Los Alamos Cancer Rate Study: Phase I

Cancer Incidence in Los Alamos County, 1970-1990

Final Report

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SUMMARY

The Los Alamos Cancer Rate Study is an on-going multi-phase study of cancer incidence among populations residing in proximity to the Los Alamos National Laboratory. The study is being conducted in response to community concerns about an alleged recent large excess occurrence of brain cancer in Los Alamos County, particularly among residents of the Western Area neighborhood. Results presented in this report comprise the major findings of a Phase I descriptive epidemiologic study of cancer incidence in Los Alamos County for the time period 1970-1990. Incidence rates for brain and nervous system cancer and 22 other major cancers were calculated for Los Alamos County using data of the population-based New Mexico Tumor Registry. The county rates were then compared to rates derived from a New Mexico state reference population and a national reference population as represented by the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) Program.

Results of the incidence study showed that Los Alamos County experienced a modest elevation in brain and nervous system cancer during the mid-to late-1980S. The county incidence during this time period was 70%-80% higher than that observed in the state and national reference populations. Due to the small number of cases, random fluctuation in the county incidence could not be ruled out as causing the observed elevated rates. The incidence of brain and nervous system cancer within different neighborhoods of Los Alamos County was examined by comparing incidence rates calculated for the five census tracts situated in the county. For the 10-year time period 1980-1990, all census tract rates were higher than a New Mexico state reference rate. The highest incidence occurred in the census tract, which corresponds, to the Western Area neighborhood. The Western Area incidence rate was based on three cases and was less than two-fold higher than the next highest census tract rate. All but one of the census tract rates were based on three or fewer cases. Due to the small case numbers, chance alone could not be ruled out as causing the increased incidence observed in Western Area.

A review of incidence rates for 22 other major cancers and childhood cancers showed that the incidence of some cancers in Los Alamos County was greater than that observed in the reference populations while the incidence of other cancers was lower than or comparable to that observed in the reference populations. Cancers with incidence rates consistently elevated in LAC during 1970-1990 included melanoma of the skin, prostate cancer, non-Hodgkin's lymphoma, ovarian cancer, and female breast cancer. Leukemia and major cancers of the respiratory and digestive systems occurred at or below the incidence levels observed in the reference populations. Several cancers showed distinct temporal patterns of increasing incidence. Most notable was the marked increase in thyroid cancer incidence observed in the mid-1980s. Thyroid cancer incidence in Los Alamos County during 1986-1990 was nearly four-times higher than that observed in the New Mexico state reference population. Based on the findings of the Phase I incidence study, a Phase 11 study was recommended which would include continued surveillance of cancer among county residents and a feasibility assessment of conducting analytical epidemiology studies to investigate causes of the elevated thyroid cancer incidence in Los Alamos County.

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LIST OF ABBREVIATIONS

LAC	Los Alamos County
NMDOH	New Mexico Department of Health
DOE	Department of Energy
CDC	Centers for Disease Control
ATSDR	Agency for Toxic Substances and Disease Registry
LANL	Los Alamos National Laboratory
SEER	Surveillance, Epidemiology, and End Results
NMTR	New Mexico Tumor Registry
NHW	Non-Hispanic White
NCHS	National Center for Health Statistics
CI	Confidence Interval
ICD	International Classification of Diseases

INTRODUCTION

Los Alamos County (LAC) is home to the Los Alamos National Laboratory (LAN-L), a nuclear research facility owned by the U.S. Department of Energy (DOE) and operated by the University of California. Community concern was raised in the summer of 1991 over publicized allegations of a recent large excess occurrence of brain cancer in LAC, particularly among residents of the Western Area neighborhood. The perception of a brain cancer "cluster" emerged from a citizen-generated case list of alleged recent brain cancer deaths among persons who had resided in relative close proximity within Western Area. Expanded versions of the case list implicated not only Western Area, but the entire county as apparently experiencing an excess of brain cancer. These allegations heightened community concerns that radioactive emissions or waste disposal practices associated with LAN-L might have increased the occurrence of cancer among county residents. In response to these concerns, the DOE funded the New Mexico Department of Health (NMDOH) to conduct descriptive epidemiologic studies of cancer incidence among populations residing in proximity to LANL. These activities comprise the Los Alamos Cancer Rate Study, an on-going multi-phase investigation of cancer occurrence in and around Los Alamos County. The results presented in this report represent major findings of a Phase I descriptive study of cancer incidence in residents of LAC during the time period 1970- 1990.

STUDY OBJECTIVES AND SPECIFIC AIMS

The primary objective of the Phase I study was to review LAC incidence rates for brain and nervous system cancer and other major cancers during the 21-year time period 1970-1990. Secondary objectives were to review mortality rate data for select cancers of concern; and to review LAC mortality data relating to benign brain and nervous system tumors.

Specific aims developed for the Phase I incidence study were as follows:

- to calculate age-adjusted cancer incidence rates for LAC and a New Mexico state reference population using data of the New Mexico Tumor Registry (NMTR);
- to compare LAC cancer incidence rates to (i) incidence rates calculated for a New Mexico state reference population, and (ii) national rates obtained from the SEER Program of the National Cancer Institute; and
- to determine if any of the LAC cancer incidence rates were elevated in comparison to rates observed in the reference populations.

The original study protocol specified that statistical tests would be used to determine whether any of the LAC rates were elevated in comparison to the reference populations. Early in the course of the study, however, it became apparent that the small number of cases for virtually all of the LAC cancers reviewed would make the finding of statistical significance unlikely for small to modest elevations in a rate. Consequently, the analysis of the LAC incidence data was expanded to include not only statistical considerations but other types of information such as temporal patterns of cancer occurrence, prevalence of established risk factors, case characteristics, and tumor cell types.

STUDY AREA DESCRIPTION

The Los Alamos townsite was created in 1943 by the U.S. Government as a secret wartime community to provide laboratory facilities and residential housing for the development, assembly, and testing of the first atomic bomb. Los Alamos County was incorporated in 1949 from portions of Sandoval and Santa Fe counties. Residential and commercial development has since occurred in LAC coincident with the expansion of laboratory activities. The government sector and LANL are responsible for roughly three-quarters of all existing jobs in the county and indirectly responsible for the remaining employment in retail sales, services, and construction.

Geography

Los Alamos County is located in the Jemez mountains of north-central New Mexico, approximately 60 miles north-northeast of Albuquerque and 25 miles northwest of Santa Fe (Fig. 1). The county land area comprises 109 square miles, of which LANL occupies 43 square miles. Two residential communities exist in the county: Los Alamos townsite and White Rock. Los Alamos townsite includes the original technical area and residential areas constructed for the development and production of the atomic bomb. White Rock is a bedroom community of LANL located approximately eight miles southeast of the Los Alamos townsite. LANL and the adjacent residential communities are situated on the Pajarito Plateau, a series of finger-like mesas separated by deep canyons. The mesa tops range in elevation from 6200-7800 feet. LANL and the community developments are confined primarily to the mesa tops. The surrounding county land is largely undeveloped.

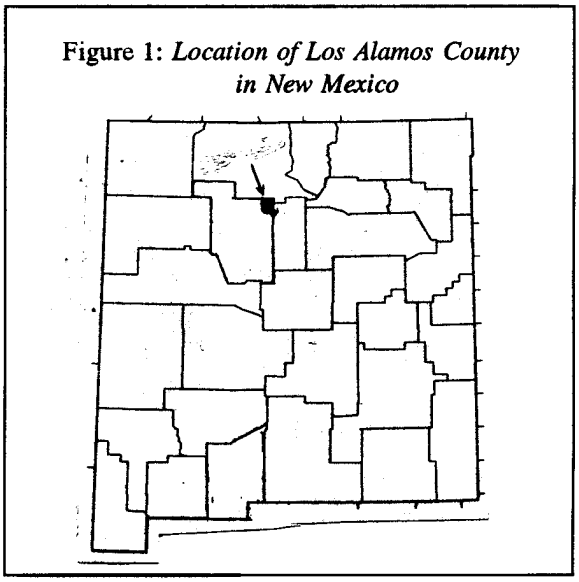


Figure 1: ***Location of Los Alamos County in New Mexico***

Population

Size - The county population nearly doubled in size over the 40-year time period 1950-1990 from roughly 10,000 residents to 18,000 residents (Table 1). The most rapid growth occurred in the 1950s, during which the county population increased by nearly 25 %. Between 1960 and 1980, the LAC population grew by roughly 15% in each successive decade. Nominal population growth occurred during the 1980s. Based on the 1990 U.S. Census, two- thirds of the county population resides in Los Alamos townsite and the remaining third in White Rock.

Table 1. Los Alamos County Population, 1950-1990

Year	Population	% Growth New Mexico†
1950	10,476	
1960	13,037	+24.4%
1970	15,198	+16.6%
1980	17,599	+15.8%
1990	18,155	+ 2.9%

†Between successive decades Source: U.S. Census

Age - The county population progressively aged over the last four decades (see Appendix E). Three out of every four county residents in 1950 were under the age of 35 years while less than 1% of the population was 65 years and older. By 1990, persons under the age of 35 years comprised less than half the county population, whereas nearly 10% of residents were 65 years and older. Over the 21 -year study time period 1970-1990, county residents 55 years and older increased from 7.5 % of the population in 1970 to 27.5 % of the population in 1990. Within this age group, the percentage of residents 65 years and older increased by over four-fold from 2.1% to 9.2% of the county population.

Other demographic and socioeconomic factors - LAC differs considerably from New Mexico and the nation with respect to many demographic and socioeconomic factors. From inception, the LAC population has been comprised largely of affluent, highly educated non-Hispanic Whites. The demographic and socioeconomic discrepancies observed in LAC compared to state and national averages are a direct result of the predominance that LANL and the government sector have over employment in the county.

Table 2 gives the racial and ethnic distribution of LAC residents over the past several decades. It shows that a vast majority of the LAC population has been composed of non-Hispanic Whites; and that Hispanics account for virtually the remainder of the county population. Non-Hispanic Whites have accounted for roughly 50% of the New Mexico state population over the last several decades; and Hispanics about 35%-40%.

Table 2. Percentage (%) Distribution of Race and Ethnicity, Los Alamos County, 1970-1990

Race	1970	1980	1990
Non-Hispanic White	80.9%	86.1%	85.4%
Hispanic White	17.8%	11.3%	11.1%
Other Races	1.3%	2.6%	3.5%
	100.0%	100.0%	100.0%

*Source: U.S. Census

Educational and income levels in LAC are among the highest in the nation. In 1980, LAC ranked first among all counties in the nation with respect to the percentage of adults with 16 years or more of schooling (47.8%). In 1985, LAC ranked 17th among all U.S. counties for highest per capita income. (Source: U.S. Census County and City Data Book, 1988). In 1980, 3.5% of LAC families were below poverty compared to 14.0% statewide and 9.1% for the nation (1980 Census). Occupational and employment factors are similarly skewed within LAC in comparison to New Mexico and the U.S. In 1980, 44% of employed persons 16 years and older held professional and managerial positions compared to approximately 26% statewide (1980 Census). Roughly 67% of all jobs held by LAC residents in 1982 were government positions (New Mexico Statistical Abstract, 1984). Because of the county's unique economic base, LAC residents have among the lowest levels of unemployment in the state and the nation. In 1986, LAC ranked first among all U.S. counties for lowest unemployment rate (1.8 %) among the

civilian labor force (U.S. Census County and City Data Book, 1988). Overall unemployment in LAC typically has averaged 2%-3%.

Natality - LAC women generally have experienced low birth rates and delayed pregnancies in comparison to women across the state. Since natality characteristics vary markedly by race and ethnicity, all state comparison rates and figures presented in Tables 3-5 are specific to non-Hispanic Whites. Table 3 reveals that LAC fertility rates have been 10 % -30 % lower than rates observed statewide for the past 15 years. While fertility rates in New Mexico non-Hispanic White women were steadily dropping over time, LAC women maintained a constant low fertility rate.

Table 3. Average Annual Fertility Rates in Los Alamos County (All Races) and New Mexico Non-Hispanic Whites, 1975-1989†

Year	Los Alamos	New Mexico
1975-1979	48.7	68.8
1980-1984	47.5	63.7
1985-1989	48.3	53.5

†Births per 1,000 women, 15-44 years.

*Source: NMDOH Office of Vital Records and Health Statistics

Tables 4 and 5 show data indicating that LAC women who choose to have children have them at older ages than women statewide on average. Table 4 reveals that the percentage of all live births in women 30 years and older has been consistently higher in LAC than statewide. For the time period 1976-1980, roughly one out of three live births in LAC occurred in women 30 years and older. Statewide, less than one in five live births occurred in women 30 years and older. Over the entire time period 1976-1989, a trend showing increasingly higher percentages of births in women 30 years and older is apparent both in LAC and across the state. For the latest time latest period 1986-1989, nearly one half of all live births in LAC occurred in women 30 years and older.

Table 5 similarly indicates that LAC women tend to delay pregnancy compared to non-Hispanic White women statewide. The data in Table 5 are specific to first live borns and show that the percentage of all first live births in women 30 years and older was roughly twice as high in LAC as that seen statewide. Roughly one out of every four first live births in LAC during 1980- 1989 occurred in women 30 years and older.

Table 4. Percentage (%) of Total Annual Live Births in Women Aged 30+ Years, Los Alamos County (All Races) and New Mexico Non-Hispanic Whites, 1976-1989

Year	Los Alamos	New Mexico
1976-1980	36.8%	17.9%
1981-1985	39.1%	23.6%
1986-1989	47.5%	31.3%

*Source: NMDOH Office of Vital Records and Health Statistics

Table 5. Percentage (%) Distribution of Total First Live Born By Age of Mother, Los Alamos County (All Races) and New Mexico Non-Hispanic Whites, 1980-1989

Age (yrs)	Los Alamos	New Mexico
<15	0.3%	0.1%
15-19	10.1%	22.8%
20-24	26.5%	36.5%
25-29	35.7%	25.8%
30+	27.4%	14.8%
	100%	100%

*Source: NMDOH Office of Vital Records and Health Statistics

Environmental Background

Nuclear-related activities have been on-going in LAC since inception of the laboratory in 1943. These activities include both radioactive air emissions and radioactive liquid waste disposal. Early time periods (1950s and 1960s) were characterized by less stringent approaches to radioactive emissions and waste disposal compared to present day standards employed by LANL. The extent to which county residents were exposed to ionizing radiation beyond background levels during these time periods is not known. Environmental monitoring data collected by LAN'L since the early 1970s suggest that LAC residents were not exposed to levels of radiation much beyond background between 1970 and present; however, specific radiation exposure data for community residents generally do not exist. In response to community concerns about radiation exposures, the Centers for Disease Control (CDC) Radiation Studies Branch recently initiated a discovery process aimed at determining the need and feasibility for a dose-reconstruction project in LAC and neighboring regions. Such a project, if deemed necessary and feasible, would provide dose measurements for ionizing radiation and any chemical exposure of significance, which might have occurred in the past. The Phase I cancer incidence study was not designed to incorporate environmental data into its analysis of incidence rates. Environmental exposure data, if and when they become available, could be teamed with the health outcome findings presented in this report to generate potential hypotheses for future analytical epidemiology studies.

METHODS

Phase I of the Los Alamos Cancer Rate Study was a descriptive study of cancer incidence among residents of Los Alamos County. Five-year average annual age-adjusted incidence rates were calculated over the 21-year time period 1970-1990 for more than 20 different major cancers. The LAC incidence rates were compared to rates calculated for New Mexico non-Hispanic Whites and to rates obtained for a national sample of the U.S. White population represented by the National Cancer Institute's (NCI) Surveillance, Epidemiology, and End Results (SEER) Program. Following a review of all LAC incidence rate data, specific cancers of concern were chosen for further evaluation. Supplemental data reviewed for cancers of concern included sub- county incidence rates, county mortality rates, case demographics, and tumor characteristics. Prior to the commencement of the study, the NMDOH convened a 13-member Steering Committee composed of local residents, members of academia, and representatives of DOE, LANL, and various Federal health agencies. The purpose of the Steering Committee was to provide technical support and oversight for the study. All study methodology, results, conclusions, and recommendations presented in this report have been reviewed and approved by the Steering Committee. The Steering Committee meetings were open to the public, and public input was solicited on all aspects of the Phase I study, including review and comment on the findings presented in this report.

Incidence Data

Data Sources - Information regarding newly diagnosed cancers among LAC residents and New Mexico non-Hispanic Whites was compiled from records collected since 1969 by the NMTR at the University of New Mexico Cancer Center. Cancer is a reportable disease in New Mexico by regulation of the NMDOH. Since the late 1960s, NMTR has been the repository of the confidential medical record abstracts and computerized masterfile for cancer in New Mexico. NMTR has been a part of the SEER Program since that program began in 1973.

Working with local hospital medical records personnel throughout the state, tumor registrars from NMTR schedule visits to each facility for case-finding, abstracting, and follow-up. Abstracted data include information about the PATIENT (birth date, gender, place of residence); the CANCER (diagnosis date, anatomic location, histologic type, grade, size, amount of direct extension to adjacent organs or structures, lymph node involvement, and metastatic spread to distant sites); the TREATMENT (surgery, radiation, chemotherapy); and the OUTCOME (vital status at annual intervals, date and cause of death if deceased). These items are abstracted and coded according to guidelines and coding rules established and monitored by the SEER Program. Standard casefinding procedures cover hospital sources, medical laboratories, radiation therapy centers, and vital records offices. Within hospitals, the primary case identification sources are pathology reports, treatment logs, and indices of diagnoses maintained by medical records departments.

Information regarding the size and age-gender-ethnic composition of the LAC and New Mexico populations was obtained from U.S. Census reports of 1970, 1980, and 1990 with the assistance of the University of New Mexico Data Bank. Population counts for intercensal years were obtained by interpolation.

Incidence data for the national reference population were obtained from the NCI SEER Program for all available years (1973-1988). The SEER Program is a network of nine population-based cancer registries encompassing five states (Connecticut, Hawaii, Iowa, New Mexico, Utah) and four metropolitan areas (Atlanta, Detroit, San Francisco, Seattle). The SEER program covers about ten percent of the U.S. population and monitors changes in cancer incidence, treatment patterns, and survival rates in the United States.

Case Definition - A case was defined as a primary malignancy diagnosed between January 1, 1970 and December 31, 1990 in a person who was a resident of Los Alamos County at the time of diagnosis. A similar case definition respectively applied to the New Mexico and SEER reference populations. Common definitions, classifications and site groupings from the International Classification of Diseases for Oncology (ICD-0) were used in the LAC, state, and national datasets. Under this coding scheme, lymphomas arising in extra-nodal sites are assigned to one of the lymphoma categories and not to the organ of occurrence.

Analysis Procedures - Age-adjusted incidence rates for cancer of 23 major anatomic sites and childhood cancers (ages 0- 19) among LAC residents and New Mexico non-Hispanic Whites were calculated by the direct method and standardized to the 1970 U.S. standard population. SEER rates calculated in the same manner were obtained from published materials (Cancer Statistics Review 1973-1988. National Cancer Institute. NIH Pub. No. 91-2789, 1991.).

Well-known differences in cancer incidence between Whites and non-Whites exist within the SEER data; and in the New Mexico population, there are well-known differences among non- Hispanic Whites, Hispanics, and American Indians. Because non-Hispanic Whites represent only 50 % of the New Mexico population but about 85 % of the LAC population, rates for non- Hispanic Whites in the New Mexico data and rates for Whites in the SEER data were considered to be most relevant for comparison to the

LAC rates. LAC rates were calculated for both non- Hispanic Whites and the total county population as represented by "All Races".

Because small changes from year to year in the numbers of cases for even the most common cancers cause sharp and erratic fluctuations in rates calculated for a population as small as that of LAC, the Steering Committee requested presentation of rates in consecutive five-year groupings, beginning with 1970-1974 and progressing one year at a time through 1986-1990, as a "sliding window" of five-year moving averages. Similar moving averages were constructed for the reference populations. Since SEER incidence data were available only up through 1988, the latest national rate is for 1984-1988. All of these data are tabulated in Appendix A and some are presented as graphs with the data presented on the select cancers of concern.

Approximate 95 % confidence intervals were calculated for the LAC incidence rates in order to ascertain the level of statistical uncertainty in each respective county rate. A wide confidence interval indicates high uncertainty in a rate, and typically occurs as a result of low case numbers. The following equations were used to calculate approximate 95% confidence intervals for the LAC incidence rates;

$$(a)\ \textit{Standard Error (SE)} = \frac{\textit{Rate}}{\sqrt{\textit{Events}}}$$

$$(b)\ 95\%\ \textit{Confidence Interval (CI)} = \textit{Rate} +/- 2SE$$

where "Events" refers to the number of cancer cases used in calculating the rate. The upper and lower 95% confidence limits were estimated by adding or subtracting two standard errors from the rate. The confidence intervals presented in the report represent approximations to the exact confidence interval, and as a result, lower confidence limits for some rates included negative values. Since an incidence rate would never be less than zero, all negative lower confidence limits were truncated at zero. Due to the similarity between the LAC non-Hispanic White rate and LAC "All Races" rate for many cancers, confidence intervals were calculated only for the non-Hispanic White rates. The confidence interval data are tabulated in Appendix A and are plotted on each incidence rate graph presented for the cancers of concern.

Incidence rate ratios (LAC rates as the numerators and the reference populations as the denominators), tabulated in Appendix Tables A. 8-A. 12, indicate the direction and magnitude of differences between the LAC rates and the reference rates. When the LAC rate is higher than the comparison rate, the rate ratio is greater than 1.00. Many rate ratios were less than 1.00, indicating that the LAC rate was less than the reference rate.

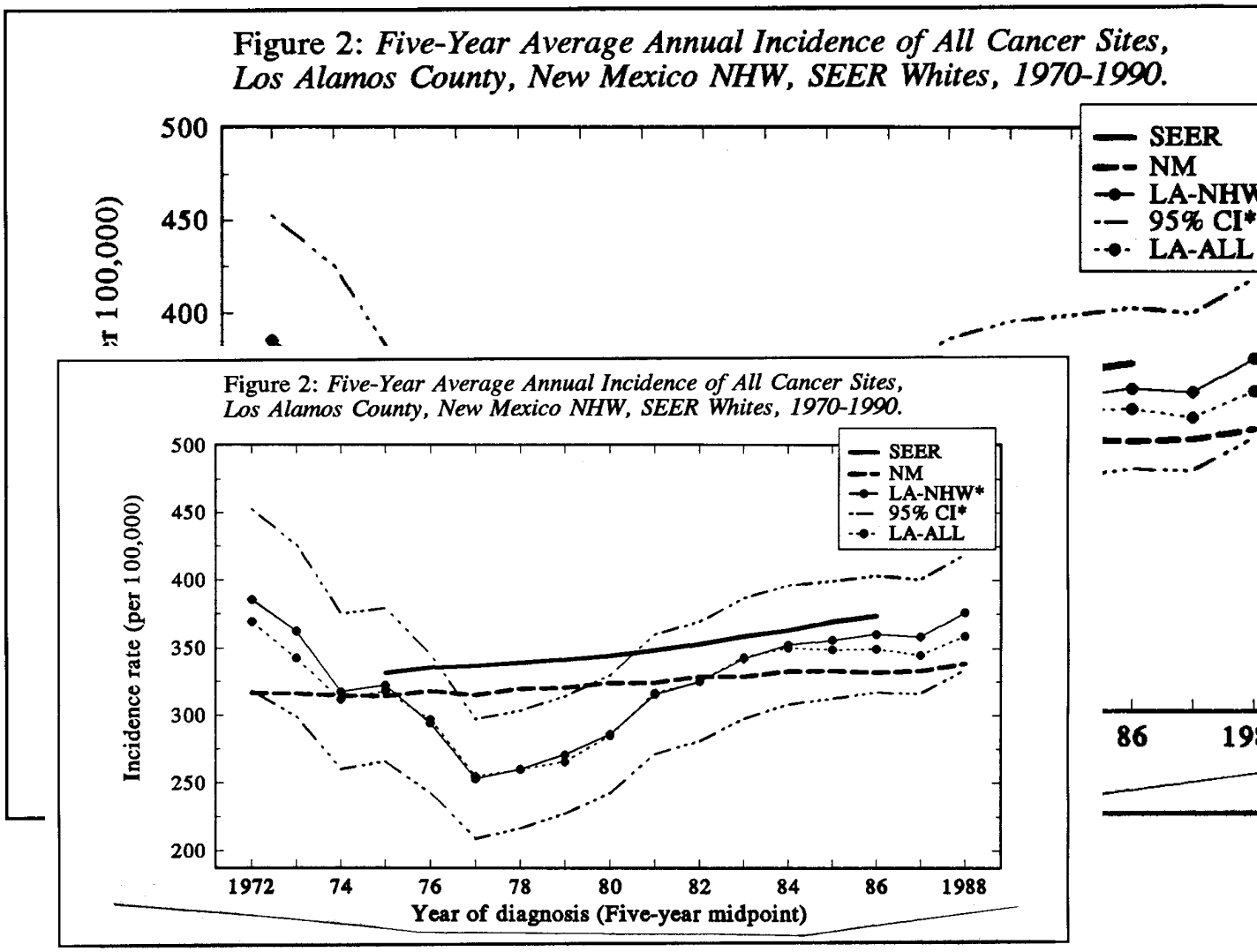
Statistical testing for elevations in the LAC rates in comparison to the reference rates was limited by the small number of cases observed for most cancers in LAC. The small case numbers resulted in wide confidence intervals for the LAC rates and an attendant lack of statistical power to detect small to modest elevations in the LAC rates. If the lower confidence limit for a given LAC rate was greater than a comparison rate, then the elevation was considered "statistically- significant", and not likely due to chance alone. However, due to the low case numbers for many LAC cancers, statistical significance was observed only in several instances where a relatively large increase in the LAC rate over the reference rate occurred. More typically, small to modest elevations in the LAC rate were observed which remained uninterpretable on statistical grounds due to the lack of adequate statistical power to appropriately test for such differences. Significance testing procedures were not modified to account for the multitude of comparisons made between the LAC rates and the reference rates. The large number of comparisons

increased the likelihood that some of the elevations observed in the LAC rates, even if statistically-significant, occurred simply as a result of chance alone (see Study Limitations).

Appendix B presents frequency distributions for diagnosis year, race-ethnicity, sex, and age at diagnosis for select cancers of concern. One case each of cerebral immunoblastic lymphoma and melanoma of the spinal meninges diagnosed in 1990 were present in the original brain cancer data (Appendix B.9), but were excluded from the brain cancer rate calculations based on the coding and classification scheme employed in the study. These adjustments are reflected in Appendix B, Figure B. 10. Appendix C presents incidence and mortality data relating to cancers among LAC residents less than 20 years of age.

Mortality Data

Mortality rate data were compiled for the select cancers of concern to look for inconsistencies in the incidence data. Mortality rates for LAC and the U.S. were obtained as age-adjusted average annual mortality rates from the National Center for Health Statistics (NCHS) and the National Cancer Institute. All rates were standardized to the 1970 U.S. Standard Population and were race-specific for Whites. Site-specific LAC mortality rates were available for the time periods 1969-1972; 1973-1977; 1978-1982; and 1983-1987. U.S. rates were available for all time periods except 1969-1972. For some cancers, both LAC



Mortality (1968-1987) – Discussion of mortality rates for all cancers combined suffers from the same limitation as the "all cancer" incidence rates. Similar to the incidence data, LAC mortality rates for all cancers combined fluctuated substantially around the more stable national mortality rates (Table 6). Overall, cancer mortality in LAC was comparable to or lower than that observed in the national reference population.

Table 6. Average Annual Age-Adjusted Mortality Rates for All Cancer Sites, Los Alamos County and U.S., Whites, 1968-1987†

	Los Alamos County		
Year	Rate‡	95% CI	U.S. Rate
1968 - 1972	154.4 (42)	(106.8, 202.8)	159.7
1973 - 1977	85.9 (41)	(59.1, 112.7)	160.6
1978 - 1982	177.7 (95)	(141.2, 214.1)	164.1
1983 - 1987	116.5 (81)	(90.6, 142.4)	167.5

†Rates are per 100,000 and are age-adjusted to the 1970 U.S standard population.

‡Number of deaths in parentheses.

*Source: National Center for Health Statistics

Selection of Cancers of Concern

Tabulated incidence rate data for 23 major cancers and childhood cancers were reviewed by the Steering Committee in order to select specific cancers of concern for further review and evaluation (see Appendix A). Cancers of concern were selected primarily on the basis of incidence rates, which were consistently higher in LAC in comparison to the state, and national reference rates; or the presence of a temporal pattern of increasing incidence in LAC, which lead to rates higher than those observed in the reference populations. Although the original review was conducted by site by site, the information provided below is categorized by major organ system in order to facilitate the presentation of results.

Oral Cavity & Pharynx - The incidence of cancer of the oral cavity & pharynx was consistently lower in LAC in comparison to the state and national reference populations.

Digestive System - Incidence rates were calculated for the following cancers of the digestive system: esophagus; stomach; colon/rectum; liver; and pancreas. None of the digestive cancer incidence rates were consistently higher in LAC in comparison to the reference population rates. Based on the known association between angiosarcoma of the liver and vinyl chloride exposure, liver cancer was chosen as a cancer of concern in order to look for unusual histologic cell types among the LAC liver tumors.

Respiratory System - Incidence rates were calculated for cancers of the larynx and lung & bronchus. The incidence of respiratory cancers was notably lower in LAC than in the state and national reference populations, probably reflecting low smoking prevalence rates.

Melanoma of Skin - The incidence of melanoma of the skin was consistently higher in LAC compared to the reference populations. LAC incidence rates were up to three-fold higher than the reference rates. Melanoma was chosen as a cancer of concern based on the consistency and magnitude of the higher incidence observed in LAC.

Female Breast - The incidence of breast cancer in LAC females was consistently 20% to 50% higher than that in the reference populations during the entire study time period. Breast cancer was chosen as a cancer of concern based on the consistency and magnitude of the higher incidence observed in LAC women.

Female Genital System- Incidence rates were calculated for cancers of the ovary, cervix uteri, and uterine corpus. Incidence rates for cancers of the uterine cervix and uterine corpus generally were lower in LAC compared to the reference populations. Ovarian cancer incidence in LAC women was consistently higher than that observed in the reference populations following the mid-1970s. Ovarian cancer was selected as a cancer of concern based on the temporal pattern of increasing incidence, which lead to an elevated incidence for LAC women.

Urinary System - Incidence rates were calculated for cancers of the urinary bladder and kidney & renal pelvis. LAC incidence rates for these cancers generally were lower than the rates observed in either reference population.

Male Genital System - Incidence rates were calculated for cancers of the prostate gland and testis. Prostate cancer was consistently higher by up to two-fold in LAC compared to the reference populations. Two-fold higher rates also were observed for testicular cancer; however, the elevations in the LAC rates were only transiently observed. Although the incidence of prostate cancer was consistently higher than that observed in the reference populations, this cancer was not chosen as a cancer of concern due to the lack of a recognizable environmental component in its etiology.

Lymphoreticular System – Incidence rates were calculated for leukemia, multiple myeloma, Hodgkin's disease, and non-Hodgkin's lymphoma. Only the incidence of non-Hodgkin's lymphoma was consistently higher in LAC compared to the reference populations. Based on this finding, non-Hodgkin's lymphoma was chosen as a cancer of concern. Leukemia was selected specifically to investigate the distribution of histologic cell types among the LAC leukemia cases.

Childhood Cancers (0-19 Years) - Incidence data for childhood cancers were not available for review during the initial selection process; however, existing mortality rate data showed that LAC ranked first among all New Mexico counties for childhood cancer death rates during the period 1953-1987. Based on an apparent excess in mortality, childhood cancers were selected for additional investigation.

Thyroid - LAC thyroid cancer incidence rates were slightly higher than the reference rates up until the mid-1980s, at which point the county incidence rose sharply. Thyroid cancer incidence in LAC during 1986-1990 was roughly four-times higher than that in the state reference population. Thyroid cancer was chosen as a cancer of concern based on the sudden and sustained rise in incidence, which lead to a four-fold higher rate in LAC, compared to the state reference rate.

Brain and Nervous System – The incidence of brain and nervous system cancers gradually rose in LAC over the 2l-year study time period. During the mid to late 1980s, LAC incidence rates were roughly 60%-80% higher than the reference population rates. Brain and nervous system cancer was chosen as a cancer of concern based on the higher incidence observed in LAC in comparison to the reference populations.

Summary - Following a review of tabulated incidence rate data for 23 major cancers, nine were selected by the Steering Committee for additional review and evaluation: liver and intrahepatic bile duct cancer; non-Hodgkin's lymphoma; leukemia; melanoma of skin; ovarian cancer; breast cancer; childhood cancers; thyroid cancer; and brain and nervous system cancer. The majority of these cancers were chosen on the basis of incidence rates, which were higher in LAC in comparison to the reference populations. Childhood cancer was chosen for further review based on mortality rate data showing an apparent excess of childhood cancer deaths in LAC. Leukemia and liver cancer were chosen as cancers of concern specifically to examine tumor cell types. Cancers not chosen for further review included major sites in the respiratory, digestive, and urinary systems. Results from the additional review and evaluation of each cancer of concern are provided in the sections that follow.

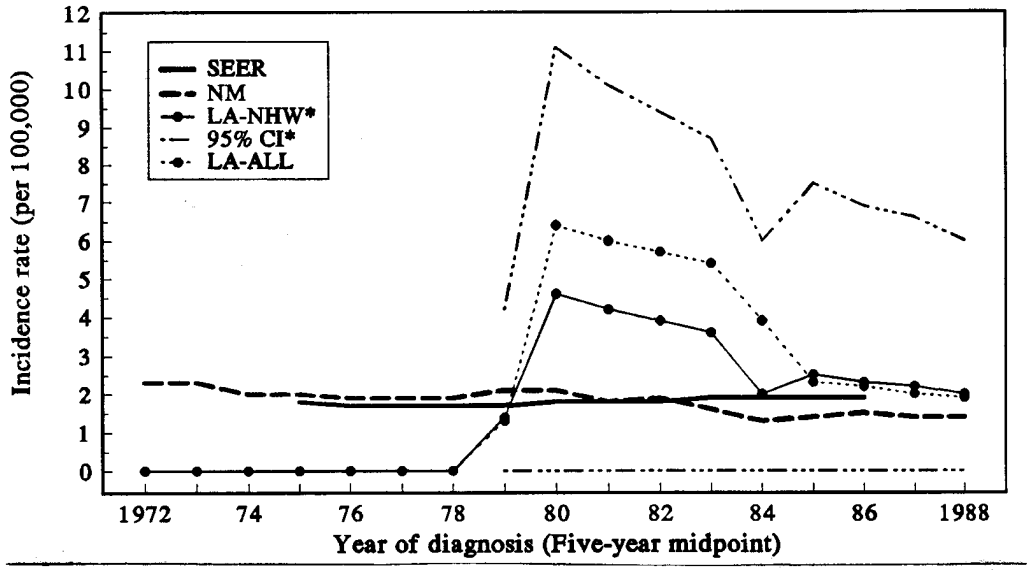
Liver and Intra-Hepatic Bile Duct Cancer

Description and Etiology – Primary liver cancer is uncommon in the U.S., accounting for roughly 0.5% of all cancers diagnosed annually. Liver cancers are divided into epithelial and non-epithelial neoplasms. Epithelial cancers predominate, of which hepatocellular carcinoma and cholangio-(intra-hepatic bile duct) carcinoma respectively constitute approximately 70% and 20% of all primary liver cancers. Non-epithelial liver cancers are exceedingly rare, but have been extensively studied because of their association with certain chemical and radiochemical exposures. Except for a small peak in young children, the incidence of liver cancer generally increases with age. Incidence is typically higher in males than females. In New Mexico, liver cancer occurs with a similar incidence in Hispanics and non-Hispanic Whites.

The etiology of liver cancer is partially understood. A large percentage of liver cancer occurs in association with cirrhosis. Etiologic factors include alcohol, hepatitis B virus, and aflatoxin. Vinyl chloride is known to cause hepatic angiosarcoma, a rare, non-epithelial liver cancer. Thorotrast, an alpha-emitting contrast agent used between 1930 and 1955, is known to cause both epithelial and non-epithelial liver cancers. Excess liver cancer has not been observed in A-bomb survivors or in persons receiving therapeutic external ionizing radiation.

Incidence (1970-1990) – Seven cases of primary liver and intra-hepatic bile duct cancer occurred in LAC. Four of the seven cases (57%) were diagnosed between 1981 and 1982. LAC incidence rates were highly variable as a result of the small number of cases and the clustered temporal distribution of cases. Zero incidence was registered up until the early 1980s, at which time the four cases diagnosed in 1981-1982 caused a marked elevation in the LAC rates in comparison to the state and national reference rates (Fig. 3). LAC rates subsequently diminished to a level consistent with the reference rates.

Figure 3: *Five-Year Average Annual Incidence of Liver and Intra-Hepatic Bile Duct Cancer, Los Alamos County, New Mexico NHW, SEER Whites, 1970-1990.*



Mortality (1969-1987) – LAC mortality rates fluctuated considerable due to the small number of observed deaths (Table 7). Excluding the 1973-1977 time period during which no deaths occurred, LAC liver cancer mortality consistently was elevated in comparison to the U.S. rates. It should be noted that the

analysis of primary liver cancer mortality is made difficult by a high prevalence of death certificate coding inaccuracies. Deaths attributable to liver cancer frequently include cancers of other organs which have spread to the liver (metastatic liver cancer). Consequently, the number of LAC liver cancer deaths actually resulting from primary (non-metastatic liver cancer is unknown). The extent to which the U.S. rates reflect true primary liver cancer mortality similarly is unknown.

Table 7. Average Annual Age-Adjusted Mortality Rates for Liver & Intra-Hepatic Bile Duct Cancer, Los Alamos County and U.S., Whites, 1969-1987†

	Los Alamos County		
Year	Rate‡	95% CI	U.S. Rate
1969 - 1972	14.6 (2)	(0.0, 35.3)	—
1973 - 1977	0.0 (0)	(—,—)	2.1
1978 - 1982	5.4 (3)	(0.0, 11.5)	2.1
1983 - 1987	7.1 (4)	(0.0, 14.1)	2.3

†Rates are per 100,000 and are age-adjusted to the 1970 U.S standard population.

‡Number of deaths in parentheses.

*Source: National Center for Health Statistics

Case/Tumor Characteristics – All incident cases occurred in persons 50 years and older (Appendix B, Table B.1). Six of the seven total cases occurred in persons 60 years and older. No unusual histologic cell types of liver cancer were observed. All cancers were of epithelial origin, with five of seven being hepatocellular carcinomas and the remaining two being cholangiocarcinomas.

Summary – The incidence of liver cancer in LAC generally was comparable to or below that observed in the state and national reference populations. As evidenced by the accompanying wide confidence intervals, the LAC rates were highly unstable. The single period of elevated incidence in the early 1980s was caused by an unusually high number of cases diagnosed in the two-year period 1981-1982. High annual case counts were not subsequently maintained and incidence diminished back to expected levels. No usual histologic tumor types were observed among the LAC cases.

Non-Hodgkin's Lymphoma

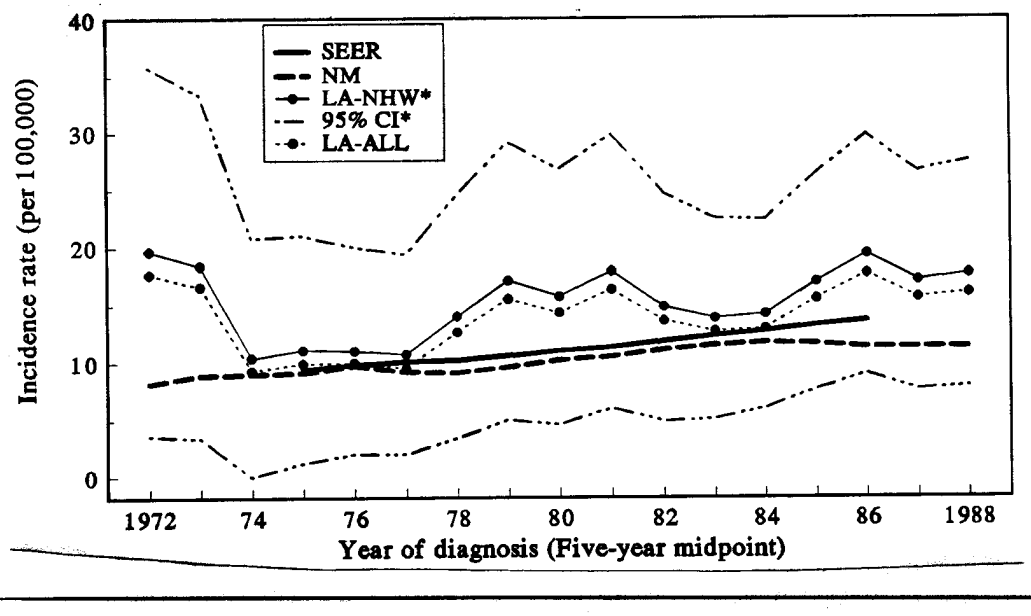
Description and Etiology - Lymphomas are cancers of the lymphoreticular system. They are characterized by the abnormal growth of lymphocytes in the lymph nodes, spleen, and thymus. Lymphoid cells in other organs such as tonsils, stomach, small intestine, and brain also may be affected. Hodgkin's disease is the most common specific type of lymphoma. Rarer lymphoreticular cancers of distinct origin include Burkitt's lymphoma and plasma cell neoplasms. The remaining lymphoreticular cancers comprise a heterogeneous assortment of different lymphoid cell neoplasms and generally are referred to as non-Hodgkin's lymphoma.

The non-Hodgkin's lymphomas are among the less common cancers in the U.S. Incidence generally increases with age and is higher in males than females. Incidence in New Mexico is roughly 50% higher in non-Hispanic Whites compared to Hispanic Whites. Etiology is not well characterized. Immunogenetic factors apparently are important, as illustrated by lymphoma- prone families and the greatly increased risks, which follow immunosuppression. Environmental risk factors remain elusive. A positive gradient with socioeconomic status and urbanization has been observed in mortality studies. Occupational studies involving various chemical exposures have been inconclusive. Radiogenic origins of non-Hodgkin's lymphoma are unclear. Excess mortality has been observed in persons receiving therapeutic irradiation, but not in A-bomb survivors.

Incidence (1970-1990) - LAC consistently experienced a small to modest elevation in incidence compared to the reference populations (Fig. 4). The magnitude of the elevated LAC incidence varied

widely up to a two-fold higher than expected level. None of the LAC lower confidence limits excluded the reference rates. Incidence in the LAC non-Hispanic White population was consistently higher than that observed in the total county population. All LAC rates were based on fourteen or fewer cases. For the most recent five-year time period 1986-1990, the rate for non-Hispanic Whites in LAC was 57% greater than the state reference rate.

Figure 4: *Five-Year Average Incidence of Non-Hodgkin's Lymphoma, Los Alamos County, New Mexico NHW, SEER Whites, 1970-1990.*



Mortality (1969-1987) - Twelve deaths from non-Hodgkin's lymphoma were registered in LAC between 1969 and 1987. Half of the deaths occurred during the 1978-1982 time period. No consistent increase in the LAC mortality rates over the U.S. rates was apparent (Table 8). The LAC mortality rates fluctuated considerably due to low numbers of deaths. The exclusion of the U.S. rate by the upper confidence limit of the 1983-1987 LAC rate reveals that a statistically significant deficit in mortality occurred in LAC during this time period.

Table 8. Average Annual Age-Adjusted Mortality Rates for Non-Hodgkin's Lymphoma, Los Alamos County and U.S., Whites, 1969-1987†

	Los Alamos County		
Year	Rate‡	95% CI	U.S. Rate
1969 - 1972	13.5 (2)	(0.0, 32.6)	—
1973 - 1977	5.8 (2)	(0.0, 14.0)	4.9
1978 - 1982	12.0 (6)	(2.2, 21.7)	5.2
1983 - 1987	2.3 (2)	(0.0, 5.6)	5.9

†Rates are per 100,000 and are age-adjusted to the 1970 U.S standard population.

‡Number of deaths in parentheses.

*Source: National Center for Health Statistics

Case/Tumor Characteristics - Unusual case characteristics were not evident (see Appendix B, Table B.2). All cases occurred in non-Hispanic Whites. Of the total 36 cases diagnosed in LAC during 1970-1990, 21 were males (58.3%) and 15 were females (41.7%). A variety of different histological cell types occurred among the LAC cases. Temporal changes in the histopathological classification and terminology of non-Hodgkin's lymphoma precluded a substantive review of tumor histology.

Summary - The incidence of non-Hodgkin's lymphoma in LAC was elevated in comparison to that observed in the reference populations for the entire study period. A consistent excess in LAC mortality was not observed. The magnitude of the elevation in LAC incidence was small to modest, ranging up to a two-fold higher than expected level. Peak elevations in incidence occurred during the early 1970s. For the most recent time period 1986-1990, the rate for non- Hispanic Whites in LAC was 57% higher than a state reference rate. Consistent with national incidence data, non-Hodgkin's lymphoma was more common in LAC males than LAC females.

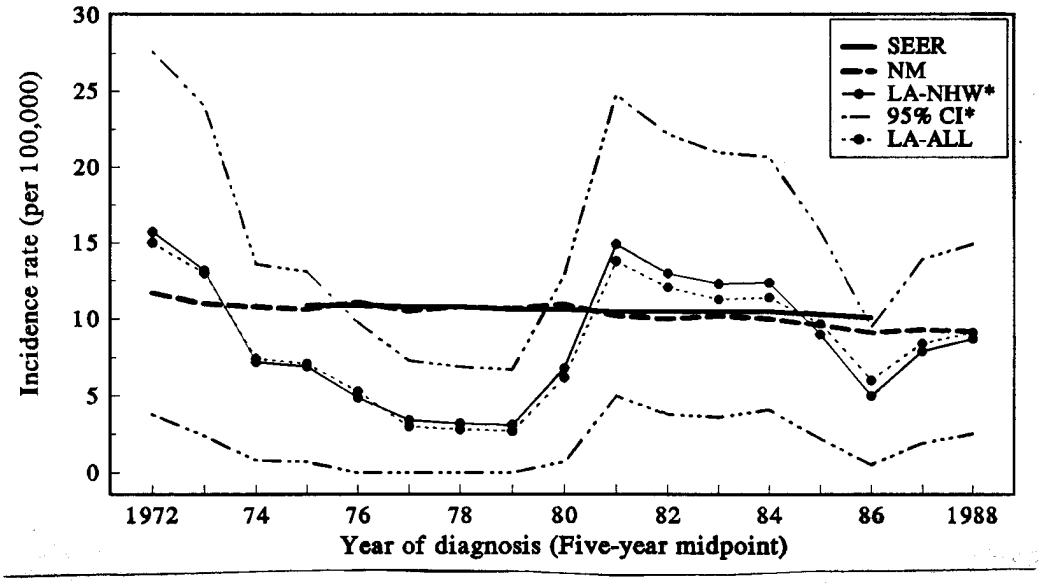
Leukemia

Description and Etiology – The leukemias are a diverse array of cancers that arise in blood and bone marrow cells. They account for roughly 5% of the total annual cancer incidence in the U.S., and constitute nearly one-third of all childhood cancers. The leukemias are characterized by temporal course of chronic or acute, and by the nature of the leukemia cells. Four main types of leukemia are recognized: acute lymphocytic leukemia (ALL): acute myelocytic (AML): chronic myelocytic (CML); and chronic lymphocytic (CLL). The specific forms of leukemia are considerably different in their incidence patterns. Acute leukemias are common in all ages and account for almost all leukemias in children and young adults, and for about two-fifths of those in older adults. CLL is rarely seen before adulthood but is common over age 50. A higher incidence occurs among males than in females. Leukemia incidence in New Mexico is twice as high in non-Hispanic Whites as in Hispanics.

Understanding the etiology of leukemia is evolving. Benzene has been shown to cause AML in humans. Ionizing radiation also is a known human leukemogen. All major forms of leukemia, except CLL, have been shown to be increased in human populations following exposure to ionizing radiation. A viral component to leukemia etiology also has been suggested but remains to be confirmed.

Incidence (1970-1990) – The incidence of leukemia in LAC generally was comparable to or lower than that observed in the reference populations (Fig. 5). Wide fluctuations in the LAC rates occurred as a result of low case numbers. All LAC rates were based on nine or fewer cases. For the most recent five-year time period 1986-1990, the LAC rate equaled the state reference rate.

Figure 5: *Five-Year Average Annual Incidence of Leukemia, Los Alamos County, New Mexico NHW, SEER Whites, 1970-1990.*



Mortality (1969-1987) - Excluding the 1973-1977 time interval, LAC leukemia mortality rates were lower than the national rates. (Table 9). Of the twelve leukemia deaths registered in LAC, half occurred during the 1973-1977 time period. LAC mortality was increased by roughly two-fold over the national rates during this time period.

Table 9. Average Annual Age-Adjusted Mortality Rates for Leukemia, Los Alamos County and U.S., Whites, 1969-1987†

	Los Alamos County		
Year	Rate‡	95% CI	U.S. Rate
1969 - 1972	1.2 (1)	(0.0, 3.6)	—
1973 - 1977	11.2 (6)	(2.1, 20.4)	6.8
1978 - 1982	1.3 (1)	(0.0, 3.8)	6.7
1983 - 1987	4.5 (4)	(0.0, 9.0)	6.5

†Rates are per 100,000 and are age-adjusted to the 1970 U.S standard population.

‡Number of deaths in parentheses.

*Source: National Center for Health Statistics

Case/Tumor Characteristics - Of the 28 cases of leukemia diagnosed in LAC between 1970 and 1990, 20 were males (71.4%) and eight were females (28.6%) (see Appendix B, Table B. 3). Five cases (17.8%) occurred among LAC residents less than age 20 compared to 14.7% for New Mexico leukemia cases. Eight cases were diagnosed in LAC during the two- year time period 1982-1983.

Table 10 reveals that the percentage distribution of histologic types for the LAC leukemia cases was roughly similar to that seen in New Mexico and in the SEER population. CLL accounted for slightly more of the leukemia cases in LAC than the reference populations.

Table 10. Percentage (%) Distribution of Histologic Types of Leukemias, Los Alamos County (All Races), New Mexico (All Races), 1970-1990, and SEER (Whites), 1984-1988

Histologic Type	Los Alamos	New Mexico	SEER
Acute lymphocytic	10.7%	17.1%	11.9%
Chronic lymphocytic	39.3%	27.5%	30.2%
Acute myeloid	17.9%	18.1%	23.2%
Chronic myeloid	7.1%	13.1%	13.4%
All other	25.0%	24.2%	21.3%
	100.0%	100.0%	100.0%

*Source: New Mexico Tumor Registry and SEER

Summary - Leukemia incidence and mortality in LAC generally was comparable to or lower than that observed in the state and national reference populations. No unusual case or tumor characteristics were observed. Of the total 28 cases in LAC during 1970-1990, eight (28.6%) were diagnosed in 1982-1983. This temporal clustering of cases lead to a transient elevation in LAC incidence during the early 1980s. The finding that LAC males were affected more often by leukemia than females was consistent with nationally observed male-to-female incidence ratios of 1. 5 - 2. Nearly 40 % of all LAC leukemia cases were diagnosed as CLL, a leukemia subtype not associated with exposure to ionizing radiation.

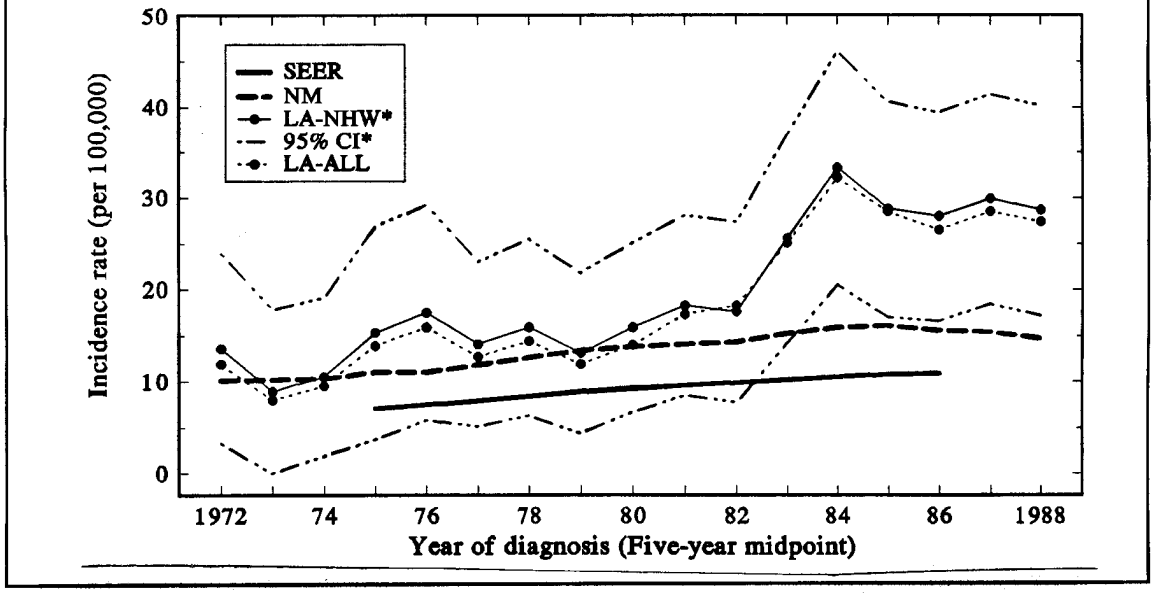
Melanoma of Skin

Description and Etiology - Melanoma is a cancer of the melanocytes, the skin cells that produce the dark pigment melanin. Melanomas can occur almost anywhere on the body, but in light- skinned persons they occur most often on the trunk in men and on the lower legs in women. The head, neck, and arms are other common sites. In dark-skinned people, melanomas occur most often on the palms of the hands and soles of the feet. Melanoma incidence in the U.S. is roughly ten times higher in whites than in blacks. In New Mexico, melanoma is roughly five times more common in non-Hispanic Whites than Hispanic Whites.

Much is known about the occurrence of melanoma, however, the etiology of melanoma remains uncertain. Melanoma is related to exposure to the ultraviolet (UV) component of solar radiation, but not in a clear manner. Since melanomas may occur on sun-shielded areas of the body, other etiologic factors likely exist. Family studies suggest that some melanomas result from inherited susceptibility traits. The role of environmental factors other than solar UV is uncertain. Evidence showing an increase in melanoma among human populations exposed to ionizing radiation has not been consistent.

Incidence (1970-1990) - The incidence of melanoma consistently was around 50% higher in New Mexico non-Hispanic Whites compared to SEER Whites. Melanoma incidence steadily increased in both reference populations. Incidence rates in LAC were higher than the state reference rates over most of the 21-year study time period (Fig. 6). Early time periods were characterized by a small elevation in the LAC incidence, whereas a more pronounced excess of melanoma in LAC began to appear in the mid-1980s. Beginning with the 1982-1986 time period, and for all subsequent time periods, the lower confidence limit of the LAC rate excluded the state reference rates. During these later time periods, the incidence of melanoma in LAC was roughly two-fold increased over that observed statewide.

Figure 6: *Five-Year Average Annual Incidence of Melanoma of Skin, Los Alamos County, New Mexico NHW, SEER Whites, 1970-1990.*



Mortality (1968-1987) - Six melanoma deaths occurred in LAC during 1968-1987, all of which involved males. The 1973-1977 LAC mortality rate was roughly three-fold higher than the comparison U.S. rate, however, the LAC rate was based only three deaths. LAC mortality rates for all other time periods were comparable to or lower than the national death rates.

Case/Tumor Characteristics - Of the total 63 cases of melanoma diagnosed in LAC, 35 were males (55.6%) and 28 were females (44.4 %) (see Appendix B, Table B. 4). Table 12 reveals that the percentage distribution of tumor sites by gender was similar for LAC and New Mexico. A differential distribution of anatomical sites was observed between genders for both populations. Males had the highest percentage of tumors on the trunk followed by the upper and lower limbs. Females had the highest percentage of tumors on the lower limbs followed by the trunk and upper limbs.

Table 11. Average Annual Age-Adjusted Mortality Rates for Melanoma of Skin, Los Alamos County and U.S., Whites, 1969-1987†

	Los Alamos County		
Year	Rate‡	95% CI	U.S. Rate
1968 - 1972	0.0 (0)	(—,—)	1.7
1973 - 1977	6.5 (3)	(0.0, 14.1)	1.9
1978 - 1982	2.9 (2)	(0.0, 6.9)	2.2
1983 - 1987	1.0 (1)	(0.0, 3.1)	2.3

†Rates are per 100,000 and are age-adjusted to the 1970 U.S standard population.

‡Number of deaths in parentheses.

*Source: National Center for Health Statistics

Table 12. Percentage (%) Distribution of Melanoma Tumor Sites by Gender, Los Alamos County and New Mexico, All Races, 1970-1990

	Los Alamos		New Mexico	
Tumor Site	Male	Female	Male	Female
Ears	11.4%	3.6%	4.6%	0.8%
Scalp & Neck	5.7%	3.6%	6.4%	4.5%
Face	0.0%	3.6%	0.6%	0.9%
Trunk	34.3%	25.0%	38.7%	22.5%
Lower Limb	17.1%	35.7%	10.2%	30.0%
Upper Limb	14.3%	21.4%	17.6%	25.4%
Not Specified	17.1%	7.1%	21.8%	16.0%
	100%	100%	100%	100%

*Source: New Mexico Tumor Registry and SEER

Summary - The incidence of melanoma in LAC was slightly increased over that observed in the state reference population up until the early to mid-1980s. Through the mid- to late-1980s, melanoma incidence was roughly two-fold higher in LAC than in the state. The elevations in incidence observed during these time periods were statistically significant, suggesting that the excess melanoma incidence was not due to random fluctuation in the LAC rates. The distribution of anatomical sites for the LAC melanoma cases was consistent with that seen in white populations both in New Mexico and across the nation. Temporal case clustering was observed in 1985-1986, a two-year time period during which nearly one-quarter of all LAC melanoma cases were diagnosed.

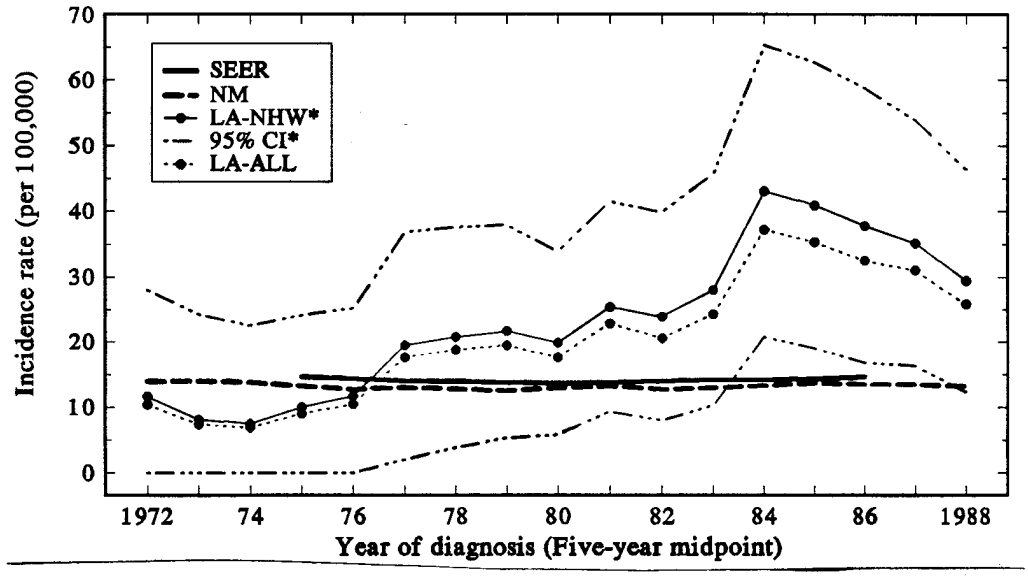
Ovarian Cancer

Description and Etiology - Ovarian cancer ranks second in incidence among gynecologic cancers only behind endometrial cancer. Ovarian cancer will occur in 1% -2 % of U. S. women in their lifetime, and will be responsible for the death of most women it strikes. Nationwide, the incidence of ovarian cancer has increased only slightly since the 1940s. The incidence of ovarian cancer in New Mexico is similar between Hispanics and non-Hispanic Whites.

The etiology of ovarian cancer is poorly understood. Childbearing is the most important known factor in reducing ovarian cancer risk, suggesting an etiologic role for hormones. Women who have had a child are half as likely to develop ovarian cancer as women who have not. Multiple pregnancies appear to confer even greater protection. An etiologic role for ionizing radiation exposure is speculative. While ionizing radiation clearly induces ovarian cancer in experimental rodents, excess risk has not been consistently observed in irradiated human populations.

Incidence (1970-1990) - LAC incidence rates steadily rose by three-fold during 1970-1990 while both the state and national reference rates remained essentially constant (Fig. 7). Initially lower than the reference rates, LAC incidence climbed to a statistically significant three-fold excess level during the 1982-1986 time period. Half of all the LAC cases (15/30) were diagnosed during this 5-year time period. LAC ovarian cancer incidence was two-fold higher than that observed in the state during the most recent five-year time period 1986-1990.

Figure 7: *Five-Year Average Annual Incidence of Ovarian Cancer, Los Alamos County, New Mexico NHW, SEER Whites, 1970-1990.*



Mortality (1969-1987) - Nine ovarian cancer deaths occurred in LAC during 1969-1987. Except for the early time interval 1969-1972, during which three deaths were observed, LAC ovarian mortality rates were comparable to or lower than the national death rates.

Table 13. Average Annual Age-Adjusted Mortality Rates for Ovarian Cancer, Los Alamos County and U.S., Whites, 1969-1987†

	Los Alamos County		
Year	Rate‡	95% CI	U.S. Rate
1969 - 1972	19.7 (3)	(0.0, 42.4)	—
1973 - 1977	5.7 (1)	(0.0, 17.1)	8.6
1978 - 1982	8.9 (3)	(0.0, 19.2)	8.1
1983 - 1987	3.8 (2)	(0.0, 9.1)	7.9

†Rates are per 100,000 and are age-adjusted to the 1970 U.S standard population.
‡Number of deaths in parentheses.

Case/Tumor Characteristics - No unusual case or tumor characteristics were observed among the LAC ovarian cancer cases (see Appendix B, Table B.5). Temporal case clustering was apparent. Of the total 30 cases diagnosed during the entire 2 1 -year study time period, six (20 %) occurred in 1986. The number of cases in years preceding and following 1986 typically ranged from zero to two cases per year. No cases of ovarian cancer were diagnosed in LAC during 1990, the latest year of case ascertainment.

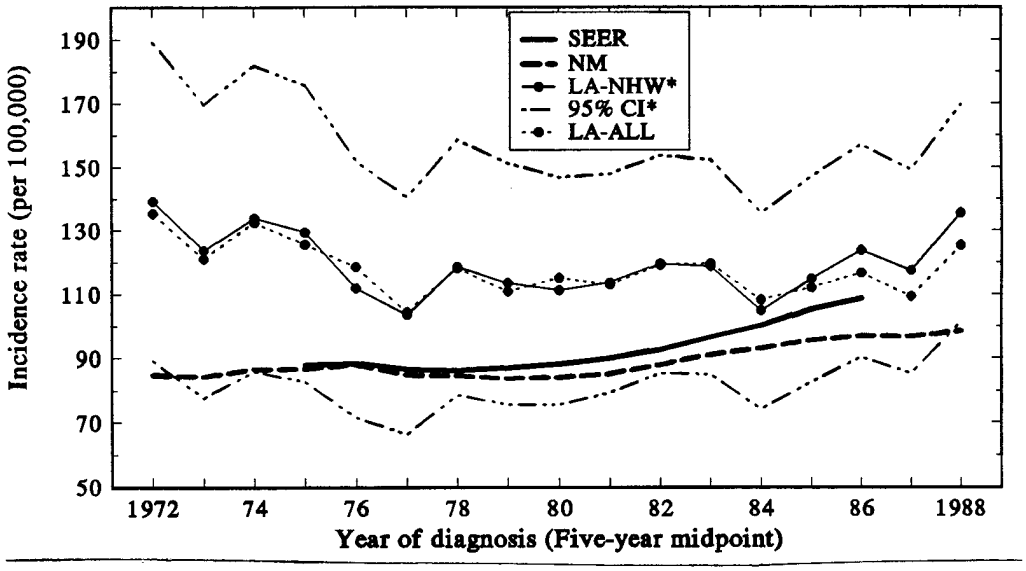
Summary - The incidence of ovarian cancer among LAC women steadily increased during 1970- 1990. Beginning in the late 1970s, an elevated incidence was observed in LAC in comparison to the reference populations. The LAC incidence rose to a peak three-fold higher than expected level during the 1982-1986 time period. By 1986-1990, the LAC rate had diminished to a two- fold increase over the state rate. The elevations in the LAC incidence during the late-1980s were statistically significant, suggesting that the excess ovarian cancer incidence observed was not a result of random fluctuation in the LAC incidence rates. Excess ovarian cancer mortality did not occur in LAC despite the observed excess incidence.

Breast Cancer (Female)

Description and Etiology - Breast cancer is the most common form of cancer (following skin cancer) among U.S. women. Nationwide, incidence has been increasing while mortality has remained relatively constant. Epidemiologic studies have identified a number of factors that carry varying degrees of risk for breast cancer. Major risk factors include the following: **Family history:** risk of breast cancer is increased when close relatives have had breast cancer; **Previous breast cancer:** women who have had cancer in one breast have a four- to five-fold higher risk of developing a second breast cancer; **Reproductive experience:** women who have never had children and women who have a **first** child after age 30 have a risk about three times greater than women who have a first child before age 18; **Menstrual history:** early onset of menstruation and late menopause both appear to increase breast cancer risk; **Socioeconomic status:** high socioeconomic status increases breast cancer risk; **Ionizing radiation:** large doses of radiation have been linked with the development of breast cancer in A-bomb survivors and women who were fluoroscoped in the past for monitoring the course of pulmonary tuberculosis. The much lower doses now used for chest X-rays and mammograms appear to carry little breast cancer risk.

Incidence (1970-1990) - Breast cancer incidence in LAC women varied little over time, whereas both reference populations displayed a temporal pattern of increasing incidence. LAC incidence rates were 10%-50% higher than the state and national reference rates over the entire study time period. The lower confidence limits for the LAC rates consistently were near the reference rates, but excluded the reference rates in only several instances.

Figure 8: *Five-Year Average Annual Incidence of Female Breast Cancer, Los Alamos County, New Mexico NHW, SEER Whites, 1970-1990.*



Mortality (1968-1987) - Breast cancer mortality in U.S. white women remained essentially constant over the 1968-1987 time period (Table 14). LAC mortality rates fluctuated around the more stable national rates. Overall, no consistent pattern of excess mortality was observed in LAC women. A notable excess in LAC mortality was observed during the 1978-1982 time period. The LAC rate was roughly two-fold greater than the comparison national rate and the increase was statistically significant. LAC mortality rates during the immediately preceding and subsequent :five-year time periods were comparable to or lower than the national mortality rates.

Table 14. Average Annual Age-Adjusted Mortality Rates for Female Breast Cancer, Los Alamos County and U.S., Whites, 1968-1987†

	Los Alamos County		
Year	Rate‡	95% CI	U.S. Rate
1968 - 1972	39.6 (8)	(11.6, 67.6)	26.9
1973 - 1977	17.4 (7)	(4.3, 30.6)	26.9
1978 - 1982	60.7 (20)	(33.5, 87.8)	26.6
1983 - 1987	29.7 (12)	(12.5, 46.8)	27.2

†Rates are per 100,000 and are age-adjusted to the 1970 U.S standard population.

‡Number of deaths in parentheses.

*Source: National Center for Health Statistics

Case/Tumor Characteristics - No unusual case or tumor characteristics were observed (see Appendix B, Table B.6). LAC breast cancer cases, however, tended to be diagnosed at an earlier stage of disease compared to cases diagnosed in New Mexico and nationwide. Of the 198 cases that occurred in LAC women between 1970 and 1990, 63% were diagnosed at a localized stage of disease. Statewide, 54% of breast cancer cases in 1970-1990 were diagnosed at a localized stage of disease. Nationwide, as represented by the SEER population, 52 % of all breast cancers among white females in 1981-1987 were diagnosed at a localized stage of disease. The remaining cases in all three populations comprise diagnoses of regional and distant stages of disease.

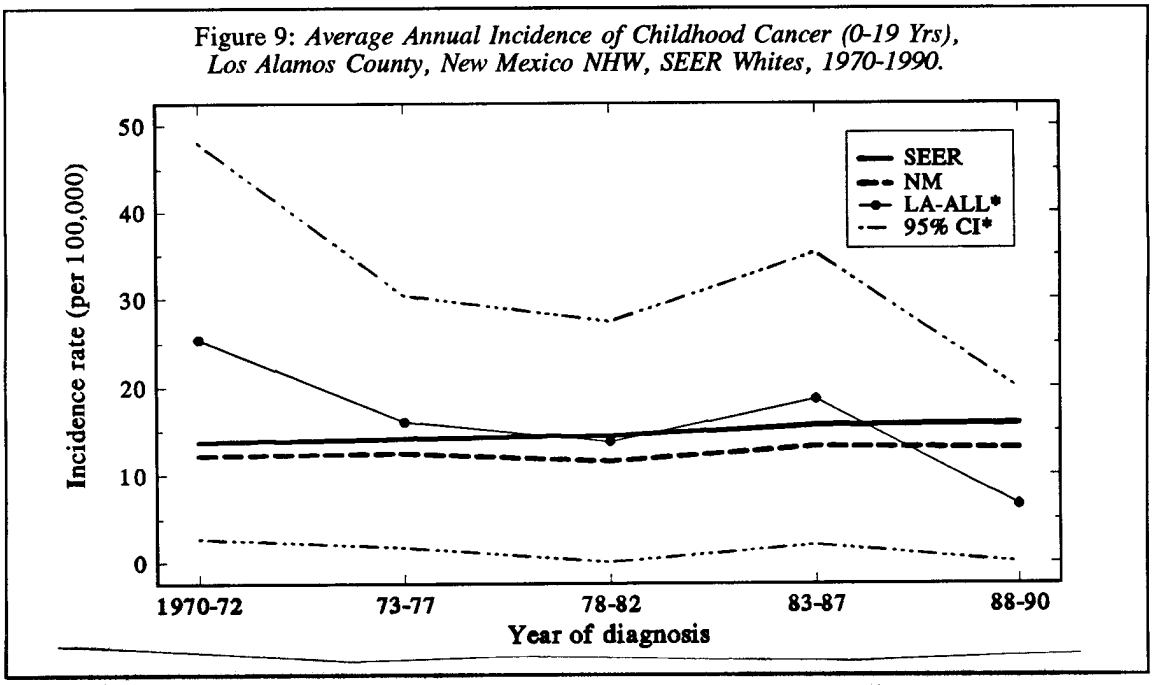
Summary - Breast cancer incidence in LAC women was consistently higher than that observed in the state and national reference populations during 1970-1990. In contrast to the temporal pattern of increasing incidence seen in the reference populations, breast cancer incidence in LAC remained virtually stationary over the entire 21-year study period. Elevations in the LAC incidence ranged from 10%-50% in comparison to the reference rates. Despite the consistent excess incidence observed among LAC women, excess breast cancer mortality was observed only during 1978-1982. Information on stage of disease at diagnosis showed that a higher percentage of LAC women were diagnosed at a localized stage of disease compared to female breast cancer cases in New Mexico and across the nation.

Childhood Cancers (0-19 Years)

Description and Etiology – Cancer is second to accidents among the leading causes of mortality in U.S. children. The sites at which cancer occurs in children are varied. The major U.S. childhood cancers are leukemia; brain and nervous system cancer; lymphoma; neuroblastoma; and soft-tissue sarcomas. Leukemias account for roughly 30% of all childhood cancer, of which the majority occur as acute lymphocytic leukemia (ALL). Brain and central nervous system cancer are the second most frequent cancers in U.S. children, accounting for about 20% of all cancers. Lymphomas, distributed roughly equally between Hodgkin's and non-Hodgkin's lymphoma, are the third most frequent childhood cancer. The remaining cancer sites, including Wilm's Tumor, account for roughly 40% of childhood cancer. The etiology of childhood cancer varies by cancer site. Risk factors broadly involve environmental carcinogens, viruses, and inherited susceptibility traits.

Incidence(1970-1990) – **Note: Figure 9 presents incidence rate data based on independent time periods and not five-year moving-averages.** LAC childhood cancer rates fluctuated around the more stable state and national reference population rates. Following an initial two-fold elevation during the earliest time period 1970-1972, subsequent time periods were characterized by incidence rates that were slightly higher than or lower than the reference incidence rates. Two childhood brain cancer cases not in the original childhood cancer dataset were discovered through a supplemental review of childhood cancer mortality statistics (see Appendix C). The two additional cases, diagnosed in 1978-1980, would raise the original 1978-1982 LAC rate (13.7 per 100,000) by about 50% to 20.3 cases per 100,000 (see Appendix C, Figure C.1) for revised incidence graph). For the latest time period 1988-1990, the incidence of childhood cancers in LAC was roughly 50% lower than that seen in the state reference population, however, the LAC rate was based on only one case.

Figure 9: *Average Annual Incidence of Childhood Cancer (0-19 Yrs), Los Alamos County, New Mexico NHW, SEER Whites, 1970-1990.*



Mortality (1968-1987) - Excluding the early time interval 1968-1972, childhood cancer mortality in LAC consistently was two to three-fold higher than that observed nationwide (Table 15). The elevated LAC rates were based on small numbers of deaths and none achieved statistical significance. While national childhood cancer mortality rates were decreasing over time, rates in LAC remained roughly stationary.

Case/Tumor Characteristics - The percentage distribution of LAC childhood cancer sites for the original and revised incidence data are presented in Table 16. Leukemia predominated, accounting for about one-quarter of all cases. Thyroid and brain cancer followed leukemia as the second most prevalent childhood cancers. Lymphomas were the next most prevalent cancer accounting for 15 % of the LAC childhood cancers. The remaining cancer sites accounted for roughly 30% of the childhood cancers.

Table 15. Average Annual Age-Adjusted Mortality Rates for Childhood Cancer, Los Alamos County and U.S., Whites, 1969-1987†

	Los Alamos County		
Year	Rate‡	95% CI	U.S. Rate
1968 - 1972	3.6 (1)	(0.0, 10.8)	6.6
1973 - 1977	12.3 (4)	(0.0, 24.6)	5.4
1978 - 1982	16.1 (5)	(1.7, 30.5)	4.6
1983 - 1987	10.6 (3)	(0.0, 22.8)	4.0

†Rates are per 100,000 and are age-adjusted to the 1970 U.S standard population.
‡Number of deaths in parentheses.
*Source: National Center for Health Statistics

Table 16. Percentage (%) Distribution of Childhood Cancer Sites, Los Alamos County, All Races, 1970-1990, Original and Revised†

Site	Original‡		Revised‡	
Leukemia	25.0%	(5)	22.8%	(5)
Thyroid	20.0%	(4)	18.2%	(4)
Brain	10.0%	(2)	18.2%	(4)
Hodgkin's Lymp.	10.0%	(2)	9.1%	(2)
Non-Hodgkin's Lymp.	5.0%	(1)	4.5%	(1)
Soft Tissues	10.0%	(2)	9.1%	(2)
Melanoma of Skin	10.0%	(2)	9.1%	(2)
Bones and Joints	*5.0%*	(1)	4.5%	(1)
Small Intestines	5.0%	(1)	4.5%	(1)
	100%	(20)	100%	(22)

†Includes two additional brain cancer cases.
‡Number of cases in parentheses.
Source: New Mexico Tumor Registry

Summary - LAC childhood cancer mortality rates were two to three-fold higher than U.S. mortality rates over the 15-year time period 1973-1987. The incidence of childhood cancers in LAC during this time period was not elevated to the same extent. Other than the early time period 1970-1972, LAC incidence was less than 50% higher than that observed in the national reference population. Except for the notable prevalence of thyroid cancer, the distribution of childhood cancer sites in LAC was largely consistent with that seen nationwide. Thyroid cancer is not considered a usual childhood cancer. Thyroid cancer accounted for 4.7% of all cancers diagnosed in New Mexico children (ages 0-19 years) during 1970-1990. Thus, thyroid cancer was nearly four times more prevalent in LAC children than children statewide. The

temporal distribution of the LAC childhood thyroid cancer cases showed the excess occurrence to be confined to the early 1970s. Three of the four LAC childhood thyroid cancer cases were diagnosed between 1970 and 1974 (see Appendix C).

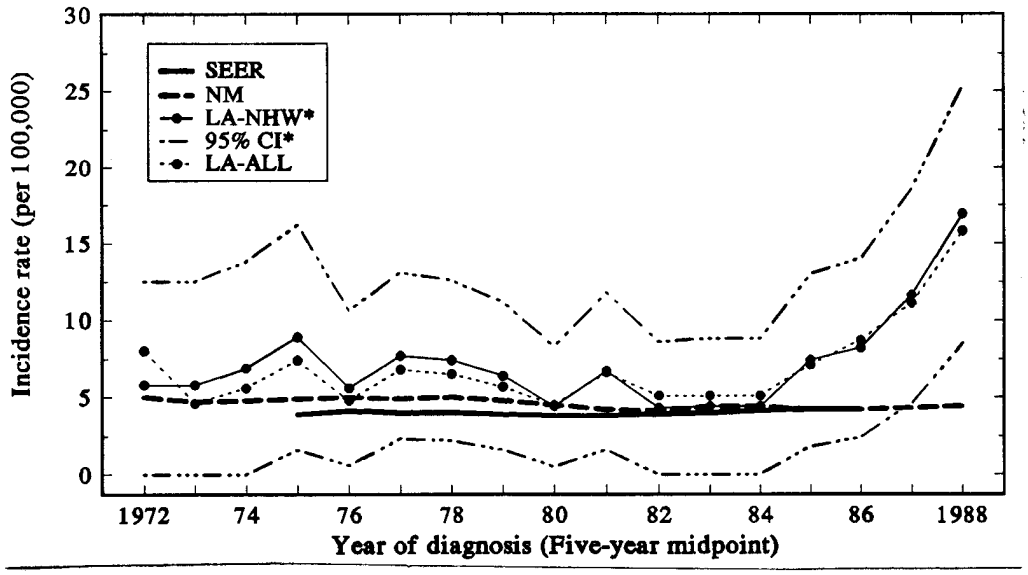
Thyroid Cancer

Description and Etiology - Thyroid cancer is a rarely diagnosed and typically nonfatal neoplasm that occurs predominantly in women. In contrast to the low morbidity and low mortality associated with thyroid cancer, prevalence at autopsy can be considerable. This finding reflects the indolent and generally non-virulent nature of thyroid cancer. The majority of thyroid cancers in the U.S. occur as adenocarcinomas (epithelial origin), of which tumors of papillary, follicular, and mixed papillary/follicular origin predominate. Other epithelial tumors diagnosed less often include anaplastic (undifferentiated) carcinoma and medullary carcinoma.

The etiology of thyroid cancer is obscure. The higher incidence in women suggests a role for hormonal factors; however, differential medical follow-up or unidentified environmental factors have not been discounted. Exposure to relatively high doses of external and internal ionizing radiation is known to cause thyroid cancer. The highest risks appear following irradiation in early childhood. Females are roughly three times more susceptible to both radiogenic and nonradiogenic (background) thyroid cancer. It is not known whether excess thyroid cancer risk is associated with exposure to low-dose ionizing radiation.

Incidence (1970-1990) - The incidence of thyroid cancer in LAC followed a variable temporal pattern. The incidence of thyroid cancer in LAC prior to the mid-1980s was roughly stationary and less than two-fold higher than that seen in the reference populations. LAC incidence rates began to rise during the mid-1980s and continued to climb up until the latest time interval 1986- 1990. The incidence of thyroid cancer in LAC during 1986-1990 was nearly four-fold higher than that observed in the state reference population. The near four-fold elevation for LAC was statistically significant. Roughly half (17/37) of 0 thyroid cancer cases which occurred in LAC between 1970 and 1990 were diagnosed during the 1986-1990 time interval.

Figure 10: *Five-Year Average Annual Incidence of Thyroid Cancer, Los Alamos County, New Mexico NHW, SEER Whites, 1970-1990*



Mortality (1969-1987) - No deaths from thyroid cancer occurred between 1969-1987. One thyroid cancer death occurred in 1990.

Case/Tumor Characteristics - Thyroid cancer (37 total cases) occurred roughly 2.5 times more frequently in LAC females than LAC males (see Appendix B, Table B.8). The distribution of histologic types was dominated by tumors of papillary, follicular, and mixed papillary/follicular origin (89.2% of all cases). Three cases of medullary carcinoma and one case of anaplastic carcinoma occurred in LAC during 1970-1990.

The near four-fold excess of thyroid cancer observed in LAC for the 1986-1990 time interval was a result of higher than usual numbers of cases diagnosed in 1987-1990. Typical annual case numbers in the years preceding 1987 ranged from zero to two, whereas three to five cases were diagnosed in each year during 1987-1990. A medical chart review was conducted on the cases diagnosed since 1987 in an effort to examine the possible role that recent advances in diagnostic imaging capabilities may have had on the observed increased thyroid cancer incidence in LAC. The chart review was conducted by Ion Johnson MD, Chairman of the LACRS Steering Committee, with the specific purpose of determining whether the observed increased incidence in LAC was due to the incidental diagnosis of thyroid cancers discovered through the use of high frequency ultrasonic imaging. Thyroid ultrasound facilitates incidental diagnoses of thyroid cancer through a capability to identify small, non-palpable thyroid nodules. The principal findings of the chart review were as follows:

- Medical records were obtained for 15 of the 16 cases diagnosed since 1987.
- A clinical diagnosis but no pathological evidence of thyroid cancer existed for one case.
- Of the remaining 14 cases, all were diagnosed by palpation of a thyroid nodule.

Based on these findings, it was concluded that virtually none of the thyroid cancers diagnosed in LAC between 1987 and 1990 were discovered incidentally following high frequency ultrasonic imaging of the thyroid. This conclusion was strengthened by thyroid tumor size data that showed LAC tumors to be generally larger than tumors seen statewide during 1988-1990 (data not presented).

Summary - LAC experienced a sudden increase in thyroid cancer incidence beginning in the mid- 1980s. Thyroid cancer in LAC prior to the mid-1980s was characterized by an incidence consistently less than two-fold higher than that observed in the state and national reference populations. A statistically significant four-fold increased incidence was observed in LAC for the most recent time interval 1986-1990. Based on a medical chart review conducted on cases diagnosed in 1987-1990, there is no reason to believe that the increased incidence resulted from incidental diagnoses of thyroid cancers discovered through the use of high frequency ultrasonic imaging. The distribution of LAC cases by gender and by histologic type for the overall study time period 1970-1990 was consistent with that seen nationwide.

Brain and Nervous System Cancer

Description and Etiology - The nervous system consists of two anatomical parts: the central nervous system (which includes the brain and the spinal cord) and the peripheral nervous system. Cancers of the nervous system are of many different types and are classified according to tumor cell type and location. The majority of nervous system cancers occur as brain cancers, of which the gliomas, including glioblastomas and astrocytomas, are the most common. Medulloblastoma, a brain cancer seen rarely in adults, accounts for roughly one-quarter of all childhood brain cancers. Males typically have a higher incidence of brain cancer than females. Brain cancers rarely metastasize outside the central nervous system; however, the brain is a frequent metastatic site for tumors originating elsewhere in the body.

Little is known about the causes of brain cancer. Studies have linked them with occupational, environmental, viral, and genetic factors. Epidemiologic findings suggest that different etiologies exist among the different types of brain cancer. High-dose ionizing radiation given as diagnostic or therapeutic radiation to the head and neck in childhood has been shown to increase the incidence of nervous system tumors. These tumors include malignant as well as benign growths of the brain, meninges, and peripheral nerves.

Incidence (1970-1990) - The occurrence of brain cancer in LAC followed a temporal pattern of increasing incidence (Fig. II). LAC incidence rates were lower than or comparable to the reference rates up until the mid-1980s. Elevations in LAC brain cancer incidence became apparent during the mid- to late-1980s. LAC incidence rates (D races) during this time period were 60%-80% higher than rates for the state and national reference populations. Two childhood brain cancer cases not present in the original dataset (see Appendix C) are included in a revised incidence rate graph presented in Appendix B (see Figure B. 12). Diagnosed in 1978 and 1980, the two additional cases raised the central portion of the incidence rate curve to a range more comparable with the reference rates, but had no effect on the rates observed during the period of elevated incidence.

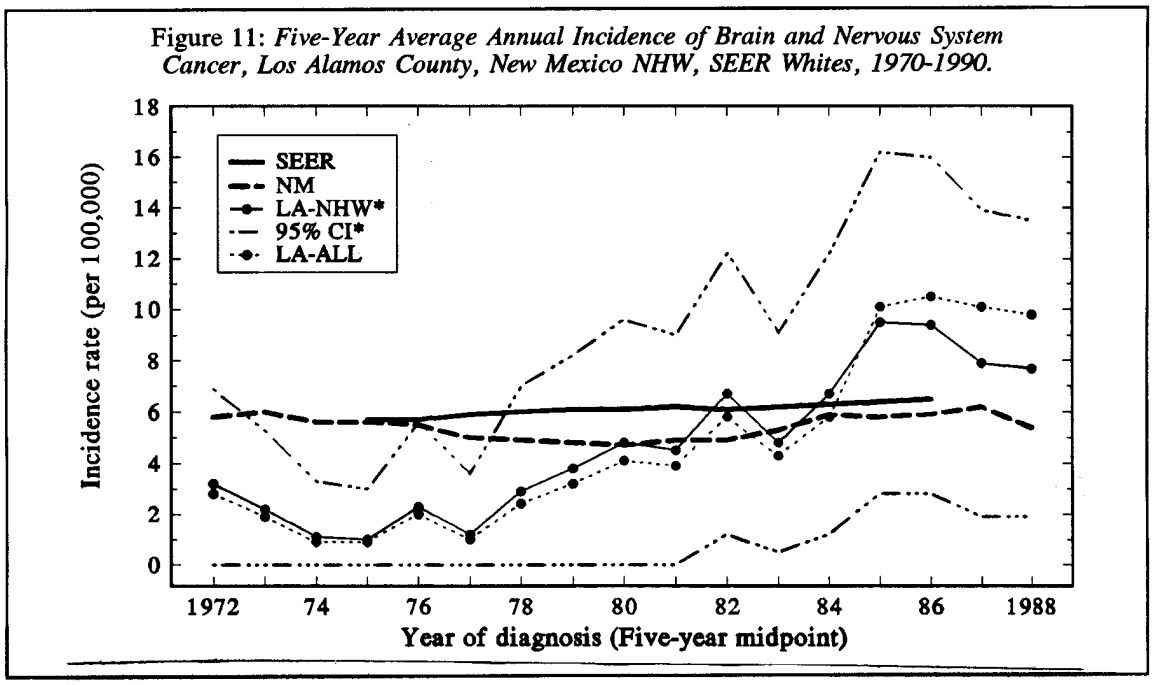


Figure 11: ***Five-Year Average Annual Incidence of Brain and Nervous System Cancer, Los Alamos County, New Mexico NHW, SEER Whites, 1970-1990.***

Mortality (1969-1987) - Except for the early time period 1969-1972, during which no deaths were observed, LAC brain and nervous system cancer mortality was consistently elevated by 35%-60% in comparison to the national mortality rates (Table 17). None of the elevations in the LAC rates were statistically- significant; however, the rates were all based on small numbers of deaths.

Table 17. Average Annual Age-Adjusted Mortality Rates for Cancers of Brain and Nervous System, Los Alamos County and U.S., Whites, 1969-1987†

	Los Alamos County		
Year	Rate‡	95% CI	U.S. Rate
1969 - 1972	0.0 (0)	(—,—)	—
1973 - 1977	6.3 (4)	(0.0, 12.6)	4.0
1978 - 1982	5.8 (5)	(0.6, 10.9)	4.1
1983 - 1987	5.8 (3)	(0.6, 10.9)	4.3

†Rates are per 100,000 and are age-adjusted to the 1970 U.S standard population.
‡Number of deaths in parentheses.
*Source: National Center for Health Statistics

Case/Tumor Characteristics - A notable peak in annual cases occurred in 1987, during which four cases were observed. Annual cases in preceding and subsequent years ranged from zero to two cases. Of the twenty-two originally designated brain and nervous system cancers, one case each of cerebral immunoblastic lymphoma and melanoma of the spinal meninges were reclassified according to their respective histologic origins (see Appendix B, Figure B. 9). These two cases are not included in the LAC incidence rate data presented in Figure 11. Two incident cases of brain cancer not present among the originally designated LAC brain and nervous system cancers are described in Appendix C. Both cancers occurred as astrocytomas in children, and were identified through a review of LAC childhood cancer mortality data. Inclusion of the two additional cases into the LAC brain cancer dataset would bring the revised case total back to the originally designated 22 cases (Appendix B, Table B. 10).

Gliomas accounted for the majority (19/22) of the LAC brain and nervous system cancers. The remaining three cases included one childhood medulloblastoma and two malignant meningiomas. Since meningiomas typically are classified as benign nervous system tumors (see section on Benign Brain and Nervous System Tumors), additional case review was conducted on the two LAC meningioma cases to ascertain the accuracy of diagnosis. The results of the review showed that one of the two cases had sufficient pathological evidence of malignancy to be classified as a nervous system cancer. The death certificate for the other meningioma case (1987) was found to be coded in the benign range, and based on the case review conducted as part of this study would likely be reclassified as a benign tumor.

Summary - The incidence of brain cancer in LAC gradually increased over the 21-year time period 1970-1990. LAC incidence rates were lower than or comparable to rates seen in the state and national reference populations up until the mid-1980s. During the mid- to late-1980s, LAC incidence was 20%-80% higher than that expected based on comparisons to the reference populations. The highest elevations in incidence were observed for rates derived from the total county population. For the latest time period 1986-1990, the LAC brain cancer incidence rate was 81 % higher than the state comparison rate. For the same time period, the rate for non- Hispanic Whites in LAC was 43% higher than the state reference rate. Two additional childhood brain cancer cases, diagnosed in 1978 and 1980, occurred prior to the period of elevated incidence. Revision of the original LAC brain cancer case data was based on standard classifications and definitions employed in the SEER Program.

Sub-County Cancer Incidence

In response to citizen allegations that the Western Area neighborhood of LAC had experienced a recent large excess occurrence of brain cancer, incidence rates for brain and nervous system cancers were calculated for sub-county regions of LAC for the 11-year time interval 1980-1990 (see Table 18). Sub-county incidence rates were similarly calculated for the other cancers of concern. The period of observation was expanded from a five-year to an 11-year time interval in order to increase case numbers. Sub-county incidence rates were not calculated for liver and intra-hepatic bile duct cancer since only three

cases occurred throughout the county in 1980-1990. Confidence intervals were calculated for all sub-county rates as described for the county incidence rates in the Methods section.

The sub-county regions included both single census tracts and multiple census tracts collapsed into regions referred to as Census Designated Places (CDPs). The five LAC census tracts roughly correspond to the different neighborhoods situated in residential areas of the county. The census tract designations are as follows: tract 1: North/Barranca Mesa; tract 2: North Community; tract 3: Western Area; tract 4: Eastern Area; Tract 5: White Rock (see Appendix D for locator map). Census tracts 1-4 (Los Alamos CDP) correspond to the Los Alamos townsite whereas Census Tract 5 (White Rock CDP) corresponds to White Rock. Incidence rates were calculated at the county (LAC) and state (New Mexico non-Hispanic Whites) level for comparison purposes.

Non-Hodgkin's Lymphoma - The incidence of non-Hodgkin's lymphoma in LAC during the time period 1980-1990 was 30% higher than that observed in the state reference population. Incidence in White Rock CDP was higher than that seen in Los Alamos CDP, and both CDP incidence rates were higher than the state reference rate. The highest and lowest census tract incidence rates varied by about five-fold. The highest census tract rate (tract 3) was based on five cases and was similar to rates observed in tract 1 and tract 5.

Leukemia - The incidence of leukemia in LAC during the time period 1980-1990 was 12 % lower than that seen in the state reference population. Leukemia incidence in White Rock CDP was slightly higher than that in the county and the state. The Los Alamos CDP rate was slightly lower than the county and state rates. The highest and lowest census tract incidence rates varied by about nine-fold. The highest tract rate (tract 3) was based on two cases.

Melanoma - The incidence of melanoma in LAC during the time period 1980-1990 was 52% higher than that seen in the state reference population. Incidence rates in Los Alamos CDP and White CDP also were roughly 50% higher than the state rate. The highest and lowest census tract incidence rates varied by about two-fold. The highest tract rate (tract 3) was based on seven cases and was similar to the tract 1 rate.

Ovarian Cancer - The incidence of ovarian cancer in LAC during the time period 1980-1990 was 80% higher than the comparison state incidence. Ovarian cancer incidence in Los Alamos CDP was greater than twice that observed in the state whereas incidence in White Rock CDP was slightly lower than that observed statewide. The highest and lowest census tract incidence rates varied by about six-fold. The highest tract rate (tract 1) was based on nine cases and was four- fold greater than the next highest tract rate. Tract 1 displayed a statistically significant six-fold elevation in incidence in comparison to the state reference population.

Breast Cancer - The incidence of breast cancer in LAC women during the time period 1980- 1990 was 29% higher than that observed in the state reference population. Breast cancer incidence in Los Alamos CDP and White Rock CDP was increased to a similar extent over the statewide incidence. The highest and lowest census tract incidence rates varied by less than two- fold. The highest tract rate (tract 3) was based on 16 cases and was similar to the tract I rate.

Childhood Cancer - The incidence of childhood cancer in LAC during the time period 1980-1990 was nearly identical to the comparison state incidence. Incidence in both Los Alamos CDP and White Rock CDP was similar to that in the county. There was zero incidence in tract 3. The highest census tract rate (tract 4) was based on 2 cases and was similar to the tract I rate.

Thyroid Cancer - The incidence of thyroid cancer in LAC during the time period 1980-1990 was 128 % higher than that observed in the state reference population. Incidence in both Los Alamos CDP and White Rock CDP was comparable to the countywide incidence. The highest and lowest census tract incidence rates varied by four-fold. The highest census tract rate (tract 1) was based on six cases and was roughly two-fold higher than the next highest tract rate.

Brain Cancer - The incidence of brain cancer in LAC during the time period 1980-1990 was 55% higher than that observed in the state reference population. Brain cancer incidence was slightly higher in White Rock CDP compared to LAC and Los Alamos CDP. The highest and lowest census tract incidence rates varied by two-fold. The highest tract rate (tract 3) was based on three cases and was roughly two-fold higher than the next highest census tract.

Summary - Review of the 1980-1990 sub-county incidence rate data did not reveal large differences in the incidence of brain and nervous system cancers or other cancers of concern for the two regional residential areas of the county; Los Alamos CDP and White Rock CDP. Incidence rates for each cancer of concern typically varied by less than 50% between the two regional areas. The exception to this occurred with ovarian cancer, where a two-fold difference was observed between Los Alamos CDP and White Rock CDP. Greater variability in incidence was observed between census tracts, however, no one particular census tract experienced an incidence widely discrepant from that observed in the other remaining tracts. The highest tract rate for any given cancer of concern was less than two-fold greater than the next highest tract rate. Again, the exception to this occurred with ovarian cancer, where a four-fold difference between the highest and next highest census tract rate was observed.

Interpretation of the differences in incidence observed between the census tracts is made difficult by small case numbers and the resultant unstable nature of the tract rates. Excluding breast cancer and melanoma, the census tract rates typically were based on five or fewer cases. The small case numbers introduced considerable uncertainty into the rates (as evidenced by the accompanying wide confidence intervals), and prevented an informative statistical analysis of the census tract data. When compared to the more stable state reference rates, none of the census tract incidence rates (except ovarian: tract 1) were found to be statistically elevated. Due to the low case numbers, however, the finding of statistical significance was unlikely for the small to modest differences in incidence observed between the census tract rates and the state reference rates.

Table 18

Average Annual Age-Adjusted Cancer Incidence Rates for Sub-County Regions of Los Alamos County, All Races, 1980-1990†

SITE	Census Tract¥					CDP‡		Los Alamos County	New Mexico NHW¶
	1	2	3	4	5	Los Alamos	White Rock		
NON-HODGKIN'S LYMPHOMA	18.9 (2) {0.0-45.6}	4.5 (2) {0.0-11.0}	20.4 (5) {2.2-38.7}	11.1 (5) {1.2-21.0}	16.7 (10) {6.1-27.2}	12.6 (14) {5.8-19.3}	16.7 (10) {6.1-27.2}	14.3 (24) {8.5-20.1}	11.0
LEUKEMIA	1.9 (1) {0.0-5.7}	10.3 (4) {0.0-20.6}	17.5 (2) {0.0-42.2}	5.5 (3) {0.0-11.8}	11.8 (7) {2.9-20.7}	7.1 (10) {2.6-11.6}	11.8 (7) {2.9-20.7}	8.5 (17) {4.4-12.6}	9.5
MELANOMA§	33.8 (10) {12.4-55.2}	22.0 (10) {8.1-35.9}	35.8 (7) {8.7-62.9}	13.5 (6) {1.5-24.5}	21.7 (11) {8.6-34.8}	23.2 (32) {15.0-31.4}	21.7 (11) {8.6-34.8}	22.0 (43) {15.3-28.7}	14.5
OVARY, Female	76.7 (9) {25.6-127.8}	19.4 (4) {0.0-38.8}	19.5 (2) {0.0-47.0}	14.0 (3) {0.0-30.2}	12.7 (4) {0.0-25.4}	27.4 (18) {14.5-40.3}	12.7 (4) {0.0-25.4}	23.0 (22) {13.2-32.8}	12.8
BREAST, Female	145.3 (28) {90.4-200.2}	120.5 (21) {67.9-173.1}	159.2 (16) {79.6-238.9}	85.3 (21) {48.1-122.5}	116.0 (41) {79.8-152.3}	119.8 (86) {93.9-145.6}	116.0 (41) {79.8-152.3}	119.0 (127) {97.9-140.1}	92.2
CHILDHOOD, <20 yrs	21.9 (2) {0.0-52.8}	6.7 (1) {0.0-20.2}	0.0 (0) { - }	24.5 (2) {0.0-59.2}	16.9 (4) {0.0-33.9}	14.2 (5) {1.5-26.9}	16.9 (4) {0.0-33.9}	15.2 (9) {5.1-25.3}	14.8
THYROID	16.0 (6) {2.9-29.1}	3.8 (2) {0.0- 9.1}	5.8 (1) {0.0-17.5}	8.7 (4) {0.0-17.4}	9.3 (9) {3.1-15.4}	9.0 (13) {4.0-14.0}	9.3 (9) {3.1-15.4}	9.8 (22) {5.6-14.0}	4.3
BRAIN	7.3 (2) {0.0-17.5}	5.7 (3) {0.0-12.4}	14.2 (3) {0.0-30.6}	7.4 (2) {0.0-18.0}	8.2 (7) {2.0-14.3}	7.4 (10) {2.7-12.1}	8.2 (7) {2.0-14.3}	7.9 (17) {4.1-11.7}	5.1

† Rates are for residence at diagnosis for all races per 100,000, age-adjusted to U.S. 1970 standard population; number of cases in parentheses ( ); 95% confidence limits in brackets { }, truncated at zero.

¥ Census Tract Designations: (1) North/Barranca Mesa; (2) North Community; (3) Western Area; (4) Eastern Area; (5) White Rock.

‡ Los Alamos Census Designated Place (CDP) comprises census tracts 1-4, White Rock CDP comprises census tract 5.

¶ Non-Hispanic Whites

§ Excludes two cases with unknown residence at diagnosis.

Source: New Mexico Tumor Registry

Benign Brain and Nervous System, Tumors (Mortality)

Description and Etiology - Benign brain and nervous system tumors are neoplasms, which lack histological or pathological features of malignancy. Although not as invariably fatal as malignant brain tumors, benign tumors of the brain and nervous system can cause death as a result of a critical tumor location or complications of treatment or surgery. Benign tumors of the brain and nervous system are of many different types and are classified according to tumor cell type and location. The most common type of benign nervous system tumor is meningioma, a tumor of the membranes (meninges) that surround the brain and spinal cord. In the U.S., meningiomas account for roughly 15 % of all primary tumors (malignant and benign) of the brain and nervous system.

The etiology of benign brain and nervous system tumors remains obscure. Except for meningiomas, men have a higher incidence than do women of all types of benign and malignant nervous system tumors. These differences in incidence suggest a possible hormonal factor in the development of nervous system tumors. Little information exists about the relation of environmental factors to benign brain and nervous system tumors. High-dose X-ray therapy received in childhood has been shown to increase the incidence of benign as well as malignant growths of the brain, meninges, and peripheral nerves.

Mortality (1969-1990) - Five LAC death certificates were identified which were coded to tumors of benign (ICD 210-229) or tumors of uncertain behavior (ICD 235-239). They were as follows:

- ICD 225.2 Benign neoplasm of cerebral meninges
- ICD 225.9 Benign neoplasm of nervous system
- ICD 237.7 Neurofibromatosis
- ICD 239.6 Brain neoplasm of unspecified nature
- ICD 239.6 Brain neoplasm of unspecified nature

A medical chart review was performed by Charles Key MD, NMTR Medical Director, on four of the five decedent cases. The neurofibromatosis death was excluded from review due to the lack of evidence that a central nervous system tumor existed. Neurofibromatosis is an inherited neurologic condition associated with tumors of the peripheral nerves. The principal findings of the chart review for the remaining four decedent cases are as follows:

- Sex: Male (1); Female (3)
- Age (Yrs): 5, 60, 75, 88
- Year of Death: 1977, 1983, 1986, 1987
- Residence at death: Census Tract 3 (1); Census Tract 5 (2); Unknown (1)

Miscellaneous findings include the following:

- One case moved to LAC after diagnosis.
- One case moved to LAC shortly before diagnosis.
- Two cases were noted as complications or recurrence of benign neoplasms, including one case included in the incidence data as malignant meningioma.

Summary and Conclusions - Five deaths from benign tumors or tumors of uncertain behavior were registered in LAC over the 22-year time period 1969-1990. All deaths involved nervous system tumors, of which four were apparently benign intracranial tumors. The singular involvement of nervous system tumors among benign tumor death statistics is not unexpected since benign tumors that result in death are often in difficult to manage locations; such as within the skull. Four benign nervous system tumor deaths were registered in LAC over the 22-year study time interval. Two of the deaths occurred during the mid- to late-1980s; the time period during which LAC brain and nervous system cancer incidence rates were elevated. The small numbers of LAC benign nervous system deaths precluded any meaningful comparisons to state and national mortality statistics. In considering benign brain tumor mortality, it is

important to remember that mortality statistics can be misleading since benign nervous system tumors are frequently curable. Incidence data would provide a more accurate reflection of benign brain tumor occurrence, however, no morbidity datasets exist for the LAC, state, and national populations. A study of benign brain and nervous system tumor incidence in LAC would require a substantial commitment of resources and funding with which to identify and enumerate cases in LAC as well as an appropriate comparison population.

DISCUSSION

Major Findings

Incidence rate data for 23 major cancers and childhood cancers were reviewed for LAC over the 21-year time period 1970-1990. Results of that review revealed that the incidence of some cancers in LAC was higher than that observed in the New Mexico state and a national reference population whereas the incidence of other cancers was lower than or comparable to that seen in the reference populations. Eight cancers and childhood cancers were selected for an examination of additional cancer morbidity and mortality data. The majority of these cancers were selected on the basis of either a consistently elevated incidence or a temporal pattern of increasing incidence leading to elevated rates. Some cancers, such as liver cancer and leukemia were selected simply to examine tumor cell types. Cancers which did not show a greater than expected incidence included major sites in the respiratory, digestive, and urinary systems.

Brain and Nervous System Cancer - Community concern about an alleged recent large excess of brain cancer in LAC, particularly among Western Area residents, prompted this descriptive study of cancer incidence. Results of the study showed an overall temporal pattern of increasing brain and nervous system cancer incidence in LAC during the 21-year time period 1970-1990. A modest elevation in the county incidence was observed during the mid- to late-1980s. Brain and nervous system cancer incidence in LAC during this time period was 70%-80% higher than that observed in the state and a national reference populations. For the most recent 5-year time period 1986-1990, the LAC brain and nervous system cancer rate was 81 % higher than the corresponding state reference rate. This elevation in LAC brain cancer incidence was not statistically significant; however, the rate was based on only ten cases. The 1986-1990 state reference rate was based on nearly 400 cases.

The elevated incidence of brain and nervous system cancer observed in LAC during the mid- to late-1980s is difficult to interpret for several reasons. Foremost is the inability to calculate stable county incidence rates for comparative purposes. A population as small as that of LAC has relatively small numbers of cases for even the most common of cancers. All of the five-year average annual brain and nervous system cancer incidence rates for LAC were based on ten or fewer cases. Instability in these rates was evidenced by the sharp and erratic fluctuations in the county incidence, which followed small changes from year to year in the number of cases (see Figure 11). The wide confidence intervals, which accompanied the county rates, attested to the considerable statistical uncertainty in the rates. The unstable rates make it difficult to determine whether the excess brain cancer observed in LAC might have resulted from an increase in the prevalence of etiologic risk factors (an actual elevation) or simply reflected random fluctuation in cancer incidence within a small population (chance alone). None of the elevations in the LAC rates were statistically significant, however, the negative significance tests were uninformative since the low case numbers did not allow sufficient statistical power to adequately test for the modest elevations observed.

In response to allegations that the Western Area neighborhood in particular had experienced a recent excess of brain cancer, the study examined I 1 -year average annual cancer incidence rates for the five designated county census tracts. The results of this analysis revealed that all LAC census tract incidence rates were higher than the state reference rate for the time period 1980- 1990. The census tract

corresponding to the Western Area neighborhood (tract 3) had the highest incidence of brain and nervous system cancer among all the LAC census tracts. The Western Area rate (14.2 per 100,000 per year) was less than two-fold higher than the next highest census tract rate (White Rock; 8.2 per 100,000 per year). The Western Area incidence was not statistically elevated in comparison to any of the other remaining census tracts or the state reference population, however, all the tract rates were based on small numbers.

The small number of cases observed in each LAC census tract limited the extent to which inference could be drawn on the sub-county rate analysis. All but one of the 1980-1990 census tract rates were based on three or fewer cases. It is obvious that the presence or absence of a single case in Western Area (or any of the other census tracts) would have had a substantial impact on the magnitude of the tract rate. This high level of instability in the incidence rates precluded a substantive interpretation of the elevated Western Area incidence. Perhaps the most notable aspect of the brain and nervous system cancer incidence in Western Area during 1980- 1990 was the temporal distribution of cases. All three Western Area cases were diagnosed during 1986-1987. If census tract rates had been calculated for the most recent five-year time period 1986-1990, the Western Area rate would be roughly twice as high as that observed in the 11-year interval 1980-1990. Progressively higher incidence rates could be generated simply by considering shorter time intervals around 1986-1987. Likewise, since no cases were diagnosed among Western Area residents during 1988-1990, the incidence during this three-year time interval is zero.

Interpretation of the elevated Western Area incidence was further complicated by uncertainty surrounding the classification of one of the Western Area cases. The distinction between benign and malignant tumors is especially problematic for intracranial tumors of the central nervous system since both types of tumors can produce similar clinical symptoms. A histologically benign, slow growing tumor may produce marked and devastating effects in a relatively short time because of its critical location, whereas a histologically malignant neoplasm may not produce overt symptoms for several months. During 1980-1990, one case each of glioblastoma, astrocytoma, and malignant meningioma were diagnosed in Western Area. The classification of the malignant meningioma case was questioned in the data analysis following the discovery that the death certificate for the subject case was coded in the range of a benign nervous system tumor. Although originally diagnosed and registered with the NMTR as a malignant tumor, subsequent case review conducted as part of this study indicated that the case was likely misclassified, and in retrospect, would probably be classified as a benign brain tumor.

The original classification of the malignant meningioma case was maintained throughout the data analysis since the increased level of scrutiny which the LAC brain cancer cases received in the study was not equally afforded to the reference populations. It should be noted, however, that malignant meningioma is a rarely diagnosed nervous system tumor; the vast majority of meningiomas being diagnosed as benign tumors. Malignant meningioma comprised less than 3% of all brain and nervous system cancers both in New Mexico in 1970-1990 and in SEER Whites in 1983-1987. The single malignant meningioma case diagnosed in Western Area during 1980-1990 represents a possible misclassification error of 33 %. Although closer case scrutiny of the reference populations would likely identify misclassification errors for malignant meningioma, the impact of such errors on the reference population rates would be insignificant compared to the impact on the Western Area rate. The actual incidence of brain and nervous system cancer in Western Area, therefore, may be overestimated by including the meningioma case as a malignant tumor in the incidence rate calculations.

Although the study results reveal a recent elevation in brain and nervous system cancer incidence in LAC, they do not substantiate allegations of a large increase in the numbers of brain cancer cases either in LAC or in Western Area. Community perception of a brain cancer "cluster" emerged from a citizen-generated list of alleged recent brain tumor deaths among persons who had resided in relative close proximity within Western Area. This case list, and subsequent expanded versions of the list, included persons diagnosed with or who had died of various types of disease, including primary brain and nervous system cancers,

benign brain and nervous system tumors, cancers which had spread from other organs to the brain (metastatic brain disease), and tumors of non-nervous tissue origin. In addition to being non-specific for disease, the case list also included persons diagnosed as LAC residents as well as former residents diagnosed out-of-county. If in fact all persons on the case list had been residents diagnosed with a primary brain cancer, then the occurrence of this malignancy in LAC, and Western Area in particular, certainly would have been extraordinary. In reality, over the last fifteen years in LAC, four cases of primary brain and nervous system cancer were diagnosed in 1976-1980; five cases in 1981-1985; and ten cases in 1986-1990. These numbers are based on the case definition criteria adopted for this incidence study; a criteria adopted in order to allow valid comparisons to be made between the LAC and the reference population incidence rates.

Another factor which may have contributed indirectly to the perception of a disproportionate level of cancer in Western Area is the age structure of the neighborhood. As shown in Appendix E, Table E.2, nearly one-quarter of all Western Area residents were 65 years and older in 1990. This compares to roughly 14% for Eastern Area, and less than 10% for the remaining county neighborhoods. Since incidence and mortality rates for virtually all types of cancer increase exponentially with age, it would not be unexpected that cancer would appear to be more prevalent among Western Area residents in comparison to resident populations in other neighborhoods of the county. Given that the LAC population is progressively aging over time (See Appendix E, Table E.1), Western Area residents could continue to appear to be disproportionately effected by "cancer" up until such time that the age distributions of the various LAC neighborhoods become more similar.

While the study results indicate a recent elevation in brain and nervous system cancer incidence in LAC residents, by their descriptive nature they do not indicate a cause. In considering causation it is important to remember that because of the small number of cases (22 brain and nervous system cancers over 21 years, including 10 cases in 1986-1990) it is not possible to rule out chance alone as causing the observed elevated incidence. In other words, even if brain cancer was in fact occurring "at random" in LAC during 1970-1990, a "cluster" of cases either in time (1986-1990) or location (Western Area), or both, could occur simply as the result of chance alone. Although brain cancer is a relatively rare malignancy (about six cases per 100,000 per year in the U.S.), it is not sufficiently rare such that cases would not be expected to occur in LAC over a multi-year period. For example, six cases of brain and nervous system cancer occurred in LAC in 1982-1986, a five-year time period during which the LAC incidence rate was comparable to the corresponding reference population rates. Thus, one might expect to see roughly six cases of brain and nervous system cancer for any given five-year time interval during the mid-to late 1980s if in fact the incidence in LAC was similar to that in the reference populations. The elevated incidence observed in the county during the five-year interval 1986- 1990, therefore, can be viewed as resulting from ten cases observed versus roughly six cases expected; an excess of four cases.

The possible impact of environmental risk factors on the occurrence of brain and nervous system cancer in LAC remains speculative since community exposure data do not exist. Thus, it is not known whether LAC residents might have been exposed to factors within the county that would be etiologically associated with an increased risk of brain cancer. Confounding any search for such risk factors is the present lack of knowledge regarding brain cancer etiology. With the exception of high-dose external ionizing radiation, no other environmental agent has shown a consistent association with brain cancer. Nevertheless, even if hypotheses were generated linking brain cancer with environmental exposures in LAC, the paucity of cases in LAC would likely preclude any ability to critically evaluate and test such hypotheses. Perhaps the most important question to consider then is simply whether the modest excess of brain and nervous system cancer observed in LAC during the mid-to late-1980s will be sustained forward in time. Answers to this question will be gained only through continued surveillance and monitoring of temporal patterns of brain cancer occurrence in LAC.

Finally, community concern was also expressed about the occurrence of benign brain tumors in LAC. Unlike malignant brain and nervous system tumors, data are not routinely collected on the incidence of benign nervous system tumors in New Mexico by the NMTR or across the nation by the SEER Program. Consequently, benign brain tumor data were not available to calculate incidence rates for comparative analyses. Despite known differences between benign brain tumor morbidity and mortality (mortality being much less than morbidity), a review of LAC death certificates nevertheless was conducted in order to enumerate deaths in LAC attributable to benign nervous system tumors. The results of the review revealed that four benign intracranial tumor deaths occurred over the 22-year time period 1969-1990. Three of the four deaths occurred during the time period 1980-1990. The low number of deaths precluded any substantive interpretation of the LAC benign brain tumor mortality data. Critical examination of the occurrence of benign brain tumors in LAC would require a costly and time- consuming effort to identify and enumerate incident cases in LAC as well as appropriate comparison populations. As illustrated with this incidence study, conclusions from a study on benign brain and nervous tumors in LAC likely would be limited by an invariably small number of cases.

Thyroid Cancer - The incidence of thyroid cancer in LAC between 1970 and 1990 consistently was higher than that observed in the state and national reference populations. LAC incidence rates were 10%-100% higher than the reference rates up through the mid-1980s. Beginning in 1987, and continuing through 1990, higher than usual numbers of thyroid cancers were diagnosed in LAC. The increased case numbers resulted in a statistically significant four-fold elevation in LAC incidence during the latest time interval 1986-1990. Based on the marked change in the temporal pattern of thyroid cancer incidence in LAC, it appears that the recent elevation in incidence may be real and not simply a result of random fluctuation in the county incidence.

Although the results show that LAC experienced a notable increase in thyroid cancer during the late-1980s, they do not indicate a cause for the increased incidence. A medical chart review conducted on cases diagnosed since 1987 showed that recent advances in high frequency ultrasonic imaging had little if any impact on the diagnosis of thyroid cancer in LAC between 1987 and 1990. Investigation of other potential diagnostic factors, such as access to or level of medical care, was beyond the scope of this incidence study. The etiology of thyroid cancer is sufficiently obscure to render any judgment on environmental risk factors entirely speculative.

Exposure to high-dose ionizing radiation has been shown to cause thyroid cancer, however, no data currently exist with which to characterize community exposures to this risk factor. Any investigation of potential causes of the increased thyroid cancer incidence ultimately would require an analytical epidemiology study involving the collection of information on environmental as well as personal risk factors. Given the small number of cases and the general lack of community environmental exposure data, such a study may not be prove feasible to conduct.

Melanoma of Skin - The incidence of cutaneous melanoma in LAC and the state reference population was at least 40% higher than that seen in the national reference population over the entire study period. The higher incidence observed in LAC and the state may be due in large part to the greater amount of sunshine that occurs in New Mexico on average as compared to the nation (as represented by nine SEER sites). Greater amounts of sunshine provide for an increased opportunity for exposure to solar UV radiation, a major risk factor for cutaneous melanoma. Only comparisons between rates for LAC and the state were considered appropriate given the marked discrepancy in incidence observed between the two reference populations.

The incidence of melanoma in LAC generally was higher than that observed statewide, but the magnitude of the elevations varied with time. Between 1970 and the mly-1980s, LAC melanoma incidence fluctuated slightly above the state incidence. Beginning in the mid-1980s, LAC incidence rose to a statistically significant two-fold increased level over the state incidence. The statistically significant elevation in LAC incidence observed for the latest time interval 1986- 1990 suggests that the excess incidence observed in LAC is real and not a result of random variability in the LAC rates.

Major risk factors for melanoma in white populations include excessive exposure to solar UV radiation and poor skin tanning capability. The extent to which these factors have been more prevalent in LAC compared to the state reference population is unknown. Similarly, it is unknown how these factors may have changed within LAC over time to influence the county incidence. Based on the high altitude at which the county is situated, it is likely that the intensity of solar UV received at ground level in LAC is higher than that observed statewide on average. UV measurement data were not available for review to confirm this. Behavioral changes involving increased voluntary sun exposure or increased awareness of melanoma cannot be discounted as other possible causes of the increased incidence. Investigation of these factors was beyond the scope of this Phase I incidence study.

Breast Cancer - An excess incidence of breast cancer was observed among LAC women over the entire study time period. The LAC incidence was 10 % -65 % greater than that expected based on comparisons to-the state and national reference populations. Unlike most of the other LAC cancers examined, breast cancer incidence rates were relatively constant over time. The magnitude of the elevations in LAC incidence changed over time, however; being highest in the early 1970s but subsequently decreasing as incidence increased in both reference populations. For the most recent time period 1986-1990, breast cancer incidence in LAC was 38% greater than that in the state reference population.

The stationary nature of the LAC incidence rates suggest that breast cancer risk factors may also have been relatively constant over time. Possible clues to the excess incidence exist with data that show both reproductive and socioeconomic risk factors to be prevalent in the county.

LAC historically has maintained a high socioeconomic status, as indicated both through a high average educational level and a high per capita income. Natality statistics show that LAC women tend to have their first child at later ages compared to non-Hispanic White women statewide. In addition, overall fertility rates historically have been 10%-30% lower in LAC women compared to non-Hispanic white women statewide, suggesting that proportionately fewer LAC women may be bearing children. High socioeconomic status, delayed first pregnancy, and nulliparity, are all factors that have been shown to increase breast cancer risk. Given the historical prevalence of these risk factors in the county, the finding of an elevated breast cancer incidence in LAC is not entirely unexpected.

Ovarian Cancer - Incidence rates for ovarian cancer in LAC women gradually increased by roughly three-fold over the study time period. This temporal pattern of increasing incidence contrasted with the nearly stationary rates observed in both reference populations. An elevated incidence was observed in LAC beginning in the mid-1970s, which continued up through to the end of the study time period. The elevation in LAC incidence reached a three-fold maximum level during the 1982-1986 time interval. LAC incidence subsequently declined such that by the latest time interval 1986-1990, ovarian cancer incidence in LAC was roughly two-fold higher than that in the state reference population.

The sub-county analysis of ovarian cancer incidence revealed that the majority of excess incidence observed at the county level in 1980-1990 occurred in the North Mesa and Barranca Mesa neighborhoods comprising census tract 1. Census tract I experienced a statistically- significant six-fold elevation in

incidence compared to the state reference population. Within LAC, the incidence in census tract I was four to six-fold higher than that in the other remaining census tracts.

Few clues exists to speculate on possible reasons for the excess ovarian cancer incidence observed in census tract 1. The etiology of ovarian cancer is not well characterized, particularly the role of environmental risk factors. It is known that childbearing is important in reducing ovarian cancer risk, suggesting that hormones have an etiologic role. Women who have children are half as likely to develop ovarian cancer as women who have not. Several pregnancies confer even greater protection. The extent to which the delaying of pregnancy and low fertility that characterizes LAC natality affected the incidence of ovarian cancer in LAC is unknown.

Other Cancers of Concern

Leukemia - The incidence of leukemia in LAC consistently was comparable to or lower than that seen in the state and national reference populations. Analysis of the different major subtypes of leukemia among LAC cases revealed a percentage distribution, which generally was similar to that seen both statewide and nationally. A slightly higher percentage of LAC leukemia cases were diagnosed with chronic lymphocytic leukemia (CLL) compared to the reference populations. Of the 28 cases diagnosed in LAC between 1970 and 1990, 11 (39.3%) were diagnosed with CLL. CLL is the only major subtype of leukemia that has not been associated with exposure to ionizing radiation.

Non-Hodgkin's Lymphoma - The incidence of non-Hodgldn's lymphoma in LAC was consistently higher than that observed in the state and national reference populations. The magnitude of the elevated incidence was not large. Except for the early 1970s, when the LAC incidence was two-fold higher than expected, LAC incidence rates typically were 20%-60% higher than the reference rates. Environmental risk factors for non-Hodgkin's lymphomas remain uncertain. Mortality from non-Hodgkin's lymphoma shows a positive gradient with socioeconomic status and urban residence. The extent to which the high socioeconomic status maintained by LAC residents might have contributed to the elevated incidence is unknown.

Study Limitations

A number of study limitations and related issues need to be highlighted in order to provide a framework for critical assessment of the study.

Small Numbers of Observations - Interpretation of cancer incidence data for small populations is inherently difficult due to small numbers of observations. Although "cancer" is a commonly recognized cause of morbidity and mortality, the number of cases for any given anatomic site can be diminishingly low for a population as small as that of LAC. Excluding the most common cancers (lung, breast, colon/rectum, and prostate), the successive five-year time intervals used to calculate each -respective LAC incidence rate typically involved ten or fewer cases (see Appendix A, Table A. 14). The small numbers problem is well illustrated by brain and nervous system cancer. Twenty-two cases were observed in LAC over the entire 21-year study time period, including ten cases diagnosed in 1986-1990. This averages out to one to two cases per year for the entire county. At the census tract level, only one of the five tracts had more than three cases over an II -year time period. The net effect of the small numbers was to render incidence rates unstable, confidence intervals large, and negative statistical tests uninformative.

Thus, caution had to be exercised in addressing the meaning of elevations in LAC rates, many of which were based on small case numbers.

Multip1e Comparisons - A large number of comparisons were performed in the study between the LAC incidence rates and the reference population incidence rates. Twenty-three major cancers, childhood cancers, and all cancer sites combined were examined over a 21-year time period by five-year moving-average intervals. Over 700 separate incidence rate ratios were generated as a result of considering every possible combination of five-year time interval in the incidence data. Making such a multitude of comparisons increased the likelihood that some of the elevations observed in the LAC incidence rates, even if statistically-significant, occurred simply as a result of chance. In view of the possibility that chance elevations in the LAC rates would be identified, the study focused more on examining temporal patterns of cancer incidence rather than simply surveying for time periods during which elevated rates were observed.

Population Mobility - Ideally, an incidence study would measure newly diagnosed cases in a population that has been rather stable over time. In reality, the population of LAC is highly mobile. Census data from 1980 indicate that 35 % of the county residents resided in a different county in 1975. Nearly one-quarter of all 1980 county residents resided in a different state in 1975, whereas only 27% of the 1980 residents were born in the state of New Mexico. Data from the 1960 and 1970 census respectively indicate that 31 % and 30 % of all county residents lived in a different county five years earlier. The relatively high population mobility characteristic of LAC must be taken into account when interpreting the county incidence rates derived in the study.

Case Residence - Residence at diagnosis was used to assign cancer cases to sub-county regions in order to measure cancer incidence within different LAC neighborhoods. The interpretive value of the sub-county incidence rate data depends on an assumption that cases had been inhabitants of their residence at diagnosis long enough to obtain critical etiologic exposures. For many types of cancer, however, such exposures could have occurred decades in the past. Census data from 1980 indicate that 45 % of county residents resided in the same house in 1975. Data from the 1960 and 1970 census respectively indicate that only 29% and 38% of county residents lived in the same house five years earlier. Thus, any interpretation of differences in cancer incidence between LAC neighborhoods must take into account the relatively high level of migration between residences characteristic of LAC.

Comparability - LAC is notably unique in regards to various socioeconomic and occupational characteristics. The county far exceeds state averages for per capita personal income and education, and in fact, has one of the highest average levels of income and education in the nation. Characteristics of employment are similarly skewed upwards. LAC has one of the highest percent levels of professional and managerial employees in the nation. On the other hand, LAC is markedly lower than state and national averages on factors such as unemployment, percent of families below poverty, and birth rates (including births to single mothers and births to teenage mothers). Thus, the choice of appropriate comparison populations to assess cancer incidence in LAC remains problematic. This study used state and national populations as comparison groups due to the stability of their incidence rates. Other counties throughout the U.S. more closely resemble LAC in regards to socioeconomic and occupational factors, however, counties invariably are small in population size and would not be expected to provide stable rates for comparison purposes.

Study Strengths

The results of the study are considered valid for several reasons. Foremost is the confidence that virtually all cancers that occurred among LAC residents between 1970-1990 were enumerated and included in the study. This belief is based on the long-standing existence of an active tumor registry (NMTR) that provides statewide coverage of cancer occurrence in New Mexico. Although inaccuracies and errors are expected in any dataset as large as the NMTR casefile, it is thought that such events occur at a minimum due to the established and comprehensive case finding and data quality control procedures employed by the NUITR. Secondly; all methodology, results, and conclusions for the study were reviewed and approved by a 13-member Steering Committee. The technical advice and oversight provided by the Steering Committee helped to insure the scientific credibility of the study. In addition, input from the general public was solicited early on in the study and has continued up through review and comment on this report. Such input allowed the study to be formulated in regard to the expressed community concerns.

Future Directions

The descriptive epidemiologic study presented in this report comprises Phase I of the Los Alamos Cancer Rate Study; an on-going study of cancer incidence among populations residing in proximity to LANL. Based upon recommendations provided by the Steering Committee, subsequent Phase 11 study activities are planned which will continue the assessment of cancer incidence. Central to the Phase 11 effort is the continued surveillance of major cancers among LAC residents. Given the unstable nature of the LAC incidence rates, it is likely that only long- term monitoring of temporal patterns of cancer incidence in LAC will resolve the uncertainty surrounding the higher than expected incidence observed in LAC for cancers such as brain and nervous system, thyroid, and ovarian. Since the NMTR requires roughly 12-14 months to finalize their casefile for a given year, the 1991 casefile should be ready for review early in 1993. In addition to continued surveillance, the NMTR will be calculating incidence rates for major cancers among select New Mexico counties. It is hoped that the county rates will provide an additional perspective to the assessment of cancer incidence in and around LAC. Finally, it is planned to assess the feasibility of conducting analytical epidemiology studies to investigate causes of the recent elevation in thyroid cancer incidence observed in LAC.

CONCLUSIONS

1. Los Alamos County experienced a modest elevation in brain and nervous system cancer incidence during the mid- to late-1980s. Incidence in the county during this time period was 70%-80% greater than that observed in a New Mexico state and a national reference population. Due to the small number of cases, random fluctuation in the LAC incidence could not be ruled out as causing the observed elevated incidence.
2. The incidence of brain and nervous system cancer was similar for the communities of Los Alamos and White Rock during the time period 1980-1990.
3. Large differences in the incidence of brain and nervous system cancer were not observed among the five Los Alamos County census tracts during the time period 1980-1990. The highest and lowest census tract incidence rates differed by roughly two-fold. The highest incidence occurred in the census tract corresponding to the Western Area neighborhood. The Western Area incidence rate was based on three cases, all of which were diagnosed between 1986-1987. Due to the small number of cases in each census tract, random fluctuation in the tract rates could not be ruled out as causing the observed variability in incidence.

4. Community perception of a brain cancer "cluster" emerged from a citizen-generated list of alleged recent brain tumor deaths among persons who had resided in relative close proximity within Western Area. This case list, and subsequent expanded versions of the list, included persons diagnosed with or who had died of various types of disease, including primary malignant brain and nervous system tumors, benign brain and nervous system tumors, cancers which had spread from other organs to the brain (metastatic brain disease), and tumors of non-nervous tissue origin. In addition to being non-specific for disease, the case list also included persons diagnosed as LAC residents as well as former residents diagnosed out-of-county.
5. A review of Los Alamos County death certificates for the 22-year time period 1969-1990 revealed four deaths attributable to benign brain and nervous system tumors. Two of the deaths occurred in persons diagnosed prior to residing in LAC or shortly after moving into the county.
6. Los Alamos County experienced a sudden and marked increase in thyroid cancer incidence in the mid-1980s. The 1986-1990 county thyroid cancer incidence rate was nearly four-fold higher than the rate for a New Mexico state reference population. For the preceding time period 1981-1985, thyroid cancer incidence in the county was roughly similar to the state incidence. The recent increase in the county thyroid cancer incidence was found to be unrelated to recent advances in high-frequency thyroid ultrasonography.
7. Breast cancer incidence in Los Alamos County women was elevated during the entire 21-year time period 1970-1990. County breast cancer incidence rates consistently were 10%-65% higher than state and national reference rates. Reproductive and demographic factors known to increase the risk of breast cancer, including urban residence, high socioeconomic status, and delayed age at first full-term pregnancy, have been prevalent in the county over the past two decades.
8. Ovarian cancer incidence in Los Alamos County women was elevated between the mid- 1970s and 1990. For the latest five-year time period 1986-1990, ovarian cancer incidence in the county was roughly two-fold higher than that observed in a New Mexico state reference population. The majority of the excess ovarian cancer incidence was confined to the census tract corresponding to the North Mesa and Barranca Mesa neighborhoods. Incidence in this census tract was four to six-fold higher than that observed in the remaining census tracts.
9. The incidence of melanoma in Los Alamos County was elevated over the entire 21-year time period 1970-1990. Peak elevations in the county incidence rates occurred during the mid- to late-1980s. Melanoma incidence in the county during this time period was approximately two-fold greater than that observed in a New Mexico state reference population. The excess melanoma incidence observed in Los Alamos County may in part be related to the high ambient solar UV radiation intensity thought to exist in the county due to its high altitude.
10. The incidence of leukemia was comparable to or lower than that observed in a New Mexico state and national reference population. The incidence of other cancers of the lymphoreticular system (excluding non-Hodgkin's lymphoma) also was comparable to or lower than that observed in the reference populations. The incidence of non- Hodgkin's lymphoma consistently was elevated in Los Alamos County during 1970-1990. County incidence rates typically were 20%-60% greater than those observed in a New Mexico state and a national reference population.
11. The incidence in Los Alamos County of cancers of the oral cavity and pharynx and major cancers of the digestive, respiratory, urinary, and female genital system (excluding ovary) was generally comparable to or lower than that observed in a New Mexico state and national reference population.

RECOMMENDATIONS

1. Provide continued surveillance of cancer incidence in Los Alamos County.

2. Calculate cancer incidence rates for select New Mexico counties, particularly counties neighboring Los Alamos County.

3. Assess the feasibility of conducting an analytical epidemiologic study to investigate possible causes of elevated thyroid cancer incidence rates.

4. Continue to respond to expressed community concerns about brain cancer or other cancers occurring among persons living in proximity to LAN-L.

5. Disseminate the findings of this study through public meetings and written summaries.

APPENDIX A

TABLES OF INCIDENCE RATES AND INCIDENCE RATE RATIOS

TABLE A.1

AGE-ADJUSTED ANNUAL CANCER INCIDENCE RATES†
U.S. SEER WHITES, MALES AND FEMALES, 1973-1988

By Primary Cancer Site and Year of Diagnosis

Site	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Oral & Pharynx	-	11.1	11.2	11.3	11.3	10.9	11.4	11.7	11.1	11.5	11.2	11.4	11.1	11.3	10.7	11.2	10.0
Esophagus	-	3.0	3.0	3.0	3.1	2.8	2.9	3.1	3.0	2.8	2.9	3.0	3.0	3.2	3.3	3.3	3.3
Stomach	-	9.5	9.1	8.4	8.7	8.1	8.1	8.3	8.0	7.8	7.6	7.5	7.3	7.1	7.2	7.0	6.9
Colon/Rectum	-	46.8	48.3	47.8	49.4	49.9	49.9	49.5	50.2	50.9	50.0	50.6	52.2	53.2	50.9	49.4	47.7
Liver	-	1.8	1.9	1.7	1.7	1.7	1.7	1.7	1.7	1.9	1.8	1.8	1.8	2.0	1.9	1.9	1.9
Pancreas	-	9.7	9.2	9.4	9.5	9.3	8.8	9.0	8.9	9.1	9.1	9.5	9.6	9.3	9.1	8.8	8.7
Larynx	-	4.4	4.5	4.4	4.7	4.4	4.7	4.8	4.6	4.7	4.7	4.9	4.4	4.8	4.4	4.6	4.5
Lung & Bronchus	-	41.7	43.3	45.1	47.2	48.3	49.7	50.4	51.1	53.3	54.6	54.6	55.9	55.6	56.3	58.2	57.7
Melanoma of Skin	-	6.2	6.4	7.2	7.4	8.1	8.2	8.6	9.7	10.1	10.0	9.8	10.1	11.2	11.4	11.4	10.4
Breast	-	45.9	52.2	48.8	47.7	46.8	47.0	47.6	47.8	49.9	50.0	52.3	54.6	58.1	59.4	63.7	61.7
Cervix Uteri	-	6.8	6.1	5.9	5.7	5.1	5.0	4.8	4.8	4.2	4.1	4.2	4.3	3.9	4.1	3.8	4.0
Corpus & Uterus, NOS	-	15.8	17.2	18.1	17.5	16.0	15.1	14.1	13.8	13.6	13.5	13.5	13.1	12.7	12.2	12.4	11.6
Ovary	-	7.9	8.2	7.8	7.8	7.6	7.5	7.3	7.6	7.4	7.5	7.6	8.0	8.1	7.3	7.9	8.3
Prostate Gland	-	25.4	26.1	27.5	29.0	29.7	29.2	30.6	31.1	32.0	32.2	33.5	33.0	34.7	36.3	41.0	41.7
Testis	-	1.6	1.7	1.8	1.7	2.1	1.8	1.9	2.2	2.1	2.3	2.3	2.2	2.3	2.4	2.4	2.3
Urinary Bladder	-	15.3	16.4	16.2	16.6	16.0	16.8	17.0	17.2	17.6	17.0	17.2	17.9	17.8	18.1	18.4	18.3
Kidney & Renal Pelvis	-	6.8	6.3	6.3	7.0	6.8	6.8	6.6	7.0	7.2	7.2	7.9	8.1	7.9	8.3	8.6	8.3
Brain & Nervous System	-	5.3	5.4	5.8	5.7	6.1	5.7	6.1	6.2	6.2	6.2	6.2	5.9	6.7	6.6	6.8	6.5
Thyroid Gland	-	3.4	3.8	3.9	4.0	4.5	4.1	3.7	3.6	3.8	3.8	4.1	4.0	4.4	4.4	4.3	4.1
Hodgkin's Disease	-	3.5	3.2	3.1	2.8	3.1	2.9	2.9	2.8	3.0	3.0	3.1	3.2	3.2	2.7	3.2	3.1
Non-Hodgkin's Lymphoma	-	8.7	9.2	9.8	9.8	9.7	10.3	10.7	10.7	11.5	11.6	12.0	13.0	13.2	13.5	14.3	14.2
Multiple Myeloma	-	3.4	3.5	3.7	3.9	1.9	3.6	3.6	3.6	3.7	3.9	3.7	4.0	3.8	3.8	4.2	3.6
Leukemia	-	10.8	10.9	10.7	11.3	10.8	11.0	10.4	10.6	10.2	10.7	10.5	10.5	10.6	10.1	9.9	9.3
Breast, Female	-	83.9	95.5	89.0	87.0	85.3	85.6	86.6	86.8	90.8	91.2	95.2	99.6	106.1	108.5	116.5	112.9
Ovary, Female	-	14.7	15.3	14.4	14.3	14.1	13.8	13.4	13.9	13.7	13.8	14.0	14.7	15.0	13.5	14.5	15.4
Lung, Male	-	72.5	73.9	75.7	78.4	79.9	81.0	80.6	82.0	83.2	83.8	82.2	84.4	82.1	81.8	83.7	80.6
Prostate, Male	-	62.4	64.5	68.5	72.2	73.9	72.9	76.4	78.1	80.1	80.5	83.4	82.2	86.0	89.5	100.5	101.9
Brain & Nerv. Sys., Male	-	6.3	6.5	6.7	6.9	7.5	6.7	7.3	7.4	7.5	7.6	7.4	6.9	8.1	7.7	7.8	7.6
Brain & Nerv Sys., Female	-	4.3	4.5	4.9	4.7	5.0	4.9	4.9	5.2	5.1	5.2	5.2	5.0	5.5	5.6	6.0	5.6
All Sites, Both Sexes	-	318.8	332.5	332.2	338.0	336.9	337.3	339.8	343.5	350.2	350.8	356.7	363.4	371.5	372.1	384.5	376.0
All Sites, Male	-	363.8	372.4	377.8	388.0	391.9	393.9	399.3	404.4	409.1	410.0	417.5	422.1	426.6	431.8	447.7	436.1
All Sites, Female	-	293.9	312.8	308.9	311.5	306.0	305.8	306.0	308.7	316.9	317.7	321.9	330.6	340.7	337.8	347.9	341.7

† Rates are per 100,000 and are age-adjusted to the 1970 U.S. standard population.

Source: U.S. SEER

TABLE A.2

AGE-ADJUSTED FIVE-YEAR AVERAGE ANNUAL CANCER INCIDENCE RATES† U.S. SEER WHITES, MALES AND FEMALES, 1973-1988

By Primary Cancer Site and Midpoint of Five-Year Interval

SITE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Oral & Pharynx	-	-	-	11.2	11.2	11.3	11.3	11.3	11.4	11.4	11.3	11.3	11.1	11.1	10.9	-	-
Esophagus	-	-	-	3.0	3.0	3.0	3.0	2.9	2.9	3.0	2.9	3.0	3.1	3.2	3.2	-	-
Stomach	-	-	-	8.8	8.5	8.3	8.2	8.1	8.0	7.8	7.6	7.5	7.3	7.2	7.1	-	-
Colon/Rectum	-	-	-	48.4	49.1	49.3	49.8	50.1	50.1	50.2	50.8	51.4	51.4	51.3	50.7	-	-
Liver	-	-	-	1.8	1.7	1.7	1.7	1.7	1.8	1.8	1.8	1.9	1.9	1.9	1.9	-	-
Pancreas	-	-	-	9.4	9.2	9.2	9.1	9.0	9.0	9.1	9.2	9.3	9.3	9.3	9.1	-	-
Larynx	-	-	-	4.5	4.5	4.6	4.6	4.6	4.7	4.7	4.7	4.7	4.6	4.6	4.5	-	-
Lung & Bronchus	-	-	-	45.1	46.7	48.1	49.3	50.6	51.8	52.8	53.9	54.8	55.4	56.1	56.7	-	-
Melanoma of Skin	-	-	-	7.1	7.5	7.9	8.4	8.9	9.3	9.6	9.9	10.2	10.5	10.8	10.9	-	-
Breast	-	-	-	48.3	48.5	47.6	47.4	47.8	48.5	49.5	50.9	53.0	54.9	57.6	59.5	-	-
Cervix Uteri	-	-	-	5.9	5.6	5.3	5.1	4.8	4.6	4.4	4.3	4.1	4.1	4.1	4.0	-	-
Corpus & Uterus, NOS	-	-	-	16.9	16.8	16.2	15.3	14.5	14.0	13.7	13.5	13.3	13.0	12.8	12.4	-	-
Ovary	-	-	-	7.9	7.8	7.6	7.6	7.5	7.5	7.5	7.6	7.7	7.7	7.8	7.9	-	-
Prostate Gland	-	-	-	27.5	28.3	29.2	29.9	30.5	31.0	31.9	32.4	33.1	33.9	35.7	37.3	-	-
Testis	-	-	-	1.8	1.8	1.9	1.9	2.0	2.1	2.2	2.2	2.2	2.3	2.3	2.3	-	-
Urinary Bladder	-	-	-	16.1	16.4	16.5	16.7	16.9	17.1	17.2	17.4	17.5	17.6	17.9	18.1	-	-
Kidney & Renal Pelvis	-	-	-	6.6	6.6	6.7	6.8	6.9	7.0	7.2	7.5	7.7	7.9	8.2	8.2	-	-
Brain & Nervous System	-	-	-	5.7	5.7	5.9	6.0	6.1	6.1	6.2	6.1	6.2	6.3	6.4	6.5	-	-
Thyroid Gland	-	-	-	3.9	4.1	4.0	4.0	3.9	3.8	3.8	3.9	4.0	4.1	4.2	4.2	-	-
Hodgkin's Disease	-	-	-	3.1	3.0	3.0	2.9	2.9	2.9	3.0	3.0	3.1	3.0	3.1	3.1	-	-
Non-Hodgkin's Lymphoma	-	-	-	9.4	9.8	10.1	10.2	10.6	11.0	11.3	11.8	12.3	12.7	13.2	13.6	-	-
Multiple Myeloma	-	-	-	3.3	3.3	3.3	3.3	3.3	3.7	3.7	3.8	3.8	3.8	3.9	3.9	-	-
Leukemia	-	-	-	10.9	10.9	10.8	10.8	10.6	10.6	10.5	10.5	10.5	10.5	10.3	10.1	-	-
Breast, Female	-	-	-	88.1	88.5	86.7	86.3	87.0	88.2	90.1	92.7	96.6	100.1	105.2	108.7	-	-
Ovary, Female	-	-	-	14.6	14.4	14.0	13.9	13.8	13.7	13.8	14.0	14.2	14.2	14.3	14.6	-	-
Lung, Male	-	-	-	76.1	77.8	79.1	80.4	81.3	82.1	82.4	83.1	83.1	82.9	82.8	82.5	-	-
Prostate, Male	-	-	-	68.3	70.4	72.8	74.7	76.3	77.6	79.7	80.9	82.4	84.3	88.3	92.0	-	-
Brain & Nerv. Sys., Male	-	-	-	6.8	6.9	7.0	7.2	7.3	7.3	7.4	7.4	7.5	7.5	7.6	7.6	-	-
Brain & Nerv. Sys., Female	-	-	-	4.7	4.8	4.9	4.9	5.0	5.1	5.1	5.1	5.2	5.3	5.5	5.5	-	-
All Sites, Both Sexes	-	-	-	331.7	335.4	336.8	339.1	341.5	344.3	348.2	352.9	358.5	362.9	369.6	373.5	-	-
All Sites, Male	-	-	-	378.8	384.8	390.2	395.5	399.7	403.3	408.1	412.6	417.1	421.6	429.1	432.9	-	-
All Sites, Female	-	-	-	306.6	309.0	307.6	307.6	308.7	311.0	314.2	319.2	325.6	329.7	335.8	339.7	-	-

† Rates are per 100,000 and are age-adjusted to the 1970 U.S. standard population.

Source: U.S. SEER

TABLE A.3

AGE-ADJUSTED FIVE-YEAR AVERAGE ANNUAL CANCER INCIDENCE RATES†
NEW MEXICO NON-HISPANIC WHITES, MALES AND FEMALES, 1970-1990

By Primary Cancer Site and Midpoint of Five-Year Interval

SITE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Oral & Pharynx	11.2	10.3	10.4	10.9	11.3	12.3	13.2	13.4	13.4	12.8	11.6	11.6	11.8	11.5	10.9	10.9	10.3
Esophagus	2.1	2.1	2.1	2.0	2.2	2.1	2.1	2.0	2.1	2.0	2.0	2.2	2.4	2.3	2.2	2.3	2.5
Stomach	7.2	7.0	6.8	6.4	6.7	6.4	6.3	5.9	6.1	5.6	5.3	5.3	5.3	4.8	5.0	4.7	4.7
Colon/Rectum	40.5	40.5	38.2	38.2	39.0	38.0	38.0	39.4	39.3	39.5	39.9	39.0	39.5	39.9	39.8	39.2	38.6
Liver	2.3	2.3	2.0	2.0	1.9	1.9	1.9	2.1	2.1	1.8	1.9	1.6	1.3	1.4	1.5	1.4	1.4
Pancreas	9.5	8.9	9.0	9.2	9.1	8.9	9.4	8.7	8.7	8.5	8.5	8.2	8.4	7.7	7.8	8.2	7.6
Larynx	4.0	3.9	4.3	4.3	4.3	4.1	4.1	3.7	3.7	3.6	3.5	3.4	3.5	3.4	3.2	3.2	3.1
Lung & Bronchus	42.5	43.1	43.2	43.0	44.3	45.9	46.3	47.5	48.5	48.4	48.5	48.3	47.9	47.4	47.7	47.6	47.8
Melanoma of Skin	10.1	10.2	10.3	11.0	11.0	11.8	12.6	13.4	13.8	14.1	14.3	15.2	15.9	16.1	15.6	15.4	14.7
Breast	45.8	45.4	46.7	47.0	47.9	46.1	45.9	45.3	45.4	46.0	47.5	49.0	50.2	51.8	52.3	52.1	53.0
Cervix Uteri	6.9	6.9	7.2	7.0	6.7	6.1	5.4	4.7	4.5	4.6	4.6	4.4	4.2	4.2	4.0	3.9	4.5
Corpus & Uterus, NOS	13.2	13.9	14.2	14.1	14.3	13.7	13.4	12.4	11.6	10.8	10.7	10.0	10.0	9.9	9.5	10.0	9.5
Ovary	7.5	7.5	7.4	7.1	6.8	6.9	6.8	6.7	6.8	7.0	6.8	7.0	7.1	7.3	7.2	7.2	7.0
Prostate Gland	31.3	31.9	31.1	29.8	29.7	30.7	31.8	32.8	34.7	36.8	39.2	39.9	40.8	40.9	40.6	41.4	46.3
Testis	2.1	2.0	2.0	1.9	1.9	1.9	1.9	2.1	2.1	2.1	2.1	2.2	2.1	2.1	2.1	2.2	2.5
Urinary Bladder	14.5	14.0	14.0	14.1	13.7	13.7	14.8	14.8	14.8	15.4	15.4	14.9	15.3	16.5	16.6	16.8	17.4
Kidney & Renal Pelvis	6.8	6.8	7.0	7.1	7.1	7.6	7.8	7.6	7.2	7.1	6.8	6.6	6.4	6.6	6.4	6.6	6.5
Brain & Nervous System	5.8	6.0	5.6	5.6	5.5	5.0	4.9	4.8	4.7	4.9	4.9	5.3	5.9	5.8	5.9	6.2	5.4
Thyroid Gland	5.0	4.7	4.8	4.9	5.0	4.9	5.0	4.8	4.5	4.2	4.1	4.4	4.4	4.2	4.2	4.3	4.4
Hodgkin's Disease	3.0	3.0	3.0	3.1	3.0	2.9	2.6	2.5	2.4	2.5	2.4	2.5	2.5	2.5	2.5	2.5	2.6
Non-Hodgkin's Lymphoma	8.2	8.9	9.0	9.1	9.7	9.2	9.1	9.6	10.2	10.5	11.1	11.5	11.7	11.6	11.3	11.3	11.3
Multiple Myeloma	3.2	3.1	3.0	3.0	2.9	2.8	3.0	2.9	3.0	3.1	3.4	3.6	3.5	3.8	3.6	3.6	3.4
Leukemia	11.7	11.0	10.8	10.6	11.1	10.5	10.8	10.7	11.0	10.2	10.0	10.2	10.0	9.6	9.1	9.3	9.2
Breast, Female	84.8	84.3	86.6	86.8	88.1	84.8	84.6	83.8	84.0	85.2	88.0	91.1	93.0	95.6	96.9	96.7	98.4
Ovary, Female	13.9	14.0	13.8	13.2	12.7	13.0	12.8	12.5	12.9	13.2	12.7	13.0	13.3	13.7	13.5	13.5	13.2
Lung, Male	72.2	72.4	71.1	69.1	70.9	73.5	73.8	75.3	76.5	74.5	73.9	71.7	70.0	67.6	67.4	65.3	65.6
Prostate, Male	73.7	74.9	73.3	70.2	70.3	72.9	75.8	78.1	82.7	87.4	93.1	94.2	96.1	96.1	94.9	96.0	106.7
Brain & Nerv. Sys., Male	6.2	6.4	6.9	7.2	7.3	6.5	6.1	6.0	5.9	6.0	5.8	6.4	7.3	7.2	7.1	7.6	6.6
Brain & Nerv. Sys., Female	4.9	5.0	4.4	4.1	3.8	3.6	3.7	3.7	3.6	3.8	4.1	4.3	4.4	4.6	4.9	4.9	5.0
All Sites, Both Sexes	316.7	316.3	315.0	314.5	317.9	315.2	319.8	320.7	324.0	324.4	328.8	328.8	332.7	333.0	331.8	332.9	338.5
All Sites, Male	359.7	356.9	353.7	351.1	355.5	359.2	367.2	372.3	378.6	378.5	383.8	381.7	384.8	381.6	378.8	380.0	391.1
All Sites, Female	290.0	291.0	291.7	293.2	295.7	287.8	290.9	288.1	289.5	290.1	293.0	294.7	299.2	301.8	301.8	302.3	303.2

† Rates are per 100,000 and are age-adjusted to the 1970 U.S. standard population.

Source: New Mexico Tumor Registry

TABLE A.4

AGE-ADJUSTED FIVE-YEAR AVERAGE ANNUAL CANCER INCIDENCE RATES† LOS ALAMOS COUNTY NON-HISPANIC WHITES, MALES AND FEMALES, 1970-1990

By Primary Cancer Site and Midpoint of Five-Year Interval

SITE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Oral & Pharynx	4.3	3.9	4.3	5.3	6.2	4.0	4.7	3.1	6.5	7.1	7.7	7.4	9.7	9.2	7.5	9.4	8.1
Esophagus	0.0	0.0	0.0	0.0	0.0	4.5	4.2	3.9	3.6	3.3	0.0	0.0	0.0	0.0	0.0	1.1	1.1
Stomach	12.9	11.9	5.8	5.4	0.0	1.1	2.1	2.1	2.0	3.0	3.2	5.2	6.9	6.5	5.2	3.7	1.4
Colon/Rectum	72.5	45.5	33.9	27.7	32.4	30.8	28.1	35.3	34.7	41.5	37.0	43.4	46.2	47.8	38.5	37.4	33.4
Liver	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	4.6	4.2	3.9	3.6	2.0	2.5	2.3	2.2	2.0
Pancreas	19.8	13.2	6.9	8.4	4.7	2.8	5.2	8.6	13.6	12.7	12.0	11.4	7.7	2.8	5.6	4.5	4.3
Larynx	0.0	0.0	2.2	2.0	1.8	1.6	1.5	1.0	2.0	2.0	2.9	3.0	2.0	1.0	1.0	0.0	0.0
Lung & Bronchus	29.0	38.1	33.2	34.4	41.5	25.0	18.8	21.2	17.2	15.2	23.8	28.7	31.2	35.9	38.6	37.1	36.2
Melanoma of Skin	13.6	8.9	10.5	15.3	17.5	14.1	15.9	13.1	15.9	18.3	17.6	25.6	33.3	28.8	28.0	29.9	28.7
Breast	72.8	65.0	68.8	67.6	58.8	53.5	63.6	60.5	57.6	57.3	60.5	58.2	51.5	58.4	63.1	60.5	70.9
Cervix Uteri	7.8	10.6	10.1	8.5	8.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
Corpus & Uterus, NOS	10.9	8.0	6.8	5.0	3.7	2.3	4.6	3.4	7.8	6.5	6.3	5.5	7.3	4.3	7.8	10.2	10.6
Ovary	5.7	4.0	3.7	6.6	7.2	12.2	12.6	12.8	10.6	13.2	11.5	13.7	21.1	20.0	18.4	17.2	14.3
Prostate Gland	36.2	56.5	55.2	64.4	51.5	45.9	35.7	37.1	34.4	42.1	46.1	52.4	53.6	51.1	51.1	53.3	62.6
Testis	2.3	2.3	2.2	2.0	1.9	5.3	5.1	5.0	4.1	4.2	0.0	0.0	0.0	1.5	2.4	2.4	2.3
Urinary Bladder	29.2	26.6	24.7	21.5	15.0	9.5	6.3	9.5	13.6	14.5	17.1	17.6	14.0	8.4	9.0	5.8	9.6
Kidney & Renal Pelvis	6.9	6.3	2.2	2.0	1.8	1.8	7.8	7.3	6.8	6.5	6.5	4.5	4.4	5.2	5.2	4.2	1.7
Brain & Nervous Sys.	3.2	2.2	1.1	1.0	2.3	1.2	2.9	3.8	4.8	4.5	6.7	4.8	6.7	9.5	9.4	7.9	7.7
Thyroid Gland	5.8	5.8	6.9	8.9	5.6	7.7	7.4	6.4	4.4	6.7	4.3	4.4	4.4	7.4	8.2	11.6	16.9
Hodgkin's Disease	4.8	4.7	4.6	1.1	1.0	1.0	0.9	2.3	1.4	1.4	4.6	4.7	3.2	5.6	5.6	4.1	4.1
Non-Hodgkin's Lymphoma	19.7	18.4	10.4	11.1	11.0	10.7	14.0	17.1	15.7	17.9	14.8	13.8	14.2	17.0	19.4	17.1	17.7
Multiple Myeloma	6.2	9.8	9.0	8.3	7.7	2.7	0.0	0.0	0.0	0.0	4.4	4.2	3.9	3.7	3.5	0.0	0.0
Leukemia	15.7	13.2	7.2	6.9	4.9	3.4	3.2	3.1	6.8	14.9	13.0	12.3	12.4	9.0	5.0	7.9	8.7
Breast, Female	139.3	123.7	133.9	129.4	111.9	103.5	118.6	113.5	111.3	113.6	119.5	118.7	104.8	114.8	123.7	117.4	135.5
Ovary, Female	11.6	8.1	7.5	10.0	11.7	19.4	20.7	21.6	19.8	25.4	23.9	28.0	43.1	40.9	37.8	35.1	29.4
Lung, Male	98.3	109.8	81.1	74.4	68.2	18.2	6.8	14.2	12.8	19.7	32.2	44.5	52.3	60.4	68.0	64.3	60.0
Prostate, Male	90.2	139.1	140.2	164.4	132.7	117.3	87.3	93.1	85.2	98.2	104.2	122.3	119.9	113.2	113.9	123.6	144.1
Brain & Nerv. Sys., Male	4.3	2.1	2.1	2.0	1.9	0.0	0.0	1.8	3.6	3.6	3.6	3.6	1.8	6.0	7.3	8.7	8.2
Brain & Nerv. Sys., Female	2.2	2.3	0.0	0.0	2.7	2.5	6.2	6.1	6.0	5.4	10.0	6.1	11.7	13.3	11.5	7.1	6.9
All Sites, Both Sexes	385.6	362.5	317.7	322.6	294.2	253.1	260.2	270.9	286.1	315.7	325.2	342.1	352.3	356.0	360.3	358.4	376.4
All Sites, Male	498.3	450.2	421.5	448.1	353.7	301.1	289.2	315.9	314.2	360.5	344.4	368.1	365.9	381.8	398.7	407.8	421.8
All Sites, Female	367.4	335.3	280.0	269.4	277.5	251.9	265.9	264.5	294.9	308.6	324.7	338.5	353.3	340.2	338.9	329.7	355.8

† Rates are per 100,000 and are age-adjusted to the 1970 U.S. standard population.

Source: New Mexico Tumor Registry

TABLE A.5

UPPER 95% CONFIDENCE LIMIT (RATE + 2 S.E.)†:
AGE-ADJUSTED FIVE-YEAR AVERAGE ANNUAL INCIDENCE RATES
LOS ALAMOS COUNTY, NON-HISPANIC WHITES, 1970-1990

By Primary Cancer Site and Midpoint of Five-Year Interval

SITE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Oral & Pharynx	10.4	9.4	10.4	11.4	12.4	8.6	9.4	6.7	13.0	14.2	14.6	14.0	17.6	16.7	14.2	17.1	15.3
Esophagus	-	-	-	-	-	13.5	12.6	11.7	10.8	9.9	-	-	-	-	-	3.3	3.3
Stomach	27.8	25.6	17.4	16.2	-	-	5.1	5.1	4.8	6.5	6.9	11.2	13.8	13.0	11.2	8.9	4.2
Colon/Rectum	104.1	68.3	53.5	43.7	50.4	47.3	43.1	51.9	50.6	57.5	52.1	59.8	62.8	64.2	53.3	51.5	46.0
Liver	-	-	-	-	-	-	-	4.2	11.1	10.1	9.4	8.7	6.0	7.5	6.9	6.6	6.0
Pancreas	36.0	26.4	14.9	16.8	10.1	6.8	10.4	15.6	23.9	22.3	21.1	20.7	15.4	6.8	10.6	9.0	8.6
Larynx	-	-	6.6	6.0	5.4	4.8	4.5	3.0	4.8	4.8	6.2	6.5	4.8	3.0	3.0	-	-
Lung & Bronchus	54.9	62.2	52.4	53.5	62.9	39.4	31.3	35.3	29.4	25.3	37.0	42.6	44.8	50.0	52.9	51.1	49.9
Melanoma of Skin	23.9	17.8	19.1	26.9	29.2	23.0	25.5	21.8	25.1	28.1	27.4	37.0	46.1	40.6	39.4	41.4	40.2
Breast	98.5	88.7	93.5	91.9	79.9	72.7	85.1	80.7	76.0	74.6	77.8	74.7	66.5	74.8	80.1	76.8	88.6
Cervix Uteri	18.8	22.8	21.8	20.5	19.3	8.7	-	-	-	-	-	-	-	-	-	-	3.0
Corpus & Uterus, NOS	19.1	14.5	12.9	10.0	8.0	5.6	9.2	7.3	14.8	13.0	12.6	11.9	13.8	8.6	14.2	17.0	17.3
Ovary	13.8	12.0	11.1	15.9	15.5	23.1	22.9	22.5	18.1	21.5	19.2	22.4	32.0	30.7	28.6	26.4	22.6
Prostate Gland	61.8	86.7	84.7	95.6	78.1	69.6	55.5	55.7	51.6	60.5	64.5	71.9	72.6	68.9	68.1	70.8	81.1
Testis	5.6	5.6	5.3	4.8	4.6	11.4	11.0	10.8	9.9	10.1	-	-	-	4.5	5.8	5.8	5.6
Urinary Bladder	53.0	46.7	43.4	39.1	28.4	19.0	13.6	19.0	23.9	25.5	28.5	29.3	23.9	15.9	16.3	11.6	16.4
Kidney & Renal Pelvis	14.9	13.6	6.6	6.0	5.4	4.3	14.8	13.8	12.9	12.3	12.3	8.5	8.3	9.4	9.4	8.0	4.1
Brain & Nervous System	6.9	5.3	3.3	3.0	5.6	3.6	7.0	8.2	9.6	9.0	12.2	9.1	12.2	16.2	16.0	13.9	13.5
Thyroid Gland	12.5	12.5	13.8	16.2	10.6	13.1	12.6	11.2	8.3	11.8	8.6	8.8	8.8	13.0	14.0	18.6	25.4
Hodgkin's Disease	11.6	11.3	11.1	3.3	3.0	3.0	2.7	5.6	4.2	4.2	9.2	9.4	6.9	10.6	10.6	8.2	8.2
Non-Hodgkin's Lymphoma	35.8	33.4	20.8	21.0	20.0	19.4	24.6	29.2	26.8	29.8	24.7	22.5	22.4	26.4	29.8	26.6	27.5
Multiple Myeloma	18.6	23.7	21.7	20.0	18.6	8.1	-	-	-	-	10.6	10.1	9.4	8.9	8.4	-	-
Leukemia	27.6	24.0	13.6	13.1	9.8	7.3	6.9	6.7	12.9	24.8	22.2	21.0	20.7	15.8	9.5	13.9	14.9
Breast, Female	189.3	169.6	182.0	175.9	152.1	140.7	158.7	151.3	146.9	147.9	153.6	152.3	135.4	147.0	157.1	149.4	169.6
Ovary, Female	28.0	24.3	22.5	24.1	25.2	36.8	37.6	37.9	33.8	41.5	39.8	45.7	65.4	62.8	58.8	53.9	46.4
Lung, Male	186.2	183.0	135.2	124.0	113.7	34.5	16.4	30.6	27.6	37.3	55.0	69.2	77.0	86.8	95.8	91.1	86.2
Prostate, Male	154.0	213.5	215.1	244.1	201.2	177.9	135.7	139.7	127.8	141.1	145.9	167.7	162.3	152.6	151.9	164.2	186.6
Brain & Nerv. Sys., Male	10.4	6.3	6.3	6.0	5.7	-	-	5.4	8.7	8.7	8.7	8.7	5.4	14.5	15.7	17.4	16.4
Brain & Nerv. Sys., Female	6.6	6.9	-	-	8.1	7.5	15.0	14.7	14.5	13.0	20.0	13.1	22.2	24.2	21.8	15.3	14.9
All Sites, Both Sexes	452.7	425.8	375.2	379.2	345.4	297.2	303.6	314.3	329.7	360.0	369.3	386.6	396.3	399.5	403.4	400.7	419.1
All Sites, Male	627.0	563.6	530.3	559.3	444.3	381.6	363.3	390.9	387.3	435.7	413.6	438.3	433.0	448.5	466.1	475.1	489.1
All Sites, Female	454.0	416.6	351.1	336.2	343.4	309.7	324.3	321.9	354.5	367.2	384.2	398.8	413.7	398.3	396.4	385.4	413.1

† Confidence limits were calculated using the following standard error (SE) formula: $SE(rate) = rate/[events]^{1/2}$

" - " = undefined; number of cases = 0

Source: New Mexico Tumor Registry

TABLE A.6

LOWER 95% CONFIDENCE LIMIT (RATE - 2 S.E.)†:
AGE-ADJUSTED FIVE-YEAR AVERAGE ANNUAL INCIDENCE RATES
LOS ALAMOS COUNTY, NON-HISPANIC WHITES, 1970-1990

By Primary Cancer Site and Midpoint of Five-Year Interval

SITE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Oral & Pharynx	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.8	1.8	1.7	0.8	1.7	0.9
Esophagus	-	-	-	-	-	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-	0.0	0.0
Stomach	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Colon/Rectum	40.9	22.8	14.3	11.7	14.4	14.3	13.1	18.7	18.8	25.5	21.9	27.0	29.6	31.4	23.7	23.3	20.8
Liver	-	-	-	-	-	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pancreas	3.6	0.0	0.0	0.0	0.0	0.0	0.0	1.6	3.3	3.1	2.9	2.1	0.0	0.0	0.6	0.0	0.0
Larynx	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
Lung & Bronchus	3.1	14.0	14.0	15.3	20.1	10.6	6.3	7.1	5.0	5.1	10.6	14.8	17.6	21.8	24.3	23.1	22.5
Melanoma of Skin	3.3	0.0	1.9	3.7	5.8	5.2	6.3	4.4	6.7	8.5	7.8	14.2	20.5	17.0	16.6	18.4	17.2
Breast	47.1	41.3	44.1	43.3	37.7	34.3	42.1	40.3	39.2	40.0	43.2	41.7	36.5	42.0	46.1	44.2	53.2
Cervix Uteri	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-	-	-	-	-	-	0.0
Corpus & Uterus, NOS	2.7	1.5	0.7	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.8	0.0	1.4	3.4	3.9
Ovary	0.0	0.0	0.0	0.0	0.0	1.3	2.3	3.1	3.1	4.9	3.8	5.0	10.2	9.3	8.2	8.0	6.0
Prostate Gland	10.6	26.3	25.7	33.2	24.9	22.2	15.9	18.6	17.2	23.7	27.7	32.9	34.6	33.3	34.1	35.8	44.1
Testis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-	0.0	0.0	0.0	0.0
Urinary Bladder	5.4	6.5	6.0	3.9	1.6	0.0	0.0	0.0	3.3	3.5	5.7	5.9	4.1	0.9	1.7	0.0	2.8
Kidney & Renal Pelvis	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.8	0.7	0.7	0.7	0.5	0.5	1.0	1.0	0.4	0.0
Brain & Nervous System	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.5	1.2	2.8	2.8	1.9	1.9
Thyroid Gland	0.0	0.0	0.0	1.6	0.6	2.3	2.2	1.6	0.5	1.6	0.0	0.0	0.0	1.8	2.4	4.6	8.5
Hodgkin's Disease	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.6	0.0	0.0
Non-Hodgkin's Lymphoma	3.6	3.4	0.0	1.2	2.0	2.0	3.4	5.0	4.6	6.0	4.9	5.1	6.0	7.6	9.0	7.6	7.9
Multiple Myeloma	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-	-	0.0	0.0	0.0	0.0	0.0	-	-
Leukemia	3.8	2.4	0.8	0.7	0.0	0.0	0.0	0.0	0.7	5.0	3.8	3.6	4.1	2.2	0.5	1.9	2.5
Breast, Female	89.3	77.8	85.8	82.9	71.7	66.3	78.5	75.7	75.7	79.3	85.4	85.1	74.2	82.6	90.3	85.4	101.4
Ovary, Female	0.0	0.0	0.0	0.0	0.0	2.0	3.8	5.3	5.8	9.3	8.0	10.3	20.8	19.0	16.8	16.3	12.4
Lung, Male	10.4	36.6	27.0	24.8	22.7	1.9	0.0	0.0	0.0	2.1	9.4	19.8	27.6	34.0	40.2	37.5	33.8
Prostate, Male	26.4	64.7	65.3	84.7	64.2	56.7	38.9	46.6	42.6	55.3	62.5	76.9	77.5	73.8	75.9	83.0	101.6
Brain & Nerv. Sys., Male	0.0	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Brain & Nerv. Sys., Female	0.0	0.0	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	2.4	1.2	0.0	1.1
All Sites, Both Sexes	318.5	299.2	260.2	266.0	243.0	209.0	216.8	227.5	242.5	271.4	281.1	297.6	308.3	312.5	317.2	316.1	333.7
All Sites, Male	369.6	336.8	312.7	336.9	263.1	220.6	215.1	240.9	241.1	285.3	275.2	297.9	298.8	315.1	331.3	340.5	354.5
All Sites, Female	280.8	254.0	208.9	202.6	211.6	194.1	207.5	207.1	235.3	250.0	265.2	278.2	292.9	282.1	281.4	274.0	298.5

†Confidence limits were calculated using the following standard error (SE) formula: $SE(rate) = rate/[events]^{1/2}$
" - " = undefined; number of cases = 0
Source: New Mexico Tumor Registry

TABLE A.7

AGE-ADJUSTED FIVE-YEAR ANNUAL AVERAGE INCIDENCE RATES†
LOS ALAMOS COUNTY, ALL RACES, 1970-1990

By Primary Cancer Site and Midpoint of Five-Year Interval

SITE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Oral & Pharynx	3.9	3.6	4.1	5.0	5.7	3.6	4.3	2.7	5.9	6.5	7.1	7.6	9.7	9.2	7.6	9.5	7.4
Esophagus	0.0	0.0	0.0	5.0	4.6	8.4	7.8	7.2	3.3	3.1	0.0	0.0	0.0	0.0	0.0	1.0	1.0
Stomach	11.7	10.8	5.3	5.0	0.0	1.0	1.9	1.8	1.8	2.6	2.9	4.8	6.4	6.0	4.8	3.5	1.3
Colon/Rectum	67.6	41.8	31.1	25.5	29.8	29.4	26.9	33.5	34.2	40.1	35.2	41.1	43.4	43.7	35.1	34.2	30.4
Liver	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	6.4	6.0	5.7	5.4	3.9	2.3	2.2	2.0	1.9
Pancreas	19.4	13.4	10.9	10.9	7.2	5.2	7.1	8.0	12.5	11.7	11.0	10.5	7.2	2.6	5.1	4.1	3.9
Larynx	0.0	0.0	2.1	1.9	1.7	1.6	1.4	0.9	1.8	1.7	2.6	2.7	1.8	1.7	1.6	0.7	0.7
Lung & Bronchus	28.2	35.1	30.3	31.5	38.0	22.8	17.3	19.6	17.8	15.8	23.5	28.0	32.6	36.1	41.3	39.7	38.6
Melanoma of Skin	11.9	8.0	9.5	13.9	15.9	12.7	14.4	11.9	14.0	17.3	18.3	25.1	32.2	28.5	26.5	28.5	27.4
Breast	71.1	63.8	68.2	65.8	62.6	54.4	63.5	59.4	60.6	57.9	61.2	59.7	54.0	57.0	59.6	56.5	65.7
Cervix Uteri	7.0	9.2	8.7	7.4	6.9	2.2	0.0	0.0	0.0	3.1	3.8	3.6	4.1	3.9	1.6	0.8	1.7
Corpus & Uterus, NOS	9.7	7.0	5.9	4.4	4.4	3.1	5.2	4.0	8.0	6.0	5.8	5.1	6.6	3.9	7.1	9.2	9.6
Ovary	5.2	3.7	3.4	6.0	6.6	11.2	11.5	11.6	9.6	11.9	10.0	12.0	18.4	17.4	16.0	15.3	12.6
Prostate Gland	33.6	52.5	53.3	61.7	49.6	44.2	34.6	38.0	35.1	46.5	50.6	57.8	55.7	53.0	50.8	51.8	58.4
Testis	1.9	1.9	1.8	1.7	1.6	4.2	4.1	4.0	3.3	3.3	0.0	0.0	0.0	1.2	2.0	2.0	2.7
Urinary Bladder	26.7	24.3	22.6	19.7	13.8	8.7	5.7	8.7	12.5	13.3	15.8	16.3	12.9	7.7	8.3	5.4	9.8
Kidney & Renal Pelvis	6.4	5.9	2.1	1.9	1.7	1.6	7.2	6.7	6.2	5.9	6.7	4.9	4.8	5.5	5.4	3.7	1.5
Brain & Nervous System	2.8	1.9	0.9	0.9	2.0	1.0	2.4	3.2	4.1	3.9	5.8	4.3	5.8	10.1	10.5	10.1	9.8
Thyroid Gland	8.0	4.6	5.6	7.4	4.8	6.8	6.5	5.7	4.5	6.6	5.1	5.1	5.1	7.1	8.7	11.1	15.8
Hodgkin's Disease	3.7	3.7	3.6	0.9	0.9	0.8	0.8	1.9	1.2	1.2	3.9	3.9	2.7	4.7	4.7	3.5	3.4
Non-Hodgkin's Lymphoma	17.7	16.6	9.3	9.9	10.0	9.5	12.6	15.5	14.3	16.3	13.6	12.7	12.9	15.5	17.7	15.6	16.0
Multiple Myeloma	5.8	9.1	8.4	7.7	7.1	2.6	0.0	0.0	0.0	0.0	4.1	3.9	3.6	3.4	3.2	0.0	0.0
Leukemia	15.0	13.0	7.4	7.1	5.3	3.0	2.8	2.7	6.2	13.8	12.1	11.3	11.4	9.7	6.0	8.4	9.1
Breast, Female	135.3	121.1	132.4	125.6	118.6	104.5	118.0	110.8	115.0	112.9	119.1	119.6	108.2	112.0	116.6	109.3	125.2
Ovary, Female	10.4	7.4	6.9	9.0	10.5	17.6	18.7	19.4	17.6	22.8	20.5	24.3	37.2	35.3	32.5	31.0	25.8
Lung, Male	95.1	102.9	75.8	69.4	63.4	16.6	6.3	13.2	15.5	21.5	32.8	43.9	50.8	55.5	68.5	64.5	60.0
Prostate, Male	85.0	131.0	135.4	157.8	127.4	112.5	83.9	98.3	89.5	109.5	115.2	133.5	122.2	115.2	111.6	118.1	133.1
Brain & Nerv. Sys., Male	3.7	1.8	1.8	1.8	1.7	0.0	0.0	1.6	3.3	3.2	3.2	3.2	1.7	9.0	11.2	14.1	13.4
Brain & Nerv. Sys., Female	2.0	2.0	0.0	0.0	2.4	2.2	5.0	4.9	4.8	4.3	8.5	5.4	10.0	11.4	9.8	5.9	5.8
All Sites, Both Sexes	369.3	342.5	311.9	318.4	297.4	254.8	260.1	265.7	285.1	316.8	325.2	343.0	350.2	348.7	349.3	344.6	358.9
All Sites, Male	474.8	420.5	406.4	448.8	357.2	318.7	303.4	330.1	323.6	374.5	351.5	375.3	360.9	369.8	385.5	389.5	400.0
All Sites, Female	351.2	320.4	278.1	262.7	281.8	246.5	259.0	250.5	285.1	295.8	313.9	328.2	346.1	332.5	327.6	316.4	337.7

† Rates are per 100,000 and are age-adjusted to the 1970 U.S. standard population.

Source: New Mexico Tumor Registry

TABLE A.8

FIVE-YEAR AVERAGE ANNUAL INCIDENCE RATE RATIOS†
LOS ALAMOS NON-HISPANIC WHITES / U.S. SEER WHITES, 1973-1988

By Primary Cancer Site and Midpoint of Five-Year Interval

SITE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Oral & Pharynx	-	-	-	0.47	0.55	0.35	0.42	0.27	0.57	0.62	0.68	0.65	0.87	0.83	0.69	-	-
Esophagus	-	-	-	0.00	0.00	1.51	1.41	1.34	1.22	1.11	0.00	0.00	0.00	0.00	0.00	-	-
Stomach	-	-	-	0.62	0.00	0.13	0.25	0.26	0.25	0.38	0.42	0.70	0.94	0.90	0.73	-	-
Colon/Rectum	-	-	-	0.57	0.66	0.62	0.56	0.70	0.69	0.83	0.73	0.84	0.90	0.93	0.76	-	-
Liver	-	-	-	0.00	0.00	0.00	0.00	0.80	2.61	2.36	2.17	1.94	1.08	1.33	1.21	-	-
Pancreas	-	-	-	0.89	0.51	0.30	0.57	0.95	1.51	1.39	1.30	1.22	0.83	0.30	0.62	-	-
Larynx	-	-	-	0.45	0.40	0.35	0.32	0.22	0.43	0.42	0.62	0.64	0.43	0.22	0.22	-	-
Lung & Bronchus	-	-	-	0.76	0.89	0.52	0.38	0.42	0.33	0.29	0.44	0.52	0.56	0.64	0.68	-	-
Melanoma of Skin	-	-	-	2.17	2.35	1.78	1.89	1.47	1.71	1.90	1.77	2.50	3.17	2.67	2.57	-	-
Breast	-	-	-	1.40	1.21	1.12	1.34	1.27	1.19	1.16	1.19	1.10	0.94	1.01	1.06	-	-
Cervix Uteri	-	-	-	1.44	1.44	0.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	-
Corpus & Uterus, NOS	-	-	-	0.30	0.22	0.14	0.30	0.23	0.56	0.47	0.47	0.41	0.56	0.34	0.63	-	-
Ovary	-	-	-	0.84	0.93	1.61	1.67	1.71	1.42	1.76	1.51	1.77	2.74	2.57	2.32	-	-
Prostate Gland	-	-	-	2.34	1.82	1.57	1.19	1.22	1.11	1.32	1.42	1.58	1.58	1.43	1.37	-	-
Testis	-	-	-	1.12	1.04	2.85	2.63	2.48	1.99	1.94	0.00	0.00	0.00	0.65	1.03	-	-
Urinary Bladder	-	-	-	1.34	0.91	0.58	0.38	0.56	0.79	0.84	0.98	1.01	0.80	0.47	0.50	-	-
Kidney & Renal Pelvis	-	-	-	0.30	0.27	0.27	1.14	1.06	0.98	0.91	0.87	0.59	0.56	0.64	0.63	-	-
Brain & Nervous System	-	-	-	0.18	0.40	0.20	0.49	0.63	0.79	0.73	1.09	0.77	1.06	1.48	1.45	-	-
Thyroid Gland	-	-	-	2.27	1.38	1.91	1.86	1.62	1.16	1.76	1.11	1.09	1.06	1.75	1.93	-	-
Hodgkin's Disease	-	-	-	0.35	0.33	0.34	0.31	0.78	0.48	0.47	1.52	1.52	1.05	1.82	1.82	-	-
Non-Hodgkin's Lymphoma	-	-	-	1.18	1.13	1.06	1.37	1.62	1.43	1.58	1.26	1.13	1.12	1.29	1.42	-	-
Multiple Myeloma	-	-	-	2.53	2.32	0.81	0.00	0.00	0.00	0.00	1.16	1.10	1.02	0.95	0.90	-	-
Leukemia	-	-	-	0.63	0.45	0.31	0.30	0.29	0.64	1.42	1.24	1.17	1.18	0.87	0.50	-	-
Breast, Female	-	-	-	1.47	1.26	1.19	1.37	1.30	1.26	1.26	1.29	1.23	1.05	1.09	1.14	-	-
Ovary, Female	-	-	-	0.69	0.81	1.39	1.49	1.57	1.44	1.85	1.70	1.97	3.04	2.85	2.59	-	-
Lung, Male	-	-	-	0.98	0.88	0.23	0.08	0.17	0.16	0.24	0.39	0.54	0.63	0.73	0.82	-	-
Prostate, Male	-	-	-	2.41	1.88	1.61	1.17	1.22	1.10	1.23	1.29	1.48	1.42	1.28	1.24	-	-
Brain & Nerv. Sys., Male	-	-	-	0.29	0.28	0.00	0.00	0.25	0.49	0.48	0.49	0.48	0.24	0.79	0.96	-	-
Brain & Nerv. Sys., Female	-	-	-	0.00	0.56	0.51	1.26	1.22	1.19	1.05	1.95	1.17	2.21	2.44	2.08	-	-
All Sites, Both Sexes	-	-	-	0.97	0.88	0.75	0.77	0.79	0.83	0.91	0.92	0.95	0.97	0.96	0.96	-	-
All Sites, Male	-	-	-	1.18	0.92	0.77	0.73	0.79	0.78	0.88	0.83	0.88	0.87	0.89	0.92	-	-
All Sites, Female	-	-	-	0.88	0.90	0.82	0.86	0.86	0.95	0.98	1.02	1.04	1.07	1.01	1.00	-	-

† Rate ratios are derived from data in Table A.4 (numerator) and Table A.2 (denominator).

Source: New Mexico Tumor Registry and U.S. SEER

TABLE A.9

FIVE-YEAR AVERAGE ANNUAL INCIDENCE RATE RATIOS†
LOS ALAMOS NON-HISPANIC WHITES / NEW MEXICO NON-HISPANIC WHITES, 1970-1990

By Primary Cancer Site and Midpoint of Five-Year Interval

SITE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Oral & Pharynx	0.38	0.38	0.41	0.49	0.55	0.33	0.36	0.23	0.49	0.55	0.66	0.64	0.82	0.80	0.69	0.86	0.79
Esophagus	0.00	0.00	0.00	0.00	0.00	2.14	2.00	1.95	1.71	1.65	0.00	0.00	0.00	0.00	0.00	0.48	0.44
Stomach	1.79	1.70	0.85	0.84	0.00	0.17	0.33	0.36	0.33	0.54	0.60	0.98	1.30	1.35	1.04	0.79	0.30
Colon/Rectum	1.79	1.12	0.89	0.73	0.83	0.81	0.74	0.90	0.88	1.05	0.93	1.11	1.17	1.20	0.97	0.95	0.87
Liver	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.67	2.19	2.33	2.05	2.25	1.54	1.79	1.53	1.57	1.43
Pancreas	2.08	1.48	0.77	0.91	0.52	0.31	0.55	0.99	1.56	1.49	1.41	1.39	0.92	0.36	0.72	0.55	0.57
Larynx	0.00	0.00	0.51	0.47	0.42	0.39	0.37	0.27	0.54	0.56	0.83	0.88	0.57	0.29	0.31	0.00	0.00
Lung & Bronchus	0.68	0.88	0.77	0.80	0.94	0.54	0.41	0.45	0.35	0.31	0.49	0.59	0.65	0.76	0.81	0.78	0.76
Melanoma of Skin	1.35	0.87	1.02	1.39	1.59	1.19	1.26	0.98	1.15	1.30	1.23	1.68	2.09	1.79	1.79	1.94	1.95
Breast	1.59	1.43	1.47	1.44	1.23	1.16	1.39	1.34	1.27	1.25	1.27	1.19	1.03	1.13	1.21	1.16	1.34
Cervix Uteri	1.13	1.54	1.40	1.21	1.19	0.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22
Corpus & Uterus, NOS	0.83	0.58	0.48	0.35	0.26	0.17	0.34	0.27	0.67	0.60	0.59	0.55	0.73	0.43	0.82	1.02	1.12
Ovary	0.76	0.53	0.50	0.93	1.06	1.77	1.85	1.91	1.56	1.89	1.69	1.96	2.97	2.74	2.56	2.39	2.04
Prostate Gland	1.16	1.77	1.77	2.16	1.73	1.50	1.12	1.13	0.99	1.14	1.18	1.31	1.31	1.25	1.26	1.29	1.35
Testis	1.10	1.15	1.10	1.05	1.00	2.79	2.68	2.38	1.95	2.00	0.00	0.00	0.00	0.71	1.14	1.09	0.92
Urinary Bladder	2.01	1.90	1.76	1.52	1.09	0.69	0.43	0.64	0.92	0.94	1.11	1.18	0.92	0.51	0.54	0.35	0.55
Kidney & Renal Pelvis	1.01	0.93	0.31	0.28	0.25	0.24	1.00	0.96	0.94	0.92	0.96	0.68	0.69	0.79	0.81	0.64	0.26
Brain & Nervous System	0.55	0.37	0.20	0.18	0.42	0.24	0.59	0.79	1.02	0.92	1.37	0.91	1.14	1.64	1.59	1.27	1.43
Thyroid Gland	1.16	1.23	1.44	1.82	1.12	1.57	1.48	1.33	0.98	1.60	1.05	1.00	1.00	1.76	1.95	2.70	3.84
Hodgkin's Disease	1.60	1.57	1.53	0.35	0.33	0.34	0.35	0.92	0.58	0.56	1.92	1.88	1.28	2.24	2.24	1.64	1.58
Non-Hodgkin's Lymphoma	2.40	2.07	1.16	1.22	1.13	1.16	1.54	1.78	1.54	1.70	1.33	1.20	1.21	1.47	1.72	1.51	1.57
Multiple Myeloma	1.94	3.16	3.00	2.77	2.66	0.96	0.00	0.00	0.00	0.00	1.29	1.17	1.11	0.97	0.97	0.00	0.00
Leukemia	1.34	1.20	0.67	0.65	0.44	0.32	0.30	0.29	0.62	1.46	1.30	1.21	1.24	0.94	0.55	0.85	0.95
Breast, Female	1.64	1.47	1.55	1.49	1.27	1.22	1.40	1.35	1.33	1.33	1.36	1.30	1.13	1.20	1.28	1.21	1.38
Ovary, Female	0.83	0.58	0.54	0.76	0.92	1.49	1.62	1.73	1.53	1.92	1.88	2.15	3.24	2.99	2.80	2.60	2.23
Lung, Male	1.36	1.52	1.14	1.08	0.96	0.25	0.09	0.19	0.17	0.26	0.44	0.62	0.75	0.89	1.01	0.98	0.91
Prostate, Male	1.22	1.86	1.91	2.34	1.89	1.61	1.15	1.19	1.03	1.12	1.12	1.30	1.25	1.18	1.20	1.29	1.35
Brain & Nerv. Sys., Male	0.69	0.33	0.30	0.28	0.26	0.00	0.00	0.30	0.61	0.60	0.62	0.56	0.25	0.83	1.03	1.14	1.24
Brain & Nerv. Sys., Female	0.45	0.46	0.00	0.00	0.71	0.69	1.68	1.65	1.67	1.42	2.44	1.42	2.66	2.89	2.35	1.45	1.38
All Sites, Both Sexes	1.22	1.15	1.01	1.03	0.93	0.80	0.81	0.84	0.88	0.97	0.99	1.04	1.06	1.07	1.09	1.08	1.11
All Sites, Male	1.39	1.26	1.19	1.28	0.99	0.84	0.79	0.85	0.83	0.95	0.90	0.96	0.95	1.00	1.05	1.07	1.08
All Sites, Female	1.27	1.15	0.96	0.92	0.94	0.88	0.91	0.92	1.02	1.06	1.11	1.15	1.18	1.13	1.12	1.09	1.17

†Rate ratios are derived from data in Table A.4 (numerator) and Table A.3 (denominator).

Source: New Mexico Tumor Registry

TABLE A.10

FIVE-YEAR AVERAGE ANNUAL INCIDENCE RATE RATIOS†
LOS ALAMOS ALL RACES / U.S. SEER WHITES 1973-1988

By Primary Cancer Site and Midpoint of Five-Year Interval

SITE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Oral & Pharynx	-	-	-	0.45	0.51	0.32	0.38	0.24	0.52	0.57	0.63	0.67	0.87	0.83	0.70	-	-
Esophagus	-	-	-	1.68	1.55	2.82	2.62	2.47	1.12	1.05	0.00	0.00	0.00	0.00	0.00	-	-
Stomach	-	-	-	0.57	0.00	0.12	0.23	0.22	0.23	0.33	0.38	0.64	0.87	0.83	0.68	-	-
Colon/Rectum	-	-	-	0.53	0.61	0.60	0.54	0.67	0.68	0.80	0.69	0.80	0.84	0.85	0.69	-	-
Liver	-	-	-	0.00	0.00	0.00	0.00	0.75	3.64	3.37	3.17	2.90	2.10	1.22	1.16	-	-
Pancreas	-	-	-	1.16	0.78	0.57	0.78	0.89	1.39	1.28	1.19	1.13	0.77	0.28	0.56	-	-
Larynx	-	-	-	0.42	0.37	0.35	0.30	0.19	0.38	0.36	0.56	0.57	0.39	0.37	0.35	-	-
Lung & Bronchus	-	-	-	0.70	0.81	0.47	0.35	0.39	0.34	0.30	0.44	0.51	0.59	0.64	0.73	-	-
Melanoma of Skin	-	-	-	1.97	2.13	1.61	1.71	1.33	1.50	1.79	1.84	2.45	3.07	2.64	2.43	-	-
Breast	-	-	-	1.36	1.29	1.14	1.34	1.24	1.25	1.17	1.20	1.13	0.98	0.99	1.00	-	-
Cervix Uteri	-	-	-	1.25	1.24	0.42	0.00	0.00	0.00	0.70	0.88	0.87	1.00	0.96	0.40	-	-
Corpus & Uterus, NOS	-	-	-	0.26	0.26	0.19	0.34	0.28	0.57	0.44	0.43	0.38	0.51	0.31	0.57	-	-
Ovary	-	-	-	0.76	0.85	1.47	1.52	1.55	1.29	1.59	1.31	1.55	2.39	2.24	2.02	-	-
Prostate Gland	-	-	-	2.24	1.75	1.51	1.16	1.25	1.13	1.46	1.56	1.75	1.64	1.48	1.36	-	-
Testis	-	-	-	0.96	0.88	2.26	2.11	1.98	1.60	1.53	0.00	0.00	0.00	0.52	0.86	-	-
Urinary Bladder	-	-	-	1.22	0.84	0.53	0.34	0.51	0.73	0.77	0.91	0.93	0.73	0.43	0.46	-	-
Kidney & Renal Pelvis	-	-	-	0.29	0.26	0.24	1.05	0.97	0.89	0.82	0.90	0.64	0.61	0.67	0.66	-	-
Brain & Nervous System	-	-	-	0.16	0.35	0.17	0.40	0.53	0.67	0.63	0.94	0.69	0.92	1.57	1.62	-	-
Thyroid Gland	-	-	-	1.89	1.18	1.68	1.63	1.45	1.18	1.74	1.32	1.27	1.23	1.67	2.05	-	-
Hodgkin's Disease	-	-	-	0.29	0.30	0.27	0.28	0.65	0.41	0.41	1.29	1.26	0.89	1.53	1.53	-	-
Non-Hodgkin's Lymphoma	-	-	-	1.05	1.02	0.94	1.23	1.47	1.30	1.44	1.16	1.04	1.02	1.17	1.30	-	-
Multiple Myeloma	-	-	-	2.35	2.14	0.78	0.00	0.00	0.00	0.00	1.08	1.02	0.94	0.87	0.82	-	-
Leukemia	-	-	-	0.65	0.48	0.28	0.26	0.25	0.59	1.32	1.15	1.08	1.09	0.94	0.60	-	-
Breast, Female	-	-	-	1.43	1.34	1.21	1.37	1.27	1.30	1.25	1.28	1.24	1.08	1.06	1.07	-	-
Ovary, Female	-	-	-	0.62	0.73	1.26	1.35	1.41	1.28	1.66	1.46	1.71	2.62	2.46	2.22	-	-
Lung, Male	-	-	-	0.91	0.82	0.21	0.08	0.16	0.19	0.26	0.39	0.53	0.61	0.67	0.83	-	-
Prostate, Male	-	-	-	2.31	1.81	1.55	1.12	1.29	1.15	1.37	1.42	1.62	1.45	1.30	1.21	-	-
Brain & Nerv. Sys., Male	-	-	-	0.27	0.25	0.00	0.00	0.22	0.45	0.43	0.43	0.43	0.23	1.19	1.47	-	-
Brain & Nerv. Sys., Female	-	-	-	0.00	0.50	0.45	1.01	0.98	0.95	0.84	1.65	1.04	1.89	2.09	1.77	-	-
All Sites, Both Sexes	-	-	-	0.96	0.89	0.76	0.77	0.78	0.83	0.91	0.92	0.96	0.97	0.94	0.94	-	-
All Sites, Male	-	-	-	1.18	0.93	0.82	0.77	0.83	0.80	0.92	0.85	0.90	0.86	0.86	0.89	-	-
All Sites, Female	-	-	-	0.86	0.91	0.80	0.84	0.81	0.92	0.94	0.98	1.01	1.05	0.99	0.96	-	-

† Rate ratios are derived from data in Table A.7 (numerator) and Table A.2 (denominator).

Source: New Mexico Tumor Registry and U.S. SEER

TABLE A.11

FIVE-YEAR AVERAGE ANNUAL INCIDENCE RATE RATIOS†
LOS ALAMOS ALL RACES / NEW MEXICO NON-HISPANIC WHITES, 1970-1990

By Primary Cancer Site and Midpoint of Five-Year Interval

SITE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Oral Cavity & Pharynx	0.35	0.35	0.39	0.46	0.50	0.29	0.33	0.20	0.44	0.51	0.61	0.66	0.82	0.80	0.70	0.87	0.72
Esophagus	0.00	0.00	0.00	2.50	2.09	4.00	3.71	3.60	1.57	1.55	0.00	0.00	0.00	0.00	0.00	0.43	0.40
Stomach	1.63	1.54	0.78	0.78	0.00	0.16	0.30	0.31	0.30	0.46	0.55	0.91	1.21	1.25	0.96	0.74	0.28
Colon/Rectum	1.67	1.03	0.81	0.67	0.76	0.77	0.71	0.85	0.87	1.02	0.88	1.05	1.10	1.10	0.88	0.87	0.79
Liver	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.62	3.05	3.33	3.00	3.38	3.00	1.64	1.47	1.43	1.36
Pancreas	2.04	1.51	1.21	1.18	0.79	0.58	0.76	0.92	1.44	1.38	1.29	1.28	0.86	0.34	0.65	0.50	0.51
Larynx	0.00	0.00	0.49	0.44	0.40	0.39	0.34	0.24	0.49	0.47	0.74	0.79	0.51	0.50	0.50	0.22	0.23
Lung & Bronchus	0.66	0.81	0.70	0.73	0.86	0.50	0.37	0.41	0.37	0.33	0.48	0.58	0.68	0.76	0.87	0.83	0.81
Melanoma of Skin	1.18	0.78	0.92	1.26	1.45	1.08	1.14	0.89	1.01	1.23	1.28	1.65	2.03	1.77	1.70	1.85	1.86
Breast	1.55	1.41	1.46	1.40	1.31	1.18	1.38	1.31	1.33	1.26	1.29	1.22	1.08	1.10	1.14	1.08	1.24
Cervix Uteri	1.01	1.33	1.21	1.06	1.03	0.36	0.00	0.00	0.00	0.67	0.83	0.82	0.98	0.93	0.40	0.21	0.38
Corpus & Uterus, NOS	0.73	0.50	0.42	0.31	0.31	0.23	0.39	0.32	0.69	0.56	0.54	0.51	0.66	0.39	0.75	0.92	1.01
Ovary	0.69	0.49	0.46	0.85	0.97	1.62	1.69	1.73	1.41	1.70	1.47	1.71	2.59	2.38	2.22	2.13	1.80
Prostate Gland	1.07	1.65	1.71	2.07	1.67	1.44	1.09	1.16	1.01	1.26	1.29	1.45	1.37	1.30	1.25	1.25	1.26
Testis	0.90	0.95	0.90	0.89	0.84	2.21	2.16	1.90	1.57	1.57	0.00	0.00	0.00	0.57	0.95	0.91	1.08
Urinary Bladder	1.84	1.74	1.61	1.40	1.01	0.64	0.39	0.59	0.84	0.86	1.03	1.09	0.84	0.47	0.50	0.32	0.56
Kidney & Renal Pelvis	0.94	0.87	0.30	0.27	0.24	0.21	0.92	0.88	0.86	0.83	0.99	0.74	0.75	0.83	0.84	0.56	0.23
Brain & Nervous System	0.48	0.32	0.16	0.16	0.36	0.20	0.49	0.67	0.87	0.80	1.18	0.81	0.98	1.74	1.78	1.63	1.81
Thyroid Gland	1.60	0.98	1.17	1.51	0.96	1.39	1.30	1.19	1.00	1.57	1.24	1.16	1.16	1.69	2.07	2.58	3.59
Hodgkin's Disease	1.23	1.23	1.20	0.29	0.30	0.28	0.31	0.76	0.50	0.48	1.63	1.56	1.08	1.88	1.88	1.40	1.31
Non-Hodgkin's Lymphoma	2.16	1.87	1.03	1.09	1.03	1.03	1.38	1.61	1.40	1.55	1.23	1.10	1.10	1.34	1.57	1.38	1.42
Multiple Myeloma	1.81	2.94	2.80	2.57	2.45	0.93	0.00	0.00	0.00	0.00	1.21	1.08	1.03	0.89	0.89	0.00	0.00
Leukemia	1.28	1.18	0.69	0.67	0.48	0.29	0.26	0.25	0.56	1.35	1.21	1.11	1.14	1.01	0.66	0.90	0.99
Breast, Female	1.60	1.44	1.53	1.45	1.35	1.23	1.39	1.32	1.37	1.33	1.35	1.31	1.16	1.17	1.20	1.13	1.27
Ovary, Female	0.75	0.53	0.50	0.68	0.83	1.35	1.46	1.55	1.36	1.73	1.61	1.87	2.80	2.58	2.41	2.30	1.95
Lung, Male	1.32	1.42	1.07	1.00	0.89	0.23	0.09	0.18	0.20	0.29	0.44	0.61	0.73	0.82	1.02	0.99	0.91
Prostate, Male	1.15	1.75	1.85	2.25	1.81	1.54	1.11	1.26	1.08	1.25	1.24	1.42	1.27	1.20	1.18	1.23	1.25
Brain & Nerv. Sys., Male	0.60	0.28	0.26	0.25	0.23	0.00	0.00	0.27	0.56	0.53	0.55	0.50	0.23	1.25	1.58	1.86	2.03
Brain & Nerv. Sys., Female	0.41	0.40	0.00	0.00	0.63	0.61	1.35	1.32	1.33	1.13	2.07	1.26	2.27	2.48	2.00	1.20	1.16
All Sites, Both Sexes	1.17	1.08	0.99	1.01	0.94	0.81	0.81	0.83	0.88	0.98	0.99	1.04	1.05	1.05	1.05	1.04	1.06
All Sites, Male	1.32	1.18	1.15	1.28	1.00	0.89	0.83	0.89	0.85	0.99	0.92	0.98	0.94	0.97	1.02	1.03	1.02
All Sites, Female	1.21	1.10	0.95	0.90	0.95	0.86	0.89	0.87	0.98	1.02	1.07	1.11	1.16	1.10	1.09	1.05	1.11

† Rate ratios are derived from Table A.7 (numerator) and Table A.3 (denominator).

Source: New Mexico Tumor Registry

TABLE A.11

FIVE-YEAR AVERAGE ANNUAL INCIDENCE RATE RATIOS†
LOS ALAMOS ALL RACES / NEW MEXICO NON-HISPANIC WHITES, 1970-1990

By Primary Cancer Site and Midpoint of Five-Year Interval

SITE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Oral Cavity & Pharynx	0.35	0.35	0.39	0.46	0.50	0.29	0.33	0.20	0.44	0.51	0.61	0.66	0.82	0.80	0.70	0.87	0.72
Esophagus	0.00	0.00	0.00	2.50	2.09	4.00	3.71	3.60	1.57	1.55	0.00	0.00	0.00	0.00	0.00	0.43	0.40
Stomach	1.63	1.54	0.78	0.78	0.00	0.16	0.30	0.31	0.30	0.46	0.55	0.91	1.21	1.25	0.96	0.74	0.28
Colon/Rectum	1.67	1.03	0.81	0.67	0.76	0.77	0.71	0.85	0.87	1.02	0.88	1.05	1.10	1.10	0.88	0.87	0.79
Liver	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.62	3.05	3.33	3.00	3.38	3.00	1.64	1.47	1.43	1.36
Pancreas	2.04	1.51	1.21	1.18	0.79	0.58	0.76	0.92	1.44	1.38	1.29	1.28	0.86	0.34	0.65	0.50	0.51
Larynx	0.00	0.00	0.49	0.44	0.40	0.39	0.34	0.24	0.49	0.47	0.74	0.79	0.51	0.50	0.50	0.22	0.23
Lung & Bronchus	0.66	0.81	0.70	0.73	0.86	0.50	0.37	0.41	0.37	0.33	0.48	0.58	0.68	0.76	0.87	0.83	0.81
Melanoma of Skin	1.18	0.78	0.92	1.26	1.45	1.08	1.14	0.89	1.01	1.23	1.28	1.65	2.03	1.77	1.70	1.85	1.86
Breast	1.55	1.41	1.46	1.40	1.31	1.18	1.38	1.31	1.33	1.26	1.29	1.22	1.08	1.10	1.14	1.08	1.24
Cervix Uteri	1.01	1.33	1.21	1.06	1.03	0.36	0.00	0.00	0.00	0.67	0.83	0.82	0.98	0.93	0.40	0.21	0.38
Corpus & Uterus, NOS	0.73	0.50	0.42	0.31	0.31	0.23	0.39	0.32	0.69	0.56	0.54	0.51	0.66	0.39	0.75	0.92	1.01
Ovary	0.69	0.49	0.46	0.85	0.97	1.62	1.69	1.73	1.41	1.70	1.47	1.71	2.59	2.38	2.22	2.13	1.80
Prostate Gland	1.07	1.65	1.71	2.07	1.67	1.44	1.09	1.16	1.01	1.26	1.29	1.45	1.37	1.30	1.25	1.25	1.26
Testis	0.90	0.95	0.90	0.89	0.84	2.21	2.16	1.90	1.57	1.57	0.00	0.00	0.00	0.57	0.95	0.91	1.08
Urinary Bladder	1.84	1.74	1.61	1.40	1.01	0.64	0.39	0.59	0.84	0.86	1.03	1.09	0.84	0.47	0.50	0.32	0.56
Kidney & Renal Pelvis	0.94	0.87	0.30	0.27	0.24	0.21	0.92	0.88	0.86	0.83	0.99	0.74	0.75	0.83	0.84	0.56	0.23
Brain & Nervous System	0.48	0.32	0.16	0.16	0.36	0.20	0.49	0.67	0.87	0.80	1.18	0.81	0.98	1.74	1.78	1.63	1.81
Thyroid Gland	1.60	0.98	1.17	1.51	0.96	1.39	1.30	1.19	1.00	1.57	1.24	1.16	1.16	1.69	2.07	2.58	3.59
Hodgkin's Disease	1.23	1.23	1.20	0.29	0.30	0.28	0.31	0.76	0.50	0.48	1.63	1.56	1.08	1.88	1.88	1.40	1.31
Non-Hodgkin's Lymphoma	2.16	1.87	1.03	1.09	1.03	1.03	1.38	1.61	1.40	1.55	1.23	1.10	1.10	1.34	1.57	1.38	1.42
Multiple Myeloma	1.81	2.94	2.80	2.57	2.45	0.93	0.00	0.00	0.00	0.00	1.21	1.08	1.03	0.89	0.89	0.00	0.00
Leukemia	1.28	1.18	0.69	0.67	0.48	0.29	0.26	0.25	0.56	1.35	1.21	1.11	1.14	1.01	0.66	0.90	0.99
Breast, Female	1.60	1.44	1.53	1.45	1.35	1.23	1.39	1.32	1.37	1.33	1.35	1.31	1.16	1.17	1.20	1.13	1.27
Ovary, Female	0.75	0.53	0.50	0.68	0.83	1.35	1.46	1.55	1.36	1.73	1.61	1.87	2.80	2.58	2.41	2.30	1.95
Lung, Male	1.32	1.42	1.07	1.00	0.89	0.23	0.09	0.18	0.20	0.29	0.44	0.61	0.73	0.82	1.02	0.99	0.91
Prostate, Male	1.15	1.75	1.85	2.25	1.81	1.54	1.11	1.26	1.08	1.25	1.24	1.42	1.27	1.20	1.18	1.23	1.25
Brain & Nerv. Sys., Male	0.60	0.28	0.26	0.25	0.23	0.00	0.00	0.27	0.56	0.53	0.55	0.50	0.23	1.25	1.58	1.86	2.03
Brain & Nerv. Sys., Female	0.41	0.40	0.00	0.00	0.63	0.61	1.35	1.32	1.33	1.13	2.07	1.26	2.27	2.48	2.00	1.20	1.16
All Sites, Both Sexes	1.17	1.08	0.99	1.01	0.94	0.81	0.81	0.83	0.88	0.98	0.99	1.04	1.05	1.05	1.05	1.04	1.06
All Sites, Male	1.32	1.18	1.15	1.28	1.00	0.89	0.83	0.89	0.85	0.99	0.92	0.98	0.94	0.97	1.02	1.03	1.02
All Sites, Female	1.21	1.10	0.95	0.90	0.95	0.86	0.89	0.87	0.98	1.02	1.07	1.11	1.16	1.10	1.09	1.05	1.11

† Rate ratios are derived from Table A.7 (numerator) and Table A.3 (denominator).

Source: New Mexico Tumor Registry

TABLE A.12

FIVE-YEAR AVERAGE ANNUAL INCIDENCE RATE RATIOS†
LOS ALAMOS ALL RACES / LOS ALAMOS NON-HISPANIC WHITES, 1970-1990

By Primary Cancer Site and Midpoint of Five-Year Interval

SITE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Oral Cavity & Pharynx	0.91	0.92	0.95	0.94	0.92	0.90	0.91	0.87	0.91	0.92	0.92	1.03	1.00	1.00	1.01	1.01	0.91
Esophagus	-	-	-	-	-	1.87	1.86	1.85	0.92	0.94	-	-	-	-	-	0.91	0.91
Stomach	0.91	0.91	0.91	0.93	-	0.91	0.90	0.86	0.90	0.87	0.91	0.92	0.93	0.92	0.92	0.95	0.93
Colon/Rectum	0.93	0.92	0.92	0.92	0.92	0.95	0.96	0.95	0.99	0.97	0.95	0.95	0.94	0.91	0.91	0.91	0.91
Liver	-	-	-	-	-	-	-	0.93	1.39	1.43	1.46	1.50	1.95	0.92	0.96	0.91	0.95
Pancreas	0.98	1.02	1.58	1.30	1.53	1.86	1.37	0.93	0.92	0.92	0.92	0.92	0.94	0.93	0.91	0.91	0.91
Larynx	-	-	0.95	0.95	0.94	1.00	0.93	0.90	0.90	0.85	0.90	0.90	0.90	1.70	1.60	-	-
Lung & Bronchus	0.97	0.92	0.91	0.92	0.92	0.91	0.92	0.92	1.03	1.04	0.99	0.98	1.04	1.01	1.07	1.07	1.07
Melanoma of Skin	0.88	0.90	0.90	0.91	0.91	0.90	0.91	0.91	0.88	0.95	1.04	0.98	0.97	0.99	0.95	0.95	0.95
Breast	0.98	0.98	0.99	0.97	1.06	1.02	1.00	0.98	1.05	1.01	1.01	1.03	1.05	0.98	0.94	0.93	0.93
Cervix Uteri	0.90	0.87	0.86	0.87	0.86	0.76	-	-	-	-	-	-	-	-	-	-	1.70
Corpus & Uterus, NOS	0.89	0.88	0.87	0.88	1.19	1.35	1.13	1.18	1.03	0.92	0.92	0.93	0.90	0.91	0.91	0.90	0.91
Ovary	0.91	0.93	0.92	0.91	0.92	0.92	0.91	0.91	0.91	0.90	0.87	0.88	0.87	0.87	0.87	0.89	0.88
Prostate Gland	0.93	0.93	0.97	0.96	0.96	0.96	0.97	1.02	1.02	1.10	1.10	1.10	1.04	1.04	0.99	0.97	0.93
Testis	0.83	0.83	0.82	0.85	0.84	0.79	0.80	0.80	0.80	0.79	-	-	-	0.80	0.83	0.83	1.17
Urinary Bladder	0.91	0.91	0.91	0.92	0.92	0.92	0.90	0.92	0.92	0.92	0.92	0.93	0.92	0.92	0.92	0.93	1.02
Kidney & Renal Pelvis	0.93	0.94	0.95	0.95	0.94	0.89	0.92	0.92	0.91	0.91	1.03	1.09	1.09	1.06	1.04	0.88	0.88
Brain & Nervous System	0.88	0.86	0.82	0.90	0.87	0.83	0.83	0.84	0.85	0.87	0.87	0.90	0.87	1.06	1.12	1.28	1.27
Thyroid Gland	1.38	0.79	0.81	0.83	0.86	0.88	0.88	0.89	1.02	0.99	1.19	1.16	1.16	0.96	1.06	0.96	0.93
Hodgkin's Disease	0.77	0.79	0.78	0.82	0.90	0.80	0.89	0.83	0.86	0.86	0.85	0.83	0.84	0.84	0.84	0.85	0.83
Non-Hodgkin's Lymphoma	0.90	0.90	0.89	0.89	0.91	0.89	0.90	0.91	0.91	0.91	0.92	0.92	0.91	0.91	0.91	0.91	0.90
Multiple Myeloma	0.94	0.93	0.93	0.93	0.92	0.96	-	-	-	-	0.93	0.93	0.92	0.92	0.91	-	-
Leukemia	0.96	0.98	1.03	1.03	1.08	0.88	0.88	0.87	0.91	0.93	0.93	0.92	0.92	1.08	1.20	1.06	1.05
Breast, Female	0.97	0.98	0.99	0.97	1.06	1.01	0.99	0.98	1.03	0.99	1.00	1.01	1.03	0.98	0.94	0.93	0.92
Ovary, Female	0.90	0.91	0.92	0.90	0.90	0.91	0.90	0.90	0.89	0.90	0.86	0.87	0.86	0.86	0.86	0.88	0.88
Lung, Male	0.97	0.94	0.93	0.93	0.93	0.91	0.93	0.93	1.21	1.09	1.02	0.99	0.97	0.92	1.01	1.00	1.00
Prostate, Male	0.94	0.94	0.97	0.96	0.96	0.96	0.96	1.06	1.05	1.12	1.11	1.09	1.02	1.02	0.98	0.96	0.92
Brain & Nerv. Sys., Male	0.86	0.86	0.86	0.90	0.89	-	-	0.89	0.92	0.89	0.89	0.89	0.94	1.50	1.53	1.62	1.63
Brain & Nerv. Sys., Female	0.91	0.87	-	-	0.89	0.88	0.81	0.80	0.80	0.80	0.85	0.89	0.85	0.86	0.85	0.83	0.84
All Sites, Both Sexes	0.96	0.94	0.98	0.99	1.01	1.01	1.00	0.98	1.00	1.00	1.00	1.00	0.99	0.98	0.97	0.96	0.95
All Sites, Male	0.95	0.93	0.96	1.00	1.01	1.06	1.05	1.04	1.03	1.04	1.02	1.02	0.99	0.97	0.97	0.96	0.95
All Sites, Female	0.96	0.96	0.99	0.98	1.02	0.98	0.97	0.95	0.97	0.96	0.97	0.97	0.98	0.98	0.97	0.96	0.95

† Rate ratios are derived from Table A.7 (numerator) and Table A.4 (denominator).

Source: New Mexico Tumor Registry

TABLE A.13

FIVE-YEAR AVERAGE ANNUAL INCIDENCE RATE RATIOS†
NEW MEXICO NON-HISPANIC WHITES / U.S. SEER WHITES, 1973-1988

By Primary Cancer Site and Midpoint of Five-Year Interval

SITE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Oral & Pharynx	-	-	-	0.98	1.01	1.09	1.17	1.18	1.18	1.12	1.03	1.03	1.06	1.03	1.00	-	-
Esophagus	-	-	-	0.67	0.74	0.70	0.70	0.68	0.71	0.68	0.68	0.74	0.78	0.73	0.68	-	-
Stomach	-	-	-	0.73	0.79	0.77	0.76	0.73	0.77	0.71	0.69	0.71	0.72	0.66	0.70	-	-
Colon/Rectum	-	-	-	0.79	0.79	0.77	0.76	0.79	0.78	0.79	0.79	0.76	0.77	0.78	0.79	-	-
Liver	-	-	-	1.14	1.09	1.12	1.12	1.21	1.19	1.01	1.06	0.86	0.70	0.74	0.79	-	-
Pancreas	-	-	-	0.98	0.98	0.97	1.03	0.96	0.97	0.93	0.92	0.88	0.90	0.83	0.86	-	-
Larynx	-	-	-	0.96	0.95	0.89	0.88	0.80	0.79	0.76	0.75	0.72	0.75	0.74	0.70	-	-
Lung & Bronchus	-	-	-	0.95	0.95	0.95	0.94	0.94	0.94	0.92	0.90	0.88	0.86	0.84	0.84	-	-
Melanoma of Skin	-	-	-	1.56	1.47	1.49	1.50	1.50	1.48	1.46	1.44	1.48	1.51	1.49	1.43	-	-
Breast	-	-	-	0.97	0.99	0.97	0.97	0.95	0.94	0.93	0.93	0.92	0.91	0.90	0.88	-	-
Cervix Uteri	-	-	-	1.18	1.21	1.15	1.06	0.98	0.98	1.04	1.06	1.06	1.02	1.03	1.00	-	-
Corpus & Uterus, NOS	-	-	-	0.83	0.85	0.85	0.88	0.85	0.83	0.79	0.79	0.75	0.77	0.77	0.77	-	-
Ovary	-	-	-	0.90	0.87	0.91	0.90	0.90	0.91	0.94	0.89	0.91	0.92	0.94	0.91	-	-
Prostate Gland	-	-	-	1.08	1.05	1.05	1.06	1.07	1.12	1.15	1.21	1.21	1.20	1.15	1.09	-	-
Testis	-	-	-	1.07	1.04	1.02	0.98	1.04	1.02	0.97	0.95	0.98	0.91	0.91	0.91	-	-
Urinary Bladder	-	-	-	0.88	0.84	0.83	0.89	0.87	0.86	0.90	0.89	0.85	0.87	0.92	0.92	-	-
Kidney & Renal Pelvis	-	-	-	1.07	1.07	1.13	1.14	1.10	1.03	0.99	0.91	0.86	0.81	0.81	0.78	-	-
Brain & Nervous System	-	-	-	0.99	0.96	0.85	0.82	0.79	0.77	0.79	0.80	0.85	0.93	0.90	0.91	-	-
Thyroid Gland	-	-	-	1.25	1.23	1.21	1.26	1.22	1.18	1.11	1.06	1.09	1.06	0.99	0.99	-	-
Hodgkin's Disease	-	-	-	0.99	0.99	0.98	0.90	0.85	0.82	0.84	0.79	0.81	0.82	0.81	0.81	-	-
Non-Hodgkin's Lymphoma	-	-	-	0.96	0.99	0.91	0.89	0.91	0.93	0.93	0.94	0.94	0.92	0.88	0.83	-	-
Multiple Myeloma	-	-	-	0.91	0.87	0.84	0.90	0.88	0.82	0.84	0.90	0.94	0.91	0.97	0.93	-	-
Leukemia	-	-	-	0.97	1.01	0.97	1.00	1.01	1.04	0.97	0.95	0.97	0.95	0.93	0.90	-	-
Breast, Female	-	-	-	0.98	1.00	0.98	0.98	0.96	0.95	0.95	0.95	0.94	0.93	0.91	0.89	-	-
Ovary, Female	-	-	-	0.91	0.88	0.93	0.92	0.91	0.94	0.96	0.91	0.91	0.94	0.96	0.92	-	-
Lung, Male	-	-	-	0.91	0.91	0.93	0.92	0.93	0.93	0.90	0.89	0.86	0.84	0.82	0.82	-	-
Prostate, Male	-	-	-	1.03	1.00	1.00	1.01	1.02	1.07	1.10	1.15	1.14	1.14	1.09	1.03	-	-
Brain & Nerv. Sys., Male	-	-	-	1.06	1.06	0.93	0.85	0.82	0.81	0.81	0.79	0.85	0.97	0.95	0.93	-	-
Brain & Nerv. Sys., Female	-	-	-	0.88	0.79	0.74	0.75	0.74	0.71	0.74	0.80	0.83	0.83	0.84	0.88	-	-
All Sites, Both Sexes	-	-	-	0.95	0.95	0.94	0.94	0.94	0.94	0.93	0.93	0.92	0.92	0.90	0.89	-	-
All Sites, Male	-	-	-	0.93	0.92	0.92	0.93	0.93	0.94	0.93	0.93	0.92	0.91	0.89	0.88	-	-
All Sites, Female	-	-	-	0.96	0.96	0.94	0.95	0.93	0.93	0.92	0.92	0.91	0.91	0.90	0.89	-	-

† Rate ratios are derived from data in Table A.3 (numerator) and Table A.2 (denominator).

Source: New Mexico Tumor Registry and U.S. SEER

TABLE A.14

NUMBER OF CANCER CASES PER FIVE-YEAR INTERVAL
LOS ALAMOS COUNTY, NON-HISPANIC WHITES, 1970-1990

By Primary Cancer Site and Midpoint of Five-Year Interval

SITE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Oral & Pharynx	2	2	2	3	4	3	4	3	4	4	5	5	6	6	5	6	5
Stomach	3	3	1	1	0	0	2	2	2	3	3	3	4	4	3	2	1
Colon/Rectum	21	16	12	12	13	14	14	18	19	27	24	28	31	34	27	28	28
Liver	0	0	0	0	0	0	0	1	2	2	2	2	1	1	1	1	1
Pancreas	6	4	3	4	3	2	4	6	7	7	7	6	4	2	5	4	4
Larynx	0	0	1	1	1	1	1	1	2	2	3	3	2	1	1	0	0
Lung & Bronchus	5	10	12	13	15	12	9	9	8	9	13	17	21	26	29	28	28
Melanoma of Skin	7	4	6	7	9	10	11	9	12	14	13	20	27	24	24	27	25
Breast	32	30	31	31	31	31	35	36	39	44	49	50	47	51	55	55	64
Cervix Uteri	2	3	3	2	2	1	0	0	0	0	0	0	0	0	0	0	1
Corpus & Uterus, NOS	7	6	5	4	3	2	4	3	5	4	4	3	5	4	6	9	10
Ovary	2	1	1	2	3	5	6	7	8	10	9	10	15	14	13	14	12
Prostate Gland	8	14	14	17	15	15	13	16	16	21	25	29	32	33	36	37	46
Testis	2	2	2	2	2	3	3	3	2	2	0	0	0	1	2	2	2
Urinary Bladder	6	7	7	6	5	4	3	4	7	7	9	9	8	5	6	4	8
Kidney & Renal Pelvis	3	3	1	1	1	2	5	5	5	5	5	5	5	6	6	5	2
Brain & Nervous System	3	2	1	1	2	1	2	3	4	4	6	5	6	8	8	7	7
Thyroid Gland	3	3	4	6	5	8	8	7	5	7	4	4	4	7	8	11	16
Hodgkin's Disease	2	2	2	1	1	1	1	2	1	1	4	4	3	5	5	4	4
Non-Hodgkin's Lymphoma	6	6	4	5	6	6	7	8	8	9	9	10	12	13	14	13	13
Multiple Myeloma	1	2	2	2	2	1	0	0	0	0	2	2	2	2	2	0	0
Leukemia	7	6	5	5	4	3	3	3	5	9	8	8	9	7	5	7	8
Breast, Female	31	29	31	31	31	31	35	36	39	44	49	50	47	51	55	54	63
Ovary, Female	2	1	1	2	3	5	6	7	8	10	9	10	15	14	13	14	12
Lung, Male	5	9	9	9	9	5	2	3	3	5	8	13	18	21	24	23	21
Prostate, Male	8	14	14	17	15	15	13	16	16	21	25	29	32	33	36	37	46
Brain & Nerv. Sys., Male	2	1	1	1	1	0	0	1	2	2	2	2	1	2	3	4	4
Brain & Nerv. Sys., Female	1	1	0	0	1	1	2	2	2	2	4	3	5	6	5	3	3
All Sites, Both Sexes	132	131	122	130	132	132	144	156	172	203	218	236	256	268	279	287	311
All Sites, Male	60	63	60	65	61	56	61	71	74	92	99	110	119	131	140	147	157
All Sites, Female	72	68	62	65	71	76	83	85	98	111	119	126	137	137	139	140	154

Source: New Mexico Tumor Registry

APPENDIX B

FREQUENCY DISTRIBUTIONS FOR SELECT CANCER SITES: CASE DEMOGRAPHIC FACTORS AND YEAR OF DIAGNOSIS

FIGURE B.1

FREQUENCY DISTRIBUTIONS - LIVER AND INTRA-HEPATIC BILE DUCT CANCER
CASE DEMOGRAPHICS AND YEAR OF DIAGNOSIS
LOS ALAMOS COUNTY, 1970-1990

YEAR OF DIAGNOSIS

1970	0	0.0%	
1971	0	0.0%	
1972	0	0.0%	
1973	0	0.0%	
1974	0	0.0%	
1975	0	0.0%	
1976	0	0.0%	
1977	0	0.0%	
1978	0	0.0%	
1979	0	0.0%	
1980	0	0.0%	
1981	1	14.3%	***
1982	3	42.9%	********
1983	0	0.0%	
1984	0	0.0%	
1985	0	0.0%	
1986	0	0.0%	
1987	1	14.3%	***
1988	0	0.0%	
1989	1	14.3%	***
1990	1	14.3%	***
	7	100.0%	

RACE

ANGLO	5	71.4%
HISPANIC	2	28.6%
	7	100.0%

SEX

MALE	4	57.1%
FEMALE	3	42.9%
	7	100.0%

AGE AT DIAGNOSIS (YRS)

0 - 9	0	0.0%	
10 - 19	0	0.0%	
20 - 29	0	0.0%	
30 - 39	0	0.0%	
40 - 49	0	0.0%	
50 - 59	1	14.3%	***
60 - 69	3	42.9%	*********
70 - 79	1	14.3%	***
80 - 89	2	28.6%	******
90+	0	0.0%	
	7	100.0%	

SOURCE: New Mexico Tumor Registry

FIGURE B.2

FREQUENCY DISTRIBUTIONS: NON-HODGKIN'S LYMPHOMA CASE DEMOGRAPHICS AND YEAR OF DIAGNOSIS, LOS ALAMOS COUNTY, 1970-1990

YEAR OF DIAGNOSIS

1970	0	0.0%	
1971	2	5.6%	**
1972	1	2.8%	*
1973	1	2.8%	*
1974	2	5.6%	**
1975	0	0.0%	
1976	0	0.0%	
1977	2	5.6%	**
1978	2	5.6%	**
1979	2	5.6%	**
1980	1	2.8%	*
1981	1	2.8%	*
1982	2	5.6%	**
1983	3	8.3%	***
1984	2	5.6%	**
1985	2	5.6%	**
1986	3	8.3%	***
1987	3	8.3%	***
1988	4	11.1%	****
1989	1	2.8%	*
1990	2	5.6%	**
	36	100.0%	

RACE

ANGLO	36	100.0%

SEX

MALE	21	58.3%
FEMALE	15	41.7%
	36	100%

AGE AT DIAGNOSIS (YRS)

0 - 9	2	5.6%	**
10 - 19	0	0.0%	
20 - 29	1	2.8%	*
30 - 39	3	8.3%	***
40 - 49	2	5.6%	**
50 - 59	9	25.0%	********
60 - 69	8	22.2%	*******
70 - 79	9	25.0%	********
80 - 89	2	5.6%	**
90+	0	0.0%	
	36	100%	

SOURCE: New Mexico Tumor Registry

FIGURE B.3

FREQUENCY DISTRIBUTIONS: LEUKEMIA CASE DEMOGRAPHICS AND YEAR OF DIAGNOSIS, LOS ALAMOS COUNTY, 1970-1990

YEAR OF DIAGNOSIS

1970	1	3.6%	*
1971	1	3.6%	*
1972	1	3.6%	*
1973	2	7.1%	**
1974	3	10.7%	****
1975	0	0.0%	
1976	0	0.0%	
1977	1	3.6%	*
1978	1	3.6%	*
1979	1	3.6%	*
1980	0	0.0%	
1981	0	0.0%	
1982	3	10.7%	****
1983	5	17.9%	******
1984	0	0.0%	
1985	0	0.0%	
1986	1	3.6%	*
1987	2	7.1%	**
1988	3	10.7%	****
1989	2	7.1%	**
1990	1	3.6%	*
	28	100.0%	

RACE

ANGLO	26	92.9%
HISPANIC	2	7.1%
	28	100.0%

SEX

MALE	20	71.4%
FEMALE	8	28.6%
	28	100%

AGE AT DIAGNOSIS (YRS)

0 - 9	3	10.7%	****
10 - 19	2	7.1%	**
20 - 29	0	0.0%	
30 - 39	2	7.1%	**
40 - 49	2	7.1%	**
50 - 59	8	28.6%	*********
60 - 69	8	28.6%	*********
70 - 79	3	10.7%	****
80 - 89	0	0.0%	
90+	0	0.0%	
	28	100%	

SOURCE: New Mexico Tumor Registry

FIGURE B.4

FREQUENCY DISTRIBUTIONS: MELANOMA OF SKIN CASE DEMOGRAPHICS AND YEAR OF DIAGNOSIS, LOS ALAMOS COUNTY, 1970-1990

YEAR OF DIAGNOSIS

1970	3	4.8%	**
1971	0	0.0%	
1972	2	3.2%	*
1973	0	0.0%	
1974	2	3.2%	*
1975	0	0.0%	
1976	2	3.2%	*
1977	3	4.8%	**
1978	2	3.2%	*
1979	3	4.8%	**
1980	1	1.6%	*
1981	0	0.0%	
1982	6	9.5%	***
1983	5	7.9%	***
1984	4	6.3%	*
1985	8	12.7%	****
1986	7	11.1%	****
1987	3	4.8%	**
1988	4	6.3%	**
1989	4	6.3%	**
1990	4	6.3%	**
	63	100.0%	

RACE

ANGLO	59	93.7%
HISPANIC	4	6.3%
	63	100.0%

SEX

MALE	35	55.6%
FEMALE	28	44.4%
	63	100.0%

AGE AT DIAGNOSIS (YRS)

0 - 9	0	0.0%	
10 - 19	2	3.2%	*
20 - 29	5	7.9%	***
30 - 39	14	22.2%	*******
40 - 49	12	19.0%	******
50 - 59	11	17.5%	******
60 - 69	13	20.6%	*******
70 - 79	4	6.3%	**
80 - 89	1	1.6%	*
90+	1	1.6%	*
	63	100.0%	

SOURCE: New Mexico Tumor Registry

FIGURE B.5

FREQUENCY DISTRIBUTIONS: OVARIAN CANCER CASE DEMOGRAPHICS AND YEAR OF DIAGNOSIS, LOS ALAMOS COUNTY, 1970-1990

YEAR OF DIAGNOSIS

1970	1	3.3%	*
1971	0	0.0%	
1972	1	3.3%	*
1973	0	0.0%	
1974	0	0.0%	
1975	0	0.0%	
1976	0	0.0%	
1977	2	6.7%	**
1978	1	3.3%	*
1979	2	6.7%	**
1980	1	3.3%	*
1981	1	3.3%	*
1982	3	10.0%	***
1983	3	10.0%	***
1984	1	3.3%	*
1985	2	6.6%	**
1986	6	20.0%	*******
1987	2	6.7%	**
1988	2	6.7%	**
1989	2	6.7%	**
1990	0	0.0%	
	30	100.0%	

RACE

ANGLO	28	93.3%
HISPANIC	0	0.0%
UNKNOWN	2	6.7%
	30	100%

AGE AT DIAGNOSIS (YRS)

0 - 9	0	0.0%	
10 - 19	0	0.0%	
20 - 29	2	6.7%	**
30 - 39	1	3.3%	*
40 - 49	12	40.0%	**********
50 - 59	6	20.0%	*******
60 - 69	4	13.3%	****
70 - 79	3	10.0%	***
80 - 89	2	6.7%	**
90+	0	0.0%	
	30	100%	

SOURCE: New Mexico Tumor Registry

FIGURE B.6

FREQUENCY DISTRIBUTIONS: BREAST CANCER CASE DEMOGRAPHICS AND YEAR OF DIAGNOSIS, LOS ALAMOS COUNTY, 1970-1990

YEAR OF DIAGNOSIS

1970	8	4.0%	*
1971	6	3.0%	*
1972	5	2.5%	*
1973	8	4.0%	*
1974	7	3.5%	*
1975	6	3.0%	*
1976	8	4.0%	*
1977	4	2.0%	*
1978	10	5.0%	**
1979	6	3.0%	*
1980	10	5.0%	**
1981	8	4.0%	*
1982	9	4.5%	*
1983	15	7.5%	**
1984	12	6.0%	**
1985	12	6.0%	**
1986	6	3.0%	*
1987	11	5.5%	**
1988	17	8.5%	***
1989	11	5.5%	**
1990	21	10.5%	***
	200	100.0%	

RACE

ANGLO	185	92.5%
HISPANIC	10	5.0%
BLACK	1	0.5%
UNKNOWN	4	2.0%
	200	100.0%

SEX

MALE	2	1.0%
FEMALE	198	99.0%
	200	100.0%

AGE AT DIAGNOSIS (YRS)

0 - 9	0	0.0%	
10 - 19	0	0.0%	
20 - 29	0	0.0%	
30 - 39	13	6.5%	**
40 - 49	56	28.0%	*********
50 - 59	59	29.5%	**********
60 - 69	41	20.5%	*******
70 - 79	21	10.5%	***
80 - 89	7	3.5%	*
90+	2	1.0%	
UNKNOWN	1	0.5%	
	200	100.0%	

SOURCE: New Mexico Tumor Registry

FIGURE B.7

FREQUENCY DISTRIBUTIONS - CHILDHOOD CANCER CASE DEMOGRAPHICS AND YEAR OF DIAGNOSIS, LOS ALAMOS COUNTY, 1970-1990

YEAR OF DIAGNOSIS

1970	4	20.0%	*******
1971	0	0.0%	
1972	1	5.0%	**
1973	1	5.0%	**
1974	3	15.0%	*****
1975	0	0.0%	
1976	0	0.0%	
1977	1	5.0%	**
1978	0	0.0%	
1979	1	5.0%	**
1980	1	5.0%	**
1981	2	10.0%	***
1982	0	0.0%	
1983	2	10.0%	***
1984	1	5.0%	**
1985	0	0.0%	
1986	1	5.0%	**
1987	1	5.0%	**
1988	0	0.0%	
1989	1	5.0%	**
1990	0	0.0%	
	20	100.0%	

AGE AT DIAGNOSIS (YRS)

0 - 9	8	40.0%
10 - 19	12	60.0%
	20	100.0%

RACE

ANGLO	14	70.0%
HISPANIC	5	25.0%
JAPANESE	1	5.0%
	20	100.0%

SEX

MALE	10	50.0%
FEMALE	10	50.0%
	20	100.0%

SOURCE: New Mexico Tumor Registry

FIGURE B.8

FREQUENCY DISTRIBUTIONS: THYROID CANCER CASE DEMOGRAPHICS AND YEAR OF DIAGNOSIS, LOS ALAMOS COUNTY, 1970-1990

YEAR OF DIAGNOSIS

1970	3	8.1%	***
1971	1	2.7%	*
1972	0	0.0%	
1973	1	2.7%	*
1974	1	2.7%	*
1975	0	0.0%	
1976	2	5.4%	**
1977	2	5.4%	**
1978	0	0.0%	
1979	4	10.8%	****
1980	0	0.0%	
1981	1	2.7%	*
1982	1	2.7%	*
1983	2	5.4%	**
1984	2	5.4%	**
1985	0	0.0%	
1986	1	2.7%	*
1987	3	8.1%	***
1988	4	10.8%	****
1989	4	10.8%	****
1990	5	13.5%	****
	37	100.0%	

RACE

ANGLO	30	81.1%
HISPANIC	6	16.2%
UNKNOWN	1	2.7%
	37	100.0%

SEX

MALE	11	29.7%
FEMALE	26	70.3%
	37	100.0%

AGE AT DIAGNOSIS (YRS)

0 - 9	1	2.7%	*
10 - 19	3	8.1%	***
20 - 29	2	5.4%	**
30 - 39	10	27.0%	*********
40 - 49	5	13.5%	****
50 - 59	11	29.7%	**********
60 - 69	4	10.8%	****
70 - 79	1	2.7%	*
80 - 89	0	0.0%	
90+	0	0.0%	
	37	100.0%	

SOURCE: New Mexico Tumor Registry

FIGURE B.8

FREQUENCY DISTRIBUTIONS: THYROID CANCER CASE DEMOGRAPHICS AND YEAR OF DIAGNOSIS, LOS ALAMOS COUNTY, 1970-1990

YEAR OF DIAGNOSIS

1970	3	8.1%	***
1971	1	2.7%	*
1972	0	0.0%	
1973	1	2.7%	*
1974	1	2.7%	*
1975	0	0.0%	
1976	2	5.4%	**
1977	2	5.4%	**
1978	0	0.0%	
1979	4	10.8%	****
1980	0	0.0%	
1981	1	2.7%	*
1982	1	2.7%	*
1983	2	5.4%	**
1984	2	5.4%	**
1985	0	0.0%	
1986	1	2.7%	*
1987	3	8.1%	***
1988	4	10.8%	****
1989	4	10.8%	****
1990	5	13.5%	****
	37	100.0%	

RACE

ANGLO	30	81.1%
HISPANIC	6	16.2%
UNKNOWN	1	2.7%
	37	100.0%

SEX

MALE	11	29.7%
FEMALE	26	70.3%
	37	100.0%

AGE AT DIAGNOSIS (YRS)

0 - 9	1	2.7%	*
10 - 19	3	8.1%	***
20 - 29	2	5.4%	**
30 - 39	10	27.0%	*********
40 - 49	5	13.5%	****
50 - 59	11	29.7%	**********
60 - 69	4	10.8%	****
70 - 79	1	2.7%	*
80 - 89	0	0.0%	
90+	0	0.0%	
	37	100.0%	

SOURCE: New Mexico Tumor Registry

FIGURE B.9

FREQUENCY DISTRIBUTIONS: BRAIN CANCER CASE DEMOGRAPHICS AND YEAR OF DIAGNOSIS, LOS ALAMOS COUNTY, 1970-1990 (Original)†

YEAR OF DIAGNOSIS

1970	1	4.5%	*
1971	1	4.5%	*
1972	0	0.0%	
1973	0	0.0%	
1974	1	4.5%	*
1975	0	0.0%	
1976	0	0.0%	
1977	0	0.0%	
1978	1	4.5%	*
1979	0	0.0%	
1980	1	4.5%	*
1981	1	4.5%	*
1982	1	4.5%	*
1983	1	4.5%	*
1984	2	9.1%	***
1985	0	0.0%	
1986	2	9.1%	***
1987	4	18.2%	******
1988	2	9.1%	***
1989	2	9.1%	***
1990	2	9.1%	***
	22	100.0%	

RACE

ANGLO	19	86.4%
HISPANIC	3	13.6%
	22	100.0%

SEX

MALE	12	54.5%
FEMALE	10	45.5%
	22	100.0%

AGE AT DIAGNOSIS (YRS)

0 - 9	2	9.1%	***
10 - 19	0	0.0%	
20 - 29	1	4.5%	*
30 - 39	4	18.2%	******
40 - 49	6	27.3%	*********
50 - 59	3	13.6%	****
60 - 69	3	13.6%	****
70 - 79	2	9.1%	***
80 - 89	1	4.5%	**
90+	0	0.0%	
	22	100.0%	

† Includes one case each of cerebral immunoblastic lymphoma (1990) and melanoma of spinal meninges (1990), neither of which were included in the brain cancer incidence rate calculations. Each was reclassified according to histologic tissue of origin.

SOURCE: New Mexico Tumor Registry

FIGURE B.10

FREQUENCY DISTRIBUTIONS: BRAIN CANCER CASE DEMOGRAPHICS AND YEAR OF DIAGNOSIS, LOS ALAMOS COUNTY, 1970-1990 (Revised)†

YEAR OF DIAGNOSIS

1970	1	4.5%	*
1971	1	4.5%	*
1972	0	0.0%	
1973	0	0.0%	
1974	1	4.5%	*
1975	0	0.0%	
1976	0	0.0%	
1977	0	0.0%	
1978	2	9.1%	***
1979	0	0.0%	
1980	2	9.1%	***
1981	1	4.5%	*
1982	1	4.5%	*
1983	1	4.5%	*
1984	2	9.1%	***
1985	0	0.0%	
1986	2	9.1%	***
1987	4	18.4%	******
1988	2	9.1%	***
1989	2	9.1%	***
1990	0	0.0%	
	22	100.0%	

RACE

ANGLO	19	86.4%
HISPANIC	3	13.6%
	22	100.0%

SEX

MALE	12	54.5%
FEMALE	10	45.5%
	22	100.0%

AGE AT DIAGNOSIS (YRS)

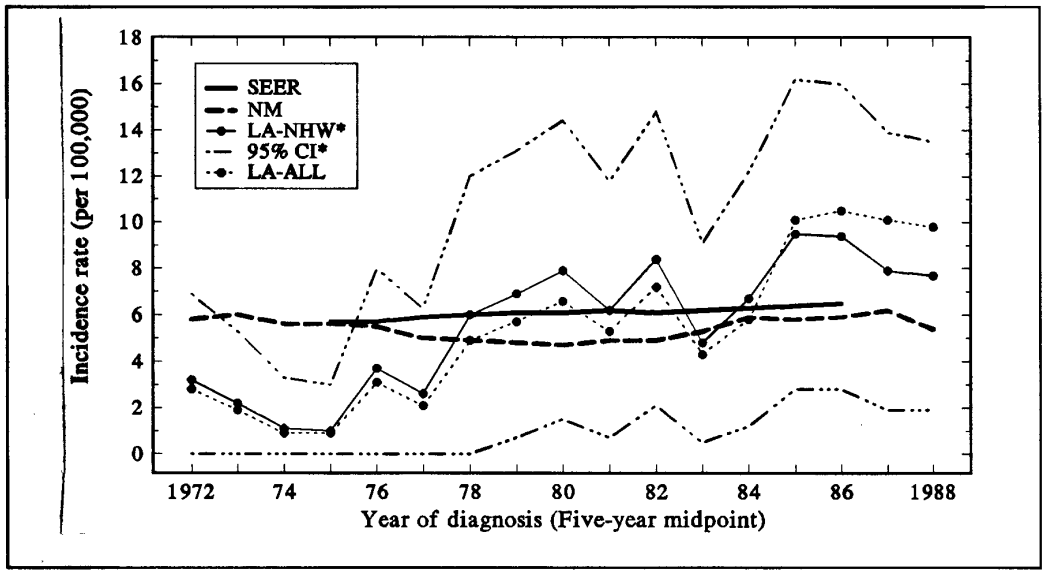
0 - 9	3	13.6%	****
10 - 19	1	4.5%	*
20 - 29	0	0.0%	
30 - 39	4	18.3%	*****
40 - 49	6	27.4%	********
50 - 59	3	13.6%	****
60 - 69	3	13.6%	****
70 - 79	2	9.1%	**
80 - 89	0	0.0%	
90+	0	0.0%	
	22	100.0%	

† Includes two additional childhood brain cancer cases (1978, 1980) described in Appendix C. Excludes one case each of cerebral immunoblastic lymphoma (1990) and melanoma of spinal meninges (1990) reclassified as described in Appendix B, Table B.9.

SOURCE: New Mexico Tumor Registry

FIGURE B.11

FIVE-YEAR AVERAGE ANNUAL INCIDENCE OF BRAIN & NERVOUS SYSTEM CANCERS:
LOS ALAMOS COUNTY, NEW MEXICO, AND SEER, 1970-1990.
(Revised)†



† Includes two additional childhood brain cancer cases diagnosed in 1978 and 1980, as described in Appendix C.
SOURCE: New Mexico Tumor Registry

APPENDIX C:

SUPPLEMENTAL CHILDHOOD CANCER DATA

Revision of Incident Childhood Cancer Case Numbers (1970-1990): Childhood cancer data presented at the second Phase I Steering Committee meeting revealed that childhood brain cancer deaths exceeded incident cases in 1970-1990. Two incident cases were observed whereas five deaths were registered (See Tables C.1 and C.2). Dr. Charles Key, NMTR Medical Director, reviewed death certificates and medical charts for the five decedent cases in order to reconcile the discrepancy between childhood brain cancer incidence and mortality. The results of the review showed that one of the death certificates (1987) was coded to the non-malignant range and the incident case actually involved a benign brain tumor (1987). Of the remaining four brain cancer deaths, the two discrepant decedent cases were found to be residents of LAC at diagnosis but had not been registered with the NMTR. One case was diagnosed out-of-state and expired prior to returning to New Mexico (1978). The second case died suddenly in New Mexico prior to diagnosis (1980). Based on the results of the case review, the number of LAC childhood brain cancer cases in 1970-1990 was revised upwards from two to four. Since both cases occurred in 1978-1980, the net effect of the revised case count on childhood cancer incidence rates was to increase the average annual rate for 1978-1982 from 13.7 cases per 100,000 to 20.3 cases per 100,000. This modification is reflected in the revised childhood cancer incidence rate graph presented as Figure C.1

TABLE C.1
DISTRIBUTION OF INCIDENT CHILDHOOD CANCER CASES (< 20 Years)
BY PRIMARY CANCER SITE AND YEAR OF DIAGNOSIS
LOS ALAMOS COUNTY, 1970-1990

Site	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	TOTAL
Bones & Joints															1							1
Soft Tissues								1				1										2
Melanoma of Skin	1													1								2
Brain & Nervous System											1						1					2
Thyroid	2				1									1								4
Hodgkin's Disease			1									1										2
Non-Hodgkin's Lymphoma				1						1												2
Leukemia	1				2													1		1		5
All Sites	4	0	1	1	3	0	0	1	0	1	1	2	0	2	1	0	1	1	0	1	0	20

Source: New Mexico Tumor Registry

APPENDIX C:

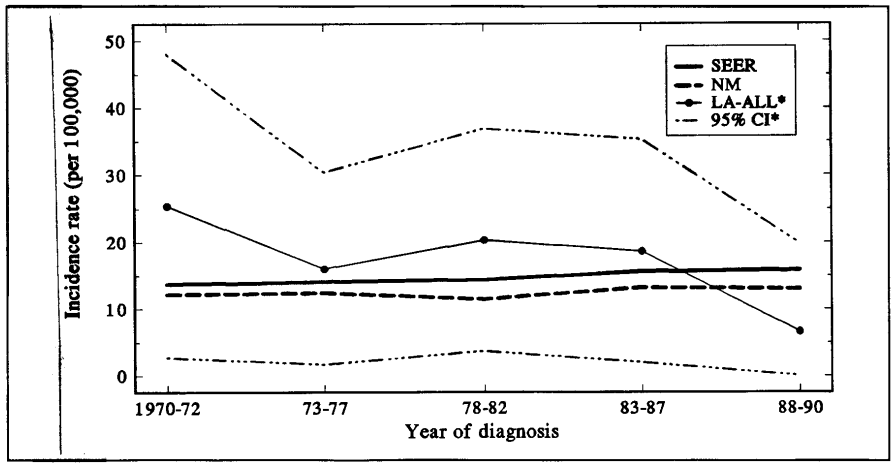
SUPPLEMENTAL CHILDHOOD CANCER RATE DATA

TABLE C.2
DISTRIBUTION OF DECEDENT CHILDHOOD CANCER CASES (< 20 Years) BY PRIMARY CANCER SITE AND YEAR OF DEATH LOS ALAMOS COUNTY, 1970-1990

Site	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	TOTAL
Soft Tissues													1									1
Brain & Nervous System †									1		1	1						2				5
Hodgkin's Disease				1																		1
Non-Hodgkin's Lymphoma											1											1
Leukemia				1		2								1								4
All Sites	0	0	0	2	0	2	0	0	1	0	2	1	1	1	0	0	0	2	0	0	0	12

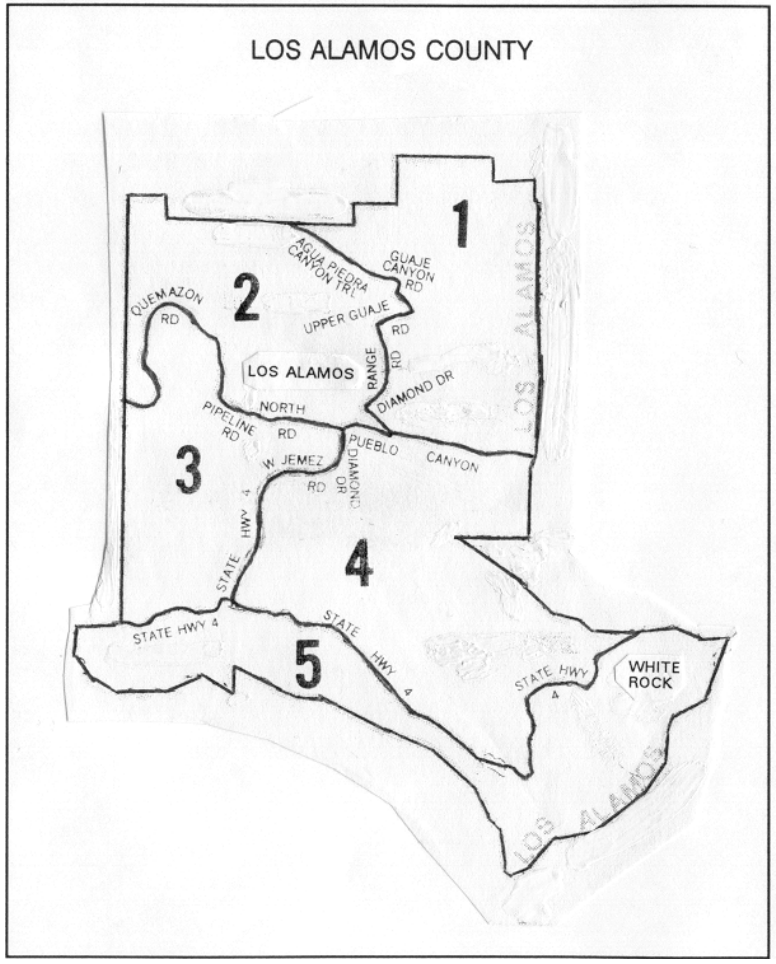
† Includes one benign brain tumor death (1987).
Source: New Mexico Tumor Registry

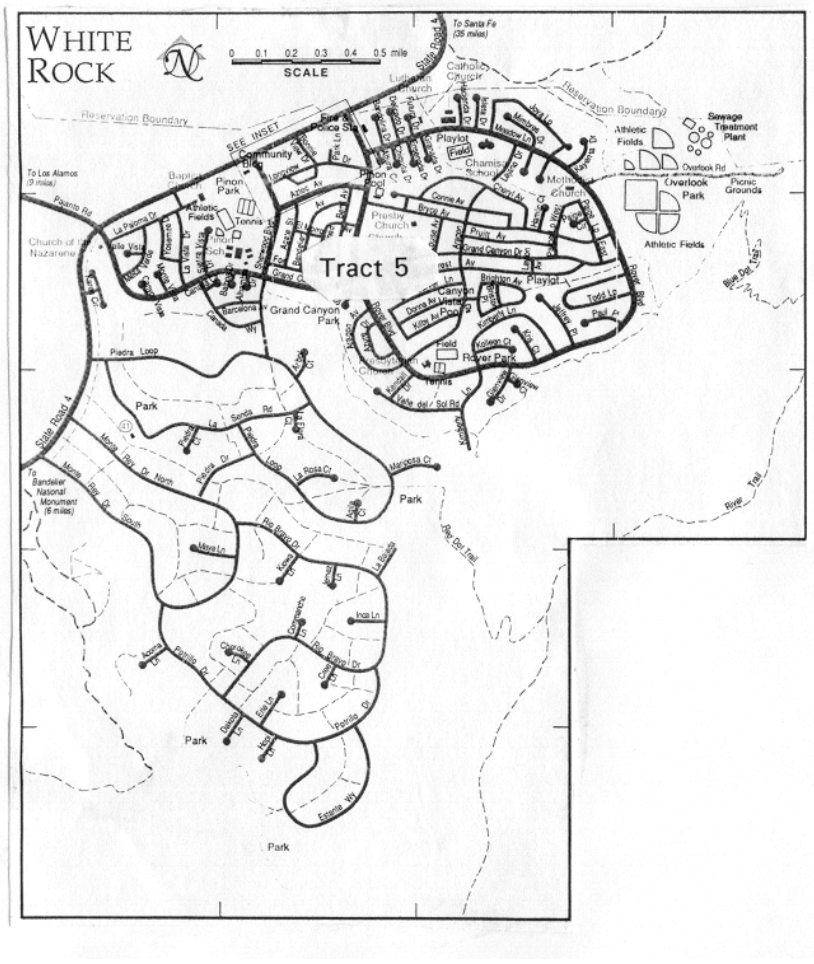
FIGURE C.1
REVISED AVERAGE ANNUAL INCIDENCE OF CHILDHOOD CANCER (<20 YEARS), LOS ALAMOS COUNTY, NEW MEXICO, SEER, 1970-1990.



APPENDIX D

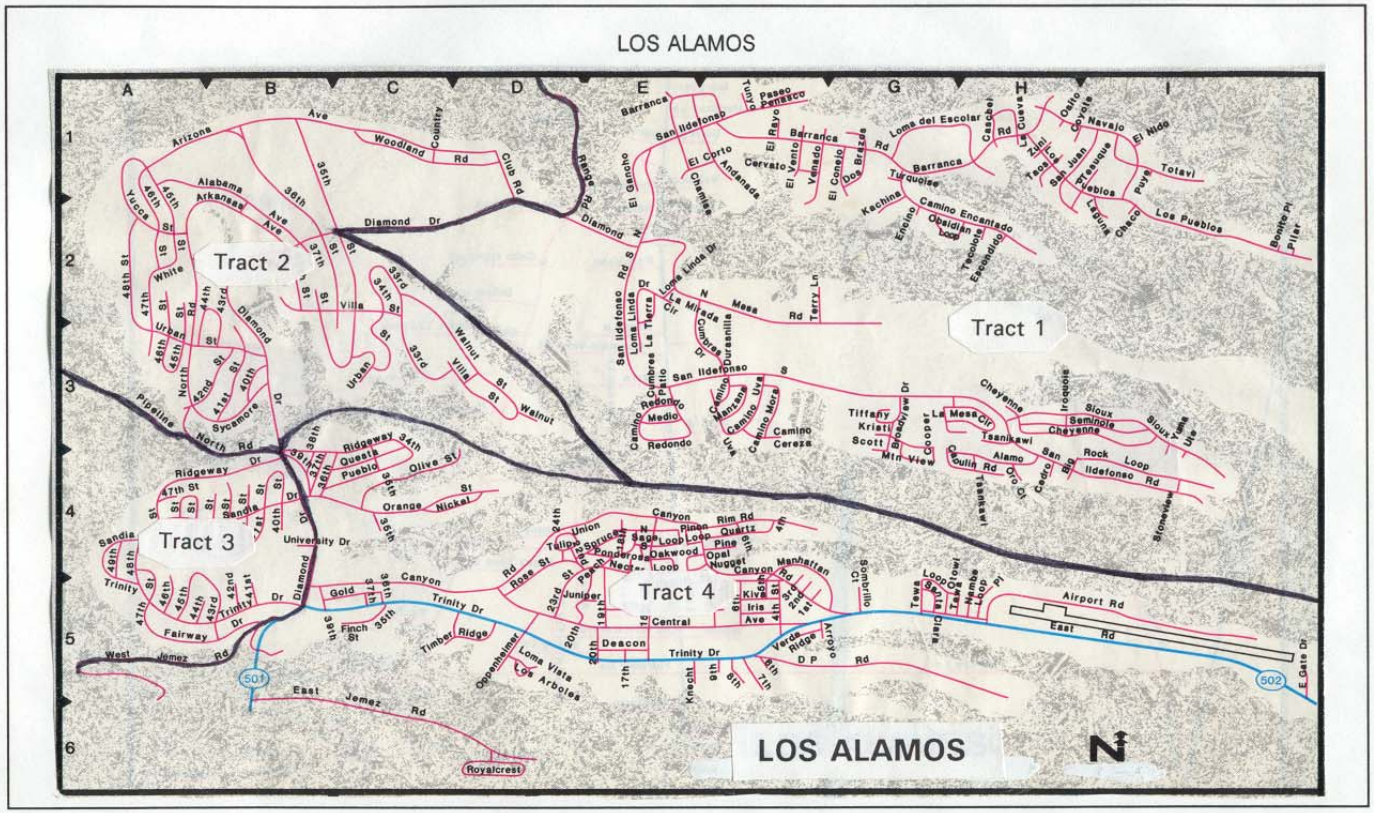
LOS ALAMOS COUNTY CENSUS TRACT MAPS





APPENDIX D

LOS ALAMOS COUNTY CENSUS TRACT MAPS



Los Alamos County census tracts roughly correspond to neighborhoods situated in White Rock and Los Alamos:

Census Tract 1: North Mesa, Barranca Mesa
Census Tract 2: North Community
Census Tract 3: Western Area
Census Tract 4: Eastern Area
Census Tarct 5: White Rock

APPENDIX E

LOS ALAMOS COUNTY POPULATION AGE DISTRIBUTIONS

TABLE E.1
POPULATION AGE DISTRIBUTION OF LOS ALAMOS COUNTY
ALL RACES, 1950-1990

	1950		1960		1970		1980		1990	
Age		%		%		%		%		%
0-4	1833	17.5	1901	14.6	1302	8.6	1115	6.3	1132	6.2
5-9	1015	9.7	1968	15.1	1942	12.8	1419	8.1	1331	7.3
10-14	503	4.8	1557	11.9	2074	13.6	1796	10.2	1411	7.8
15-19	359	3.4	701	5.4	1399	9.2	1659	9.4	1188	6.6
20-24	1005	9.6	375	2.9	570	3.8	805	4.6	566	3.1
25-29	1784	17.0	931	7.1	912	6.0	1126	6.4	1102	6.1
30-34	1477	14.1	1329	10.2	1149	7.6	1482	8.4	1449	8.0
35-39	980	9.4	1518	11.6	1168	7.7	1703	9.7	1563	8.6
40-44	600	5.7	1135	8.7	1264	8.3	1452	8.3	1716	9.5
45-49	340	3.2	704	5.4	1325	8.7	1236	7.0	1665	9.2
50-54	232	2.2	403	3.1	946	6.2	1255	7.1	1356	7.5
55-59	162	1.5	221	1.7	551	3.6	1153	6.6	1074	5.9
60-64	93	0.9	152	1.2	278	1.8	676	3.8	894	4.9
65+	93	0.9	142	1.1	318	2.1	722	4.1	1688	9.2
TOTAL	10476		13037		15198		17599		18115	

Source: U.S. Census