March 28, 2012

Summary Report of
Texas Department of State Health Services Investigation of
Specific Cancers Occurrences
Within Zip Code 77541, Freeport, Texas
Brazoria County, Texas

Covering 2000–2009

Background

Concern about a possible excess of cancer diagnoses prompted the Texas Department of State Health Services (DSHS) to re-examine the occurrence of cancer in zip code 77541, Freeport, Texas. A request from the regional office of the Texas Commission on Environmental Quality about the Gulf Chemical and Metallurgical (GCMC), a catalyst recycling/reclaiming facility that has emissions of nickel, vanadium, cobalt, arsenic, ammonia, sulfur dioxide, and aluminum oxide, led to investigation #10002 which found a statistically significant elevations for lung cancer in males and females and male Hodgkin's lymphoma which could now be updated. The scientific literature has shown an association with nickel and lung and nasal sinus cancer and arsenic exposure and cancers of the liver, bladder, and lungs. DSHS evaluated 2000–2009 incidence data for cancers of the stomach, prostate, liver and intrahepatic bile duct, lung and bronchus, bladder, kidney and renal pelvis, brain and other nervous system (brain/CNS), nasopharynx, nose, nasal cavity, and middle ear, Hodgkin's lymphoma, non-Hodgkin's lymphoma, and selected leukemia subtypes. Cluster analyses require complete statewide cancer data and currently the Texas Cancer Registry (TCR) is complete through 2009.

For this investigation DSHS used cancer incidence data which shows the number and types of cancer diagnosed each year. Cancer incidence data are the best indicator of cancer occurrence and cancer incidence data for Texas currently meet national standards for timeliness and data quality. This report presents information on methods used to conduct this investigation, the results, recommendations, and general information on cancer risk factors.

Investigation Methodology

According to the National Cancer Institute (NCI), a cancer cluster is a greater than expected number of cancers among people who live or work in the same area and who develop or die from the same cancer within a short time of each other. A cancer cluster investigation is designed with the specific intention of addressing the question, "Is there more cancer in the area or population of concern than we would expect?" While these types of investigations can be used to investigate whether the amount of cancer in a community is more than expected, they cannot determine either the cause of the cancers or possible associations with any risk factors.

DSHS follows guidelines recommended by the federal Centers for Disease Control and Prevention (CDC) for investigating cancer clusters.[1] If DSHS finds more cancer than expected or if rare or unlikely cancers are found in unusual age groups, various factors are considered to determine whether further study could identify a likely cause. Very few cancer cluster investigations in the United States proceed to this stage.

To determine whether a statistically significant excess of cancer existed in the geographic areas of concern, the number of observed cases was compared to what would be "expected" by applying state cancer rates to the average of the 2000 and 2010 Census population data for the area under investigation. Calculating the expected number(s) of cancer cases takes into consideration the race, sex, and ages of those who are diagnosed with cancer. This is important because all of these factors can impact cancer rates. When trying to determine if there is more or less cancer in a community compared to the rest of Texas, an investigation must ensure that differences in cancer rates are not simply due to differences in population demographics. Since a higher than expected number of cancer cases in a community can occur by chance alone, the role of chance also is considered in the statistical analysis.

Attached table (Table 1) presents the number of observed cases for males and females; number of "expected" cases; standardized incidence ratio (SIR); and corresponding 99% confidence interval. The SIR is simply the number of observed cases divided by the number of "expected" cases. When the SIR of a selected cancer is equal to 1.0, then the number of observed cases is equal to the expected number of cases, based on incidence rates in the state. When the SIR for a particular cancer is less than 1.0, there are fewer cases of that type of cancer in the area than would be expected. Conversely, an SIR greater than 1.0 indicates that there are more cases of a specific type of cancer in the area than would be expected.

Since an excess of cancer can occur by chance alone, statistics are used in the analysis to calculate the 99% confidence intervals to determine the likelihood that the resultant SIR (whether it is greater or lower than 1.0) is due to chance. A 99% confidence interval provides a range that we would expect the SIR to fall 99% of the time. If the confidence interval for a specific SIR includes 1.0, the result is not statistically significant and the observed number of cases is within the range not considered to be different than the expected number of cases. Confidence intervals are particularly important when trying to interpret small numbers of cases. Wide confidence intervals, which are common when dealing with small populations and small numbers of cases, reflect a greater uncertainty in the results. For instance, if only one or two cases are expected, three or four observed cases will result in a very large SIR. A more extreme example would be when due to the small size of the population the expected number of cases is less than 1.0; in this instance one observed case can result in a very high SIR. As long as the 99% confidence interval contains 1.0, the SIR is still within the expected range and therefore is not statistically significant.

Investigation Results

From January 1, 2000 to December 31, 2009, the number of cancers of the stomach, prostate, liver and intrahepatic bile duct, bladder, kidney and renal pelvis, brain and other nervous system (brain/CNS), nasopharynx, nose, nasal cavity, and middle ear, Hodgkin's lymphoma, non-Hodgkin's lymphoma, and selected leukemia subtypes were within the expected range in both males and females in zip code 77541, Freeport, Texas. Lung cancer was found to show statistically significant elevations (SIR=1.5, SIR=1.7), respectively for both males and females. Analysis summaries are presented in Table 1.

Discussion

We do not know why lung cancer incidence was elevated in zip code 77541 males and females, nor may we ever know why. Determining the cause of any excess is beyond the scope of the cancer cluster investigation. However, part of any cancer cluster investigation is to evaluate if further study is recommended at this time. We were not able to separate out the possible effects of smoking in the population under study. According to the American Cancer Society, smoking accounts for 90% of male lung cancer deaths and 80% of female lung cancer deaths.

Like other studies, this cancer cluster investigation had limitations. The incidence data used in the cluster analysis did not include data for the most recent years. Also, cancer incidence data are based on residence at the time of diagnosis. It is possible that some residents who developed cancer no longer lived in the area at the time of diagnosis, so were not included in the analyses. However, it is also possible that people may have moved into the area and then developed cancer because of an exposure from a prior residential location or other factors. These cases are included in the investigation.

Recommendations

Based on the findings and the information discussed above, although we are unable to separate out the possible effects of smoking, we will continue to update the investigation for lung cancer because of the link between nickel and arsenic with lung cancer.

Information on Cancer and Cancer Risk Factors:

Overall, the occurrence of cancer is common, with approximately two out of every five persons alive today predicted to develop some type of cancer in their lifetime.[2] In Texas, as in the United States, cancer is the leading cause of death for people under the age of 85.[3] Also, cancer is not one disease, but many different diseases. Different types of cancer are generally thought to have different causes. If a person develops cancer, it is probably not due to one factor but to a combination of factors such as heredity; diet, tobacco use, and other lifestyle factors; infectious agents; chemical exposures; and radiation exposures. Although cancer may impact individuals of all ages, it primarily is a disease of older persons with over one-half of cancer cases and two-thirds of cancer deaths occurring in persons 65 and older. Finally, it takes time for cancer to develop, between 10–40 years can go by between the exposure to a carcinogen and a diagnosis of cancer.[4]

The chances of a person developing cancer as a result of exposure to an environmental contaminant are slight. Most experts agree that exposure to pollution, occupational, and industrial hazards account for fewer than 10% of cancer cases.[5] The Harvard Center for

Cancer Prevention estimates 5% of cancer deaths are due to occupational factors, 2% to environmental pollution and 2% to ionizing/ultraviolet radiation.[6] In contrast, the National Cancer Institute estimates that lifestyle factors such as tobacco use and diet cause 50 to 75 percent of cancer deaths.[7] Eating a healthy diet and refraining from tobacco are the best ways to prevent many kinds of cancer. It is estimated that one-third of all cancer deaths in this country could be prevented by eliminating the use of tobacco products. Additionally, about 25 to 30 percent of the cases of several major cancers are thought to be associated with obesity and physical inactivity.[8]

Known Risk Factors for Cancers Examined in This Investigation:
The following is a brief discussion summarized from the American Cancer Society and the National Cancer Institute about cancer risk factors for the specific cancers studied in this investigation.[9,10]

The occurrence of cancer may vary by race/ethnicity, gender, type of cancer, geographic location, population group, and a variety of other factors. Scientific studies have identified a number of factors for various cancers that may increase an individual's risk of developing a specific type of cancer. These factors are known as risk factors. Some risk factors individuals can do nothing about, but many are a matter of choice.

Bladder Cancer

The greatest risk factor for bladder cancer is smoking. Men get bladder cancer at a rate four times that of women. Smokers are more than twice as likely to get bladder cancer as nonsmokers. Whites are two times more likely to develop bladder cancer than are African Americans. Other risk factors for bladder cancer include occupational exposure to aromatic amines such as benzidine and beta-napthylamine, aging, chronic bladder inflammation, personal history of urothelial carcinomas, birth defects involving the bladder and umbilicus, infection with a certain parasite, high doses of certain chemotherapy drugs, and arsenic in your drinking water.

Stomach Cancer

Stomach cancer is about twice as common in men as it is in women. Other risk factors for stomach cancer include Helicobacter pylori infection, diets high in smoked and salted foods, tobacco and alcohol abuse, obesity, previous stomach surgery, pernicious anemia, type A blood, familial cancer syndromes, aging, and stomach polyps. Japanese have a very high rate of stomach cancer when they live in Japan. If they move to the United States, the rate goes down after a number of years, but still remains higher than that of people born in the U.S.

Prostate Cancer

Prostate cancer is the most common type of malignant cancer (other than skin) diagnosed in men, affecting an estimated one in five American men. Risk factors for prostate cancer include aging, a high fat diet, physical inactivity, and a family history of prostate cancer.

African American men are at higher risk of acquiring prostate cancer and dying from it. Prostate cancer is most common in North America and northwestern Europe. It is less common in Asia, Africa, Central America, and South America.

Lung and Bronchus Cancer

The greatest single risk factor for lung cancer is smoking. The American Cancer Society estimates that more than 80% of lung cancer deaths are due to smoking. Several studies have shown that the lung cells of women have a genetic predisposition to develop cancer when they are exposed to tobacco smoke. Other risk factors include secondhand smoke, asbestos exposure, radon exposure, other carcinogenic agents in the workplace such as arsenic or vinyl chloride, marijuana smoking, recurring inflammation of the lungs, exposure to industrial grade talc, people with silicosis and berylliosis, personal and family history of lung cancer, and diet. In some cities, air pollution may slightly increase the risk of lung cancer. This risk is far less than that caused by smoking.

Liver and Intrahepatic Bile Duct Cancer

In contrast to many other types of cancer, the number of people who develop liver cancer and die from it is increasing. This cancer is about 10 times more common in developing countries. The risk factors for liver cancer include viral hepatitis, cirrhosis, long-term exposure to aflatoxin, exposure to vinyl chloride and thorium dioxide, older forms of birth control pills, anabolic steroids, obesity, arsenic in drinking water, tobacco use, bile duct disease, ulcerative colitis, liver fluke infection, and aging. Chemicals that are associated with bile duct cancer include dioxin, nitrosamines, and polychlorinated biphenyls (PCBs).

Kidney and Renal Pelvis Cancer

Kidney cancer risk factors include smoking, obesity, a sedentary lifestyle, occupational exposure to heavy metals or organic solvents, advanced kidney disease, family history, high blood pressure, certain medications, and aging. Men have higher rates of kidney cancer.

Nasopharyngeal Cancer

Risk factors for pharyngeal cancer include Epstein-Barr virus infection, family history, genetic factors, and diets high in salt-cured meat.

Nose and Nasal Cavity Cancer

Smoking is a risk factor for nasal cavity cancer, as well as several other cancers. Occupational exposure to dusts from wood, textiles, leather, and even perhaps flour are associated with this cancer when inhaled. Other substances linked to this cancer are glues, formaldehyde, solvents, nickel and chromium dust, mustard gas, isopropyl alcohol, and radium. People with retinoblastoma or human papilloma virus infection have a higher risk of nasal cavity cancer.

Brain/CNS Cancer

The large majority of brain cancers are not associated with any risk factor. Most brain cancers simply happen for no apparent reason. A few risk factors associated with brain cancer are known and include radiation treatment, occupational exposure to vinyl chloride, immune system disorders, and family history of brain and spinal cord cancers. Some population-based studies have suggested a possible increased risk of brain tumors with cell phone use, but most of the larger studies to date have not found an increased risk, either overall or among specific types of tumors. There are very few studies of long-term use (10 years or more), and cell phones haven't been around long enough to determine the possible risks of lifetime use.

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Hodgkin's Lymphoma

Some people who have reduced immune systems, for example, those with AIDS, and organ transplant patients, are at a higher risk of Hodgkin's lymphoma. Possible risk factors include being in young or late adulthood, being male, being infected with the Epstein-Barr virus, or having a first-degree relative with Hodgkin's lymphoma. The risk of Hodgkin disease is greater in people with a higher socioeconomic background. The reason for this is not clear.

Non-Hodgkin's Lymphoma

Risk factors for non-Hodgkin's lymphoma include infection with Helicobacter pylori, human immunodeficiency virus (HIV), human T-cell leukemia/lymphoma virus (HTVL-1), or the Epstein-Barr virus and malaria. Other possible risk factors include obesity, aging, certain genetic diseases, radiation exposure, immuno-suppressant drugs after organ transplantation, benzene exposure, the drug Dilantin, exposure to certain pesticides, a diet high in meats or fat, or certain chemotherapy drugs.

Acute Lymphocytic Leukemia (ALL)

Possible risk factors for ALL include the following: being male, being white, being older than 70, past treatment with chemotherapy or radiation therapy, radiation exposure, certain viral infections, or having a certain genetic disorder such as Down syndrome.

Chronic Lymphocytic Leukemia (CLL)

Possible risk factors for CLL include the following: being middle-aged or older, male, or white; a family history of CLL or cancer of the lymph system; or having exposure to herbicides or insecticides including Agent Orange, an herbicide used during the Vietnam War.

Acute Myeloid Leukemia (AML)

Possible risk factors for AML include the following: being male; smoking, especially after age 60; treatment with chemotherapy or radiation therapy in the past; treatment for childhood ALL in the past; being exposed to atomic bomb radiation or the chemical benzene; or having a history of a blood disorder such as myelodysplastic syndrome. Scientists estimate that as many as 1 out of 5 cases of AML is caused by smoking

Chronic Myeloid Leukemia (CML)

Being exposed to high-dose radiation (such as being a survivor of an atomic bomb blast or nuclear reactor accident) is the only known environmental risk factor for chronic myeloid leukemia. Aging is also a risk factor for chronic myeloid leukemia.

For additional information about cancer, visit the "Resources" link on the DSHS Web site at http://www.dshs.state.tx.us/tcr/.

Questions or comments regarding this investigation may be directed to Ms. Brenda Mokry, Epidemiology Studies & Initiatives Branch, at 512-776-3606 or Brenda.Mokry@dshs.state.tx.us.

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Table 1
Number of Observed and Expected Cancer Cases and Adjusted Standardized Incidence Ratios, Selected Cancers, Zip Code 77541, Freeport, TX, 2000–2009

Males				
Site	**Observed**	**Expected**	**SIR**	**99% CI**
Stomach	13	7.0	1.9	0.8 – 3.6
Prostate	126	107.4	1.2	0.9 – 1.5
Lung and Bronchus	92	61.6	1.5*	1.1 – 1.9
Liver and Intrahepatic Bile Duct	10	9.7	1.0	0.4 – 2.2
Kidney and Renal Pelvis	20	17.4	1.2	0.6 – 2.0
Bladder	19	20.5	0.9	0.5 – 1.6
Brain/CNS	10	6.4	1.6	0.6 – 3.4
Nasopharynx	1	0.6	1.6	0.0 – 12.0
Nose, Nasal Cavity, and Middle Ear	2	0.7	2.8	0.2 – 13.0
Hodgkin's Lymphoma	4	2.3	1.7	0.3 – 5.4
Non-Hodgkin's Lymphoma	21	16.4	1.3	0.7 – 2.2
Acute Lymphocytic Leukemia	0	2.0	0.0	0.0 – 2.7
Chronic Lymphocytic Leukemia	3	4.3	0.7	0.1 – 2.5
Acute Myeloid Leukemia	3	3.1	1.0	0.1 – 3.5
Chronic Myeloid Leukemia	0	1.6	0.0	0.0 – 3.3
Aleukemic, Subleukemic, & NOS	1	0.6	1.8	0.0 – 13.1
Females				
Site	**Observed**	**Expected**	**SIR**	**99% CI**
Stomach	7	3.9	1.8	0.5 – 4.4
Lung and Bronchus	65	39.1	1.7*	1.2 – 2.3
Liver and Intrahepatic Bile Duct	1	3.3	0.3	0.0 – 2.3
Kidney and Renal Pelvis	10	9.8	1.0	0.4 – 2.2
Bladder	8	5.3	1.5	0.5 – 3.5
Brain/CNS	3	4.7	0.6	0.1 – 2.3
Nasopharynx	1	0.2	4.2	0.0 – 31.4
Nose, Nasal Cavity, and Middle Ear	1	0.4	2.5	0.0 – 18.4
Hodgkin's Lymphoma	2	1.8	1.1	0.1 – 5.3
Non-Hodgkin's Lymphoma	15	12.5	1.2	0.6 – 2.3
Acute Lymphocytic Leukemia	1	1.5	0.7	0.0 – 4.9
Chronic Lymphocytic Leukemia	5	2.4	2.1	0.5 – 5.9
Acute Myeloid Leukemia	2	2.4	0.9	0.0 – 3.9
Chronic Myeloid Leukemia	1	1.1	0.9	0.0 – 7.0
Aleukemic, Subleukemic, & NOS	0	0.4	0.0	0.0 – 12.6

Note: The SIR (standardized incidence ratio) is defined as the number of observed cases divided by the number of expected cases. The latter is based on race-, sex-, and age-specific cancer incidence rates for Texas during the period 2000–2009. The SIR has been rounded to the first decimal place.
*Significantly higher than expected at the $p < 0.01$ level.
**Significantly lower than expected at the $p < 0.01$ level.