ROCKY MOUTAIN ARSENAL MEDICAL MONITORING PROGRAM

SUPPLEMENTAL UPDATE OF CANCER INCIDENCE IN NORTHEAST DENVER RESIDENTS LIVING IN THE VICINITY OF THE ROCKY MOUNTAIN ARSENAL 1997-2009

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SUPPLEMENTAL UPDATE OF CANCER INCIDENCE IN NORTHEAST DENVER RESIDENTS LIVING IN THE VICINITY OF THE ROCKY MOUNTAIN ARSENAL, 1997-2009

INTRODUCTION

This document reports findings of cancer surveillance for 1997-2009 for communities in the northeast Denver metropolitan area, surrounding the Rocky Mountain Arsenal (RMA) in southern Adams County, Colorado. Cancer surveillance is one of the community health activities conducted by the Rocky Mountain Arsenal Medical Monitoring Program at the Colorado Department of Public Health and Environment (CDPHE)[1]. Cancer surveillance in the communities surrounding the arsenal was undertaken in response to recommendations made to the department by the Rocky Mountain Arsenal Medical Monitoring Advisory Group[2].

This supplemental report is the final evaluation in a series of CDPHE cancer investigations and is being conducted to address a recommendation from the 2010 report (CDPHE 2010) to produce an addendum to that study when the 2010 U.S. Census population data became available. Very large population growth was identified as a potentially significant factor that added to the uncertainty of the 2010 study findings. The current 2013 supplemental analysis, which uses 2000 and 2010 Census data, improves estimates of study area population counts, as well as age, race/ethnicity and gender distributions which were previously based only on the 2000 Census data. This final supplemental update uses the last complete year of cancer data available from the state Cancer Registry at the time the 2010 Census population data were released. Having more precise population counts and additional years of cancer occurrence data (longer time period of study) should provide a more accurate description of the cancer burden in the neighborhoods assessed.

In Colorado, surveillance of cancer incidence is possible using data collected by the Colorado Central Cancer Registry (CCCR) at CDPHE. All cancers diagnosed in Colorado are reported to the Cancer Registry with the exception of non-melanoma skin cancers. The registry is mandated by Colorado law and by Colorado Board of Health regulation. Information is collected from all Colorado hospitals, pathology labs, outpatient clinics, state Vital Statistics, and directly from physicians, where the physician

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1 The RMA Medical Monitoring Program was created by the RMA On-Post Record of Decision (ROD), and was signed by the U.S. Army, the U.S. Environmental Protection Agency (EPA), and the CDPHE on June 11, 1996, with concurrence of the U.S. Fish and Wildlife Service and Shell Oil Company.

2 The ROD stipulated that a Medical Monitoring Advisory Group (MMAG) be formed to evaluate information concerning exposure pathways and to identify and recommend appropriate public health actions and to communicate this information to the community. The Advisory Group recommendations defined goals, objectives and the methods of a program designed to respond effectively to RMA-related health concerns of the community. The ROD stated that the primary goals of the Medical Monitoring Program are to monitor any off-post impact on human health due to the remediation and provide mechanisms for evaluation of human health on an individual and community basis, until such time as the soil remedy is completed.

is solely responsible for diagnosis and treatment of a particular cancer. Pertinent data are registered on all malignant tumors, except basal and squamous cell carcinomas of the skin. All individual patient, physician, and hospital information is confidential, as required by Colorado law.

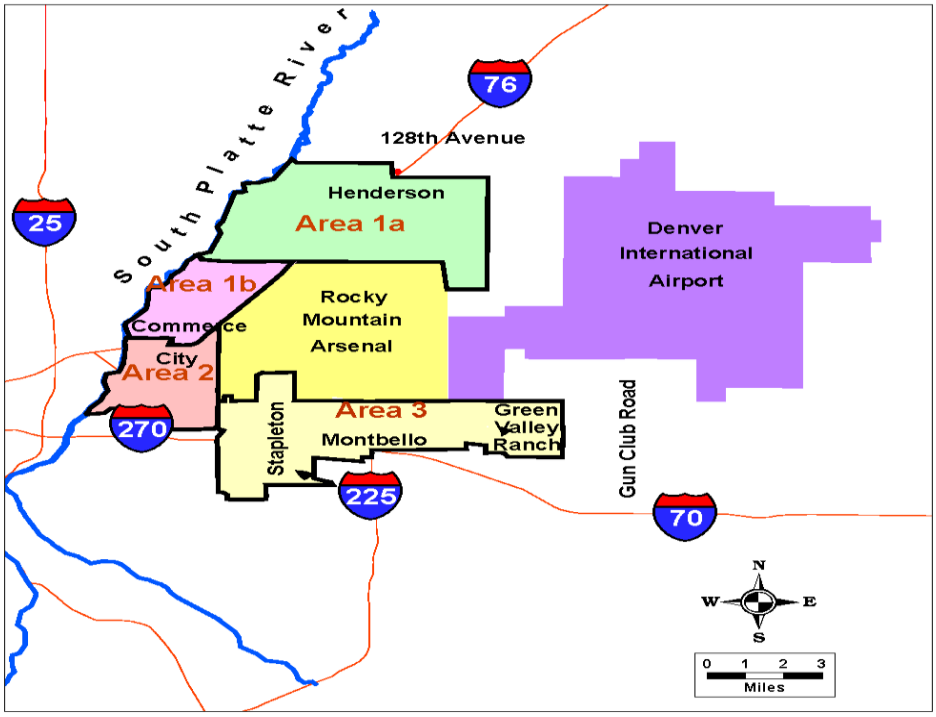
Current and past studies conducted to assess cancer outcome in communities around the RMA look at disease frequency at the group level. Cancer surveillance studies such as this allow public health officials to investigate whether cancer is occurring in numbers that are significantly higher than background rates. There are recognized limitations to these types of studies, however, including lack of data on important individual risk factors, such as exposure to carcinogens in the workplace or indoor or outdoor ambient air, and length of residence at the address recorded in the cancer registry records. An additional limitation is that it is not possible to control for the influence of common potentially carcinogenic exposure such as traffic-related exposure to benzene or other industrial influences within a given study boundary. In addition, assignment to a broad geographic area, such as a census tract, must be used to indicate individual exposure status. While a variety of exposures may contribute to the overall individual and population risk of some of the cancers reported, these factors cannot be accounted for or fully assessed with this type of study.

CANCER INVESTIGATION HISTORY AND STUDY OBJECTIVES

The objectives of the ongoing cancer surveillance, previously established by the Rocky Mountain Arsenal Medical Monitoring Advisory Group, are to use cancer incidence data collected by the Colorado Central Cancer Registry to: 1) establish existing rates of cancer incidence prior to the RMA soil remediation, 2) analyze cancer incidence rates for significant temporal or spatial changes during and after the RMA soil remediation, and 3) investigate any increased, or otherwise unexplained, rates of cancer.

The 2013 supplemental update addresses objectives 2 and 3 above for a thirteen-year period, 1997-2009, beginning about the time that soil remediation commenced at the Rocky Mountain Arsenal. An earlier report, *Analysis of Diagnosed vs. Expected Cancer Cases for the Northeast Denver Metropolitan Area in the Vicinity of the Rocky Mountain Arsenal, 1979-1996*, was published January, 2003 and addressed objectives 1 and 3 by analyzing 1979-1996 cancer data for the geographic area first described in the 1993 report *Cancer Incidence in the Northeastern Denver Metro Area: Report of the Ad Hoc Panel* (CDPHE 1993) (see Figure 1). A second analysis of cancer incidence, the initial post-baseline analysis, was published in October 2003. This study reported on cancer incidence for the time period 1997-2000. A third analysis of cancer incidence was published in May 2010 covering the time period of 1997-2005. The current study evaluates an additional four years of cancer data for the same cancer types and geographic area assessed in the May 2010 report. A summary of findings from all three of these cancer surveillance reports is provided in Table 3 in the discussion section of this report.

Figure 1. Study area for the analysis of diagnosed vs. expected cancer cases for the northeast Denver area in the vicinity of the Rocky Mountain Arsenal, Colorado, 1997-2009, Surveillance Areas 1a, 1b, 2, and 3.



METHODS

As with previous studies, cancer case counts were obtained from the CDPHE Central Cancer Registry. Virtually all cancer cases diagnosed since 1979 in the area of interest are identified and registered with the state Cancer Registry. Identification and registration of cancer cases involves standard processes including searching hospital medical charts, pathology laboratory records, and examining death certificate information.

As part of the present investigation, a common method of analysis was used to compare cancer diagnosis counts for an area in the vicinity of the Rocky Mountain Arsenal, for the time period of 1997-2009, to expected counts, using the remainder of the Denver metropolitan area as a standard or comparison population. The expected number of cancers was calculated by multiplying the cancer site-specific incidence rates in the standard population, adjusted by age, sex, and race/ethnicity, and then applying these rates to the study population. Study methods are consistent with those used in the 2010 cancer incidence study and were previously described in detail in the 2010 report (CDPHE 2010).

The boundaries for the study area used for this supplemental analysis were selected originally based on 1990 U.S. Census tract designations. The study area was composed of three smaller areas (Areas 1 through 3) based on the geography first described in the 1993 report *Cancer Incidence in the Northeastern Denver Metro Area: Report of the Ad Hoc Panel* (CDPHE 1993). In the present investigation, as in the earlier reports, Area 1 has been further subdivided into Areas 1a, 1b, and Area 1 Combined, to better track cancer incidence in this region of rapid population growth. All five of these subdivisions of the overall study area are described below and shown in Figure 1.

Area 1a, north of the Rocky Mountain Arsenal, was defined as census tract 85.12 with a population of 1,334 in 1980, 1,405 in 1990, 2,194 in 2000, and 25,530 in 2010. Its boundaries were Henderson Rd., E. 124th Ave., State Hwy. 51, E. 120th Ave., Tower Rd., Irondale Rd. (E. 88th Ave.), Buckley Rd., E. 96th Ave., McKay Rd., and the South Platte River.

Area 1b, northwest of the Rocky Mountain Arsenal, was defined as census tracts 88.01 and 88.02 with a combined population of 7,766 in 1980, 6,971 in 1990, 8,513 in 2000, and 8,827 in 2010. Its boundaries were McKay Rd., E. 96th Ave., State Hwy. 2, E. 72nd Ave., U.S. Hwy. 85, E. 74th Ave. (State Hwy. 224), and the South Platte River.

Area 1 Combined, was defined as Area 1a and Area 1b together with a combined population of 9,100 in 1980, 8,376 in 1990, 10,707 in 2000, and 34,357 in 2010.

Area 2, west of the Rocky Mountain Arsenal, was defined as census tracts 87.03, 87.05, 87.06, and 89.01 with a combined population of 17,292 in 1980, 15,740 in 1990, 18,939 in 2000, and 20,329 in 2010. Its boundaries were E. 74th Ave. (State Hwy. 224), U.S. Hwy. 85, E. 72nd Ave., State Hwy. 2, Quebec, Denver-Adams County Line, and the South Platte River.

Area 3, south of the Rocky Mountain Arsenal, was defined as census tracts 41.05 (see the description of a slight revision to the current study area in the footnote, below)[3], 83.03, 83.04, 83.05, 83.06, 83.10, 83.11, and 83.12 with a combined population of 16,828 in 1980, 21,626 in 1990, 39,311 in 2000, and 70,302 in 2010. Its boundaries were the Denver-Adams County Line, E. 56th Ave., Picadilly Rd., Denver-Adams County Line,

Tower Rd., Denver-Adams County Line, E. 46th Ave., Denver-Adams County Line, Montview Blvd., Syracuse, E. 23rd Ave., Quebec, E. 48th Ave., Denver-Adams County Line, and Quebec.

This analysis examined all diagnosed malignancies combined, as well as cancers of the 30 anatomical sites listed in Table 1. All cases of cancer diagnosed between 1997 and 2009 that occurred in residents living in the study area were identified. The address at the time of diagnosis for each case was used to assign residence within the census boundaries.

In order to estimate the number of cancers expected in the areas under study, it is critical to use the best available population data by gender, race and age for each year of the evaluation period. In this way, as the population grows or declines year by year in each area, the combination of the number of persons and years of follow-up (person-years) contributes to the number of cancers that would be expected. For example, if an area has high growth in the latter years of the evaluation period, the larger number of residents contributes fewer years toward the total expected number of cancers than if they had lived there the entire period. For this study, U.S. Census counts of population for census tracts by age, race/ethnicity, and gender for 1990, 2000 and 2010 were obtained from the Colorado Division of Local Government (State Demographers Office) or from the U.S. Census website.

Cancer rates from the Denver metropolitan area (excluding the study area) over this time period were used as standards for calculating expected numbers of cancers for the areas because: (1) complete age-specific rates by race/ethnicity and gender were available from the CCCR, and (2) the Denver metropolitan area serves as a local standard of comparison, which is preferable to using a statewide or national standard since these

3 As with the 2010 analysis, the geographic area used for the current 1997-2009 supplemental update to define census tract 41.05 in Area 3 (located at the western end of Area 3, mostly west of Peoria, which includes the old Stapleton Airport) excludes the prison population located there and removes all cancer cases from the analysis where patient address was the same as that of the jail intake facility. The residential population and cancer cases from census tract 41.05, including Stapleton residences, are included.

Table 1 – Anatomical sites of cancers included in the *Analysis of Diagnosed vs. Expected Cancer Cases for the Northeast Denver Area in the Vicinity of the Rocky Mountain Arsenal, 1997-2009.*

Salivary Gland	Kidney
Oral cavity	Thyroid
Nasopharynx	Other Endocrine
Other Oral and Pharynx	Brain and Other Nervous System
Esophagus	Bone
Stomach	Leukemia
Small Intestine	Multiple Myeloma
Colorectal	Lymphoma
Liver and Intrahepatic Bile Duct	Soft Tissue
Other Biliary	Prostate
Pancreas	Testis
Larynx	Female Breast
Lung and Bronchus	Cervix
Melanoma	Uterus
Bladder	Ovary

Notes:
Oral cavity includes tongue, floor of mouth, and gum.
Other Oral and Pharynx includes tonsil, oropharynx, and hypopharynx.
Other Biliary includes gallbladder, extrahepatic bile duct, and ampulla of vater.
Other Endocrine includes thymus, adrenal gland, and other endocrine glands.
Bone includes bone and joints.

areas may be less likely to reflect local background cancer rates. The Denver metropolitan area is defined as the seven counties of Adams, Arapahoe, Boulder, Broomfield, Denver, Douglas, and Jefferson.

Cancer rates from the Cancer Registry for men and women of comparable race/ethnic groups and ages were used to calculate the expected number of cancers for the areas. A cancer rate is the number of new cancer cases diagnosed per 100,000 population in a one-year period of time. The population in each study area, stratified by age, gender, and race/ethnicity, was multiplied by the cancer rate for each age, gender, and race/ethnic group in the comparison population to produce the expected number of cancers. A diagnosed-to-expected ratio is then calculated by dividing the number of cancers diagnosed in the area by the number of expected cases. If the ratio is greater than 1, then more cancer cases than expected were reported in the area. When this occurs, the next step is to look more closely at that relationship. It is important to know if that ratio could have been higher by chance alone, so a confidence interval is calculated for the ratio. The confidence interval has a lower number (minimum value) and a higher number (maximum value). It is common to use a 95 percent confidence interval, which means, with 95 percent certainty, the true ratio occurs within the range between the lower and

higher values. If the ratio is greater than 1 but the confidence interval includes the number 1, then the ratio is within expected statistical limits. If the confidence interval does not include the number 1, then the ratio is statistically significant. A statistically significant elevated ratio means that there were more diagnosed cases than expected and that there is less than a 5 percent chance that this greater number is due to chance alone.

Because the estimate of expected cancers is based on the larger Denver metropolitan region population, this estimate will be a central tendency, or average number, of expected cases for the time period, 1997-2009. Cancer rates for specific populations, such as in smaller cities, towns, or neighborhoods, will likely be either higher or lower than the "expected average." Smaller populations tend to show greater variability. The variability of small populations is statistically reflected in the 95 percent confidence interval for the ratio of diagnosed to expected cases. Confidence intervals for small populations tend to be wider than for large populations. When the expected number of cancer cases is small, slight increases can result in seemingly large diagnosed to expected ratios. For example, if only one case of cancer is expected in a small population in a given year, and two were actually diagnosed, the ratio would of course show a doubling of cases. But, in this situation, twice the number of expected cases would be within expected statistical limits. Statistical testing was not done on ratios with less than three diagnosed cases because of the inherent variability in such small numbers.

When statistically significant elevations of diagnosed-to-expected ratios were observed, other data recorded in the Cancer Registry abstract were also reviewed. These data help to characterize potential exposure commonalities among the cases, including the presence of important known risk factors for certain cancers, and allow separation of selected anatomical categories of cancer into cell types. The case abstract data reviewed for this study included occupation, smoking history, and tumor-specific information, such as histology (or cell type of the tumor), anatomical sub-site, and multiple tumor sequencing. Available data were reviewed for discernible patterns within and across geographic areas.

RESULTS

The results of the study show that cancer incidence was statistically elevated in both genders combined for Area 1a, Area 1 Combined, and Area 3. Statistically significant elevations in cancer incidence were identified for twelve of the thirty anatomic sites studied, including, lung, colorectal, stomach, nasopharynx, bladder, kidney, larynx, leukemia, prostate, thyroid, uterus, and extrahepatic bile duct/gallbladder. However, these elevations were not consistent across location, gender, race, or time.

Tables A1- A15, located in Appendix 1, display the number of diagnosed cancers in each of the study areas (Area 1a, 1b, 1 Combined, 2, and 3) by cancer type and gender, for 1997-2009, compared to the number that would be expected based on the population of male and female residents in the areas by race/ethnicity and age. Tables A16-A28, also located in the Appendix, display additional detail for selected areas, gender groups and/or cancer types that had statistically high findings or particularly relevant findings compared to previous time periods. Cancer rates from the Cancer Registry for males and females of comparable race/ethnic groups and ages were used to calculate the expected number of cancers for the areas. The ratios of diagnosed to expected cases along with the 95 percent confidence intervals for these ratios provide information about the relative rate of cancer in these areas. Observed/expected ratios and confidence intervals are displayed with rounding to two decimal points.

Area 1a, 1b and Combined Area 1 – Tables A1-A9 display statistics for Areas 1a, 1b, and Combined Area 1 for 1997-2009 for males and females separately and together.

Area 1a - Table A1 shows that the number of all cancers combined diagnosed among both males and females together in Area 1a was statistically high (388 cases compared to about 334 cases expected for a ratio of 1.16). The ratio for females (Table A3) was not statistically high, but Table A2 shows that the ratio for male cancers of all types combined was statistically high at 1.26 with 202 cases compared to about 160 cases expected. The cancer elevations in Area 1a included statistically high ratios for several individual types of cancer. Specific elevated cancer types were: other biliary (which includes gallbladder and extrahepatic bile duct cancers), lung, kidney, thyroid, and colorectal, Since all of these individual cancer type elevations (except thyroid) were also reflected in Combined Area 1 results, further information about these cancers is reported under the section "Combined Area 1". For thyroid cancer among both genders combined and for females in Area 1a, Tables A1 and A3 show that the ratios were statistically high (20 thyroid cancer cases compared to about 11 cases expected among both genders for a ratio of 1.85 with 16 of these cases being female compared to about eight cases expected for a ratio of 1.93). Table A16 shows the distribution of thyroid cancer cases by race and age in Area 1a. Only white, non-Hispanic persons had a ratio that was statistically high at 2.50 (16 cases compared to about six cases expected). CCCR abstracts showed a variety of occupations for the 20 cases and three cases (15%) had a history of tobacco use. Almost all of the 20 thyroid cancers were papillary carcinomas (90%), consistent with the predominance of this cell type in the Denver metropolitan area (87%).

Area 1b – Tables A4-A6 show that the number of all cancers combined diagnosed in Area 1b was generally close to the number expected in this area during this time period.

Tables A4 - A6 also display colorectal and lung cancer elevations for both genders in Area 1b. Since these colorectal and lung cancer elevations were also reflected in Combined Area 1, they are described in more detail in the Combined Area 1 section of this report.

Combined Area 1 - Table A7 shows that the number of all cancers combined diagnosed among both males and females together in Area 1 Combined was statistically high (801 cases compared to about 722 cases expected for a ratio of 1.11). The ratio for females (Table A9) was not statistically high, but Table A8 shows that the ratio for male cancers of all types combined was statistically high at 1.17 with 419 cases compared to about 359 cases expected. Four individual types of cancer, kidney, colorectal, other biliary, and lung, had statistically high ratios.

Table A7 shows that there were 31 kidney cancer diagnoses among both males and females together in Combined Area 1, compared to about 21 cases expected during 1997-2009, for a statistically high ratio of 1.50. Males and females separately did not show statistically high ratios. Table A17 shows the distribution of kidney cancer cases by race and age in Combined Area 1. None of the race/ethnicity cancer ratios were statistically elevated. Only the 45-54 age group showed a statistically high ratio (2.35) with nine cases compared to about four cases expected. CCCR abstracts showed a variety of occupations among the 31 kidney cancer cases. Fifteen of the 31 cases (48%) had a history of smoking documented in Cancer Registry abstracts. Including only abstracts where smoking information was recorded, 58% of cases were smokers. There were no uncommon histological cell types recorded and the distribution of types of kidney cancer in Combined Area 1 during 1997-2009 was similar to the Denver metropolitan area. The cases included the major forms of kidney cancer, renal cell carcinomas (74% vs. 83% in metropolitan Denver), transitional cell tumors (7% vs. 8%), and all other types (19% vs. 9%).

Table A7 shows that there were 101 colorectal cancer diagnoses among both males and females together in Combined Area 1, compared to about 67 cases expected during 1997-2009, for a statistically high ratio of 1.51. Table A8 shows a similar finding for the male ratio (1.63), which is statistically high, with 60 cases compared to about 37 cases expected. Table A18 shows the distribution of colorectal cancer cases by race and age in Combined Area 1. The ratio for white, non-Hispanic cases was statistically high at 1.67 (69 cases compared to 41 cases expected). Two age groups, 55-64 and 65-74, showed statistically high ratios of 1.87 and 1.68, respectively. CCCR abstracts showed a variety of occupations among the 101 cases. Forty-seven of the 101 cases (47%) had a history of smoking documented in Cancer Registry abstracts. Including only abstracts where smoking information was recorded, 58% of cases were smokers. The anatomical distribution among the 101 colorectal cancer cases was similar to the distribution found in the Denver metropolitan area. The ascending colon accounted for 25% of Area 1 colorectal cancer cases compared to 30% of Denver cases, the hepatic and splenic flexure and transverse colon accounted for 20% of Area 1 cases compared to 13% of Denver cases, and the descending colon accounted for 55% of Area 1 cases compared to

57% of Denver cases. Twelve of the 101 colorectal cancers (12%) were diagnosed among just six individuals, each with double primary tumors during this time period, which is close to twice the percentage of multiple tumors among colorectal cancer cases compared to the Denver area. Colorectal cancers in Combined Area 1 were detected at earlier stages of disease (48%) than was typical in the rest of the Denver metropolitan area (44%).

Table A7 shows that there were ten other biliary cancers (including gallbladder cancer) diagnosed among both males and females together in Combined Area 1, compared to about four cases expected during 1997-2009 for a statistically high ratio of 2.81. Five of these ten cases were cancers of the gallbladder. Seven of these ten cases were diagnosed in Area 1a where males and both genders combined had statistically high ratios, 6.55 and 4.74, respectively (see Tables A1 and A2). Table A19 shows that the distribution of the ten other biliary cancers by race and age revealed a statistically high ratio (3.27) among white, non-Hispanics with six cases compared to about two cases expected in Combined Area 1. None of the age-group ratios were statistically high. CCCR abstracts showed little detail about occupations for the ten cases. Five of the ten cases (50%) had a history of smoking documented in Cancer Registry abstracts. One-half of these other biliary cancer cases (five out of ten) were gallbladder cancers, which have a history of gallstones 75-90% of the time, according to the scientific literature.

Table A7 shows that there were 118 lung cancer diagnoses in Combined Area 1, compared to about 67 cases expected during 1997-2009, for a statistically high ratio of 1.76. Tables A8 and A9 also show statistically high findings for the male ratio (1.99) and female ratio (1.48). Tables A1-A6 show statistically high elevations in Areas 1a and 1b, for males and females combined and males and females alone , except for females in Area 1a. Table A20 shows that most lung cancer cases in Area 1 Combined were White, non-Hispanic (95 cases out of 118 cases) and the ratio for White, non-Hispanic cases was statistically high at 2.02 (95 cases compared to about 47 cases expected). The distribution of cases by age showed elevations in all age groups from 45 and above, with ratios in age groups from 55 and above being statistically high, ranging from 1.58 to 2.01. Cancer Registry abstracts showed a variety of occupations among these 118 lung cancer cases. About 83 percent of these cases (98 out of 118 cases) had a history of smoking. Limiting this calculation to only cases with smoking information recorded on the abstracts, 94 percent of lung cancer cases (98 out of 104) were smokers. There were no uncommon histological cell types recorded and the distribution of types of lung cancer in Combined Area 1, during 1997-2009, was similar to the Denver metropolitan area. The cases included the major forms of lung cancer, squamous cell carcinomas (18% vs. 18% in metropolitan Denver), large cell carcinomas (6% vs. 5%), small cell carcinomas (18% vs. 14%), adenocarcinomas (30% vs. 37%), and all other types (28% vs. 26%).

Area 2 - Tables A10-A12 show that the number of all cancers combined diagnosed in Area 2 was generally close to the number expected in this area during 1997-2009. There were five types of cancer found to have statistically higher numbers of cases than expected: stomach, female larynx, lung, uterus and male leukemias.

Table A10 shows that there were 24 stomach cancers diagnosed in Area 2 compared to about 14 cases expected for a statistically high ratio of 1.69. Table A11 and A12 show similarly elevated ratios for males (1.66) and females (1.73), but neither ratio was statistically high. Table A21 shows the distribution of stomach cancers in Area 2 by race and age. Most cases were white, non-Hispanic (15 cases compared to about six cases expected) and the ratio of diagnosed to expected cases of 2.49 was statistically high. The 55-64 age group was the only age group to have a statistically high ratio (3.58), with eight cases compared to about two cases expected. Cancer Registry abstracts showed a variety of occupations among these 24 stomach cancer cases. About 42 percent of these cases (ten out of 24 cases) had a history of smoking. Limiting this calculation to only cases with smoking information recorded on the abstracts, 50 percent of stomach cancer cases (ten out of 20) were smokers. There were no uncommon histological cell types recorded and the distribution of types of stomach cancer in Area 2 during 1997-2009 was similar to the Denver metropolitan area. Adenomas and adenocarcinomas accounted for 71% of Area 2 cases and 67% of Denver cases, carcinomas accounted for 8% of Area 2 cases and 4% of Denver cases, and cystic, mucinous, and serous neoplasms represented 21% of Area 2 and Denver cases.

Table A12 shows that there were five female larynx cancers diagnosed in Area 2 during 1997-2009 compared to one or two cases expected for a statistically high ratio of 3.57. Table A22 shows that there were too few cases among the race/ethnic categories or specific age groups to perform stratified statistical testing. Little occupation information was found on Cancer Registry abstracts, but 80% of the cases had a positive history of smoking (four out of five cases). These five cases were all squamous cell carcinomas, consistent with the predominance of this cell type for larynx cancers; 91% of Denver area cases were this cell type.

Table A10 shows that there were 141 lung cancer diagnoses in Area 2 compared to about 93 cases expected during 1997-2009 for a statistically high ratio of 1.52. Table A11 also shows a statistically high ratio for males (1.78) with 87 cases compared to about 49 cases expected. Table A23 shows that most cases were white, non-Hispanic (107 out of 141 cases) and the ratio for white, non-Hispanic cases only was statistically high at 1.68 (107 cases compared to about 64 cases expected). The distribution of lung cancer cases by age showed statistically high ratios in each age group 55 and above. The one case in the 0-4 age group was diagnosed in a child whose very rare cancer was found to be linked to a likely familial syndrome. Cancer Registry abstracts showed a variety of occupations among these 141 lung cancer cases. About 74 percent of these cases (104 out of 141 cases) had a history of smoking. Limiting this calculation to only cases with smoking information recorded on the abstracts, 95 percent of lung cancer cases in Area 2 (104 out of 110) were smokers. There were no uncommon histological cell types recorded and the distribution of types of lung cancer in Area 2 during 1997-2009 was similar to the Denver Metropolitan Area. The cases included the major forms of lung cancer, squamous cell carcinomas (25% vs. 18% in metropolitan Denver), large cell carcinomas (6% vs. 5%), small cell carcinomas (12% vs. 14%), adenocarcinomas (23% vs. 37%), and all other types (34% vs. 26%).

Table A12 shows that there were 34 uterine cancers diagnosed in Area 2 during 1997-2009 compared to about 20 cases expected for a statistically high ratio of 1.69. Table

A24 shows that most cases were white, non-Hispanic (26 cases out of 34 cases) and the ratio for white, non-Hispanic cases only was statistically high at 2.01 (26 cases compared to about 13 cases expected). One age group (55-64) had a statistically high ratio of 2.45 (14 cases compared to about six cases expected). Cancer Registry abstracts showed a variety of occupations among these 34 cases. About 24 percent of these cases (eight out of 34 cases) had a history of smoking. Limiting this calculation to only cases with smoking information recorded on the abstracts, 32 percent of uterine cancer cases in Area 2 (eight out of 25) were smokers. There were no uncommon histological cell types recorded and the distribution of types of uterine cancer in Area 2 during 1997-2009 was similar to the Denver metropolitan area. Endometroid adenocarcinomas accounted for 56% of Area 2 cases and 55% of Denver cases, other adenocarcinomas accounted for 24% of Area 2 cases and 32% of Denver cases, sarcomas accounted for 15% of Area 2 cases and 6% of Denver cases and all other cell types represented 5% of Area 2 cases and 7% of Denver cases.

Table A11 shows that there were 26 male leukemias diagnosed in Area 2 during 1997-2009 compared to about 15 cases expected for a statistically high ratio of 1.69. As seen in Table A25, which displays race and age distributions for the 26 male leukemias, one age group (65-74) had a statistically high ratio (2.53) and one race group (Hispanics) had a statistically higher number of cases than expected (12 cases compared to about six cases expected) for a ratio of 2.16. About 46 percent of the male leukemia cases (12 out of 26 cases) had a history of smoking. Limiting this calculation to only cases with smoking information recorded on the abstracts, 60 percent of the male leukemias (12 out of 20 cases) were smokers. There was a variety of leukemia types represented among the 26 male cases with the distribution by type similar to the Denver area. Acute lymphocytic leukemia (ALL) accounted for 19% of Area 2 cases and 13% of Denver cases, acute myeloid leukemia (AML) accounted for 31% of Area 2 cases and 26% of Denver cases, chronic lymphoctyic leukemia (CLL) accounted for 35% of Area 2 cases and 33% of Denver cases and chronic myeloctyic leukemia accounted for 4% of Area 2 cases and 12% of Denver cases. Only 11 of 26 male leukemia cases in Area 2 had occupations listed on Cancer Registry abstracts, but five of the eight AML cases were listed as truck drivers. AML is a type of leukemia associated with occupational exposure to benzene from diesel exhaust.

Area 3 - Table A13 shows that the number of all cancers combined diagnosed among both males and females together in Area 3 was statistically high (1562 cases compared to about 1432 cases expected for a ratio of 1.09). The ratio for male cancers of all types combined in Table A14 was statistically high at 1.10 with 785 cases compared to about 715 cases expected and Table A15 shows that the ratio for female cancers of all types combined was statistically high at 1.08 with 777 cases compared to about 717 cases expected. It is interesting to note that this elevation among female cancers was comprised of a number of ratios of cancer types modestly elevated, with only one type (bladder cancer) having a statistically high ratio. The lung cancer ratio among females of 1.17 (71 cases compared to about 60 cases expected), was sufficient alone to force the statistically high ratio for all cancers combined for females. In other words, excluding lung cancers, all other cancers combined for females in Area 3 were within expected statistical limits. The group of female lung cancers also had a strong connection with smoking; 68% of the cases had a CCCR abstract mention of a smoking

history, and excluding cases with unknown smoking status, 89% of the cases had a positive smoking history. Tables A13-A15 display statistically high ratios for three individual types of cancer in Area 3, as well: nasopharynx, prostate, and bladder.

Table A13 shows that there were six nasopharynx cancers diagnosed in Area 3 during 1997-2009 compared to about two cases expected for a statistically high ratio of 3.06. Tables A14 and A15 show that the ratios for males and females separately were not statistically elevated. Table A26 shows that there were too few cases among the race/ethnic categories and specific age groups to perform statistical testing. Case abstract review showed that two of the six cases (one male and one female) were in patients born in Southeast Asia, an area where cancers of the nasopharynx are extremely common (ACS, 2001). Occupation information from the Cancer Registry abstracts was limited, but two of the remaining four cases had automobile service jobs. Five of the six cases diagnosed were carcinomas (the other case was listed only as malignant neoplasm). Two cases occurred in the 10-14 age group. One child was listed as having fetal alcohol syndrome. Both mothers of the two younger cases had a past history of cancer. It is also of interest to note that, in light of the fact that two cases had a potentially strong risk factor for this disease (i.e., Southeast Asia birthplace), even one less case (five cases rather than six cases) would have resulted in a ratio within expected statistical variation for this area.

Table A14 shows that there were 270 prostate cancers diagnosed in Area 3 during 1997-2009 compared to about 225 cases expected for a statistically high ratio of 1.20. Table A27 shows that the ratio for White, non-Hispanics (1.54) was statistically high (71 cases compared to about 46 cases expected). Only one of the age groups (45-54) had a statistically high ratio (1.51). Occupation information from the Cancer Registry abstracts was quite varied showing no particular pattern of employment. About 33 percent of the prostate cancer cases (90 out of 270 cases) had a history of smoking. Limiting this calculation to only cases with smoking information recorded on the abstracts, 55 percent of the cases (90 out of 163 cases) were smokers. These smoking percentages are almost identical to prostate cancer cases in the Denver metropolitan area, 34% and 55%, respectively. There were no uncommon histological cell types recorded. Adenocarcinomas accounted for 99% of prostate cancers reported in Area 3 during 1997-2009, which was similar to the Denver metropolitan area distribution of 96% adenocarcinomas.

Table A13 shows that there were 50 male and female bladder cancer cases in Area 3 compared to about 31 cases expected during 1997-2009, resulting in a statistically high ratio of 1.59. Table A14 shows that the ratio for males is not statistically high, but Table A15 displays a female ratio of 2.17, which is statistically high, with 16 cases compared to about seven cases expected. Table A28 shows that about half of the bladder cancer cases were white, non-Hispanic, and the ratio for white, non-Hispanic cases was statistically high at 1.94 (23 cases compared to about 12 cases expected). The distribution of cases by age showed statistically high elevations in the 35-44 and 45-54 age groups, with ratios of 6.66 and 2.62, respectively. CCCR abstracts showed a variety of occupations for these 50 bladder cancer cases. Thirty of the 50 cases (60%) had a history of smoking documented in Cancer Registry abstracts. Including only abstracts where smoking information was recorded, 30 of 36 cases (83%) were

smokers. Almost all of the 50 bladder cancers were transitional cell carcinomas (92%), consistent with the predominance of this cell type for this cancer.

Table 2 provides a summary of all statistically elevated cancer counts for the time period 1997-2009. Cancers that were statistically lower than expected included: female breast (Area 1 Combined, and Area 2); prostate (Area 1b and Area 2); melanoma (for males and females separately and combined in Area 2 and males and females combined in Area 1b); and other pharynx (for males & females combined in Area 3).

Table 2. Summary of statistically elevated cancer findings, by area and gender, for the period 1997-2009.

Cancer Site	Combined AREA 1			AREA 1A			AREA 1B			AREA 2			AREA 3		
	M			M			M		B	M			M		B
Bladder															X
Lung	X			X			X		X	X					
Larynx															
Colorectal	X			X			X		X						
Other Biliary/ Gallbladder	X			X											
Stomach															
Nasopharynx															X
Leukemia										X					
Uterus															
Kidney															
Prostate													X		
Thyroid															
All cancers	X			X									X		X

X indicates a statistically elevated number of cancers
M = Males
F = Females
B = Both males and females combined

STATISTICAL ANALYSIS AND THE MULTIPLE COMPARISONS PROBLEM

Studies examining multiple health outcomes in several sub-populations may observe statistically elevated rates of those outcomes simply due to chance. This statistical phenomenon is commonly referred to as the "multiple comparisons" problem. If these tests are conducted at a 95 percent confidence level, about 5 percent of the tests are predicted to be statistically significant by chance alone; about 2.5 percent may be statistically higher than expected and 2.5 percent lower. In this study of cancer in the northeast Denver area, with 216 independent statistical tests conducted on separate cancer sites, by gender and for several different areas, there were 15 ratios statistically higher than expected (6.9 percent of the tests compared to about 2.5 percent predicted by chance alone) and five ratios statistically lower than expected (2.3 percent of the tests compared to about 2.5 percent predicted by chance alone). Note that ratios based on less than three cases were not tested statistically, which likely partially accounts for the lower percentage of statistically low outcomes reported in this study.

DISCUSSION

The primary focus of the 2013 supplemental update of cancer incidence in the RMA study area was to address uncertainty in the 2010 study results due to large population growth over the time period studied. The 2013 analysis includes the addition of 2010 Census population data which improves estimates of study area population counts, as well as age, race/ethnicity and gender distributions which were previously based only on the 2000 Census data. Having more precise population counts and additional years of cancer occurrence data (longer time period of study) should provide a more accurate description of the cancer burden in the neighborhoods assessed. This evaluation focused on cancer outcome data for the time period when on-post soil cleanup commenced at the Rocky Mountain Arsenal (1997), through 2009, the last complete year of cancer data available at the time the study began.

The epidemiological information presented in the 2010 cancer study for many of the cancers that were found to be statistically higher than expected is still considered the state of the science for those cancers (lung, larynx, colorectal, bladder, stomach, leukemia, nasopharynx and gallbladder/other biliary) and readers are directed to that study for more detailed information about known causes and possible associations with environmental and occupational exposures.

The 2013 supplemental analysis showed a variety of cancers that were statistically higher than expected within the northeast Denver study areas in the vicinity of the RMA during the time period 1997-2009 (see Table 2). For eight cancer types (bladder in both genders combined in Area 3, nasopharynx in both genders combined in Area 3, lung in both genders combined in Area 2, larynx in females in Area 2, leukemia in males in Area 2, stomach in both genders combined in Area 2, lung in both genders in Combined Area 1 and 1b, colorectal in both genders in Combined Area 1 and1b, and gallbladder/other biliary in both genders in Combined Area 1 and 1a) the results of the 2013 supplemental analysis are essentially unchanged from the 2010 study with the exception of some slight differences in gender reported as statistically significant. Differences are generally based on slight differences in the number of cases contributing to incidence slightly above or

below statistical significance, and expected fluctuation in outcomes over time due to changing time periods/cutpoints selected for data analysis. For Areas 1 and 3, improved population estimation based on 2010 Census data may also account for some changes.

In addition, some cancers reported as statistically high in the 2010 study were no longer found to be statistically higher than expected in the 2013 supplemental analysis (bladder cancer in males in Area 1b and cancer of the small intestine in males in Area 3). Four cancer types were also found to be statistically lower than expected: female breast (Area 1 Combined and Area 2); prostate (Area 1b and Area 2); melanoma (for males and females separately and combined in Area 2 and in males and females combined in Area 1b); and other pharynx (for males and females combined in Area 3).

Four new cancer types were reported in the 2013 supplemental analysis as statistically higher than expected --- kidney, thyroid, prostate and uterine cancer. To better evaluate the statistically high findings detected in this study, additional case review and investigation of cancer-specific etiologies were conducted to help interpret the outcomes, as was done for the 2010 study. These additional cancer types are discussed below.

Kidney Cancer – According to the American Cancer Society (ACS 2013), tobacco use is the strongest risk factor for kidney cancer, with about 30% of the remaining cases attributable to obesity. Hypertension (high blood pressure) and chronic renal failure are also associated with increased risk of kidney cancer. Some rare inherited conditions can also cause kidney cancer. Many studies have suggested that workplace exposure to certain substances increases the risk for renal cell carcinoma. Some of these substances are asbestos, cadmium, some herbicides, benzene, and organic solvents, particularly trichloroethylene (TCE). Additional studies examining specific occupations and risk of kidney cancer found excess mortality associated with computer manufacturing among both men and women, elevated risk among male food industry workers and suggestive increased risk among sawmill workers based on dermal exposure to pentachlorophenol (Clapp 2008).

In this study, kidney cancer was elevated in both genders combined in Area 1 Combined and 1a and in females in Area 1a. In an evaluation of all kidney cancers (31 cases) in Area 1 Combined, only the 45-54 age group showed a statistically high ratio. In the general population, kidney cancer most often occurs in people 55 and older, with an average age of diagnosis of 64. A high percentage of the cases were categorized in the cancer abstract as smokers. There was also one case (Wilms tumor) reported in a young child. Certain genetic syndromes or birth defects can increase the risk of Wilms tumor in children. The American Cancer Society (ACS) website, http://www.cancer.org, states that there are "no known lifestyle-related or environmental causes of Wilms tumor". The observed/expected ratio of kidney cancer in Area 1 Combined, recalculated excluding this childhood case, is 1.28, which is within expected statistical limits. Kidney cancer incidence rates have increased by 3.1% per year, primarily due to an increase in early stage detection~~isease~~, and some of the increase in kidney cancer rates is believed to be due to incidental diagnosis during abdominal imaging performed for unrelated health issues, as well as other tumor classification changes over time (ACS 2013). This sort of screening affect may disproportionately affect cancer rates in discrete populations but cannot be controlled for or assessed in this type of cancer incidence study.

Thyroid Cancer is the fastest growing cancer in both men and women in the U.S. and has more than doubled in the past 3 decades. Much of this is attributable to improved detection of the disease by thyroid ultrasound and ultrasound-guided fine needle aspiration. In addition, as obesity rates increase in the U.S., additional tumors may be detected during routine investigation of thyroid function as a possible contributing cause to obesity and being overweight. Risk factors for thyroid cancer include being female; having a history of goiter (enlarged thyroid) or thyroid nodules, or a family history of thyroid cancer; a history of exposure to radiation (medical treatment as a child; exposure to fallout from weapons testing and nuclear power plant accidents) as well as certain genetic conditions and other familial syndromes (ACS 2013). While older age increases risk for most adult cancers, 80% of newly diagnosed thyroid cancer patients are under 65 years of age. The excessive risk for thyroid cancer associated with exposure to external ionizing radiation is well established. Increased risk of thyroid cancer from exposure to environmental pollutants such as perchlorate, flame retardants, pesticides and bisphenol A have been studied with no conclusive associations yet established. There is some suggestive evidence that risk of thyroid cancer may be greater in obese individuals and those using drinking water with high levels of nitrate (Pellegriti 2013).

Thyroid cancer was reported to be elevated in females and both genders combined in Area 1A only in the 2013 supplemental study. Incidence was statistically elevated in only one racial/ethnic group (white Non-Hispanics), with no unusual pattern of occurrence across age groups. This outcome was based on a small number of cases (20 diagnosed cases of thyroid cancer in males and females combined, compared to about 11 cases expected) with the elevation primarily occurring in females.

Prostate Cancer - Prostate cancer is the most frequently diagnosed cancer in men aside from skin cancer, with incidence rates being 70% higher in African Americans than in whites. The only well-established risk factors for prostate cancer are increasing age, African ancestry, and a family history of the disease. About 60% of all prostate cancer cases are diagnosed in men 65 years of age and older, and 97% occur in men 50 and older. African American men and Jamaican men of African descent have the highest documented prostate cancer incidence rates in the world. Genetic studies suggest that strong familial predisposition may be responsible for 5%-10% of prostate cancers (ACS 2013). Recent studies suggest that a diet high in processed meat or dairy foods may be a risk factor, and obesity appears to increase risk of aggressive prostate cancer. There is some evidence that occupational exposures of firefighters (e.g., toxic combustion products) moderately increase risk. In addition, the evidence regarding the links with pesticides and prostate cancer is becoming stronger with new evidence emerging from ongoing analyses of the Agricultural Health Study, primarily among applicators exposed to certain organophosphate and triazine pesticides. One study examining adipose tissue levels of persistent pesticides found a significant increase in prostate cancer risk for chlordane and a range of additional pesticides or their metabolites, while another study examining adipose levels of PCB also reported elevated risk of prostate cancer for those with the highest exposure levels (Clapp 2008). A meta-analysis of prostate cancer among pesticide manufacturing workers found significantly increased risk, with evidence of a non-significant increased risk of prostate cancer associated with several classes of pesticides, and a significantly increased risk for accidental and non-accidental exposure

to phenoxy herbicides contaminated with polychlorinated dibenzodioxins and polychlorinated dibenzo-furans (Van Maele-Fabry 2006).

In this study, prostate cancer was statistically elevated in males only in Area 3. A statistically high ratio was reported in the 45-54 age group which is a younger age at diagnosis than the typical profile for prostate cancer. This is an age group that includes the early 50s when screening has historically been started with PSA testing and/or digital rectal examination to detect prostate cancer. Of the 47 cases in this age group, most were black, African American (34 cases compared to about 20 cases expected, which resulted in a statistically high ratio of 1.72). It is plausible that some of this elevation could be due to better detection of the disease since there has been special interest in the last 20-25 years to increase screening for the black population (including Area 3 with a high percentage of black residents) because the prostate cancer mortality rate has been so much higher in this group. In one study, a gene-environment interaction was observed with a polymorphism in the GSTP1 gene. Men under age 60 who carried the GSTP1 Val variant and were exposed to high levels of PAHs were at a significant increased risk of prostate cancer (Rybicki 2006). Little information about occupational history was available from medical abstract case review for this age group.

Uterus – Cancer of the uterus (endometrial cancer) is most strongly associated with factors that increase the amount of estrogen in the body, such as obesity, greater abdominal fatness, and menopausal estrogen therapy without use of progestin (Kaaks 2002). Other factors that increase estrogen exposure include late menopause, never having had children, obesity, and a history of polycystic ovary syndrome. Tamoxifen, a drug used to reduce breast cancer risk, increases risk slightly because it has estrogen-like effects on the uterus. Medical conditions that increase risk include Lynch syndrome, also known as hereditary nonpolyposis colorectal cancer (HNPCC), and diabetes. Pregnancy, use of oral contraceptives or intrauterine devices, and physical activity provide protection against endometrial cancer (ACS 2013). No established association with environmental pollution or occupational exposure was located in the literature.

Uterine cancer was statistically elevated in Area 2 only in the 2013 supplemental analysis of cancer incidence in residents in the vicinity of the RMA, with statistical elevations noted for white Non-Hispanic females and the 55-64 age group. Histological review of the cancer cases reported in the study population showed a slightly higher percent of sarcomas (15%) than is reported for the general U. S. population (5%), but this finding is based on a small number of reported cases (5 sarcomas).

As was the case for the 2010 RMA cancer study, the 2013 supplemental analysis shows inconsistent groupings for many of the cancers that were significantly elevated, with statistically high incidence of many cancers being reported in only one gender or one geographic area. A residential environmental exposure to a cancer-causing agent, such as drinking contaminated water or breathing contaminated air, typically is expected to cause a similar effect in both men and women, although there are still many unknowns about specific mechanisms responsible for cancer causation and what role gender-specific factors, such as hormone levels or capacity to store fat-soluble chemicals, may play.

As with differences in rates of diagnosis between genders, an elevation of a particular cancer in only one race/ethnicity sub-population, tends to argue against a common causative agent or co-factor present among the entire population, whereas an elevation in more than a single race/ethnic group may suggest shared risk factors. For this study, anatomical sites, or types, of cancer for which the race/ethnicity distribution was reviewed for selected genders were thyroid, kidney, colorectal, lung, bladder, gallbladder and other biliary, stomach, uterus, leukemia, nasopharyx, and prostate. Statistically significant elevations were limited to only one racial/ethnic segment of the population, White, non-Hispanic cases, with the exception of statistically elevated numbers of cancer reported in Hispanics for male leukemia in Area 2. This finding may be partly attributable to the size of each population segment within the study areas, with generally small numbers of cancers of other racial and ethnic groups resulting in an inability to statistically compare some race-specific observed/expected cancer ratios.

Table 3. Comparison of statistically elevated cancer incidence from 1997-2009 with outcomes from earlier CDPHE incidence studies.

TIME PERIOD	ELEVATED CANCER SITE BY STUDY AREA				
	Combined Area 1	Area 1a	Area 1b	Area 2	Area 3
1997-2009	Lung (M,F,B) Colorectal (M,B) Other Biliary (M,B) Kidney (B) All Cancers (M,B)	Lung (M, B) Colorectal (M) Other Biliary (M,B) Kidney (F,B) Thyroid (F,B) All Cancers (M,B)	Lung (M,F,B) Colorectal (M,F,B)	Lung (M,B) Larynx (F) Stomach (B) Leukemia (M) Uterus (F)	Bladder (F,B) Nasopharynx,B) Prostate (M) All cancers (M,F,B)
1997-2005	Lung (M,B) Colorectal (M,B) Other Biliary (B)	Other Biliary (M,B)	Bladder (M) Lung (M,B) Colorectal (M,B)	Lung (M,B) Larynx (F) Stomach (M,B) Leukemia (M)	Bladder (F,B) Nasopharynx (M,B) Small intestine (M,B) All cancers (F,B)
1997-2000	Lung (M,F,B) Pancreas (B)	Lung (M,B) Pancreas (B)	Lung (M,F,B)	Lymphoma (M)	Brain (F,B)
1979-1996	Bladder (M,B) Lung (F,B) Stomach (M)		Bladder (M,B) Lung (B) Other oral/ Pharynx (M)	Lung (B) Cervix (F)	Salivary gland (F,B)
1989-1996	Lung (M,B) Stomach (M,B)		All cancers (B) Lung (M,B) Larynx (M) Kidney (F) Stomach (M,B)	Leukemia (F,B)	Salivary gland (F,B)
1979-1988		Lung (F) Kidney (M)	Lung (B)	Lung (M,F,B) Larynx (B) Cervix (F)	Multiple Myeloma (F)

M= Statistically elevated number of cancers in males
F= Statistically elevated number of cancers in females
B= Statistically elevated number of cancers in males and females combined

Multiple Comparisons Assessment

The evaluation of the statistical outcome of the independent multiple comparisons made in this analysis predicted that 2.5 percent of the comparisons made would be statistically significantly high, and 2.5 percent statistically significantly low. Among the independent comparisons made, 6.9 percent were high and 2.3 percent were low. Since six of the 15 statistically high ratios were among cancer sites with strong smoking connections (e.g. lung, larynx, and bladder cancer) and Cancer Registry abstracts documented positive smoking histories in most study area patients with these cancers, recalculating the percentage of high ratios excluding these three cancer types (nine out of 192 tests) resulted in 4.7 percent of the ratios being statistically high. This outcome does not suggest an overall marked departure from that predicted. Note that ratios based on less than three cases were not tested statistically, which likely partially accounts for the low percentage of the number of statistically lower than expected tests found.

Study Limitations

The current cancer incidence evaluation for residents living in the vicinity of the RMA used a standard ecological study design. A well-recognized limitation of this type of study is that surveillance data are analyzed at the group level, rather than for the individual. Reliable data are typically not available, or are incomplete, for critical exposure variables, such as individual estimates or measures of exposure, individual-level data about length of residence, in- and out-migration, and other exposures inside or outside the home. Geographic area is used as a surrogate for individual exposure status, and each individual diagnosed with cancer at a residence within the study area is presumed to have resided within the study area for a sufficient amount of time to have elapsed between a given environmental exposure and a clinical diagnosis of cancer to establish a biologically plausible association. Rapid population growth over time may have an uncertain impact on this assumption. Inherent in this study design is that information on some potential confounders may be lacking and cannot be easily controlled for with this study design. For instance, it is not possible to control for the influence of common carcinogenic exposure such as traffic-related exposure to benzene or other industrial influences within a given study boundary.

This study was able to control for potential confounding due to population differences in age and sex, by calculating age- and sex-adjusted tumor rates. In addition, medical abstracts were reviewed for each case among each age-gender specific grouping with a statistically elevated number of cancers. For many cases, potential confounders or individual risk factors such as smoking, occupational exposure to known carcinogens, and other predisposing conditions were identified. However, the available data do not provide a complete history for each individual. For this reason, studies such as this one cannot be used to draw conclusions about causal association but are considered to be hypothesis generating and are valuable for exploring issues that may warrant additional investigation.

Comparison with Past Studies

For most of the 30 cancer types investigated, no obvious patterns or trends in cancer occurrence over time were identified (see Table 3). Statistically high numbers of cancers reported in previous post-remediation studies for several individual cancer types (pancreas, lymphoma, brain and small intestine) did not persist in the current study. A finding of statistically elevated numbers of bladder cancers in females in Area 3 was unchanged from the the 1997-2005 time period, however the number of bladder cancer cases reported for males in Area 1b, which was statistically elevated during the 1997-2005 time period, was no longer statistically high for the longer time period studied in the 2013 supplemental analysis. Cancer incidence findings are generally considered to be more stable and reliable for longer time periods studied.

Elevations previously reported for lung and colorectal cancer in Area 1 Combined and lung cancer in Area 2 did persist with slightly stronger findings reported for females than in the 2010 study. As with previous studies, these cancers were not statistically elevated in Area 3. Review of case abstract data for the current study confirmed that most individuals diagnosed with lung cancer were smokers. Smoking is also recognized by the ACS as a risk factor for colorectal cancer (ACS 2013). In addition, obesity, which is strongly associated with increased risk of colorectal cancer, has been reported previously at higher rates in the RMA study area population than in the Denver control population.

For the first time in the 2013 study, in Areas 1 Combined and 1a, the category of "all cancers combined" was statistically elevated for both genders combined and for males. In Area 3 the "all cancers combined" group was statistically elevated for each gender (for males for the first time in the 2013 study) and for both genders combined. It is difficult to evaluate the importance of the "all cancers combined" category for this study given the many types of cancers included. But it is noteworthy that for each area/gender finding mentioned above, if the individual cancers that are statistically elevated are excluded from each table, the observed/expected ratios calculated from summing the remaining cancers are all within expected statistical limits.

For the four new cancer types reported in the 2013 update (kidney, thyroid, prostate and uterus), none have been reported in any of the previous time periods studied and statistically elevated numbers were reported in different study areas.

CONCLUSIONS

Statistical elevations in cancer incidence reported in the 2013 supplemental analysis generally varied across location, gender, race and time. Cancer incidence was statistically elevated in both males and females for only two of the 30 cancer types assessed: lung cancer in Area 1B and Area 1 Combined and colorectal cancer in Area 1B. For the other 10 types of cancer that were reported as statistically elevated (stomach, nasopharynx, bladder, larynx, leukemia, extrahepatic bile duct/gallbladder, uterus, kidney, prostate and thyroid), statistically significant findings resulted primarily from higher than expected numbers in one gender alone. A finding of statistically high ratios of cancer in only one gender is generally considered an inconsistency when investigating environmental exposures, making it less likely that cancer outcomes were caused by a common environmental agent in the ambient environment. In addition, these 10 cancer types were individually elevated in only one of the three geographic areas studied, and as a group were distributed across all three geographic areas of interest with no discernible pattern of occurrence. A common environmental cause would be more likely when several cases of the same type of cancer occur and that type of cancer is not common in the general population.

Cancer outcomes from the current study were also compared to previous data reviews and no unusual patterns or historical trends were identified. Statistically high numbers of several cancer types (lung, bladder, stomach, leukemia) have been reported in the study area in earlier time periods, however, results are not consistent across gender or geographic area with the exception of lung cancer which has remained elevated in Areas 1 and 2 over time (Table 3).

According to the most recent literature review from the ACS, smoking is considered an important contributing risk factor for several of the cancer types reported in this study as statistically elevated, namely nasopharynx, larynx, lung, kidney, leukemia, bladder, stomach, and colorectal, and is likely the predominant cause of the elevated cancer findings reported in this study for lung, bladder, kidney and larynx, due to the high relative risks associated with smoking (ACS 2013). The possibility of some interaction effect from exposure to other risk co-factors, such as exposure to carcinogens in an occupational setting or other chemical exposures indoors or in the outdoor ambient air environment, cannot be ruled out by this analysis, but any such effect would likely be small compared to the smoking effect for these cancer types. Additional review of individual case-level medical records confirmed a high rate of smoking in individuals diagnosed with several types of smoking-related cancers.

Review of all available case information (smoking history, alcohol use, occupation, predisposing genetic factors and family history of cancer) was conducted for each cancer type that occurred in statistically high numbers in some sub-populations. Case investigation identified typical risk profiles that partially explain the slight to moderate increased risk reported in this study for a variety of cancer types. Identification of other contributing risk factors at the individual case level cannot be fully assessed with this study, but the presence of known risk factors or a high proportion of persons with high-

risk health behaviors further weakens the likelihood of a common environmental exposure.

This type of cancer incidence study assesses the occurrence of a group of common diseases (cancer) in a potentially exposed population compared to expected outcomes in a demographically similar group absent the environmental exposure of concern. Many other factors may differ among the populations being compared. In the U.S., obesity and being overweight have a clear association with increased risk of developing colorectal, endometrial, and kidney cancer (ACS 2013). There is also growing evidence of an association with increased risk for cancer of the gallbladder, thyroid cancer and some aggressive forms of prostate cancer (Pellegriti 2013; Larsson 2007; ACS 2013). Studies have shown a higher prevalence of obesity and being overweight in the northeast Denver population living in the vicinity of the RMA than in the Denver metropolitan area as a whole, but individual-level data are not available to control for this potential confounder. It is estimated that the prevalence of obesity has more than doubled for the time period 2003-2006 compared to the previous 25 years, which has the potential for a significant influence on cancer outcomes in populations with different risk profiles.

Cancer incidence for several cancer types reported for the first time as statistically elevated in the 2013 study -prostate, thyroid and kidney- is known to to be susceptible to screening effects. A possible impact on prostate cancer outcomes in the RMA study area was discussed previously in this report. While overall rates of age-adjusted cancer incidence have declined in the U.S. in the past two decades, both kidney and thyroid cancer are rising in the general population. Incidence rates for both are believed to be influenced by improved diagnostic techniques and changes in disease coding and classification. Other unidentified causes are believed to be contributing to this increase over time, particularly for thyroid cancer (Pellegriti 2013). Differences in the study population and control population may exist which are not currently recognized or controlled for.

In this study, many statistical tests were carried out and it is expected that some of them would be statistically high or low by chance alone. Tumor rates are quite variable in small populations and rarely match the overall average rate for a larger area, such as the state or the greater Denver metropolitan area. For any given time period, some sub-populations have rates above the overall rate and others have rates below the overall rate, so that even when there is an excess of cancer cases reported, this may be consistent with expected random variation. For this reason, it is important to evaluate statistically elevated findings within the broader context of overall patterns and consistency over location, time, demographic characteristics and cancer type (MMWR 2013).

Based on past recommendations of the RMA Medical Monitoring Advisory Group (MMAG), the time period of this study was selected to coincide with soil cleanup activities at the RMA. Cancer cases diagnosed from 1997-2009 are not likely related to cleanup activities because focused air monitoring of 27 RMA-related chemicals has not shown ongoing or significant off-site release that would cause significant exposure or increased risk of cancer to surrounding communities for RMA chemicals.

The 2013 supplemental update of cancer incidence in residents living in the vicinity of the RMA was able to address uncertainty introduced into statistical analyses performed in the 2010 cancer study due to large and rapid shifts in population that have occurred in the vicinity of the RMA over time but were not reflected in the 2000 Census population estimates available at the time the 2010 study was conducted. Age adjustment is particularly critical for any investigation of cancer outcomes, because cancer is largely a disease of older persons, particularly for certain types of cancers, with about 77% of all cancers being diagnosed in individuals age 55 and older (ACS, 2008). The 2013 updated analysis using the 2010 Census population counts provides a more robust and reliable picture of cancer burden in the study population and can be used by state and local health officials to develop and communicate cancer prevention messages.

RECOMMENDATIONS

Cancer surveillance is one of the community health activities conducted by the Rocky Mountain Arsenal Medical Monitoring Program, which is based at the Colorado Department of Public Health and Environment, and was undertaken in response to recommendations made by the Rocky Mountain Arsenal Medical Monitoring Advisory Group. This report covers the period 1997-2009, a time period beginning just after the initiation of the arsenal soil remediation activities. The following activities are recommended to address the findings in the current study:

1. Post the addendum to the current study on the state RMA web page, for consideration during the five-year site review process.

2. Communicate the findings of this report to the Comprehensive Cancer Control Section at the state health department, local health departments serving the study area and affected neighborhood groups, to provide risk prevention information and to improve cancer control strategies in the northeast Denver metropolitan area, e.g. obesity prevention and, particularly smoking cessation.

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APPENDIX 1

UPDATE OF CANCER INCIDENCE IN RESIDENTS LIVING IN THE VICINITY OF THE ROCKY MOUNTAIN ARSENAL, 1997-2009

DATA TABLES

Tables A1- A15 display the number of diagnosed cancers in each of the study areas (Area 1a, 1b, 1, 2, and 3) by cancer type and gender for 1997-2009 compared to the number that would be expected based on the population of male and female residents in the areas by race/ethnicity and age. Tables A16-A28 display additional detail for selected areas, gender groups and/or cancer types that had statistically high findings or particularly relevant findings to compare to previous time periods.

Table A1 – Number of Cancer Diagnoses Compared to the Expected Number in Area 1a, 1997-2009 – Males and Females

	Cancers Diagnosed	Cancers Expected	Diagnosed / Expected	95% C.I. for Ratio
All Cancers	388	333.503	1.16**	(1.05-1.28)
Salivary Gland	2	0.909	2.20	NC
Tongue, Mouth & Gum	5	3.152	1.59	(0.51-3.71)
Nasopharynx	2	0.618	3.24	NC
Other Oral & Pharynx	1	2.010	0.50	NC
Esophagus	3	2.811	1.07	(0.22-3.12)
Stomach	3	4.791	0.63	(0.13-1.83)
Small Intestine	4	1.214	3.30	(0.90-8.43)
Colorectal	40	28.827	1.39	(0.99-1.89)
Liver	2	6.442	0.31	NC
Other Biliary	7	1.476	4.74**	(1.90-9.78)
Pancreas	9	6.358	1.42	(0.65-2.69)
Larynx	1	2.093	0.48	NC
Lung & Bronchus	40	28.430	1.41*	(1.01-1.92)
Melanoma	19	21.048	0.90	(0.54-1.41)
Bladder	13	9.636	1.35	(0.72-2.31)
Kidney	19	9.171	2.07**	(1.25-3.24)
Thyroid	20	10.812	1.85*	(1.13-2.86)
Other Endocrine	1	0.730	1.37	NC
Brain & Other Nervous System	7	6.381	1.10	(0.44-2.26)
Bones & Joints	0	1.096	0.00	NC
Leukemia	9	9.960	0.90	(0.41-1.72)
Multiple Myeloma	3	3.363	0.89	(0.18-2.61)
Lymphoma	15	16.644	0.90	(0.50-1.49)
Soft Tissue	3	2.807	1.07	(0.22-3.13)

Note: Diagnosed/Expected ratios that have a 95% Confidence Interval that brackets the value 1.00 are not considered statistically high or low.

* Ratio is statistically significant at p=0.05 level. (** p=0.01 level)

NC = not calculated due to less than 3 diagnoses (see text for explanation).

Table A2 – Number of Cancer Diagnoses Compared to the Expected Number in Area 1a, 1997-2009– Males

	Cancers Diagnosed	Cancers Expected	Diagnosed / Expected	95% C.I. for Ratio
All Cancers	202	160.449	1.26**	(1.09-1.44)
Salivary Gland	2	0.500	4.00	NC
Tongue, Mouth & Gum	2	2.090	0.96	NC
Nasopharynx	2	0.471	4.25	NC
Other Oral & Pharynx	1	1.671	0.60	NC
Esophagus	2	2.173	0.92	NC
Stomach	3	3.036	0.99	(0.20-2.89)
Small Intestine	3	0.741	4.05	(0.83-11.83)
Colorectal	25	15.795	1.58*	(1.02-2.33)
Liver	1	4.673	0.21	NC
Other Biliary	4	0.611	6.55**	(1.78-16.74)
Pancreas	6	3.497	1.72	(0.63-3.74)
Larynx	1	1.640	0.61	NC
Lung & Bronchus	27	15.628	1.73*	(1.14-2.52)
Melanoma	13	11.162	1.16	(0.62-1.99)
Prostate	48	43.680	1.10	(0.81-1.46)
Testis	2	3.615	0.55	NC
Bladder	10	7.464	1.34	(0.64-2.46)
Kidney	10	5.860	1.71	(0.82-3.14)
Thyroid	4	2.541	1.57	(0.43-4.03)
Other Endocrine	1	0.471	2.12	NC
Brain & Other Nervous System	6	3.539	1.70	(0.62-3.69)
Bones & Joints	0	0.618	0.00	NC
Leukemia	6	5.799	1.03	(0.38-2.25)
Multiple Myeloma	0	1.987	0.00	NC
Lymphoma	9	9.504	0.95	(0.43-1.80)
Soft Tissue	3	1.630	1.84	(0.38-5.38)

Note: Diagnosed/Expected ratios that have a 95% Confidence Interval that brackets the value 1.00 are not considered statistically high or low.

* Ratio is statistically significant at p=0.05 level. (** p=0.01 level)

NC = not calculated due to less than 3 diagnoses (see text for explanation).

Table A3 – Number of Cancer Diagnoses Compared to the Expected Number in Area 1a, 1997-2009 – Females

	Cancers Diagnosed	Cancers Expected	Diagnosed/ Expected	95% C.I. for Ratio
All Cancers	186	173.054	1.07	(0.93-1.24)
Salivary Gland	0	0.410	0.00	NC
Tongue, Mouth & Gum	3	1.062	2.83	(0.58-8.26)
Nasopharynx	0	0.147	0.00	NC
Other Oral & Pharynx	0	0.339	0.00	NC
Esophagus	1	0.638	1.57	NC
Stomach	0	1.755	0.00	NC
Small Intestine	1	0.473	2.12	NC
Colorectal	15	13.032	1.15	(0.64-1.90)
Liver	1	1.769	0.57	NC
Other Biliary	3	0.865	3.47	(0.72-10.14)
Pancreas	3	2.862	1.05	(0.22-3.06)
Larynx	0	0.453	0.00	NC
Lung & Bronchus	13	12.802	1.02	(0.54-1.74)
Melanoma	6	9.886	0.61	(0.22-1.32)
Female Breast	59	66.665	0.89	(0.67-1.14)
Cervix	6	4.576	1.31	(0.48-2.86)
Uterus	7	8.029	0.87	(0.35-1.80)
Ovary	9	5.886	1.53	(0.70-2.90)
Bladder	3	2.172	1.38	(0.28-4.04)
Kidney	9	3.311	2.72*	(1.25-5.16)
Thyroid	16	8.271	1.93*	(1.11-3.14)
Other Endocrine	0	0.260	0.00	NC
Brain & Other Nervous System	1	2.842	0.35	NC
Bones & Joints	0	0.478	0.00	NC
Leukemia	3	4.161	0.72	(0.15-2.11)
Multiple Myeloma	3	1.376	2.18	(0.45-6.37)
Lymphoma	6	7.140	0.84	(0.31-1.83)
Soft Tissue	0	1.177	0.00	NC

Note: Diagnosed/Expected ratios that have a 95% Confidence Interval that brackets the value 1.00 are not considered statistically high or low.

* Ratio is statistically significant at p=0.05 level. (** p=0.01 level) NC=not calculated (see text)

Table A4 – Number of Cancer Diagnoses Compared to the Expected Number in Area 1b, 1997-2009 – Males and Females

	Cancers Diagnosed	Cancers Expected	Diagnosed / Expected	95% C.I. for Ratio
All Cancers	413	388.618	1.06	(0.96-1.17)
Salivary Gland	0	1.064	0.00	NC
Tongue, Mouth & Gum	4	3.625	1.10	(0.30-2.82)
Nasopharynx	0	0.377	0.00	NC
Other Oral & Pharynx	1	2.257	0.44	NC
Esophagus	1	3.652	0.27	NC
Stomach	11	5.739	1.92	(0.96-3.43)
Small Intestine	1	1.639	0.61	NC
Colorectal	61	37.914	1.61**	(1.23-2.07)
Liver	9	6.761	1.33	(0.61-2.53)
Other Biliary	3	2.089	1.44	(0.30-4.20)
Pancreas	12	8.793	1.36	(0.70-2.38)
Larynx	3	2.636	1.14	(0.23-3.33)
Lung & Bronchus	78	38.674	2.02**	(1.60-2.52)
Melanoma	12	21.654	0.55*	(0.29-0.97)
Bladder	18	13.758	1.31	(0.77-2.07)
Kidney	12	11.526	1.04	(0.54-1.82)
Thyroid	6	8.910	0.67	(0.25-1.47)
Other Endocrine	0	0.661	0.00	NC
Brain & Other Nervous System	10	6.451	1.55	(0.75-2.85)
Bones & Joints	1	1.115	0.90	NC
Leukemia	11	11.443	0.96	(0.48-1.72)
Multiple Myeloma	5	4.381	1.14	(0.37-2.67)
Lymphoma	14	18.977	0.74	(0.40-1.24)
Soft Tissue	2	2.927	0.68	NC

Note: Diagnosed/Expected ratios that have a 95% Confidence Interval that brackets the value 1.00 are not considered statistically high or low.

* Ratio is statistically significant at p=0.05 level. (** p=0.01 level)

NC = not calculated due to less than 3 diagnoses (see text for explanation).

Table A5 – Number of Cancer Diagnoses Compared to the Expected Number in Area 1b, 1997-2009 – Males

	Cancers Diagnosed	Cancers Expected	Diagnosed / Expected	95% C.I. for Ratio
All Cancers	217	198.262	1.09	(0.95-1.25)
Salivary Gland	0	0.625	0.00	NC
Tongue, Mouth & Gum	2	2.398	0.83	NC
Nasopharynx	0	0.260	0.00	NC
Other Oral & Pharynx	1	1.845	0.54	NC
Esophagus	1	2.855	0.35	NC
Stomach	6	3.598	1.67	(0.61-3.63)
Small Intestine	0	0.982	0.00	NC
Colorectal	35	20.953	1.67**	(1.16-2.32)
Liver	8	5.015	1.60	(0.69-3.14)
Other Biliary	1	0.920	1.09	NC
Pancreas	7	4.697	1.49	(0.60-3.07)
Larynx	3	2.061	1.46	(0.30-4.26)
Lung & Bronchus	46	21.059	2.18**	(1.60-2.92)
Melanoma	6	12.466	0.48	(0.18-1.05)
Prostate	36	55.327	0.65*	(0.45-0.90)
Testis	1	3.102	0.32	NC
Bladder	17	10.717	1.59	(0.92-2.54)
Kidney	10	7.232	1.38	(0.66-2.54)
Thyroid	2	2.421	0.83	NC
Other Endocrine	0	0.405	0.00	NC
Brain & Other Nervous System	6	3.678	1.63	(0.60-3.55)
Bones & Joints	0	0.618	0.00	NC
Leukemia	6	6.751	0.89	(0.33-1.94)
Multiple Myeloma	2	2.643	0.76	NC
Lymphoma	6	10.858	0.55	(0.20-1.20)
Soft Tissue	2	1.676	1.19	NC

Note: Diagnosed/Expected ratios that have a 95% Confidence Interval that brackets the value 1.00 are not considered statistically high or low.

* Ratio is statistically significant at p=0.05 level. (** p=0.01 level)

NC = not calculated due to less than 3 diagnoses (see text for explanation).

Table A6 – Number of Cancer Diagnoses Compared to the Expected Number in Area 1b, 1997-2009 – Females

	Cancers Diagnosed	Cancers Expected	Diagnosed/ Expected	95% C.I. for Ratio
All Cancers	196	190.355	1.03	(0.89-1.18)
Salivary Gland	0	0.439	0.00	NC
Tongue, Mouth & Gum	2	1.226	1.63	NC
Nasopharynx	0	0.116	0.00	NC
Other Oral & Pharynx	0	0.412	0.00	NC
Esophagus	0	0.797	0.00	NC
Stomach	5	2.141	2.34	(0.76-5.46)
Small Intestine	1	0.657	1.52	NC
Colorectal	26	16.962	1.53*	(1.00-2.25)
Liver	1	1.746	0.57	NC
Other Biliary	2	1.169	1.71	NC
Pancreas	5	4.096	1.22	(0.40-2.85)
Larynx	0	0.575	0.00	NC
Lung & Bronchus	32	17.615	1.82**	(1.24-2.57)
Melanoma	6	9.189	0.65	(0.24-1.42)
Female Breast	54	68.982	0.78	(0.59-1.02)
Cervix	4	3.923	1.02	(0.28-2.61)
Uterus	9	8.467	1.06	(0.49-2.02)
Ovary	5	6.440	0.78	(0.25-1.81)
Bladder	1	3.041	0.33	NC
Kidney	2	4.294	0.47	NC
Thyroid	4	6.489	0.62	(0.17-1.58)
Other Endocrine	0	0.256	0.00	NC
Brain & Other Nervous System	4	2.773	1.44	(0.39-3.69)
Bones & Joints	1	0.497	2.01	NC
Leukemia	5	4.692	1.07	(0.34-2.49)
Multiple Myeloma	3	1.738	1.73	(0.36-5.05)
Lymphoma	8	8.119	0.99	(0.42-1.94)
Soft Tissue	0	1.251	0.00	NC

Note: Diagnosed/Expected ratios that have a 95% Confidence Interval that brackets the value 1.00 are not considered statistically high or low.

* Ratio is statistically significant at p=0.05 level. (** p=0.01 level) NC=not calculated (see text)

Table A7 – Number of Cancer Diagnoses Compared to the Expected Number in Area 1 Combined , 1997-2009 – Males and Females

	Cancers Diagnosed	Cancers Expected	Diagnosed / Expected	95% C.I. for Ratio
All Cancers	801	722.121	1.11**	(1.03-1.19)
Salivary Gland	2	1.973	1.01	NC
Tongue, Mouth & Gum	9	6.777	1.33	(0.61-2.52)
Nasopharynx	2	0.995	2.01	NC
Other Oral & Pharynx	2	4.267	0.47	NC
Esophagus	4	6.463	0.62	(0.17-1.58)
Stomach	14	10.530	1.33	(0.73-2.23)
Small Intestine	5	2.853	1.75	(0.57-4.10)
Colorectal	101	66.741	1.51**	(1.15-1.72)
Liver	11	13.203	0.83	(0.42-1.49)
Other Biliary	10	3.564	2.81**	(1.35-5.16)
Pancreas	21	15.151	1.39	(0.86-2.12)
Larynx	4	4.729	0.85	(0.23-2.16)
Lung & Bronchus	118	67.104	1.76**	(1.46-2.11)
Melanoma	31	42.702	0.73	(0.49-1.03)
Bladder	31	23.394	1.33	(0.90-1.88)
Kidney	31	20.697	1.50*	(1.02-2.13)
Thyroid	26	19.722	1.32	(0.86-1.93)
Other Endocrine	1	1.392	0.72	NC
Brain & Other Nervous System	17	12.831	1.32	(0.77-2.12)
Bones & Joints	1	2.233	0.45	NC
Leukemia	20	21.403	0.93	(0.57-1.45)
Multiple Myeloma	8	7.744	1.03	(0.45-2.03)
Lymphoma	29	35.621	0.81	(0.55-1.17)
Soft Tissue	5	5.734	0.87	(0.28-2.04)

Note: Diagnosed/Expected ratios that have a 95% Confidence Interval that brackets the value 1.00 are not considered statistically high or low.

* Ratio is statistically significant at p=0.05 level. (** p=0.01 level)

NC = not calculated due to less than 3 diagnoses (see text for explanation).

Table A8 – Number of Cancer Diagnoses Compared to the Expected Number in Area 1 Combined, 1997-2009 – Males

	Cancers Diagnosed	Cancers Expected	Diagnosed / Expected	95% C.I. for Ratio
All Cancers	419	358.712	1.17**	(1.06-1.29)
Salivary Gland	2	1.124	1.78	NC
Tongue, Mouth & Gum	4	4.489	0.89	(0.24-2.28)
Nasopharynx	2	0.731	2.74	NC
Other Oral & Pharynx	2	3.516	0.57	NC
Esophagus	3	5.028	0.60	(0.12-1.75)
Stomach	9	6.635	1.36	(0.62-2.57)
Small Intestine	3	1.723	1.74	(0.36-5.09)
Colorectal	60	36.748	1.63**	(1.25-2.10)
Liver	9	9.688	0.93	(0.43-1.76)
Other Biliary	5	1.531	3.27*	(1.06-7.63)
Pancreas	13	8.194	1.59	(0.84-2.71)
Larynx	4	3.700	1.08	(0.29-2.76)
Lung & Bronchus	73	36.687	1.99**	(1.56-2.50)
Melanoma	19	23.627	0.80	(0.48-1.26)
Prostate	84	99.007	0.85	(0.68-1.05)
Testis	3	6.717	0.45	(0.09-1.31)
Bladder	27	18.181	1.49	(0.98-2.16)
Kidney	20	13.092	1.53	(0.93-2.36)
Thyroid	6	4.963	1.21	(0.44-2.63)
Other Endocrine	1	0.876	1.14	NC
Brain & Other Nervous System	12	7.217	1.66	(0.86-2.90)
Bones & Joints	0	1.258	0.00	NC
Leukemia	12	12.549	0.96	(0.49-1.67)
Multiple Myeloma	2	4.630	0.43	NC
Lymphoma	15	20.362	0.74	(0.41-1.22)
Soft Tissue	5	3.306	1.51	(0.49-3.54)

Note: Diagnosed/Expected ratios that have a 95% Confidence Interval that brackets the value 1.00 are not considered statistically high or low.

* Ratio is statistically significant at p=0.05 level. (** p=0.01 level)

NC = not calculated due to less than 3 diagnoses (see text for explanation).

Table A9 – Number of Cancer Diagnoses Compared to the Expected Number in Area 1 Combined, 1997-2009 – Females

	Cancers Diagnosed	Cancers Expected	Diagnosed/ Expected	95% C.I. for Ratio
All Cancers	382	363.409	1.05	(0.95-1.16)
Salivary Gland	0	0.849	0.00	NC
Tongue, Mouth & Gum	5	2.288	2.19	(0.71-5.11)
Nasopharynx	0	0.264	0.00	NC
Other Oral & Pharynx	0	0.751	0.00	NC
Esophagus	1	1.435	0.70	NC
Stomach	5	3.895	1.28	(0.42-3.00)
Small Intestine	2	1.129	1.77	NC
Colorectal	41	29.993	1.37	(0.98-1.85)
Liver	2	3.515	0.57	NC
Other Biliary	5	2.033	2.46	(0.80-5.75)
Pancreas	8	6.957	1.15	(0.50-2.26)
Larynx	0	1.028	0.00	NC
Lung & Bronchus	45	30.417	1.48*	(1.08-1.98)
Melanoma	12	19.075	0.63	(0.32-1.10)
Female Breast	113	135.650	0.83**	(0.69-1.00)
Cervix	10	8.498	1.18	(0.57-2.16)
Uterus	16	16.496	0.97	(0.55-1.57)
Ovary	14	12.326	1.14	(0.62-1.91)
Bladder	4	5.213	0.77	(0.21-1.96)
Kidney	11	7.605	1.45	(0.72-2.59)
Thyroid	20	14.759	1.36	(0.83-2.09)
Other Endocrine	0	0.515	0.00	NC
Brain & Other Nervous System	5	5.614	0.89	(0.29-2.08)
Bones & Joints	1	0.975	1.03	NC
Leukemia	8	8.854	0.90	(0.39-1.78)
Multiple Myeloma	6	3.114	1.93	(0.71-4.20)
Lymphoma	14	15.259	0.92	(0.50-1.54)
Soft Tissue	0	2.428	0.00	NC

Note: Diagnosed/Expected ratios that have a 95% Confidence Interval that brackets the value 1.00 are not considered statistically high or low.

* Ratio is statistically significant at p=0.05 level. (** p=0.01 level) NC=not calculated (see text)

Table A10 – Number of Cancer Diagnoses Compared to the Expected Number in Area 2, 1997-2009 – Males and Females

	Cancers Diagnosed	Cancers Expected	Diagnosed / Expected	95% C.I. for Ratio
All Cancers	877	909.076	0.96	(0.90-1.03)
Salivary Gland	1	2.471	0.40	NC
Tongue, Mouth & Gum	7	8.249	0.85	(0.34-1.75)
Nasopharynx	2	0.872	2.29	NC
Other Oral & Pharynx	4	5.059	0.79	(0.22-2.02)
Esophagus	8	8.537	0.94	(0.40-1.84)
Stomach	24	14.195	1.69*	(1.08-2.52)
Small Intestine	7	3.947	1.77	(0.71-3.66)
Colorectal	89	91.739	0.97	(0.78-1.19)
Liver	16	16.250	0.98	(0.56-1.60)
Other Biliary	7	5.294	1.32	(0.53-2.73)
Pancreas	28	21.482	1.30	(0.87-1.88)
Larynx	11	6.179	1.78	(0.89-3.18)
Lung & Bronchus	141	92.936	1.52**	(1.28-1.79)
Melanoma	25	46.828	0.53**	(0.34-0.79)
Bladder	34	32.009	1.06	(0.73-1.49)
Kidney	36	27.330	1.32	(0.92-1.82)
Thyroid	15	19.845	0.76	(0.42-1.25)
Other Endocrine	0	1.504	0.00	NC
Brain & Other Nervous System	12	14.697	0.82	(0.42-1.43)
Bones & Joints	1	2.577	0.39	NC
Leukemia	32	26.894	1.19	(0.81-1.68)
Multiple Myeloma	10	10.702	0.93	(0.45-1.72)
Lymphoma	44	44.379	0.99	(0.72-1.33)
Soft Tissue	6	6.848	0.88	(0.32-1.91)

Note: Diagnosed/Expected ratios that have a 95% Confidence Interval that brackets the value 1.00 are not considered statistically high or low.

* Ratio is statistically significant at p=0.05 level. (** p=0.01 level)

NC = not calculated due to less than 3 diagnoses (see text for explanation).

Table A11 – Number of Cancer Diagnoses Compared to the Expected Number in Area 2, 1997-2009 – Males

	Cancers Diagnosed	Cancers Expected	Diagnosed / Expected	95% C.I. for Ratio
All Cancers	463	451.307	1.03	(0.93-1.12)
Salivary Gland	1	1.423	0.70	NC
Tongue, Mouth & Gum	7	5.330	1.31	(0.53-2.71)
Nasopharynx	1	0.579	1.73	NC
Other Oral & Pharynx	4	4.067	0.98	(0.27-2.52)
Esophagus	7	6.501	1.08	(0.43-2.22)
Stomach	14	8.430	1.66	(0.91-2.79
Small Intestine	6	2.287	2.62	(0.96-5.72)
Colorectal	49	48.733	1.01	(0.74-1.33)
Liver	11	11.704	0.94	(0.47-1.68)
Other Biliary	3	2.195	1.37	(0.28-4.00)
Pancreas	15	10.936	1.37	(0.77-2.26)
Larynx	6	4.778	1.26	(0.46-2.74)
Lung & Bronchus	87	48.899	1.78**	(1.43-2.19)
Melanoma	15	26.708	0.56*	(0.31-0.93)
Prostate	85	125.055	0.68**	(0.54-0.84)
Testis	2	6.692	0.30	NC
Bladder	25	24.508	1.02	(0.66-1.50)
Kidney	20	16.522	1.21	(0.75-1.87)
Thyroid	2	5.278	0.38	NC
Other Endocrine	0	0.897	0.00	NC
Brain & Other Nervous System	7	8.133	0.86	(0.35-1.78)
Bones & Joints	1	1.426	0.70	NC
Leukemia	26	15.383	1.69*	(1.10-2.48)
Multiple Myeloma	5	6.187	0.81	(0.26-1.89)
Lymphoma	28	24.580	1.14	(0.76-1.65)
Soft Tissue	3	3.831	0.78	(0.16-2.29)

Note: Diagnosed/Expected ratios that have a 95% Confidence Interval that brackets the value 1.00 are not considered statistically high or low.

* Ratio is statistically significant at p=0.05 level. (** p=0.01 level)

NC = not calculated due to less than 3 diagnoses (see text for explanation).

Table A12 – Number of Cancer Diagnoses Compared to the Expected Number in Area 2, 1997-2009 – Females

	Cancers Diagnosed	Cancers Expected	Diagnosed/ Expected	95% C.I. for Ratio
All Cancers	414	457.768	0.90	(0.82-1.00)
Salivary Gland	0	1.048	0.00	NC
Tongue, Mouth & Gum	0	2.919	0.00	NC
Nasopharynx	1	0.293	3.41	NC
Other Oral & Pharynx	0	0.992	0.00	NC
Esophagus	1	2.037	0.49	NC
Stomach	10	5.764	1.73	(0.83-3.19)
Small Intestine	1	1.661	0.60	NC
Colorectal	40	43.005	0.93	(0.66-1.27)
Liver	5	4.546	1.10	(0.36-2.57)
Other Biliary	4	3.099	1.29	(0.35-3.30)
Pancreas	13	10.546	1.23	(0.66-2.11)
Larynx	5	1.400	3.57*	(1.16-8.34)
Lung & Bronchus	54	44.037	1.23	(0.92-1.60)
Melanoma	10	20.120	0.50*	(0.24-0.91)
Female Breast	113	161.370	0.70**	(0.58-0.84)
Cervix	12	9.229	1.30	(0.67-2.27)
Uterus	34	20.068	1.69**	(1.17-2.37)
Ovary	12	15.387	0.78	(0.40-1.36)
Bladder	9	7.501	1.20	(0.55-2.28)
Kidney	16	10.808	1.48	(0.85-2.40)
Thyroid	13	14.567	0.89	(0.47-1.52)
Other Endocrine	0	0.608	0.00	NC
Brain & Other Nervous System	5	6.564	0.76	(0.25-1.78)
Bones & Joints	0	1.151	0.00	NC
Leukemia	6	11.512	0.52	(0.19-1.14)
Multiple Myeloma	5	4.515	1.11	(0.36-2.59)
Lymphoma	16	19.799	0.81	(0.46-1.31)
Soft Tissue	3	3.017	0.99	(0.20-2.91)

Note: Diagnosed/Expected ratios that have a 95% Confidence Interval that brackets the value 1.00 are not considered statistically high or low.

* Ratio is statistically significant at p=0.05 level. (** p=0.01 level) NC=not calculated (see text)

Table A13 – Number of Cancer Diagnoses Compared to the Expected Number in Area 3, 1997-2009– Males and Females

	Cancers Diagnosed	Cancers Expected	Diagnosed / Expected	95% C.I. for Ratio
All Cancers	1562	1432.137	1.09**	(1.04-1.15)
Salivary Gland	5	3.237	1.54	(0.50-3.61)
Tongue, Mouth & Gum	9	11.092	0.81	(0.35-1.60)
Nasopharynx	6	1.963	3.06*	(1.12-6.66)
Other Oral & Pharynx	3	9.918	0.30*	(0.06-0.89)
Esophagus	14	12.262	1.14	(0.62-1.92)
Stomach	27	23.270	1.16	(0.76-1.69)
Small Intestine	9	6.339	1.42	(0.65-2.69)
Colorectal	155	135.840	1.14	(0.97-1.34)
Liver	24	32.564	0.74	(0.47-1.10)
Other Biliary	12	8.055	1.49	(0.77-2.60)
Pancreas	31	34.241	0.91	(0.61-1.29)
Larynx	14	11.557	1.21	(0.66-2.03)
Lung & Bronchus	149	137.440	1.08	(0.92-1.27)
Melanoma	37	43.512	0.85	(0.19-1.17)
Bladder	50	31.486	1.59**	(1.18-2.09)
Kidney	55	44.802	1.23	(0.92-1.60)
Thyroid	53	41.146	1.29	(0.96-1.69)
Other Endocrine	2	3.581	0.56	NC
Brain & Other Nervous System	35	24.453	1.43	(0.99-1.99)
Bones & Joints	2	5.314	0.38	NC
Leukemia	43	38.393	1.12	(0.81-1.51)
Multiple Myeloma	17	25.603	0.66	(0.39-1.06)
Lymphoma	59	66.589	0.89	(0.67-1.14)
Soft Tissue	16	13.269	1.21	(0.69-1.96)

Note: Diagnosed/Expected ratios that have a 95% Confidence Interval that brackets the value 1.00 are not considered statistically high or low.

* Ratio is statistically significant at p=0.05 level. (** p=0.01 level)

NC = not calculated due to less than 3 diagnoses (see text for explanation).

Table A14 – Number of Cancer Diagnoses Compared to the Expected Number in Area 3, 1997-2009 – Males

	Cancers Diagnosed	Cancers Expected	Diagnosed / Expected	95% C.I. for Ratio
All Cancers	785	715.495	1.10*	(1.02-1.17)
Salivary Gland	2	1.698	1.18	NC
Tongue, Mouth & Gum	5	7.841	0.64	(0.21-1.49)
Nasopharynx	4	1.562	2.56	(0.70-6.55)
Other Oral & Pharynx	3	8.273	0.36	(0.07-1.06)
Esophagus	14	8.892	1.57	(0.86-2.64)
Stomach	15	14.776	1.02	(0.57-1.67)
Small Intestine	7	3.467	2.02	(0.81-4.16)
Colorectal	85	72.648	1.17	(0.94-1.45)
Liver	18	23.964	0.75	(0.44-1.19)
Other Biliary	6	3.055	1.96	(0.72-4.28)
Pancreas	15	18.664	0.80	(0.45-1.33)
Larynx	12	9.431	1.27	(0.66-2.22)
Lung & Bronchus	78	76.992	1.01	(0.80-1.27)
Melanoma	18	21.103	0.85	(0.50-1.35)
Prostate	270	224.577	1.20**	(1.06-1.36)
Testis	17	12.540	1.36	(0.79-2.17)
Bladder	34	24.118	1.41	(0.97-1.97)
Kidney	31	28.695	1.08	(0.73-1.53)
Thyroid	13	7.915	1.64	(0.87-2.81)
Other Endocrine	1	2.114	0.47	NC
Brain & Other Nervous System	17	13.005	1.31	(0.76-2.09)
Bones & Joints	1	3.206	0.31	NC
Leukemia	25	22.225	1.12	(0.73-1.66)
Multiple Myeloma	9	13.598	0.66	(0.30-1.26)
Lymphoma	36	39.253	0.92	(0.64-1.27)
Soft Tissue	10	6.908	1.45	(0.70-2.66)

Note: Diagnosed/Expected ratios that have a 95% Confidence Interval that brackets the value 1.00 are not considered statistically high or low.

* Ratio is statistically significant at p=0.05 level. (** p=0.01 level)

NC = not calculated due to less than 3 diagnoses (see text for explanation).

Table A15 – Number of Cancer Diagnoses Compared to the Expected Number in Area 3, 1997-2009– Females

	Cancers Diagnosed	Cancers Expected	Diagnosed/ Expected	95% C.I. for Ratio
All Cancers	777	716.642	1.08*	(1.01-1.16)
Salivary Gland	3	1.539	1.95	(0.40-5.70)
Tongue, Mouth & Gum	4	3.250	1.23	(0.34-3.15)
Nasopharynx	2	0.401	4.99	NC
Other Oral & Pharynx	0	1.645	0.00	NC
Esophagus	0	3.370	0.00	NC
Stomach	12	8.494	1.41	(0.73-2.47)
Small Intestine	2	2.872	0.70	NC
Colorectal	70	63.189	1.11	(0.87-1.40)
Liver	6	8.600	0.70	(0.26-1.52)
Other Biliary	6	5.000	1.20	(0.44-2.61)
Pancreas	16	15.577	1.03	(0.59-1.67)
Larynx	2	2.126	0.94	NC
Lung & Bronchus	71	60.452	1.17	(0.92-1.48)
Melanoma	19	22.409	0.85	(0.51-1.33)
Female Breast	281	267.350	1.05	(0.93-1.18)
Cervix	30	21.103	1.42	(0.96-2.03)
Uterus	39	31.621	1.23	(0.88-1.69)
Ovary	24	21.195	1.13	(0.73-1.68)
Bladder	16	7.368	2.17**	(1.24-3.53)
Kidney	24	16.107	1.49	(0.96-2.22)
Thyroid	40	33.232	1.20	(0.86-1.64)
Other Endocrine	1	1.467	0.68	NC
Brain & Other Nervous System	18	11.448	1.57	(0.93-2.48)
Bones & Joints	1	2.108	0.47	NC
Leukemia	18	16.168	1.11	(0.66-1.76)
Multiple Myeloma	8	12.005	0.67	(0.29-1.31)
Lymphoma	23	27.336	0.84	(0.53-1.26)
Soft Tissue	6	6.360	0.94	(0.35-2.05)

Note: Diagnosed/Expected ratios that have a 95% Confidence Interval that brackets the value 1.00 are not considered statistically high or low.

* Ratio is statistically significant at p=0.05 level. (** p=0.01 level) NC=not calculated (see text)

Table A16 – Number of Thyroid Cancer Diagnoses by Race/Ethnicity and by Age Compared to the Expected Number in Area 1a, 1997-2009 – Males and Females

Race/ Ethnicity	Cancers Diagnosed	Cancers Expected	Ratio of Diagnosed to Expected	95% C.I. for Ratio
White Non-Hispanic	16	6.404	2.50**	(1.43-4.06)
Hispanic	3	2.176	1.38	(0.28-4.03)
Black	1	0.197	5.08	NC
Other	0	2.036	0.00	NC
Age				
25-34	5	2.466	2.03	(0.66-4.74)
35-44	5	3.024	1.65	(0.53-3.86)
45-54	4	2.264	1.77	(0.48-4.52)
55-64	4	1.736	2.30	(0.63-5.89)
65-74	2	0.649	3.08	NC
75+	0	0.241	0.00	NC
Total	20	10.812	1.85*	(1.13-2.86)

Note: Diagnosed/Expected ratios that have a 95% Confidence Interval that brackets the value 1.00 are not considered statistically high or low.

* Ratio is statistically significant at p=0.05 level. (** p=0.01 level)

NC = not calculated due to less than 3 diagnoses (see text for explanation).

Table A17 – Number of Kidney Cancer Diagnoses by Race/Ethnicity and by Age Compared to the Expected Number in Area 1 Combined, 1997-2009 – Males and Females

Race/ Ethnicity	Cancers Diagnosed	Cancers Expected	Ratio of Diagnosed to Expected	95% C.I. for Ratio
White Non-Hispanic	19	12.106	1.57	(0.95-2.45)
Hispanic	11	6.946	1.58	(0.79-2.83)
Black	0	0.516	0.00	NC
Other	1	1.130	0.88	NC
Age				
0- 4	1	0.421	2.38	NC
5- 9	0	0.068	0.00	NC
10-14	0	0.010	0.00	NC
15-19	0	0.013	0.00	NC
20-24	0	0.062	0.00	NC
25-34	0	0.341	0.00	NC
35-44	4	1.598	2.50	(0.68-6.41)
45-54	9	3.837	2.35*	(1.08-4.45)
55-64	9	5.973	1.51	(0.69-2.86)
65-74	4	5.088	0.79	(0.21-2.01)
75+	4	3.285	1.22	(0.33-3.12)
Total	31	20.697	1.50*	(1.02-2.13)

Note: Diagnosed/Expected ratios that have a 95% Confidence Interval that brackets the value 1.00 are not considered statistically high or low.

* Ratio is statistically significant at p=0.05 level. (** p=0.01 level)

NC = not calculated due to less than 3 diagnoses (see text for explanation).

Table A18 – Number of Colorectal Cancer Diagnoses by Race/Ethnicity and by Age Compared to the Expected Number in Area 1 Combined, 1997-2009 – Males and Females

Race/ Ethnicity	Cancers Diagnosed	Cancers Expected	Ratio of Diagnosed to Expected	95% C.I. for Ratio
White Non-Hispanic	69	41.217	1.67**	(1.30-2.12)
Hispanic	25	18.658	1.34	(0.86-1.98)
Black	1	1.459	0.69	NC
Other	6	5.407	1.11	(0.41-2.42)
Age				
25-34	2	1.037	1.93	NC
35-44	7	3.879	1.81	(0.72-3.72)
45-54	12	10.127	1.19	(0.61-2.07)
55-64	30	16.015	1.87**	(1.27-2.68)
65-74	31	18.425	1.68**	(1.14-2.31)
75+	19	17.053	1.11	(0.67-1.74)
Total	101	66.741	1.51**	(1.15-1.72)

Note: Diagnosed/Expected ratios that have a 95% Confidence Interval that brackets the value 1.00 are not considered statistically high or low.

* Ratio is statistically significant at p=0.05 level. (** p=0.01 level)

NC = not calculated due to less than 3 diagnoses (see text for explanation).

Table A19 – Number of Other Biliary Cancer Diagnoses by Race/Ethnicity and by Age Compared to the Expected Number in Area 1 Combined, 1997-2009 – Males and Females

Race/ Ethnicity	Cancers Diagnosed	Cancers Expected	Ratio of Diagnosed to Expected	95% C.I. for Ratio
White Non-Hispanic	6	1.836	3.27*	(1.20-7.12)
Hispanic	4	1.296	3.09	(0.84-7.89)
Black	0	0.077	0.00	NC
Other	0	0.354	0.00	NC
Age				
45-54	1	0.515	1.94	NC
55-64	2	0.701	2.85	NC
65-74	3	1.009	2.97	(0.61-8.69)
75+	4	1.157	3.46	(0.94-8.84)
Total	10	3.564	2.81**	(1.35-5.16)

Note: Diagnosed/Expected ratios that have a 95% Confidence Interval that brackets the value 1.00 are not considered statistically high or low.

* Ratio is statistically significant at p=0.05 level. (** p=0.01 level)

NC = not calculated due to less than 3 diagnoses (see text for explanation).

Table A20 – Number of Lung Cancer Diagnoses by Race/Ethnicity and by Age Compared to the Expected Number in Area 1Combined, 1997-2009 – Males and Females

Race/ Ethnicity	Cancers Diagnosed	Cancers Expected	Ratio of Diagnosed to Expected	95% C.I. for Ratio
White Non-Hispanic	95	47.024	2.02**	(1.64-2.47)
Hispanic	21	13.440	1.56	(0.96-2.39)
Black	2	1.567	1.28	NC
Other	0	5.073	0.00	NC
Age				
45-54	11	6.117	1.80	(0.90-3.22)
55-64	34	16.905	2.01**	(1.39-2.81)
65-74	44	23.701	1.86**	(1.35-2.49)
75+	29	18.350	1.58*	(1.06-2.27)
Total	118	67.104	1.76**	(1.46-2.11)

Note: Diagnosed/Expected ratios that have a 95% Confidence Interval that brackets the value 1.00 are not considered statistically high or low.

* Ratio is statistically significant at p=0.05 level. (** p=0.01 level)

NC = not calculated due to less than 3 diagnoses (see text for explanation).

Table A21 - Number of Stomach Cancer Diagnoses by Race/Ethnicity and by Age Compared to the Expected Number in Area 2, 1997-2009 – Males and Females

Race/ Ethnicity	Cancers Diagnosed	Cancers Expected	Ratio of Diagnosed to Expected	95% C.I. for Ratio
White Non-Hispanic	15	6.029	2.49**	(1.39-4.11)
Hispanic	8	7.260	1.10	(0.48-2.17)
Black	1	0.286	3.50	NC
Other	0	0.619	0.00	NC
Age				
35-44	2	0.637	3.14	NC
45-54	2	1.538	1.30	NC
55-64	8	2.237	3.58**	(1.54-7.04)
65-74	3	3.893	0.77	(0.16-2.25)
75+	9	5.479	1.64	(0.75-3.12)
Total	24	14.195	1.69*	(1.08-2.52)

Note: Diagnosed/Expected ratios that have a 95% Confidence Interval that brackets the value 1.00 are not considered statistically high or low.

* Ratio is statistically significant at p=0.05 level. (** p=0.01 level)

NC = not calculated due to less than 3 diagnoses (see text for explanation).

Table A22 - Number of Larynx Cancer Diagnoses by Race/Ethnicity and by Age Compared to the Expected Number in Area 2, 1997-2009 – Females

Race/ Ethnicity	Cancers Diagnosed	Cancers Expected	Ratio of Diagnosed to Expected	95% C.I. for Ratio
White Non-Hispanic	3	0.805	3.73	(0.77-10.90)
Hispanic	1	0.559	1.79	NC
Black	1	0.026	38.46	NC
Other	0	0.010	0.00	NC
Age				
45-54	1	0.266	3.76	NC
55-64	2	0.269	7.44	NC
65-74	2	0.525	3.81	NC
75+	0	0.261	0.00	NC
Total	5	1.400	3.57*	(1.16-8.34)

Note: Diagnosed/Expected ratios that have a 95% Confidence Interval that brackets the value 1.00 are not considered statistically high or low.

* Ratio is statistically significant at p=0.05 level. (** p=0.01 level)

NC = not calculated due to less than 3 diagnoses (see text for explanation).

Table A23 – Number of Lung Cancer Diagnoses by Race/Ethnicity and by Age Compared to the Expected Number in Area 2, 1997-2009 – Males and Females

Race/ Ethnicity	Cancers Diagnosed	Cancers Expected	Ratio of Diagnosed to Expected	95% C.I. for Ratio
White Non-Hispanic	107	63.534	1.68**	(1.38-2.04)
Hispanic	30	25.413	1.18	(0.80-1.69)
Black	3	2.091	1.44	(0.30-4.20)
Other	1	1.898	0.53	NC
Age				
0- 4	1	0.004	250.00	NC
5- 9	0	0.000	0.00	NC
10-14	0	0.029	0.00	NC
15-19	0	0.008	0.00	NC
20-24	0	0.015	0.00	NC
25-34	1	0.253	3.95	NC
35-44	2	1.340	1.49	NC
45-54	8	6.084	1.32	(0.57-2.59)
55-64	27	17.583	1.54*	(1.01-2.24)
65-74	46	32.886	1.40*	(1.02-1.87)
75+	56	34.733	1.61**	(1.22-2.10)
Total	141	92.936	1.52**	(1.28-1.79)

Note: Diagnosed/Expected ratios that have a 95% Confidence Interval that brackets the value 1.00 are not considered statistically high or low.

* Ratio is statistically significant at p=0.05 level. (** p=0.01 level)

NC = not calculated due to less than 3 diagnoses (see text for explanation).

Table A24 – Number of Uterus Cancer Diagnoses by Race/Ethnicity and by Age Compared to the Expected Number in Area 2, 1997-2009 – Females

Race/ Ethnicity	Cancers Diagnosed	Cancers Expected	Ratio of Diagnosed to Expected	95% C.I. for Ratio
White Non-Hispanic	26	12.958	2.01**	(1.31-2.94)
Hispanic	7	6.384	1.10	(0.44-2.26)
Black	1	0.277	3.61	NC
Other	0	0.449	0.00	NC
Age				
25-34	1	0.274	3.65	NC
35-44	1	1.341	0.75	NC
45-54	7	3.878	1.81	(0.72-3.72)
55-64	14	5.706	2.45**	(1.34-4.12)
65-74	5	4.925	1.02	(0.33-2.37)
75+	6	3.877	1.55	(0.57-3.37)
Total	34	20.068	1.69**	(1.17-2.37)

Note: Diagnosed/Expected ratios that have a 95% Confidence Interval that brackets the value 1.00 are not considered statistically high or low.

* Ratio is statistically significant at p=0.05 level. (** p=0.01 level)

NC = not calculated due to less than 3 diagnoses (see text for explanation).

Table A25 – Number of Leukemia Diagnoses by Race/Ethnicity and by Age Compared to the Expected Number in Area 2, 1997-2009 – Males

Race/ Ethnicity	Cancers Diagnosed	Cancers Expected	Ratio of Diagnosed to Expected	95% C.I. for Ratio
White Non-Hispanic	14	9.334	1.50	(0.82-2.52)
Hispanic	12	5.565	2.16*	(1.11-3.76)
Black	0	0.229	0.00	NC
Other	0	0.255	0.00	NC
Age				
0- 4	1	1.051	0.95	NC
5- 9	1	0.388	2.58	NC
10-14	1	0.435	2.30	NC
15-19	0	0.432	0.00	NC
20-24	0	0.211	0.00	NC
25-34	1	0.873	1.15	NC
35-44	1	0.766	1.31	NC
45-54	3	1.462	2.05	(0.42-6.00)
55-64	3	2.147	1.40	(0.29-4.08)
65-74	8	3.163	2.53*	(1.09-4.98)
75+	7	4.465	1.57	(0.63-3.23)
Total	26	15.383	1.69*	(1.10-2.48)

Note: Diagnosed/Expected ratios that have a 95% Confidence Interval that brackets the value 1.00 are not considered statistically high or low.

* Ratio is statistically significant at p=0.05 level. (** p=0.01 level)

NC = not calculated due to less than 3 diagnoses (see text for explanation).

Table A26 – Number of Nasopharynx Cancer Diagnoses by Race/Ethnicity and by Age Compared to the Expected Number in Area 3, 1997-2009 – Males and Females

Race/ Ethnicity	Cancers Diagnosed	Cancers Expected	Ratio of Diagnosed to Expected	95% C.I. for Ratio
White Non-Hispanic	1	0.275	3.64	NC
Hispanic	1	0.382	2.62	NC
Black	2	0.668	2.99	NC
Other	2	0.638	3.14	NC
Age				
0- 4	0	0.000	0.00	NC
5- 9	0	0.012	0.00	NC
10-14	2	0.041	48.78	NC
15-19	0	0.040	0.00	NC
20-24	0	0.040	0.00	NC
25-34	2	0.287	6.97	NC
35-44	0	0.490	0.00	NC
45-54	0	0.370	0.00	NC
55-64	0	0.309	0.00	NC
65-74	1	0.316	3.17	NC
75+	1	0.057	17.54	NC
Total	6	1.963	3.06*	(1.12-6.66)

Note: Diagnosed/Expected ratios that have a 95% Confidence Interval that brackets the value 1.00 are not considered statistically high or low.

* Ratio is statistically significant at p=0.05 level. (** p=0.01 level)

NC = not calculated due to less than 3 diagnoses (see text for explanation).

Table A27 - Number of Prostate Cancer Diagnoses by Race/Ethnicity and by Age Compared to the Expected Number in Area 3, 1997-2009 – Males

Race/ Ethnicity	Cancers Diagnosed	Cancers Expected	Ratio of Diagnosed to Expected	95% C.I. for Ratio
White Non-Hispanic	71	46.251	1.54**	(1.20-1.94)
Hispanic	29	26.056	1.11	(0.75-1.60)
Black	164	143.490	1.14	(0.97-1.33)
Other	6	8.779	0.68	(0.25-1.49)
Age				
35-44	1	2.573	0.39	NC
45-54	47	31.205	1.51*	(1.11-2.01)
55-64	102	90.064	1.13	(0.92-1.38)
65-74	91	76.934	1.18	(0.95-1.45)
75+	29	23.755	1.22	(0.82-1.75)
Total	270	224.577	1.20**	(1.06-1.36)

Note: Diagnosed/Expected ratios that have a 95% Confidence Interval that brackets the value 1.00 are not considered statistically high or low.

* Ratio is statistically significant at p=0.05 level. (** p=0.01 level)

NC = not calculated due to less than 3 diagnoses (see text for explanation).

Table A28 - Number of Bladder Cancer Diagnoses by Race/Ethnicity and by Age Compared to the Expected Number in Area 3, 1997-2009 – Males and Females

Race/ Ethnicity	Cancers Diagnosed	Cancers Expected	Ratio of Diagnosed to Expected	95% C.I. for Ratio
White Non-Hispanic	23	11.849	1.94**	(1.23-2.91)
Hispanic	9	5.390	1.67	(0.77-3.17)
Black	18	12.767	1.41	(0.83-2.23)
Other	0	1.482	0.00	NC
Age				
25-34	1	0.512	1.95	NC
35-44	8	1.201	6.66**	(2.87-13.11)
45-54	12	4.577	2.62**	(1.35-4.58)
55-64	7	8.460	0.83	(0.33-1.71)
65-74	15	9.242	1.62	(0.91-2.68)
75+	7	7.362	0.95	(0.38-1.96)
Total	50	31.486	1.59**	(1.18-2.09)

Note: Diagnosed/Expected ratios that have a 95% Confidence Interval that brackets the value 1.00 are not considered statistically high or low.

* Ratio is statistically significant at p=0.05 level. (** p=0.01 level)

NC = not calculated due to less than 3 diagnoses (see text for explanation).