

HPV-Related Cancers and HPV Vaccination Rates in New York State

Introduction

Human papillomavirus (HPV) infection is the most common sexually transmitted infection in the United States. Nearly 79 million Americans are currently infected with HPV and there are estimated to be about 14 million new infections each year (<http://www.cdc.gov/hpv/>). HPV infection is also a risk factor for a number of cancers, including those of the cervix, oropharynx, anus, vagina, vulva, and penis. HPV is believed to be the cause of nearly all cases of cervical cancer, 90% of anal cancers, 40% of penile, vaginal and vulvar cancers and 35% of cancers of the oropharynx (Jemal et al., 2013). The recent introduction of a vaccine to prevent HPV infection offers the hope of the potential elimination of many HPV associated cancers in the future.

The purpose of this short report is to present counts and rates for HPV-related cancers in New York State by sex, race/ethnicity, and geography. We compare these data to national counts and rates and also present data on HPV vaccination rates.

For this report, HPV-related cancers were categorized according to the criteria used in two previous studies (Watson et al., 2008; Jemal et al. 2013). Cancers were restricted to cell types in which HPV DNA is frequently found. "Oropharynx" as defined in this report also includes the base of the tongue and tonsils. Detailed definitions are provided in the appendix.

HPV-related cancer counts and rates

On average, 2,375 New York State residents are diagnosed with an HPV-related cancer each year, nearly two-thirds of whom are women (Figure 1). Cervical cancer alone accounts for 35.3% of all HPV-related cancers and for 55.6% of the total number of HPV-related cancers among women. Cancers of the oropharynx account for 72.3% of HPV-related cancers among men, 11.2% of HPV-related cancers among women, and 33.5% of HPV-related cancers among men and women combined.

The rates of HPV-related cancers in New York are similar to those for the nation (Table 1). This is also true of individual sites, with the exception of oral cancer in men (about 10% lower in New York) and anal cancer in men (30% higher in New York). The remaining sites have differences that are within 10% or are statistically equivalent.

Rates of anal cancer are higher among women than among men, in New York State and nationally. Rates of oropharyngeal cancer among men are more than four times higher than among women. Factors other than HPV such as smoking and alcohol use are believed to account for some of the difference in oropharyngeal cancer rates.

Figure 1. Average annual number of new HPV-related cancers overall, and by sex, in New York State, 2007-2011.

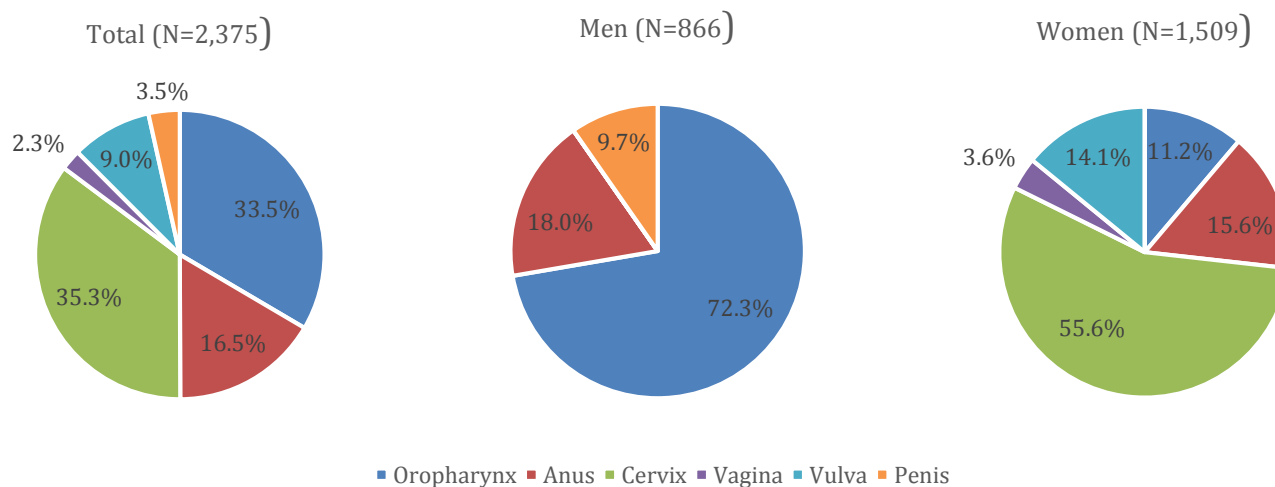


Table 1. Age-adjusted incidence rates per 100,000, for HPV-related cancers by sex, New York State and United States, 2007-2011.

Sex Cancer Site	New York State ¹		United States ²	
	Cases ³	Rate ⁴	Cases ³	Rate ⁴
Males				
All HPV-related cancers ⁵	866	8.7 (8.4-8.9)	14,040	9.0 (8.9-9.0)
Oropharynx	626	6.1 (5.9-6.4)	11,027	6.9 (6.9-7.0)
Anus	156	1.6 (1.5-1.7)	1,884	1.2 (1.2-1.3)
Penis	84	0.9 (0.8-1.0)	1,129	0.8 (0.8-0.8)
Females				
All HPV-related cancers ⁵	1,509	14.0 (13.2-13.8)	21,984	13.4 (13.3-13.5)
Oropharynx	168	1.4 (1.3-1.5)	2,632	1.5 (1.5-1.5)
Anus	236	2.0 (1.9-2.1)	3,551	2.0 (2.0-2.1)
Cervix	838	7.9 (7.6-8.1)	11,649	7.5 (7.4-7.6)
Vagina	54	0.4 (0.4-0.5)	767	0.4 (0.4-0.4)
Vulva	213	1.8 (1.7-1.9)	3,383	1.9 (1.9-2.0)

¹ Source: New York State Cancer Registry.

² Data are from population-based registries that participate in the National Program of Cancer Registries (NPCR) and/or the Surveillance, Epidemiology, and End Results (SEER) Program and meet high-quality data criteria. These registries cover approximately 99% of the U.S. population.

³ Average number of new cases per year, rounded to the nearest integer.

⁴ Rates are per 100,000 persons, age adjusted to the 2000 U.S. standard population, with 95% confidence intervals in parentheses.

⁵ See appendix for definitions/inclusion criteria.

HPV-related cancers impact racial and ethnic groups to varying degrees. These disparities have been well-documented by other researchers and are evident in the national data, and are accounted for in part by differing levels of engagement in high-risk sexual activities and adherence to screening guidelines for cervical cancer (Jemal et al., 2013; Jeudin et al., 2014). In general, blacks tend to have higher rates, whites and Hispanics have close to average rates, and Asians and Pacific Islanders (APIs) and American Indians/Alaska Natives have lower rates.

New York deviates from these patterns somewhat (Table 2). Among males, for all HPV-related cancers combined, whites, blacks and Hispanics have similar rates, while APIs have rates about 75% lower. (The category of American Indians/Alaska Natives was excluded from this report because of very small numbers.) APIs also have the lowest rate for each of the three cancer sites that affect men. There are additional racial/ethnic differences for specific HPV-related cancers among males: whites have the highest rate of oropharyngeal cancer, blacks the highest rate of anal cancer, and Hispanics the highest rate of penile cancer.

For females, there are significant differences in rates between all four racial/ethnic groups, with blacks having the highest overall rate, followed by Hispanics, whites, then APIs; there is nearly a twofold difference between blacks and APIs. The relative order of the groups varies for some of the sites; notably, whites have the highest rates of oropharyngeal cancer and vulvar cancer.

In Table 3, the data are further stratified into New York City and the remainder of New York State. Cancer rates in New York City are typically lower than in the rest of New York State, in part due to lower smoking rates and healthier diets that are typical of immigrants. HPV-related cancers do not follow this pattern, however, as rates in New York City are higher among women and similar among men. As for specific sites, New York City has higher rates of cervical and male anal cancer, while the remainder of New York State has higher rates of vulvar and male oropharyngeal cancer.

Table 2. Age-adjusted incidence rates per 100,000, for HPV-related cancers by race/ethnicity and sex, New York State, 2007-2011.

Cancer Site	Race/Ethnicity	Males		Females	
		Cases ¹	Rate ²	Cases ¹	Rate ²
All HPV-related cancers ³	White non-Hispanic	632	9.0 (8.7-9.4)	915	12.6 (12.2-12.9)
	Black non-Hispanic	114	9.5 (8.7-10.4)	283	17.5 (16.6-18.4)
	Hispanic	100	9.2 (8.4-10.1)	224	15.2 (14.3-16.1)
	API non-Hispanic	14	2.2 (1.7-2.8)	71	9.6 (8.6-10.6)
Oropharynx	White non-Hispanic	483	6.8 (6.6-7.1)	123	1.6 (1.4-1.7)
	Black non-Hispanic	69	5.7 (5.1-6.4)	25	1.5 (1.2-1.8)
	Hispanic	61	5.8 (5.1-6.5)	14	1.0 (0.8-1.3)
	API non-Hispanic	9	1.3 (1.0-1.8)	5	0.7 (0.5-1.0)
Anus	White non-Hispanic	98	1.4 (1.3-1.6)	161	2.0 (1.9-2.2)
	Black non-Hispanic	32	2.6 (2.2-3.0)	36	2.1 (1.8-2.5)
	Hispanic	20	1.6 (1.3-2.0)	35	2.4 (2.1-2.8)
	API non-Hispanic	2	0.4 (0.2-0.7)*	3	0.4 (0.2-0.7)*
Cervix	White non-Hispanic			431	6.6 (6.3-6.9)
	Black non-Hispanic			189	12.0 (11.0-12.6)
	Hispanic			149	9.7 (9.0-10.5)
	API non-Hispanic			59	7.8 (6.9-8.8)
Vagina	White non-Hispanic			32	0.4 (0.3-0.4)
	Black non-Hispanic			12	0.8 (0.6-1.0)
	Hispanic			7	0.5 (0.3-0.7)
	API non-Hispanic			1	0.2 (0.1-0.5)*
Vulva	White non-Hispanic			168	2.0 (1.9-2.2)
	Black non-Hispanic			21	1.3 (1.1-1.6)
	Hispanic			20	1.5 (1.2-1.9)
	API non-Hispanic			2	0.4 (0.2-0.7)*
Penis	White non-Hispanic	51	0.8 (0.7-0.9)		
	Black non-Hispanic	12	1.2 (0.9-1.6)		
	Hispanic	18	1.8 (1.4-2.2)		
	API non-Hispanic	3	0.5 (0.3-0.8)*		

¹ Average number of new cases per year, rounded to the nearest integer.

² Rates are per 100,000 persons, age adjusted to the 2000 U.S. standard population, with 95% confidence intervals in parentheses.

³ See appendix for definitions/inclusion criteria.

* Rates based on fewer than four cases per year (i.e., fewer than 20 cases for the 5-year time period) are unstable.

Table 3. Age-adjusted incidence rates per 100,000, for HPV-related cancers by race/ethnicity and sex, New York City and New York State excluding New York City, 2007-2011.

Cancer Site Race/Ethnicity	New York City				New York State excluding New York City			
	Males		Females		Males		Females	
	Cases ¹	Rate ²	Cases ¹	Rate ²	Cases ¹	Rate ²	Cases ¹	Rate ²
All HPV-related cancers³								
All	310	8.4 (8.0-8.8)	666	14.6 (14.1-15.1)	556	8.8 (8.5-9.1)	842	12.8 (12.4-13.2)
White non-Hispanic	135	8.6 (8.0-9.3)	219	12.4 (11.6-13.2)	496	9.2 (8.8-9.5)	696	12.6 (12.2-13.1)
Black non-Hispanic	80	10.0 (9.0-11.0)	211	18.4 (17.3-19.5)	34	8.7 (7.3-10.1)	72	15.4 (13.9-17.1)
Hispanic	78	9.9 (8.9-11.0)	169	15.5 (14.5-16.6)	22	7.3 (5.8-9.0)	55	13.7 (12.0-15.5)
API non-Hispanic	12	2.4 (1.8-3.2)	58	10.3 (9.1-11.6)	3	1.4 (0.7-2.4)	13	7.7 (5.8-10.0)
Oropharynx								
All	194	5.2 (4.9-5.5)	61	1.3 (1.2-1.5)	432	6.7 (6.4-7.0)	107	1.5 (1.4-1.6)
White non-Hispanic	90	5.7 (5.2-6.3)	28	1.5 (1.2-1.8)	393	7.2 (6.8-7.5)	95	1.6 (1.4-1.7)
Black non-Hispanic	47	5.8 (5.0-6.6)	18	1.5 (1.2-1.8)	23	5.7 (4.7-6.9)	7	1.5 (1.0-2.0)
Hispanic	48	6.2 (5.4-7.0)	11	1.1 (0.8-1.4)	13	4.6 (3.5-6.0)	3	0.8 (0.4-1.4)
API non-Hispanic	7	1.4 (0.9-2.0)	4	0.8 (0.5-1.2)	2	1.1 (0.6-2.1)*	1	0.5 (0.1-1.3)*
Anus								
All	79	2.1 (1.9-2.4)	94	2.0 (1.8-2.2)	76	1.3 (1.1-1.4)	141	2.0 (1.9-2.2)
White non-Hispanic	34	2.2 (1.9-2.6)	35	1.9 (1.6-2.2)	64	1.2 (1.1-1.4)	125	2.1 (1.9-2.3)
Black non-Hispanic	25	3.0 (2.4-3.5)	26	2.2 (1.8-2.6)	8	1.8 (1.3-2.5)	10	2.1 (1.5-2.7)
Hispanic	16	1.8 (1.4-2.3)	30	2.8 (2.3-3.2)	4	1.3 (0.8-2.2)	5	1.3 (0.8-2.0)
API non-Hispanic	2	0.5 (0.2-0.9)*	2	0.4 (0.2-0.8)*	0	0.0 (0.0-0.6)*	1	0.4 (0.1-1.0)*
Cervix								
All			421	9.4 (9.0-9.8)			417	6.9 (6.6-7.2)
White non-Hispanic			112	6.9 (6.3-7.5)			319	6.5 (6.1-6.8)
Black non-Hispanic			145	12.8 (11.8-13.7)			44	9.4 (8.2-10.8)
Hispanic			109	9.8 (9.0-10.6)			40	9.3 (8.0-10.7)
API non-Hispanic			49	8.6 (7.5-9.7)			10	5.8 (4.2-7.8)
Vagina⁴								
All			21	0.4 (0.4-0.5)			33	0.4 (0.4-0.5)
Vulva								
All			69	1.4 (1.3-1.6)			144	2.0 (1.9-2.2)
White non-Hispanic			37	1.8 (1.5-2.1)			131	2.1 (1.9-2.3)
Black non-Hispanic			15	1.3 (1.0-1.6)			6	1.4 (1.0-2.0)
Hispanic			14	1.4 (1.1-1.8)			5	1.8 (1.1-2.6)
API non-Hispanic			2	0.4 (0.2-0.7)*			1	0.5 (0.1-1.4)*
Penis⁴								
All	36	1.0 (0.9-1.2)			48	0.8 (0.7-1.0)		

¹ Average number of new cases per year, rounded to the nearest integer.

² Rates are per 100,000 persons, age adjusted to the 2000 U.S. standard population, with 95% confidence intervals in parentheses.

³ See appendix for definitions/inclusion criteria.

* Rates based on fewer than four cases per year (i.e., fewer than 20 cases for the 5-year time period) are unstable.

⁴ Race/ethnicity specific data are not provided for cancers of the vagina and penis because of small numbers and absence of differences between NYC and the rest of the New York State.

HPV vaccination rates

There are 12 strains of HPV known to cause cancer: 16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58 and 59, with strains 16 and 18 causing the majority of cancers. Presently there are three HPV vaccines licensed by the Food and Drug Administration (FDA) in the United States: a bivalent vaccine protecting against types 16 and 18 (2vHPV); a quadrivalent vaccine that is additionally protective against types 6 and 11 (4vHPV), which cause genital warts; and a 9-valent HPV vaccine (9vHPV), approved by the FDA in December 2014, that will be additionally protective against strains 31, 33, 45, 52 and 58 (American Academy of Pediatrics, 2014). The 9-valent vaccine will be effective against strains that cause 90% of all HPV-related cancers (Joura et al., 2014).

The Advisory Committee on Immunization Practices (ACIP) recommends routine vaccination with three doses of 9vHPV, 4vHPV, or 2vHPV vaccine for girls aged 11 or 12. The vaccination is recommended through age 26 for girls not previously vaccinated or who have not completed the 3-dose series. ACIP also recommends three doses of 9vHPV or 4vHPV for boys aged 11 or 12, with vaccination recommended through age 21 for boys with consideration up through age 26 for boys not previously vaccinated or who have not completed the 3-dose series. Vaccination may begin as early as age 9 for girls and boys (Markowitz et al., 2014; ACIP February 26, 2015 meeting).

Since 2006, the Centers for Disease Control and Prevention (CDC) has performed an annual National Immunization Survey (NIS) for adolescents/teens between the ages of 13-17 called the NIS Teen Vaccination Coverage Survey. This survey provides estimated vaccination coverage of this population and specifically surveys for the HPV vaccine in both girls and boys. The 2013 survey revealed that HPV vaccination coverage among teens continues to steadily increase, but is still far from universal. Specifically, 57% of girls and 35% of boys had received at least one dose of HPV vaccine in 2013, up from 54% and 24% in 2012 (Stokley et al., 2014). Statewide comparisons are only available from 2012. In this year, New York State ranked 22nd among 51 states (including the District of Columbia) in the percent of adolescent girls with at least one HPV dose, at 56%, and 34th among 49 states for boys, at 18% (two states had missing data) (Curtis et al., 2013). Rhode Island had the highest rates for both girls and boys, at 74% and 55%, respectively. For girls, New York City had slightly lower HPV vaccination coverage than the rest of New York State (54% versus 58%), while for boys, coverage in New York City was considerably higher (27% versus 12%).

HPV vaccine outreach

The New York State Department of Health (Department) is engaged in outreach activities to improve the awareness and uptake of the HPV vaccine and has partnered with outside organizations, including the New York State Cancer Consortium, Roswell Park Cancer Institute and American Academy of Pediatrics, New York District 2, in order to extend outreach initiatives. These partnerships have focused on coordinating efforts and sharing outreach materials. The Department has pursued an HPV media campaign consisting of television, radio and mall advertisements as well as social media sponsored posts and banner advertisements. The Department is sending reminder letters to parents of 11 to 13 year-old children who have either initiated the HPV vaccination series but are overdue for their next dose or who have not yet initiated the series. The Department is conducting Assessment, Feedback, Incentives and eXchange (AFIX) quality improvement visits with medical providers, focused on improving HPV vaccine series initiation and completion. All of these initiatives have an emphasis on ensuring that children 11 to

13 years of age are immunized. The Take Control initiative includes internet banner advertisements aimed at improving immunization knowledge and uptake among the 13 to 18 year-old population.

Conclusion

Although HPV-related cancers represent a small percentage of the entire cancer burden, thousands of New Yorkers continue to develop HPV-related cancers each year, with women representing 64% of those affected. Among several disparities we have identified, cervical cancer rates among blacks and Hispanics, and specifically among blacks in New York City, are of particular concern. The widespread availability of the HPV vaccine offers the potential to eliminate HPV-related cancers within the next generation. New York State has historically been a leader in cancer screening and cancer reporting and now has the opportunity to assert its leadership in cancer vaccination.

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Appendix

Classification criteria used for HPV-related cancers:

1. Limited to microscopically confirmed cancers;
2. Limited to site and histology codes specified below.

Cancer Site ¹	ICD-O-3 ² Site Code for included sub-sites	ICD-O-3 Histology Code
Oropharynx	C01.9 Base of tongue, NOS ³ C02.4 Lingual tonsil C02.8 Overlapping lesion of tongue C09 Tonsil C10.2 Lateral wall of oropharynx C10.8 Overlapping lesion of oropharynx C10.9 Oropharynx, NOS C14.0 Pharynx, NOS C14.2 Waldeyer ring C14.8 Overlapping lesion of lip, oral cavity and pharynx	Squamous cell carcinomas: 8050-8084, 8120-8131
Anus	C21 Anus and anal canal C20.9 ⁴ Rectum, NOS	Squamous cell carcinomas*: 8050-8084, 8120-8131
Vulva	C51 Vulva	Squamous cell carcinomas*: 8050-8084, 8120-8131
Vagina	C52 Vagina	Squamous cell carcinomas*: 8050-8084, 8120-8131
Cervix	C53 Cervix uteri	All carcinomas: 8010-8671, 8940-8941.
Penis	C60 Penis	Squamous cell carcinomas: 8050-8084, 8120-8131

¹ Cancer site as referred to in this report.

² ICD-O-3, International Classification of Diseases for Oncology, 3rd Edition.

³ NOS, not otherwise specified.

⁴ Squamous cell carcinomas of the rectum are included. Because the rectum is made up of glandular cells and not squamous cells, we assume that microscopically confirmed rectal squamous cell carcinomas were miscoded to the rectum or were overlapping anal lesions.

* Code 8077/2 (intraepithelial neoplasia 3) is excluded for vulvar, vaginal, and anal cancers.