



Data Brief:

Oropharyngeal Cancer in Massachusetts

Massachusetts Department of Public Health

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PURPOSE

The purpose of this report is to present the epidemiology of oropharyngeal cancer in Massachusetts from 2004 to 2014. Oropharyngeal cancers include cancers that occur on the base of the tongue, tonsils, soft palate, and other oropharynx. This report describes the incidence, mortality, trends over time, percentage of cancers attributable to human papillomavirus (HPV) infection, and risk factors for oropharyngeal cancer, and compares the findings from Massachusetts to national data on oropharyngeal cancer. Data are from the Massachusetts Cancer Registry and Massachusetts Registry of Viral Records and Statistics. Rates of HPV vaccination in Massachusetts are examined. A quick summary of risk factors not related to HPV infection are examined.

KEY FINDINGS

- In Massachusetts from 2004-2014, oropharyngeal cancer was the most common HPV-associated cancer among males and the third most common HPV-associated cancer among females.
- Oropharyngeal cancer was the most common cause of death from an HPV-associated cancer for males and second most common cause of death from an HPV-associated cancer for females from 2008-2014 in Massachusetts.
- The incidence rate of oropharyngeal cancer among males in Massachusetts has been increasing by 2.8% each year from 2004-2014 with statistical significance.
- The age-adjusted incidence rate of oropharyngeal cancer was 4.1 times higher among Massachusetts males than among females.
- The incidence rate of oropharyngeal cancer is higher in Massachusetts than the United States.

OROPHARYNGEAL CANCER COMPARED WITH OTHER HPV-ASSOCIATED CANCERS

Table 1. Total cases and age-adjusted incidence rates[^] of the most common HPV-associated cancers, Massachusetts, 2004-2014

Male			Female		
Cancer Site	Cases	Incidence Rate [^]	Cancer Site	Cases	Incidence Rate [^]
All HPV-associated	3,912	9.99	All HPV-associated	5,130	11.84
Oropharynx*	3,127	7.85	Cervix	2,193	5.46
Anus*	422	1.09	Vulva*	1,046	2.24
Penis*	328	0.95	Oropharynx*	869	1.91

*These sites are restricted to squamous cell carcinomas; [^]per 100,000 and age-standardized to the 2000 U.S. population; 1 person did not identify as male or female; HPV-associated cancer sites include anus, cervix, oropharynx, penis, rectum, vagina, and vulva; data source: Massachusetts Cancer Registry

New Cases

- From 2004-2014, 3,912 males and 5,130 females were diagnosed with a HPV-associated cancer in Massachusetts. Of those, 3,127 males and 869 females were diagnosed with oropharyngeal cancer.
- In Massachusetts, oropharyngeal cancer was the most common HPV-associated cancer diagnosed in males and the third most common HPV-associated cancer diagnosed in females.
- From 2004-2014, 80% of all HPV-associated cancers in males, and 17% of all HPV-associated cancers in females, were oropharyngeal cancers.

Deaths

- From 2008-2014, 682 males and 956 females died from a HPV-associated cancer in Massachusetts. Of those, 586 deaths among males and 234 deaths among females were due to oropharyngeal cancer.
- In Massachusetts, oropharyngeal cancer was the leading cause of death from an HPV-associated cancer in males and the second leading cause of death from an HPV-associated cancer in females.
- From 2008-2014, 86% of all HPV-associated cancer deaths in males, and 24% of all HPV-associated cancer deaths in females were due to oropharyngeal cancer.

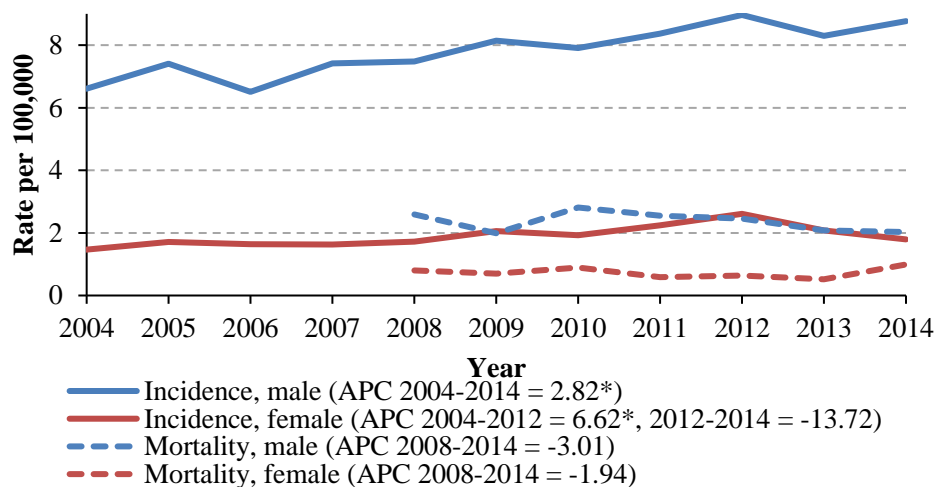
Table 2. Total deaths and age-adjusted mortality rates[^] of the most common HPV-associated cancers, Massachusetts, 2008-2014

Male			Female		
Cancer Site	Deaths	Mortality Rate [^]	Cancer Site	Deaths	Mortality Rate [^]
All HPV-associated	682	2.77	All HPV-associated	956	3.08
Oropharynx	586	2.35	Cervix	374	1.29
Penis	49	0.23	Oropharynx	234	0.73
Anus	47	0.19	Vulva	221	0.67

Cancer sites are not restricted to squamous cell carcinomas; [^]per 100,000 and age-standardized to the 2000 U.S. population; 1 person did not identify as male or female; data source: Massachusetts Registry of Vital Records and Statistics

OROPHARYNGEAL CANCER TRENDS

Figure 1. Trends in the incidence (2004-2014) and mortality (2008-2014) rates[^] of oropharyngeal cancer, Massachusetts



	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Incidence, male	6.60	7.41	6.51	7.42	7.48	8.14	7.90	8.37	8.96	8.29	8.77
Incidence, female	1.47	1.71	1.64	1.63	1.72	2.06	1.92	2.24	2.61	2.08	1.80
Mortality, male	-	-	-	-	2.59	1.99	2.81	2.55	2.46	2.08	2.03
Mortality, female	-	-	-	-	0.80	0.70	0.90	0.59	0.64	0.52	0.99

[^]per 100,000 and age-standardized to the 2000 U.S. population; *indicates a statistically significant trend ($p < 0.05$); APC = Annual Percent Change; Data source: Massachusetts Cancer Registry and Massachusetts Registry of Vital Records and Statistics

Incidence

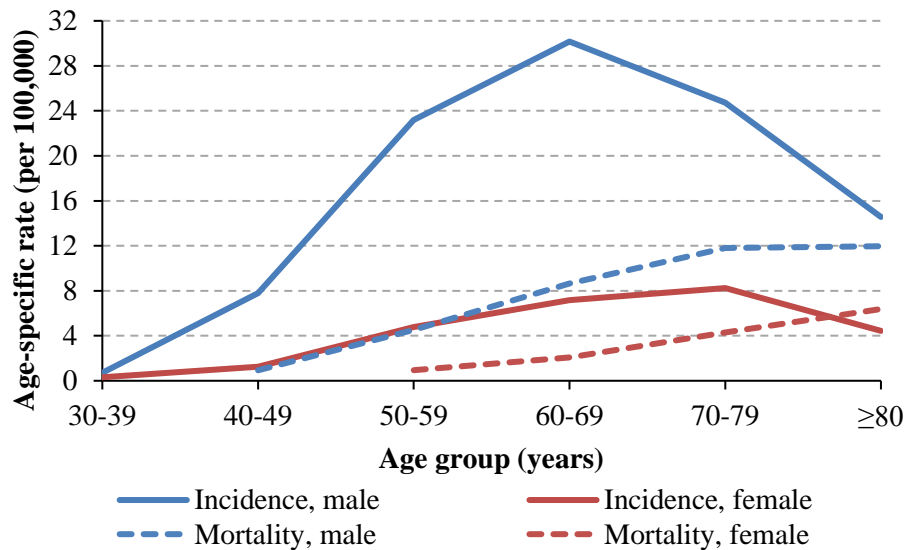
- Overall, the age-adjusted incidence rate of oropharyngeal cancer was 4.7 cases per 100,000. The incidence rate increased by 3.0% annually from 2004-2014 with statistical significance.
- The age-adjusted incidence rate of oropharyngeal cancer was 4.1 times higher among Massachusetts males than among females (7.9 and 1.9 per 100,000 respectively during 2004-2014).
- The incidence rate among males increased by 2.8% annually from 2004-2014 with statistical significance. The incidence rate among females increased by 6.6% annually from 2004-2012 with statistical significance, but then decreased from 2012-2014 by 13.7% without statistical significance.
- Massachusetts had a higher incidence rate of oropharyngeal cancer than the United States (5.0 vs 4.5 per 100,000) from 2008-2012.¹

Mortality

- Overall, the age-adjusted mortality rate from oropharyngeal cancer was 1.5 deaths per 100,000. The mortality rate decreased annually by 1.9% from 2008-2014, without statistical significance.
- The age-adjusted mortality rate from oropharyngeal cancer was 3.2 times higher among Massachusetts males than among females (2.4 and 0.7 per 100,000 respectively during 2008-2014).
- The mortality rate among males and females did not change with statistical significance from 2008-2014 in Massachusetts.

PATTERNS IN OROPHARYNGEAL CANCER INCIDENCE AND MORTALITY BY AGE

Figure 2. Age-specific incidence (2004-2014) and mortality (2008-2014) rates[^] of oropharyngeal cancer, Massachusetts



	Age Group (Years)					
	30-39	40-49	50-59	60-69	70-79	80+
Incidence, male	0.71	7.80	23.18	30.16	24.71	14.57
Incidence, female	0.31	1.25	4.79	7.18	8.24	4.44
Mortality, male	-	0.93	4.51	8.64	11.79	11.96
Mortality, female	-	-	0.94	2.08	4.30	6.38

[^]per 100,000; cells with fewer than 10 people not shown; Data source: Massachusetts Cancer Registry and Massachusetts Registry of Vital Records and Statistics

Incidence by age group

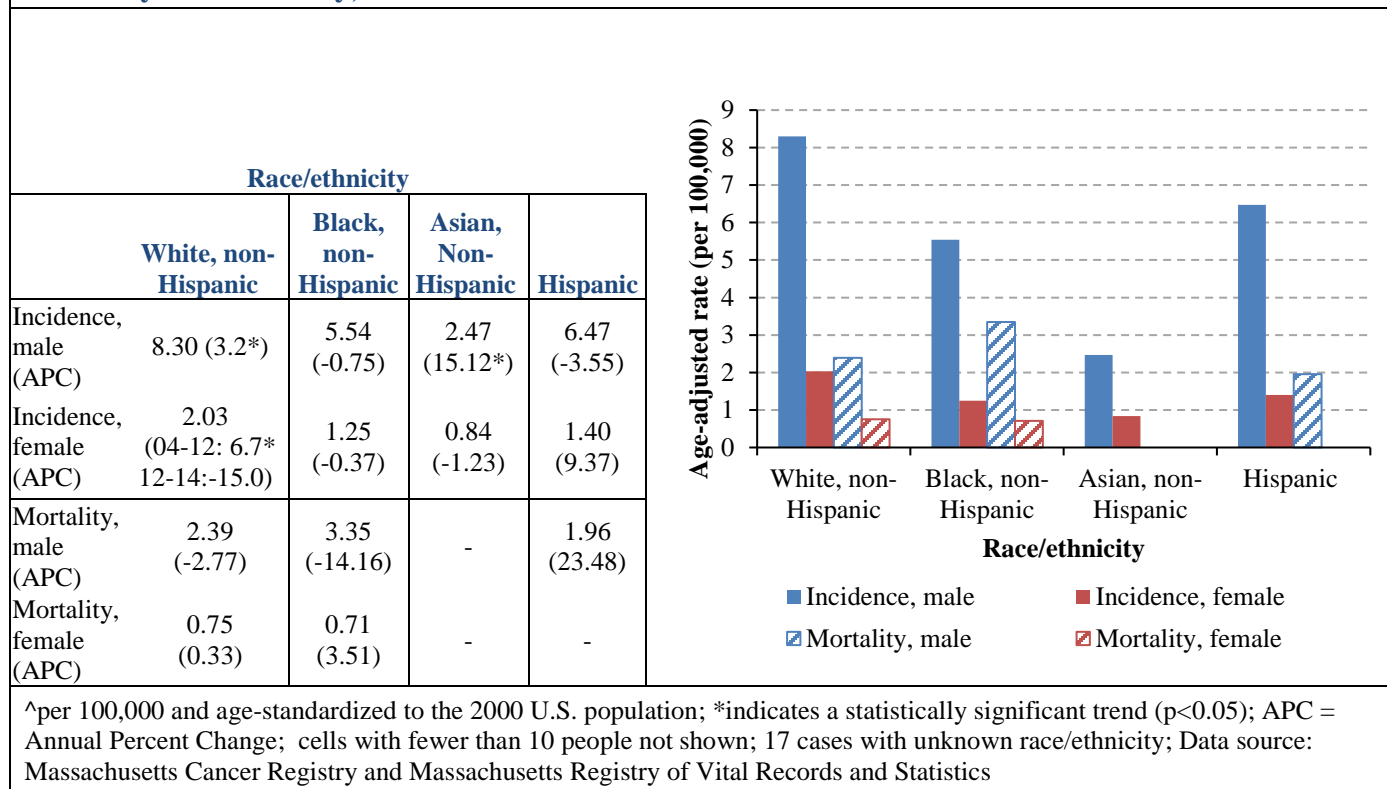
- Among males, the highest age-specific incidence rates from 2004-2014 were among males diagnosed in their 60s (30.2 cases per 100,000 males) and 70s (24.7 cases per 100,000 males).
- Among females, the highest age-specific incidence rates from 2004-2014 were among females in their 70s (8.2 cases per 100,000 females) and 60s (7.2 cases per 100,000 females).

Mortality by age group

- Among males, the highest age-specific mortality rates from 2008-2014 were among males in their 80s and older (12.0 deaths per 100,000 males) and 70s (11.8 deaths per 100,000 males).
- The highest age-specific mortality rates from 2008-2014 were among females in their 80s and older (6.4 deaths per 100,000 females) and 70s (4.3 deaths per 100,000 females).

PATTERNS IN OROPHARYNGEAL CANCER INCIDENCE AND MORTALITY BY RACE/ETHNICITY

Figure 3. Age-adjusted incidence (2004-2014) and mortality (2008-2014) rates[^] of oropharyngeal cancer by race/ethnicity, Massachusetts



Incidence by race/ethnicity

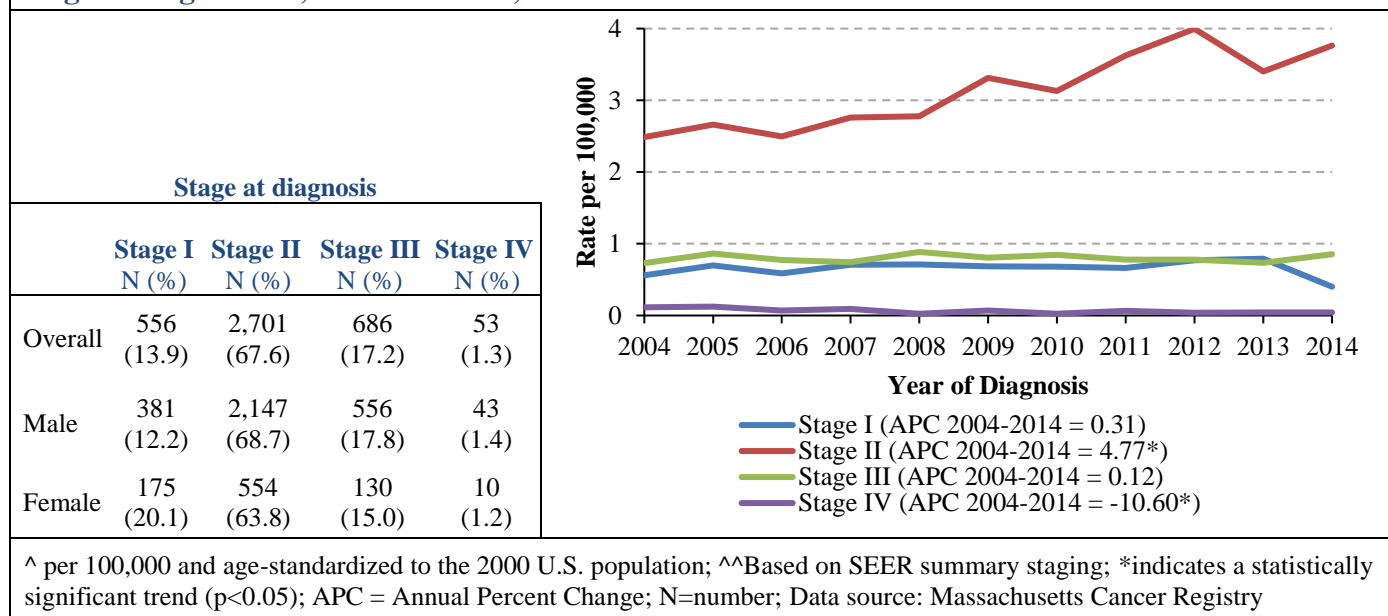
- Among males and females, non-Hispanic whites had the highest age-adjusted incidence rates of oropharyngeal cancer (8.3 and 2.0 per 100,000 respectively).
- The incidence rate of oropharyngeal cancer was 1.5 times greater among non-Hispanic white males than non-Hispanic black males, and 1.6 times greater among non-Hispanic white females than non-Hispanic black females.
- Non-Hispanic white and Asian males had increases in the age-adjusted incidence rate of oropharyngeal cancer from 2004-2014 with statistical significance (3.2% and 15.1% respectively). Non-Hispanic white females had an annual increase in the incidence rate from 2004-2012 with statistical significance (6.7%), but then saw a non-statistically significant annual decrease in the incidence rate from 2012-2014.

Mortality by race/ethnicity

- Among males, non-Hispanic blacks had the highest age-adjusted mortality rate of oropharyngeal cancer (3.4 deaths per 100,000).
- The mortality rate of oropharyngeal cancer was 1.4 times higher among non-Hispanic black males than non-Hispanic white males.
- There were no statistically significant changes in the annual mortality rates of oropharyngeal cancer for any race/ethnicity from 2008-2014 in Massachusetts.

PATTERNS OF OROPHARYNGEAL CANCER BY STAGE AT DIAGNOSIS

Figure 4. Number, percentage distribution, and incidence rate[^] of oropharyngeal cancer cases by stage at diagnosis^{^^}, Massachusetts, 2004-2014



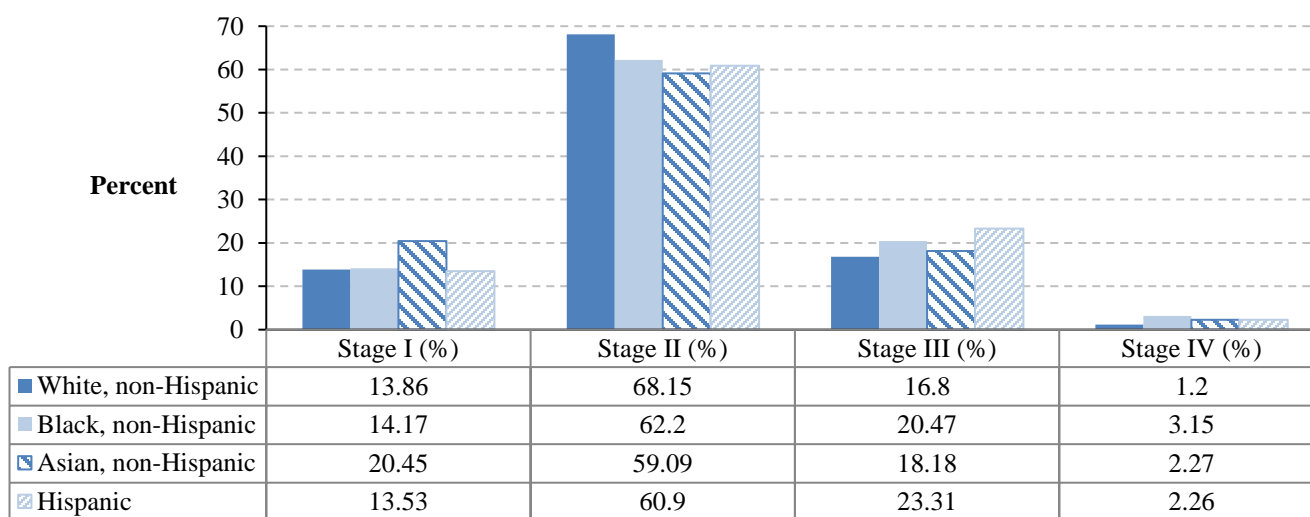
Stage at diagnosis

- 68% of males and females with oropharyngeal cancer in Massachusetts were diagnosed with stage II disease from 2004 to 2014.
- There was a statistically significant 4.8% annual increase in the incidence rate of stage II

oropharyngeal cancer and a statistically significant 10.6% annual decrease in the incidence rate of stage IV oropharyngeal cancer from 2004-2014 in Massachusetts.

- There were no statistically significant differences in stage at diagnosis by race/ethnicity.

Figure 5. Stage at diagnosis^{^^} by race/ethnicity, Massachusetts, 2004-2014



^{^^} Based on SEER summary staging, data source: Massachusetts Cancer Registry

OROPHARYNGEAL CANCER INCIDENCE ATTRIBUTABLE TO HPV

Table 3. Estimated annual average number of oropharyngeal cancer cases attributable to HPV, Massachusetts, 2004-2014

	Average Annual Number	Attributable to any HPV type Number (%)	Attributable to HPV 16/18 Number (%)	Attributable to HPV 16/18/31/33/45/52/58 Number (%)
All Oropharyngeal	363	250 (70.1)	220 (60.2)	240 (65.9)
Male	284	210 (72.4)	180 (63.4)	190 (67.8)
Female	79	50 (63.3)	40 (50.8)	50 (60.3)

Number attributable to HPV is rounded to the nearest 10; due to rounding, numbers in columns may not add up; Data source: Massachusetts Cancer Registry and percentages from Saraiya et al, *JNCI*, 2015²; no direct evidence of HPV strains was collected in MCR

Number attributable to HPV

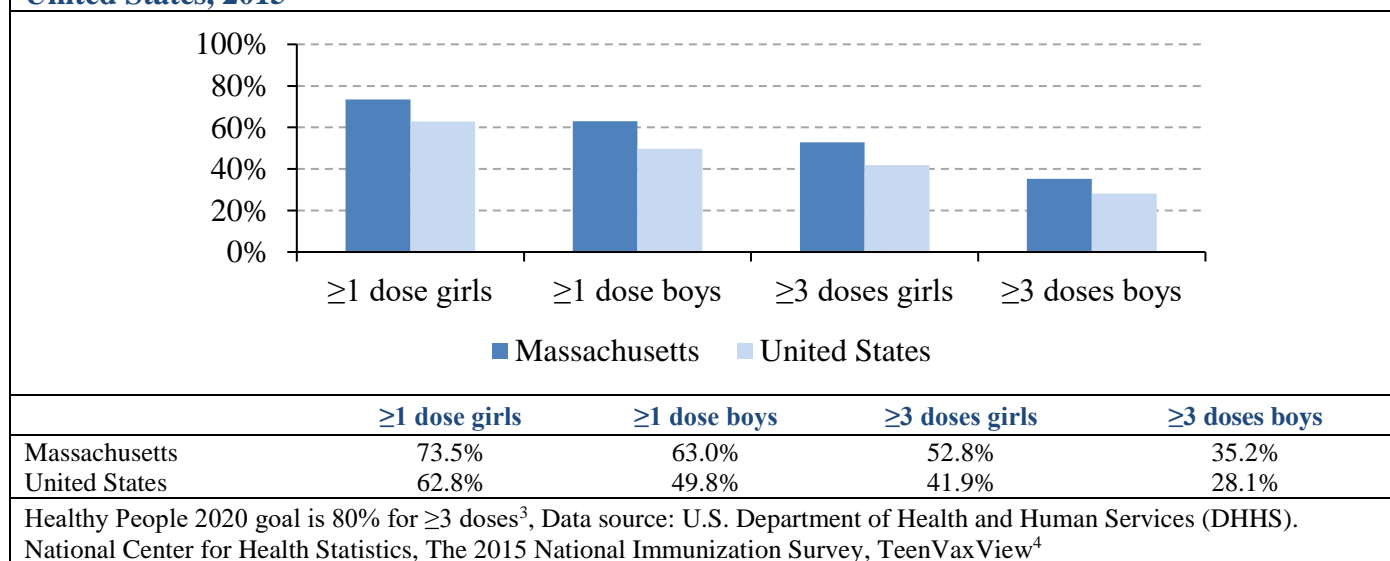
- In Massachusetts, 250 cases of oropharyngeal cancer were estimated to be attributable to infection with any strain of HPV each year.
- Of those 250 cases attributable to any strain of HPV, 220 cases each year were attributable to HPV strains 16 and 18. All available HPV vaccines protect against HPV 16 and 18.

HPV Vaccination

- Of those cases attributable to any strain of HPV, 240 were attributable to HPV 16, 18, 31, 33, 45, 52, and 58. The 9 valent vaccine protects against those seven HPV strains. In Massachusetts, 70.6% of females age 18-26 years reported having ever received a HPV vaccine in the 2015 BRFSS. Of those who ever received a HPV vaccine, 78.2% reported they completed the vaccine series.
- Among younger Massachusetts teens ages 13-17 years old, 73.5% of females and 63.0% of males reported ever having at least one dose of the HPV vaccine. Teens in Massachusetts have a higher prevalence of the HPV vaccine compared to the United States.⁴

HPV VACCINATION IN MASSACHUSETTS COMPARED TO THE UNITED STATES

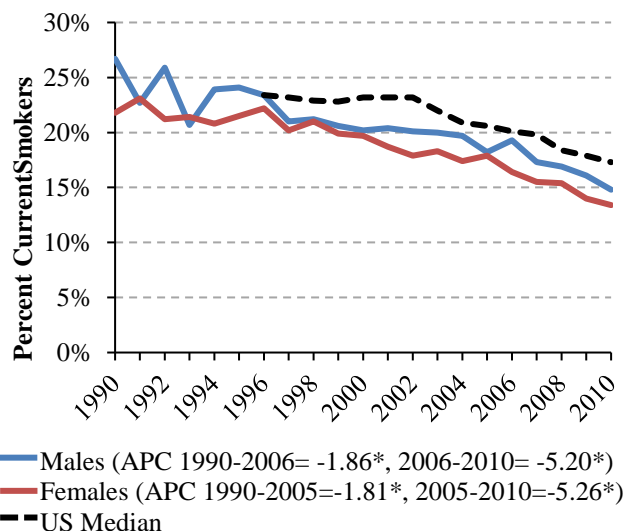
Figure 6. Percent of teens, ages 13-17 years, receiving the HPV vaccine in Massachusetts and the United States, 2015



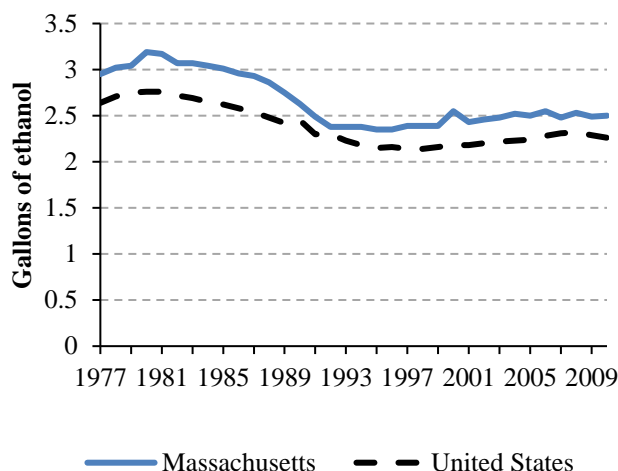
TRENDS IN SELECT RISK FACTORS FOR OROPHARYNGEAL CANCER

Figure 7. Traditional risk factors for oropharyngeal cancer

Current cigarette smoking among adults from BRFSS⁵



Per capita ethanol consumption among people 14 and older from NIAAA⁶



- HPV-negative oropharyngeal cancers are often caused by alcohol (ethanol) and tobacco use.
- Massachusetts had a smaller percent of current smokers than the United States. The percent of current smokers has been decreasing from 1990-2010 with statistical significance.

- Massachusetts had a higher per capita ethanol consumption than the United States. Massachusetts, when compared to the United States, also had a higher prevalence of heavy drinking (7.2% vs 5.9%) and binge drinking (17.7% vs 16.3%) in 2015.^{5,6}

DATA SUMMARY

- In Massachusetts from 2004-2014, oropharyngeal cancer was the most common HPV-associated cancer among males and the third most common HPV-associated cancer among females.
- Oropharyngeal cancer was the most common cause of death from an HPV-associated cancer for males and second most common cause of death from an HPV-associated cancer for females from 2008-2014 in Massachusetts.
- The incidence rate of oropharyngeal cancer among males in Massachusetts has been increasing by 2.8% each year from 2004-2014 with statistical significance.
- The age-adjusted incidence rate of oropharyngeal cancer was 4.1 times higher among Massachusetts males than among females.
- The incidence rate of oropharyngeal cancer is higher in Massachusetts than the United States.
- The incidence rate of oropharyngeal cancer was highest among non-Hispanic whites and the mortality rate was highest among non-Hispanic blacks in Massachusetts.
- Each year, the 9 valent vaccine has the potential to prevent an estimated 240 cases of oropharyngeal cancer in Massachusetts. Although Massachusetts has higher HPV vaccination rates than the US, it still falls short of the Healthy People 2020 goal.
- Massachusetts has a lower prevalence of smoking than the United States but a higher prevalence of heavy and binge drinking than the United States.

DISCUSSION AND IMPLICATIONS FOR PREVENTION

Oropharyngeal cancer is the most common HPV-associated cancer in males in Massachusetts and the third most common HPV-associated cancer in females in Massachusetts. The incidence rate of oropharyngeal cancer among males in Massachusetts has been increasing and the rate is higher than the rate in the United States. Traditionally HPV-negative oropharyngeal cancers were due to alcohol and tobacco use. However, the decreasing prevalence of these risk factors, coupled with the increase in oropharyngeal cancer, points to a larger burden of HPV-positive oropharyngeal cancers.

There are no routine screening tests for oropharyngeal cancer, making the HPV vaccine very important for the prevention of oropharyngeal cancer. Vaccines for HPV have been approved by the US Food and Drug Administration (FDA) since 2006. Current recommendations from the Advisory Committee on Immunization Practices (ACIP) include:⁷

- Boys and girls are recommended to start the series of vaccines at age 11 or 12.
- People who are not immunocompromised and initiated the HPV vaccine between ages 9 and 14 are recommended to get 2 doses of the HPV vaccine.
- People initiating the HPV vaccine between ages 15 and 26, along with those who are immunocompromised, should receive 3 doses of the HPV vaccine.

Besides getting the HPV vaccine for prevention, avoiding the risk factors of smoking and alcohol may help reduce the risk of oropharyngeal cancer. The American Cancer Society also recommends eating a healthy diet, wearing properly fitted dentures, reducing your risk of HPV infection by limiting the number of sexual partners, and treating pre-cancerous growths.⁸

In summary, the increasing incidence rate of oropharyngeal cancer in Massachusetts highlights the need for improved HPV vaccination rates, especially among boys. Improving HPV vaccination coverage has the potential to prevent an estimated 96% of all HPV-attributable oropharyngeal cancer cases. Individual, community, and statewide

interventions to promote healthy lifestyles are needed to reduce the burden of disease.

DATA SOURCES

Massachusetts Behavioral Risk Factor Surveillance System (BRFSS):

The Behavioral Risk Factor Surveillance System (BRFSS) is an ongoing random-digit-dial telephone survey of adults age 18 and older in collaboration with the Centers for Disease Control and Prevention (CDC). The survey has been conducted in Massachusetts since 1986 and collects data on a variety of health risk factors, preventive behaviors, and emerging public health issues. Data are collected on HPV vaccination and current smoking. National BRFSS data were also examined.⁵

Massachusetts Cancer Registry (MCR):

Data on the incidence of oropharyngeal cancers are provided by the Massachusetts Cancer Registry (MCR), which is part of the Massachusetts Department of Public Health (MDPH). The MCR is a population-based registry that has been collecting reports of newly diagnosed cancer cases since 1982. The North American Association of Central Cancer Registries (NAACCR) has estimated that the MCR case ascertainment is more than 95% complete. The cancer cases in this report are primary invasive cancers diagnosed among Massachusetts residents. Incident cases were used from 2004-2014.

Massachusetts Registry of Vital Records and Statistics (MRVRS):

The oropharyngeal cancer death data are provided by the MDPH's Massachusetts Registry of Vital Records and Statistics (MRVRS). The MRVRS has legal responsibility for collecting reports of death on Massachusetts residents. We looked at cancer deaths from 2008-2014 to account for the long survival period of oropharyngeal cancer.

National Center for Health Statistics (NCHS):

The population estimates used for rate calculations and data on the 2000 US population are provided by the National Center for Health Statistics (NCHS). The NCHS produces population estimates in collaboration with the U.S. Census Bureau's Population Estimation Program.

National Institute on Alcohol Abuse and Alcoholism (NIAAA):

The National Institute on Alcohol Abuse and Alcoholism (NIAAA) is part of the National Institutes of Health (NIH) and collects information on alcohol use in the United States. Data on per capita ethanol consumption from 1997-2010 were obtained from the NIAAA.⁶

TECHNICAL NOTES AND DEFINITIONS

Age-Adjusted Rates: Rates were age-adjusted using the direct method of standardization. The weights were the proportions of person-time in the corresponding age groups of the 2000 U.S. Census bureau population per 100,000. Rates were adjusted using eighteen 5-year age groups. Incidence rates were calculated from 2004-2014. Mortality rates were calculated from 2008-2014 to allow for survival time.

HPV-Associated Cancer Estimates: Inclusion of selected cancers was based on CDC-defined codes.¹ Since not all HPV-associated cancers are caused by HPV, we used the CDC methodology on HPV-associated cancers to estimate the number of cancers attributable to HPV applying estimated percentages from genotyping studies.^{1,2}

Incidence: The incident cases of oropharyngeal cancer are the number of people who are newly diagnosed with the disease during a specific time period. The incidence data for oropharyngeal cancer were collected for cancers with the International Classification of Disease for Oncology (ICD-O) codes: C01.9, C02.4, C02.8, C05.1-5.2, C09.0-10.9, and C14.0-14.2.

Joinpoint Regression Analysis of Cancer Trends: The annual percent change (APC) is a linear approximation of trends over time. The $APC = 100 * (e^m - 1)$, where m is a slope of the linear regression line, which is an approximation of the function of the natural logarithm of the rates by the year of diagnosis. SEER provides software to calculate the number and location of points where trends change direction (joinpoints).⁹

Mortality: The number of deaths was the number of people who died due to oropharyngeal cancer during a specific time period. The mortality data were collected for deaths with International Classification of Diseases tenth edition (ICD-10) codes: C01, C02.4-2.9, C05.1-5.2, C09.0-10.9, and C14.0-14.2.

Statistically Significant: Results were considered to be statistically significant when the p value < 0.05 for all analyses.

DATA LIMITATIONS

When interpreting the cancer data, it is important to consider certain limitations which include:

- **Under-reporting in areas close to neighboring states:** Although the MCR has reciprocal reporting agreements with 36 states as of April 2015, there may still be some Massachusetts residents who were diagnosed out of state and not reported to the MCR.
- **Interpretation of trends:** Apparent increases or decreases in cancer incidence over time may reflect changes in diagnostic methods or case reporting rather than true changes in cancer occurrence.
- **Small number of cases:** Many of the calculations in this report involved small numbers of cases. As a result, differences in rates may be due to chance, and the data should be interpreted with caution.
- **Estimation of proportion attributable to HPV:** The MCR does not contain information on the HPV DNA present in cancer tissues. Therefore, we consider HPV-associated cancers to be those where HPV DNA is frequently found from other studies. These numbers are the best estimates but may not reflect the true proportion attributable to HPV.

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