Massachusetts
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Public Health

Evaluation of Cancer Incidence in Oxford, MA

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I. Introduction

At the request of Representative Frost and the health inspector for the Town of Oxford, an evaluation of cancer incidence in Oxford, MA was conducted. The purpose of this evaluation was to address general cancer concerns raised by a resident of Oxford. Staff in the Community Assessment Program (CAP) of the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health (BEH) reviewed and analyzed data available from the Massachusetts Cancer Registry (MCR) for diagnoses in the community of Oxford during 2003 to 2007 (MCR 2010a). For those cancer types with an elevation in incidence during this five-year time period, MCR data were also reviewed and analyzed by census tract. In addition, CAP conducted a qualitative review of cancer diagnoses that occurred in a particular area of concern to the resident, which includes the neighborhood near the Greenbrier Recreation Area in North Oxford.

II. Methods for Analyzing Cancer Incidence

A. Case Identification/Definition

Cancer incidence data (i.e., reports of new cancer diagnoses) were obtained for the community of Oxford from the MCR, a division in the MDPH Bureau of Health Information, Statistics, Research, and Evaluation (BHISRE). Because the concern was cancers in general, twenty-three main cancer types were evaluated in this investigation. Cancer incidence rates for these cancer types are published annually by the MCR in its city and town supplement. Individuals diagnosed with cancer were selected for inclusion based on the residential address provided to the hospital or reporting medical facility at the time of diagnosis.

The MCR is a population-based surveillance system that that has been monitoring cancer incidence in the Commonwealth since 1982. All new diagnoses of invasive cancer, as well as certain in situ (localized) cancers, are required by law to be reported to the MCR within six months of the date of diagnosis (M.G.L. c.111. s 111b). This information is kept in a confidential database. Data are collected on a daily basis and reviewed for accuracy and completeness on an annual basis. Due to the high volume of data collected by the MCR and the 6-month period between diagnosis and required reporting, the most current registry data that are complete will be a minimum of two years prior to the current date. The five-year period 2003-2007 constitutes the period for which the most recent and complete cancer incidence data were available at the initiation of this analysis.

The term "cancer" is used to describe a variety of diseases associated with abnormal cell and tissue growth. Epidemiologic studies have revealed that different types of cancer are individual diseases with separate causes, risk factors, characteristics and patterns of survival (Berg 1996). Cancers are classified by the location in the body where the disease originated (the primary site) and the tissue or cell type of the cancer (histology). Therefore, each of the cancer types reviewed in this report was evaluated separately. Cancers that occur as the result of the metastasis, or the spread of a primary site cancer to another location in the body, are not considered as separate cancers and, therefore, were not included in this analysis.

It should be noted that duplicate records have been eliminated from the MCR data used in this report. Duplicate cases are additional reports of the same primary site cancer diagnosed in an individual by another health-care provider. The decision that a diagnosis was a duplicate and should be excluded from the analyses was made by the MCR. However, reports of individuals

with multiple primary site cancers were included as separate diagnoses in this report. A diagnosis of a multiple primary cancer is defined by the MCR as a new cancer in a different location in the body or a new cancer of the same histology as an earlier cancer, if diagnosed in the same primary site more than two months after the initial diagnosis (MCR 2003).

B. Calculation of a Standardized Incidence Ratio

To assess the incidence of cancer in Oxford, a statistic called the standardized incidence ratio (SIR) was calculated using data from the MCR. The SIR is a comparison of the number of diagnoses in the community to the number of expected diagnoses based on the statewide rate. Specifically, an SIR is the ratio of the observed number of cancer diagnoses in an area to the expected number of diagnoses multiplied by 100. Age-specific statewide incidence rates were applied to the population distribution of Oxford to calculate the number of expected cancer diagnoses.

SIRs were not calculated for some cancer types due to the small number of observed cases (less than five). It is standard BHISRE policy not to calculate rates with fewer than five observed diagnoses due to the instability of the rate. However, the expected number of diagnoses was calculated and compared to the observed number of diagnoses to determine whether excess numbers of cancer diagnoses were occurring.

Because accurate age-group and gender-specific population data are required to calculate SIRs, the census tract (CT) is the smallest geographic area for which cancer incidence rates can be accurately calculated. A CT is a smaller geographic subdivision of a city or town that is designated by the U.S. Census Bureau; Oxford is divided into two CTs. The area of concern, which includes the neighborhood near the Greenbrier Recreation Area, is located in CT 7531

(see Figure 1). For those cancer types with an elevation in incidence during the five-year time period 2004-2008, SIRs were also calculated for each census tract.

C. Interpretation of a Standardized Incidence Ratio

An SIR is an estimate of the occurrence of cancer in a population relative to what might be expected if the population had the same cancer experience as a larger comparison population designated as "normal" or average. Usually, the state as a whole is selected to be the comparison population, which provides a stable population base for the calculation of incidence rates. The statewide incidence rate is applied to the population structure of each community to calculate the number of expected cancer diagnoses. Comparison of SIRs between communities or census tracts is not possible because each of these areas has different population characteristics.

An SIR of 100 indicates that the number of cancer diagnoses observed in the population being evaluated is equal to the number of cancer diagnoses expected in the comparison or “normal” population. An SIR greater than 100 indicates that more cancer diagnoses occurred than expected, and an SIR less than 100 indicates that fewer cancer diagnoses occurred than expected. Accordingly, an SIR of 150 is interpreted as 50% more diagnoses than the expected number; an SIR of 90 indicates 10% fewer diagnoses than expected.

Caution should be exercised, however, when interpreting an SIR. The interpretation of an SIR depends on both its size and the stability. Two SIRs may have the same size but not the same stability. For example, an SIR of 150 based on four expected diagnoses and six observed diagnoses indicates a 50% excess in cancer, but the excess is actually only two diagnoses. Conversely, an SIR of 150 based on 400 expected diagnoses and 600 observed diagnoses represents the same 50% excess in cancer, but because the SIR is based upon a greater number of

diagnoses, the estimate is more stable. It is very unlikely that 200 excess diagnoses of cancer would occur by chance alone. As a result of the instability of incidence rates based on small numbers of diagnoses, SIRs are not calculated when fewer than five diagnoses were observed for a particular cancer type.

D. Calculation of the 95% Confidence Interval

To help interpret or measure the stability of an SIR, the statistical significance of an SIR can be assessed by calculating a 95% confidence interval (CI) to determine if the observed number of diagnoses is "statistically significantly different" from the expected number or if the difference may be due solely to chance (Rothman and Boice 1982). Specifically, a 95% CI is the range of estimated SIR values that have a 95% probability of including the true SIR for the population. If the 95% CI range does not include the value 100, then the study population is significantly different from the comparison or "normal" population. "Statistically significantly different" means there is less than a 5% percent chance that the observed difference (either increase or decrease) in the rate is the result of random fluctuation in the number of observed cancer diagnoses.

For example, if a confidence interval does not include 100 and the interval is above 100 (e.g., 105-130), then there is a statistically significant excess in the number of cancer diagnoses. Similarly, if the confidence interval does not include 100 and the interval is below 100 (e.g., 45-96), then the number of cancer diagnoses is statistically significantly lower than expected. If the confidence interval range includes 100, then the true SIR may be 100. In this case, it cannot be determined with certainty whether the difference between the observed and expected number of diagnoses reflects a real cancer increase or decrease or is the result of chance. It is important to

note that statistical significance alone does not necessarily imply public health significance. Determination of statistical significance is just one tool used to interpret cancer patterns.

In addition to the range of the estimates contained in the confidence interval, the width of the confidence interval also reflects the stability of the SIR estimate. For example, a narrow confidence interval (e.g., 103-115) allows a fair level of certainty that the calculated SIR is close to the true SIR for the population. A wide interval (e.g., 85-450) leaves considerable doubt about the true SIR, which could be much lower than or much higher than the calculated SIR. This would indicate an unstable statistic. Again, due to the instability of incidence rates based on a small numbers of diagnoses, statistical significance was not assessed when fewer than five diagnoses were observed.

E. Evaluation of Cancer Risk Factor Information

As previously mentioned, cancer is not just one disease but rather a general term used to describe a variety of different diseases. Studies have generally shown that different cancer types have different risk factors. One or even several factors acting over time can be related to the development of cancer. Available information reported to the MCR related to risk factors for cancer development was reviewed for residents of Oxford who were diagnosed with a cancer type that was elevated in the community during 2003 to 2007. This information is collected for each individual at the time of diagnosis and includes the individual's age at time of diagnosis, the stage of disease, and the individual's history of tobacco use and occupation. The available risk factor information was compared to known or established incidence patterns for the specific type of cancer.. To protect the privacy of those Oxford residents diagnosed with cancer during this time period, the information is presented in this report as a summary without any specific

identifying details. Unfortunately, information about personal risk factors such as family history, medical history, diet, and other factors that may also influence the development of cancer is not collected by the MCR. Therefore, it was not possible to consider their contributions to cancer development in this investigation.

F. Determination of Geographic Distribution of Cancer Cases

Using a computerized geographic information system (GIS), address at the time of diagnosis was mapped for each individual diagnosed with a type of cancer that was elevated in Oxford during 2003 to 2007. The address at the time of diagnosis was also mapped for each resident within the area of concern diagnosed with cancer during 2003 to 2009 (ESRI 2009). This allowed for an evaluation of the spatial distribution of the individual diagnoses at a smaller geographic level within a community (i.e., neighborhoods). This evaluation of the point pattern of diagnoses included consideration of the variability in population density within the community.

The MDPH is bound by state and federal patient privacy and research laws not to make public the names or any other information (e.g., place of residence) that could personally identify individuals with cancer whose diagnoses have been reported to the MCR (M.G.L. c.111. s. 24A). Therefore, for confidentiality reasons, it is not possible to release maps showing the locations of individuals diagnosed with cancer in public reports. However, a summary of the evaluation of geographic distribution with any notable findings is presented in this report.

III. Results

Table 1 contains incidence data for 23 types of cancer for the community of Oxford for the five-year time period of 2003-2007 (MCR 2010a). The incidence of the following cancer types

occurred about as expected or less frequently over the five-year time period evaluated: breast, cervix, colon/rectum, esophagus, kidney and renal pelvis, larynx, leukemia, liver and intrahepatic bile duct, melanoma of the skin, multiple myeloma, ovary, pancreas, prostate, stomach, testes, and uterus.

Elevations were noted in the following cancer types in Oxford during 2003 to 2007, two of which were statistically significant:

- Statistically significant elevations occurred in thyroid cancer and cancers of the oral cavity and pharynx.

- Elevations that were not statistically significant occurred in bladder cancer, lung and bronchus cancers, non-Hodgkin lymphoma, Hodgkin lymphoma, and brain and other nervous system (ONS) cancers.

The incidence for each of the seven types of cancer listed above was further evaluated by census tract for the same time period. Table 2 contains SIRs for CT 7531 and Table 3 contains SIRs for CT 7532. The incidence of these seven cancer types is discussed further in the following sections.

A. Thyroid Cancer

During this five-year time period, the incidence of thyroid cancer among residents of Oxford was elevated among males (9 observed versus 3 expected) and less than expected among females (3 observed versus 9 expected). The elevation among males is statistically significant (SIR = 353, 95% CI 161-670) (MCR 2010a). A separate evaluation by census tract revealed that the incidence among males was about as expected in CT 7531 (1 observed versus 1 expected) but

statistically significantly elevated in CT 7532 with 8 observed diagnoses compared to about one expected (SIR = 685, 95% CI 295-1350). The incidence among females was less than or about as expected in both CTs (3 observed versus 5 expected in CT 7531; zero observed versus 4 expected in CT 7532). A review of diagnoses of thyroid cancer in Oxford during the previous five-year time period from 1998 to 2002 revealed that no diagnoses occurred among males when approximately two would have been expected and six diagnoses occurred among females when five would have been expected. Therefore, the statistically significant elevation among males is limited to the five-year time period of 2003-2007 and does not appear to be a consistent trend over a longer time period (MCR 2005).

Thyroid cancer is commonly diagnosed at a younger age than most other adult cancers with nearly 2 out of 3 diagnoses occurring in individuals between the ages of 20 and 55 (ACS 2011a). In Oxford, 58% of those diagnosed with thyroid cancer during 2003 to 2007 were in this age range.

There are several different histologies (cell types) of thyroid cancer. About 80% of thyroid cancers are papillary carcinomas. The next most common type is follicular carcinoma and accounts for about 10% of thyroid cancers (ACS 2011a). The cell types of thyroid cancer diagnosed among residents of Oxford during 2003 to 2007 generally follow the national statistics with 67% diagnosed with papillary carcinomas and about 17% diagnosed with follicular carcinomas.

A few risk factors that increase the risk of developing thyroid cancer have been identified, including certain inherited medical conditions, exposure to ionizing radiation such as that used for the treatment of other cancers, and a diet low in iodine (ACS 2011a). However, the MCR

does not collect information related to these risk factors and, hence, they could not be evaluated. In addition, it is possible that each subtype of thyroid cancer may have different risk factors associated with its development.

Diagnoses of thyroid cancer in Oxford during 2003 to 2007 were also reviewed to determine if any unusual temporal or spatial patterns existed. Diagnoses fluctuated from year to year with a maximum of five occurring in a given year. The geographic distribution of address at the time of diagnosis generally followed the pattern of population density within the community and no unusual concentrations were observed.

B. Cancers of the Oral Cavity and Pharynx

During the five-year time period 2003-2007, the incidence of cancers of the oral cavity and pharynx was elevated among males in the community of Oxford with 11 observed diagnoses compared to approximately 5 that would have been expected (SIR = 210, 95% CI 105-375). This elevation is statistically significant. Among females within Oxford, the incidence was slightly elevated (5 observed diagnoses versus 2 expected). A separate evaluation by census tract revealed that the incidence of this cancer type among males was about as expected in CT 7531 (5 observed versus 3 expected) and slightly elevated in CT 7532 (6 observed versus 3 expected) but not statistically significant. The incidence among females was about as expected in both census tracts (3 observed versus 1 expected in CT 7531; 2 observed versus 1 expected in CT 7532). Although the number of observed diagnoses in the census tracts exceeded the number of expected diagnoses in some cases by one or two, this was likely a result of random fluctuation and represents natural variation.

The average age of individuals diagnosed with these cancers in the United States is 62, with about one-third younger than age 55. However, these cancers are rarely diagnosed in children (ACS 2011b). Among Oxford residents diagnosed with cancer of the oral cavity and pharynx during 2003 to 2007, the average age at diagnosis was 61 years and 69% were age 55 or over at the time of their diagnosis. No children were diagnosed with this cancer type in Oxford during this time period. Therefore, the age distribution at the time of diagnosis among Oxford residents during this time period is consistent with what would be expected based on national statistics.

In the United States, cancers of the oral cavity and pharynx occur most commonly in the tongue (about 25% of diagnoses), the tonsils (about 10% to 15%), the lip (about 10% to 15%), and the minor salivary glands (about 10% to 15%) (ACS 2011b). In Oxford, 25% of individuals diagnosed with cancer of the oral cavity and pharynx between 2003 and 2007 were diagnosed with cancer in the tongue and 13% were diagnosed with cancer in the tonsils. In addition, there are several different histologies of cancer of the oral cavity and pharynx. More than 90% of cancers of the oral cavity and pharynx are squamous cell carcinomas (ACS 2011b). In Oxford, 75% of individuals diagnosed with oral cavity and pharynx cancers between 2003 and 2007 were diagnosed with this histology.

According to the American Cancer Society (ACS), the risk of developing cancers of the oral cavity and pharynx is related to tobacco use and increases with greater quantity and longer duration. About 80% of individuals diagnosed with these cancers in the United States use tobacco (ACS 2011b). Of the 14 individuals diagnosed with this cancer type in Oxford during 2003 to 2007 and for whom tobacco history was reported to the MCR, 12 (86%) were current or former smokers at the time of their diagnosis. In addition, drinking alcohol increases the risk of

developing oral cavity and pharynx cancers and, according to the ACS, about 70% of individuals diagnosed with these cancers nationwide are heavy drinkers (ACS 2011b). The MCR does not collect information on alcohol consumption. As a result, this risk factor could not be evaluated.

In addition to reviewing available risk factor information, the occurrence of cancers of the oral cavity and pharynx in Oxford from 2003 to 2007 was also evaluated to determine if any unusual temporal or spatial patterns existed. Diagnoses were spread fairly evenly over the 5-year time period, with no more than 4 diagnoses occurring in a given year. Place of residence at the time of diagnosis was mapped for each of the 16 individuals diagnosed with cancers of the oral cavity and pharynx in Oxford during this five-year time period. The geographic distribution of diagnoses generally followed the pattern of population density with no unusual concentrations at the neighborhood level.

C. Bladder Cancer

Bladder cancer can be either invasive or non-invasive depending on its extent in the wall of the bladder, which has several layers. If the cancer is confined to the inner layer of the bladder, it is called non-invasive cancer or carcinoma in situ. If the cancer extends into deeper layers of the bladder, it is considered invasive cancer. The data provided in this report include diagnoses of both invasive and non-invasive bladder cancers.

During 2003 to 2007, the incidence of bladder cancer among residents of Oxford was elevated among males (18 observed versus 13 expected) and slightly elevated among females (8 observed versus 5 expected). However, neither elevation is statistically significant. At the census tract level, the incidence of bladder cancer among residents of CT 7531 was also elevated among males (11 observed versus 7 expected) and slightly elevated among females (5 observed versus 2

expected) during the same time period. In CT 7532, the incidence was as expected among both males (7 observed versus 7 expected) and females (3 observed versus 3 expected).

The risk of bladder cancer increases with age and nearly 90% of people with this cancer are over the age of 55 at the time of diagnosis (ACS 2011c). The average age of those diagnosed with bladder cancer in Oxford during 2003 to 2007 was 69 and 81% were above the age of 55 at the time of diagnosis. This is consistent with national trends.

The ACS states that smoking is the most important risk factor for bladder cancer. Smokers are more than twice as likely to develop bladder cancer as nonsmokers. The risk of developing bladder cancer also increases with the number of packs smoked per day and with duration of smoking (ACS 2011c). Of the 24 individuals diagnosed with bladder cancer for whom tobacco history was provided to the MCR, 16 (67%) reported being current or former smokers at the time of their diagnosis.

Workplace exposures to certain industrial chemicals, such as benzidine and beta-naphthylamine, may possibly increase the risk of bladder cancer. These chemicals were common in the dye industry in the past. A higher risk of developing bladder cancer has also been observed among workers in the rubber, leather, textiles, metal, printing, and paint products industries. Further, the risk of bladder cancer from occupational exposures may be increased among smokers (ACS 2011c). Of the 14 individuals diagnosed with bladder cancer in Oxford during 2003 to 2007 who reported an occupation to the MCR, four (29%) appeared to have worked in an occupation that may possibly be a risk factor for the development of bladder cancer. However, a complete occupational history and/or specific job information that could further define exposure potential for these individuals is not available through the MCR.

Other risk factors for bladder cancer include a family history of bladder cancer, certain rare birth defects involving the bladder, a previous cancer diagnosis in any part of the urinary tract, and prior treatment with radiation to the pelvis. The MCR does not collect information related to these personal risk factors. In addition, arsenic in drinking water has been associated with an increased risk of bladder cancer. The chance of being exposed to arsenic depends on where you live and the source of your drinking water (ACS 2011c).

Lastly, the number of diagnoses of bladder cancer in any given year in Oxford fluctuated between three and 8 over the five-year time period from 2003 to 2007. A review of the geographic distribution of the reported residences of individuals diagnosed with bladder cancer in Oxford during 2003 to 2007 did not reveal any unusual spatial patterns or concentrations.

D. Lung and Bronchus Cancers

The incidence of lung and bronchus cancer in Oxford during 2003 to 2007 was elevated among males with 32 observed diagnoses compared to 23 expected. This elevation is not statistically significant. Among females, the incidence was about as expected (25 diagnoses observed versus 23 expected). In CT 7531, the incidence of lung and bronchus cancer was about as expected among males (14 observed versus 13 expected) and females (10 observed versus 12 expected) during the same time period. In CT 7532, the incidence was elevated among males but was not statistically significant (18 observed versus 12 expected). Among females in CT 7532, the incidence was about as expected (14 observed versus 13 expected).

Available risk factor information was reviewed for those residents in Oxford diagnosed with lung and bronchus cancer between 2003 and 2007. According to the ACS, about two-thirds of people diagnosed with lung and bronchus cancer in the U.S. are over 65 years of age at the time

of diagnosis and fewer than 3% are under the age of 45 (ACS 2011e,f). In Oxford, 63% of those diagnosed with this cancer type during this time period were over 65 years of age at diagnosis and 5% were under the age of 45 at diagnosis.

Smoking is by far the most important risk factor for lung and bronchus cancer. It is estimated that about 87% of deaths from lung and bronchus cancer are caused by smoking. The longer a person has been smoking and the higher the number of cigarettes smoked per day, the greater the risk of lung cancer. In addition, there is no evidence that smoking low tar or "light" cigarettes reduces the risk of lung cancer and mentholated cigarettes are thought to increase the risk of lung cancer even more. If an individual stops smoking before a cancer develops, the damaged lung tissue gradually repairs itself. No matter the age of an individual or how long someone has used tobacco, quitting may help an individual to live longer (ACS 2011e,f). Tobacco use history was reviewed for residents in Oxford diagnosed with lung and bronchus cancer between 2003 and 2007. Of the 51 individuals for whom tobacco history was reported, 45 (88%) were current or former smokers at the time of their diagnosis.

There are two main types of lung and bronchus cancers: small cell lung cancer (SCLC) and non-small cell lung cancer (NSCLC). About 85% to 90% of lung and bronchus cancers are NSCLC, of which there are three subtypes: adenocarcinoma, squamous cell carcinoma, and large-cell (undifferentiated) carcinoma. Adenocarcinoma is usually found in the outer region of the lung and is the most common subtype in the U.S., accounting for about 40% of lung and bronchus cancer diagnoses. Squamous cell carcinoma accounts for about 25% to 30% of lung and bronchus cancers and tends to be found in the middle of the lungs, near a bronchus. Large-cell carcinoma accounts for about 10% to 15% of lung and bronchus cancers and may appear in any

part of the lung. SCLC also accounts for about 10% to 15% of all lung and bronchus cancers but often starts in the bronchi (ACS 2011e,f). The distribution of histologies among those residents of Oxford diagnosed with lung and bronchus cancers during 2003 to 2007 followed what would be expected based on national statistics. Of the 45 individuals with a specific histology reported to the MCR, 36 (80%) were diagnosed with NSCLC and 8 (18%) were diagnosed with SCLC. Furthermore, adenocarcinoma was the most common type of NSCLC (31% of those with a specific histology classification), followed by squamous cell carcinoma (20%) and large cell carcinoma (2%).

Exposure to radon has been identified as the second leading cause of lung and bronchus cancer, and the leading cause among nonsmokers. Radon is a naturally occurring radioactive gas produced by the breakdown of uranium in soil and rocks. High indoor levels of radon can occur in homes and buildings, especially in basements. Because radon levels in the soil vary across the country and can be high almost anywhere, testing is the only way to determine the radon level in a home (ACS 2011e,f).

Workplace exposure to asbestos has also been identified as an established risk factor for lung and bronchus cancer. Exposure to asbestos may occur in mines, mills, textile plants, shipyards, and where insulation is used. Asbestos is not usually considered harmful as long as it is not released into the air by deterioration, demolition, or renovation. Additional chemical compounds that are occupational risk factors include arsenic, beryllium, cadmium, silica, vinyl chloride, nickel compounds, chromium compounds, coal products, mustard gas, chloromethyl ethers, diesel exhaust, and radioactive ores such as uranium. The risk of developing lung and bronchus cancer from workplace exposure to these compounds is even higher for smokers (ACS 2011e,f). Of the

57 Oxford residents diagnosed with lung and bronchus cancer during 2003 to 2007, 13 (23%) reported an occupation possibly associated with an increased risk of developing this cancer type. It should be noted, however, that such data are generally limited to job title and/or industry and often do not include specific job duty information that could further define exposure potential for individual diagnoses. Moreover, occupation was reported as unknown, at home, or retired for 21% of the individuals.

A review of the temporal distribution of diagnoses revealed that the number of diagnoses of lung and bronchus cancer among Oxford residents fluctuated between 8 and 15 diagnoses per year over the five-year time period of 2003-2007. The geographic distribution of the reported residences of Oxford residents diagnosed with lung and bronchus cancer during this time period did not appear unusual. MDPH also evaluated the geographic distribution of residence at diagnosis for those individuals with lung and bronchus cancer who did not have a history of smoking as well as for those with no potential for an occupational exposure, and again found no unusual spatial patterns. The spatial patterns for both groups generally followed the population density of the community.

E. Non-Hodgkin Lymphoma

During 2003 to 2007, the incidence of NHL in the community of Oxford was elevated among males with 11 observed diagnoses compared to 7 expected but is not statistically significant. Among females, the incidence was about as expected with 5 observed diagnoses compared to 6 expected. At the census tract level, the incidence of NHL was about as expected among both males and females in CT 7531 (5 observed versus 4 expected for males; 1 observed versus 3

expected for females) and in CT 7532 (6 observed versus 4 expected for males; 4 observed versus 3 expected for females).

Although some types of NHL are among the more common childhood cancers, more than 95% of diagnoses occur in adults. Incidence generally increases with age, with around half of patients older than 65 and an average age at diagnosis in the 60s (ACS 2011g). During 2003 to 2007, the majority of residents diagnosed with NHL in Oxford were adults. More than 74% of those adults were over the age of 65, with an average age of 69 years.

NHL is a classification of all lymphomas except Hodgkin lymphoma. B-cell lymphomas account for about 85% of all NHL diagnoses in the U.S. and consist of many subtypes. T-cell lymphomas are less common but also consist of several subtypes (ACS 2011g). Among those diagnosed with NHL in Oxford during 2003 to 2007, 75% were diagnosed with B-cell lymphomas and the remaining 25% were diagnosed with T-cell lymphomas.

The number of diagnoses of NHL among Oxford residents fluctuated from year to year over the five-year time period 2003-2007 with a minimum of zero diagnoses and a maximum of six. A review of the geographic distribution of the reported residences of individuals diagnosed with NHL in Oxford during 2003 to 2007 did not reveal any unusual spatial patterns or concentrations.

Although NHL is associated with a number of risk factors, such as weakened immune systems, most patients do not have any known risk factors and the causes are unknown. This is complicated by the fact that NHL is actually a diverse group of cancers. It is possible that each subtype of NHL may have different risk factors associated with its development.

F. **Hodgkin Lymphoma**

During 2003 to 2007, the incidence of Hodgkin lymphoma (also called Hodgkin's disease) was slightly elevated among males (4 observed versus 1 expected) and was as expected among females (1 observed versus 1 expected). At the census tract level, the incidence was about as expected among males and females in both CT 7531 (3 observed versus 1 expected for males; zero observed versus 1 expected for females) and CT 7532 (1 observed versus 1 expected for males; 1 observed versus 1 expected for females).

Hodgkin lymphoma is most common in young adults usually between the ages of 15 and 40 and in adults aged 55 and over. Although it is rare in children younger than 5 years of age, it is the most common cancer among individuals ages 15 to 29 (ACS 2011h, Bleyer et al. 2006). In Oxford, the majority of those diagnosed during 2003 to 2007 were young adults, with an average age of 29 years.

In developed countries such as the U.S., a specific type of Hodgkin lymphoma called classic Hodgkin disease accounts for about 95% of diagnoses. Although there are four subtypes of classic Hodgkin disease, nodular sclerosis Hodgkin disease occurs most often in young adults and accounts for about 60% to 80% of all diagnoses of Hodgkin disease in developed countries (ACS 2011h). The histology types of those individuals diagnosed with Hodgkin lymphoma in Oxford during 2003 to 2007 are consistent with what would be expected based on these statistics. To protect the privacy of the Oxford residents diagnosed with Hodgkin lymphoma, their specific cancer subtypes will not be discussed here.

A few risk factors that increase the risk of developing Hodgkin lymphoma have been identified, including infection with the Epstein-Barr virus (which causes mononucleosis, often called

"mono" for short) and a family history of siblings with the disease (ACS 2011h). The MCR does not collect information related to these risk factors and, hence, they could not be evaluated.

Diagnoses of Hodgkin lymphoma in Oxford were spread evenly over the 5-year time period of 2003 to 2007 with no unusual temporal patterns. Similarly, a review of the geographic distribution of address at diagnosis of individuals diagnosed with Hodgkin lymphoma in Oxford during 2003 to 2007 revealed no unusual spatial patterns.

G. Brain and Other Nervous System (ONS) Cancers

During the five-year time period of 2003-2007, the incidence of malignant brain and ONS cancers among females in Oxford was slightly elevated with five diagnoses observed when two would have been expected (SIR = 226, 95% CI 73-526). This elevation is not statistically significant. Among males in the community, the incidence of this cancer type was about as expected (2 observed versus 3 expected). A separate evaluation by census tract revealed that the incidence among females was about as expected in both CT 7531 (3 observed versus 1 expected) and CT 7532 (2 observed versus 1 expected). Likewise, the incidence among males was about as expected in both CT 7531 (2 observed versus 2 expected) and CT 7532 (zero observed versus 1 expected).

Brain and ONS cancers are the second most common cancer type among children (after leukemia) and account for over 20% of childhood cancers. After a peak in childhood, the risk of brain and ONS cancers increases with age between 25 and 75 years (ACS 2011i,j; MCR 2010b). The majority of residents diagnosed in Oxford during 2003 to 2007 were adults, with an average age of 53 years.

Primary brain and ONS tumors consist of two main types: gliomas and meningiomas. Gliomas are a general classification of brain and ONS tumors that develop from glial cells and include astrocytomas, oligodendrogliomas, and ependymomas. According to the ACS, gliomas account for approximately 80% of malignant brain and ONS tumors. Astrocytomas are the most common type of glioma. Glioblastoma multiforme (also referred to as glioblastoma for short) is a high grade, aggressive form of astrocytoma. In adults, glioblastomas account for about two-thirds of all astrocytomas and are the most common malignant brain tumors. Meningiomas arise from the meninges, the layers of tissue that surround the outer part of the brain and spinal cord. Approximately 80% of meningiomas are non-malignant (ACS 2011i). The types of malignant brain and ONS cancers diagnosed among individuals in Oxford during 2003 to 2007 appear to be consistent with what would be expected based on the medical literature and national cancer statistics. The majority of those whom were adults at the time of diagnosis were diagnosed with gliomas. To protect the privacy of the Oxford residents diagnosed with brain and ONS cancers, their specific cancer subtypes will not be discussed here.

Despite numerous scientific and medical studies, the causes of brain and ONS cancers are still largely unknown. Most brain and ONS cancers develop for no apparent reason and are not associated with anything that the person did or didn't do, or with any known exposures in the environment. The most established risk factor for brain and ONS tumors is high-dose exposure to ionizing radiation such as that used for the treatment of other cancers (ACS 2011i,j).

Diagnoses of brain and ONS cancers in Oxford were spread fairly evenly over the 5-year time period of 2003-2007 with no unusual temporal patterns. The geographic distribution of address

at the time of diagnosis for the seven residents diagnosed in Oxford during 2003 to 2007 was generally consistent with the pattern of population distribution with no unusual spatial patterns.

H. Cancer Incidence in the Greenbrier Neighborhood

CAP staff also conducted a qualitative review of cancer diagnoses that occurred during the seven-year time period of 2003-2009 in the neighborhood near the Greenbrier Recreation Area, which was specified as the particular area of concern. As mentioned previously, the census tract (CT) is the smallest geographic area for which cancer incidence rates can be accurately calculated. In addition, the MCR data file for the more recent years of 2008 to present had not yet been closed at the time of this investigation. For these reasons, an expected number of diagnoses could not be calculated for these years or for this smaller area of interest.

A total of 24 individuals within the neighborhood of interest were diagnosed with 13 different cancer types during this seven-year time period. A separate evaluation by gender revealed that 12 females were diagnosed with 8 different cancer types, four of which are the most common cancer types diagnosed among Massachusetts females: breast cancer, lung and bronchus cancers, cancers of the colon/rectum, and cancers of the corpus uteri (uterus). During 2003 to 2007, these four cancer types represented approximately 59% of all new cancer diagnoses among females in the Commonwealth. In the Greenbrier neighborhood, these four cancer types comprised 67% of the diagnoses that occurred among females during 2003 to 2009. Similar to cancer in females in the Greenbrier neighborhood, 12 males were diagnosed with 8 different cancer types, two of which are the among the most common cancer types diagnosed among Massachusetts males: prostate cancer and lung and bronchus cancers. These two cancer types represented 57% of all diagnoses among males in the neighborhood of interest during 2003 to 2009 compared to

approximately 42% of all diagnoses among males in Massachusetts during 2003 to 2007 (MCR 2010b).

For the majority of the individuals, age at diagnosis and the histology (cell type) was consistent with what would be expected based on state and national trends for the specific type of cancer. Twenty-two of the 24 individuals (92%) diagnosed in the Greenbrier neighborhood between 2003 and 2009 were over age 50 at the time of their diagnosis.

Tobacco use history was reviewed for those individuals diagnosed with a cancer type for which smoking is an established risk factor. Of the 12 individuals for whom tobacco history was reported, 75% (n = 8) were current or former smokers at the time of diagnosis.

Lastly, no unusual spatial or temporal patterns were observed in this area. It should be noted that the neighborhood near the Greenbrier Recreation Area is one of the more densely populated areas in the community of Oxford.

IV. Discussion

According to ACS statistics, cancer is the second leading cause of death in Massachusetts and the United States. Not only will one out of three women and one out of two men develop cancer in their lifetime, but cancer will affect three out of every four families. For this reason, cancers often appear to occur in "clusters," and it is understandable that someone may perceive that there are an unusually high number of cancer cases in their neighborhood or town. Upon close examination, many of these "clusters" are not unusual increases, as first thought, but are related to such factors as local population density, variations in reporting or chance fluctuations in occurrence. In other instances, the "cluster" in question includes a high concentration of

individuals who possess related behaviors or risk factors for cancer. Some, however, are unusual; that is, they represent a true excess of cancer in a workplace, a community, or among a subgroup of people. A suspected cluster is more likely to be a true cancer cluster if it involves a large number of cases of one type of cancer diagnosed in a relatively short time period rather than several different types diagnosed over a long period of time (i.e., 20 years), a rare type of cancer rather than common types, and/or a large number of cases diagnosed among individuals in age groups not usually affected by that cancer. These types of clusters may warrant further public health investigation.

Descriptive epidemiological analyses such as this report can be useful in evaluating the pattern of cancer in a geographic context, assessing the possibility of a common cause or etiology, and determining whether further public health investigations or actions may be warranted. This descriptive analysis of cancer incidence data alone cannot be used to establish a causal link between a particular risk factor (either environmental or non-environmental) and the development of cancer. In addition, this type of analysis cannot determine the cause of cancer in any one particular individual. The purpose of this report was to evaluate the incidence of cancer in the community of Oxford to determine whether such patterns appear unusual.

Of the seven cancer types that were evaluated further, all but thyroid cancer occur more commonly among men in the United States than women. These include cancers of the oral cavity and pharynx, bladder cancer, lung and bronchus cancers, NHL, and brain and ONS cancers as well as Hodgkin lymphoma, which occurs slightly more often in males than in females. The incidence of these cancer types in Oxford followed these national trends at the community level with the exception of brain and ONS cancers and thyroid cancer.

In general, men are more likely to develop a brain tumor than women; however, some specific types of brain tumors are more common in women. Men are generally more likely to develop gliomas than women, while women are more likely to develop meningiomas. The ACS estimates that approximately 22,300 individuals will be diagnosed with malignant brain and ONS cancers in the U.S. in 2011, accounting for less than 2% of all cancer diagnoses (ACS 2011d,i). In Massachusetts, the incidence of brain and ONS cancers follows the national statistic, with rates generally remaining steady from 2003 to 2007 (MCR 2010b).

Unlike the six other cancer types that were evaluated further, thyroid cancer is more common among women than men in the United States. According to the ACS, women are three times more likely to develop thyroid cancer than men (ACS 2011a). However, more men than women were diagnosed with thyroid cancer in Oxford during 2003 to 2007. The ACS estimates that about 48,000 individuals will be diagnosed with thyroid cancer in the U.S. in 2011 (ACS 2011a). In Massachusetts, thyroid cancer accounted for approximately 3% of all cancers diagnosed between 2003 and 2007 (MCR 2010b). Incidence rates of thyroid cancer have been increasing in Massachusetts since 1984, with significant increases since 1997. These changes mirror national increases and are attributed to better detection using fine needle aspiration biopsy, ultrasound, and an increase in neck palpation as part of routine medical exams (MCR 2011).

V. Conclusions

Overall, there does not seem to be an unusual pattern of cancer in the community of Oxford or, more specifically, in the neighborhood near the Greenbrier Recreation Area based on the information reviewed in this report. The incidence of the majority of the cancer types evaluated was less than or about as would be expected, based on the statewide cancer experience.

Statistically significant elevations were noted for two cancer types – thyroid cancer and cancers of the oral cavity and pharynx. Although not statistically significant, elevations were observed in five additional cancer types – bladder cancer, lung and bronchus cancers, Hodgkin lymphoma, NHL, and brain and ONS cancers.

Of the seven cancer types that were elevated in Oxford during 2003 to 2007 and evaluated more closely, the only cancer type that deviated from what would be expected based upon the epidemiological literature was thyroid cancer. Although women are three times more likely to develop thyroid cancer than men, more men than women were diagnosed in Oxford during this five-year time period and the incidence among men was statistically significantly elevated at the community level and in CT 7532. For the remaining six cancer types, the gender, age at diagnosis and histologies were generally consistent with what would be expected based on state and national trends. Further, it appears that smoking may have contributed to the incidence of three of the seven cancer types with elevations (cancers of the oral cavity and pharynx, bladder cancer, lung and bronchus cancers).

A qualitative evaluation at the neighborhood level revealed that many different cancer types were diagnosed among residents of the neighborhood near the Greenbrier Recreation Area during 2003 to 2009. Several of these cancer types were among the most common cancer types diagnosed among Massachusetts residents. Age at diagnosis and the histology (cell type) was consistent with what would be expected based on state and national trends for each specific type of cancer. Although several diagnoses did occur among individuals whose residences at the time of diagnosis were located within this neighborhood, this is an area of relative higher population density and no unusual spatial patterns were observed.

VI. Recommendations

In response to the findings of this evaluation, three recommendations are made:

(1) The MDPH will monitor the incidence of thyroid cancer in Oxford through the Massachusetts Cancer Registry. No other investigations of cancer incidence in Oxford are recommended by MDPH at this time.

(2) The MDPH recommends that residents who would like more information about quitting smoking contact the Massachusetts Tobacco Control Program at 1-800-Try-To-Stop or 1-800-879-8678. A fact sheet on the use of tobacco in the community of Oxford has been included as an attachment to this report.

(3) The MDPH recommends that residents concerned about radon in indoor air have their homes tested for radon. For further questions about radon, you may contact MDPH's Radiation Control Program toll free at (800) 723-6695 for advice on home testing.

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Figure 1
Location of Area of Concern and Census Tracts
Oxford, Massachusetts

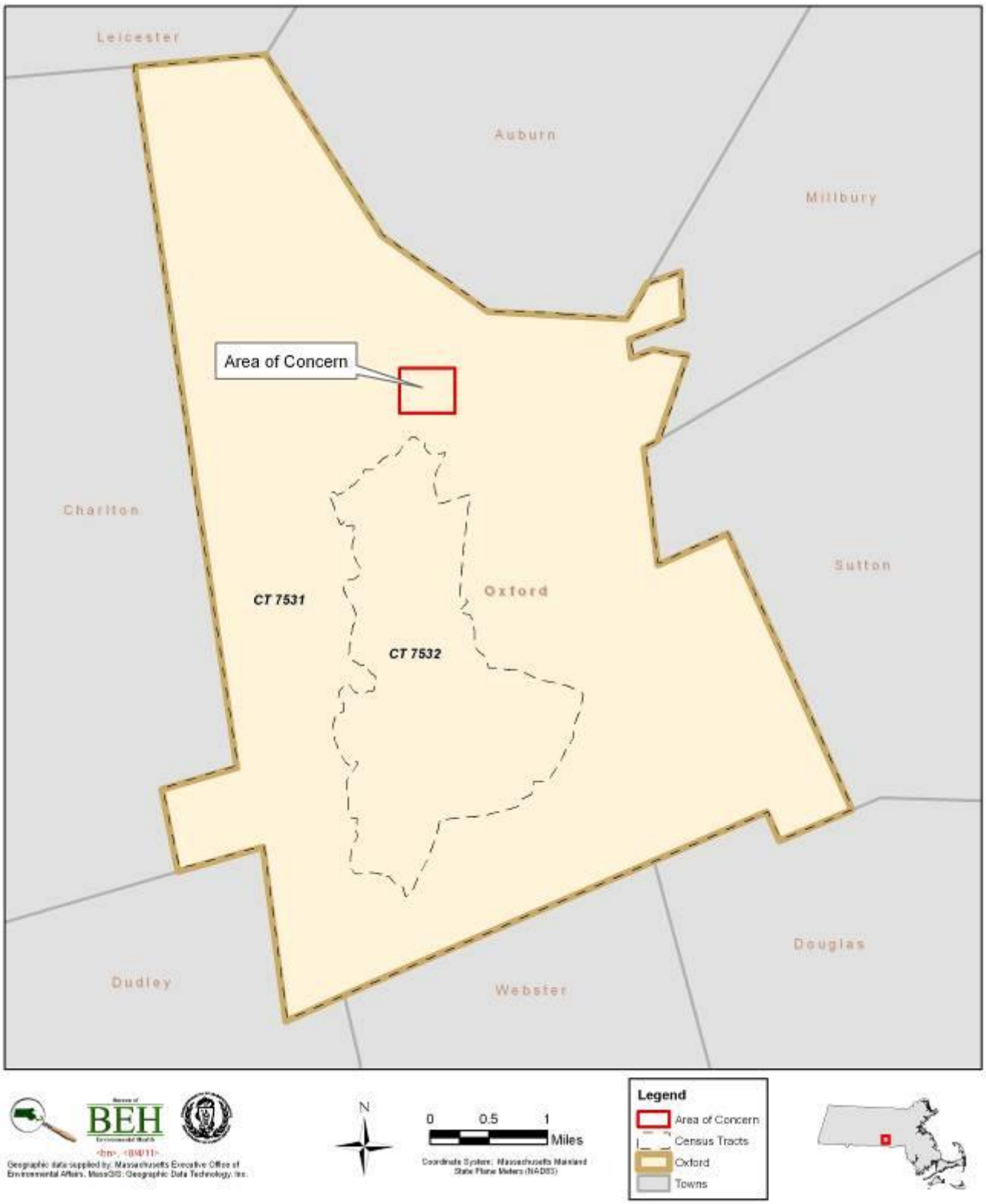

Table 1
Massachusetts Cancer Registry City and Town Supplement
Observed and Expected Case Counts, with Standardized Incidence Ratios
Oxford, Massachusetts
2003 – 2007

	Obs	Exp	SIR	95% CI
Bladder, Urinary				
Male	18	12.6	142.8	(84.6-225.7)
Female	8	4.6	174.7	(75.2-344.2)
Brain and Other Nervous System				
Male	2	2.7	nc	(nc-nc)
Female	5	2.2	225.5	(72.7-526.3)
Breast				
Male	2	0.4	nc	(nc-nc)
Female	50	49.4	101.1	(75.1-133.4)
Cervix Uteri				
Female	0	2.3	nc	(nc-nc)
Colon / Rectum				
Male	14	17.3	80.9	(44.2-135.8)
Female	17	15.9	107.0	(62.3-171.3)
Esophagus				
Male	4	3.4	nc	(nc-nc)
Female	1	0.9	nc	(nc-nc)
Hodgkin Lymphoma				
Male	4	1.3	nc	(nc-nc)
Female	1	1.0	nc	(nc-nc)
Kidney & Renal Pelvis				
Male	8	6.6	121.0	(52.1-238.3)
Female	1	3.9	nc	(nc-nc)
Larynx				
Male	3	2.0	nc	(nc-nc)
Female	1	0.6	nc	(nc-nc)
Leukemia				
Male	3	4.6	nc	(nc-nc)
Female	3	3.4	nc	(nc-nc)
Liver and Intrahepatic Bile Ducts				
Male	4	3.3	nc	(nc-nc)
Female	1	1.1	nc	(nc-nc)
Lung and Bronchus				
Male	32	23.2	137.6	(94.1-194.3)
Female	25	22.7	110.0	(71.2-162.4)

	Obs	Exp	SIR	95% CI
Melanoma of Skin				
Male	5	8.6	58.5	(18.8-136.4)
Female	6	7.1	84.1	(30.7-183.0)
Multiple Myeloma				
Male	3	2.0	nc	(nc-nc)
Female	1	1.5	nc	(nc-nc)
Non-Hodgkin Lymphoma				
Male	11	7.3	151.7	(75.6-271.5)
Female	5	6.1	81.5	(26.3-190.3)
Oral Cavity & Pharynx				
Male	11	5.2	209.7	(104.5-375.2)
Female	5	2.4	210.6	(67.9-491.5)
Ovary				
Female	4	4.9	nc	(nc-nc)
Pancreas				
Male	5	3.9	127.6	(41.1-297.7)
Female	3	3.9	nc	(nc-nc)
Prostate				
Male	36	48.7	73.9	(51.7-102.3)
Stomach				
Male	2	3.0	nc	(nc-nc)
Female	0	1.7	nc	(nc-nc)
Testis				
Male	2	2.1	nc	(nc-nc)
Thyroid				
Male	9	2.5	353.1	(161.1-670.3)
Female	3	8.6	nc	(nc-nc)
Uteri Corpus and Uterus, NOS				
Female	8	10.8	73.9	(31.8-145.5)
All Sites / Types				
Male	194	174.0	111.5	(96.3-128.3)
Female	162	167.8	96.5	(82.2-112.6)

- Obs = observed case count; Exp = expected case count;
- SIR = standardized incidence ratio ((Obs / Exp) X 100);
- 95% CI = 95% confidence intervals, a measure of the statistical significance of the SIR;
- Shading indicates the statistical significance of the SIR at 95% level of probability;
- nc = The SIR and 95% CI were not calculated when Obs < 5;

TABLE 2
Cancer Incidence
CT 7531, Oxford, Massachusetts
2003 - 2007

Cancer Type	Males				Females			
	Obs	Exp	SIR	95% CI	Obs	Exp	SIR	95% CI
Bladder	11	6.7	164	82 -- 294	5	2.3	222	72 -- 518
Brain and ONS	2	1.5	NC	NC -- NC	3	1.2	NC	NC -- NC
Hodgkin Lymphoma	3	0.7	NC	NC -- NC	0	0.6	NC	NC -- NC
Lung and Bronchus	14	12.6	111	61 -- 187	10	11.5	87	42 -- 160
Non-Hodgkin's Lymphoma	5	4.0	126	41 -- 295	1	3.1	NC	NC -- NC
Oral Cavity and Pharynx	5	3.0	168	54 -- 392	3	1.2	NC	NC -- NC
Thyroid	1	1.4	NC	NC -- NC	3	4.8	NC	NC -- NC

Note: SIRs are calculated based on the exact number of expected diagnoses.
Expected number of diagnoses presented are rounded to the nearest tenth.
SIRs and 95% CIs are not calculated when the observed number is < 5.

Obs = Observed number of diagnoses
Exp = Expected number of diagnoses
SIR = Standardized Incidence Ratio
95% CI = 95% Confidence Interval
NC = Not calculated
* = Statistical significance

Data Source: Massachusetts Cancer Registry, Bureau of Health Information, Statistics, Research and Evaluation, Massachusetts Department of Public Health.

TABLE 3
Cancer Incidence
CT 7532, Oxford, Massachusetts
2003 - 2007

Cancer Type	Males				Females			
	Obs	Exp	SIR	95% CI	Obs	Exp	SIR	95% CI
Bladder	7	6.5	107	43 -- 221	3	2.6	NC	NC -- NC
Brain and ONS	0	1.3	NC	NC -- NC	2	1.1	NC	NC -- NC
Hodgkin Lymphoma	1	0.6	NC	NC -- NC	1	0.5	NC	NC -- NC
Lung and Bronchus	18	11.7	153	91 -- 242	14	12.8	109	60 -- 184
Non-Hodgkin's Lymphoma	6	3.5	169	62 -- 369	4	3.4	NC	NC -- NC
Oral Cavity and Pharynx	6	2.5	238	87 -- 518	2	1.3	NC	NC -- NC
Thyroid	8	1.2	685	* 295 -- 1350	0	3.9	NC	NC -- NC

Note: SIRs are calculated based on the exact number of expected diagnoses.
Expected number of diagnoses presented are rounded to the nearest tenth.
SIRs and 95% CIs are not calculated when the observed number is < 5.

Obs = Observed number of diagnoses
Exp = Expected number of diagnoses
SIR = Standardized Incidence Ratio
95% CI = 95% Confidence Interval
NC = Not calculated
* = Statistical significance

Data Source: Massachusetts Cancer Registry, Bureau of Health Information, Statistics, Research and Evaluation, Massachusetts Department of Public Health.

Community Fact Sheet

Oxford, Massachusetts Data Updated: 10/27/11

Cigarette Smoking

An estimated 1,921 smokers live in Oxford (19.5% of adults, age 18+).

The adult smoking rate is 21 percent higher in Oxford than statewide (19.5% in Oxford compared to 16.1% statewide).

The rate of smoking during pregnancy in Oxford is 54 percent higher than for the overall state of Massachusetts (11.4% in Oxford compared to 7.4% statewide).

MassHealth Tobacco Cessation Benefit

Since coverage of the tobacco cessation began in July 2006, 147 MassHealth smokers from Oxford have used the benefit - an estimated 53.8% of MassHealth smokers living in Oxford. Statewide, more than 75,000 MassHealth smokers (41%) have used the tobacco cessation benefit since July 2006.

QuitWorks

Health care providers referred 36 smokers living in Oxford to the QuitWorks program to help them quit smoking. In addition, 69 people from Oxford called the Massachusetts Smokers' Helpine to quit smoking (fiscal years 2004 to 2009).

Illegal Tobacco Sales to Minors

The rate of illegal sales to minors (those under age 18) is 88 percent higher in Oxford (15.2%) compared to the state of Massachusetts (8.1%) based on data from FY 2010.

Health Effects of Smoking

Mortality from lung cancer is 27 percent higher among males in Oxford compared to the state of Massachusetts.

The rate of hospitalizations for lung cancer is not significantly different among females in Oxford compared to the state of Massachusetts.

The rate of hospitalizations for lung cancer is 40 percent higher among males in Oxford compared to the state of Massachusetts.

Community Fact Sheet

Oxford, Massachusetts Data Updated: 10/27/11

Data Sources

Smoking figures are based on data from the 2008 Massachusetts Department of Public Health, Massachusetts Tobacco Control Program. Small area estimates derived based on data from the Behavioral Risk Factor Surveillance System (BRFSS).

Figures on smoking during pregnancy are based on 2003 to 2007 Births (Vital Records), Massachusetts Department of Public Health.

MassHealth utilization of the tobacco cessation benefit was obtained from the Executive Office of Health and Human Services, MassHealth agency covering fiscal years 2007 to 2009 (through April 30, 2009).

The number of referrals to the QuitWorks program and calls to the Massachusetts Smokers Helpline is based on data collected by the Massachusetts Tobacco Cessation and Prevention Program from fiscal years 2004 to 2009.

The rate of illegal sales to minors is based on compliance checks performed in Oxford during FY 2010 (n= 33).

Figures on lung cancer mortality are based on 2003 to 2007 Deaths (Vital Records), Massachusetts Department of Public Health.

Rates of lung cancer hospitalizations are age-adjusted and based on data from the 2002 to 2006 Uniform Hospital Discharge Data System (UHDDS) maintained by the Massachusetts Division of Health Care Finance and Policy.