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Evaluation of Cancer Incidence in Saugus, MA

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I. Introduction

The purpose of this evaluation was to address general concerns about the incidence of cancer in Saugus as a whole and in each of its census tracts with regard to the location of the Wheelabrator facility at 100 Salem Turnpike. The Wheelabrator facility consists of an ash landfill and adjacent energy-from-waste plant. 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 Saugus during 2007 to 2011. 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.

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 Saugus from the MCR, a division in the MDPH Office of Data Management and Outcomes Assessment. 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 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 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. The five-year period 2007-20011 constitutes the period for which the most recent and complete cancer incidence data were available at the initiation of this analysis[1].

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 a specified period of time after the initial diagnosis depending upon the particular cancer type (NCI 2012).

[1] The cancer statistics reported here may differ slightly from those in other publications. These differences may be due to file updates, differences in calculation methods (such as grouping ages differently or rounding off numbers at different points in calculations), and updates or differences in population estimates.

B. Calculation of a Standardized Incidence Ratio

To assess the incidence of cancer in Saugus, 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 Saugus 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 MCR 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; Saugus is divided into five CTs. For reference, the Wheelabrator facility, located at 100 Salem Turnpike in Saugus, is located on the border of CTs 2081.01 and 2081.02 (see Figure 1). For those cancer types with an elevation in incidence during the five-year time period 2007-20011, 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 Saugus who were diagnosed with a cancer type that was elevated in the community during 2007 to 2011. 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[2]. 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 Saugus residents diagnosed with cancer during this

[2] Based on research by the MCR (MCR 2013), which included an evaluation of the reliability of the tobacco use history information reported to the MCR, it appears that the category of "never smoker" is less reliable than other reporting categories (such as current or former smoker). Many individuals are reported as never having smoked when, based on medical record reviews, they are individuals who are not current smokers but whose past tobacco use is unknown. These individuals should more accurately be reported as having an unknown tobacco use history rather than being categorized as never having used tobacco products. This misclassification is expected to result in an overestimation of those categorized as "never smokers" and an underestimate of those categorized as "former smokers".

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 Saugus during 2007 to 2011. 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 presents a summary of incidence data for 23 types of cancer for the community of Saugus from the MCR's City/Town Supplement (MCR 2015a). The incidence of the following

cancer types occurred about as expected or less frequently over the five-year time period evaluated: bladder, breast, cervical, colorectal, esophageal, Hodgkin lymphoma, laryngeal, leukemia, liver and intrahepatic bile duct, melanoma of skin, multiple myeloma, non-Hodgkin lymphoma, ovarian, pancreatic, prostate, stomach, thyroid and uterine. Although the number of observed diagnoses may have exceeded the number of expected diagnoses, this difference was likely a result of random fluctuation and represents natural variation in the number of diagnoses.

Elevations were noted in the following cancer types in Saugus as a whole during 2007 to 2011, two of which were statistically significant:

- Statistically significant elevations occurred in brain and other nervous system (ONS) cancers among females and in testicular cancer among males.
- Elevations that were not statistically significant occurred in cancers of the kidney and renal pelvis among males, lung and bronchus cancers among males and females, and cancers of the oral cavity and pharynx among males.

The incidence for each of the five cancer types listed above was further evaluated by census tract for the same time period and is presented in Tables 2 through 6. No cancer types were statistically significantly elevated at the census tract level. The incidence of each of these five cancer types is discussed further in the following sections.

A. Brain and Other Nervous System (ONS) Cancers

During 2007 to 2011, the incidence of brain and ONS cancers was statistically significantly elevated among females in Saugus (12 observed versus 5 expected, SIR = 224, 95% CI 116-392) and less than expected among males (3 observed versus 6 expected). A separate evaluation by

CT revealed that the elevation among females occurred primarily in CTs 2083 and 2084 where four diagnoses were observed compared to about one that would be expected (Table 2). A review of the temporal distribution of diagnoses did not reveal any unusual patterns at the community or census tract level. Similarly, the geographic distribution of addresses at the time of diagnosis was generally consistent with the pattern of population density.

Brain and ONS cancers are the second most common cancer type diagnosed 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 2015a; MCR 2015b). The majority of females diagnosed in Saugus during 2007 to 2011 were adults, with an average age of 59 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. 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. Although meningiomas are the most common type of primary brain tumor among adults, the vast majority are non-malignant (ACS 2014a,b; ASCO 2014; CBTRUS 2012). The types of malignant brain and ONS cancers diagnosed among individuals in Saugus during 2007 to 2011 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.

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 2014a,b).

B. Testicular Cancer

The incidence of testicular cancer was statistically significantly elevated among males in Saugus during 2007 to 2011 (11 observed versus 4 expected, SIR = 295, 95% CI 147-527). The diagnoses occurred in four of the five census tracts in Saugus with a slight elevation noted in CT 2081.01 (4 observed versus 1 expected) (Table 3). No unusual temporal or spatial patterns were observed at the community or census tract level.

Although this cancer type can affect males of any age, including infants and elderly men, about 90% of testicular cancers occur between the ages of 20 and 54 and the average age at the time of diagnosis is 33 years (ACS 2015b). All of the males diagnosed in Saugus during 2007 to 2011 were adults, with an average age of 35 years.

More than 90% of cancers of the testicle develop in special cells known as germ cells. There are two main types of germ cell tumors (GCTs) in men: seminomas and non-seminomas. The two types occur about equally. Seminomas develop from the sperm-producing germ cells of the testicle. There are two main subtypes of these tumors: classical (or typical) and spermatocytic.

More than 95% of seminomas are classical. The average age of men diagnosed with spermatocytic seminoma is 65, while classical seminomas tend to occur in men aged 25 to 45. Non-seminomas usually occur in men between their late teens and early 30s. There are four main types of non-seminoma tumors: embryonal carcinoma, yolk sac carcinoma, choriocarcinoma, and teratoma. Most non-seminoma tumors are mixed with at least two different types (ACS 2015b). The types of testicular cancers diagnosed among men of various ages in Saugus during 2007 to 2011 follow these patterns.

Few risk factors have been identified that make a man more likely to develop testicular cancer and most men with testicular cancer do not have any of the known risk factors. A family history of testicular cancer increases the risk. A personal history of testicular cancer is another risk factor. About 3 to 4% of men who have been treated for cancer in one testicle will eventually develop cancer in the other testicle. For reasons that are unclear, one of the main risk factors for testicular cancer is a condition called cryptorchidism, or undescended testicle(s). About 10% of diagnoses of testicular cancer occur in men with a history of cryptorchidism (ACS 2015b, MCR 2010).

C. Cancers of the Kidney and Renal Pelvis

During 2007 to 2011, the incidence of cancers of the kidney and renal pelvis was elevated among males in Saugus (26 observed versus 18 expected) and less than expected among females (10 observed versus 11 expected). The elevation among males was not statistically significant. At the census tract level, slight elevations were observed among males in CT 2083 (8 observed versus 5 expected) and CT 2084 (7 observed versus 4 expected) (Table 4). No unusual temporal

patterns were observed at the community or census tract level. Similarly, the geographic distribution of addresses at the time of diagnosis generally followed population density.

Kidney and renal pelvis cancers occur most often in individuals age 55 and older and are uncommon in people younger than age 45. The average age at diagnosis is 64 (ACS 2014c). Among Saugus males diagnosed with kidney and renal pelvis cancers during 2007 to 2011, the average age at diagnosis was 62 years and 77% were age 55 or older at the time of their diagnosis.

According to ACS, smoking is a major risk factor for kidney and renal pelvis cancers and the risk increases with quantity (ACS 2014c). Of the 19 males diagnosed with this cancer type in Saugus during 2007 to 2011 and for whom tobacco history was reported to the MCR, 14 (74%) were current or former smokers at the time of their diagnosis.

Many studies suggest that workplace exposures to certain substances, such as cadmium, and certain organic solvents and herbicides, are associated with an increased risk of developing kidney and renal pelvis cancers (ACS 2014c). Of the 19 males diagnosed with kidney and renal pelvis cancer during 2007 to 2011 who reported an occupation to the MCR, none appeared to have worked in an occupation that may possibly be a risk factor for the development of this cancer type. It should be noted, however, that a complete occupational history or specific job information that could further define exposure potential for these individuals is not available through the MCR. Moreover, occupation was reported as unknown, at home, or retired for 27% of the individuals.

Other risk factors for kidney cancer include obesity, and genetic and hereditary risk factors, including certain inherited conditions and syndromes. Other possible risk factors include a

family history of kidney cancer, high blood pressure, and certain medications, such as diuretics used to treat high blood pressure (ACS 2014c). As mentioned, the MCR does not collect information related to these personal risk factors and, hence, they could not be evaluated.

D. Lung and Bronchus Cancers

The incidence of lung and bronchus cancer in Saugus during 2007 to 20011 was elevated among both males (71 observed versus 65 expected) and females (78 observed versus 67 expected). These elevations are not statistically significant. At the census tract level, slight elevations were observed among males in CT 2081.02 (11 observed versus 7 expected) and CT 2082 (17 observed versus 14 expected). Among females, slight elevations were observed in the following three census tracts: CT 2081.01 (16 observed versus 12 expected), CT 2082 (19 observed versus 16 expected) and CT 2083 (21 observed versus 18 expected) (Table 5). Overall, no unusual temporal or spatial patterns were observed at the community or census tract level.

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 2% are under the age of 45 (ACS 2014d,e). In Saugus, nearly 70% of males diagnosed with this cancer type during this time period were over 65 years of age at diagnosis and less than 5% were under the age of 45 at diagnosis. Among females in Saugus, 67% were over 65 years of age at diagnosis and none were under the age of 45.

Smoking is by far the most important risk factor for lung and bronchus cancer. 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 2014d,e). Tobacco use history was reviewed for residents in Saugus diagnosed with lung and bronchus cancer between 2007 and 20011. Of the 58 males for whom tobacco history was reported, nearly all (98%) were current or former smokers at the time of their diagnosis. Of the 65 females for whom tobacco history was reported, 61 (94%) 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. SCLC accounts for about 10% to 15% of all lung and bronchus cancers but often starts in the bronchi (ACS 2014d,e). The distribution of histologies among those residents of Saugus diagnosed with lung and bronchus cancers during 2007 to 2011 followed what would be expected based on national statistics. Of the 63 males with a specific histology reported to the MCR, 47 (75%) were diagnosed with NSCLC and 11 (17%) were diagnosed with SCLC. Of the 76 females with a specific histology reported to the MCR, 52 (68%) were diagnosed with NSCLC and 12 (16%) were diagnosed with SCLC.

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 2014d,e).

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 2014d,e). Of the 45 males diagnosed with lung and bronchus cancer in Saugus during 2007 to 20011 who reported an occupation to the MCR, 11 (24%) reported an occupation possibly associated with an increased risk of developing this cancer type. Of the 33 females diagnosed with lung and bronchus cancer in Saugus during 2007 to 20011 who reported an occupation to the MCR, only one reported an occupation possibly associated with an increased risk of developing this cancer type. However, a complete occupational history or specific job information that could further define exposure potential for these individuals is not available through the MCR. Moreover, occupation was reported as unknown, at home, or retired for 36% of the males and 58% of the females.

E. Cancers of the Oral Cavity and Pharynx

During 2007 to 2011, the incidence of cancers of the oral cavity and pharynx was elevated among males in Saugus (20 observed versus 15 expected). Among females in Saugus, the

incidence of cancers of the oral cavity and pharynx was about as expected (7 observed versus 7 expected). A separate evaluation by census tract revealed that the incidence of this cancer type was slightly elevated among males in CT 2083 (7 observed versus 4 expected) and CT 2084 (6 observed versus 3 expected) (Table 6). Overall, the number of diagnoses fluctuated from year to year with no unusual temporal patterns. Likewise, the geographic distribution of address at the time of diagnosis generally followed the pattern of population density.

The average age of individuals diagnosed with these cancers in the United States is 62, with nearly 75% occurring in adults older than age 55 (ACS 2014f). Among Saugus males diagnosed with cancer of the oral cavity and pharynx during 2007 to 2011, the average age at diagnosis was 63 years and 74% were age 55 or over at the time of their diagnosis.

More than 90% of cancers of the oral cavity and pharynx are squamous cell carcinomas (ACS 2014f). In Saugus, 84% of males diagnosed with oral cavity and pharynx cancers between 2007 and 2011 were diagnosed with this histology (cell type).

Tobacco and alcohol use are among the strongest risk factors for oral cavity and oropharyngeal cancers (ACS 2014f). Of the 17 males diagnosed with this cancer type in Saugus during 2007 to 20011 and for whom tobacco history was reported to the MCR, 16 (94%) were current or former smokers at the time of their diagnosis. According to the ACS, about 70% of individuals diagnosed with these cancers nationwide are heavy drinkers (ACS 2014f). The MCR does not collect information on alcohol consumption. As a result, this risk factor could not be evaluated.

Per ACS, the overall rate of new cases of this disease in recent years has been stable in men and dropping slightly in women. However, there has been a recent rise in cases of oropharyngeal cancer linked to infection with human papilloma virus (HPV) in white men and women. HPV is

a group of more than 150 types of viruses. The specific type linked to oropharyngeal cancer is HPV16. HPV can be passed from one person to another during skin-to-skin contact and through sex, including vaginal and anal intercourse and oral sex. Most people with HPV infections of the mouth and throat have no symptoms, and only a very small percentage develop oropharyngeal cancer. The reason for the rising rate of HPV-linked cancers of the oral cavity and pharynx is unclear, although some think that it could be due to changes in sexual practices in recent decades, in particular an increase in oral sex (ACS 2014f).

IV. Discussion

According to ACS statistics, 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 Saugus to determine whether such patterns appear unusual.

V. Conclusions

Overall, there does not seem to be an unusual pattern of cancer in the community of Saugus 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 – brain and ONS cancers and testicular cancer. Although not statistically significant, elevations were observed in three additional cancer types – cancers of the kidney and renal pelvis, lung and bronchus cancers, and cancers of the oral cavity and pharynx. A separate evaluation of these five cancer types at the census tract level did not reveal any statistically significant elevations. The geographic distribution of the addresses at the time of diagnosis for each cancer type closely followed the pattern of population density within the community and no unusual spatial or temporal patterns were observed. Available information reported to the MCR related to risk factors for cancer

development was reviewed for residents of Saugus who were diagnosed with a cancer type that was elevated during 2007 to 2011 and found to be consistent with known or established incidence patterns for the specific type of cancer. It is important to note, however, that it appears that smoking may have contributed to the incidence of three of the five cancer types with elevations (cancers of the kidney and renal pelvis, lung and bronchus cancers, cancers of the oral cavity and pharynx).

VI. Recommendations

In response to the findings of this evaluation, the MDPH does not recommend further analysis of cancer incidence data. The department does, however, recommend that residents who would like more information about quitting smoking contact the Massachusetts Smokers' Helpline at 1-800-QuitNow or 1-800-784-8669. For Spanish call 1-800-8-Déjalo or 1-800-833-5256. Furthermore, 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 Radon Control Program toll free at 1-800-RADON95 or 1-800-723-6695 for advice on home testing.

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Figure 1
Location of Wheelabrator Facility and Census Tracts
Saugus, Massachusetts

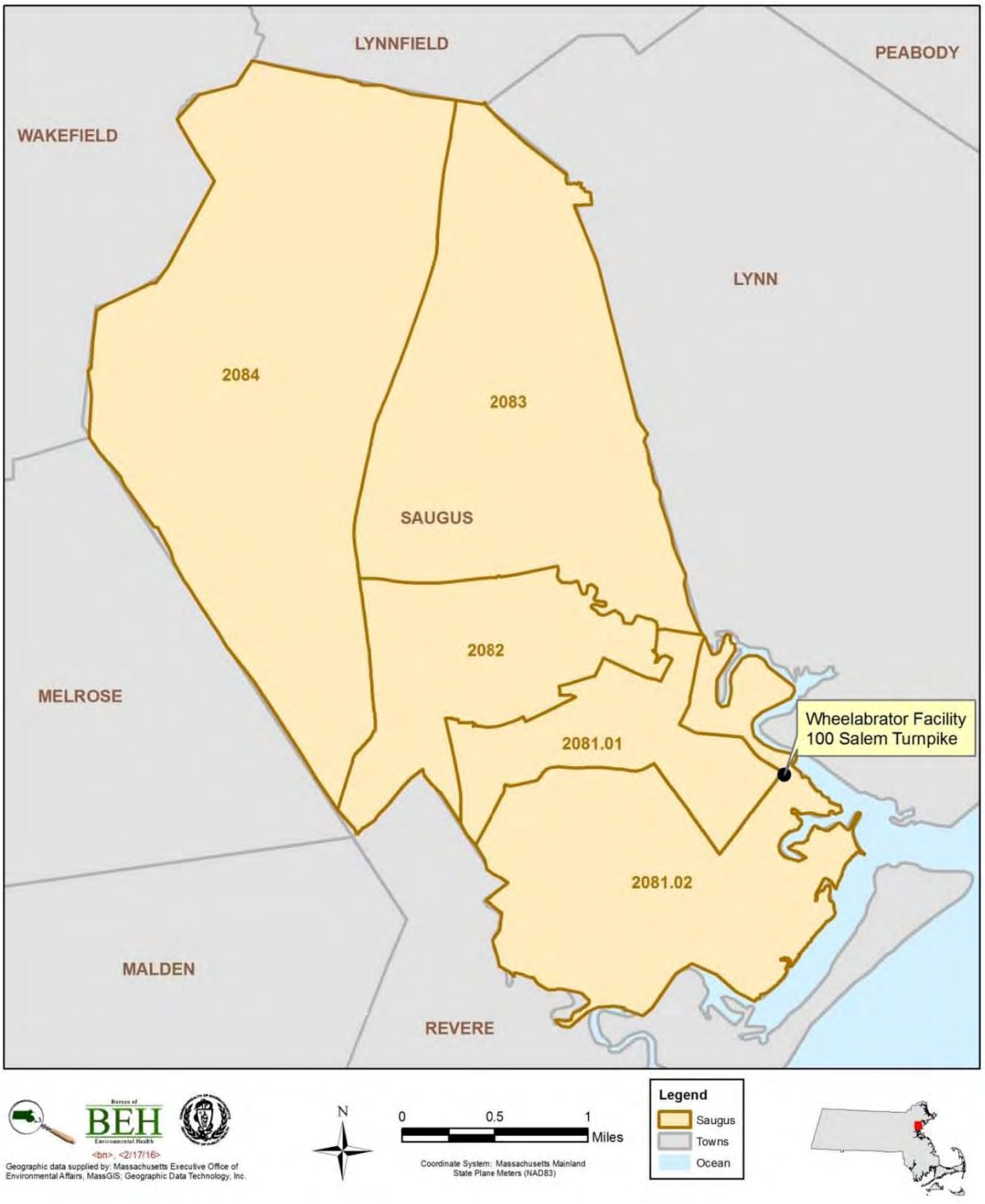

Table 1
Massachusetts Cancer Registry City and Town Supplement
Observed and Expected Case Counts, with Standardized Incidence Ratios
Saugus, Massachusetts
2007 – 20011

	Obs	Exp	SIR	95% CI
Bladder, Urinary				
Male	40	35.7	112	(80-152.5)
Female	15	12.9	116	(64.9-191.4)
Brain and Other Nervous System				
Male	3	6.3	nc	(nc-nc)
Female	12	5.4	224.1	(115.7-391.6)
Breast				
Male	1	1.1	nc	(nc-nc)
Female	139	132.7	104.7	(88-123.6)
Cervix Uteri				
Female	3	4.5	nc	(nc-nc)
Colon / Rectum				
Male	44	39.5	111.5	(81-149.7)
Female	39	40.2	97.1	(69-132.7)
Esophagus				
Male	10	9.5	105.4	(50.5-193.9)
Female	4	2.7	nc	(nc-nc)
Hodgkin Lymphoma				
Male	4	2.5	nc	(nc-nc)
Female	2	2	nc	(nc-nc)
Kidney & Renal Pelvis				
Male	26	18.3	142.4	(93-208.6)
Female	10	10.8	92.6	(44.3-170.3)
Larynx				
Male	7	5.2	135.3	(54.2-278.9)
Female	3	1.6	nc	(nc-nc)
Leukemia				
Male	17	13.3	128.2	(74.6-205.3)
Female	6	9.7	61.8	(22.6-134.6)
Liver and Intrahepatic Bile Ducts				
Male	11	10.8	101.6	(50.6-181.7)
Female	1	3.8	nc	(nc-nc)
Lung and Bronchus				
Male	71	65.1	109.1	(85.2-137.6)
Female	78	67.4	115.8	(91.5-144.5)

	Obs	Exp	SIR	95% CI
Melanoma of Skin				
Male	11	22.5	48.9	(24.4-87.4)
Female	11	17.5	62.7	(31.3-112.2)
Multiple Myeloma				
Male	5	6.4	78.7	(25.4-183.6)
Female	2	5.2	nc	(nc-nc)
Non-Hodgkin Lymphoma				
Male	21	19.7	106.5	(65.9-162.8)
Female	12	16.6	72.3	(37.3-126.3)
Oral Cavity & Pharynx				
Male	20	14.7	135.9	(83-209.9)
Female	7	6.6	106.4	(42.6-219.3)
Ovary				
Female	7	12.1	57.8	(23.2-119.1)
Pancreas				
Male	9	11.7	77.1	(35.2-146.4)
Female	14	12.5	112.2	(61.3-188.3)
Prostate				
Male	104	131.7	79	(64.5-95.7)
Stomach				
Male	11	8.3	132	(65.8-236.2)
Female	3	4.9	nc	(nc-nc)
Testis				
Male	11	3.7	294.7	(146.9-527.4)
Thyroid				
Male	8	7.7	104	(44.8-204.9)
Female	18	23.1	77.8	(46.1-123)
Uteri Corpus and Uterus, NOS				
Female	25	31	80.7	(52.2-119.2)
All Sites / Types				
Male	468	469.1	99.8	(90.9-109.2)
Female	450	459.6	97.9	(89.1-107.4)

- 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
Brain and Other Nervous System (ONS) Cancer Incidence
Saugus, Massachusetts
2007 - 2011

Census Tract	Males				Females			
	Obs	Exp	SIR	95% CI	Obs	Exp	SIR	95% CI
2081.01	1	1.2	NC	NC -- NC	1	1.0	NC	NC -- NC
2081.02	0	0.7	NC	NC -- NC	0	0.6	NC	NC -- NC
2082	0	1.3	NC	NC -- NC	3	1.2	NC	NC -- NC
2083	0	1.7	NC	NC -- NC	4	1.4	NC	NC -- NC
2084	2	1.4	NC	NC -- NC	4	1.1	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, Office of Data Management and Outcomes Assessment, Massachusetts Department of Public Health.

TABLE 3
Testicular Cancer Incidence
Saugus, Massachusetts
2007 - 2011

Census Tract	Males			
	Obs	Exp	SIR	95% CI
2081.01	4	0.8	NC	NC -- NC
2081.02	0	0.5	NC	NC -- NC
2082	3	0.8	NC	NC -- NC
2083	3	1.0	NC	NC -- NC
2084	1	0.7	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, Office of Data Management and Outcomes Assessment, Massachusetts Department of Public Health.

TABLE 4
Kidney and Renal Pelvis Cancer Incidence
Saugus, Massachusetts
2007 - 2011

Census Tract	Males					Females				
	Obs	Exp	SIR	95% CI		Obs	Exp	SIR	95% CI	
2081.01	4	3.5	NC	NC	NC	1	2.0	NC	NC	NC
2081.02	2	2.1	NC	NC	NC	2	1.3	NC	NC	NC
2082	5	3.8	133	43	309	2	2.4	NC	NC	NC
2083	8	4.9	162	70	319	2	2.9	NC	NC	NC
2084	7	4.2	166	66	342	3	2.3	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, Office of Data Management and Outcomes Assessment, Massachusetts Department of Public Health.

TABLE 5
Lung and Bronchus Cancer Incidence
Saugus, Massachusetts
2007 - 2011

Census Tract	Males						Females					
	Obs	Exp	SIR	95% CI			Obs	Exp	SIR	95% CI		
2081.01	8	12.3	65	28	--	128	16	12.2	131	75	--	213
2081.02	11	7.2	153	77	--	275	13	7.7	168	89	--	287
2082	17	13.6	125	73	--	200	19	15.7	121	73	--	189
2083	18	17.5	103	61	--	162	21	17.9	117	73	--	180
2084	16	14.9	107	61	--	174	10	14.3	70	34	--	129

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, Office of Data Management and Outcomes Assessment, Massachusetts Department of Public Health.

TABLE 6
Oral Cavity and Pharynx Cancer Incidence
Saugus, Massachusetts
2007 - 2011

Census Tract	Males				Females			
	Obs	Exp	SIR	95% CI	Obs	Exp	SIR	95% CI
2081.01	2	2.8	NC	NC -- NC	0	1.2	NC	NC -- NC
2081.02	1	1.7	NC	NC -- NC	1	0.8	NC	NC -- NC
2082	3	3.0	NC	NC -- NC	1	1.5	NC	NC -- NC
2083	7	4.0	177	71 -- 365	4	1.7	NC	NC -- NC
2084	6	3.4	174	64 -- 379	1	1.4	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, Office of Data Management and Outcomes Assessment, Massachusetts Department of Public Health.