



**Oregon Department of Human Services
Superfund Health Investigation and Education Program (SHINE)**

Health Consultation

**Cancer Investigation for Three Neighborhoods
Surrounding J.H. Baxter & Co. and Other Industrial Sites
Eugene, OR**

PUBLIC COMMENT RELEASE – VERSION 2

Prepared by the
Oregon Public Health Division
Superfund Health Investigation and Education Program



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SUMMARY

The Superfund Health Investigation and Education (SHINE) program, part of Oregon Public Health Division (OPHD), developed this health consultation in response to a cancer investigation request in the neighborhoods of Bethel, River Road, and Trainsong located in Northwest Eugene, Oregon. These densely populated neighborhoods border the J.H. Baxter wood treatment plant, along with several other industrial sites. While collecting community concerns for the J.H. Baxter site in 2003, SHINE was petitioned by community members living in this area to investigate the incidence of acute myelogenous leukemia (AML) and brain cancer. Residents were concerned that there were excess rates of these two types of cancers, possibly caused by contaminants released from the wood treatment facility along with the other nearby industries. SHINE prepared an initial report, released in September 2006, which reviewed cancer incidence rates in this area to determine if the number of cases of AML, brain, nasal, and lung cancers was higher than expected for the period of 1996 to 2003, the years for which data were available from the state cancer registry. Since the time of that initial report, additional data have become available, and this follow-up report includes data for the period of 1996-2004. The cancer investigation focused on the rates of these cancers in the six census tracts that make up the Bethel, River Road, and Trainsong neighborhoods. Rates of AML and brain cancer were reviewed because these were the cancers residents thought were occurring at higher rates. Rates of lung and nasal cancer were added to the review because of the close proximity of the wood treatment plant and the association noted in the scientific literature between exposure to the wood preservative creosote and these cancers. In addition “all cancers” and “all other cancers” (cancers other than AML, brain, lung and nasal) were reviewed. There were no statistically significant elevations for brain and nasal cancers for the 1996-2004 period, but an elevation was detected in lung cancer cases in census tract 42 for the years 1996-2004. In addition, cases of AML in the six census tract overall and in census tract 43 were significantly elevated in the period of 2002-2004. Because the investigators found inconsistent yet interesting significant results across groupings of years and for census tracts for AML and lung and brain cancer, further review of case information will be conducted for public health service and community outreach purposes.

PURPOSE AND HEALTH ISSUES

The Superfund Health Investigation and Education (SHINE) program, part of Oregon Public Health Division, prepared this health consultation to address whether certain types of cancer are elevated in the neighborhoods of Bethel, River Road, and Trainsong located in Northwest Eugene, Oregon. While collecting community concerns for the J.H. Baxter site in 2003, SHINE was petitioned by community members living in this area to investigate the incidence of acute myelogenous leukemia (AML) and brain cancer.

In 2003, SHINE completed a health consultation for J.H. Baxter, which concluded that there was not enough data to evaluate whether contaminants being released from J.H. Baxter posed a public health risk. The document stated that although the low-level concentrations of contaminants from J.H. Baxter were not likely to be associated with elevated cancer rates, an investigation should be conducted to address the residents’ concerns [1]. SHINE recommended

that the Oregon State Cancer Registry (OSCaR) and SHINE collaborate to complete this investigation. Residents expressed concern specifically about AML and brain cancer rates during a public meeting related to J.H. Baxter.

In 2004, OSCaR performed an initial investigation into the rates of AML and brain cancer in Northwest Eugene near J.H. Baxter. That investigation used data reported at the Zip Code level, and produced no evidence of increased rates for the cancers of concern. At that time, OSCaR was in the process of adding data to their database that allowed them to analyze the data for individual census tracts, which are smaller geographic areas than Zip Codes. OSCaR and SHINE concluded that when the complete data set became available, another review of the data would be performed. This health consultation summarizes the results of the census tract-level cancer investigation performed by OSCaR in collaboration with the SHINE program.

The follow-up census tract-level cancer investigation began in the winter of 2005. The focus was on census tracts 26.00, 27.00, 28.00, 41.00, 42.00, and 43.00 because they make up the majority of the area in the Bethel, River Road, and Trainsong neighborhoods. In addition to AML and brain cancer, SHINE requested that OSCaR expand the investigation to include lung and nasal cancer because these cancers have been linked to exposure to creosote, which is used for wood treatment by J.H. Baxter.

In September 2006, SHINE released an initial health consultation which evaluated cancer data for the six census tracts for the period of 1996-2003. Data for cases of lung cancer and all cancers combined were available for the period of 1996-2002. Both the initial health consultation released in September 2006 and the present document focus on answering the specific question about cancer rates in these neighborhoods. This version of the health consultation uses additional data which have since become available and evaluates the data for the six census tracts for the period of 1996-2004. SHINE is aware that, in addition to cancer rates, residents in the three neighborhoods have expressed concerns about other potential health effects from exposure to contaminants released by J.H. Baxter and the other industrial sites in the immediate area. Although there are many sources of contamination near the three neighborhoods, we are unable to draw conclusions about the public health impacts related to the individual or collective contaminant sources at this time. SHINE also released a report (*Follow-up J.H. Baxter Health Assessment Based on New Air Monitoring Data*) in April 2007 re-evaluate the public health impact posed by air emissions from J.H. Baxter.

BACKGROUND

In 2003, residents of the Bethel, River Road, and Trainsong neighborhoods expressed concern to SHINE staff about the possibility of increased rates of AML and brain cancer due to chemicals released by industrial sites closely bordering the densely populated neighborhoods. A map of the area of interest can be seen in Figure 1. According to the U.S. 2000 Census (Table 1), approximately 27,000 people live in Bethel, River Road, and Trainsong neighborhoods. The primary census tracts that make up the three neighborhoods are 26.00, 27.00, 28.00, 41.00, 42.00, and 43.00 (Figure 1).

The concerns about cancer rates were raised while SHINE was evaluating the health risk posed by emissions from J.H. Baxter and Company, a wood treatment plant. The original complaint from community members was the unpleasant odor coming from the wood creosoting plant. During a public meeting they described their frustration with the odors coming from the plant, and their concerns that exposure to the chemicals coming from this plant could be causing health effects, specifically cancer, in local residents. The chemical compounds used as preservatives at J.H. Baxter include pentachlorophenol, creosote, and ammonia copper zinc arsenate (ACZA). Polycyclic aromatic hydrocarbons (PAH's), a primary constituent of creosote, have been associated with lung and nasal cancer. SHINE prepared an initial health consultation to evaluate public health risks related to emissions from the J.H. Baxter plant. Inhalation was identified as a completed exposure pathway for the site. The initial consultation concluded that there was an *indeterminate public health hazard* because of a lack of data. The health consultation recommended that more data on emissions from the site be gathered to better assess chemicals released by the plant. The health consultation also concluded that an investigation be conducted to address the cancer concerns raised by community members although it was unlikely that the wood preservative emissions from the plant could be associated with increased cancer rates. It was suggested that the cancer investigation be conducted in coordination between the community, SHINE, and the Oregon State Cancer Registry (OSCaR).

The Lane Regional Air Pollution Agency (LRAPA) has conducted air sampling, and a follow-up health consultation is being prepared based on these data that re-assess public health risk from exposure to contaminants from J.H. Baxter.

Several other industrial sites also exist near residents' homes in or near the Bethel, River Road, and Trainsong neighborhoods (Figure 1), including Union Pacific Railroad (UPRR), many of which contain chemicals released in the area that are known or suspected carcinogens. Although there are many sources of contamination in these neighborhoods, we are unable to draw conclusions about the public health impacts from the individual or collective contaminant sources at this time.

COMMUNITY HEALTH CONCERNS

SHINE has had many opportunities to collect and listen to concerns expressed by residents in Trainsong, Bethel, and River Road neighborhoods over the past several years. Concerns have ranged from the immediate effects of breathing in air emissions from J.H. Baxter to long-range health effects, particularly cancer. Other long-term concerns include endocrine disruption, and damage to the respiratory and immune system. Residents have expressed concern regarding the contamination of air, soil, and water. Several residents have questions about how contaminants released from heavy automobile traffic and the numerous industrial sites may interact and impact the health of neighborhood residents.

Residents' specific concerns related to a potential cancer cluster stemmed from a number of AML cases within a small area in the Bethel neighborhood. Residents also learned about what seemed to them an unusual number of brain cancer cases in the neighborhood. Because of the odors from J.H. Baxter and knowledge about chemicals released by the different industrial sites,

residents came to believe that these cancer cases were related to environmental exposures. This document is intended to address some of those concerns.

EUGENE NEIGHBORHOOD CANCER INVESTIGATION HISTORY

In 2004, information on cancer rates was only available at the Zip Code level (for Zip Code 97402) at the time the initial Eugene cancer investigation was requested for AML and brain cancer [2]. Because of the data limitations, a more detailed look at cancer incidence at the neighborhood level was not possible in 2004. Residents thought there were an unusual number of AML cancer cases within the Bethel neighborhood, a much smaller area than what was reviewed at the Zip Code level. A community member consulted with a local physician and he stated that he thought the number of AML cases in the small geographic area seemed elevated. Other residents said that they knew of a former employee of J.H. Baxter who had died from a brain malignancy and an unusually large number of brain cancer cases in Northwest Eugene but did not specify in which neighborhood. In 2004, an OSCaR staff member recommended that a more detailed cancer investigation be conducted at the census tract level once geocoded information was available to better address area residents' specific concerns.

Figure 1. Map of Census Tracts and Industrial Sites in Bethel, River Road, and Trainsong Neighborhoods, Eugene, OR

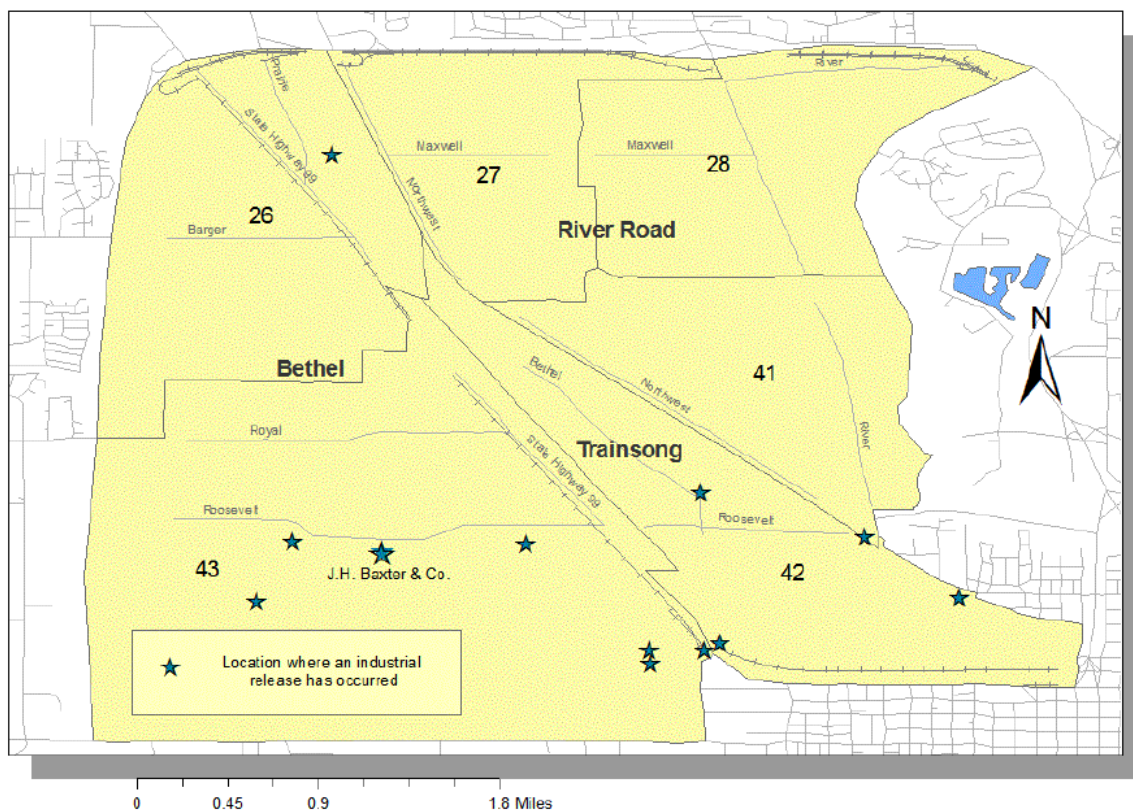


Table 1 Demographic Information for Bethel, River Road, and Trainsong Neighborhoods (Based on 2000 Census)

	Bethel		River Road			Trainsong
	Census Tract 26	Census Tract 43	Census Tract 27	Census Tract 28	Census Tract 41	Census Tract 42
Total population	5482	6515	3854	3960	3906	4066
Percent of Total Eugene Population	16.9%	20.2%	11.9%	12.2%	12.1%	12.6%
Male	2732	3147	1930	1910	1895	2337
Female	2750	3368	1924	2050	2011	1729
Race or Ethnicity						
Caucasian	4968	5847	3410	3532	3491	3205
Black or African American	51	62	51	32	40	63
American Indian or Alaska Native	66	72	67	65	45	80
Asian	91	72	41	22	35	67
Native Hawaiian or Pacific Islander	5	22	13	8	3	15
Hispanic or Latino	278	434	232	254	235	654
Total Households	2076	2624	1407	1595	1534	1627
Owner Occupied	1284	1507	1041	957	1043	360
Renter Occupied	792	1117	366	638	491	1267
% Below Poverty Level 1999	11.42%	12.57%	8.28%	15.33%	13.95%	36.03%

Data are specifically for the 6 census tracts that make up the majority of Bethel, River Road and Trainsong Neighborhoods.

METHODS

After the data for census tracts became available for the years 1996 to 2004, the Oregon State Cancer Registry (OSCaR) reviewed cancer incidence for the census tracts that make up the majority of the area in the Bethel River Road and Trainsong neighborhoods. Information available from OSCaR about cancer in Oregon comes from a variety of sources including hospital cancer registries/medical records departments, ambulatory surgical centers, physician offices, pathology laboratories, other state cancer registries, and death certificates. Citizens can also report cases to OSCaR directly by means of the “Cancer Inquiry Report Form”.

The number of cancer cases (the “observed” cases) in each identified census tract was compared with the number of “expected” cases for each census tract during the years between 1996 and 2004 (See Table 1). OSCaR used current cancer rates in the State of Oregon to calculate the expected number of cases of AML, brain, lung, and nasal cancers in these census tracts. The Oregon Cancer Registry calculated the expected number of cases of each type of cancer for each census tract. For a detailed description of how expected rates were calculated, see Appendix A. They also did a comparison for all other cancers, and all cancers combined to determine whether cancer in general was elevated in those census tracts. Background information on the four cancers of specific interest can be found in Appendix C.

Comparison of Observed and Expected Cancers

The method for calculating the expected number of cases in a small geographic area often produces some odd effects. Specifically, it is not uncommon that the number of expected cases at the census tract level could be expressed as a fraction of a person (i.e. 2.4 expected cases). This is because the number of expected cases is based on the number of cases in the larger population, and cancer at the population level is expressed in terms of the number of cases per 100,000 people. For example, if the rate for the number of bladder cancer cases in Oregon in 1996 was 24/100,000 and we were looking at a geographic area that only included 1,000 people, we would say the number of expected cases of bladder cancer is .24 - or roughly ¼ of a case. This happens because there is a relatively low rate of bladder cancer at the population level and because the local population is small (1,000). This is important to understand because of the way that we express the excess number of observed cases. For instance, if we expect .24 cases, and we observe 1 case, mathematically we would say we have four times the number of cancer cases than expected. This is misleading because it suggests that we have a much larger problem than we actually do, when what we actually have is a mathematical effect from a small number of cases.

One way to address this problem caused by small numbers is to test the numbers statistically. A statistical test is used to test the possibility that increases in observed vs. expected number of cases could happen simply as a matter of chance. When a condition is relatively rare (as many cancers are) we use a test called a Poisson distribution, which is used when the probability of an event happening is very low. This test helps us evaluate whether the difference between the expected and observed numbers is significant and not likely to be the result of chance or coincidence. It does not, however, tell us why there is a significant difference.

These analyses do not control for key factors including industrial and occupational exposures, smoking, years of residence in a census tract and other potential risk factors.

Some Cancer Facts

Cancer is a group of diseases characterized by the uncontrolled growth and spread of abnormal cells. If the spread is not controlled, it can result in death. Cancer is caused by both external (tobacco, chemicals, radiation and infectious organisms) and internal factors (inherited mutations, hormones, immune conditions, and mutations that occur from metabolism). These causal factors may act together or in sequence to initiate or promote carcinogenesis. Ten or more years often pass between exposure to external factors and detectable cancer.

- American Cancer Society

RESULTS

Table 2 summarizes cancer cases for all 6 census tracts from 1996 to 2004 and compares the actual number of cases (the “observed”) to the number of cases we would expect to see, based on the rates of these cancers in Oregon. The statistical significance was determined by comparing the observed cases with the expected cases using a Poisson distribution. As described above, the Poisson distribution is an appropriate test of significance when the disease occurrence is rare (a small number of cases relative to the size of the population). Detailed data tables reporting the observed and expected number of cases for the cancers of concern for all available years can be found in Appendix B along with the numbers summarizing the statistical significance.

Table 2 Summary of Cancer Cases in Six Census Tracts in Northwest Eugene, OR for the Period 1996-2004

Census Tract	Acute Myelogenous Leukemia		Brain Cancer		Lung Cancer		Nasal Cancer		All Other Cancers		All Cancers	
	Obs	Exp	Obs	Exp	Obs	Exp	Obs	Exp	Obs	Exp	Obs	Exp
26	1	1.6	6 ^(a)	3.3	41	31.4	1	0.3	206	197.5	255	234.1
27	0	1.1	0	2.5	31	24.6	0	0.2	131	150.6	162	179.0
28	2	1.1	4	2.5	19	23.6	0	0.2	147	150.9	172	178.3
41	2	1.0	4	2.3	23	19.8	0	0.2	137	134.1	166	157.5
42	0	0.7	4	1.9	29 ^(b)	11.0	0	0.1	66	88.8	99	102.5
43	5	2.3	5	4.4	50	48.2	0	0.4	254	289.5	314	344.7
Total	10 ^(c)	7.9	23	16.8	193	158.6	1	1.4	941	1011.4	1168	1196.2

(a) $p = .117$ (Poisson distribution), not statistically significant

(b) $p < .001$ (Poisson distribution), statistically significant

(c) $p = .271$ (Poisson distribution), not statistically significant

All Cancers Combined

The observed number of cases for all cancer combined between 1996 and 2004 for all census tracts was below the expected number of cases. “All other cancers” included all cancers from 1996 to 2004 except AML, brain, lung, and nasal cancer. The observed number of cases for all other cancers was also less than the expected number of cases for this time period.

Brain and Nasal Cancer

After running the appropriate statistical tests, we learned that there were no statistically significant elevations in rates for brain or nasal cancer in any of the census tracts during the period 1996-2004 in the three Eugene neighborhoods. We examined brain cancer cases by groups and by years and determined that in census tract 26 the highest number of cases ($n=2$) of brain cancer were diagnosed in 2001, but there was no elevation in the observed number of cases in that census tract before 2001 or after 2002. In one instance (from 1996 to 2002), the number of cases of brain cancer was significantly greater than the number of cases we expected to find. In census tract 26 there were 6 cases of brain cancer when we expected to see 3.3. While we are always concerned with possible evidence of higher than expected rates of cancer, it is difficult to draw conclusions from these findings because small increases in cancer rates in small geographic

areas are not uncommon. This is especially true when an increase occurs over a one or two year period rather than consistently, over a several year period. At this time, the data indicate that the measurable increase in brain cancer may be due to chance; a possibility strengthened by the fact that we see very low numbers of cases in the years before 2001 and no cases after 2002.

Lung Cancer

Data from OSCaR indicate a statistically significant elevation in lung cancer in census tract 42 for period from 1996 to 2004. In census tract 42, the number of cases of lung cancer (n=29) significantly exceed the expected number of cases (n=11). Based on a review of vital statistics from the Oregon Center for Health Statistics, 28 persons with lung cancer in census tract 42 died from their illness. In 27 of the 28 deaths, vital records indicate that tobacco was the underlying cause or probable cause of the person’s death. Tobacco use is strongly associated with lung cancer with eighty percent of all lung cancer considered to be caused by smoking.

OSCaR conducted an additional review of the cases to determine if people lived within the census tract for a period of time that would make plausible the possibility that a common environmental exposure in the area could be associated with the development of lung cancer. Lung cancer is thought to have a long latency between exposure to a carcinogen and development of clinical disease (10-30 years according to ATSDR).

Table 3 Length of residence in Eugene Census Tract 42 for lung cancer patients at time of diagnosis

Number of Years	Number of patients
24	1
23	1
18	2
16	1
15	1
11	2
8	4
7	1
5	1
4	2
<1 year	4
Unknown	9
Total	29

OSCaR learned that of the 29 people diagnosed with lung cancer for the period of 1996-2004 and living in census tract 42 at the time of diagnosis, 15 had a documented residence in that census tract prior to diagnosis. Documented period of residence for the cases in census tract 42 ranged from less than one year to 24 years. Nine people had unknown addresses prior to diagnosis; the

remaining four appeared to be living outside census tract 42 prior to diagnosis. In terms of common factors related to residency, OSCaR learned that, at the time of diagnosis, 3 people were living at a local mission, 4 people were residents of the same low-income housing complex, and another 2 persons were residents of the same mobile home park. These locations are not adjacent to one another.

In summary, we were able to determine residency in the census tract prior to diagnosis in approximately 69% of cases. Where residence information is known, nearly three quarters of the patients lived in census tract 42 less than 10 years prior to diagnosis. The high rate of smoking in the group of cancer patients, combined with the low percentage of people residing in the area for greater than 10 years, indicate that it is unlikely that cases of lung cancer are attributable to an environmental exposure, but are likely attributable to exposure to carcinogens in tobacco.

Acute Myelogenous Leukemia (AML)

Ten (10) cases of AML were diagnosed in the 6 census tracts in the period of 1996-2004 when 7.9 cases were expected in that period (See Table 4). This is not a statistically significant increase. A closer look at the data show that only 2 of those cases occurred before the year 2000. Between 2002 and 2004, 8 of the 10 cases occurred, when 3.3 were expected. This *does* represent a statistically significant elevation. In addition, 5 of the 10 cases in all census tracts occurred in census tract 43, and 4 of the 8 cases reported between 2002 and 2004 were in census tract 43.

Table 4 Summary of AML Cases by Location and Time Period (See Appendix B for Detailed Data Tables)

Cases of AML	1996-2004			2002-2004		
	<i>Obs</i>	<i>Exp</i>	<i>p-value</i>	<i>Obs</i>	<i>Exp</i>	<i>p-value</i>
All Census Tracts	10	7.9	0.271	8	3.3	0.020*
Census Tract 43	5	2.3	0.083	4	0.8	0.009*

**Statistically Significant*

When the years 2002-2004 are considered, OSCaR data indicate statistically significant increases in AML across all of the 6 census tracts, and AML in census tract 43. This excess for a sub-set of years (2002-2004) indicates the presence of a statistical cancer cluster in this area, with census tract 43, an area of particular concern. In general, focus on an isolated time period in this fashion is not a standard approach in assessing a multi-year cancer data review. However, in this case, the decision was made to do so since the apparent increase in observed cases involved the most recent years for which data are available. We must further evaluate whether the apparent clustering of AML cases could be due to environmental or other risk factors for disease which are shared by each of the cases, unless enough data after the year 2004 becomes available to suggest the increased rate of was due to chance.

OSCaR conducted an additional review of the observed cases from census tract 43.00 between the years 1996 to 2004 to determine if they lived within the census tract for a period of time that would make plausible the possibility that a common environmental exposure in the area could be

associated with the development of AML. The latency period for development of AML is approximately 5 years.

OSCaR learned that 4 of the 5 people with AML in census tract 43 lived in the area for nine years or longer. All 5 of the AML patients had a history of tobacco use, and 1 patient had a history of chemotherapy treatment. Both tobacco use and chemotherapy are associated with development of AML[8]. Based on residential history, it is unclear whether there are additional common exposures that could also be associated with AML cases.

CANCER CLUSTER INVESTIGATIONS

Cancer cluster investigations are complex and difficult for several reasons, and when they are undertaken, they are implemented in a careful and methodical way. First, as in this case, a comparison is made between the expected number of cases in a specific geographic area during a specific period of time. When this comparison shows an excess number of cases, additional steps in a cancer cluster investigation are indicated. Generally, a cancer cluster investigation seeks to determine if the people with cancer in a specific area could have been exposed to something in their environment that may have caused their cancer. If a large proportion of people with cancer moved into the area after (or shortly before) they were diagnosed with cancer, it reduces the likelihood that an environmental exposure in that area is responsible for the excess cases of cancer.

If that is not the case, and a plausible connection is made between the cases of cancer and the period of time it would take between exposure to an environmental contaminant and the diagnosis of cancer is made, the investigation will continue. At that point more specific information is needed from the people with a cancer diagnosis, or their next of kin, to determine if there is a way to measure the level and type of exposure they may have had to an environmental contaminant or to account for other factors such as occupational exposure, smoking history and family history of cancer. Determining the cause of cancer is a challenge because exposure to cancer-causing agents may have occurred many years earlier.

What is a Cancer Cluster?

A cancer cluster is a greater-than-expected number of cancer cases that occurs within a group of people in a geographic area over a period of time. Cancer cases are more likely to represent a cancer cluster if they involve (1) one type of cancer, (2) a rare type of cancer, or (3) a type of cancer in a group not usually affected by that cancer.

*-Centers for Disease Control
and Prevention*

SENSITIVE POPULATIONS

Several factors put people at greater risk for developing cancer. Some people are more susceptible to developing cancer because they inherit altered genes, a weak immune system, or altered hormone levels [3]. Exposure to a cancer-causing chemical, behavioral choices, health, age, and gender can put people at greater risk for developing different types of cancer in addition to inherited conditions or genes. Occupational exposure to certain substances may also put workers at greater risk for developing cancer.

CHILD HEALTH CONSIDERATIONS

In general, SHINE and ATSDR recognize that infants and children may be more vulnerable than adults to exposures to contaminants in air, water, soil, or food. For this investigation, expected rates of cancer were calculated for all age groups, and the observed number cases were compared to expected number of cases by age group as well as geographic area. These comparisons indicated that children in this area were no more likely to have increased rates of cancer than their adult counterparts.

CONCLUSIONS

For the period of 1996-2004 for all census tracts combined, the data indicate no statistically significant elevation in the number of cases of AML when compared with the number of expected cases. For the period of 2002-2004 in the six census tracts overall and in census tract 43, the cases of AML were significantly elevated. It appears that the significant excess in observed cases in all census tracts for the period of 2002-2004 is attributable to the excess cases in census tract 43, since no other census tract shows a significant increase in observed cases as compared with expected cases for that period. A review of the available residency information indicates that 4 of the 5 people with AML in census tract 43 lived in the area prior to their diagnosis for at least 9 years. All AML patients reported a history of, or current use of tobacco and one patient had a history of chemotherapy treatment. Additional investigation is needed to determine if these cases of AML are attributable to other or additional risk factors including an environmental exposure

For the period of 1996-2004 for all census tracts combined, the data indicate a statistically significant excess in the number of cases of lung cancer when compared with the number of expected cases. For the period of 1996-2004, cases of lung cancer in census tract 42 were also significantly elevated. It appears that the significant excess in observed cases in all census tracts is attributable to the excess cases in census tract 42. A review of the residency information available indicates that 73% lived in census tract 42 for less than 10 years prior to diagnosis. Lung cancer has a latency period of 10-20 years; this combined with the high incidence of smoking in this group indicates that it is unlikely that exposure to an environmental contaminant is the cause of lung cancer in these patients.

For the period 1996-2004, there were no statistically significant elevations for nasal and brain cancers. In census tract 26, we observed the highest number of cases of brain cancer in 2001 (n=2). These cases represented a statistically significant elevation for the period of 1996-2002 however, none of the other study years had a significant elevation.

For the period of 1996-2004 for all census tracts combined, the data indicate that cases of "All Other Cancers" were far fewer than expected when compared with the number of expected cases; this result was statistically significantly lower. It appears that this is the result of lung cancers not being included in the analysis for "all other cancers," since lung cancers from all tracts account for a large number of observed cancers in this and other geographic areas.

Preliminary data from OSCaR, comparing the number of observed cases of cancer compared with the expected number, indicate the presence of a “statistical” cancer cluster of lung cancer in census tract 42 for all years, and brain cancer in census tract 26 and AML in census tract 43 for select years. Additional investigation is needed to determine if “confirmed” cancer clusters in these geographic areas exist. A confirmed cluster means that a group of cancer cancers that are statistically significantly elevated are due to a common, shared exposure. SHINE is unable at this time to determine if there is a relationship between the excess number of cases of brain or lung cancer or AML and exposure to environmental contaminants from a single or multiple sources. The public health impact of individual or multiple contaminants in these census tracts cannot be rigorously assessed due to a lack of information about individual case histories and the environmental data for the 1990’s, which are needed to evaluate the relationship between exposure to contaminants and individual health effects. However, individuals are strongly encouraged to abstain from tobacco use which is highly associated with both lung cancer and AML.

RECOMMENDATIONS/PUBLIC HEALTH ACTION PLAN

SHINE recommends that cases of AML in all census tracts be reviewed for information on risks for AML including exposure to high doses of irradiation, therapeutic radiation, chemotherapy for the treatment of cancer, and/or direct occupational or other exposure to benzene, a chemical associated with the development of AML.

In response to community concerns, OSCaR will monitor the brain cancer rate in census tract 26 as case information becomes available for 2005 and 2006 to assess that elevation in brain cancer rates were due to chance and are not ongoing.

SHINE will continue community involvement and outreach activities in the neighborhoods of Bethel, River Road, and Trainsong to address concern about environmental contaminants in the area and their impacts on public health.

SHINE will present the results for the follow-up health consultation for J.H. Baxter, a site of concern for neighbors in Bethel, River Road, and Trainsong neighborhoods, at the public meeting being held in Eugene, OR on May 17th. The report for this follow-up investigation can be found at: www.healthoregon.org/superfund.

PUBLIC COMMENT

Second Public Comment Release

Due to the fact that this follow-up health consultation addresses additional years of data from the Oregon Cancer Registry, and the findings of this follow-up report substantially differ from the initial report, we are offering the opportunity to the public to comment on SHINE's findings and proposed activities contained in this document. The public comment period for this document is from May 15, 2007 to June 30, 2007. Comments are requested and should be directed to:

SHINE

Oregon Department of Human Services, Health Services
800 NE Oregon #827
Portland, OR 97232

Initial Public Comment Release

The initial health consultation report released in September 2006 was made available for was made available for 30 days. OPHD received comments from 4 citizens. The comments and our response are reflected below.

Comment

The decision to include in the study area census tracts relatively far from JH Baxter seems to artificially dilute the dataset and make it less likely that any real cancer effects linked to pollutants from that facility would be found.

Response

The expected cancer rates for each area were calculated separately, permitting evaluation of each census tract separately (i.e. we assessed the observed v. expected rate for each cancer in each census tract) so no dilution of the dataset occurred. The six census tracts in the study area for this investigation were included because they comprise the three neighborhoods where residents expressed concern about cancer rates. They also comprise the “first ring” of the small geographic areas around the J.H. Baxter site that could plausibly have the highest rate of exposure to the emissions from the plant.

Comment

The data in the report shows that cases of Acute Myelogenous Leukemia (AML) are twice as high as expected in the Bethel census tract nearest the Baxter plant, but the elevation is just short of reaching statistical significance. I think that this elevation deserves more investigation, given the lethality of the condition, the known link to environmental exposures, and the difficulty of establishing statistical significance for rare cancers in a small geographic and population area.

Response

At the time that the initial report was published SHINE was only able to analyze data for the 1996 through 2003, and although the data indicated an excess number of cases over what is expected in census tract 43, as you note, the increase was not statistically significant. At the time of the writing of this second report, additional data for 2004 became available and we learned that the excess did reach the level of statistical significance for all census tracts and for census tract 43 when data for 2002-2004 are considered in isolation.

Comment

.....they make no comment about something that just leaps out of Table 2: lung cancers in census tract 42. They expect 8.5 cases, on the average, but find 21 cases.

A statistical test that uses a Poisson distribution is valid for small numbers of expected cases (say 1-10) out of a large population (say 1000), can be used to test any one particular category.

Using a Poisson test, the chance that 21 or more cases of lung cancer would have occurred at random in tract 42 is .0002--which is significant.

Response

SHINE initially received a report from the cancer registry that included the expected rate for lung cancer in census tract 42 as 8.5, which is why it is listed this way in the initial report. In a later version of the table received from the cancer registry, this number of expected cases in census tract 42 was revised to 18.5. The reason for this revision is not entirely clear, although it was noted, in review of the analysis, that the chi square value calculated for census tract 42 was "18.5" and this may inadvertently have been substituted for the expected number of cases. Using this higher, but incorrect, expected number of cases, lung cancer in census tract 42 was not significantly elevated, and therefore there was no comment or explanation of the more modest difference between the Observed =21 and Expected =18.5.

In response to the above comment, calculations were reviewed and it was determined that the original expected number of 8.5 was in fact correct, and that the difference between observed and expected cases of lung cancer in census tract 42 was statistically significant. This has been corrected in this report. At the time of the writing of this report, the data for lung cancer have been updated to include 2004 cases. Using the updated figures, the observed number of lung cancer cases in census tract 42 is 29 with 11 cases expected. The report has been modified to correct the earlier data errors, and to include the new data.

Comment

The choice of describing this as a study of cancer in areas surrounding JH Baxter unfairly implies that this one facility is the only (or most likely) culprit in releasing pollutants that might be linked to the cancers investigated, or overall cancer rates. Also, the study is not as comprehensive a look at cancer rates or exposures as the title might imply, and more investigation is warranted.

Response

This investigation began with inquiries and concerns expressed by neighbors in the area around J.H. Baxter. While J.H. Baxter is featured as a possible source of exposure that could lead to cancer in people in the area, other potential sources of exposure are specifically identified in the section

"Several other industrial sites also exist near residents' homes in or near the Bethel, River Road, and Trainsong neighborhoods (Figure 1), including Union Pacific Railroad (UPRR), many of which contain chemicals released in the area that are known or suspected carcinogens. Although there are many sources of contamination in these neighborhoods, we are unable to draw conclusions about the public health impacts from the individual or collective contaminant sources at this time."

Comment

... the study is not as comprehensive a look at cancer rates or exposures as the title might imply, and more investigation is warranted.

Response

The cancer data for this area have been reviewed twice; first at the Zip Code level by OSCaR and then at the census tract level by OSCaR and SHINE. In the first instance OSCaR was unable to detect an excess in cancer cases. In this second instance OSCaR did detect excess lung cancer cases in census tract 42 for the period 1996-2004, and excess cases of AML in the 6 census tracts overall and in census tract 43 for the period 2002-2004. An initial investigation on the lung cancer cases was conducted by OSCaR, and we learned that of the 29 cases reported, 28 deaths had occurred and of those 28 deaths, 27 were identified as tobacco-related. SHINE is recommending that a more thorough investigation of the lung cancer cases be conducted to learn if those people with lung cancer in census tract 42 had lived in the area prior to their diagnosis.

SHINE is also recommending that a thorough case review be conducted on all cases of AML in the 6 census tracts to confirm if a cancer cluster exists. SHINE is unable at this time to determine if there is a relationship between the excess number of cases of lung cancer or AML and exposure to environmental contaminants from a single or multiple sources. Oregon Public Health will continue to monitor rates of brain cancer in census tract 26 to determine if increases in cases are repeated in future years.

Comment

The Chi-square function is a continuous function, assuming continuous variables that can take on fractional values, and not counting variables, integers, such as we have here. I tell students to not even think about using a Chi-square test unless they expect at least 10 values of any particular data category. But you can see from table 2 that they use expected values for categories of 3, 2, 1, .3, .2!!! Chi-square isn't valid for such small values.

Response

You correctly point out that a Poisson distribution is necessary in this instance. At SHINE's request, the cancer registry re-ran the calculation using the Poisson distribution, and the results of the analysis using the Poisson distribution are provided. The findings of no significant difference between observed and expected number of cases of brain cancer did not change.

Comment

The copy of the SHINE report I got:

1. is missing table 3 that it refers to on page 6.
2. is missing the detailed data tables in Appendix A referred to in Table 2
3. has no breakdown of how Chi square was used, the statistical results, or any discussion of significance.

Response

1. You correctly note that there is a reference to a third table, but no such table is included in the report. In an earlier draft of the report we had included the observed v. expected

cases of brain cancer for census tract 26. We removed it because it was not helpful to the discussion, but neglected to remove the reference to it in the text.

2. SHINE was advised by ATSDR to remove the detailed data tables, as they are excessively cumbersome and not necessarily helpful in communicating the initial findings of the investigation. The reference to the tables was inadvertently left in the report. However, in light of additional data made available for 2003 and 2004, and in order to limit any concerns about the availability of information, these tables have been added back in to the report and are located in Appendix B.
3. Chi-square was initially used to analyze the difference between the expected number of cases of cancers the number of observed cases, and found that no statistically significant increase in the number of observed cases could be detected. The use of the chi-square statistic was inappropriate however, because of the small number of cases, so OSCaR reran the calculations using the Poisson distribution, and statistic that is appropriate for small numbers of cases. The Poisson distribution also found no statistically significant increase in the number of observed cases as compared with the number of expected cases of nasal and brain cancer for the period of 1996-2004. However, statistically significant elevations of lung cancer in census tract 42 for the period 1996-2004, as well as AML in all census tracts and in census tract 43 for the period 2002-2004 were detected.

Comment

Appendix C (ATSDR Plain Language Glossary of Environmental Health Terms) has definitions that don't match the words they are supposed to be describing. Starting with "Cancer" on page 15 and continuing through page 20, the correct definitions are not the adjacent ones but are one down from the adjacent ones. The term for "See Community Assistance Panel." is missing and at the end of the list, there is no definition for "Urgent Public Health Hazard".

Response

The table of terms has been corrected and is now located in Appendix D.

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CERTIFICATION

The Superfund Health Investigation and Education Program of the Oregon Department of Human Services prepared this report of a cancer investigation for the Bethel, River Road, and Trainsong neighborhoods under a cooperative agreement with the Agency for Toxic Substances and Disease Registry. This document was completed in accordance with approved methodology and procedures existing at the time the health consultation was initiated. Editorial review was completed by the Cooperative Agreement partner.

Robert B. Knowles, M.S., REHS
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Agency for Toxic Substances & Disease Registry

I have reviewed this health consultation, as the designated representative of the Agency for Toxic Substances and Disease Registry and concur with its findings.

Alan W. Yarbrough, M.S.
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APPENDIX A - CALCULATING EXPECTED NUMBER OF CANCER CASES

To calculate the estimated expected number of cases in each census tract, a count was created using indirect adjustment, using age-specific rates for the State as a whole and information about the population in each census tract.

Eighteen age groups were used to calculate the estimate. The age-specific rates for Oregon were calculated by dividing the number of cases of each cancer in Oregon (AML, brain, lung, nasal) by the number of people in Oregon in each age group. The 18 age groups were in five-year groupings (e.g. 0-4, 5-9, 10-14, and so on). Cases were included for the entire time period that the registry has been in operation; cases diagnosed from January 1, 1996 through 2004, which is the most recent completed data year. Population estimates from the US 2000 Census were used.

As an example, to calculate Oregon's age-specific rate for all cancers during 1996-2004 among people age 50-54, the number of cases of cancer in that age-group between 1996 and 2004 (13,035) was divided by nine times the number of Oregonians aged 50-54 from the 2000 Census (235,840 X 9 = 2,122,560). This number was then multiplied by 100,000 to give an age-adjusted rate per 100,000 of 614.1.

To outline the calculation in general terms: age-specific rate per 100,000 = (number of cases in age group in a given time period / combined population in that age group over that time period) X 100,000.

To calculate the expected number of cases for a given census tract during 1996-2004, the number of people in a given age group in that census tract was multiplied by the Oregon age-specific rate for that age group. For example, in census tract 42 there were 236 people age 50-54 in the 2000 Census. That number was multiplied by 9 to estimate 9 years of population (236 X 9 = 2,124). That estimate was then multiplied by the state's age-specific rate for all cancers in the 50-54 age group (2,124 X 614.1) and divided by 100,000 to produce the expected number of cases for the 50-54 age group in census tract 42 (13). This same process was carried out for each age group, and the results were added together to produce the total number of expected cancer cases in census tract 42 (102.5). The expected number of cases was compared to the observed number of cases in the same time period (99).

To summarize: calculation of expected count in census tract = (population in age group X age-specific rate) / 100,000.

APPENDIX B – OBSERVED V. EXPECTED RATES OF CANCERS IN 6 LANE CTY. CENSUS TRACTS

Acute Myeloid Leukemia (AML) by census tract and year, 1996-2004

Lane Cty CT	Year									Year Grouping								Test of Significance			
	1996	1997	1998	1999	2000	2001	2002	2003	2004	1996-2002		1996-2003		1996-2004		2002-2004		poisson			
	OBS	OBS	OBS	OBS	OBS	OBS	OBS	OBS	OBS	EXP	OBS	EXP	OBS	EXP	OBS	EXP	OBS	96-02	96-03	96-04	02-04
002600	0	0	0	0	0	0	0	1	0	1.2	0	1.4	1	1.6	1	0.6	1	0.301	0.500	0.500	0.451
002700	0	0	0	0	0	0	0	0	0	0.9	0	1.0	0	1.1	0	0.9	0	0.406	0.367	0.332	0.406
002800	0	0	1	0	0	0	1	0	0	0.9	2	1.0	2	1.1	2	0.4	1	0.227	0.264	0.300	0.330
004100	0	0	0	0	0	0	1	0	1	0.8	1	0.9	2	1.0	2	0.4	2	0.500	0.227	0.264	0.062
004200	0	0	0	0	0	0	0	0	0	0.6	0	0.6	0	0.7	0	0.3	0	0.500	0.500	0.496	0.500
004300	0	0	0	1	0	0	1	2	1	1.7	2	2.0	4	2.3	5	0.8	4	0.500	0.142	0.083	0.009
TOTAL	0	0	1	1	0	0	3	3	2	6.0	5	6.8	9	7.9	10	3.3	8	0.446	0.245	0.271	0.020

*Case definition for AML has been changed from the initial public comment version of this health consultation. Initial case definition included all acute leukemias. This case definition includes only acute myeloid leukemia (AML)

Brain cancer by census tract and year, 1996-2004

Lane Cty CT	Year									Year Grouping						Test of Significance		
	1996	1997	1998	1999	2000	2001	2002	2003	2004	1996-2002		1996-2003		1996-2004		poisson		
	OBS	OBS	OBS	OBS	OBS	OBS	OBS	OBS	OBS	EXP	OBS	EXP	OBS	EXP	OBS	96-02	96-03	96-04
002600	1	1	0	0	1	2	1	0	0	2.4	6	2.8	6	3.3	6	0.035	0.065	0.117
002700	0	0	0	0	0	0	0	0	0	1.8	0	2.1	0	2.5	0	0.165	0.122	0.082
002800	1	0	1	0	0	0	2	0	0	1.9	4	2.1	4	2.5	4	0.125	0.161	0.242
004100	0	0	2	0	0	1	1	0	0	1.7	4	2.0	4	2.3	4	0.093	0.142	0.200
004200	1	0	0	1	0	0	0	0	2	1.4	2	1.6	2	1.9	4	0.408	0.475	0.125
004300	0	1	0	0	1	1	0	0	2	3.3	3	3.8	3	4.4	5	0.500	0.473	0.448
TOTAL	3	2	3	1	2	4	4	0	4	12.5	19	14.5	19	16.8	23	0.052	0.147	0.268

Lung cancer by census tract and year, 1996-2004

	Year									Year Grouping						Test of Significance		
	1996	1997	1998	1999	2000	2001	2002	2003	2004	1996-2002		1996-2003		1996-2004		poisson		
Lane Cty CT	<i>OBS</i>	<i>OBS</i>	<i>OBS</i>	<i>OBS</i>	<i>OBS</i>	<i>OBS</i>	<i>OBS</i>	<i>OBS</i>	<i>OBS</i>	<i>EXP</i>	<i>OBS</i>	<i>EXP</i>	<i>OBS</i>	<i>EXP</i>	<i>OBS</i>	96-02	96-03	96-04
002600	3	5	7	1	6	5	9	3	2	24.4	36	27.8	39	31.4	41	0.016	0.025	0.056
002700	2	3	3	6	3	1	8	3	2	19.1	26	21.8	29	24.6	31	0.076	0.080	0.119
002800	1	3	2	2	1	1	3	5	1	18.3	13	20.9	18	23.6	19	0.127	0.309	0.201
004100	2	1	2	5	3	2	4	1	3	15.4	19	17.6	20	19.8	23	0.209	0.314	0.264
004200	3	2	7	2	1	1	6	2	5	8.5	22	9.7	24	11.0	29	0.000	0.000	0.000
004300	5	5	4	4	5	8	4	7	8	37.3	35	42.6	42	48.2	50	0.393	0.500	0.416
TOTAL	16	19	25	20	19	18	34	21	21	122.9	151	140.4	172	158.6	193	0.007	0.005	0.004

Nasal cancer by census tract and year, 1996-2004

	Year									Year Grouping						Test of Significance		
	1996	1997	1998	1999	2000	2001	2002	2003	2004	1996-2002		1996-2003		1996-2004		poisson		
Lane Cty CT	<i>OBS</i>	<i>OBS</i>	<i>OBS</i>	<i>OBS</i>	<i>OBS</i>	<i>OBS</i>	<i>OBS</i>	<i>OBS</i>	<i>OBS</i>	<i>EXP</i>	<i>OBS</i>	<i>EXP</i>	<i>OBS</i>	<i>EXP</i>	<i>OBS</i>	96-02	96-03	96-04
002600	0	0	0	0	1	0	0	0	0	0.2	1	0.3	1	0.3	1	0.181	0.259	0.259
002700	0	0	0	0	0	0	0	0	0	0.2	0	0.2	0	0.2	0	0.500	0.500	0.500
002800	0	0	0	0	0	0	0	0	0	0.2	0	0.2	0	0.2	0	0.500	0.500	0.500
004100	0	0	0	0	0	0	0	0	0	0.1	0	0.2	0	0.2	0	0.500	0.500	0.500
004200	0	0	0	0	0	0	0	0	0	0.1	0	0.1	0	0.1	0	0.500	0.500	0.500
004300	0	0	0	0	0	0	0	0	0	0.3	0	0.4	0	0.4	0	0.500	0.500	0.500
TOTAL	0	0	0	0	1	0	0	0	0	1.1	1	1.3	1	1.4	1	0.500	0.500	0.500

All other cancers by census tract and year, 1996-2004

	Year									Year Grouping						Test of Significance		
	1996	1997	1998	1999	2000	2001	2002	2003	2004	1996-2002		1996-2003		1996-2004		poisson		
Lane Cty CT	<i>OBS</i>	<i>OBS</i>	<i>OBS</i>	<i>OBS</i>	<i>OBS</i>	<i>OBS</i>	<i>OBS</i>	<i>OBS</i>	<i>OBS</i>	<i>EXP</i>	<i>OBS</i>	<i>EXP</i>	<i>OBS</i>	<i>EXP</i>	<i>OBS</i>	96-02	96-03	96-04
002600	21	19	25	17	21	23	24	26	30	150.7	150	172.8	176	197.5	206	0.499	0.414	0.282
002700	11	16	16	14	11	10	19	13	21	115.1	97	131.9	110	150.6	131	0.048	0.029	0.057
002800	15	18	10	16	17	20	20	15	16	115.0	116	131.9	131	150.9	147	0.475	0.492	0.396
004100	18	23	13	15	5	12	19	14	18	102.0	105	117.1	119	134.1	137	0.396	0.443	0.413
004200	9	12	8	6	4	8	7	7	5	67.2	54	77.3	61	88.8	66	0.057	0.033	0.007
004300	32	36	24	32	20	29	31	29	21	221.2	204	253.6	233	289.5	254	0.130	0.102	0.018
TOTAL	106	124	96	100	78	102	120	104	111	771.3	726	884.5	830	1011.4	941	0.052	0.034	0.013

All cancers by census tract and year, 1996-2004

	Year									Year Grouping						Test of Significance		
	1996	1997	1998	1999	2000	2001	2002	2003	2004	1996-2002		1996-2003		1996-2004		poisson		
Lane Cty CT	<i>OBS</i>	<i>OBS</i>	<i>OBS</i>	<i>OBS</i>	<i>OBS</i>	<i>OBS</i>	<i>OBS</i>	<i>OBS</i>	<i>OBS</i>	<i>EXP</i>	<i>OBS</i>	<i>EXP</i>	<i>OBS</i>	<i>EXP</i>	<i>OBS</i>	96-02	96-03	96-04
002600	25	25	32	18	29	30	34	30	32	179.7	193	205.9	223	234.1	255	0.152	0.111	0.082
002700	13	19	19	20	14	11	27	16	23	137.6	123	157.5	139	179.0	162	0.113	0.073	0.107
002800	17	21	14	18	18	21	26	20	17	136.7	135	156.7	155	178.3	172	0.465	0.467	0.336
004100	20	24	17	20	8	15	25	15	22	120.5	129	138.2	144	157.5	166	0.231	0.322	0.259
004200	13	14	15	9	5	9	13	9	12	78.3	78	89.9	87	102.5	99	0.500	0.406	0.389
004300	37	42	28	37	26	38	36	38	32	264.7	244	303.3	282	344.7	314	0.106	0.115	0.050
TOTAL	125	145	125	122	100	124	161	128	138	917.4	902	1051.6	1030	1196.2	1168	0.325	0.268	0.221

APPENDIX C - GENERAL CANCER INFORMATION

Note – The citations listed in this section can be found in the reference section at the end of the main body of this document

The American Cancer Society (ACS) estimates that approximately one in two men and one in three women will develop cancer in their lifetime [4]. Nearly eighty percent (77%) of all cancer cases occur in adults 55 years or older. It is a disease associated with increasing age. It is the leading cause of death for people under the age of 85 [5], and the second leading cause of all deaths in the United States.

Cancer, a group of over 200 diseases, develops inside the cell and disrupts the normal process of cell development [3]. Cancer causes cells to divide continuously when new cells are not needed.

It is estimated that smoking causes nearly two-thirds of cancers, and 25-30% of cancers are caused by obesity and physical inactivity. [3]. Other environmental factors linked to cancer include viruses, radiation, medications, and chemicals in the air and water. Identifying the factor or factors that act alone or in combination to cause cancer is difficult.

A cancer cluster is defined as a greater-than-expected number of cancer cases that occurs within a group of people in a geographic area over a period of time [6]. It is not uncommon to wonder about the cause of cancers when they are grouped in a geographic area and people often fear that pollution or environmental contamination is the cause. Cancer clusters can and do occur because of exposures from a common source but they are difficult to document [5]. There are some important considerations to take into account when trying to evaluate whether a cancer cluster exists.

- 1.) Cancer is the second leading cause of death in the U.S., and consists of about 200 different types and may not share a common cause.
- 2.) It is difficult to track the cause of most cancers. For some, the cause is unknown and for others there may be a long period of time between one more exposures that trigger the disease and the diagnosis of cancer.
- 3.) A person may change residence between exposure and development of cancer, often making it difficult draw the connection between exposure and disease.
- 4.) Occupation and individual behavior (smoking, nutrition, and exercise) play significant roles in the risk of developing cancer.

Possible cancer clusters can initially be evaluated by defining a population (i.e., neighborhood or workplace) and calculating the expected number of cases in that group over a period of time, based on a comparison population. The observed number of cases is then compared to the expected number of cancer cases in that population.

AML

Acute myelogenous leukemia (AML) is the most common type of leukemia, a cancer of the blood and bone marrow [7]. It causes the production of abnormal cells including blasts that normally develop into white blood cells, red blood cells, and platelets. The abnormal leukemia cells crowd out normal red and white blood cells and platelets. It is a disease that usually affects

older adults (average age at diagnosis is 65 years) and nearly 12,000 new cases are diagnosed in the U.S. each year.

Occupational exposures to certain hazardous substances and specific occupations are associated with an increased risk of developing leukemia [8]. A strong association exists between exposure to benzene, ethylene oxide, and ionizing radiation along with working in boot and shoe manufacturing and repair. An association means there is evidence of a link between an environmental exposure and a disease [9] but it does not assume that exposure to that substance will automatically result in that disease. An association between exposure and disease does not automatically mean that exposure to a hazardous substance will automatically result in a disease. Other substances or industries that may also be linked to an increased risk of developing leukemia are formaldehyde, non-arsenical (non-arsenic containing) pesticides and the rubber industry or petroleum refining [8].

Brain

Brain cancers are categorized according to the type of cell affected. There are several types of brain cancers since tumors can form in any of the brain tissues, cells, or a mixture of cell types [4]. Only primary malignant brain tumors were included in this investigation – not benign tumors or tumors that had spread from other sites. There is strong evidence linking brain cancer with pesticide exposure and ionizing radiation [5]. There is some evidence of a link between brain cancer and solvents such as benzene and toluene and metals such as lead, arsenic and mercury.

Lung

Lung cancer is the second most common type of cancer [5]. It is estimated that nearly 175,000 people will develop lung cancer in the U.S. in 2006 [10]. There are two main types of lung cancer small cell and non-small cell. Several environmental contaminants are associated with lung cancer in addition to the well-known link between lung cancer and tobacco smoke. Natural fibers such as silica, wood dust, and asbestos are strongly linked with lung cancer as well as exposure to arsenic, beryllium, cadmium, and chromium [5]. Exposure to polycyclic aromatic hydrocarbons (PAHs), ionizing radiation, benzene, toluene, mustard agent, and coal tar pitch is also linked with lung cancer.

Nasal

Nasal cancer is a rare cancer that affects approximately 2,000 people each year in the U.S. [11]. Several different cells make up the nasal cavity resulting in several different potential types of nasal cancer [4]. The most common type of nasal cancer is squamous cell carcinoma. Occupational exposures have been linked to nasal cancer including exposure to dusts from wood, textiles, and leather, glues, formaldehyde, solvents used in furniture and shoe production, nickel and chromium dust, mustard agent, isopropyl ("rubbing") alcohol, and radium [4]. Inhalation of naphthalene, a PAH that is a major constituent of coal tar and petroleum, has also been shown to cause nasal cancer in an animal study [12].

Appendix D - ATSDR Plain Language Glossary of Environmental Health Terms.

Absorption	How a chemical enters a person's blood after the chemical has been swallowed, has come into contact with the skin, or has been breathed in.
Acute Exposure	Contact with a chemical that happens once or only for a limited period of time. ATSDR defines acute exposures as those that might last up to 14 days.
Additive Effect	A response to a chemical mixture, or combination of substances, that might be expected if the known effects of individual chemicals, seen at specific doses, were added together.
Adverse Health Effect	A change in body function or the structures of cells that can lead to disease or health problems.
ATSDR	The A gency for T oxic S ubstances and D isease R egistry. ATSDR is a federal health agency in Atlanta, Georgia that deals with hazardous substance and waste site issues. ATSDR gives people information about harmful chemicals in their environment and tells people how to protect themselves from coming into contact with chemicals.
Background Level	An average or expected amount of a chemical in a specific environment. Or, amounts of chemicals that occur naturally in a specific environment.
Bioavailability	See Relative Bioavailability .
CAP	See Community Assistance Panel .
Cancer	A group of diseases which occur when cells in the body become abnormal and grow, or multiply, out of control
Carcinogen	Any substance shown to cause tumors or cancer in experimental studies.
CERCLA	See Comprehensive Environmental Response, Compensation, and Liability Act .
Chronic Exposure Completed Exposure Pathway	A contact with a substance or chemical that happens over a long period of time. ATSDR considers exposures of more than one year to be <i>chronic</i> .

Comparison Value (CVs)	Concentrations of substances in air, water, food, and soil that are unlikely, upon exposure, to cause adverse health effects. Comparison values are used by health assessors to select which substances and environmental media (air, water, food and soil) need additional evaluation while health concerns or effects are investigated.
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)	CERCLA was put into place in 1980. It is also known as Superfund . This act concerns releases of hazardous substances into the environment, and the cleanup of these substances and hazardous waste sites. This act created ATSDR and gave it the responsibility to look into health issues related to hazardous waste sites.
Concentration	How much or the amount of a substance present in a certain amount of soil, water, air, or food.
Contaminant	See Environmental Contaminant .
Delayed Health Effect	A disease or injury that happens as a result of exposures that may have occurred far in the past.
Dermal Contact	A chemical getting onto your skin. (see Route of Exposure).
Dose	The amount of a substance to which a person may be exposed, usually on a daily basis. Dose is often explained as “amount of substance(s) per body weight per day”.
Dose / Response	The relationship between the amount of exposure (dose) and the change in body function or health that result.
Duration	The amount of time (days, months, years) that a person is exposed to a chemical.
Environmental Contaminant	A substance (chemical) that gets into a system (person, animal, or the environment) in amounts higher than the Background Level , or what would be expected.
Environmental Media U.S.	Usually refers to the air, water, and soil in which chemicals of interest are found. Sometimes refers to the plants and animals that are eaten by humans. Environmental Media is the second part of an Exposure Pathway .
Environmental Protection Agency (EPA)	The federal agency that develops and enforces environmental laws to protect the environment and the public’s health.

Epidemiology	The study of the different factors that determine how often, in how many people, and in which people will disease occur.
Exposure	Coming into contact with a chemical substance. (For the three ways people can come in contact with substances, see Route of Exposure .)
Exposure Assessment	The process of finding the ways people come in contact with chemicals, how often and how long they come in contact with chemicals, and the amounts of chemicals with which they come in contact.
Exposure Pathway	<p>A description of the way that a chemical moves from its source (where it began) to where and how people can come into contact with (or get exposed to) the chemical.</p> <p>ATSDR defines an exposure pathway as having 5 parts</p> <ol style="list-style-type: none">1. Source of Contamination,2. Environmental Media and Transport Mechanism,3. Point of Exposure,4. Route of Exposure, and5. Receptor Population. <p>When all 5 parts of an exposure pathway are present, it is called a Completed Exposure Pathway. Each of these 5 terms is defined in this Glossary.</p>
Frequency	How often a person is exposed to a chemical over time; for example, every day, once a week, twice a month.
Hazardous Waste	Substances that have been released or thrown away into the environment and, under certain conditions, could be harmful to people who come into contact with them.
Health Effect	ATSDR deals only with Adverse Health Effects (see definition in this Glossary).
Indeterminate Public Health Hazard	The category is used in Public Health Assessment documents for sites where important information is lacking (missing or has not yet been gathered) about site-related chemical exposures.
Ingestion	Swallowing something, as in eating or drinking. It is a way a chemical can enter your body (See Route of Exposure).

Inhalation	Breathing. It is a way a chemical can enter your body (See Route of Exposure).
LOAEL	Lowest Observed Adverse Effect Level. The lowest dose of a chemical in a study, or group of studies, that has caused harmful health effects in people or animals.
Malignancy	See Cancer .
MRL	Minimal Risk Level. An estimate of daily human exposure – by a specified route and length of time -- to a dose of chemical that is likely to be without a measurable risk of adverse, non-cancerous effects. An MRL should not be used as a predictor of adverse health effects.
NPL	The National Priorities List. (Which is part of Superfund .) A list kept by the U.S. Environmental Protection Agency (EPA) of the most serious uncontrolled or abandoned hazardous waste sites in the country. An NPL site needs to be cleaned up or is being looked at to see if people can be exposed to chemicals from the site.
NOAEL	No Observed Adverse Effect Level. The highest dose of a chemical in a study, or group of studies, that did not cause harmful health effects in people or animals.
No Apparent Public Health Hazard	The category is used in ATSDR's Public Health Assessment documents for sites where exposure to site-related chemicals may have occurred in the past or is still occurring but the exposures are not at levels expected to cause adverse health effects.
No Public Health Hazard	The category is used in ATSDR's Public Health Assessment documents for sites where there is evidence of an absence of exposure to site-related chemicals.
PAH	Polycyclic Aromatic Hydrocarbons - one of a class of chemical compounds, organic pollutants
PHA	Public Health Assessment. A report or document that looks at chemicals at a hazardous waste site and tells if people could be harmed from coming into contact with those chemicals. The PHA also tells if possible further public health actions are needed.
Plume	A line or column of air or water containing chemicals moving from the source to areas further away. A plume can be a column or clouds of smoke from a chimney or contaminated underground water sources or contaminated surface water (such as lakes, ponds and streams).

Point of Exposure	The place where someone can come into contact with a contaminated environmental medium (air, water, food or soil). Some examples include the area of a playground that has contaminated dirt, a contaminated spring used for drinking water, or the backyard area where someone might breathe contaminated air.
PRP	Potentially Responsible Party. A company, government or person that is responsible for causing the pollution at a hazardous waste site. PRP's are expected to help pay for the clean up of a site.
Public Health Assessment(s)	See PHA .
Public Health Hazard	The category is used in PHA's for sites that have certain physical features or evidence of chronic, site-related chemical exposure that could result in adverse health effects.
Health Hazard Criteria	People who live or work in the path of one or more chemicals, and who could come into contact with them (See Exposure Pathway).
Reference Dose (RfD)	An estimate, with safety factors (see safety factor) built in, of the daily, life-time exposure of human populations to a possible hazard that is <u>not</u> likely to cause harm to the person.
Relative Bioavailability	The amount of a compound that can be absorbed from a particular medium (such as soil) compared to the amount absorbed from a reference material (such as water). Expressed in percentage form.
Route of Exposure	The way a chemical can get into a person's body. There are three exposure routes – breathing (also called inhalation), – eating or drinking (also called ingestion), and – getting something on the skin (also called dermal contact).
Safety Factor	Also called Uncertainty Factor . When scientists don't have enough information to decide if an exposure will cause harm to people, they use "safety factors" and formulas in place of the information that is not known. These factors and formulas can help determine the amount of a chemical that is <u>not</u> likely to cause harm to people.
SARA	The Superfund Amendments and Reauthorization Act in 1986 amended CERCLA and expanded the health-related responsibilities of ATSDR. CERCLA and SARA direct ATSDR to look into the health effects resulting from chemical exposures at hazardous waste sites.

Sample Size	The number of people that are needed for a health study.
Sample	A small number of people chosen from a larger population (See Population).
Source (of Contamination)	The place where a chemical comes from, such as a landfill, pond, creek, incinerator, tank, or drum. Contaminant source is the first part of an Exposure Pathway .
Special Populations	People who may be more sensitive to chemical exposures because of certain factors such as age, a disease they already have, occupation, sex, or certain behaviors (like cigarette smoking). Children, pregnant women, and older people are often considered special populations.
Statistics	A branch of the math process of collecting, looking at, and summarizing data or information.
Superfund Site	A way to collect information or data from a group of people (population). Surveys can be done by phone, mail, or in person. ATSDR cannot do surveys of more than nine people without approval from the U.S. Department of Health and Human Services.
Synergistic effect	A health effect from an exposure to more than one chemical, where one of the chemicals worsens the effect of another chemical. The combined effect of the chemicals acting together are greater than the effects of the chemicals acting by themselves.
Toxic	Harmful. Any substance or chemical can be toxic at a certain dose (amount). The dose is what determines the potential harm of a chemical and whether it would cause someone to get sick.
Toxicology	The study of the harmful effects of chemicals on humans or animals.
Tumor	Abnormal growth of tissue or cells that have formed a lump or mass.
Uncertainty Factor	See Safety Factor .