



Data Brief:

Cervical Cancer in Massachusetts

Massachusetts Department of Public Health

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PURPOSE

The purpose of this report is to present the epidemiology of cervical cancer in Massachusetts from 2004 to 2014. This report describes the incidence, mortality, trends over time, percentage of cervical cancers attributable to human papillomavirus (HPV) infection, and compares the findings in Massachusetts to national data on cervical cancer. Data are from the Massachusetts Cancer Registry and Massachusetts Registry of Vital Records and Statistics. Cervical cancer can be prevented or detected early through routine screening or HPV vaccination; therefore, we are examining rates of screening and vaccination in Massachusetts.

KEY FINDINGS

- Among females, cervical cancer was the most common HPV-associated cancer from 2004-2014, and most common cause of death from an HPV-associated cancer from 2008-2014, in Massachusetts.
- The incidence rate of cervical cancer in Massachusetts has been decreasing by 2.4% each year from 2004-2014 with statistical significance. The mortality rate of cervical cancer has been decreasing by 3.7% annually for 2008-2014 without statistical significance.
- The incidence rate of cervical cancer was lower in Massachusetts than the United States from 2008-2012.

CERVICAL CANCER COMPARED WITH OTHER HPV-ASSOCIATED CANCERS

Table 1. Total cases, age-adjusted incidence rates (2004-2014),^ total deaths, and age-adjusted mortality rates (2008-2014)^ of the most common HPV-associated cancers in females, Massachusetts

Cancer Site	Cases	Incidence Rate [^]	Deaths	Mortality Rate [^]
All HPV-associated cancer sites	5,130	11.84	956	3.08
Cervix	2,193	5.46	374	1.29
Vulva*	1,046	2.24	221	0.67
Oropharynx*	869	1.91	234	0.73

*These sites are restricted to squamous cell carcinomas for incidence data; ^per 100,000 and age-standardized to the 2000 U.S. population; HPV associated cancer sites in females are anus, cervix, oropharynx, rectum, vagina, and vulva; data source: Massachusetts Cancer Registry and Massachusetts Registry of Vital Records and Statistics

New Cases

- From 2004- 2014, 5,130 cases of HPV-associated cancers were diagnosed in Massachusetts females. Of those cases, 2,193 (43%) were diagnosed with cervical cancer.
- Cervical cancer is the most common HPV-associated cancer diagnosed in females in Massachusetts (on average 199 cases of cervical cancer each year).

Deaths

- From 2008-2014, 956 deaths due to an HPV-associated cancer occurred in Massachusetts females. Of those deaths, 374 (39%) were due to cervical cancer.
- Cervical cancer was the leading cause of cancer death from an HPV-associated cancer in Massachusetts (on average 53 deaths from cervical cancer each year).

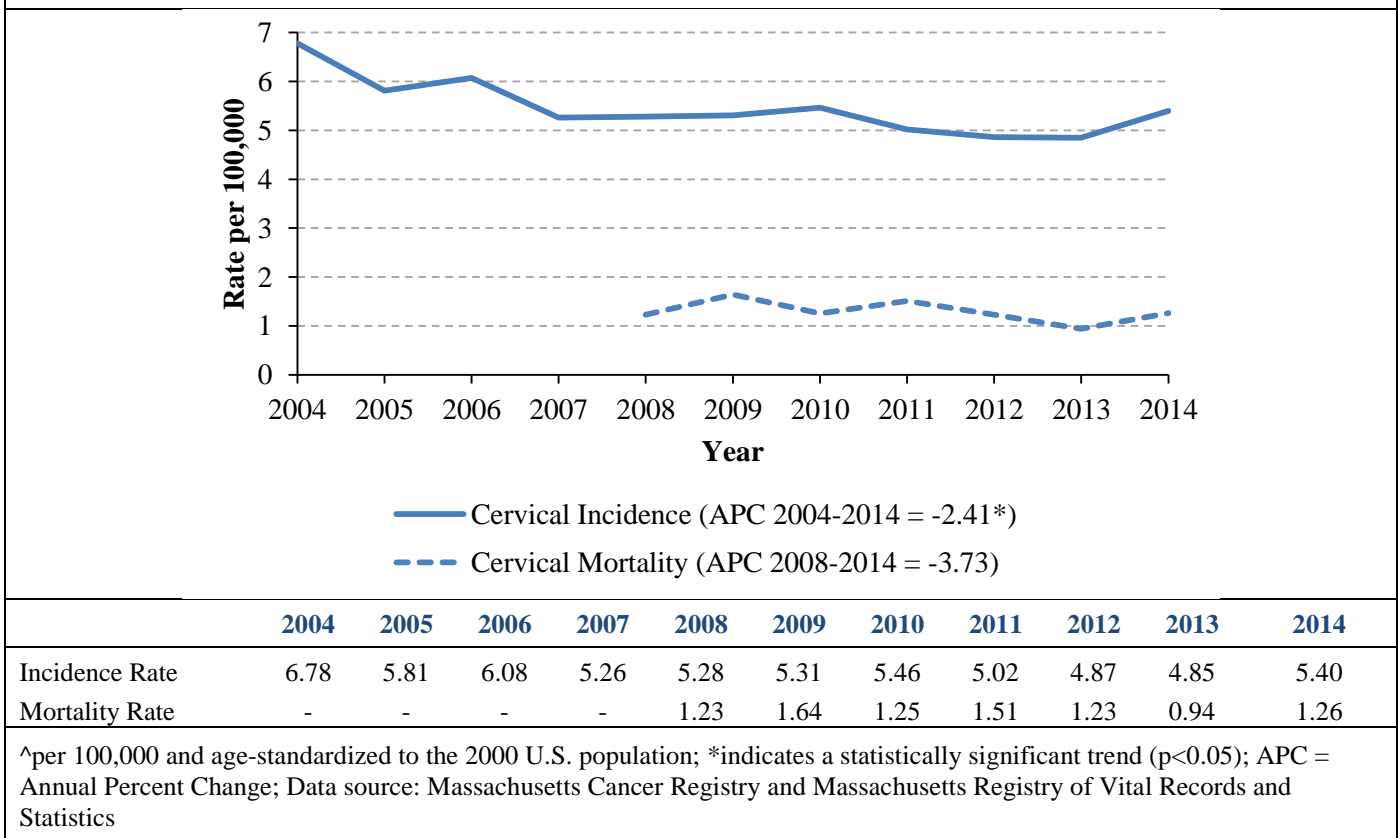
Incidence

- The age-adjusted incidence rate of cervical cancer was 5.5 cases per 100,000 females. The incidence rate decreased by 2.4% annually from 2004-2014 (p=0.004).
- Massachusetts had a lower incidence rate of cervical cancer than the United States (5.2 vs 7.4 per 100,000) from 2008-2012.¹
- The age-adjusted mortality rate from cervical cancer was 1.3 deaths per 100,000 females. The mortality rate decreased annually by 3.7% from 2008-2014, a non-significant decline (p=0.29).
- Massachusetts had a lower mortality rate from cervical cancer than the United States (1.3 vs 2.3 per 100,000) from 2009-2013.²

Mortality

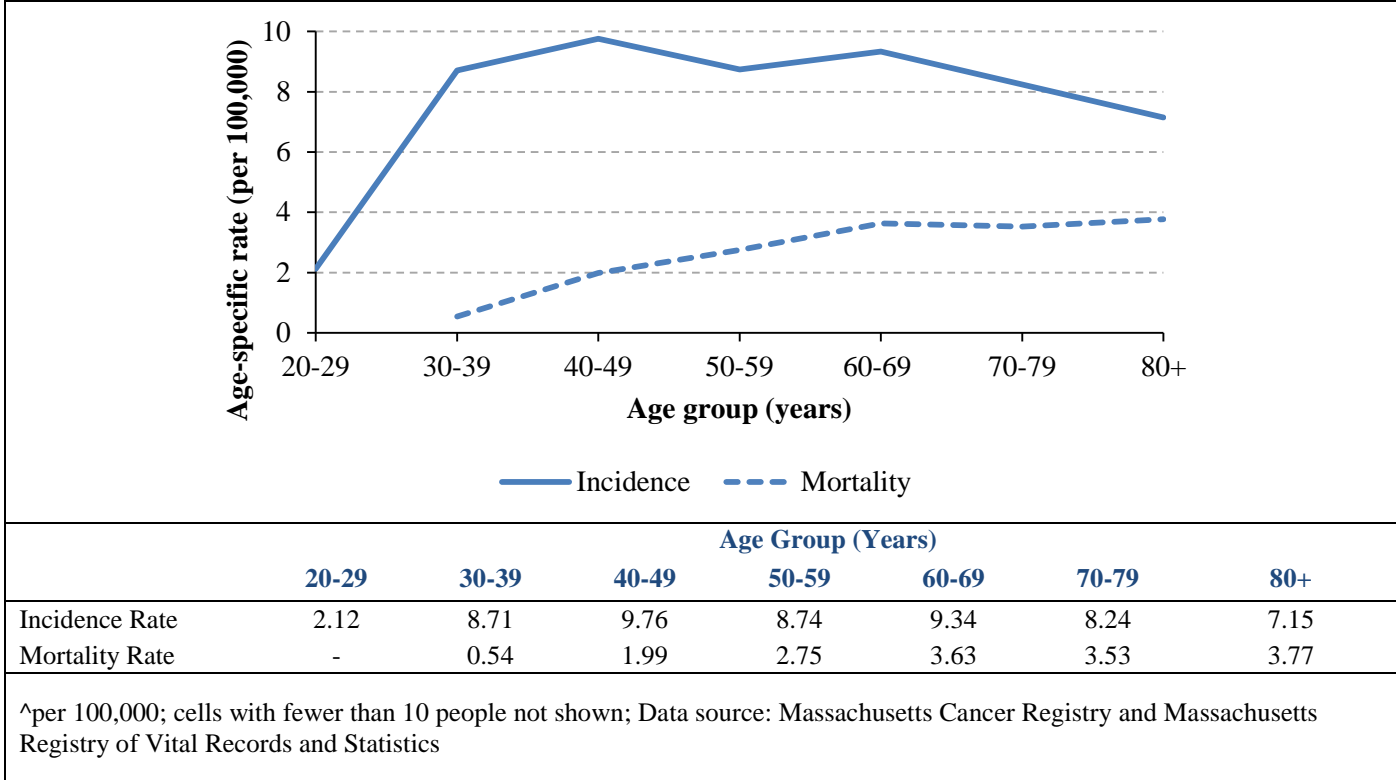
CERVICAL CANCER TRENDS

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



PATTERNS IN CERVICAL CANCER INCIDENCE AND MORTALITY BY AGE

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



Incidence by age group

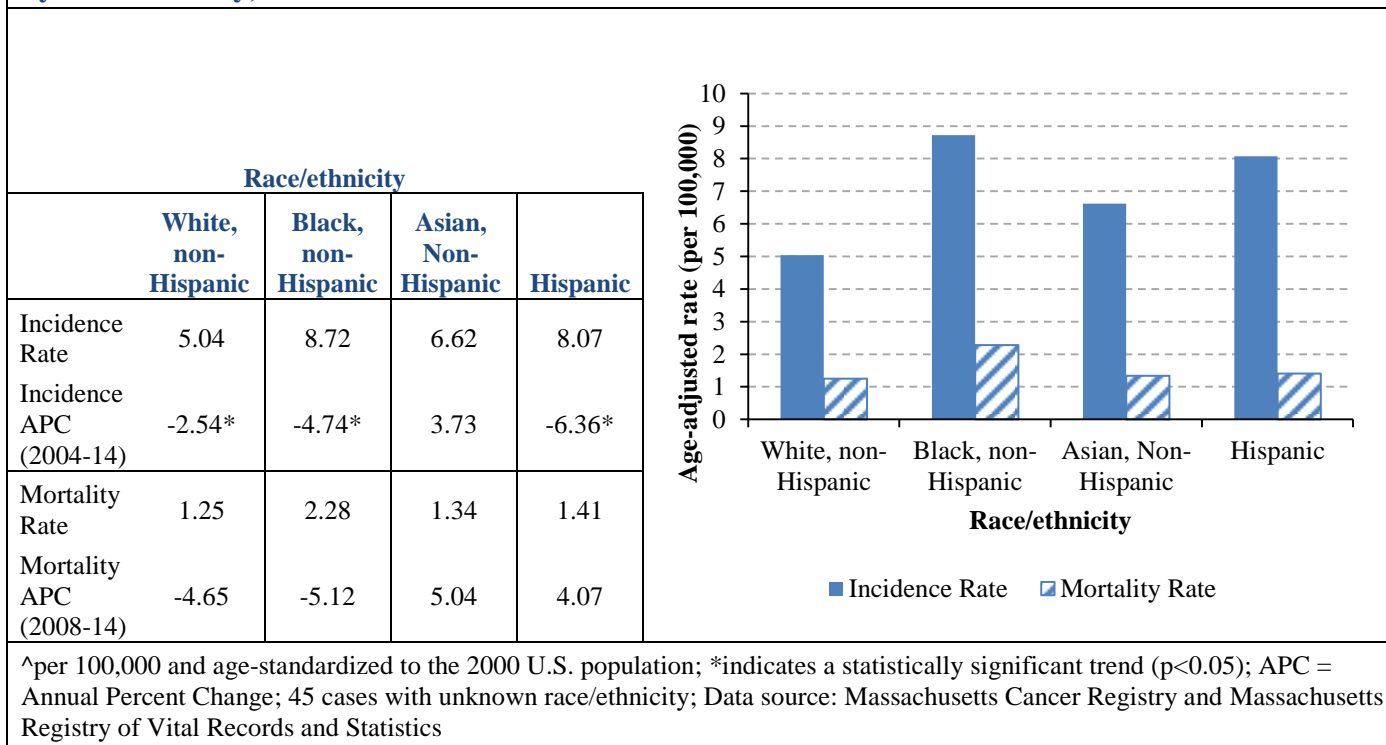
- The highest age-specific incidence rates from 2004-2014 were among females diagnosed in their 40s (9.8 cases per 100,000 females) and 60s (9.3 cases per 100,000 females).
- Females age 30-39 and age 50-59 saw statistically significant annual decreases in the age-specific incidence rate of cervical cancer (-3.9%, p=0.027, and -3.8%, p=0.0002, respectively). Other age groups saw non-statistically significant annual decreases in the incidence rate of cervical cancer from 2004-2014.

Mortality by age group

- The highest age-specific mortality rates from 2008-2014 were among females in their 80s and older (3.8 deaths per 100,000 females) and 60s (3.6 deaths per 100,000 females).
- Females in their 60s saw a statistically significant annual decrease in the age-specific mortality rate of cervical cancer (-11.9%, p=0.025). Females in their 50s saw a statistically significant annual increase in the mortality rate from 2008-2010 (30.6%, p=0.026) followed by a statistically significant annual decrease in the mortality rate from 2010-2014 (-6.1%, p=0.034).

PATTERNS IN CERVICAL CANCER INCIDENCE AND MORTALITY BY RACE/ETHNICITY

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



Incidence by race/ethnicity

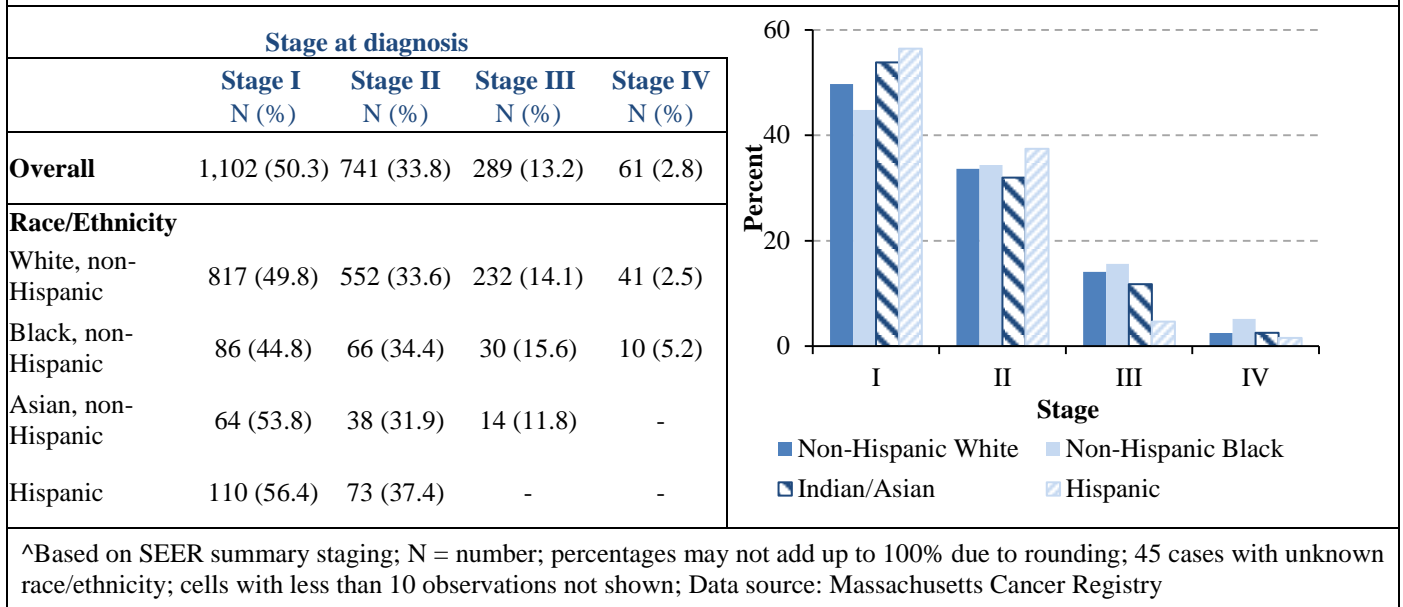
- Non-Hispanic blacks had the highest age-adjusted incidence rate of cervical cancer (8.7 cases per 100,000) followed by Hispanics (8.1), Asians (6.6) and non-Hispanic whites (5.0) from 2004-2014.
- The incidence rate of cervical cancer was 1.7 times higher among non-Hispanic black females than non-Hispanic white females.
- Non-Hispanic whites, non-Hispanic blacks, and Hispanics all had decreases in the age-adjusted incidence rate of cervical cancer from 2004-2014 (-2.5%, p=0.020; -4.7%, p=0.028; and -6.4%, p=0.010, respectively). Asians had a 3.7% annual increase in the age-adjusted incidence rate of cervical cancer, which was not statistically significant.

Mortality by race/ethnicity

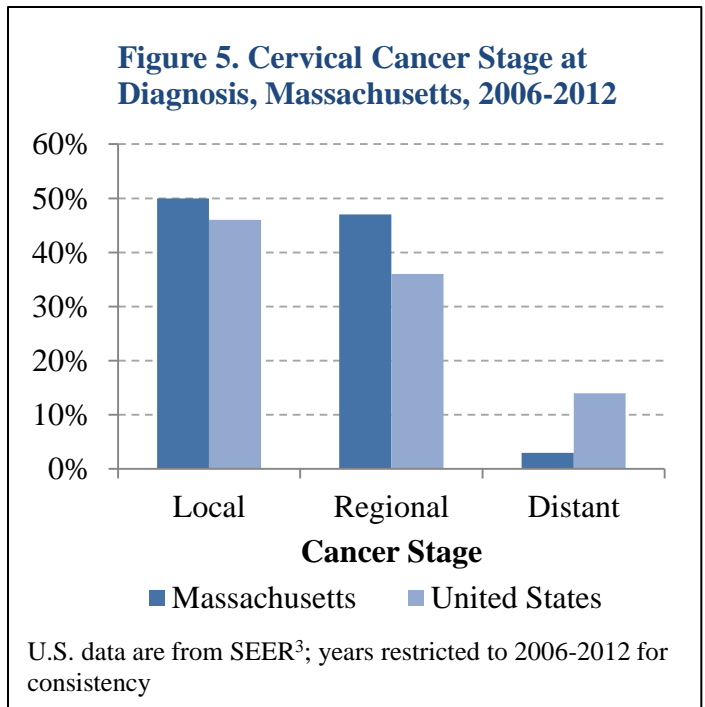
- Non-Hispanic blacks had the highest age-adjusted mortality rate of cervical cancer (2.3 deaths per 100,000) followed by Hispanics (1.4), Asians (1.3) and non-Hispanic whites (1.3) from 2008-2014.
- The mortality rate of cervical cancer was 1.8 times higher among non-Hispanic black females than non-Hispanic white females.
- Non-Hispanic whites and non-Hispanic blacks had decreases in the age-adjusted mortality rate of cervical cancer from 2008-2014 (-4.7% and -5.1% respectively) that were not statistically significant. Asians and Hispanics had increases in the age-adjusted mortality rate of cervical cancer from 2008-2014 (5.0% and 4.1% respectively) that were not statistically significant.

PATTERNS OF CERVICAL CANCER BY STAGE AT DIAGNOSIS

Figure 4. Number and percentage distribution among cervical cancer cases by stage at diagnosis[^] overall and by race/ethnicity, Massachusetts, 2004-2014



- Fifty percent of females with cervical cancer in Massachusetts were diagnosed with stage I disease from 2004 to 2014. Only 16.0% of females were diagnosed with stage III or IV disease.
- Hispanic females were more likely to be diagnosed with stage I or II disease when compared with white, non-Hispanic females (93.8% vs 83.4% respectively).
- Black, non-Hispanic females were less likely to be diagnosed with stage I or II disease when compared with white, non-Hispanic females (79.2% vs 83.4% respectively).
- There was a 4.3% annual decrease in the incidence rate of stage I cervical cancer from 2004-2014 in Massachusetts, with statistical significance. While all other stages saw annual decreases, none of them were statistically significant (stage II: -0.3%, stage III -0.9%, stage IV -4.3%).
- Fewer females in Massachusetts were diagnosed at a distant stage when compared to the United States from 2006-2012 (Distant stage: MA=3%, US=14%).³



CERVICAL CANCER INCIDENCE ATTRIBUTABLE TO HPV

Table 2. Estimated annual average number of cervical cancer cases attributable to HPV, Massachusetts, 2004-2014

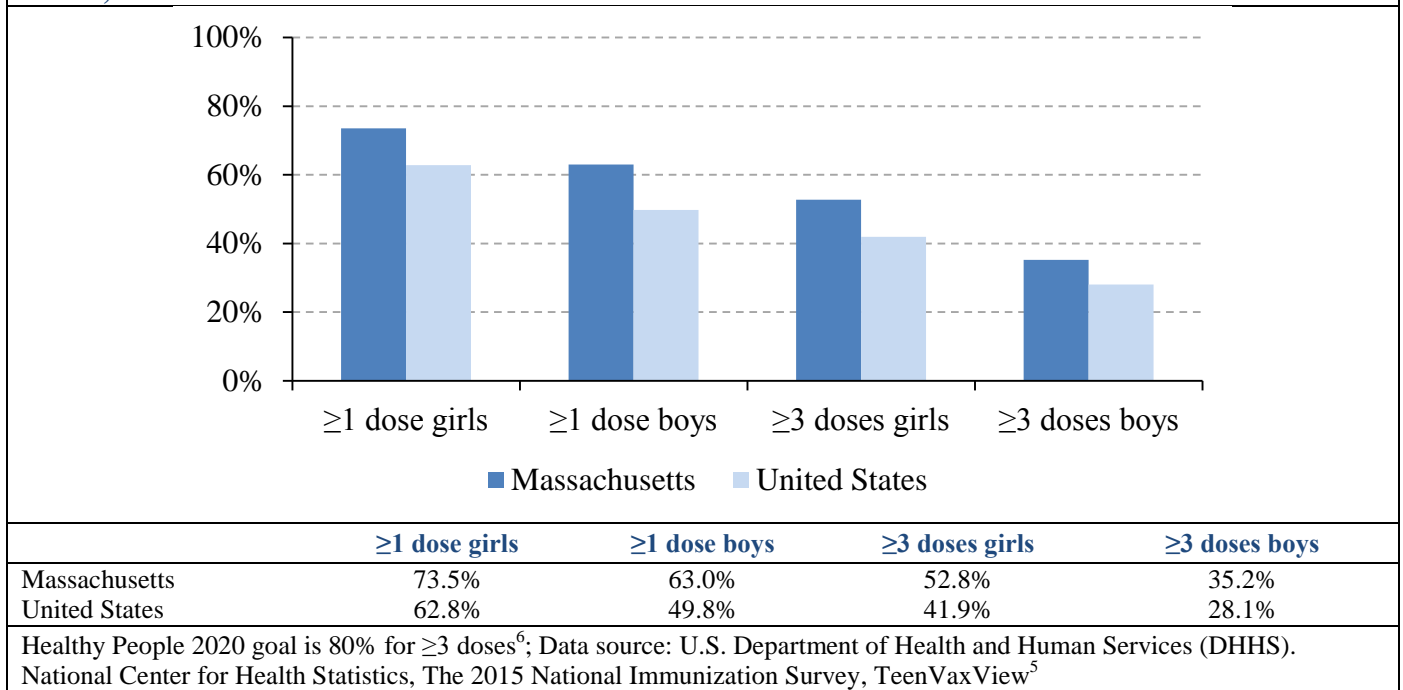
	Average Annual Number	Attributable to any HPV type Number (%)	Attributable to HPV 16/18 Number (%)	Attributable to HPV 16/18/31/33/45/52/58 Number (%)
Cervical Cancer	199	180 (90.6)	130 (66.3)	160 (80.9)

Number attributable to HPV is rounded to the nearest 10; Data source: Massachusetts Cancer Registry and assumes percentages from Saraiya et al, *JNCI*, 2015⁴; no direct evidence of HPV strains was collected in MCR

- In Massachusetts, 180 cases of cervical cancer were estimated to be attributable to infection with any strain of HPV each year.
- Of those 180 cases attributable to any strain of HPV, 130 cases each year were estimated to be attributable to HPV 16 and 18. All available HPV vaccines protect against HPV 16 and 18.
- Of those cases attributable to any strain of HPV, 160 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 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 females, ages 13-17 years old, 73.5% reported ever having at least one dose of the HPV vaccine. Teens in Massachusetts have a higher prevalence of HPV vaccination compared to the United States.⁵

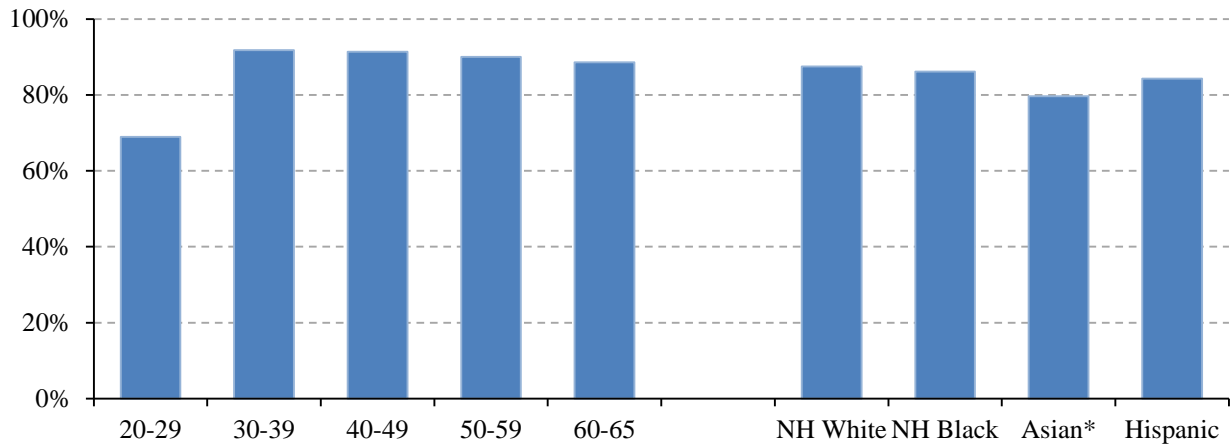
HPV VACCINATION IN MASSACHUSETTS COMPARED TO THE UNITED STATES

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



PREVALENCE OF CERVICAL CANCER SCREENING BY PAP SMEAR

Figure 7. Percent of females^ ages 20-65 that reported a Pap smear in the past 3 years by age and race/ethnicity, Massachusetts, 2014



^Among females without a history of hysterectomy; *2012 data was used for Asians due to insufficient data in 2014, and was statistically significant from white females in 2012; NH = Non-Hispanic; Healthy People 2020 goal is 93%⁶; Data source: Massachusetts BRFSS

- In 2014, 86.2% of females in Massachusetts, age 20-65 and who did not have a hysterectomy, had a Pap smear in the past 3 years.
- The prevalence of Pap smears was lowest among females age 20-29 (69.0%) and was highest among females age 30-39 (91.8%).
- Asian females had a lower age-adjusted prevalence of Pap smears than non-Hispanic white females (79.7% compared to 89.7% respectively) in 2012. Non-Hispanic black females, Hispanic females, and non-Hispanic white females had a similar age-adjusted prevalence of Pap smears (86.2%, 84.3% and 87.5% respectively) in 2014.
- In the United States, 80.7% of females aged 21-65 reported having a Pap smear in the last 3 years compared to 86.2% of females in Massachusetts ages 20-65.⁷
- In the United States, the prevalence of Pap smears was lower among Asians, Hispanics, and females aged 51-65 years, which was similar to trends in Massachusetts, except the younger Massachusetts females (20-29 years old) who had lower rates of Pap smear screening.⁷

DATA SUMMARY

- Cervical cancer was the most common HPV-associated cancer from 2004-2014, and most common cause of death from an HPV-associated cancer from 2008-2014, among females in Massachusetts.
- The incidence rate of cervical cancer in Massachusetts has been decreasing with statistical significance by 2.4% each year from 2004-2014. The mortality rate of cervical cancer has been decreasing without statistical significance by 3.7% annually for 2008-2014.
- The incidence rate of cervical cancer was lower in Massachusetts than the United States from 2008-2012.
- The incidence and mortality rate of cervical cancer was highest among non-Hispanic black females in Massachusetts. Compared to non-Hispanic whites, the incidence rate was 1.6 times higher and the mortality rate was 1.8 times higher for non-Hispanic blacks.
- Most females with cervical cancer in Massachusetts were diagnosed with stage I disease. Hispanic females were more likely than non-Hispanic white females to be diagnosed with stage I or II disease. Fewer females in Massachusetts were diagnosed at a distant stage when compared with the United States.
- Each year, the 9 valent vaccine has the potential to prevent an estimated 180 cases of cervical 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 fairly high prevalence of cervical cancer screening; however, screening rates remain low for females in their 20s and Asian females.

DISCUSSION AND IMPLICATIONS FOR PREVENTION

Cervical cancer is the most common HPV-associated cancer in females in Massachusetts. Both the incidence and mortality rates of cervical cancer in Massachusetts have been decreasing and Massachusetts has lower rates than the United States. However, disparities in the incidence and mortality rates of cervical cancer in Massachusetts still exist, with non-Hispanic black females having a higher burden of cervical cancer when compared with non-Hispanic white females.

Due to the availability of screening tests and the HPV vaccine, cervical cancer should be almost completely preventable. Screening allows early pre-cancerous lesions to be found and removed, and it can detect disease while it is still at an early stage, both of which can decrease the incidence and mortality of cervical cancer.

Primary prevention of HPV-associated cancers exists in the form of HPV vaccination. 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:⁸

- 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.

Secondary prevention of cervical cancer exists in the form of cytology (Pap smears) and HPV tests. Current recommendations include:⁹

- Females between the ages of 21 and 65 should be screened for cervical cancers.
- Screening can be done with cytology alone every 3 years or in combination with HPV testing every 5 years starting at age 30 in healthy females.
- Any abnormal findings should be evaluated and the screening schedule should be updated accordingly.

In summary, while cervical cancer has a decreasing incidence and mortality rate in Massachusetts, further efforts are needed to reduce the burden of this highly preventable cancer. Racial and ethnic disparities in the rates of cervical cancer still exist in Massachusetts. Improving HPV vaccination coverage has the potential to prevent an estimated 89% of all HPV-attributable cervical cancer cases. In addition, individual, community, and statewide interventions to promote healthy lifestyles and cervical cancer screening in Massachusetts 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, hysterectomies, and pap smears. National BRFSS data were also collected on HPV vaccination and Pap smears.¹⁰

Massachusetts Cancer Registry (MCR):

Data on the incidence of cervical cancer 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 Massachusetts cancer cases reported in this report are primary cases of invasive cancer diagnosed among Massachusetts residents. Incident cases were used from 2004-2014.

Massachusetts Registry of Vital Records and Statistics (MRVRS):

The cervical 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 deaths for Massachusetts residents. We looked at cancer deaths from 2008-2014 to account for the long survival period of cervical cancers.

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.

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.⁴ 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.^{1,4}

Hysterectomy Adjustment: Females who had a hysterectomy should be removed from the population when calculating rates of cervical cancer. The data on hysterectomy status is not available in the MCR dataset so estimates were needed using data from BRFSS to correct the population for the prevalence of hysterectomies. Data collected in the BRFSS were insufficient to calculate the hysterectomy prevalence by age and race/ethnicity or by race/ethnicity alone. Since data on hysterectomies was collected every two years, we used an average of the data collected before and after the missing year to get the missing year's data for each category. Due to small sample sizes we were not able to obtain the hysterectomy prevalence for females under age 30 and above 70. We assumed a hysterectomy prevalence of 0% for females under age 30 and assumed the hysterectomy prevalence for females age 70 and above was the same as 60-69 year olds. To get an adjusted population we multiplied the female population by percent without a hysterectomy. We used the adjusted population to calculate the age-specific standardized rates.

Incidence: The incident cases of cervical cancer are the number of people who are newly diagnosed with the disease during a specific time period. The incidence data for cervical cancer were collected for cancers with the International Classification of Disease for Oncology (ICD-O) codes: C53.0, C53.1, C53.8, and C53.9.

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).¹¹

Mortality: The number of deaths was the number of people who died due to cervical cancer during a specific time period. The mortality data were collected for deaths with International Classification of Diseases tenth edition (ICD-10) codes: C53.0, C52.1, C53.8, and C53.9.

Stage: We used SEER summary staging to assign females to stage I – stage IV cervical cancer. Stage I disease was considered local disease, stage II and stage III were considered regional disease, and stage IV was considered distant disease.

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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