

**Cancer Incidence in West Swanzey, New Hampshire  
Analysis of Potential Cancer Cluster  
December 20, 2014**

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The Honorable James W. McConnell  
Post Office Box G  
Keene, NH 03431

December 30, 2014

Dear Rep. McConnell:

Thank you for contacting us with your concern regarding cancer incidence and Methyl Tertiary-Butyl Ether (MTBE) exposure in the West Swanzey area. We appreciate you bringing this matter to our attention.

#### BACKGROUND

From your letter we understand that you became aware of various types of cancers in West Swanzey affecting residents of a wide range of ages and even extending to household pets. A local newspaper (*Keene Sentinel*, dated 9/29/2014) reported that Mr. Short had recorded 18 cancer cases in your locality; and your concern is that the gasoline leak that happened some years ago in the West Swanzey area could have possibly caused those cancers. Laboratory results showed evidence of MTBE concentrations below the maximum contaminant level of 13 µg/L in a water sample collected by Mr. Short from a local school.

I would like to start out by providing some general information about cancer and cancer cluster investigations. Cancer is not just one disease but many, each associated with a specific set of possible causes. A latency (lag) period elapses between the time of exposure to a cancer-causing substance and the later diagnosis of cancer in an exposed individual. The task of recognizing a true cancer cluster is hindered by variability between individuals in factors such as the duration of the latency period; susceptibility to a specific carcinogen; the dose and duration of the exposure; and exposure to carcinogens other than the ones under investigation.

It is also true that cancer diagnoses are becoming more and more frequent as people are living longer. According to the American Cancer Society, one out of three people will be diagnosed with cancer during their lifetime, making this a very common condition. Improvements in cancer treatments have also led people to live longer after a cancer diagnosis, which in turn means that the number of cancer survivors in a community is higher than it was before these advances in medical care. Since 2005, cancer has been the #1 leading cause of death in NH overtaking heart disease, and it is the cause of approximately 25% of all deaths in NH.

Because cancer is such a common illness and occurs in so many people, it's not surprising that, when observed casually, cancer cases sometimes appear to cluster in neighborhoods. This is why we conduct statistical analyses to see whether local variations in cancer rates are within the normal limits of random chance.

## CANCER CLUSTER IDENTIFICATION PROCESS

The Centers for Disease Control and Prevention (CDC) defines a cancer cluster as “a greater than expected number of cancer cases occurring within a group of people, in a geographic area, or over a period of time”. According to the National Cancer Institute (NCI), a suspected cancer cluster is more likely to be a true cluster, rather than a coincidence, if it involves:

- 1) A large number of cases of a similar type of cancer, rather than several different types;
- 2) A rare type of cancer, rather than common types; and
- 3) An increased number of cases of a certain type of cancer in an age group that is not usually affected by that type of cancer.

## CANCER CLUSTER INVESTIGATION METHODS

To derive valid interpretations from statistical analyses (SIR, mentioned below) we need two pieces of information: (i) the number and ages of people diagnosed with cancer during a specified period residing in the area of concern, and (ii) the number and age distribution of the population of that area during the time period being assessed. Interpretation of the statistical analyses is more difficult when the number of cancer cases is very small; the number of cases in turn depends on the population size and the time period being studied. For this reason we used a 7-year time period (2005-2011) to obtain a sufficient number of cases for this analysis. During the period 2005-2011, residents of the town of West Swanzey experienced approximately 12 or 13 newly diagnosed cases of cancer per year.

We encountered several specific difficulties in our efforts to analyze data for West Swanzey: (i) we began by examining the towns of residence in the New Hampshire state cancer registry database. Using geocodes to identify the place of residence as either West Swanzey or the surrounding area of Swanzey, we found 86 cancer patients in West Swanzey between 2005 and 2011. Of these, about 21% of addresses in the registry database were Post Office Boxes i.e. not residential street addresses. Consequently, the place of residence for those patients was not confirmed as West Swanzey. Some patients may have used PO Boxes at their place of work, along the commute from home to work, or simply the post office was closest to their residence in either Swanzey or West Swanzey. In contrast, 194 cancer patients were identified from the same period as residents of ‘rest of Swanzey’ town (excluding West Swanzey). Only about 1.5% of these cases had addresses listed as a PO Box. The difference in the proportions of PO Box addresses between West Swanzey and Swanzey suggests some systematic difference in the use of PO Boxes in these two regions, and we concluded that we cannot assume that the large number of PO Box users in West Swanzey were truly residents of that town. It was unclear whether all 86 could be considered cancer patients among West Swanzey residents. (ii) A second problem that we encountered was the lack of published population numbers (by age and sex) for the town of West Swanzey. West Swanzey is a village within the larger town of Swanzey. As West Swanzey is a census-designated place (CDP), we have the age distribution of West Swanzey population only for year 2000 and year 2010 (census years). However, with this limited information, it was not possible to conduct an accurate analysis (SIR) in West Swanzey village. For these reasons, we are unable to present data on West Swanzey alone, and have instead considered the entire Town of Swanzey for our analysis.

For this analysis, we followed a standard practice used by CDC and the National Program for Cancer Registries (NPCR) by evaluating invasive cancer cases only. We analyzed data collected by the NH State Cancer Registry (NHSCR), which are certified as being of high quality, and are collected through rigorous quality checking from various NH hospitals, clinics, and doctor's offices. The NHSCR also receives cancer information from neighboring states through a data exchange agreement. The NHSCR maintains statistics on cancer incident cases of all NH residents.

We calculated the Standardized Incidence Ratio (SIR), which is a statistical measure that examines whether the observed numbers of cancer cases in entire Swanzey town exceeded the expected number of cases. In this way, SIR compared the cancer rate in Swanzey with that of the entire state of NH, taking into account differences in age in the different communities. As an aid to interpretation, an SIR of 1.0 means the rate of cancer in the community is the same as the state of NH. An SIR greater than 1.0 suggests a higher risk of cancer than expected, and an SIR less than 1.0 suggests a lower risk. In order to understand significance of these values the SIR must be interpreted together with the 95% confidence interval.

The 95% confidence interval (CI) is a measure of the variability associated with the measure; when the range between the lower and upper confidence intervals includes 1.0, then the SIR result is not statistically significant, that is, we can't conclude that there is a true difference between the two populations being compared, but the result is consistent with differences attributable to random chance. For example, an SIR of 1.76 with a confidence interval from 0.57 to 5.45 (see table 1) is not significantly different than 1.0 because the confidence interval includes 1.0. A detailed discussion of this technique is described in Appendix A.

We began by analyzing all cancers in men, women, and overall. In addition, as you have mentioned that there was a historical evidence of gasoline leakage in your locality, we conducted some analyses on cancers that are possibly related to MTBE exposure in laboratory animals. Following a limited review of scientific literature to identify potentially linked cancer types, we focused on blood-related cancers (Leukemia, Lymphomas), brain, kidney, liver, and testis cancer and multiple myeloma.

Each type of cancer was analyzed within 19 age groups (<1, 1-4, 5-9, 10-14, 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, 75-79, 80-84, and 85+ years). This process allowed for a comparison between the observed numbers of cancer cases in Swanzey, per cancer type, to the expected number of cases derived using the comparison NH population.

## CANCER CLUSTER INVESTIGATION FINDINGS

The findings from our analyses are shown in Table 1. From 1/2005 to 12/2011, a total of 287 cancer incidences were reported from Swanzey. The expected number for a town of this size and age distribution in NH is 303, which is similar. The cancer rates overall, and in males and females examined separately, were not elevated in Swanzey when compared with rates in New Hampshire as a whole. No significant elevated SIRs were observed in any of the cancer sites examined separately. This means all were within the range of random chance.

**Table 1:** Standardized Incidence Ratios for different cancer types of cancer in Swanze, 2005-2011

Site	SIR	95% Lower CI	95% Upper CI
All sites, both sexes	0.95	0.85	1.07
All sites, males	0.92	0.78	1.08
All sites, females	0.98	0.83	1.15
Non-Hodgkin's lymphoma	1.30	0.80	2.12
Leukemia	1.28	0.69	2.38
Kidney & renal pelvis	0.78	0.37	1.64
Liver and intrahepatic bile duct	1.65	0.69	3.96
Brain & CNS	0.93	0.35	2.48
Testis	1.76	0.57	5.45
Multiple Myeloma	1.15	0.31	2.94

SIR= Standardized Incidence Rate Ratio. CI = 95% Confidence Intervals.

DHHS relies on the quality of the NHSCR data to conduct descriptive epidemiological analyses for the SIR calculations, and we believe that the quality of our cancer data is very high. It should be noted that the SIR analyses performed were descriptive in nature and were not an in depth epidemiological study involving personal interviews about cancer risk factors. While the SIR method has limitations, it is a well-accepted method for public health assessment as it can determine whether a further epidemiological investigation (in depth cancer cluster investigation) is warranted.

### CONCLUSIONS

Overall, our review of the available data does not show any statistically significant elevations of cancer rates in Swanze; nor does it show a pattern that is consistent with any of the 3 defining criteria for a cancer cluster as described above. Our results are within the range of what is expected based on what we observe across all of New Hampshire. These results are reassuring.

The data and analyses do not show conclusive evidence of elevated cancer levels in the town of Swanze; unfortunately we cannot provide analyses relating to the smaller village of West Swanze. Our analyses do not prove absolutely that there are no cancer issues in your community, and the available data cannot tell us why any specific person, or group of people, developed cancer. However, these results suggest that there has not been a widespread measurable increase in cancer incidence in Swanze either overall, or in relation to the cancer sites analyzed. Based on the data available to us, we conclude that a further in-depth community level cluster investigation is not warranted at this time. However, if individuals who reside in West Swanze or elsewhere in the community believe they have been exposed to high levels of MTBE, or if an individual with cancer is concerned that the cancer might have been caused by exposure to MTBE, they should consult their physician and/or contact us directly at the New Hampshire Division of Public Health Services.

Please note that the Drinking Water & Groundwater Bureau of the NH Department of Environmental Services is closely monitoring the water quality in West Swanze area since the gasoline leakage. Going back to 2003,

Drinking Water and Groundwater Bureau of the Hampshire Department of Environmental Services has not issued any violations to West Swanzey Water District for an MTBE maximum contaminant level (MCL) exceedance.

Should you have further questions or if we may be of assistance in any way, please don't hesitate to contact us at 603-271-7812 or toll free 1-800-852-3345 ext-7812 or by email. If you have any further questions or concerns or feel we did not address your concerns we would be happy to speak with you to see if there is more we can do.

Thank you once again.

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## **Explanation of a Standardized Incidence Ratio (SIR) And 95% Confidence Interval<sup>1</sup>**

In order to evaluate cancer incidence, a statistic known as a standardized incidence ratio (SIR) is calculated for each cancer type. 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 some larger comparison population designated as “normal” or average. Usually, the state as a whole is selected to be the comparison population. Using the state as a comparison population provides a stable population base for the calculation of incidence rates. As a result of the instability of incidence rates based on small numbers of cases, SIRs were not calculated when fewer than five cases were observed.

Specifically, an SIR is the ratio of the observed number of cancer cases to the expected number of cases. An SIR of 1 indicates that the number of cancer cases observed in the population evaluated is equal to the number of cancer cases expected in the comparison or “normal” population. An SIR greater than 1 indicates that more cancer cases occurred than expected and an SIR less than 1 indicates that fewer cancer cases occurred than expected. Accordingly, an SIR of 1.50 is interpreted as 50% more cases than the expected number; an SIR of 0.90 indicates 10% fewer cases than expected.

Caution should be exercised, however, when interpreting an SIR. The interpretation of an SIR depends on both the size and the stability of the SIR. Two SIRs can have the same size but not the same stability. For example, an SIR of 1.5 based on 4 expected cases and 6 observed cases indicates a 50% excess in cancer, but the excess is actually only two cases. Conversely, an SIR of 1.5 based on 400 expected cases and 600 observed cases represents the same 50% excess in cancer, but because the SIR is based upon a greater number of cases, the estimate is more stable. It is very unlikely that 200 excess cases of cancer would occur by chance alone.

To determine if the observed number of cases is significantly different from the expected number or if the difference may be due solely to chance, a 95% confidence interval (CI) was calculated for each SIR. A 95% CI assesses the magnitude and stability of an SIR. Specifically, a 95% CI is the range of estimated SIR values that has a 95% probability of including the true SIR for the population. If the 95% CI range does not include the value 1, then the study population is significantly different from the comparison or “normal” population. “Significantly different” means there is less than 5% percent chance that the observed difference is the result of random fluctuation in the number of observed cancer cases.

For example, if a confidence interval does not include 1 and the interval is above 1 (e.g., 1.05-1.30), then there is statistically significant excess in the number of cancer cases. Similarly, if the confidence interval does not include 1 and the interval is below 1 (e.g., 0.45-0.96), then the number of cancer cases is statistically significantly lower than expected. If the confidence interval range includes 1, then the true SIR may be 1, and it cannot be concluded with sufficient confidence that the observed number of cases is not the result of chance and reflects a real cancer increase or decrease.

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., 1.03-1.15) allows a fair level of certainty that the calculated SIR is close to the true SIR for the population. A wide interval (e.g., 0.55-4.50) 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.

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<sup>1</sup> Source: Massachusetts Department of Public Health, Bureau of Environmental Health Assessment (2008)