CANCER INCIDENCE STUDY

Cancer Incidence Follow-Up Investigation for Monticello, San Juan County, Utah Covering the Period from 1973 to 2009

October 1, 2012

Prepared by the

Utah Department of Health
Division of Disease Control and Prevention
Bureau of Epidemiology
Environmental Epidemiology Program

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ACKNOWLEDGMENT

Cancer data used for this investigation was obtained from the Utah Cancer Registry. The Utah Cancer Registry is funded by contract N01-PC-35141 from the National Cancer Institute's SEER Program with additional support from the Utah Department of Health and University of Utah.

Other data and analytical tools used for this investigation were obtained from the Utah Environmental Public Health Tracking Network. In addition, the Utah Environmental Public Health Tracking Network provides geocoding services to Utah Cancer Registry data. The Utah Environmental Public Health Tracking Network is funded by a grant from the Centers for Disease Control and Prevention, Environmental Public Health Tracking Branch. The current Utah Environmental Public Health Tracking Network award is number 1U38EH000954.

EXECUTIVE SUMMARY

Monticello, Utah is a rural city located in San Juan County in southeastern Utah. From 1943 to 1960, an active uranium and vanadium processing mill was located immediately adjacent to Monticello. Mill waste was deposited at the Monticello Mill Tailings Site (MMTS). Those tailings were contaminated with heavy metal and radioactive materials. Contaminated materials from the MMTS migrated into Monticello either as a result of natural phenomena or local utilization. Both the MMTS and the community were cleaned up; however, exposure to hazardous materials occurred before remediation. It is known that residents were exposed to both heavy metal and radioactive contaminates from the MMTS. Potential adverse health outcomes for exposure to contaminate materials from the MMTS include certain types of cancer disease. The Environmental Epidemiology Program, Utah Department of Health, conducted a cancer incidence study in 2006 and in 2007. Those studies looked at the rates of cancer for Monticello from 1973 to 2003 and 2004 respectively. Because of the long latency period of some types of cancer, periodic follow-up studies are recommended. This study is a five-year review of the 2007 study.

This report is a statistical review of cancer incidence among residents of Monticello from 1973 through 2009. The incidence of cancer, quantified as multi-year indirect age-standardized incidence rates of residents of Monticello are compared to corresponding incidence rates for the state of Utah. Cancer data was obtained from the Utah Cancer Registry and population data was derived from commercially available U.S. census data. Comparisons of the rates were conducted using a standardized rate ratio with 95% confidence intervals. Cancers with sufficient cancer incidence were analyzed in sequential 5-year analytical periods and the full 1973-2009 period that cancer data were available.

This study found that the rate of lung and bronchial cancer was elevated for all periods that had a case count larger than three and significantly elevated during three consecutive periods: 1995-1999 (standardized incidence ratio [SIR] = 3.3, 95% confidence interval = [1.5-6.2]), and 2000-2004 (SIR = 2.8, [1.1-5.9]), and 2005-2009 (SIR = 3.6, [1.2-7.1]). The lung and bronchial cancer rate was also elevated for males during the 1995-1999 study period (SIR = 3.5, [1.3-7.7]). Lung cancer has been associated with exposure to radioactive heavy metals such as uranium. The methodology used in this study is unable to conclusively link the observed lung cancers to contaminant exposure from the MMTS. Although inconclusive, these results, like previous investigations, are consistent with an increased risk of lung cancer having resulted from exposure to the MMTS. Furthermore, these results underscore that public health responses concerning past exposures, health risks, and adverse health outcomes, particularly cancer, are important for this community and that continued public health support is warranted.

INTRODUCTION

Monticello, Utah	
Location:	37^{O}52'09" N 109^{O}20'31" W
Elevation:	7,070 ft (2,155 m)
ZIP Code:	84535
Federal Information Processing Standards (FIPS) Code:	49-51580
Geographic Names Information System (GNIS) Code:	1443568
2000 U.S. Census Tract:	49.037.978100

Monticello, Utah is a rural city located in San Juan County in southeastern Utah. The U.S. Census Bureau (USCB) estimates the 2010 population for the City of Monticello at 1,972 persons. In this population estimate, 346 persons are children ages 0 to 9 years old. The median age of Monticello's population is 32 years. Approximately three percent (3%) of the total 2010 Monticello population are of a non-Caucasian race, and approximately thirteen percent (13%) of the population are of Hispanic or Latino ethnicity (USCB, 2012a). Monticello has approximately 615 households. Seventy-eight percent (78%) of the households are families and 40% of the households are families with children under 18 years of age. The median household income is $39,388. An estimated 9.4% of families have an annual income below the poverty level. The USCB does not have an estimate for the level of health insurance coverage for Monticello families. Approximately 55% of the population 16 years of age or older are in the labor force. Most employed residents work in education, health care or social services (20%), public administration (18%), construction (16%), or retail trade (14%). Fifty-two percent (52%) work for the government. Only about three percent (3%) are self employed (USCB, 2012b).

Statement of Concern: From 1943 to 1960, an active uranium and vanadium processing mill was located immediately adjacent to Monticello. Mill waste was deposited at the Monticello Mill Tailings Site (MMTS). These tailings were contaminated with heavy metals and radioactive materials. Contaminated materials from the MMTS migrated into Monticello either as a result of natural phenomena or local utilization. In 1986 and 1989, the Monticello Vicinity Properties (MVP), properties in Monticello that had contamination from the MMTS, and the MMTS were placed on the National Priority List (NPL) for clean-up actions. Remediation of the MVP was completed in 1999. Remediation of the MMTS was completed in 2004. Exposure to hazardous materials occurred before remediation. Although stringent controls were implemented to keep contamination from spreading, some exposure may have occurred on contaminated MVP properties during the remediation time period depending on scheduling of property clean-up activities. The MMTS was not accessible to the public during remediation and no exposure occurred during remediation for that property (ATSDR, 2012). Since the completion of remediation, these sites no longer pose a public health hazard. Potential adverse health outcomes associated with the exposures of concern from these sites include certain types of cancers. The Environmental Epidemiology Program (EEP), Utah Department of Health (UDOH) conducted a cancer incidence study in 2006 and 2007. Those studies analyzed the rates of cancer for

Monticello from 1973 to 2003 or 2004 respectively (EEP, 2006; EEP, 2007). Because of the long latency period of some types of cancer, periodic follow-up studies were recommended. This study is a five-year review of the 2007 study.

Study Objectives: This study was conducted as a follow-up to the previous studies of cancer rates in Monticello (EEP, 2006; EEP, 2007). This study investigates periodic rates and trends in rates of cancer incidence in Monticello, compared to corresponding rates of the state of Utah. This study does not quantify the linkage of cancer rates to possible causal risk factors.

Authority and Funding: This study is authorized by the executive director's office of the Utah Department of Health to meet requirements for the cooperative agreement the department has with the Agency for Toxic Substances and Disease Registry (ATSDR). The cooperative agreement known as the "ATSDR's Partnership to Promote Localized Efforts to Reduce Environmental Exposure (APPLETREE)" Program is funded this year under grant award 1U61TS000154. Recent public health assessments and previous cancer investigations recommend periodic statistical reviews of cancer in Monticello (ATSDR, 2012; EEP, 2006). Health outcome, population, and geographic data for this investigation are collected, maintained and made available by the Utah Environmental Public Health Tracking Network (UEPHTN). The UEPHTN also funds the SAS and ArcGIS analytical software application licenses that were used to conduct this investigation. The UEPHTN is funded by a grant from the Centers for Disease Control and Prevention (see Acknowledgments). Personnel time used to conduct this investigation was charged against state funded Environmental Health Administrative funds. No federal funds were directly used to conduct this investigation.

DATA AND METHODS

Study Design: This investigation is a retrospective statistical review of cancer incidence among residents of Monticello (Jekel et al., 1996; Mann, 2003). Statistical reviews are not cancer cluster investigations and lack the power to link cancer incidence to putative risk factors. Statistical reviews are a tool used by the EEP to review the health status of a population and assess public health activities. This investigation responds to a recommendation for periodic re-evaluation of the cancer health status in Monticello (ATSDR, 2012). Monticello has been the recipient of Health Resources and Services Administration (HRSA) funds since 2008 to assist with cancer screening (HRSA, 2008, 2009, 2010). This investigation will be useful as part of the evaluation of the HRSA funded programmatic intervention.

The incidence of cancer, quantified in sequential 5-year analytical periods for each cancer category among the residents of Monticello, is compared to an expected incidence count derived from the incidence rate for the state of Utah. The study null hypothesis is that the incidence of cancer in Monticello is not significantly different from what would be expected if the incidence of cancer for the state of Utah was applied to the Monticello population. Figure 1 in the appendices details the location of Monticello.

Defining the Study Population: The study area was limited specifically to the city of Monticello. Cancer data includes a residential city and ZIP code as part of the record. The population enumeration data used by this investigation is tabulated for the U.S. 2000 Census block group boundaries. The EEP geocodes cancer records to their point location to get an X- and Y-coordinate that can then be used to assign that record to the U.S. 2000 Census block group. However, most (65.7%) of Monticello records do not have an address that can be geocoded. Because it is essential to match health outcome data to population enumeration data, this study will use different definitions for study area for health outcome and population data. The EEP attempted to use the most precise definition feasible and still be able to link health outcome and population tabulation data. The definitions used here are more precise than those used by previous investigations which used ZIP code and ZIP code tabulation area (ZCTA) to define the study population (EEP 2006, EEP 2007). Cancer incidence cases with "Monticello" as the residential city listed in the cancer record were considered part of the study area. This study assumes that all cancer with a residential address in Monticello resided within the city boundaries. For this study, the population for Monticello was obtained from the aggregated populations of 2000 Utah census block groups 49.037.978100.2 and 49.037.978100.3. These two census block groups include all of the residential area of Monticello.

Cancer Data: Cancer incidence data on persons diagnosed with primary invasive cancer between 1973 and 2009 were obtained from the Utah Cancer Registry (UCR). The EEP receives cancer data for all invasive cancers that have completed the rigorous data completion and data quality control requirements from the UCR on an annual basis. The most recent years of data are not made available to the EEP until they have been finalized. The UCR data includes diagnostic information, patient demographics, and residential addresses of the cases, as well as information about the behavior of the cancer. The residential address information provided by the UCR includes the city and ZIP code. Individuals with multiple primary invasive cancers have multiple records in the data set in sequential order. These cancers are distinguished by individually unique cancer registry tracking numbers and a cancer sequence number. The sequence number allows discrimination between the very first cancer diagnosis and subsequent diagnoses (UCR, 2012). Diagnostic coding of cancers includes the International Classification of Disease Oncology, 3rd Edition (ICD-O-3) codes for site, histology and behavior (WHO, 2012). The UCR groups cancer into forty-two major cancer types by site following the guidance provided by the National Cancer Institute (NCI) Surveillance, Epidemiology and End Results (SEER) Program (NCI, 2012). These 42 UCR site codes are a convenient grouping for conducting surveillance analyses (UCR, 2012).

Statewide between 1973 and 2009, 190,236 cancer reports among 166,893 individuals were registered by UCR. Of those, 196 persons living in Monticello experienced 219 cancer incidences.

The UCR also provides the EEP records of in-situ cancers that have been diagnosed. Because statewide ascertainment of carcinoma in-situ (CIS) is incomplete, incidence of CIS are not

included as part of this investigation. Carcinoma in-situ (often called "pre-cancer") are non-invasive. Statewide a total of 2,577 reports of CIS, including two from Monticello were excluded from the study.

Certain kinds of medical treatment for cancer and other diseases, such as radiation therapy, increases an individual's risk for the development of subsequent leukemia, particularly myeloid leukemia (sometimes known as therapy-induced leukemia) (Godley and Larson, 2008; Leone et al., 1999; Leone et al., 2011; Sill et al., 2011; Wilkins and Woodgate, 2008). Myeloid leukemia cases that were the first of any sequence of cancers for an individual were included for this investigation. Myeloid leukemia cases that were subsequent to a previous cancer and could be therapy-induced leukemia were excluded. Statewide, 292 reports of subsequent myeloid leukemia incidence were excluded from this investigation. None of these cases were from Monticello.

Clean-up of both the MMTS and MVP were completed by the year 2000. Therefore, all children (with or without cancer) born after 2000, as represented in the cancer data or the population estimates, were excluded from this investigation. Statewide, 512 reports of children born after 2000 with cancer were excluded. None of these cases were from Monticello.

Among Monticello residents, the diagnoses of 217 incidences of invasive primary cancer among 194 individuals occurring between 1973 and 2009, potentially resulting from environmental exposure to MMTS or MVP contaminates were reported to the UCR.

Population Data: The 2000 U.S. census divides Utah into 1,481 census block groups (USCB, 2004) with a median population of 1,364 persons per census block group in the year 2000. Commercially available U.S. census population data for Utah for the 1970, 1980, 1990, 2000 and 2010 censuses (Geolytics, 2002 a-c; Geolytics, 2012 a-b) were used to estimate annual age-group and sex population counts for each census block group for each intercensal year. These estimations were made by applying annual growth rates derived from the previous and subsequent decennial data. This method follows national population estimation guidelines (USCB, 2012c). Children born after 2000 were excluded from the population estimates.

Indirect Age-Standardized Incidence Rates: SAS version 9.2 (a statistical analyses program) was used to manage and analyze the data. Cancer case and population data were aggregated into six age cohorts: 0-19 years of age, 20-34 years of age, 35-49 years of age, 50-64 years of age, 65-74 years of age, and 75 years and older. The indirect age-standardized incidence rate was calculated using standard methods (Anderson and Rosenberg, 1998; Jekel et al., 1996; Selvin, 1996). This is the preferred method for analysis of disease with small case counts per analytical period. Seven five-year analytical periods (except the first period, which was seven years) were used for this investigation. Those analytical periods were 1973-1979, 1980-1984, 1985-1989, 1990-1994, 1995-1999, 2000-2004, and 2005-2009. The expected incidence count and rate computed from the state cancer incidence rate applied to the Monticello population for each

analytical period using the indirect age-standardization method was computed. Sex-specific rates and rates for both sexes combined were computed. See the definitions appendix to this report for details on how the indirect age-standardized incidence rate was computed.

Standardized Incident Ratio (SIR): The incidence of cancer for Monticello is evaluated against an expected number of cases derived by applying the incidence rate of cancer for the state of Utah to the Monticello population distribution. An SIR greater than one (1.0) indicates that the Monticello cancer incidence is greater than would be expected based on the state incidence rate for that period of analysis. Conversely, an SIR less than one indicates that the Monticello cancer incidence rate is less than would be expected. Statistical significance is determined by applying the Byar's 95% confidence interval for the SIR (Breslow and Day, 1987; Rothman and Boice, 1979, 1982; Sahai and Khurshid, 1983, 1996). The criteria for a specific cancer to demonstrate statistical significance are an SIR greater than one (1.0) and a confidence interval (expressed by the lower and upper limits) that does not include one (1.0). For statistical validity, SIRs and corresponding 95% confidence intervals were only calculated for time periods with four or more cases (Bender et al., 1990; Caldwell, 1990; Thun and Sinks, 2004).

Using a 95% confidence interval is a well-established standard for interpreting an SIR with respect to statistical significance. It should be noted that an SIR may be statistically significant using this interpretation criteria, and be a mathematical artifact and not biologically meaningful or relevant (Bender et al., 1990; Besag and Newell, 1991). When conducting multiple analyses using the 95% confidence interval to interpret the data, one would expect one in 20 (5%) of the analyses to have a statistically significant interpretation as a result of random chance. The EEP considers the results meaningful if there are two consecutive time periods with a statistically significant result, and the number of cases in each time period is greater than three (Langeberg et al., 2004). The EEP is required to protect confidential data from unlawful disclosure; therefore, the EEP does not report the exact results for time periods containing three or fewer cases.

FINDINGS

The analytical results for Monticello for 42 different cancer sites as classified by the UCR are presented in Table 1 (see appendix). Interpretation of the results in Table 1 to identify cancer types that are statistically elevated, is based on the SIR and the 95% confidence limit to the SIR. If the SIR is greater than 1.0, and the confidence limit does not include 1.0 (meaning the lower limit is also greater than 1.0) then the incidence of cancer is interpreted to be significantly elevated. If there are two consecutive analytical periods of statistically elevated rates, then the rates are considered meaningful as well.

Cancer of the lung and bronchus was the only cancer site that was found to have significantly elevated rates. Four of the seven analytical periods were found to have elevated incidence. For the analytical period from 1973-1979 the results were not statistically significant. The last three sequential analytical periods; 1995-1999, 2000-2004, and 2005-2009 each had statistically

significant results. These last three periods, with statistically elevated rates for lung and bronchial cancers are meaningful and could represent a potential cluster. A cancer statistical review is not a cluster investigation and cannot link elevated results to risk factors. However, this exploratory investigation suggests that further investigation is warranted. In addition, the rates (72 per 100,000 total persons (both sexes) in 1995-1999; 60.5 for 2000-2004; and 78.0 for 2005-2009) do not appear to be decreasing. This finding suggests that continued intervention is warranted.

DISCUSSION

Cancer: Cancer is a broad group of more than 100 diseases that involve uncontrollable cell replication and growth. Often these cells are "undifferentiated," meaning they have lost their tissue-specific characteristics. As these cells grow to form tumor tissue, they invade nearby healthy tissue or spread through metastasis to other tissues. This invasion, or spread, disrupts the functions of the affected healthy tissues. Cancer cells may also produce metabolic products that can be transported to other parts of the body resulting in adverse health effects (NCI, 2012). The American Cancer Society (ACS) estimates that about one in two men and one in three women will develop cancer (all invasive sites) sometime in their life (lifetime risk) (ACS, 2012; NCI, 2011a-b). In the United States, cancer is the second leading cause of death (CDC 2012). Among all causes of death, approximately one in four men and one in five women will die of cancer (ACS, 2012; NCI, 2011a-b). On average, about one in nine people will develop two or more cancers in his or her lifetime (Wilkins and Woodgate, 2008).

Risk factors that contribute to the development of cancer include both inherent and external factors. Inherent factors include a variety of genetic susceptibilities. External factors include life choices and behaviors (e.g., tobacco use, alcohol use, poor diet, obesity, lack of physical activity, excessive sunlight exposure, and sexual behavior), medical conditions and medications, oncogenic pathogens, and chemical or radiological environmental exposures. Cancer may be the result of several factors interacting together with a triggering event (NCI, 2012).

Lung Cancer: Lung cancer is the leading cause of cancer-related mortality in the United States (Alberg and Samet, 2003; Alberg et al., 2007; Molina et al., 2009). It is also one of the few types of cancer that has been linked to environmental exposure to alpha-emitting radiation (Coggle et al., 1986; Mould, 2001; Nermina, 2005; Shottenfeld and Fraumeni, 1996; Tomasek et al., 1993). Approximately 1 in 13 men and 1 in 16 women will develop lung cancer during their lifetime and 1 in 15 men and 1 in 20 women will die of lung cancer (ACS, 2012). Lung cancer was previously found to be a cancer of concern for Monticello (EEP, 2007). There are several different kinds of lung cancer. The four major types include squamous cell (also called epidermoid) carcinoma, adenocarcinoma (cancers of the glands of the lung), large cell carcinoma, and small cell undifferentiated carcinoma. Together these four types of lung cancer account for more than 90 percent of lung cancer cases in the United States (Alberg and Samet,

2003; Field et al., 2004). This investigation does not differentiate the different kinds of lung cancer.

The most important risk factors for all types of lung cancer include smoking, exposure to secondhand smoke, alcohol use, the presence of certain smoking-related lung diseases (e.g., chronic obstructive pulmonary disease), poor diet, lack of physical activity, a family history (genetic susceptibility) of lung cancer, respiratory exposure to radon gas, respiratory exposure to asbestos, respiratory exposure to polycyclic aromatic hydrocarbons, and respiratory exposure to certain metals such as arsenic, chromium or nickel (Alberg and Samet, 2003; Alberg et al., 2007; Armstrong et al., 2004; Bronson et al., 2002; Brenner et al., 2011; Darby et al., 2001; Molina et al., 2009; Samet and Eradze 2000; Samet et al., 2009). Smoking and exposure to second hand smoke represents approximately 84% of all lung cancer deaths in the United States (Giovino, 2002).

This study does not control for behavior or life choice risk factors (tobacco use or alcohol use) or genetic risk factors, and cannot quantify the amount of lung cancer risk that would be associated with environmental exposures. The Utah Behavioral Risk Factors Survey (UBRFS) indicates that in the Southeastern Utah District Health Department region (SEUDHD), which includes Carbon, Emery, Grand and San Juan counties, the smoking rate among white men is 20.62% (versus 12.43% for the state of Utah). In this same region, the smoking rate among white women is 15.54% (versus 9.30% for the state of Utah) for the period covering 1999 - 2010 (UDOH, 2012). However, these UBRFS results may not be applicable to Monticello. The UBRFS statistics include populations outside of Monticello that are known to have higher smoking rates. Although tobacco use rates specific just to Monticello are not available, the demographics and local knowledge about Monticello suggests that Monticello's smoking rates are irrelevant.

Comparison to previous studies: All incidence of cancer available to the previous studies were available to this study. The 2007 study made an effort through collaboration with Monticello residents and through survey to ensure that cancer incidence ascertainment was as complete as possible. The UCR reviewed and validated all reported cases and updated the registry when appropriate. The data used by EEP for this investigation included those data developed through the 2007 investigation process.

Overall, the three studies that EEP has conducted for Monticello report the same findings. In the 2006 finding, lung and bronchial cancer rates were found to be significantly elevated (SIR = 2.4 [1.0-4.3]) for the 1993-1997 analytical period (EEP, 2006). The 2007 study found lung and bronchial cancer rates to be elevated for two analytical periods: 1993-1997 (SIR = 3.3 [1.3-6.3]) and 1998-2004 (SIR = 2.5 [1.1-4.6]). The 2007 study also reported an elevated rate of lung and bronchial cancer for the entire study period (1973-2004, SIR = 1.9 [1.2-2.8]). The 2007 study also reported a cluster of four stomach cancers during the 1998-2004 period (SIR = 6.14 [1.6-13.6]) (EEP, 2007).

This study found slightly higher risk than the previous studies for the last three analytical periods. For the 1995-1999 analytical period, the SIR was 3.3 (1.5-6.2) for lung and bronchial cancer for the total population (both sexes). For the 2000-2004 analytical period the SIR=2.8 (1.1-5.9) and for the 2005-2009 analytical period the SIR=3.6 (1.2-7.1). Men also had significantly elevated incidence rates for these periods.

Previous studies had included an investigation period (e.g., 1973-2003 or 1973-2004) analysis as well. However, this approach assumes factors associated with cancer, cancer risk, cancer diagnosis and reporting, and cancer treatment remain stable through all that period. Since this assumption is unlikely true, this investigation does not include the 37 year period (1973-2009).

After coordinating with the UCR to refine this investigation, EEP feels that this is the strongest of the three studies. This investigation applies the most precise definition of the study area, uses the most consistent approach to population estimates and includes better inclusion and exclusion criteria.

Rural Health Outreach Project: With the assistance of Utah Senator Orrin Hatch's office, the UDOH was able to secure a Special Congressional Initiatives Program funding from the HRSA starting in August 2008. The purpose of these funds was to 1) implement an outreach program to identify at-risk individuals and notify those individuals about cancer screening programs, and 2) institute a voucher system to provide financial assistance to qualified at-risk individuals seeking cancer screening or treatment. Funding was also used to develop and implement a community-wide public health education program for Monticello that consisted of cancer awareness literature and community awareness events. From September 2009 through August 2012, thirty-nine new cancers were diagnosed in residents of Monticello. These included: two cases of lung cancer, two cases of brain cancers, four cases of colon cancer, five cases of thyroid cancer, one case of bladder cancer, two cases of prostate cancer, two cases of multiple myeloma, two cases of leukemia (unspecified type), once case of lymphoma (unspecified type), three cases of esophageal cancer, one case of cancer involving the stomach and liver, one case of liver cancer, three cases of cutaneous melanoma, four cases of squamous cell carcinoma, two cases of basal cell carcinoma, one case of uterine cancer, and one case of cervical cancer. Thirty-two people with precancerous polyps were also diagnosed and treated (EEP, 2011; SEUDHD, 2012).

Limitations: The public often wants public health investigations to determine if cancer risk can be linked to a putative environmental concern. The methodology (indirect standardized incidence ratio) used in this study does not have the capability to definitively link Monticello's elevated lung cancer rate to exposure to the MMTS. These kinds of cancer statistical reviews are based on annual incidence data reported to the UCR. The incidence of cancer per year is dependent on diagnosis of clinically manifested cancer. There are a number of limitations that impede this linkage. There is seldom any knowledge about the frequency, duration, or intensity of cancer victims' exposure to putative environmental concerns. The latency period (the period between causative exposure and the manifestation of disease) among various people will be different.

Cancer can be present for some period before an individual seeks medical assistance that leads to diagnosis. There is seldom sufficient information available to control for the many non-environmental factors that contribute to cancer risk, or the exposure to other potential environmental risks that are not the putative environmental concern. For small populations, the incidence of cancer has a tendency to manifest in arbitrary clusters. This is a common phenomenon encountered when investigating the rate of rare diseases in a small population. Often, a few types of cancer may be statistically elevated for disparate periods, but that conclusion may change if the analytical periods are changed. Overcoming these limitations usually requires a comprehensive assessment of individual risk supported by a clear and consistent trend of elevated rates for a population.

CONCLUSIONS AND RECOMMENDATIONS

This investigation found evidence that from 1973-2009, lung and bronchial cancer in Monticello, Utah is approximately three times higher than what would be expected from 1995 through 2009, compared to the state of Utah's cancer rate. There does not appear to be a trend of improvement during the past 15 years. Further periodic investigation should be conducted to monitor the rates for lung and bronchial cancer. This report illustrates the importance of and continued need for cancer screening assistance for the community of Monticello.

While this study's methodology is incapable of conclusively linking cancer in Monticello to any particular environmental risk, it cannot preclude any link either. Taking together the type of cancer that was elevated, and the environmental hazards known to have existed, these results suggest a potential link between Monticello's lung and bronchial cancer incidence and exposure to the contaminates associated with MMTS or MVP. The EEP recommends that the SEUDHD continue a program of cancer screening and health education services for the community of Monticello. The EEP recommends the continued federal or state support of the cancer assistance program as it currently exists. Continued federal financial support is very important for this community because it is relatively isolated from other potential resources. The EEP will continue to work with SEUDHD to identify and solicit resources for those programs. The EEP recommends reassessment of the cancer incidence after the 2014 cancer data become available to the EEP. Reassessment is useful to monitor the trend of cancer in Monticello and to evaluate intervention programs.

AUTHORSHIP, REVIEW AND CITATION

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Recommended Citation:

Environmental Epidemiology Program. *Cancer Incidence Follow-Up Investigation for Monticello, San Juan County, Utah Covering the Period from 1973 to 2009*. October 1, 2012. Salt Lake City, UT: Utah Department of Health.

CERTIFICATION

This report titled "Cancer Incidence Follow-Up Investigation for Monticello, San Juan County, Utah Covering the Period from 1973 to 2009" was prepared by the Environmental Epidemiology Program, Utah Department of Health. This report covers an investigation of cancer incidence using standard and approved methodology and procedures existing at the time the investigation herein reported was begun. Editorial and technical review was completed by UDOH certifying reviewers and program partners.

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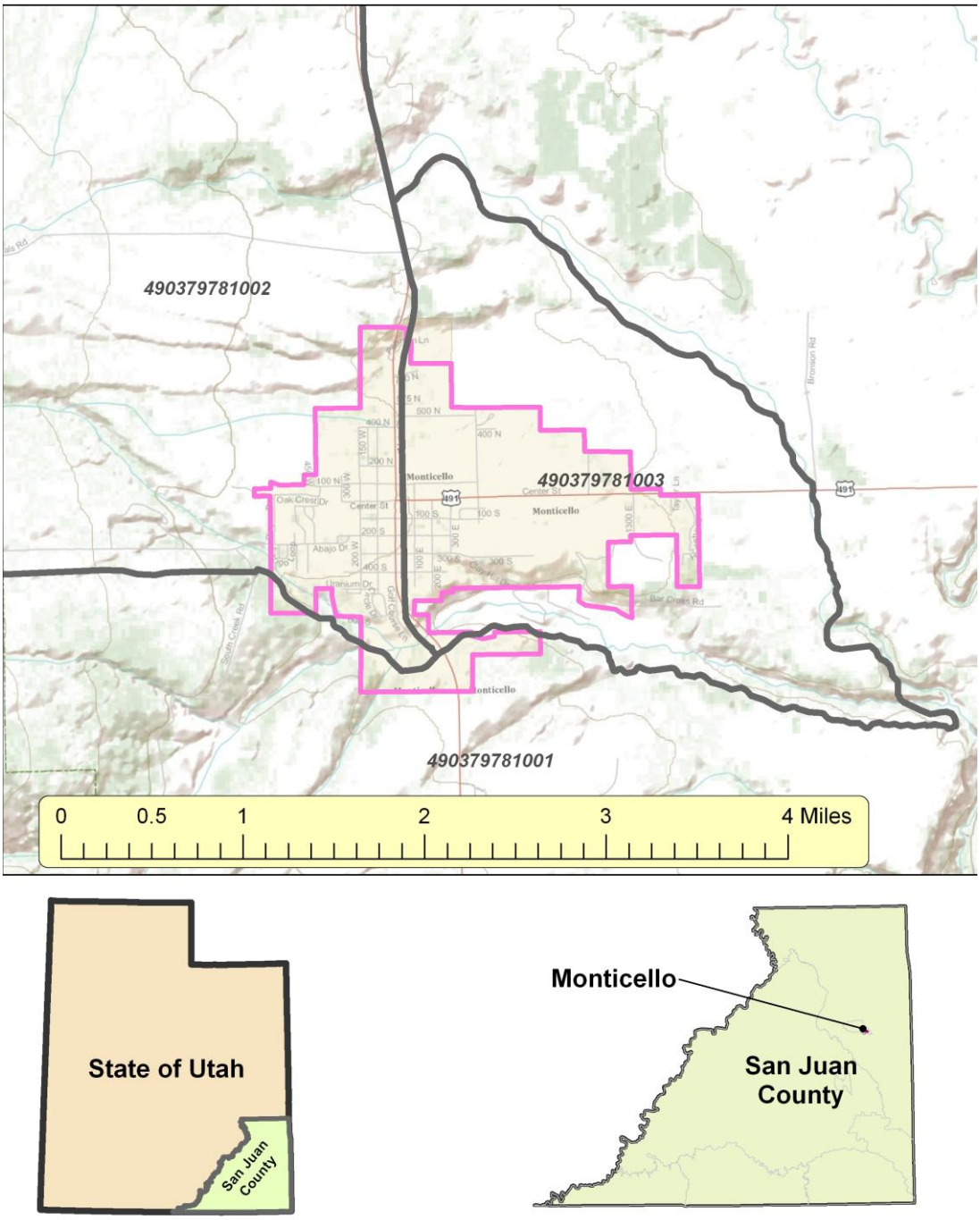
FIGURES

Figure 1. Maps detailing census blocks and the location of Monticello, Utah.



TABLES

Table 1. Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
01 Oral cavity and pharynx	1973-1979	M	≤3			
		F	≤3			
		B	≤3			
	1980-1984	M	≤3			
		F	≤3			
		B	≤3			
	1985-1989	M	≤3			
		F	≤3			
		B	≤3			
	1990-1994	M	≤3			
		F	≤3			
		B	≤3			
	1995-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2004	M	≤3			
		F	≤3			
		B	≤3			
	2005-2009	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
02 Esophagus	1973-1979	M	≤3			
		F	≤3			
		B	≤3			
	1980-1984	M	≤3			
		F	≤3			
		B	≤3			
	1985-1989	M	≤3			
		F	≤3			
		B	≤3			
	1990-1994	M	≤3			
		F	≤3			
		B	≤3			
	1995-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2004	M	≤3			
		F	≤3			
		B	≤3			
	2005-2009	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
03 Stomach	1973-1979	M	≤3			
		F	≤3			
		B	≤3			
	1980-1984	M	≤3			
		F	≤3			
		B	≤3			
	1985-1989	M	≤3			
		F	≤3			
		B	≤3			
	1990-1994	M	≤3			
		F	≤3			
		B	≤3			
	1995-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2004	M	≤3			
		F	≤3			
		B	≤3			
	2005-2009	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
04 Small intestine	1973-1979	M	≤3			
		F	≤3			
		B	≤3			
	1980-1984	M	≤3			
		F	≤3			
		B	≤3			
	1985-1989	M	≤3			
		F	≤3			
		B	≤3			
	1990-1994	M	≤3			
		F	≤3			
		B	≤3			
	1995-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2004	M	≤3			
		F	≤3			
		B	≤3			
	2005-2009	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
05 Colon	1973-1979	M	≤3			
		F	≤3			
		B	≤3			
	1980-1984	M	≤3			
		F	≤3			
		B	≤3			
	1985-1989	M	≤3			
		F	≤3			
		B	≤3			
	1990-1994	M	≤3			
		F	≤3			
		B	≤3			
	1995-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2004	M	≤3			
		F	≤3			
		B	≤3			
	2005-2009	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
06 Rectum and recto-sigmoid junction	1973-1979	M	≤3			
		F	≤3			
		B	≤3			
	1980-1984	M	≤3			
		F	≤3			
		B	≤3			
	1985-1989	M	≤3			
		F	≤3			
		B	≤3			
	1990-1994	M	≤3			
		F	≤3			
		B	≤3			
	1995-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2004	M	≤3			
		F	≤3			
		B	≤3			
	2005-2009	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
07 Anus, anal canal and anorectum	1973-1979	M	≤3			
		F	≤3			
		B	≤3			
	1980-1984	M	≤3			
		F	≤3			
		B	≤3			
	1985-1989	M	≤3			
		F	≤3			
		B	≤3			
	1990-1994	M	≤3			
		F	≤3			
		B	≤3			
	1995-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2004	M	≤3			
		F	≤3			
		B	≤3			
	2005-2009	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
08 Liver and interhepatic bile duct	1973-1979	M	≤3			
		F	≤3			
		B	≤3			
	1980-1984	M	≤3			
		F	≤3			
		B	≤3			
	1985-1989	M	≤3			
		F	≤3			
		B	≤3			
	1990-1994	M	≤3			
		F	≤3			
		B	≤3			
	1995-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2004	M	≤3			
		F	≤3			
		B	≤3			
	2005-2009	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
09 Gallbladder and biliary bile ducts	1973-1979	M	≤3			
		F	≤3			
		B	≤3			
	1980-1984	M	≤3			
		F	≤3			
		B	≤3			
	1985-1989	M	≤3			
		F	≤3			
		B	≤3			
	1990-1994	M	≤3			
		F	≤3			
		B	≤3			
	1995-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2004	M	≤3			
		F	≤3			
		B	≤3			
	2005-2009	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
10 Pancreas	1973-1979	M	≤3			
		F	≤3			
		B	≤3			
	1980-1984	M	≤3			
		F	≤3			
		B	≤3			
	1985-1989	M	≤3			
		F	≤3			
		B	≤3			
	1990-1994	M	≤3			
		F	≤3			
		B	≤3			
	1995-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2004	M	≤3			
		F	≤3			
		B	≤3			
	2005-2009	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
11 Other digestive system	1973-1979	M	≤3			
		F	≤3			
		B	≤3			
	1980-1984	M	≤3			
		F	≤3			
		B	≤3			
	1985-1989	M	≤3			
		F	≤3			
		B	≤3			
	1990-1994	M	≤3			
		F	≤3			
		B	≤3			
	1995-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2004	M	≤3			
		F	≤3			
		B	≤3			
	2005-2009	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
12 Larynx	1973-1979	M	≤3			
		F	≤3			
		B	≤3			
	1980-1984	M	≤3			
		F	≤3			
		B	≤3			
	1985-1989	M	≤3			
		F	≤3			
		B	≤3			
	1990-1994	M	≤3			
		F	≤3			
		B	≤3			
	1995-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2004	M	≤3			
		F	≤3			
		B	≤3			
	2005-2009	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
13 Lung and bronchus	1973-1979	M	4	62.0	2.2	0.6-5.7
		F	≤3			
		B	4	31.4	1.7	0.4-4.5
	1980-1984	M	≤3			
		F	≤3			
		B	≤3			
	1985-1989	M	≤3			
		F	≤3			
		B	≤3			
	1990-1994	M	≤3			
		F	≤3			
		B	≤3			
	1995-1999	M	6	92.7	3.5	1.3-7.7 S
		F	≤3			
		B	9	72.2	3.3	1.5-6.2 S
	2000-2004	M	4	65.6	2.7	0.7-6.6
		F	≤3			
		B	7	60.5	2.8	1.1-5.9 S
	2005-2009	M	≤3			
		F	≤3			
		B	6	78.0	3.6	1.2-7.1 S

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
14 Other respiratory system	1973-1979	M	≤3			
		F	≤3			
		B	≤3			
	1980-1984	M	≤3			
		F	≤3			
		B	≤3			
	1985-1989	M	≤3			
		F	≤3			
		B	≤3			
	1990-1994	M	≤3			
		F	≤3			
		B	≤3			
	1995-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2004	M	≤3			
		F	≤3			
		B	≤3			
	2005-2009	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
15 Bones and joints	1973-1979	M	≤3			
		F	≤3			
		B	≤3			
	1980-1984	M	≤3			
		F	≤3			
		B	≤3			
	1985-1989	M	≤3			
		F	≤3			
		B	≤3			
	1990-1994	M	≤3			
		F	≤3			
		B	≤3			
	1995-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2004	M	≤3			
		F	≤3			
		B	≤3			
	2005-2009	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
16 Soft tissue (including heart)	1973-1979	M	≤3			
		F	≤3			
		B	≤3			
	1980-1984	M	≤3			
		F	≤3			
		B	≤3			
	1985-1989	M	≤3			
		F	≤3			
		B	≤3			
	1990-1994	M	≤3			
		F	≤3			
		B	≤3			
	1995-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2004	M	≤3			
		F	≤3			
		B	≤3			
	2005-2009	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
17 Cutaneous melanoma	1973-1979	M	≤3			
		F	≤3			
		B	≤3			
	1980-1984	M	≤3			
		F	≤3			
		B	≤3			
	1985-1989	M	≤3			
		F	≤3			
		B	≤3			
	1990-1994	M	≤3			
		F	≤3			
		B	≤3			
	1995-1999	M	≤3			
		F	≤3			
		B	4	36.8	2.4	0.7-6.3
	2000-2004	M	≤3			
		F	≤3			
		B	≤3			
	2005-2009	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
18 Other non-melanoma skin cancers	1973-1979	M	≤3			
		F	≤3			
		B	≤3			
	1980-1984	M	≤3			
		F	≤3			
		B	≤3			
	1985-1989	M	≤3			
		F	≤3			
		B	≤3			
	1990-1994	M	≤3			
		F	≤3			
		B	≤3			
	1995-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2004	M	≤3			
		F	≤3			
		B	≤3			
	2005-2009	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
19 Breast	1973-1979	M	≤3			
		F	≤3			
		B	≤3			
	1980-1984	M	≤3			
		F	≤3			
		B	≤3			
	1985-1989	M	≤3			
		F	4	75.4	0.9	0.3-2.4
		B	4	37.9	0.9	0.3-2.4
	1990-1994	M	≤3			
		F	≤3			
		B	≤3			
	1995-1999	M	≤3			
		F	8	143.2	1.6	0.7-3.1
		B	8	71.5	1.6	0.7-3.1
	2000-2004	M	≤3			
		F	4	80.8	0.9	0.2-2.2
		B	4	40.3	0.8	0.2-2.2
	2005-2009	M	≤3			
		F	4	120.6	1.2	0.3-3.0
		B	5	75.2	1.4	0.5-3.4

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
20 Cervix	1973-1979	F	≤3			
	1980-1984	F	≤3			
	1985-1989	F	≤3			
	1990-1994	F	≤3			
	1995-1999	F	≤3			
	2000-2004	F	≤3			
	2005-2009	F	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
21 Uterus	1973-1979	F	≤3			
	1980-1984	F	≤3			
	1985-1989	F	≤3			
	1990-1994	F	≤3			
	1995-1999	F	≤3			
	2000-2004	F	≤3			
	2005-2009	F	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
22 Ovary	1973-1979	F	≤3			
	1980-1984	F	≤3			
	1985-1989	F	≤3			
	1990-1994	F	≤3			
	1995-1999	F	≤3			
	2000-2004	F	≤3			
	2005-2009	F	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
23 Other female genital	1973-1979	F	≤3			
	1980-1984	F	≤3			
	1985-1989	F	≤3			
	1990-1994	F	≤3			
	1995-1999	F	≤3			
	2000-2004	F	≤3			
	2005-2009	F	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
24 Prostate	1973-1979	M	4	65.7	1.2	0.3-3.2
	1980-1984	M	5	90.8	1.4	0.4-3.2
	1985-1989	M	≤3			
	1990-1994	M	5	91.3	0.7	0.2-1.6
	1995-1999	M	4	61.5	0.6	0.2-1.5
	2000-2004	M	4	66.1	0.5	0.1-1.4
	2005-2009	M	9	229.0	1.6	0.7-3.1

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
25 Testis	1973-1979	M	≤3			
	1980-1984	M	≤3			
	1985-1989	M	≤3			
	1990-1994	M	≤3			
	1995-1999	M	≤3			
	2000-2004	M	≤3			
	2005-2009	M	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
26 Other male genital	1973-1979	M	≤3			
	1980-1984	M	≤3			
	1985-1989	M	≤3			
	1990-1994	M	≤3			
	1995-1999	M	≤3			
	2000-2004	M	≤3			
	2005-2009	M	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
27 Bladder	1973-1979	M	≤3			
		F	≤3			
		B	≤3			
	1980-1984	M	≤3			
		F	≤3			
		B	≤3			
	1985-1989	M	≤3			
		F	≤3			
		B	≤3			
	1990-1994	M	≤3			
		F	≤3			
		B	≤3			
	1995-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2004	M	≤3			
		F	≤3			
		B	≤3			
	2005-2009	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
28 Kidney and renal pelvis	1973-1979	M	≤3			
		F	≤3			
		B	≤3			
	1980-1984	M	≤3			
		F	≤3			
		B	≤3			
	1985-1989	M	≤3			
		F	≤3			
		B	≤3			
	1990-1994	M	≤3			
		F	≤3			
		B	≤3			
	1995-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2004	M	≤3			
		F	≤3			
		B	≤3			
	2005-2009	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
29 Other urinary	1973-1979	M	≤3			
		F	≤3			
		B	≤3			
	1980-1984	M	≤3			
		F	≤3			
		B	≤3			
	1985-1989	M	≤3			
		F	≤3			
		B	≤3			
	1990-1994	M	≤3			
		F	≤3			
		B	≤3			
	1995-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2004	M	≤3			
		F	≤3			
		B	≤3			
	2005-2009	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
30 Eye and orbit	1973-1979	M	≤3			
		F	≤3			
		B	≤3			
	1980-1984	M	≤3			
		F	≤3			
		B	≤3			
	1985-1989	M	≤3			
		F	≤3			
		B	≤3			
	1990-1994	M	≤3			
		F	≤3			
		B	≤3			
	1995-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2004	M	≤3			
		F	≤3			
		B	≤3			
	2005-2009	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
31 Brain	1973-1979	M	≤3			
		F	≤3			
		B	≤3			
	1980-1984	M	≤3			
		F	≤3			
		B	≤3			
	1985-1989	M	≤3			
		F	≤3			
		B	≤3			
	1990-1994	M	≤3			
		F	≤3			
		B	≤3			
	1995-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2004	M	≤3			
		F	≤3			
		B	≤3			
	2005-2009	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
32 Other central nervous system	1973-1979	M	≤3			
		F	≤3			
		B	≤3			
	1980-1984	M	≤3			
		F	≤3			
		B	≤3			
	1985-1989	M	≤3			
		F	≤3			
		B	≤3			
	1990-1994	M	≤3			
		F	≤3			
		B	≤3			
	1995-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2004	M	≤3			
		F	≤3			
		B	≤3			
	2005-2009	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
33 Thyroid	1973-1979	M	≤3			
		F	≤3			
		B	≤3			
	1980-1984	M	≤3			
		F	≤3			
		B	≤3			
	1985-1989	M	≤3			
		F	≤3			
		B	≤3			
	1990-1994	M	≤3			
		F	≤3			
		B	≤3			
	1995-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2004	M	≤3			
		F	≤3			
		B	≤3			
	2005-2009	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
34 Other endocrine	1973-1979	M	≤3			
		F	≤3			
		B	≤3			
	1980-1984	M	≤3			
		F	≤3			
		B	≤3			
	1985-1989	M	≤3			
		F	≤3			
		B	≤3			
	1990-1994	M	≤3			
		F	≤3			
		B	≤3			
	1995-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2004	M	≤3			
		F	≤3			
		B	≤3			
	2005-2009	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
35 Hodgkin lymphoma	1973-1979	M	≤3			
		F	≤3			
		B	≤3			
	1980-1984	M	≤3			
		F	≤3			
		B	≤3			
	1985-1989	M	≤3			
		F	≤3			
		B	≤3			
	1990-1994	M	≤3			
		F	≤3			
		B	≤3			
	1995-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2004	M	≤3			
		F	≤3			
		B	≤3			
	2005-2009	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
36 Non-Hodgkin lymphoma	1973-1979	M	≤3			
		F	≤3			
		B	≤3			
	1980-1984	M	≤3			
		F	≤3			
		B	≤3			
	1985-1989	M	≤3			
		F	≤3			
		B	≤3			
	1990-1994	M	≤3			
		F	≤3			
		B	≤3			
	1995-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2004	M	≤3			
		F	≤3			
		B	≤3			
	2005-2009	M	≤3			
		F	≤3			
		B	4	55.7	3.2	0.8-8.3

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
37 Multiple myeloma	1973-1979	M	≤3			
		F	≤3			
		B	≤3			
	1980-1984	M	≤3			
		F	≤3			
		B	≤3			
	1985-1989	M	≤3			
		F	≤3			
		B	≤3			
	1990-1994	M	≤3			
		F	≤3			
		B	≤3			
	1995-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2004	M	≤3			
		F	≤3			
		B	≤3			
	2005-2009	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
38 Lymphocytic leukemia	1973-1979	M	≤3			
		F	≤3			
		B	≤3			
	1980-1984	M	≤3			
		F	≤3			
		B	≤3			
	1985-1989	M	≤3			
		F	≤3			
		B	≤3			
	1990-1994	M	≤3			
		F	≤3			
		B	≤3			
	1995-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2004	M	≤3			
		F	≤3			
		B	≤3			
	2005-2009	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
39 Myeloid leukemia	1973-1979	M	≤3			
		F	≤3			
		B	≤3			
	1980-1984	M	≤3			
		F	≤3			
		B	≤3			
	1985-1989	M	≤3			
		F	≤3			
		B	≤3			
	1990-1994	M	≤3			
		F	≤3			
		B	≤3			
	1995-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2004	M	≤3			
		F	≤3			
		B	≤3			
	2005-2009	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
40 Monocytic leukemia	1973-1979	M	≤3			
		F	≤3			
		B	≤3			
	1980-1984	M	≤3			
		F	≤3			
		B	≤3			
	1985-1989	M	≤3			
		F	≤3			
		B	≤3			
	1990-1994	M	≤3			
		F	≤3			
		B	≤3			
	1995-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2004	M	≤3			
		F	≤3			
		B	≤3			
	2005-2009	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
41 Other leukemia	1973-1979	M	≤3			
		F	≤3			
		B	≤3			
	1980-1984	M	≤3			
		F	≤3			
		B	≤3			
	1985-1989	M	≤3			
		F	≤3			
		B	≤3			
	1990-1994	M	≤3			
		F	≤3			
		B	≤3			
	1995-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2004	M	≤3			
		F	≤3			
		B	≤3			
	2005-2009	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among Monticello residents between 1973 and 2009 reported to the Utah Cancer Registry by site code. The total number of cases is 217. Case counts ≤3 means the count could be 0 to 3. Rates are indirect age-standardized incidence rate per 100,000 person-years. The SIRs are the standardized incidence ratio (SIR) with Byar's 95% confidence intervals (CI). Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
42 Other sites/types	1973-1979	M	≤3			
		F	≤3			
		B	≤3			
	1980-1984	M	≤3			
		F	≤3			
		B	≤3			
	1985-1989	M	≤3			
		F	≤3			
		B	≤3			
	1990-1994	M	≤3			
		F	≤3			
		B	≤3			
	1995-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2004	M	≤3			
		F	≤3			
		B	≤3			
	2005-2009	M	≤3			
		F	≤3			
		B	≤3			

DEFINITIONS

ACS — American Community Survey. The ACS is an ongoing survey that provides annual updates to population and demographic estimates derived from census data. The ACS is operated by the USCB. For more information see: http://www.census.gov/acs/www/.

AGRC — Automated Geographic Reference Center. An agency within the Utah Department of Information Technology, responsible for maintaining a repository of geographic information system (GIS) data files and GIS functionality. For more information see: http://gis.utah.gov/.

ATSDR — Agency for Toxic Substances and Disease Registry. An agency with the Centers for Disease Control and Prevention, National Centers of Environmental Health. The ATSDR was created under authority of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, sometimes called "superfund"). The role of the ATSDR is to assess and document CERCLA sites that are on the National Priority List (NPL) for public health risks and to assess priority contaminates frequently found associated with CERCLA sites and to provide documentation and decision-making criteria for evaluating CERCLA sites. In some states, such as Utah, the ATSDR works through a cooperative agreement with the state. For more information see: http://www.atsdr.cdc.gov/.

APPLETREE — ATSDR's Partnership to Promote Localized Efforts to Reduce Environmental Exposures. This program is a grant funded program to identify exposure pathways, conduct exposure and risk assessment, and provide public health education to affected communities and health care professionals. For more information see: http://www.atsdr.cdc.gov/states/background.html and http://health.utah.gov/enviroepi/appletree/appleindex.htm.

CIS — Carcinoma in-situ is an early form of cancer that is defined by the absence of invasion of tumor cells into the surrounding tissue. Instead the lesion is flat or follows the existing architecture of the organ. In this state, CIS seldom cause clinical systems sufficient to prompt the person with CIS to seek medical assistance and are generally undetected. CIS can progress to invasive tumors and are therefore considered a precursor or incipient form of cancer.

EEP — Environmental Epidemiology Program. A program within the Bureau of Epidemiology, Division of Disease Control and Prevention, UDOH. The EEP was established in 1996 and is responsible for investigating diseases related to the environment. The program has two sections. One section conducts surveillance and data management activities including managing the UEPHTN. The other

	section conducts health hazards risk assessment, including cancer investigations. The program is staffed with personnel by experience and expertise in environmental epidemiology, environmental sciences, toxicology, statistics, public health informatics and geomatics, and health education. For more information see: http://health.utah.gov/enviroepi/.
GeoLytics	GeoLytics is a commercial vendor of census and demographic data calibrated to the 2000 census boundaries. The EEP has purchased 1970, 1980, 1990, 2000 and 2010 census data from GeoLytics to be the basis for estimating intercensal population counts for each of the 1481 census block group boundaries in Utah. Population counts are aggregated into 5-year age groups for each sex. For more information see: http://www.geolytics.com/
GOPB	Governor's Office of Planning and Budget. The GOPB is an agency within the Utah Governor's executive office. The GOPB conducts a variety of tasks to assist Utah government develop strategy and coordinate programs related to Utah's economy, population growth, and policy-making. Within the GOPB, the Demographic and Economic Analysis section manages, analyzes and disseminates economic, demographic, and fiscal data. These data take advantage of other data within state government about Utah's population dynamics. For more information see: http://www.governor.utah.gov/gopb/.
HRSA	Health Resources and Services Agency. An agency of the U.S. Department of Health and Human Services. One of the roles of HRSA is to administer the Rural Health Outreach Projects. Starting in 2008, HRSA made funding available to SEUDHD through the UDOH for three Rural Health Outreach Project for Monticello. For more information see: http://www.hrsa.gov/index.html.
ICD-O-3	International Classification of Disease - Oncology, 3rd Edition. The ICD-O-3 is one of a number of internationally established coding standards for coding site (topography) and histology (morphology) of neoplasms (cancers). For more information see: http://www.who.int/classifications/icd/adaptations/oncology/en/.
MMTS	Monticello Mill Tailings Site. One of two superfund (NPL) sites associated with the uranium milling operations that occurred in Monticello. The MMTS is specifically the site of the mill tailings (radioactive waste materials) that were located just south of Monticello. For more information see: http://www.epa.gov/region8/superfund/ut/monticello/index.html.
MVP	Monticello Vicinity Properties. Also called Monticello Radioactively Contaminated Properties. One of two superfund (NPL) sites associated with the Uranium milling operations that occurred in Monticello. The MVP is specifically

	associated with private and commercial properties in Monticello that were contaminated with materials from the MMTS. For more information see: http://www.epa.gov/region8/superfund/ut/monticelloradioact/index.html
NCI	National Cancer Institute. The NCI is one of the National Institutes of Health and part of the U.S. Department of Health and Human Services. The NCI was established under the National Cancer Act of 1937 and is primarily responsible for conducting surveillance and research about cancer incidence, diagnosis, prevention, treatment, and rehabilitation. The SEER program is operated by the NCI. For more information see: http://www.cancer.gov/.
NPL	National Priority List. A list of sites, also called superfund sites, that have national priority for cleanup and remediation. NPL sites are listed because of a known or potential release of hazardous substances, pollutants or contaminates. Once a site is placed on the NPL, a series of activities are conducted by the U.S. Environmental Protection Agency, other federal agencies, and in Utah, the Utah Department of Environmental Quality, that leads to cleanup and remediation. Some of those activities involve health assessments conducted by the UDOH. For more information see: http://www.epa.gov/superfund/sites/npl/.
SAS	SAS is a robust internationally-accepted statistical software for conducting data management and analysis. The SAS application provides many statistical methodologies that can be applied to data tables. For more information see: http://www.sas.com/.
SEER	Surveillance, Epidemiology and End Results Program. The SEER program is an agency within the NCI. The SEER program works with state cancer registries to develop and disseminate incidence and mortality statistics about cancer in the United States. The SEER program also establishes standards for the analysis of cancer data and interpretation of cancer statistics. For more information see: http://seer.cancer.gov/.
SEUDHD	Southeastern Utah District Health Department. Once of twelve local health departments serving Utah residents. The SEUDHD covers Carbon, Emery, Grand and San Juan counties. For more information see: http://www.southeastuthealth.org/.
UBRFS	Utah Behavioral Risk Factors Survey. The UBRFS is an ongoing telephonic survey conducted by the Office of Public Health Assessment, UDOH. This survey collects data about health-related behaviors in the non-institutionalized Utah adult population. For more information, see: http://health.utah.gov/opha/OPHA_BRFSS.htm.

UCR — Utah Cancer Registry. The UCR is operated under authority from the UDOH by the University of Utah. The UCR was established in 1966 to be a state-wide population-based cancer registry. Utah administrative rule requires the reporting of cancer diagnoses to the UCR. The UCR collaborates with the NCI, SEER and the North American Association of Central Cancer Registries to implement data standards for cancer data. The UCR provide cancer to the EEP through the UEPHTN. For more information, see: http://ucr.utah.edu/.

UDOH — Utah Department of Health. The UDOH is one of the executive agencies within Utah state government. The UDOH strives to improve health in Utah through promoting healthy lifestyles, evidence-based interventions, creating healthy and safe communities and eliminating health disparities. The EEP is a program within the UDOH. For more information, see: http://health.utah.gov/.

UEPHTN — Utah Environmental Public Health Tracking Network. The UEPHTN is a data warehouse that contains health outcome, environmental and supporting data. Data from the UCR and population data derived from the USCB is warehoused in the UEPHTN. For more information see: http://health.utah.gov/enviroepi/activities/EPHTP/NewEPHT/ephtpnew.htm.

USCB — U.S. Census Bureau. Officially the "Bureau of the Census," the USCB is an agency authorized by Federal law, within the U.S. Department of Commerce that is charged with preparing and conducting regular surveys and censuses of the United States population. In addition to the decennial population survey, the USCB conducts a number of other surveys and has recently implemented the ACS. For more information, see: http://www.census.gov/.

ZCTA — ZIP Code Tabulation Areas are statistical geographies created by aggregating census blocks that generally form a ZIP code area. ZCTA boundaries are not exactly the same as ZIP code areas. Since some ZIP codes do not have an associated geography, a ZCTA may actually incorporate several ZIP codes. ZCTAs are not constrained by county boundaries. For more information, see: http://www.census.gov/geo/ZCTA/zcta.html.

Cancer Incidence: The term incidence refers to new cases occurring in a period of time, usually annually. Cancer incidence is the number of new cases that occurred in a year. New cancer cases occur when a diagnosis is made. The 2009 national age-adjusted incidence rate is 4.64 cancer cases per 1,000 population per year. For more information, see: http://www.cancer.gov/statistics/glossary/incidence.

Cancer Prevalence: The term prevalence refers to the number of cases that exist either at a moment in time or during a period of time (e.g., annual, lifetime, etc.). When using this term, the time should be included. The 2009 national lifetime cancer prevalence rate is approximately 414.65 cases of cancer among 1,000 population. Cancer prevalence is the total number of cases that exist. For more information, see: http://www.cancer.gov/statistics/glossary/prevalence.

Cancer Incidence Rate: This is a ratio of the cancer incidence (the number of new cancer diagnoses) over the total population. The computing a multiple year rate, the total population added from each year of the rate period is used to get the rate. For more information, see: http://www.cancer.gov/statistics/glossary/incidence.

Indirect Standardized Incidence Rate. The raw (sometimes called "crude") disease incidence rate (number of case incidences per time period divided by the person-years per period) reflects reality. The raw rate is the simplest and most straightforward summary of the population experience. Interpretation of a disease incidence rate involves a comparison of that rate with some comparison or acceptable rate to determine if the rate in question is high or low. Because rates will almost always involve comparing two populations with two different age distributions, comparison of a raw disease incidence rate with a comparison rate is problematic. It does not make sense to compare the rate of disease of a relatively young population with a relatively older population for a disease that is more common in the elderly and be able to state with confidence that the disease rate is higher or lower than expected. For this reason, when the objective is to compare two rates, age standardized rates are preferable. However, it should be noted that the rate itself, once standardized, is not the exact disease burden. The standardized rate should be of the same magnitude as the raw rate.

The indirect standardization method is the preferable method when the disease count in each age group is small or zero. A disadvantage of the indirect method is that the rate is comparable to the comparison population used in its computation, but is not comparable to other population rates. For example, for this study, the Monticello cancer rates are adjusted using the Utah state population and therefore are comparable to the Utah state rates. However, they are not comparable to the San Juan County rates or to national rates.

The Indirect Standardized Rate for Monticello (ISR_M) is calculated by:

$$ISR_M = \frac{C_M}{\sum_{age}\left(\frac{C_{U,age}}{P_{U,age}} P_{M,age}\right)} \times \left(\frac{C_U}{P_U}\right) \times 100{,}000$$

Where: ISR_M is the Indirect Standardized Incidence Rate for Monticello.

C_M is the total cancer incidence count for Monticello for a specific analytical period (e.g., 1990 - 1994).

$C_{U,age}$ is an age-group (e.g., 0 to 19 year in age, etc.) specific cancer incidence count for the state of Utah for a specific analytical period.

$P_{U,age}$ is the age-group specific count of person-years (e.g., number of 0-19 year olds in 1990 plus number of 0-19 year olds in 1991 plus number of 0-19 year olds in 1992 ..., etc.) for the state of Utah for a specific analytical period.

$P_{M,age}$ is the age-group specific count of person-years for Monticello for a specific analytical period.

C_U is the total cancer incidence count for the state of Utah for a specific analytical period.

P_U is the total count of person-years for the state of Utah for a specific analytical period.

For purposes of presentation, it is standard practice to present rates per a population of 100,000 people. For example, the statement "60 cases per 100,000 people" is easier to understand than the statement "0.00006 cases per person."

E_M is the expected case count of cancer incidence for Monticello for a specific analytical period. This is the denominator factor of the first term of the rate formula.

$$E_M = \sum_{age}\left(\frac{C_{U,age}}{P_{U,age}} P_{M,age}\right)$$

Standardized Incidence Ratio. The standardized incidence ratio (SIR) is a way of comparing two rates. When using the indirect standardized rate method, the SIR is the first term of the

$$SIR = \frac{C_M}{\sum_{age}\left(\frac{C_{U,age}}{P_{U,age}} P_{M,age}\right)} = \frac{C_M}{E_M}$$

formula to compute the rate.

$$\overline{\underline{SIR}} = \frac{(C_M + k)}{E_M} \times \left[1 - \left(\frac{1}{3 \cdot (C_M + k)}\right) + \left(\frac{\pm 1.96}{3 \cdot \sqrt{C_M + k}}\right)\right]^3$$

The Byar's 95% confidence limits ($Z_\alpha = 1.96$) can be calculated for the SIR by:

Where:

SIR is the standardized incidence ratio. The bar over and under means the upper and lower confidence limits of the SIR.

C_M is the total case count of cancer incidence count for Monticello for a specific analytical period.

E_M is the expected case count of cancer incidence for Monticello for a specific analytical period.

k is a constant for symmetry. For the upper confidence limit, k = 1. For the lower confidence limit, k = 0.

±1.96 is the normal distribution (Z_α) function for a 95% confidence interval. For the upper confidence interval it is a positive value. For the lower confidence interval it is a negative value.