Agency for Toxic Substances and Disease Registry
Division of Health Studies

HEALTH CONSULTATION

HEALTH OUTCOME DATA EVALUATION KELLY AIR FORCE BASE, SAN ANTONIO, BEXAR COUNTY, TEXAS

October 2005

DEPARTMENT OF HEALTH & HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Atlanta, Georgia 30333

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Health Outcome Data
Leukemia Update
Kelly Air Force Base
San Antonio, Bexar County, Texas
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Final Report

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Abstract

In 1996, Congressman Frank Tejeda petitioned the Agency for Toxic Substances and Disease Registry (ATSDR) to address health concerns of people living near Kelly Air Force Base in San Antonio, Texas. The community felt that environmental pollutants from the base were causing cancer and birth defects. In response, ATSDR conducted a public health assessment and a health consultation. The public health assessment examined the occurrence of cancer in 1990 to 1994 and reported that leukemia and liver, kidney, and cervical cancer occurred more frequently in residents near the base than in two reference areas (Texas and California) (ATSDR 1999). The health consultation expanded the analysis to include cancer data in 1991 and 1995 and examined birth defects, infant mortality, and blood lead levels in children. It also noted a greater occurrence of liver, kidney, and cervical cancer in people living near the base than in the two reference areas of Texas and California. The incidence of leukemia, birth defects, low birth weights, and deaths from liver cancer and leukemia was also comparatively higher among residents near the base.

Public comments on the consultation and health assessment requested additional analyses on leukemia occurrence and mortality. This health outcome updates these conditions. From 1990 to 1996, the Cancer Registry Division of the Texas Department of Health (now the Department of State Health Services) reported that 128 people living in ZIP code areas 78211, 78226, 78227, 78228, and 78237, near Kelly Air Force Base, were diagnosed with leukemia. In comparison with males living in Texas, males living in ZIP code area 78227 had a higher occurrence of leukemia. In addition, males living in ZIP code areas 78227 and 78237 had a higher occurrence of deaths due to leukemia than did males living in Texas. No increases of the occurrence of leukemia cases or deaths were observed with females living in these ZIP code areas. The distribution of leukemia that occurred in children less than 19 years of age was similar to national proportions.

This analysis compared the occurrence and deaths from leukemia in these ZIP code areas to leukemia in Texas. The results give a general picture of the occurrence of disease in these ZIP codes. They should not be used to determine the cause of leukemia in this community because the risk factors for leukemia are varied. Those risk factors can include diet, heredity, radiation, smoking, treatment with chemotherapeutic agents, viral infections, occupational exposures to chemicals, and individual characteristics such as socioeconomic status, occupation, and lifestyle. This analysis does not account for these factors. They are needed to further assess the association between environmental exposures in these ZIP code areas and the occurrence of leukemia.

Because leukemia can take a long time to develop, ATSDR recommended that the Texas Department of Health monitor leukemia incidence and mortality as more data become available. In August, 2003, the Texas Department of Health reported on the occurrence of leukemia incidence and mortality from 1992 to 2001 in 18 ZIP code areas near Kelly Air Force Base. The

results showed no statistically significant elevations of leukemia in those ZIP code areas.

Introduction

Kelly Air Force Base (Kelly AFB) in San Antonio, Texas, is one of the U.S. Air Force's largest and oldest aircraft maintenance facilities. According to the toxic release inventory of the U.S. Environmental Protection Agency, the base released several tons of hazardous waste per year. In 1996, Congressman Frank Tejeda petitioned the Agency for Toxic Substances and Disease Registry (ATSDR) to address concerns that environmental pollutants caused cancer and birth defects among residents near the base and that the rates of these conditions were elevated.

In 1999, ATSDR conducted a public health assessment to evaluate whether past, present, or future exposures may be harmful and whether health conditions are elevated (ATSDR 1999). The assessment concluded that "currently levels of exposure are not expected to make people sick" and that "past levels may have been high enough to cause some health concern." The public health assessment examined the occurrence of cancers in residents near the base, birth defects and birth weight in infants born to parents living near the base, and blood lead levels of children living near the base. For the cancer comparisons, race-, sex-, and age-specific standardized incidence ratios or standardized mortality ratios were calculated using all California and Texas residents as the reference populations. The report concluded that, in comparison to the Texas and California populations, more residents living near the base were diagnosed with liver, kidney, and cervical cancer, and leukemia, and more people died from liver cancer and leukemia. The report also noted an increased number of babies born with a heart and circulatory birth defect or with a low birth weight. The percent of children with elevated blood lead (greater than or equal to10 μg/dL) was slightly above the state average. Because of these elevations, the report recommended that the Texas Department of Health (now the Department of State Health Services) continue to evaluate health outcome data as it becomes available. This analysis looks for elevations in the different types of leukemia that were reported in five ZIP code areas that are adjacent to Kelly Air Force Base.

Methods

The health outcome data evaluation update examined the occurrence and deaths from leukemia in 1991 to 1997 in residents of five ZIP codes near the base. These data were obtained from the Texas Department of Health Cancer Registry Division (CRD). The expected number of cases and deaths and the standard incidence ratios and standard mortality ratios were calculated using race-, sex-, and age-specific cancer incidence rates for Texas for the years 1992 and 1995 combined. If the cell type of a leukemia was not available, it was classified as "other."

The Texas Cancer Incidence Reporting Act (Chapter 82, Health and Safety Code, as amended 1991) requires every hospital, clinical laboratory, and cancer treatment center to report all cases of cancer to the Cancer Registry Division (CRD). Although this is a passive registry, CRD staff members perform case-finding and other quality control checks at these institutions. The reporting is 90%–95% complete for the years 1990–1994 for Public Health Region 8, which includes San Antonio. Data on cancer mortality data were obtained by CRD from death certificate information maintained by the Texas Bureau of Vital Statistics. CRD records residence by ZIP code and thus the analysis was based upon occurrence of each health outcome by ZIP code.

CRD calculated race-adjusted standardized incidence ratios for 1990–1996 and standard mortality ratios for 1990–1997 for leukemia that was diagnosed in residents of ZIP code areas that are adjacent or near to Kelly AFB (78211, 78226, 78227, 78228, and 78237). The reference populations were the 1992 and 1995 statewide populations of Texas (Appendix).

Results

From 1990 to 1996, CRD reported that 128 people living in ZIP code areas 78211, 78226, 78227, 78228, and 78237 were diagnosed with leukemia (Table 1). The most common leukemia was acute lymphocytic leukemia (30) and acute myeloid leukemia (29). A further 43 people were diagnosed with chronic leukemia. The type of leukemia was not classified for 26 people. During this period, 23 children and 105 adults were diagnosed with leukemia (Table 2). The most common leukemia in children was acute lymphocytic leukemia (11); the most common leukemia in adults was acute myeloid leukemia (26). Males accounted for 76 (59.4%) of the leukemia cases. A statistically significantly higher than expected number of leukemia cases in males was observed in ZIP code area 78227 (Table 3).

From 1990 to 1996, the CRD reported that 98 people in ZIP code areas 78211, 78226, 78227, 78228, and 78237 died from leukemia (Table 4). The two most common leukemia deaths were acute myeloid leukemia (22) and chronic myeloid leukemia (17) (Table 4). The type of leukemia was not classified for 32 of the deaths. Deaths due to acute or chronic lymphocytic leukemia accounted for the remaining deaths. For the period and areas considered, 9 children and 89 adults died from leukemia (Table 5). The most common leukemia death in children was acute lymphocytic leukemia (3); the most common leukemia in adults was acute myeloid leukemia (21). Males accounted for 66 (67.3%) of the deaths. A statistically significant, higher than expected number of leukemia deaths was observed for males in ZIP code areas 78211 and 78227 (Table 6).

Conclusions and Recommendations

When compared to the males living in Texas, males living in ZIP code area 78227 had a higher occurrence of leukemia. In addition, males living in ZIP code areas 78227 and 78237 had a higher occurrence of deaths due to leukemia than did males living in Texas.

This analysis compares the occurrence of leukemia to in these ZIP codes to the occurrence of leukemia in Texas. The results give a general picture of the occurrence of disease in these ZIP code areas. They should not be used to determine the cause of leukemia in this community because the risk factors for leukemia are varied. They include diet, heredity, radiation, smoking, treatment with chemotherapeutic agents, and viral infections. Occupational exposures to chemicals are also suspected of influencing the development of leukemia. Other individual characteristics, such as socioeconomic status, occupation, lifestyle, and amount of exposure influence the occurrence of disease and are not accounted for in the analysis. Data pertaining to those factors is needed to further assess the association between environmental exposures in these ZIP code areas and the occurrence of leukemia.

Because leukemia takes a long time to develop, ATSDR recommends that the Texas Department of State Health Services continue to monitor leukemia incidence and mortality as more data become available.

Epilogue

On August 8, 2003, the Texas Department of Health released a report on the morbidity of liver cancer and leukemia from 1995–1999 and mortality of liver cancer and leukemia from 1992–2001 in 18 ZIP code areas near Kelly Air Force Base (Texas Department of Health 2003). The study calculated standardized incidence (SIR) and mortality (SMR) ratios using Texas and California residents as the reference population. The Texas Cancer Registry changed from using a 95% to a 99% confidence interval to test for statistical significance for their cancer cluster investigations. This change allows the Cancer Registry to be consistent with other state cancer cluster investigation protocols and practices. The analysis showed leukemia morbidity and mortality was not elevated in the 18 ZIP codes near Kelly Air Force Base.

On March 8, 2005, the Texas Department of State Health Services released a report on the morbidity and mortality of liver cancer and leukemia from 1993–2003 in five ZIP codes near Kelly Air Force Base (Appendix) (Texas Department of State Health Services 2005). The incidence and mortality of leukemia was similar to state rates. Liver cancer mortality showed a

statistically significant elevation among males living in ZIP code areas 78211, 78228, and 78237.

In response to these findings, staff from the Texas Department of State Health Services, Texas Department of State Health Services—Cancer and Epidemiology Branch, San Antonio Metro Health, and the Agency for Toxic Substances and Disease Registry met on March 10, 2005, to discuss follow-up activities related to the increased liver cancer rates. The group decided to determine the frequency of liver cancer risk factors and then conduct a case-control study if there is evidence of a condition or exposure that may be associated with the occurrence of liver cancers.

Author, Contributors, and Acknowledgments

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Acknowledgments This report would not have been possible without the assistance of the Texas Department of Health (TDH) in providing the data reviewed in this report. Specific thanks to Judy Henry, Codirector, Environmental Epidemiology and Toxicology Division, TDH. Thanks are also due to the efforts of our colleagues in the Division of Health Assessment and Consultation at ATSDR, specifically, John Abraham and David Fowler. Their thorough comments are appreciated.

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Tables and Figures

Table 1. Distribution of Leukemia Cases by ZIP Code Areas and Cell Type: San Antonio, Texas, 1990–1996

	Leukemia Cell Type					
ZIP Code	*ALL*	*CLL*	*AML*	*CML*	*Other*	*Total*
78211	7	1	4	5	6	20
78226	4	1	2	1	0	8
78227	9	8	7	9	3	36
78228	6	9	10	4	9	38
78237	4	2	6	6	8	26
Total	30	21	29	22	26	128

Data provided by the Cancer Registry Division of the Texas Department of Health which is now grouped in the Texas Department of State Health Services.
ALL: acute lymphocytic leukemia
CLL: chronic lymphocytic leukemia
AML: acute myeloid leukemia
CML: chronic myelogenous leukemia

Table 2. Distribution of Leukemia Cases in ZIP Code Areas 78211, 78226, 78227, 78228, and 78237 by Age and Cell Type: San Antonio, Texas, 1990–1997

	Leukemia Cell Type					
ZIP Code	*ALL*	*CLL*	*AML*	*CML*	*Other*	*Total*
Adult	15	21	26	19	24	105
Child	15	0	3	3	2	23
Total	**30**	**21**	**29**	**22**	**26**	**128**

Data provided by the Cancer Registry Division of the Texas Department of Health which is now grouped in the Texas Department of State Health Services.
ALL: acute lymphocytic leukemia
CLL: chronic lymphocytic leukemia
AML: acute myeloid leukemia
CML: chronic myelogenous leukemia

Table 3. Race and Age Adjusted Standard Incidence Ratios for Leukemia Cases for ZIP Codes 78211, 78226, 78227, 78228, and 78237: San Antonio, Texas, 1990–1996

ZIP Code	Number of Leukemia Cases Observed—Males	Number of Leukemia Cases Expected—Males	Standard Incidence Ratio and 95% Confidence Interval	
78211	10	8.8	1.1	(0.5, 2.1)
78226	5	1.9	2.6	(0.8, 6.1)
78227	26	12.5	2.1*	(1.4, 3.0)
78228	23	19.9	1.2	(0.7, 1.7)
78237	12	11.0	1.4	(0.6, 1.9)

ZIP Code	Number of Leukemia Cases Observed—Females	Number of Leukemia Cases Expected—Females	Standard Incidence Ratio and (95% Confidence Interval)	
78211	10	6.9	1.4	(0.7, 2.7)
78226	3	1.5	2.0	(0.4, 5.8)
78227	10	9.7	1.0	(0.5, 1.9)
78228	15	17.5	0.9	(0.5, 1.4)
78237	14	9.2	1.5	(0.8, 2.6)

Data provided by the Cancer Registry Division of the Texas Department of Health which is now grouped in the Texas Department of State Health Services
* Significantly higher (at the 5% level)

Table 4. Distribution of Leukemia Deaths by ZIP Code Areas and by Cell Type: San Antonio, Texas, 1990–1996

	Leukemia Cell Type					
ZIP Code	*ALL*	*CLL*	*AML*	*CML*	*Other*	*Total*
78211	2	2	4	4	4	16
78226	0	1	2	0	1	4
78227	5	6	6	3	4	24
78228	3	3	5	5	14	30
78237	4	6	5	5	14	30
Total	**14**	**13**	**22**	**17**	**32**	**98**

Data provided by the Cancer Registry Division of the Texas Department of Health which is now grouped in the Texas Department of State Health Services
ALL: acute lymphocytic leukemia
CLL: chronic lymphocytic leukemia
AML: acute myeloid leukemia
CML: chronic myelogenous leukemia

Table 5. Distribution of Leukemia Deaths in ZIP Code Areas 78211, 78226, 78227, 78228, and 78237 by Age and Cell Type: San Antonio, Texas, 1990–1997

	Leukemia Cell Type					
ZIP Code	*ALL*	*CLL*	*AML*	*CML*	*Other*	*Total*
Adult	11	13	21	16	28	89
Child	3	0	1	1	4	9
Total	**14**	**13**	**22**	**17**	**32**	**98**

Data provided by the Cancer Registry Division of the Texas Department of Health which is now grouped in the Texas Department of State Health Services
ALL: acute lymphocytic leukemia
CLL: chronic lymphocytic leukemia
AML: acute myeloid leukemia
CML: chronic myelogenous leukemia

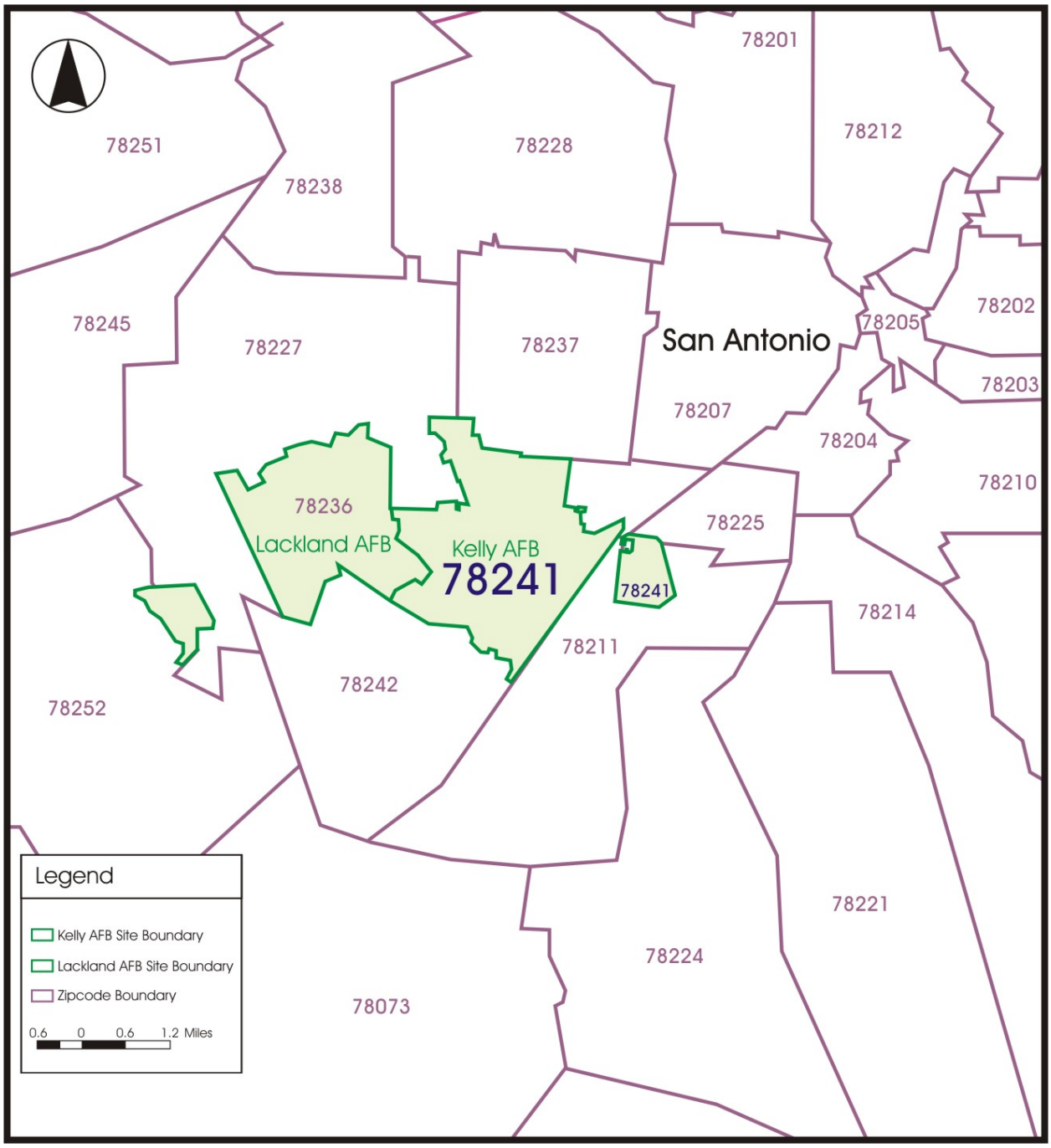
Table 6. Race and Age Adjusted Standard Mortality Ratios for Leukemia Deaths for ZIP Codes 78211, 78226, 78227, 78228, and 78237: San Antonio, Texas, 1990–1997

ZIP Code	Number of Leukemia Deaths Observed—Males	Number of Leukemia Deaths Expected—Males	Standard Incidence Ratio and 95% Confidence Interval
78211	10	6.7	1.5* (1.1, 3.0)
78226	3	1.2	2.5 (0.5, 7.3)
78227	19	8.8	2.2* (1.3, 3.4)
78228	19	16.1	1.2 (0.7, 1.8)
78237	15	8.2	1.8 (1.0, 3.0)
Total	**66**		

ZIP Code	Number of Leukemia Deaths Observed—Females	Number of Leukemia Deaths Expected—Females	Standard Incidence Ratio and (95% Confidence Interval)
78211	6	4.9	1.3 (0.5, 2.7)
78226	1	1.0	1.0 (0.0, 5.6)
78227	5	6.7	0.7 (0.2, 1.7)
78228	11	13.4	0.8 (0.4, 1.5)
78237	9	6.7	1.3 (0.6, 2.6)
Total	**32**		

Data provided by the Cancer Registry Division of the Texas Department of Health which is now grouped in the Texas Department of State Health Services
* Significantly higher (at the 5% level)

Figure 1. Map of ZIP Code Boundaries Near Kelly Air Force Base



Appendix

Texas Department of State Health Services
Summary of Investigation Into the Occurrence of Cancer
ZIP Codes 78211, 78226, 78227, 78228, & 78237, San Antonio
Bexar County, Texas
1993–2002
February 23, 2005

Background

The Texas Cancer Registry (TCR), Texas Cancer Epidemiology and Surveillance Branch, Texas Department of State Health Services (DSHS), in collaboration with the Environmental and Injury Epidemiology and Toxicology Branch—DSHS, San Antonio Metropolitan Health District, and Agency for Toxic Substances and Disease Registry–Centers for Disease Control and Prevention updated and re-evaluated the occurrence of liver and leukemia cancers in ZIP code areas 78211, 78226, 78227, 78228, and 78237, San Antonio, Texas. Local residents remain concerned about cancer and environmental contaminants in the air and ground water. The TCR evaluated 1995–2001 incidence data (the best available data) and 1993–2002 mortality data for liver/intrahepatic bile duct cancer and leukemia by cell type (acute lymphocytic, chronic lymphocytic, acute myeloid, chronic myeloid, and other categories). Liver/intrahepatic bile duct cancer was only requested for ZIP codes 78211, 78228, and 78237. Incidence data are the best indicator of the occurrence of cancer in an area because they show how many cancers were diagnosed each year and are considered complete (more than 95%) statewide through 2001. Cancer mortality data are used as a supplemental measure and are complete for the entire state through 2002. The rest of this report examines the investigative methods the TCR used, the results of the investigation, recommendations, and general information on cancer risk factors.

Methodology

According to the National Cancer Institute, 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. The cancer cluster investigation is the primary tool used by the TCR to investigate the possibility of excess cancer in a community. The cancer cluster investigation is not used to determine that cancer was associated with or caused by environmental or other risk factors. Instead, the cancer cluster investigation is specifically intended to address the question, "Is there an excess of cancer in the area or population of concern?"

The TCR follows guidelines recommended by the Centers for Disease Control and Prevention for investigating cancer clusters.[1] In order to determine if an excess of cancer is occurring and if further study is recommended, biologic and epidemiologic evidence is considered. Such evidence may include documented exposures; the toxicity of the exposures; plausible routes by

which exposures can reach people (ingesting, touching, breathing); the actual amount of exposure to the people which can lead to absorption in the body; the time from exposure to development of cancer; the statistical significance of the findings; the magnitude of the effect observed; risk factors; and the consistency of the findings over time. The occurrence of rare cancers or unlikely cancers in certain age groups may indicate a cluster needing further study. Because excesses of cancer may occur by chance alone, the role of chance is also considered in the statistical analysis.

If further study is recommended, the TCR will work with the Environmental and Injury Epidemiology and Toxicology Branch–DSHS to determine the feasibility of conducting an epidemiologic study examining the cancer(s) and exposure(s) of concern. If the study is feasible, the final step is to perform an etiologic investigation to see if the cancer can be related to the exposure. 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 and deaths was compared to what would be "expected" based on the state cancer rates. Calculating the expected number(s) of cancer cases takes into consideration the race, sex, and ages of people who are diagnosed or die from cancer. This is important because peoples' race, sex, and age all impact cancer rates. If we are trying to determine if there is more or less cancer in a community compared to the rest of the state, we must consider that the difference in cancer rates is not simply due to one of these factors.

The attached Tables 1–10 present the number of observed cases and deaths for males and females, the number of "expected" cases and deaths, the standardized incidence ratio (SIR) or standardized mortality ratio (SMR), and the corresponding 99% confidence interval. The standardized incidence or mortality ratio (SIR, SMR) is simply the number of observed cases or deaths compared to the number of "expected" cases or deaths. When the SIR or SMR of a selected cancer is equal to 1.00, then the number of observed cases or deaths is equal to the expected number of cases or deaths, based on the incidence or mortality in the rest of the state. When the SIR or SMR is less than 1.00, fewer people developed or died of cancer than we would have expected. Conversely, an SIR or SMR greater than 1.00 indicates that more people developed or died of cancer than we would have expected. To determine if an SIR or SMR greater than 1.00 or less than 1.00 is statistically significant or outside the variation likely to be due to chance, confidence intervals are also calculated.

A 99% confidence interval is used for statistical significance and takes the likelihood that the result occurred by chance into account. It also indicates the range in which we would expect the SIR or SMR to fall 99% of the time. If the confidence interval contains a range that includes 1.00, no statistically significant excess of cancer is indicated. The confidence intervals are particularly important when trying to interpret small numbers of cases. If only one or two cases are expected for a particular cancer, then the report of three or four observed cases will result in a very large SIR or SMR. As long as the 99% confidence interval contains 1.00, this indicates that the SIR or SMR is still within the range one might expect and, therefore, not statistically

significant.

Results

The analysis of incidence data for ZIP code 78211, San Antonio, Texas, from January 1, 1995–December 31, 2001, and mortality data from January 1, 1993–December 31, 2002, showed selected leukemia subtype incidence and mortality to be within normal ranges for both males and females. Liver cancer mortality showed a statistically significant elevation among males (SMR=2.12). Analysis summaries are presented in Tables 1–2.

During the same time period, the analysis of ZIP code 78226, San Antonio, Texas, for incidence and mortality data showed selected leukemia subtypes were within normal ranges for both males and females. Analysis summaries are presented in Tables 3–4.

During the same time period, the analysis of ZIP code 78227, San Antonio, Texas, for incidence and mortality data showed selected leukemia subtypes were within normal ranges for both males and females. Analysis summaries are presented in Tables 5–6.

During the same time period, the analysis of ZIP code 78228, San Antonio, Texas, for incidence and mortality data showed a statistically significant elevation for liver cancer incidence and mortality among males (SIR=1.76, SMR=1.61), respectively. The selected leukemia subtypes were within normal ranges for both males and females. Analysis summaries are presented in Tables 7–8.

During the same period, the analysis of ZIP code 78237, San Antonio, Texas, for incidence and mortality data showed selected leukemia subtypes were within normal ranges for both males and females. Liver cancer incidence and mortality showed statistically significant elevations among males (SIR=1.74, SMR=2.52), respectively. Analysis summaries are presented in Tables 9–10.

Discussion

The observed liver and intrahepatic bile duct cancer elevations in ZIP codes 78211, 78228, and 78237 remain similar to findings in prior analyses conducted since 1998. It is important to note however the potential for problems with cause of death accuracy and liver cancers. Some studies on the quality of cause of death information have found as much as 40%–50% of liver cancers reported on death certificates, actually originating in other organs.[2,3]

Like other studies, this cancer cluster investigation had limitations. The number of years of incidence data examined was limited to seven years and did not include data for the most recent years. Ten years of mortality data were examined as a supplemental measure and did include data for one more recent year. Also, cancer incidence data are based on residence at the time of

diagnosis. Address data quality issues were identified for Bexar County 1995–2001 cancer incidence data relating to military personnel and unknown place of residence at the time of diagnosis. It is also possible that some residents who may have been exposed and developed cancer no longer lived in the area at the time of diagnosis so were not included in the data. However, it is possible that people with no exposure may have moved into the area and then developed cancer because of other factors. These cases are included in the investigation.

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. In Texas, as in the United States, cancer is the second leading cause of death, exceeded only by heart disease. 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, usually 20 to 40 years. Conditions that have prevailed for only the last 5 or 10 years are unlikely to be related to the current incidence of cancer in a community.

The chances of a person developing cancer as a result of exposure to an environmental contaminant are slight. According to Richard Doll and Richard Peto, renowned epidemiologists at the University of Oxford, pollution and occupational exposures are estimated to collectively cause 4%–6% of all cancer deaths.[4] 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.[5] In contrast, the National Cancer Institute estimates that lifestyle factors such as tobacco use and diet cause 50% to 75% of cancer deaths.[6] Eating a healthy diet and refraining from tobacco are the best ways to prevent many kinds of cancer.

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 we can do nothing about, but many are a matter of choice.

Known Risk Factors for Cancers Examined in This Investigation

The following is a brief discussion summarized from the National Cancer Institute and the American Cancer Society about cancer risk factors for the specific cancers studied in this investigation.[7,8]

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, arsenic in drinking water, tobacco use, bile duct disease, ulcerative colitis, liver fluke infection, and aging. Chemicals that are possibly associated with bile duct cancer include dioxin, nitrosamines, and polychlorinated biphenyls (PCBs).

Acute Lymphocytic Leukemia

Possible risk factors for ALL include the following: being male, being white, being older than 70 years of age, past treatment with chemotherapy or radiation therapy, exposure to atomic bomb radiation, or having a certain genetic disorder such as Down's syndrome.

Chronic Lymphocytic Leukemia

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; having relatives who are Russian Jews or Eastern European Jews; or having exposure to herbicides or insecticides including "Agent Orange," an herbicide used during the Vietnam War.

Acute Myeloid Leukemia

Possible risk factors for AML include the following: being male; smoking, especially after age 60; having had treatment with chemotherapy or radiation therapy in the past; having had 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.

Chronic Myeloid Leukemia
Most people with CML have a gene mutation (change) called the Philadelphia chromosome. The Philadelphia chromosome is not passed from parent to child.

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

Questions or comments regarding this investigation may be directed to Brenda Mokry, Texas Cancer Registry, at 1-800-252-8059 or brenda.mokry@dshs.state.tx.us.

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Table 1

Number of Observed and Expected Cancer Cases and Race Adjusted Standardized Incidence Ratios, Selected Cancers, ZIP Code 78211, San Antonio, TX, 1995–2001

Males				
Site	**Observed**	**Expected**	**SIR**	**99% CI**
Liver and Intrahepatic Bile Duct	12	12.30	0.98	0.40 – 1.96
Acute Lymphocytic Leukemia	5	2.83	1.77	0.38 – 5.01
Chronic Lymphocytic Leukemia	0	1.67	0.00	0.00 – 3.17
Acute Myeloid Leukemia	3	2.81	1.07	0.12 – 3.91
Chronic Myeloid Leukemia	2	1.55	1.29	0.07 – 6.00
Other Leukemia	0	0.74	0.00	0.00 – 7.19
Females				
Site	**Observed**	**Expected**	**SIR**	**99% CI**
Liver and Intrahepatic Bile Duct	11	6.33	1.74	0.68 – 3.60
Acute Lymphocytic Leukemia	4	2.29	1.74	0.29 – 5.49
Chronic Lymphocytic Leukemia	1	1.10	0.91	0.00 – 6.74
Acute Myeloid Leukemia	4	2.31	1.73	0.29 – 5.44
Chronic Myeloid Leukemia	1	1.13	0.89	0.00 – 6.60
Other Leukemia	2	0.75	2.68	0.14 – 12.44

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 1995–2001. The SIR has been rounded to the second decimal place.

*Significantly higher than expected at the $p< 0.01$ level.
**Significantly lower than expected at the $p< 0.01$ level.

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02/23/2005

Table 2

Number of Observed and Expected Cancer Deaths and Race Adjusted Standardized Mortality Ratios, Selected Cancers, ZIP Code 78211, San Antonio, TX, 1993–2002

Males				
Site	**Observed**	**Expected**	**SMR**	**99% CI**
Liver and Intrahepatic Bile Duct	33	15.54	2.12*	1.29 – 3.28
Acute Lymphocytic Leukemia	0	1.37	0.00	0.00 – 3.86
Chronic Lymphocytic Leukemia	1	1.01	0.99	0.00 – 7.36
Acute Myeloid Leukemia	4	2.37	1.69	0.28 – 5.32
Chronic Myeloid Leukemia	1	1.06	0.94	0.00 – 7.00
Other Leukemia	2	2.16	0.93	0.05 – 4.30
Females				
Site	**Observed**	**Expected**	**SMR**	**99% CI**
Liver and Intrahepatic Bile Duct	17	9.25	1.84	0.89 – 3.33
Acute Lymphocytic Leukemia	1	1.15	0.87	0.00 – 6.47
Chronic Lymphocytic Leukemia	0	0.66	0.00	0.00 – 8.03
Acute Myeloid Leukemia	3	1.95	1.54	0.17 – 5.62
Chronic Myeloid Leukemia	2	0.69	2.90	0.15 – 13.43
Other Leukemia	3	1.83	1.64	0.18 – 6.00

Note: The SMR (standardized mortality ratio) is defined as the number of observed deaths divided by the number of expected deaths. The latter is based on race-, sex-, and age-specific cancer mortality rates for Texas during the period 1993–2002. The SMR has been rounded to the second decimal place.

*Significantly higher than expected at the $p < 0.01$ level.

**Significantly lower than expected at the $p < 0.01$ level.

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Table 3

Number of Observed and Expected Cancer Cases and Race Adjusted Standardized Incidence Ratios, Selected Cancers, ZIP Code 78226, San Antonio, TX, 1995–2001

Males				
Site	**Observed**	**Expected**	**SIR**	**99% CI**
Acute Lymphocytic Leukemia	0	0.81	0.00	0.00 – 6.54
Chronic Lymphocytic Leukemia	0	0.45	0.00	0.00 – 11.83
Acute Myeloid Leukemia	2	0.77	2.59	0.13 – 11.99
Chronic Myeloid Leukemia	2	0.41	4.89	0.25 – 22.69
Other Leukemia	0	0.20	0.00	0.00 – 26.78
Females				
Site	**Observed**	**Expected**	**SIR**	**99% CI**
Acute Lymphocytic Leukemia	1	0.65	1.55	0.01 – 11.49
Chronic Lymphocytic Leukemia	0	0.27	0.00	0.00 – 19.28
Acute Myeloid Leukemia	0	0.62	0.00	0.00 – 8.51
Chronic Myeloid Leukemia	2	0.29	6.96	0.36 – 32.28
Other Leukemia	0	0.18	0.00	0.00 – 29.10

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 1995–2001. The SIR has been rounded to the second decimal place.

*Significantly higher than expected at the $p< 0.01$ level.
**Significantly lower than expected at the $p< 0.01$ level.

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Table 4

Number of Observed and Expected Cancer Deaths and Race Adjusted Standardized Mortality Ratios, Selected Cancers, ZIP Code 78226, San Antonio, TX, 1993–2002

Males				
Site	**Observed**	**Expected**	**SMR**	**99% CI**
Acute Lymphocytic Leukemia	0	0.35	0.00	0.00 – 15.11
Chronic Lymphocytic Leukemia	0	0.27	0.00	0.00 – 19.43
Acute Myeloid Leukemia	1	0.64	1.55	0.01 – 11.54
Chronic Myeloid Leukemia	2	0.27	7.30	0.38 – 33.84
Other Leukemia	0	0.57	0.00	0.00 – 9.33
Females				
Site	**Observed**	**Expected**	**SMR**	**99% CI**
Acute Lymphocytic Leukemia	0	0.30	0.00	0.00 – 17.48
Chronic Lymphocytic Leukemia	1	0.15	6.54	0.03 – 48.56
Acute Myeloid Leukemia	0	0.52	0.00	0.00 – 10.18
Chronic Myeloid Leukemia	0	0.17	0.00	0.00 – 31.29
Other Leukemia	0	0.45	0.00	0.00 – 11.79

Note: The SMR (standardized mortality ratio) is defined as the number of observed deaths divided by the number of expected deaths. The latter is based on race-, sex-, and age-specific cancer mortality rates for Texas during the period 1993–2002. The SMR has been rounded to the second decimal place.

*Significantly higher than expected at the $p< 0.01$ level.
**Significantly lower than expected at the $p< 0.01$ level.

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Table 5

Number of Observed and Expected Cancer Cases and Race Adjusted Standardized Incidence Ratios, Selected Cancers, ZIP Code 78227, San Antonio, TX, 1995–2001

Males				
Site	**Observed**	**Expected**	**SIR**	**99% CI**
Acute Lymphocytic Leukemia	5	3.80	1.31	0.28 – 3.72
Chronic Lymphocytic Leukemia	4	3.41	1.17	0.20 – 3.69
Acute Myeloid Leukemia	6	4.37	1.37	0.35 – 3.59
Chronic Myeloid Leukemia	2	2.23	0.89	0.05 – 4.15
Other Leukemia	0	1.43	0.00	0.00 – 3.70
Females				
Site	**Observed**	**Expected**	**SIR**	**99% CI**
Acute Lymphocytic Leukemia	2	2.82	0.71	0.04 – 3.29
Chronic Lymphocytic Leukemia	3	2.30	1.31	0.15 – 4.78
Acute Myeloid Leukemia	3	3.48	0.86	0.10 – 3.16
Chronic Myeloid Leukemia	0	1.56	0.00	0.00 – 3.39
Other Leukemia	0	1.18	0.00	0.00 – 4.48

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 1995–2001. The SIR has been rounded to the second decimal place.

*Significantly higher than expected at the $p < 0.01$ level.
**Significantly lower than expected at the $p < 0.01$ level.

Prepared by:
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02/23/2005

Table 6

Number of Observed and Expected Cancer Deaths and Race Adjusted Standardized Mortality Ratios, Selected Cancers, ZIP Code 78227, San Antonio, TX, 1993–2002

Males				
Site	**Observed**	**Expected**	**SMR**	**99% CI**
Acute Lymphocytic Leukemia	2	1.89	1.06	0.05 – 4.90
Chronic Lymphocytic Leukemia	6	2.42	2.48	0.64 – 6.48
Acute Myeloid Leukemia	10	4.16	2.40	0.89 – 5.14
Chronic Myeloid Leukemia	5	1.50	3.34	0.72 – 9.45
Other Leukemia	3	3.44	0.87	0.10 – 3.19
Females				
Site	**Observed**	**Expected**	**SMR**	**99% CI**
Acute Lymphocytic Leukemia	1	1.38	0.72	0.00 – 5.37
Chronic Lymphocytic Leukemia	4	1.42	2.82	0.47 – 8.87
Acute Myeloid Leukemia	3	3.23	0.93	0.10 – 3.40
Chronic Myeloid Leukemia	0	0.94	0.00	0.00 – 5.66
Other Leukemia	0	2.56	0.00	0.00 – 2.07

Note: The SMR (standardized mortality ratio) is defined as the number of observed deaths divided by the number of expected deaths. The latter is based on race-, sex-, and age-specific cancer mortality rates for Texas during the period 1993–2002. The SMR has been rounded to the second decimal place.

*Significantly higher than expected at the $p < 0.01$ level.
**Significantly lower than expected at the $p < 0.01$ level.

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Table 7

Number of Observed and Expected Cancer Cases and Race Adjusted Standardized Incidence Ratios, Selected Cancers, ZIP Code 78228, San Antonio, TX, 1995–2001

Males				
Site	**Observed**	**Expected**	**SIR**	**99% CI**
Liver and Intrahepatic Bile Duct	40	22.74	1.76*	1.12 – 2.61
Acute Lymphocytic Leukemia	2	4.80	0.42	0.02 – 1.93
Chronic Lymphocytic Leukemia	8	4.48	1.79	0.57 – 4.15
Acute Myeloid Leukemia	2	6.09	0.33	0.02 – 1.52
Chronic Myeloid Leukemia	2	3.25	0.62	0.03 – 2.85
Other Leukemia	1	2.00	0.50	0.00 – 3.72
Females				
Site	**Observed**	**Expected**	**SIR**	**99% CI**
Liver and Intrahepatic Bile Duct	14	12.10	1.16	0.51 – 2.22
Acute Lymphocytic Leukemia	3	4.05	0.74	0.08 – 2.71
Chronic Lymphocytic Leukemia	2	3.22	0.62	0.03 – 2.88
Acute Myeloid Leukemia	5	5.14	0.97	0.21 – 2.75
Chronic Myeloid Leukemia	5	2.45	2.04	0.44 – 5.78
Other Leukemia	6	1.94	3.09	0.79 – 8.07

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 1995–2001. The SIR has been rounded to the second decimal place.

*Significantly higher than expected at the $p< 0.01$ level.
**Significantly lower than expected at the $p< 0.01$ level.

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Table 8

Number of Observed and Expected Cancer Deaths and Race Adjusted Standardized Mortality Ratios, Selected Cancers, ZIP Code 78228, San Antonio, TX, 1993–2002

Males				
Site	**Observed**	**Expected**	**SMR**	**99% CI**
Liver and Intrahepatic Bile Duct	47	29.27	1.61*	1.07 – 2.31
Acute Lymphocytic Leukemia	4	2.48	1.61	0.27 – 5.08
Chronic Lymphocytic Leukemia	5	3.20	1.56	0.34 – 4.43
Acute Myeloid Leukemia	4	5.69	0.70	0.12 – 2.21
Chronic Myeloid Leukemia	3	2.26	1.33	0.15 – 4.86
Other Leukemia	6	5.12	1.17	0.30 – 3.06
Females				
Site	**Observed**	**Expected**	**SMR**	**99% CI**
Liver and Intrahepatic Bile Duct	24	17.96	1.34	0.74 – 2.21
Acute Lymphocytic Leukemia	0	2.17	0.00	0.00 – 2.45
Chronic Lymphocytic Leukemia	2	2.17	0.92	0.05 – 4.27
Acute Myeloid Leukemia	2	4.76	0.42	0.02 – 1.95
Chronic Myeloid Leukemia	3	1.58	1.90	0.21 – 6.95
Other Leukemia	11	4.35	2.53	0.99 – 5.24

Note: The SMR (standardized mortality ratio) is defined as the number of observed deaths divided by the number of expected deaths. The latter is based on race-, sex-, and age-specific cancer mortality rates for Texas during the period 1993–2002. The SMR has been rounded to the second decimal place.

*Significantly higher than expected at the $p < 0.01$ level.
**Significantly lower than expected at the $p < 0.01$ level.

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Table 9

Number of Observed and Expected Cancer Cases and Race Adjusted Standardized Incidence Ratios, Selected Cancers, ZIP Code 78237, San Antonio, TX, 1995–2001

Males				
Site	**Observed**	**Expected**	**SIR**	**99% CI**
Liver and Intrahepatic Bile Duct	28	16.06	1.74*	1.01 – 2.79
Acute Lymphocytic Leukemia	3	3.13	0.96	0.11 – 3.51
Chronic Lymphocytic Leukemia	4	2.14	1.87	0.31 – 5.87
Acute Myeloid Leukemia	3	3.49	0.86	0.10 – 3.15
Chronic Myeloid Leukemia	1	1.93	0.52	0.00 – 3.86
Other Leukemia	2	0.93	2.15	0.11 – 9.97
Females				
Site	**Observed**	**Expected**	**SIR**	**99% CI**
Liver and Intrahepatic Bile Duct	11	8.79	1.25	0.49 – 2.59
Acute Lymphocytic Leukemia	5	2.65	1.88	0.41 – 5.33
Chronic Lymphocytic Leukemia	0	1.53	0.00	0.00 – 3.46
Acute Myeloid Leukemia	0	2.96	0.00	0.00 – 1.79
Chronic Myeloid Leukemia	0	1.44	0.00	0.00 – 3.68
Other Leukemia	0	1.02	0.00	0.00 – 5.20

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 1995–2001. The SIR has been rounded to the second decimal place.

*Significantly higher than expected at the $p< 0.01$ level.
**Significantly lower than expected at the $p< 0.01$ level.

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Table 10

Number of Observed and Expected Cancer Deaths and Race Adjusted Standardized Mortality Ratios, Selected Cancers, ZIP Code 78237, San Antonio, TX, 1993–2002

Males				
Site	**Observed**	**Expected**	**SMR**	**99% CI**
Liver and Intrahepatic Bile Duct	52	20.64	2.52*	1.71 – 3.57
Acute Lymphocytic Leukemia	1	1.57	0.64	0.00 – 4.75
Chronic Lymphocytic Leukemia	1	1.36	0.74	0.00 – 5.47
Acute Myeloid Leukemia	2	2.93	0.68	0.04 – 3.17
Chronic Myeloid Leukemia	1	1.34	0.74	0.00 – 5.53
Other Leukemia	2	2.76	0.72	0.04 – 3.36
Females				
Site	**Observed**	**Expected**	**SMR**	**99% CI**
Liver and Intrahepatic Bile Duct	22	13.0	1.70	0.91 – 2.87
Acute Lymphocytic Leukemia	3	1.40	2.15	0.24 – 7.85
Chronic Lymphocytic Leukemia	0	0.99	0.00	0.00 – 5.36
Acute Myeloid Leukemia	2	2.60	0.77	0.04 – 3.56
Chronic Myeloid Leukemia	1	0.91	1.10	0.01 – 8.19
Other Leukemia	2	2.49	0.80	0.04 – 3.72

Note: The SMR (standardized mortality ratio) is defined as the number of observed deaths divided by the number of expected deaths. The latter is based on race-, sex-, and age-specific cancer mortality rates for Texas during the period 1993–2002. The SMR has been rounded to the second decimal place.

*Significantly higher than expected at the $p < 0.01$ level.
**Significantly lower than expected at the $p < 0.01$ level.

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