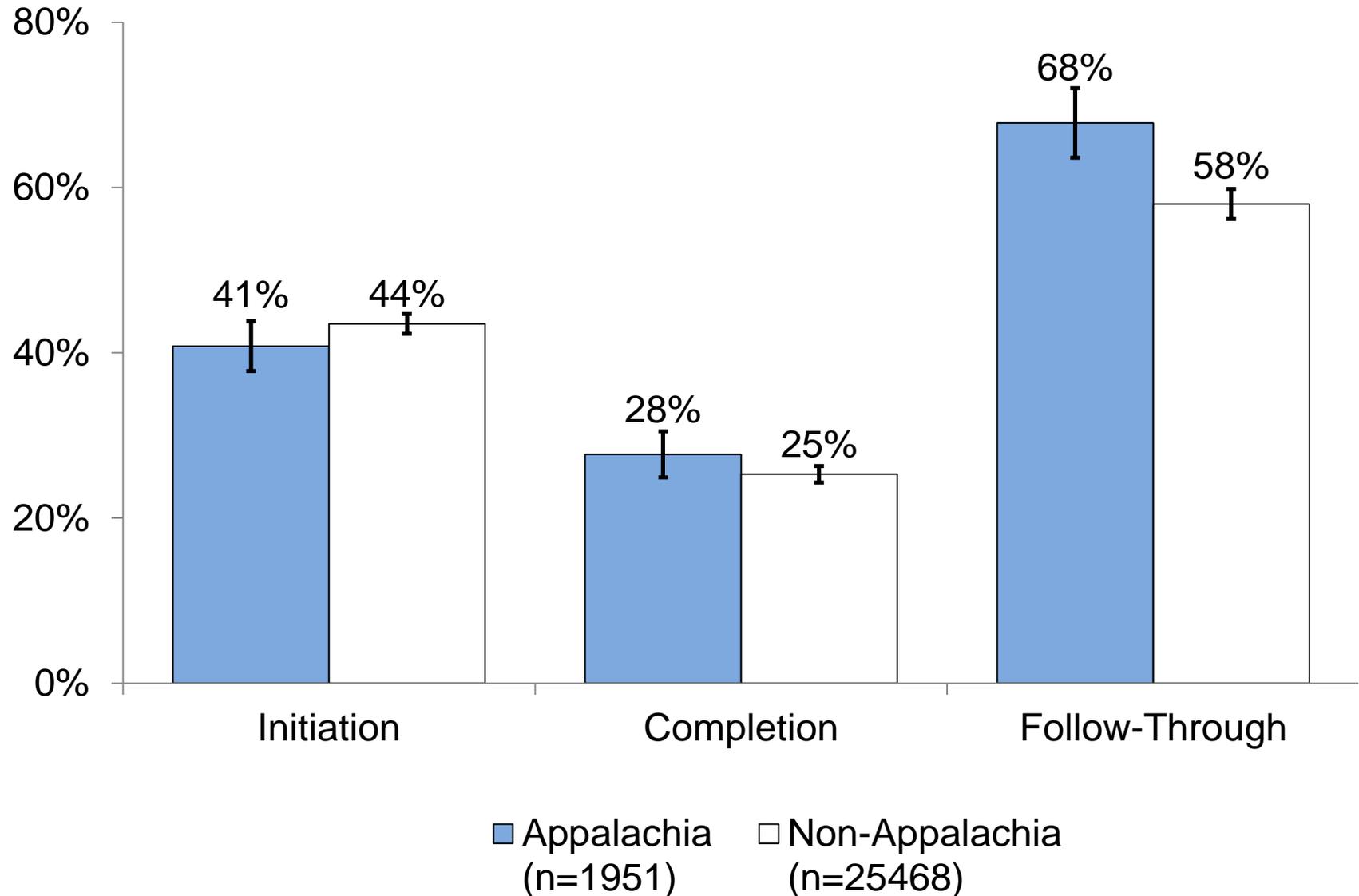
HPV Vaccination: 2008-2010



HPV Vaccination: 2008-2010



HPV Vaccination: 2008-2010



HPV Vaccination: 2008-2010

Multivariate ORs and 95% CIs

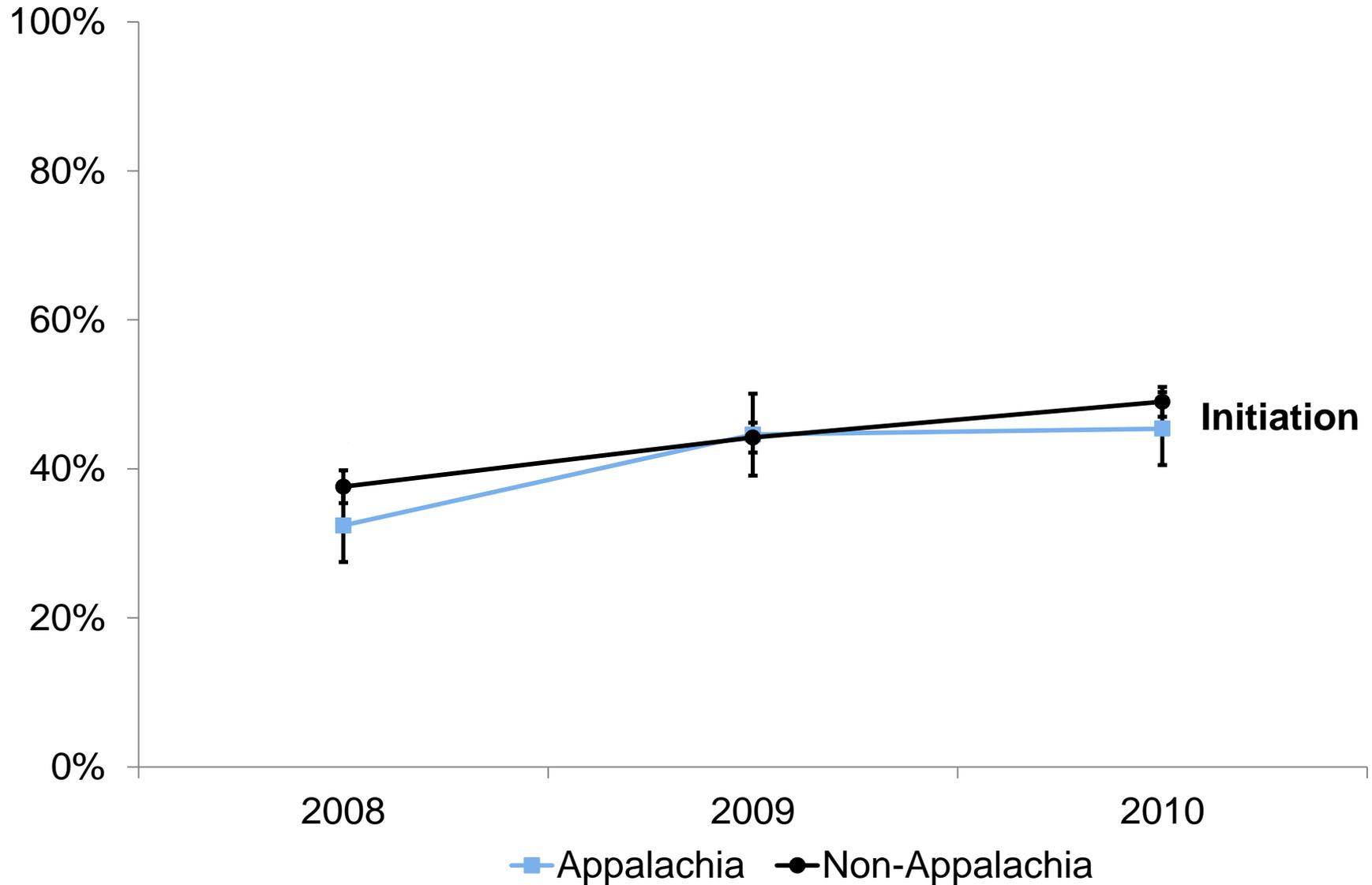
	Initiation	Completion	Follow-Through
Appalachian	0.92 (0.79-1.07)	1.12 (0.95-1.32)	1.36 (1.07-1.72)*
Non-Appalachian	ref.	ref.	ref.

*p<0.05, **p<0.001

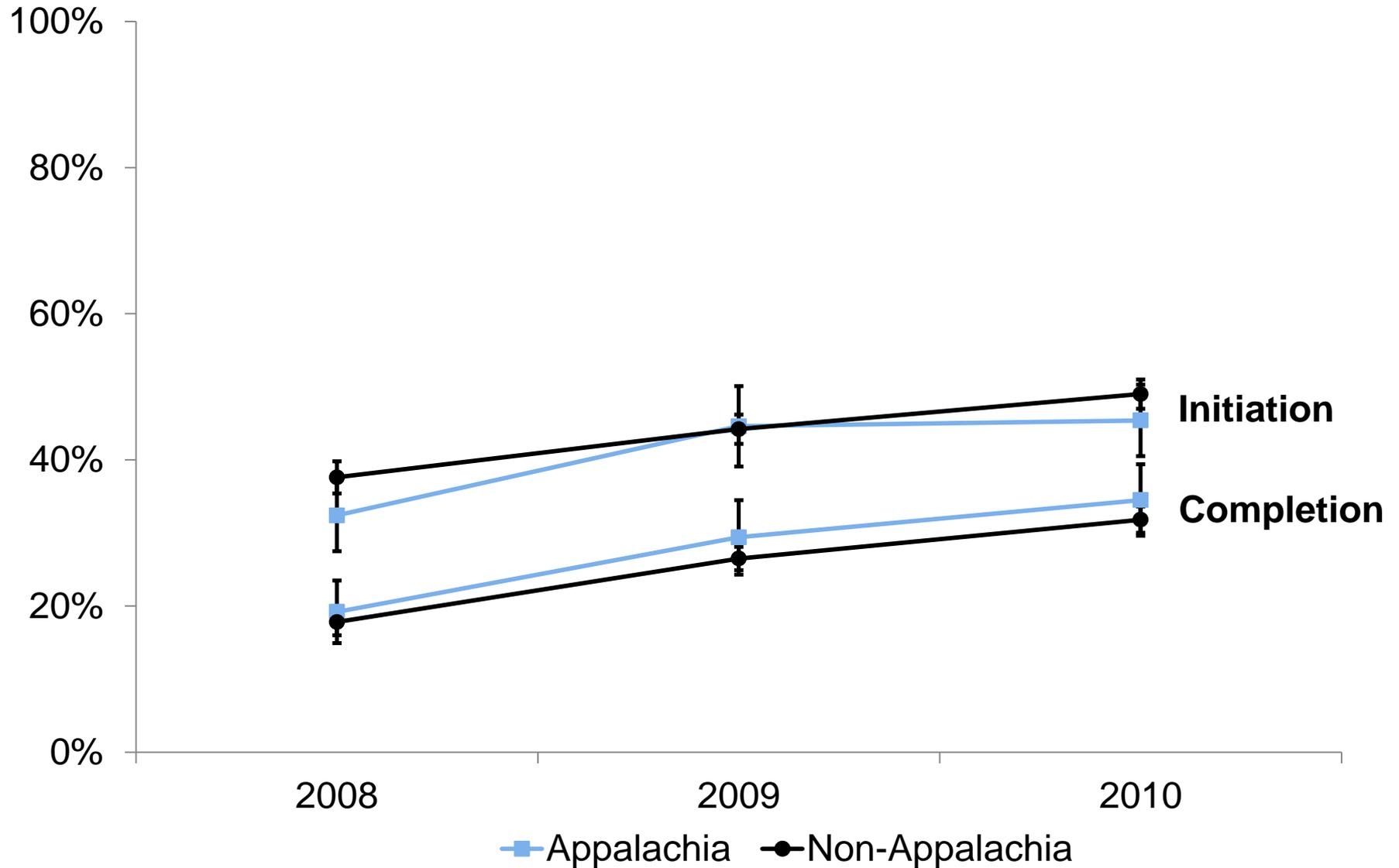
Note. Multivariate ORs adjusted for demographic and health-related characteristics.

On the surface, Appalachia and non-Appalachia are somewhat similar. But, are there differences by time or place?

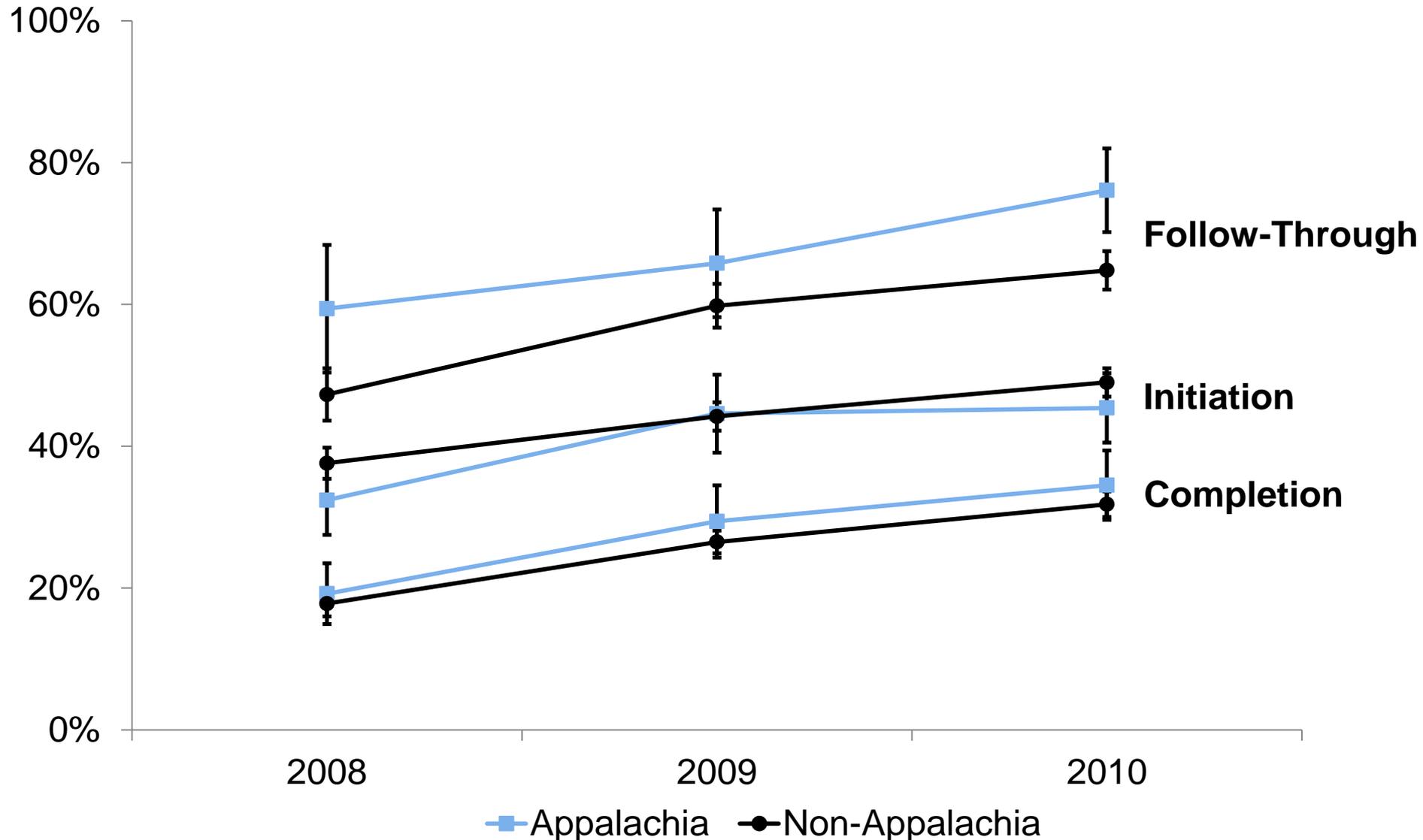
HPV Vaccination By Year



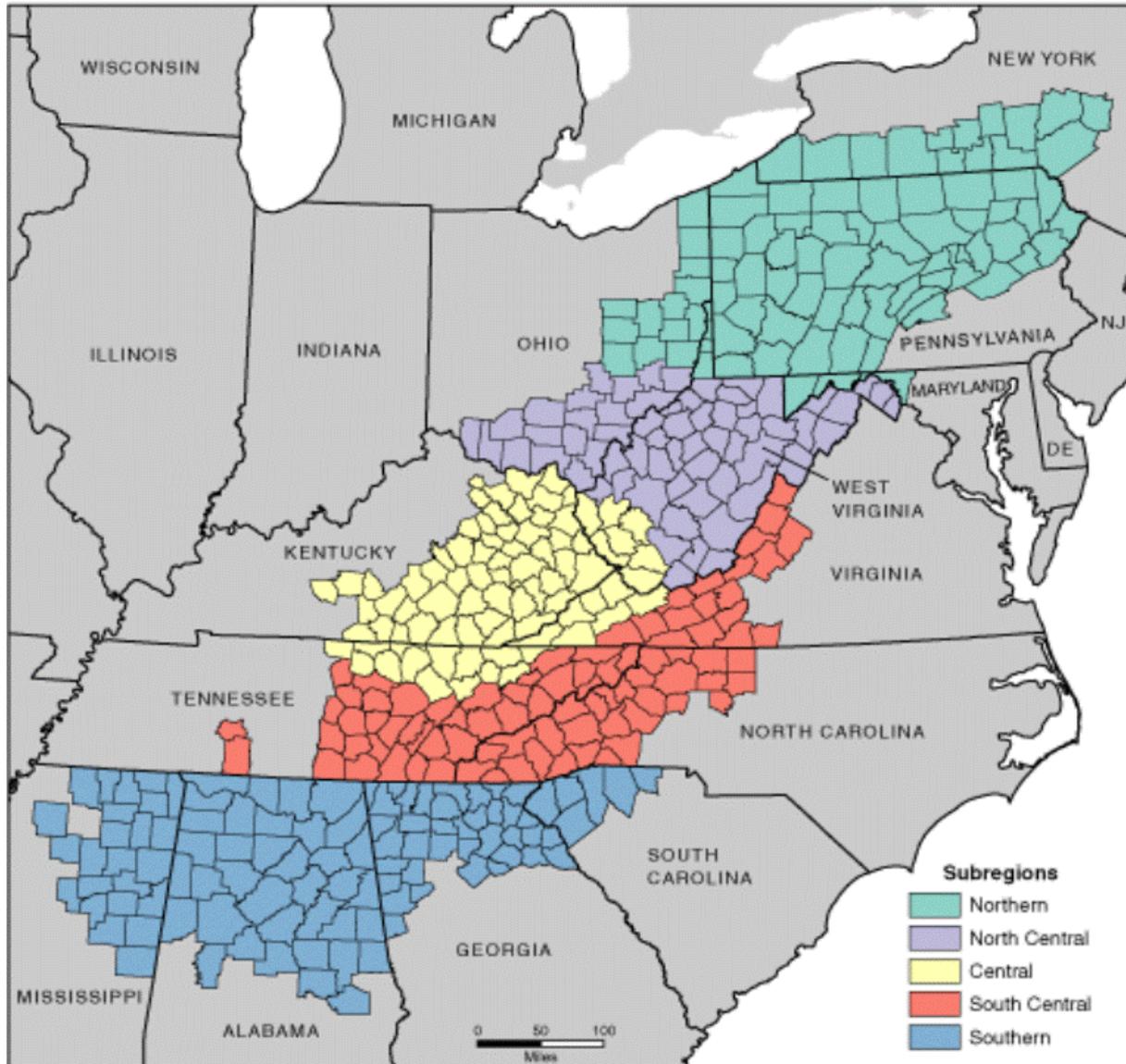
HPV Vaccination By Year



HPV Vaccination By Year

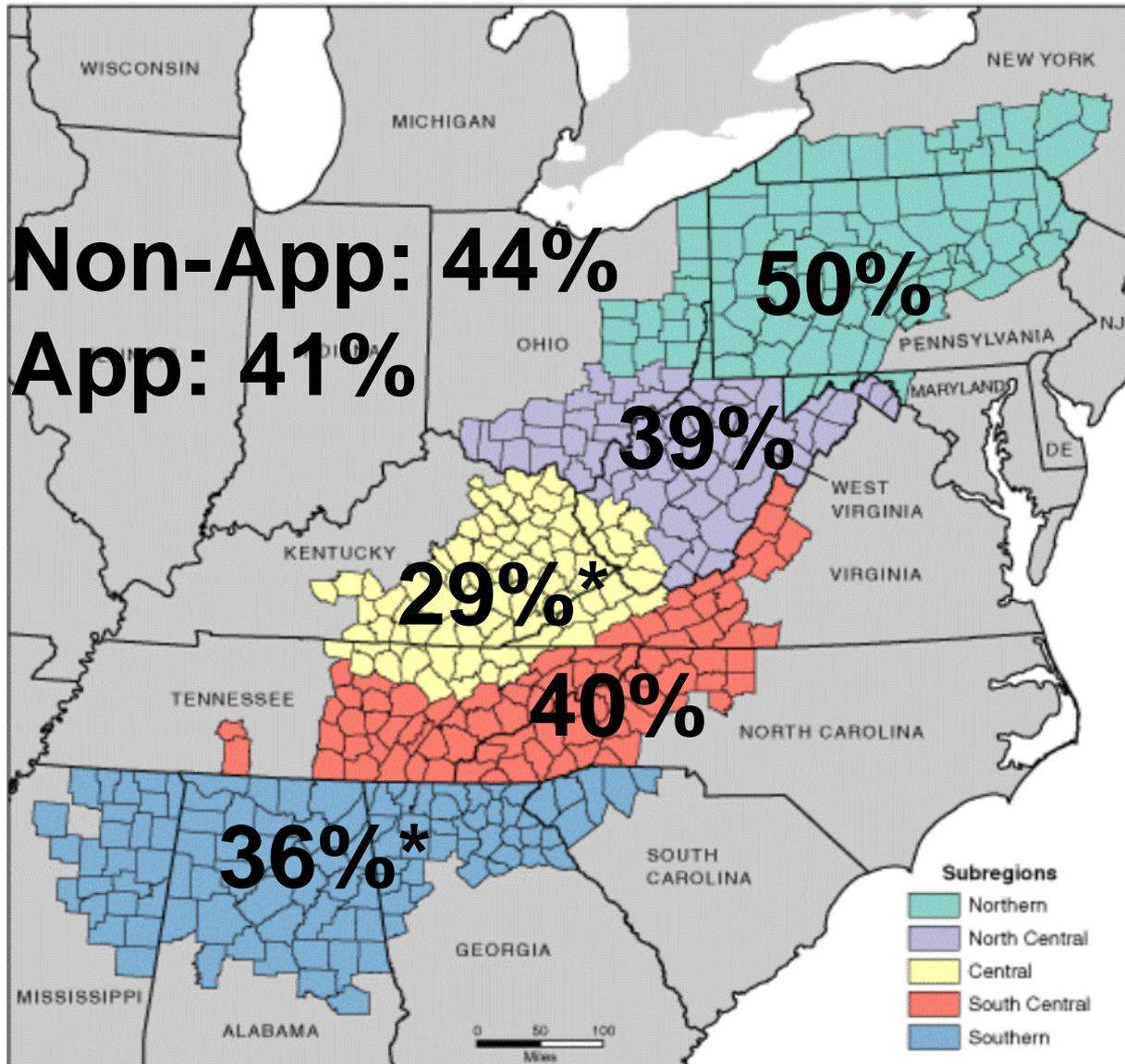


Subregions

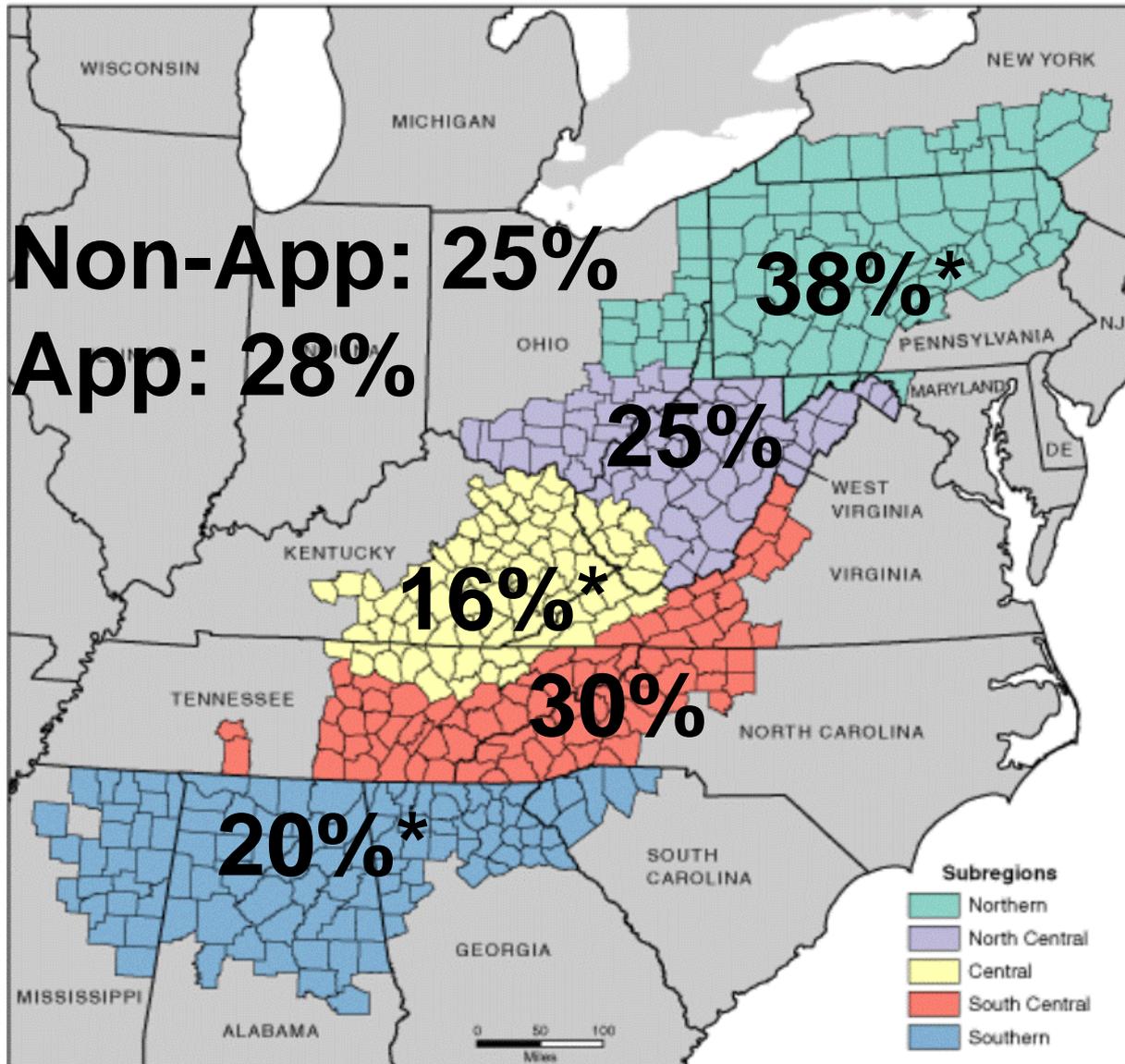


Map by: Appalachian Regional Commission, November 2009.

Subregions - Initiation

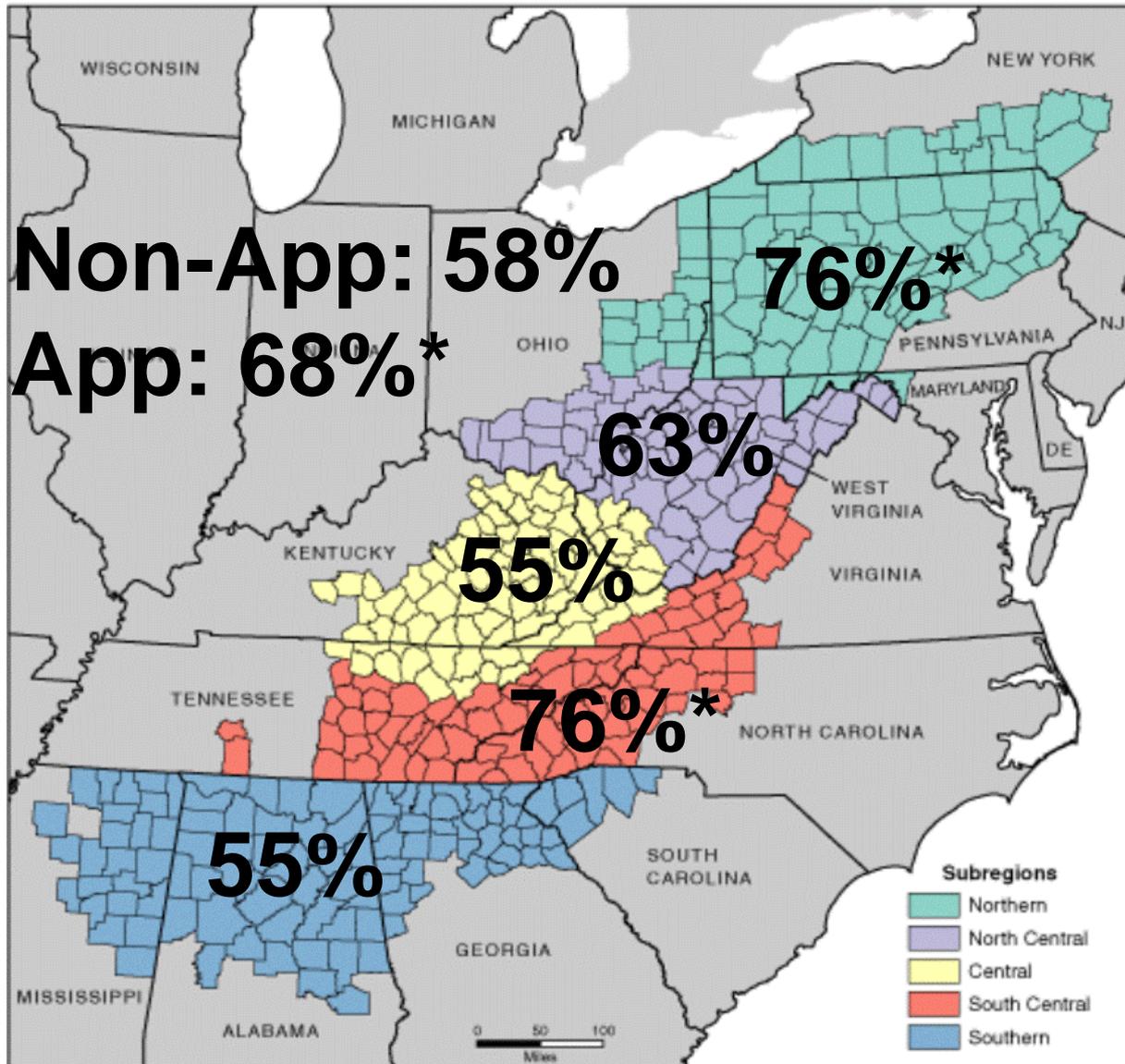


Subregions - Completion



Map by: Appalachian Regional Commission, November 2009.

Subregions – Follow-Through



Map by: Appalachian Regional Commission, November 2009.

West Virginia

- HPV vaccination is lacking
 - Initiation=38%
 - Completion=23%
 - Follow-Through=61%
- Ranks in bottom half of Appalachian states for all outcomes
 - Similar to OH, KY, and TN



Conclusions

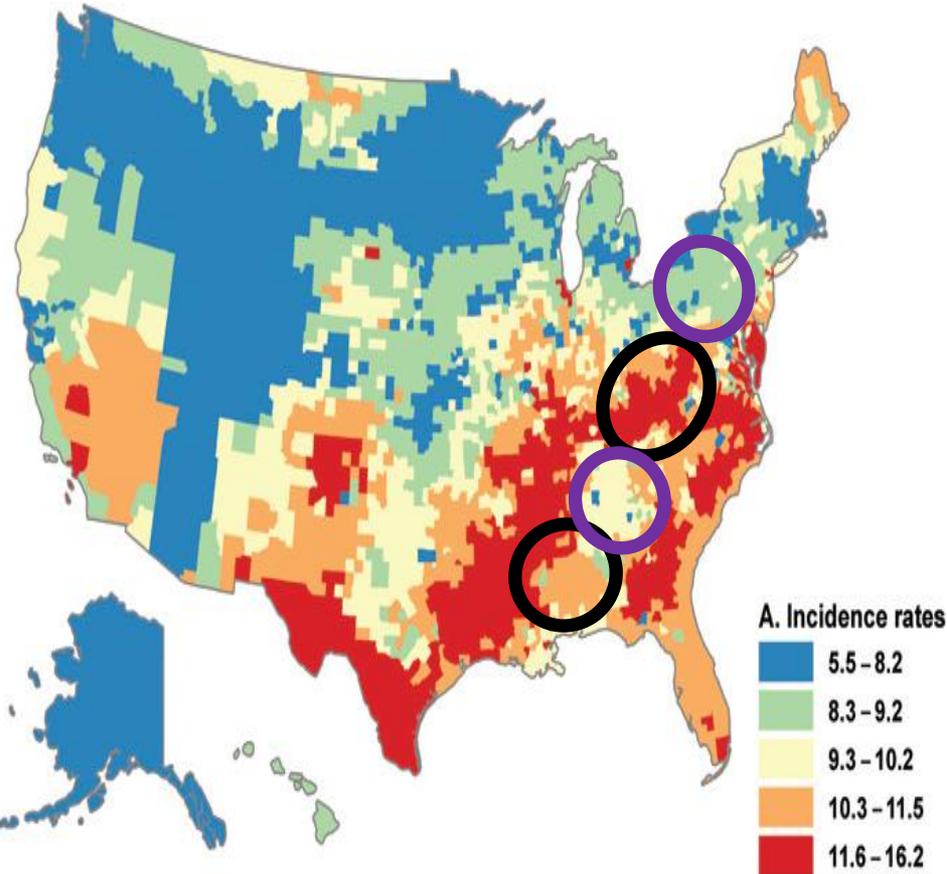
- First estimates of HPV vaccination among adolescent females in Appalachia
- On the surface, HPV vaccination in Appalachia is similar to non-Appalachia
 - Similar in terms of vaccine initiation and completion
 - Better follow-through
- Time trends have been pretty consistent across these three outcomes

Conclusions

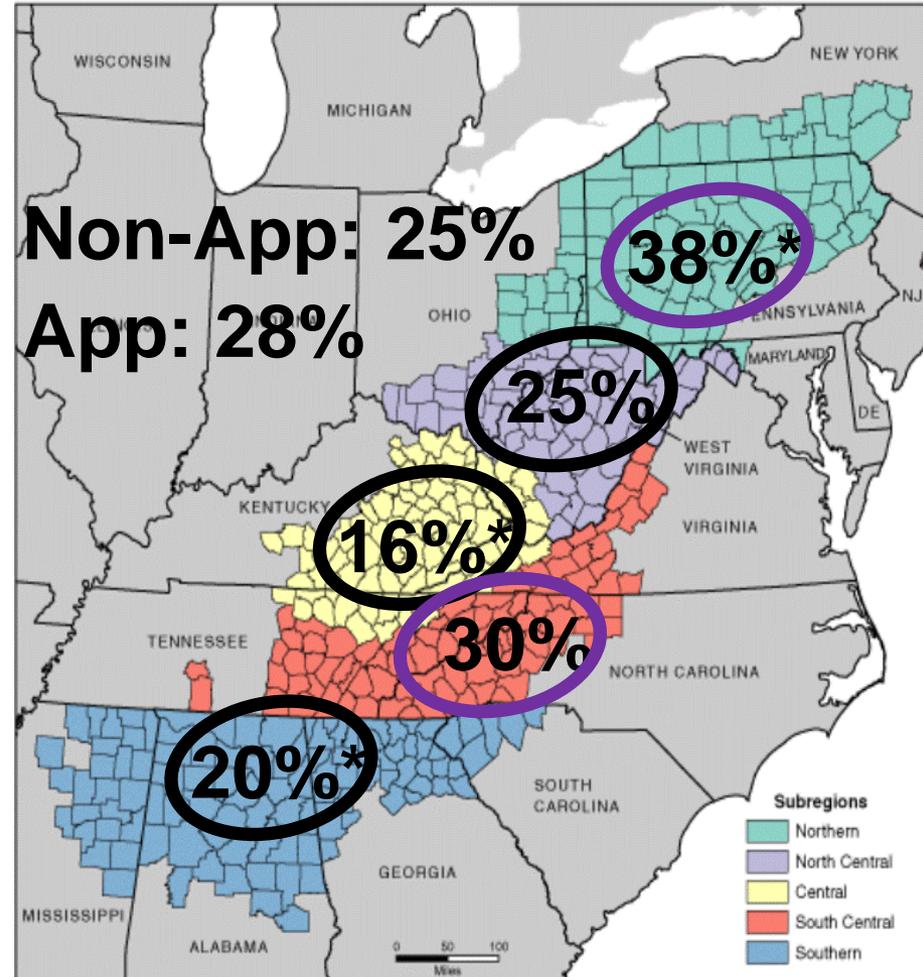
- It makes a big difference where you live in Appalachia!
 - Northern and South Central subregions are promising areas
 - North Central, Central, and Southern subregions are more problematic areas
- So, what does this mean for cervical cancer (and maybe other HPV-related) disparities?

Conclusions

**Cervical Cancer Incidence
1995-2004**



**HPV Vaccine Completion
2008-2010**



If this pattern continues, cervical cancer disparities will persist and maybe even worsen!

What Can We Do?

- Need programs to increase HPV vaccination in Appalachia
 - Focus on high-risk regions within Appalachia
 - OSU multilevel intervention (PI: Paskett)
- Ideal that multiple states partner with one another
 - Example: OH, WV, and KY
 - Contiguous states that have similar HPV-related problems (high cancer rates, low vaccination rates)

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CDC: Cooperative agreement number U58/CCU000768)

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Thank you for your time!

Questions?