FOLLOW-UP ON SPRING VALLEY HEALTH STUDY

COMMUNITY HEALTH ASSESSMENT TECHNICAL REPORT

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A summary report can be found at: www.jhsph.edu/springvalley
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ACKNOWLEDGEMENTS

The Johns Hopkins Follow-up on Spring Valley Health Study team would like to thank the Spring Valley and Chevy Chase communities for their participation and interest in this work. This study was conducted under contract with the District of Columbia Department of the Environment (DDOE).

The information on cancer incidence contained in this report was provided by the District of Columbia Cancer Registry, District of Columbia Department of Health (DCDOH). Mortality data for the top 15 causes of death and selected cancer mortality were provided by the DCDOH Division of Vital Records.

Contents

Introduction and Overview

Study Approach

This analysis of community-level health data examined questions of potential health impacts of the American University Experiment Station (AUES)-related contamination by making comparisons between the Spring Valley area (potentially "exposed") and the Chevy Chase area ("unexposed"). Through these comparisons, we addressed in an indirect way the possible influence of AUES-related contamination.

Updating Prior Work

The Johns Hopkins 2007 Scoping Study presented a general assessment of community health indicators for each study area including descriptive demographics from the 2000 Census, data on the top 15 causes of mortality in the United States (US) for 2002-2003, and cancer incidence and mortality for selected causes of cancer for 1994 – 2004. The main findings of the 2007 Scoping Study are provided in Supplement A[1].

In this section the 2007 Scoping Study community health assessment for both study areas is updated as follows with:

- Demographics from the 2010 Census and American Community Survey, 2006-2010;
- Top 15 causes of death (US), 2004 – 2010; and
- Selected cancer incidence and mortality, 2005 - 2009.

Data sources include US Census, and District of Columbia Department of Health (DCDOH) vital statistics and cancer registries. The Spring Valley and Chevy Chase study areas were represented by ZIP Code and census tracts (see descriptive maps in Supplement B). The Spring Valley formerly used defense site (FUDS) boundary is contained within ZIP Code 20016 and DC census tracts 801, 901, 1001, 1002; the Chevy Chase area is represented by ZIP Code 20015 and DC census tracts 1100, 1401, 1402, 1500.

This community health status assessment plan and related data needs were reviewed and approved by the Johns Hopkins Bloomberg School of Public Health Institutional Review Board and DCDOH Institutional Review Board for the Public's Health.

Other Health Analyses

This assessment explored the following two health topics in response to findings of the 2007 Scoping Study, as well as community concerns and interests:

- Mortality data for anemias and peripheral neuropathy were requested from DCDOH in follow-up to findings from the Scoping Study analysis of anecdotal aplastic anemia and peripheral

[1] Full Scoping Study report available at:
http://www.nab.usace.army.mil/Portals/63/docs/HopkinsHealthStudy_2007.pdf

neuropathy disease reports. Mortality data are the only readily available data for these outcomes; no systematic surveillance program exists.

- A literature review was conducted to identify studies or reports on community health concerns near other FUDS sites with similar contamination and exposure conditions to Spring Valley.

Demographic Profile Update: Spring Valley and Chevy Chase

For the 2007 Scoping Study, the Chevy Chase, D.C. area was selected as a comparison population for the Spring Valley study area on the basis of similar demographic characteristics. The Scoping Study used 2000 Census data for those comparisons. The data shown below include data from the 2010 Census and the American Community Survey covering the years 2006-2010 (U.S. Census Bureau 2012a, b). The demographic data for the study areas (as defined by census tracts), shown in Table CH-1, remain quite comparable in racial and ethnic composition (predominantly white), median household income (above $130,000), and adult educational attainment (above 80% with college degree). The study areas' demographic statistics continue to stand in contrast to the District of Columbia and the US overall in regards to these same characteristics. The comparability of the study areas' environmental health indicators was explored in the Environmental Assessment Report.

Table CH-1. Selected Demographic Data, 2006-2010

	Spring Valley[a]	Chevy Chase[b]	District of Columbia	U.S.
Total Population	24,762	16,766	617,996	311,591,917
% White	84.3	81.8	38.5	63.7
% Black	4.4	8.7	50.7	12.6
% Hispanic	7.4	6.5	9.1	16.3
% Other	4.0	3.1	1.7	7.4
Median Household Income[c]	$139,724	$132,773	$ 58,526	$ 51,914
% College Degree[d]	82	82	49	28

a Defined by census tracts: 801, 901, 1001, 1002
b Defined by census tracts: 1100, 1401, 1402, 1500
c Average across census tracts for Spring Valley and Chevy Chase
d Percent of adults over age 25 with a Bachelor's or higher degree (averaged across census tracts for Spring Valley and Chevy Chase)

Age is an important determinant of health and there are some differences to note across the comparison populations presented in Table CH-2. Chevy Chase's population is older than that of Spring Valley, DC and the US, with a larger proportion of people over age 40. Spring Valley has a larger proportion of population 60 years or age and older than does DC and the US. Differences in age distributions can make it challenging to interpret population-level health data. To address this difficulty, all rates were age-adjusted or standardized to the 2000 US population to account for the age differences and for consistency in comparisons to DC and US data.

Table CH-2. Age Distribution – Percent of Population by Age Category 2010

Age Category	Spring Valley[a]	Chevy Chase[b]	District of Columbia	U.S.
% Less than 20	24.3	21.5	20.5	26.9
% 20 – 39	33.8	21.2	38.6	26.8
% 40 – 59	22.6	29.8	24.6	27.8
% 60 – 79	15.3	19.8	13.1	14.8
% 80 and up	4.0	7.7	3.3	3.7

a Defined by census tracts: 801, 901, 1001, 1002
b Defined by census tracts: 1100, 1401, 1402, 1500

Demographic Findings

- Demographic characteristics of the Spring Valley and Chevy Chase areas remain similar with regards to racial and ethnic composition, income and educational attainment.
- The Chevy Chase area has a greater proportion of population in older age groups than Spring Valley, DC or US.

Community Health Assessment (Part I): Analysis of Mortality Data

Background

To characterize overall community health status the 2007 Scoping Study analyzed the top 15 causes of mortality for the Spring Valley and Chevy Chase areas using available electronic data (2002-2003 non-age adjusted data by ZIP Code).

Current Analysis

The following analysis updates the 2007 assessment with data on the Top 15 causes of mortality for 2004 to 2010. Data were requested and obtained from the DCDOH Division of Vital Records. These 15 major causes of death in the US account for about 80% of all deaths (National Center for Health Statistics [NCHS] 2010). We also requested mortality data on two additional outcomes – anemias and neuropathies. Mortality data are recognized as a readily available but limited resource to evaluate these health conditions because of the rarity of aplastic anemia and the chronic, manageable nature of peripheral neuropathy. However, if an unusual number of deaths were reported, such findings would be of great concern.

Mortality data for the top 15 causes of death were requested from the DCDOH Division of Vital Statistics for ZIP Codes 20016 (containing Spring Valley) and 20015 (containing Chevy Chase) for the 2004 – 2010 period. This ZIP Code level analysis is consistent with the 2007 Scoping Study. Annual average rates were calculated and age-adjusted to the US 2000 population to improve comparability across populations and to be consistent with the US data. The rates for each study area are presented with a 95% statistical confidence interval reflecting the uncertainty of the rate calculation. The confidence interval can be interpreted to represent the range of values within which the true rate lies with 95% probability.

A ratio of Spring Valley and Chevy Chase rates to the US rate is presented to identify causes of death where rates in the study areas are different (higher or lower) than the nation's. A ratio less than 1 indicates that the study area rate is lower than the US rate; a ratio greater than 1 indicates that the study area rate is higher than the US rate.

Results: Top 15 Causes of Death, 2004-2010

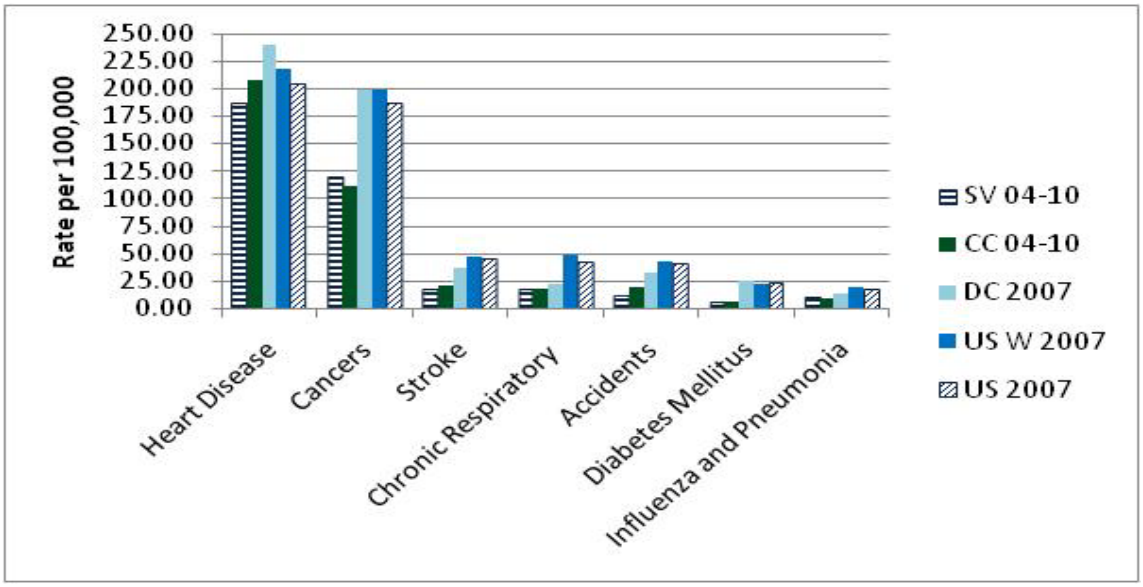
Figures CH-1a and CH-1b and Table CH-3 present comparisons of annual average age-adjusted rates by cause of death for the period 2004-2010. Rates for 12 of the 15 top causes of mortality were similar (no statistical differences) in the Spring Valley and Chevy Chase areas; these included malignant neoplasms (cancers), cerebrovascular diseases, chronic lower respiratory diseases, diabetes, influenza and pneumonia, Alzheimer's Disease, nephritis, nephritic syndrome, nephrosis, septicemia, suicide, chronic liver disease and cirrhosis, essential hypertension and related kidney disease, and Parkinson's Disease. Rates for three of the top 15 causes of death were lower in Spring Valley (and higher in Chevy Chase); these were heart disease, accidents, and homicides.

Comparing the study areas to the US, we see that rates for 14 of the 15 causes in the Spring Valley area were lower than US rates (essential hypertension and related kidney disease rates were similar in 20016 and the US). In the Chevy Chase area rates for 14 of the 15 causes were lower than US rates (heart disease deaths were slightly higher in 20015 and the US).

Comparing the study areas to DC, we find the mortality rates mostly lower than those in DC with the exception that rates of Alzheimer's and Parkinson's Diseases in the study areas were similar or slightly higher than DC rates.

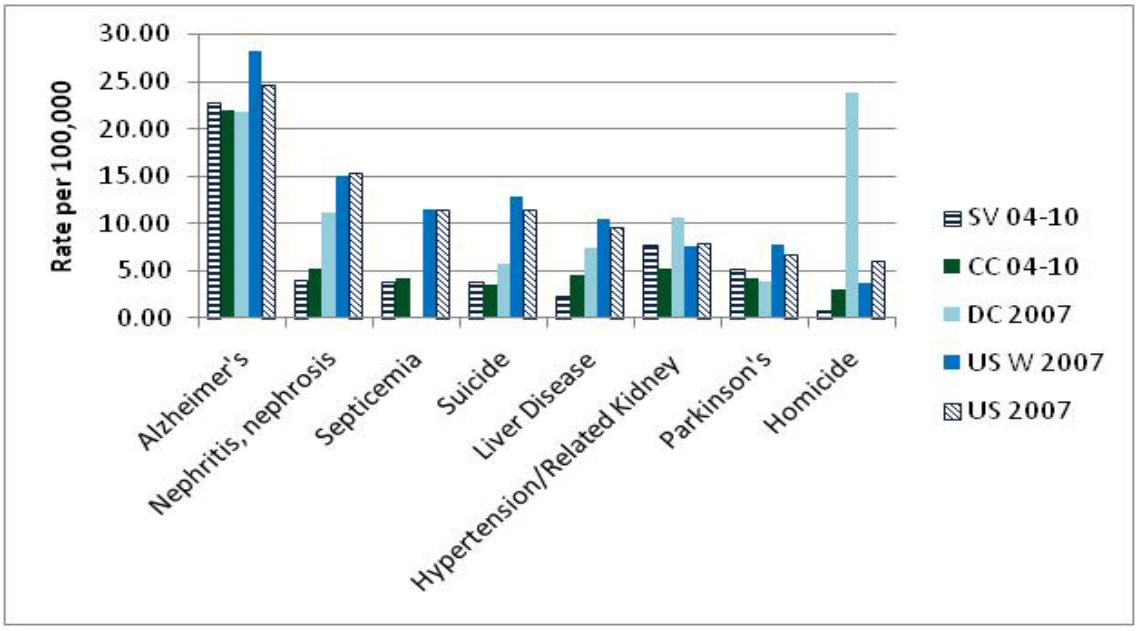
We also examined these data broken into 3- and 4-year time periods to assess potential patterns (see Supplement C). Looking at the shorter time periods we find more variability in the rates. Such variability is typical of small area analysis; deaths from any particular cause may vary greatly year-to-year. Therefore, looking at the seven-year time period in aggregate offers the best snapshot of overall community health.

Figure CH-1a. Comparison of Annual Average Age-Adjusted Mortality Rates (per 100,000) for the Top 7 Causes of Death for ZIP Codes 20016 and 20015 for 2004-2010 with DC and US rates for 2007.



Legend abbreviations:
SV, Spring Valley area (represented by ZIP code 20016)
CC, Chevy Chase area (represented by ZIP code 20015)
DC, District of Columbia (All races)
US W, US Whites
US, US (All races)

Figure CH-1b. Comparison of Annual Average Age-Adjusted Mortality Rates (per 100,000) for the 8th to 15th Top Causes of Death for ZIP Codes 20016 and 20015 for 2004-2010 with DC and US rates for 2007.



Legend abbreviations:
SV, Spring Valley area (represented by ZIP code 20016)
CC, Chevy Chase area (represented by ZIP code 20015)
DC, District of Columbia (All races)
US W, US Whites
US, US (All races)
Note: DC data on septicemia not available.

Table CH-3. Annual Average Age-Adjusted Mortality Rates (per 100,000) for ZIP Codes 20016 and 20015 for 2004-2010 with DC (All Races) and US Rates for 2007 (US Whites and All Races).

Top 15 Causes of Death	20016[a] 2004-10 Rate (#) [CI]	20015[b] 2004-10 Rate (#) [CI]	DC All 2007	US Whites 2007	US All 2007	SV/US Ratio[c]	CC/US Ratio[c]
Diseases of Heart	↓ 187 (601) [179, 194]	207 (450) [197, 217]	239.4	218.30	204.30	0.92	1.01
Malignant Neoplasms	119 (349) [113, 126]	112 (200) [104, 120]	199.1	198.70	186.60	0.64	0.60
Cerebrovascular Diseases	18 (62) [16, 21]	21(48) [18, 24]	36.9	47.10	45.10	0.40	0.47
Chronic Lower Respiratory Diseases	17 (54) [15, 20]	18 (37) [15, 21]	22.4	48.50	42.40	0.40	0.42
Accidents	↓ 11.5 (37) [9.6, 13.4]	20 (30) [16, 23]	32.4	43.60	41.00	0.28	0.49
Diabetes Mellitus	5.4 (17) [4.1, 6.7]	7 (14) [5.1, 8.8]	25.2	23.20	23.70	0.23	0.30
Influenza and Pneumonia	10.2 (35) [8.5, 11.9]	8.8 (23) [6.9, 11]	13.2	18.90	17.50	0.58	0.50
Alzheimer's Disease	22.8 (79) [20.3, 25.4]	22 (52) [19, 25]	21.8	28.30	24.70	0.92	0.89
Nephritis, nephrotic syndrome, nephrosis	4 (13) [2.9, 5.1]	5.2 (12) [3.7, 6.7]	11.2	15.10	15.40	0.26	0.25
Septicemia	3.8 (12) [2.7, 4.8]	4.2 (11) [2.9, 5.4]	NA	11.40	11.50	0.33	0.33
Intentional Self-harm (Suicide)	3.8 (9) [2.5, 5.1]	3.6 (4) [1.8, 5.4]	5.8	12.90	11.50	0.33	0.21
Chronic Liver Disease and Cirrhosis	2.4 (7) [1.5, 3.4]	4.5 (6) [2.7, 6.9]	7.5	10.50	9.70	0.25	0.79
Essential Hypertension and Related Kidney Disease	7.7 (26) [6.2, 9.2]	5.3 (11) [3.7, 6.9]	10.6	7.60	7.90	0.97	0.67
Parkinson's Disease	5.3 (16) [4, 6.7]	4.2 (10) [2.9, 5.5]	3.8	7.70	6.70	0.79	0.13
Assault (Homicide)	↓ 0.9(2) [0.3, 1.6]	3.1 (5) [1.7, 4.5]	23.8	3.70	6.10	0.15	0.51

a ZIP code 20016 represents the Spring Valley area
b ZIP code 20015 represents the Chevy Case area
c Ratio calculated with data for US All Races
↓ Spring Valley rate statistically different (lower) than Chevy Chase rate

Results: Examination of Anemias and Peripheral Neuropathy

Mortality data for aplastic and other anemias and peripheral neuropathies were obtained from the DCDOH Division of Vital Records for ZIP codes 20016 and 20015 for the 2002 – 2010 period. (We requested data for 2002-2003 so this analysis would include the full time period covered by both the Scoping Study as well as this follow-up work.)

Only one death in the category of aplastic and other anemias and no deaths from neuropathy were reported. Given these small numbers, no rates were able to be calculated. The anemia death was in a teenager which may indicate the inherited form of the disease, as described below. As noted above, mortality data are all that is readily available but not well suited to evaluate these outcomes so the lack of data is not unexpected.

In absence of data specific to the study areas, a literature review on aplastic anemia and peripheral neuropathy in the general population was conducted to provide background information on the burden of these conditions in the US. This information is summarized in Box CH1.

Box CH1. Information on Aplastic Anemia and Peripheral Neuropathy in the US

Aplastic anemia is very rare in the US, with only about 0.2 new cases per 100,000 people per year (or 2 cases per million per year). In aplastic anemia, the bone marrow fails to produce enough blood cells. Aplastic anemia can be inherited, i.e., caused by genetic mutations passed from parent to child. Inherited aplastic anemia most often occurs in children. Aplastic anemia can be acquired in people with no genetic abnormalities; this form usually occurs in adults. Some drug and other chemical exposures have been associated with increased risk of aplastic anemia. Examples of drugs associated with aplastic anemia include sulfonamide antibiotics and forms of penicillin, some diabetes medications and diuretics. Chemicals associated with increased risk of aplastic anemia include benzene and organophosphate pesticides. Most cases of aplastic anemia are unexplained (American Cancer Society 2012a).

Peripheral neuropathy is common in the US. There are an estimated 20 million cases of peripheral neuropathy in the US which relates to an overall rate of about 6%[1] (The Neuropathy Association 2012). A prospective community study in the United Kingdom found an annual incidence rate of 15 per 100,000 (MacDonald et al. 2000). There are numerous causes of peripheral neuropathy including genetic/hereditary, autoimmune disorder, nutritional imbalance, infection, and toxic exposure (including arsenic ingestion and inhalation [ATSDR 2007]); these causes combined account for approximately 40% of cases. The other major cause of peripheral neuropathy is diabetes (30% of cases); for the remaining 30% of cases the cause is unknown (The Neuropathy Association 2012).

Aplastic anemia is very rare in the US. The data reviewed does not suggest a strong link to AUES-related contamination and most cases of aplastic anemia are unexplained. Peripheral neuropathy is very common in the US and arsenic exposure is among a number of known causes. Further assessment of these outcomes was beyond the scope of this study.

Community Health Assessment Part I – Mortality Data Findings

- Community health in the Spring Valley and Chevy Chase areas continues to be very good. Rates for all of the 15 major causes of mortality in the Spring Valley area were lower than in the US overall. Rates for 14 of the 15 top causes of death were lower in the Chevy Chase area than in the US overall. The mortality rate for heart diseases in Chevy Chase was slightly higher than the US rate. Rates for three of the top 15 causes of death were lower in Spring Valley (and higher in Chevy Chase); these causes are heart disease, accidents, and homicides.

- Rates for major causes of mortality in the study areas were mostly lower than those in DC with the exception that rates of Alzheimer's and Parkinson's Diseases in the study areas are similar or slightly higher than DC rates. This is likely due to demographic differences between the study areas and DC.

- One death from aplastic anemia was reported. No mortality data for peripheral neuropathy were reported. Further investigation of these outcomes would require a study where individual patients could be identified and/or patient health records could be reviewed.

Community Health Assessment (Part II): Cause-specific Cancer Incidence and Mortality

Background

In contrast to the analysis of the major causes of death above, the analysis of cause-specific cancer data addresses the more specific concerns over long-term health impacts of potential AUES-related exposures. The cancer sites of interest are those that are known or potential arsenic-related cancers (including bladder, kidney and renal pelvis, liver and intrahepatic bile duct, lung and bronchus) and also leukemias, lymphomas and melanoma as sites of interest to the community based on the anecdotal community reports summarized in the 2007 Scoping Study.

Data and Methods

Data were obtained from the District of Columbia Cancer Registry and Division of Vital Records. The rates presented are age-adjusted to the US 2000 population to improve comparability and consistency with US data sources. The statistical confidence interval presented reflects the uncertainty of the rate calculation and represents the range of values within which the true rate lies with 95% probability. US cancer incidence rates were obtained from the Surveillance, Epidemiology and End Results (SEER) program; US cancer mortality rates were obtained from the National Center for Health Statistics (NCHS 2010).

A ratio of Spring Valley and Chevy Chase rates to the US rate is presented to identify cancers where incidence rates in the study areas are different (higher or lower) than the nation's. A ratio less than 1 indicates that the study area rate is lower than the US rate; a ratio greater than 1 indicates that the study area rate is higher than the US rate.

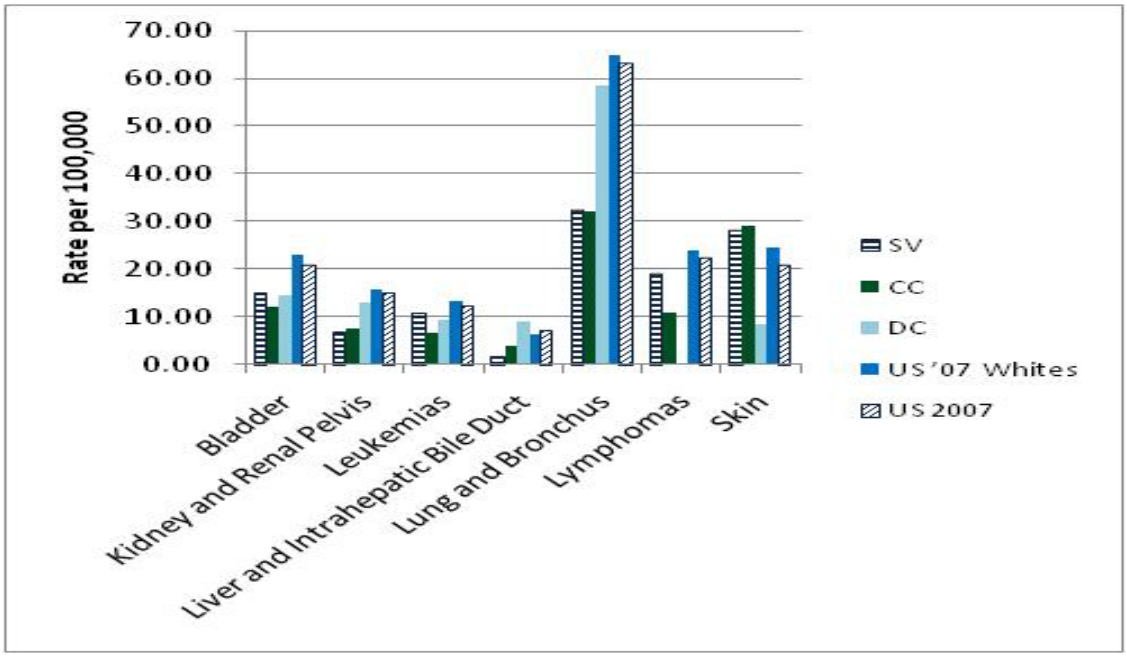
Results: Cancer Incidence

Figure CH-2 and Table CH-4 present comparisons of annual average age-adjusted cancer incidence rates for the period 2004-2009. Because incidence reflects new cases of disease, it is thought to best represent disease risk in contrast to mortality rates which also reflect the influence of treatment. Incidence rates for bladder, kidney and renal pelvis, leukemias, liver and intrahepatic bile duct, lung and bronchus and skin cancers were similar in both study areas (no statistical differences). The incidence of lymphomas was higher in the Spring Valley area than in the Chevy Chase area (however, rates in both areas were lower than the US rate).

Incidence rates for bladder, kidney and renal pelvis, leukemias, liver and intrahepatic bile duct, lung and bronchus and lymphomas in both Spring Valley and Chevy Chase areas were lower than US rates. In the Spring Valley area rates were 15% to 75% lower that US rates, depending on the type of cancer. In the Chevy Chase area, rates were about 40 to 50% lower than US rates. The incidence rates for skin cancer (melanoma) in the Spring Valley and Chevy Chase areas were similar (no statistical differences) but 35-38% higher than US rates.

Incidence rates for bladder, kidney and renal pelvis, leukemias, liver and intrahepatic bile duct, lung and bronchus cancers in both Spring Valley and Chevy Chase areas were lower than DC rates. Incidence rates for melanoma skin cancer were higher in the study areas than in DC.

Figure CH-2. Estimated annual average age-adjusted cancer incidence rates (per 100,000) for Spring Valley, Chevy Chase and DC for 2005 – 2009, and US 2007



Legend abbreviations:
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CC, Chevy Chase area (represented by census tracts 1100, 1401, 1402, 1500)
DC, District of Columbia (All races)
US, US (All races)
Note: DC data on lymphomas not available.

Table CH-4. Estimated annual average age-adjusted cancer incidence rates (per 100,000) for Spring Valley, Chevy Chase and DC for 2005 – 2009, and US 2007 with SV/US and CC/US Ratios

Cancer Incidence 2005 – 2009	SV Avg. Rate (#) [CI]	CC Avg. Rate (#) [CI]	DC	US '07 Whites	US 2007	SV/US Ratio	CC/US Ratio
Bladder	15.3 (21) [12.0, 18.6]	12.0 (21) [9.2, 15.0]	14.6	22.9	21.1	0.73	0.57
Kidney and Renal Pelvis	6.9 (10) [4.7, 9.1]	7.5 (10) [5.0, 10.0]	13.0	15.6	15.2	0.45	0.49
Leukemias	10.9 (12) [7.8, 14.1]	6.5 (7) [4.1, 9.0]	9.2	13.3	12.6	0.87	0.52
Liver and Intrahepatic Bile Duct	1.8 (2) [0.5, 3.0]	3.9 (2) [2.1, 5.6]	9.1	6.4	7.5	0.24	0.52
Lung and Bronchus	32.6 (47) [27.9, 37.4]	32.0 (47) [27.0, 37.0]	58.4	64.8	36.1	0.52	0.51
Lymphomas	19.3 (24) [15.3, 23.2]	↓ 11.0 (15) [8.4, 14.0]	NA	23.8	22.6	0.85	0.49
Skin (Melanoma)	28.4 (37) [23.7, 33.1]	29.0 (33) [24.0, 34.0]	8.5	24.5	21.0	1.35	1.38

NA, not available
'↓' Rate statistically different (lower) than local comparison area

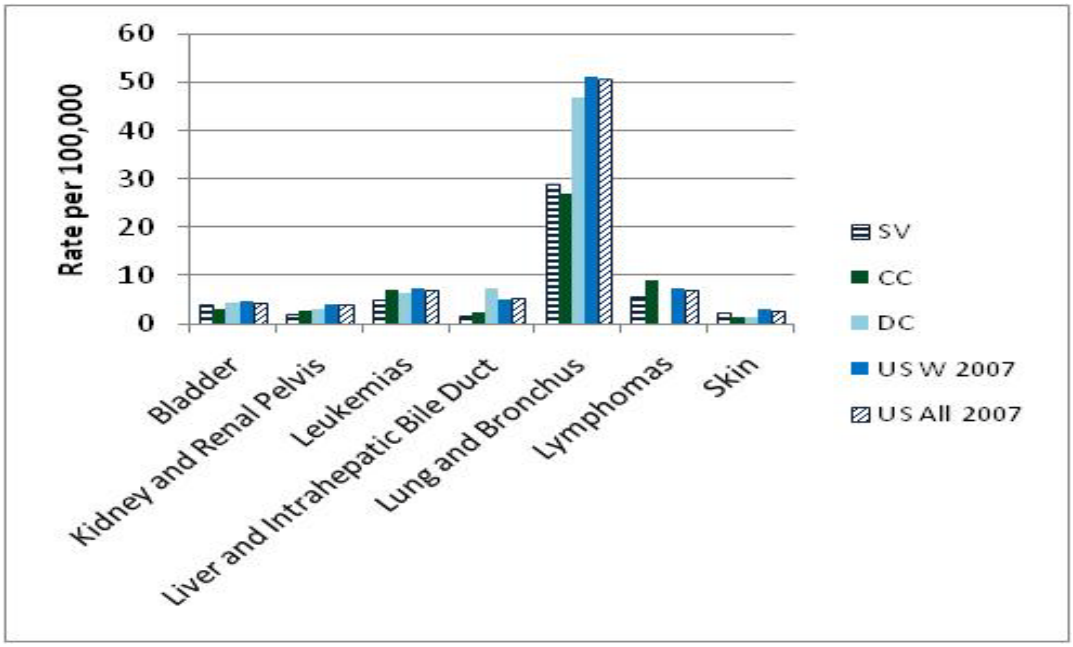
Results: Cancer Mortality

Figure CH-3 and Table CH-5 present comparisons of annual average age-adjusted cancer mortality rates for the period 2005-2009. Mortality rates for all selected cancers were similar in both study areas (no statistical differences).

Mortality rates in the Spring Valley area for the cancers examined were lower than US rates. In the Spring Valley area rates were 7% to 67% lower that US rates, depending on the type of cancer. Mortality rates for 6 of the selected cancers were lower in the Chevy Chase area than in the US, including bladder, kidney and renal pelvis, liver and intrahepatic bile duct, lung and bronchus and skin. In the Chevy Chase area leukemia mortality was very similar to the US rate and the lymphoma mortality rate was higher than the US rate. For bladder, kidney and renal pelvis, liver and intrahepatic bile duct, and lung and bronchus cancers in the Chevy Chase area, rates were about 30-50% lower than US rates.

Mortality rates for 6 of the selected cancers were lower in the Spring Valley area than in DC, including bladder, kidney and renal pelvis, liver and intrahepatic bile duct, and lung and bronchus. The leukemia mortality rate was higher in Chevy Chase than in DC and the skin cancer mortality rates were higher in both study areas, relative to the DC rate.

Figure CH-3. Estimated annual average age-adjusted cancer mortality (per 100,000) for Spring Valley, Chevy Chase and DC for 2005 – 2009, and US 2007



Legend abbreviations:
SV, Spring Valley area (represented by census tracts 801, 901, 1001, 1002)
CC, Chevy Chase area (represented by census tracts 1100, 1401, 1402, 1500)
DC, District of Columbia (All races)
US W, United States Whites
US All, United States (All races)
Note: DC data on lymphomas not available.

Table CH-5. Estimated annual average age-adjusted cancer mortality (per 100,000) for Spring Valley Chevy Chase and DC for 2005 – 2009, and US 2007 with SV/US and CC/US Ratios

Cancer Mortality 2005 – 2009	SV Avg. Rate (#) [CI]	CC Avg. Rate (#) [CI]	DC	US '07 Whites	US 2007	SV/US Ratio	CC/US Ratio
Bladder	4.1 (6) [2.4, 5.7]	2.9 (6) [1.7, 4.1]	4.4	4.6	4.4	0.93	0.66
Kidney and Renal Pelvis	2.2 (3) [0.9, 3.5]	2.6 (5) [1.5, 3.8]	2.9	4.1	4.0	0.55	0.65
Leukemias	4.9 (7) [3.0, 6.7]	6.9 (8) [4.4, 9.3]	6.3	7.2	7.0	0.70	0.99
Liver and Intrahepatic Bile Duct	1.8 (2) [0.5, 3.0]	2.5 (3) [1.1, 4.0]	7.3	5.0	5.4	0.33	0.46
Lung and Bronchus	29.0 (29) [24.0, 33.0]	27.0 (40) [23.0, 31.0]	46.7	51.2	50.7	0.57	0.53
Lymphomas	5.6 (9) [3.7, 7.5]	9.0 (14) [6.6, 11.0]	NA	7.2	6.9	0.81	1.30
Skin (Melanoma)	2.5 (3) [1.1, 4.0]	1.3 (3) [0.6, 2.1]	1.2	3.0	2.7	0.93	0.48

Abbreviations: CC, Chevy Chase; DC, District of Columbia; SV, Spring Valley; US, United States.

Trends in Selected Causes of Cancer

Including data from the 2007 Scoping Study and the current analysis it is possible to assess trends in incidence and mortality rates over a period from the 1990's to 2009 for the selected cancers examined. We conducted a 2-stage analysis. First we examined the aggregated data (5-or 6-years combined) to identify any differences in trends between the study areas and the US. Then, for those cancers where differences were observed rates were analyzed by year to more closely examine the changes over time.

Trends in Aggregated Data

Trends for the study areas are presented below with comparison to US rate trends. Trend indicators used for the tables are defined as follows:

- Up – increase in rates over the time period;
- Down – decrease in rates over the time period;
- Mixed – alternating increase and decrease in rates over the time period; and
- Stable – little or no change in rates over the time period.

In the Spring Valley area, incidence rates have been going up for bladder, lung and bronchus and skin cancers and incidence rate trends were mixed or stable for kidney and renal pelvis, leukemia, liver and interhepatic bile duct and lymphomas. In the Chevy Chase area incidence rates have been going up for kidney and renal pelvis, liver and interhepatic bile duct and skin cancers; incidence rate trends were mixed or stable for bladder, lung and bronchus and lymphomas; incidence rates were going down for leukemias. US incidence rates have been increasing for kidney and renal pelvis, liver and intrahepatic bile duct, lymphomas and skin cancers; US cancer incidence rates have been declining for bladder, leukemia, and lung and bronchus cancers, see Table CH-6 (Surveillance, Epidemiology and End Results [SEER] 2012a).

Unshaded cells of Table CH- 6 highlight the types of cancer where trends in the aggregated data were different from the general US trend. Shaded cells of Table CH-6 indicate a mixed trend or no difference between a study area trend and the US trend.

Table CH-6. Trends in Cancer Incidence, 1990s to 2009

	SV (1994-2009)	CC (1994-2009)	US (1992-2009)
Bladder	**Up**	**Mixed**	**Stable**
Kidney and renal pelvis	**Mixed**	**Up**	**Up**
Leukemia	**Mixed**	**Down**	**Down**
Liver and intrahepatic bile duct	**Stable**	**Up**	**Up**
Lung and bronchus	**Up**	**Mixed**	**Down**
Lymphoma	**Mixed**	**Mixed**	**Up**
Skin (Melanoma)	**Up**	**Up**	**Up**

Source: SEER Cancer Statistics Review

Trends in cancer mortality for the selected cancers are presented in Table CH-7. In the Spring Valley area mortality rates have been going up for bladder, liver and interhepatic bile duct, lung and bronchus, and lymphomas; and incidence rate trends were mixed for kidney and renal pelvis, and leukemia. In the Chevy Chase area incidence rates have been going up for leukemia and lymphomas; incidence rate trends were mixed for bladder, kidney and renal pelvis, and liver and intrahepatic bile duct cancers. US mortality rates have been increasing for liver cancer; US cancer mortality rates have been declining for bladder, kidney and renal pelvis, leukemia, lung and bronchus, and lymphomas; US rates were stable for melanoma skin cancer.

Unshaded cells of Table CH-7 highlight the types of cancer where trends in the aggregated data were different from the general US trend. Shaded cells of Table CH-7 indicate a mixed trend or no difference between a study area trend and the US trend.

Table CH-7. Trends in Cancer Mortality, 1990s to 2009

	SV (1994-2009)	CC (1994-2009)	US (1992-2009)
Bladder	**Up**	**Mixed**	**Down**
Kidney and renal pelvis	**Mixed**	**Mixed**	**Down**
Leukemia	**Mixed**	**Mixed**	**Down**
Liver and intrahepatic bile duct	**Up**	**Mixed**	**Up**
Lung and bronchus	**Up**	**Mixed**	**Down**
Lymphoma	**Up**	**Up**	**Down**
Skin (Melanoma)	**Up**	**Mixed**	**Stable**

Source: U.S. Mortality files, National Center for Health Statistics.

In this analysis of aggregated data, several differences in study area and national trends were observed. In the Spring Valley area bladder and lung and bronchus cancer incidence rates are trending up while the national trend is down. (In the Chevy Chase area, the incidence trend data is mostly consistent with US trends or mixed, so differences cannot be discerned.) Also concerning are the mortality trends in the Spring Valley area for bladder, lung and bronchus, lymphoma and skin cancers. Similarly, in the Chevy Chase area mortality rate for lymphoma is trending up while US rates are going down.

Trend analysis by year

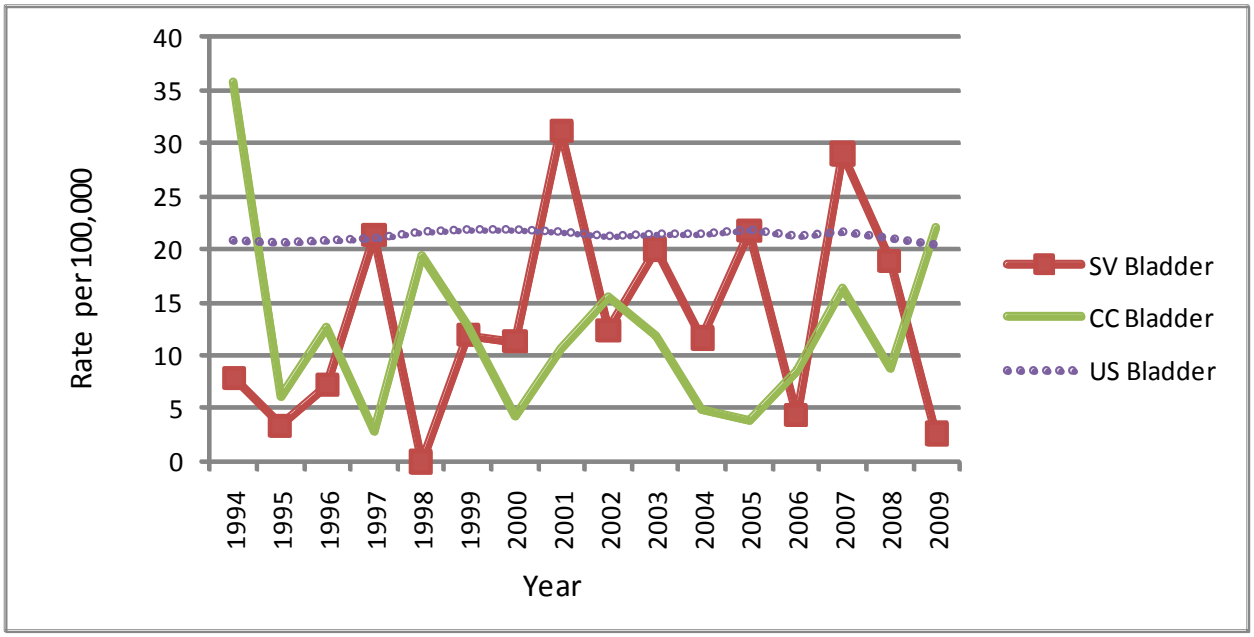
For state and national cancer trend analysis, the typical approach to assess trends is to analyze changes in rates year-by-year (National Cancer Institute 2012). This type of analysis can be challenging when assessing smaller geographic areas due to the rarity of some cancers resulting in high variability in numbers of cases year to year. Therefore, we conducted an annual trend analysis for cancers that were identified in the aggregate data (with trends running counter to US trends) and where adequate data were available in order to better understand and begin to quantify the trends. Cancers assessed for annual trend included bladder and lung and bronchus incidence as well as lung and bronchus and lymphoma mortality. Rates for Chevy Chase were presented for bladder and lung and bronchus incidence for consistency. Bladder and skin cancer mortality were excluded because of the very small number of deaths, less than one per year over the 1994-2009 period.

Figures 4 to 7 show plots of the annual cancer rates by year for the cancers evaluated. Each figure contains a line with markers for Spring Valley (SV) and a line without markers for Chevy Chase (CC) and a dashed line with the US rate. The highly variable nature of cancer rates by year in the study areas is evident in each figure. Tables with the data plotted below are included in Supplement D.

Bladder and Lung Cancer Incidence Trends

Figure CH-4 shows bladder cancer incidence rates from 1994 to 2009. The range of rates (per 100,000) in the Spring Valley area was 0 to 31; and 3 – 36 in the Chevy Chase area. The US rate was stable at about 21 per 100,000.

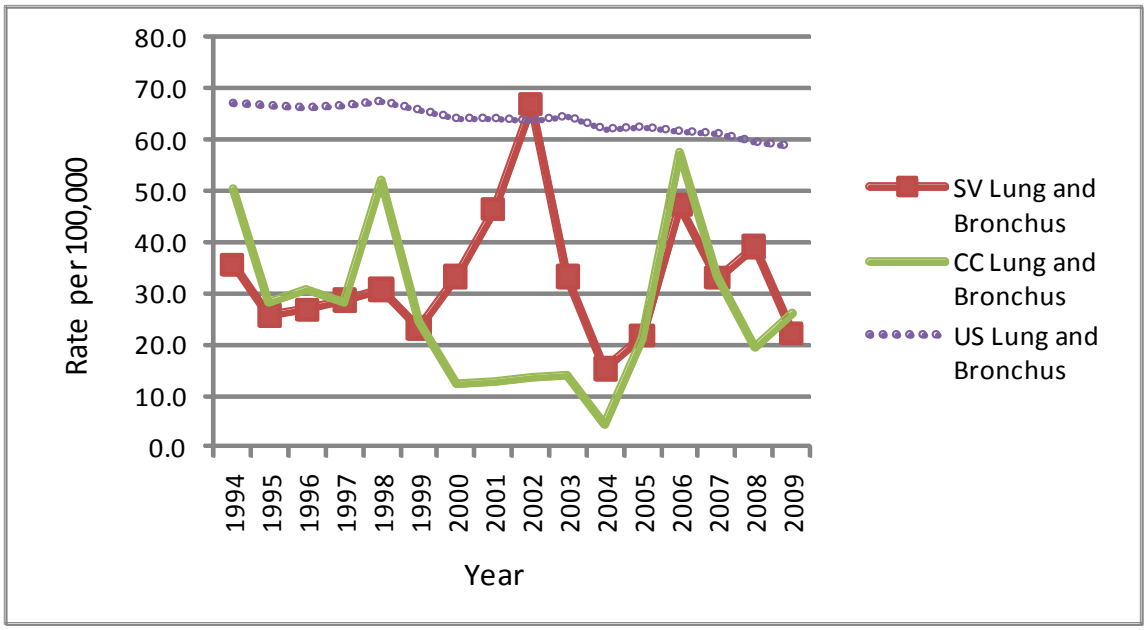
Figure CH-4 Bladder Cancer Incidence Rate Trends, 1994 - 2009



Abbreviations: CC, Chevy Chase; SV, Spring Valley; US, United States

Figure CH-5 shows lung and bronchus cancer incidence rates from 1994 to 2009. The range of rates (per 100,000) in the Spring Valley area was 15 to 67; and 3 – 57 in the Chevy Chase area. The US rate has decreased from about 67 to 59 per 100,000.

Figure CH-5 Lung and Bronchus Cancer Incidence Rate Trends, 1994 – 2009

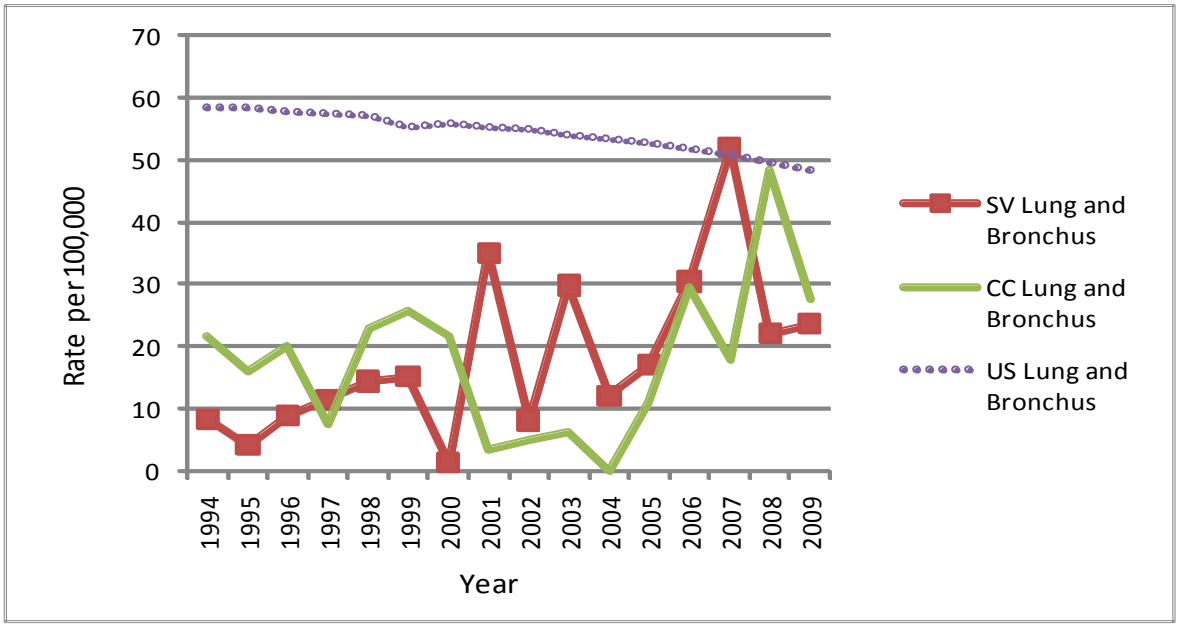


Abbreviations: CC, Chevy Chase; SV, Spring Valley; US, United States

Lung and Bronchus and Lymphoma Mortality Trends

Figure CH-6 shows lung and bronchus cancer mortality rates from 1994 to 2009. The range of rates (per 100,000) in the Spring Valley area was 1 to 52; and 0 to 48 in the Chevy Chase area. The US rate has decreased from about 59 to 48 per 100,000.

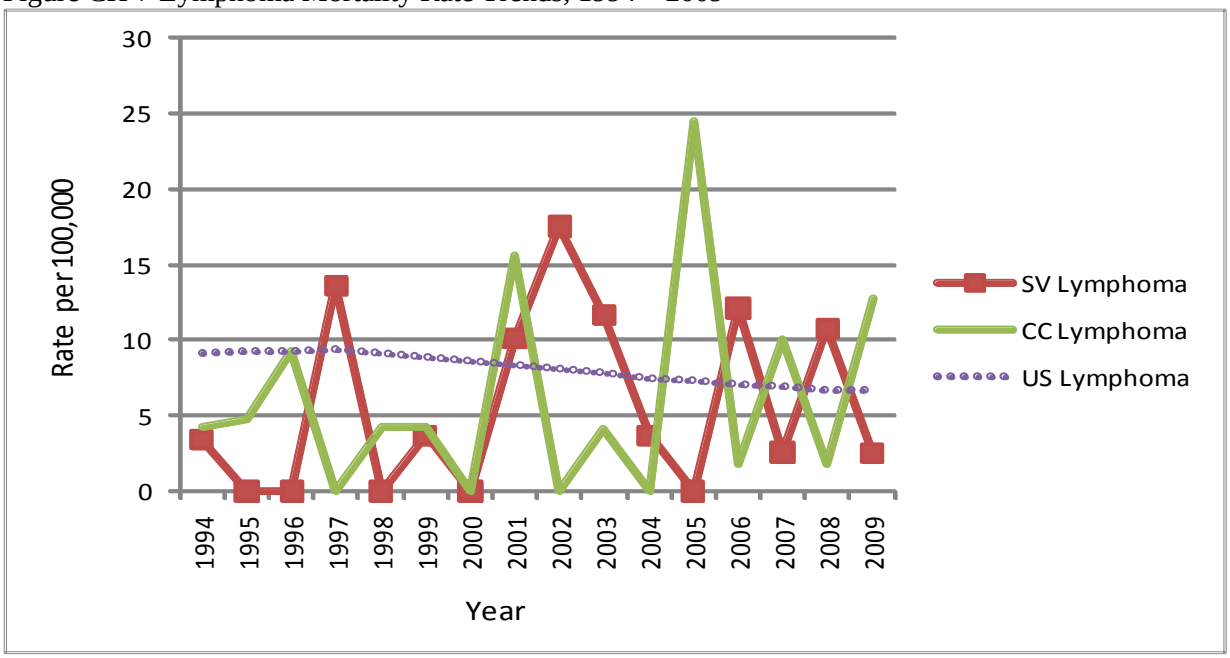
Figure CH-6 Lung and Bronchus Cancer Mortality Rate Trends, 1994 – 2009



Abbreviations: CC, Chevy Chase; SV, Spring Valley; US, United States

Figure CH-7 shows lymphoma mortality rates from 1994 to 2009. The range of rates (per 100,000) in the Spring Valley area was 0 to 18; and 0 to 24 in the Chevy Chase area. The US rate has decreased from about 9 to 7 per 100,000.

Figure CH-7 Lymphoma Mortality Rate Trends, 1994 – 2009



Abbreviations: CC, Chevy Chase; SV, Spring Valley; US, United States

Quantifying the relationship of changes in rates with time

Annual rates were correlated with time in years to develop an indicator of the direction and "strength" of the trend[2]. Correlation results are presented in Table CH-8. A positive number indicates an increase in the rate with increasing time. A negative number indicates a decrease in the rate with increasing time. The value of the number indicates the strength of the correlation, e.g., numbers near zero reflect little to no relationship of the rates with time and numbers approaching 1.00 indicate a strong relationship.

Table CH-8 Correlation of rates with time in years

Cancers Evaluated	Spring Valley	Chevy Chase
Bladder Incidence	0.25	-0.01
Lung and Bronchus Incidence	0.15	-0.07
Lung and Bronchus Mortality	0.67*	0.19
Lymphoma Mortality	0.26	0.15

* Statistically significant at $p<0.01$

[2] Spearman's rank order correlation was used to quantify trends in rates with time. Spearman's rank order correlation is a non-parametric method, meaning that it is applicable to many types of data and does not require making assumptions about the parameters of the true distribution of the underlying data.

For bladder and lung and bronchus incidence in Spring Valley there were small positive correlations of the rates with time. In Chevy Chase there was essentially no relationship between time and change in rates of bladder and lung and bronchus incidence. In Spring Valley there was a moderate positive correlation of the rates of lung and bronchus mortality with time and small positive correlations with lymphoma mortality. In Chevy Chase there were small positive correlations of lung and bronchus and lymphoma mortality rates with time. Only the trend for lung and bronchus mortality in the Spring Valley area is statistically significant ($p<0.01$).

Community Health Assessment Part II – Selected Causes of Cancer Findings

Comparison of Rates Aggregated over the 2005-2009 Period

- Incidence and mortality rates for the all of the selected cancers in the Spring Valley area are lower than US rates.

- The rates of the selected cancers were also very similar comparing the study areas. Only one statistical difference was found in the analysis of incidence and mortality of selected cancers in the study areas: the incidence of lymphoma in the 2005-2009 period is higher in Spring Valley than in Chevy Chase.

- Incidence rates for all selected cancers in the Chevy Chase area are lower than US rates. Mortality rates in the Chevy Chase area for bladder, kidney and renal pelvis, liver and intrahepatic bile duct, and lung and bronchus cancers are lower than US rates. Rates for leukemia mortality in Chevy Chase are similar to the US; rates for lymphoma mortality are higher than US rates.

- Aggregated data for the study areas over the 1994 to 2009 period suggest increasing rate trends that run counter to US trends. In the Spring Valley area increasing rate trends were found for bladder and lung and bronchus incidence; and bladder, lung and bronchus, lymphoma and skin (melanoma) mortality. In the Chevy Chase area an increasing trend was found for lymphoma mortality.

Trend Analysis by Year

- Year-by-year rate trends were highly variable in both study areas, as is typical for small-area analyses. The high variability is due to the small numbers of cases and deaths from year-to-year and the trend data should be interpreted with caution.
- Small positive correlations (increasing trend) were found for bladder and lung and bronchus incidence, and lymphoma mortality in the Spring Valley area. There was a moderate positive correlation (increasing trend) for lung and bronchus cancer mortality in Spring Valley; this is the only statistically significant trend finding.
- Small positive correlations (increasing trend) were found for lung and bronchus and lymphoma mortality in the Chevy Chase area. Small negative correlations (decreasing trend) were found for bladder and lung and bronchus incidence in the Chevy Chase area.

Other Health Analyses – Literature Search on Other FUDS

Background and Approach

Information on community health at other FUDS may provide additional context to understand the community concerns and potential risks at Spring Valley.

We searched on the terms "formerly used defense site" and "FUDS" in four databases of health and science literature. The databases were PubMed, Scopus, Web of Knowledge and Academic Search Complete.

We contacted the Agency for Toxic Substances and Disease Registry (ATSDR) to request a search of Health Consultations and Public Health Assessments related to chemical weapons or munitions. We also contacted the US Army Corps of Engineers (USACE) and reviewed Government Accountability Office (GAO) documents to identify other similar FUDS.

Results of search

Health and science literature
Two articles relevant to population or community health near FUDS were identified. These case studies addressed polychlorinated biphenyls (PCBs) from the Northeast Cape on St. Lawrence Island, Alaska (Carpenter et al. 2005) and mercury contamination from Fort Totten in Queens County, New York (Goldblum et al. 2006). The past history, activities and contaminants at these FUDS are different from Spring Valley and these FUDS were not further evaluated.

Other articles identified included reports on technologies for detecting buried ordnance (Howard 2001) or phytoremediation (Ebbs et al. 2010), case-studies of site clean-ups (Elmore and Graff 1999), land use and demographics (Verell 2008) and an overview of the Defense Environmental Restoration Program (Lubbert and Chu 2000).

ATSDR
The search of ATSDR reports identified two munitions sites, the Former Nansemond Ordnance Depot in Suffolk, Virginia and Tobyhanna Army Depot in Monroe County, Pennsylvania (ATSDR 1997 and 2004). The main contamination issue at Tobyhanna Army Depot was volatile organic solvents in private drinking water wells. The Former Nansemond Ordnance Depot handled and decommissioned ordnance from 1917 to 1960. However, based on ATSDR's report, no chemical weapons or related materials were managed there. The main contamination issues at Former Nansemond Ordnance Depot were trinitrotoluene (TNT) and lead contamination of soil and water contamination with a number of metals. From review of ATSDR's reports on the Tobyhanna Army Depot and the Former Nansemond Ordnance Depot it appeared that: 1) the sites did not handle chemical weapons; and 2) the sites were not highly residential. The past history, activities and contaminants at these sites were different from Spring Valley and therefore they were not evaluated further.

USACE and GAO

Through review of a recent GAO (2009) report and information from US ACE (email correspondence with Mr. Ed Hughes on November 28, 2011), Former Camp Sibert in Alabama was identified as a FUDS

with contamination issues similar to those of Spring Valley. A profile of Former Camp Sibert was developed.

Community health concerns documented by ATSDR and other available demographic and health statistics were used to evaluate whether information from Former Camp Sibert was relevant to the Spring Valley area.

Profile of Former Camp Sibert, Alabama

Former Camp Sibert was a WWII-era chemical weapons training site where large-scale exercises were conducted using Lewisite, mustard, and phosgene (ATSDR 2007b). Former Camp Sibert covers more than 37,000 acres in parts of Etowah and St. Clair Counties, Alabama (ATSDR 2007b). Recent finds at the site include a Livens projectile and numerous mortars (US Army Corps of Engineers Mobile District, 2012).

Community characteristics

In 2007, ATSDR reported that much of the Former Camp Sibert area was still undeveloped and the majority of land was agricultural. Only a few homes were on or near sites investigated during the Engineering Evaluation/Cost Analysis (EE/CA). An important concern underlying the Health Consultation was the expectation of changing land use with residential and other development continuing in the area (ATSDR 2007b).

Selected demographic data are presented below with comparisons to the Spring Valley and Chevy Chase study areas (U.S. Census 2012b), see Table CH-9. The demographics of the Former Camp Sibert area differ in important ways from the Spring Valley and Chevy Chase study areas. The Former Camp Sibert area has a somewhat larger Black population and lower income and educational attainment than the Spring Valley and Chevy Chase study areas.

Table CH-9. Selected Demographic Data

	Etowah County	St. Clair County	Spring Valley[a]	Chevy Chase[b]
Total Population	104,430	83,593	24,762	16,766
% White	81	90	84.3	81.8
% Black	16	8	4.4	8.7
% Other	3	2	11.4	9.6
Median Household Income[c]	$37,802	$45,976	$139,724	$132,773
% College Degree[d]	13	14	82	82

a Defined by census tracts: 801, 901, 1001, 1002
b Defined by census tracts: 1100, 1401, 1402, 1500
c Average across census tracts for Spring Valley and Chevy Chase
d Percent of adults over age 25 with a Bachelor's or higher degree (averaged across census tracts for Spring Valley and Chevy Chase)

Community concerns summarized by ATSDR

Two general community concerns were included in ATSDR's Health Consultation: 1) exposure to chemical warfare agents volatilizing from soil; and 2) concerns about air quality in schools and other buildings. No specific disease reports were included in the Health Consultation (ATSDR 2007b). The ATSDR report focused its recommendations on continued public awareness of the potential hazards, safety of drinking water and preventing exposure to contaminated soil.

Community health in the Former Camp Sibert area

Available health statistics for the Former Camp Sibert area were few. Those that were available indicated poorer community health than in the Spring Valley and Chevy Chase study areas. For example, both Etowah and St. Clair Counties have cancer mortality rates that were higher than the US rate while Spring Valley and Chevy Chase rates are lower than the US rate (Alabama Department of Public Health 2013).

<u>Literature Search on Other FUDS - Findings</u>

- There was little peer-reviewed literature on community health near other FUDS.
- Only Former Camp Sibert in Alabama was found to have contamination issues similar to those of Spring Valley.
- The potential for community exposure is likely lower in the Former Camp Sibert area because it has not been heavily residential and has been under development only in recent years.
- Population characteristics of the Former Camp Sibert area were not comparable to the Spring Valley area.
- There was little community health information to draw on but what was available suggested poorer community health in the Former Camp Sibert area than in the Spring Valley area.

Summary of Community Health Assessment Findings

Demographics and Major Causes of Mortality (2004-2010)

- Population demographics of the study areas continue to be largely comparable and distinct from DC and the US overall.
- Community health in the Spring Valley and Chevy Chase areas continues to be very good. Rates for all of the 15 major causes of mortality in the Spring Valley area were lower than in the US overall. Rates for 14 of the 15 top causes of death were lower in the Chevy Chase area than in the US overall. The mortality rate for heart diseases in Chevy Chase was slightly higher than the US rate. Rates for three of the top 15 causes of death were lower in Spring Valley (and higher in Chevy Chase); these causes were heart disease, accidents, and homicides.
- Rates for major causes of mortality in the study areas were mostly lower than those in DC with the exception that rates of Alzheimer's and Parkinson's Diseases in the study areas are similar or slightly higher than DC rates.

Cancer Incidence and Mortality for Selected Causes (2005-2009)

- Incidence and mortality rates for the all of the selected cancers in the Spring Valley area were lower than US rates.
- The rates of the selected cancers were also very similar comparing the study areas. Only one statistical difference was found in the analysis of incidence and mortality of selected cancers in the study areas: the incidence of lymphoma in the 2005-2009 period was higher in Spring Valley than in Chevy Chase.
- Incidence rates for all selected cancers in the Chevy Chase area were lower than US rates. Mortality rates in the Chevy Chase area for bladder, kidney and renal pelvis, liver and intrahepatic bile duct, and lung and bronchus cancers were lower than US rates. Rates for leukemia mortality in Chevy Chase were similar to the US; rates for lymphoma mortality were higher than US rates.

Cancer Trends

- Year-by-year rate trends were highly variable in both study areas and the trend data should be interpreted with caution.
- Small to moderate positive correlations (indicates increasing trend) were found for bladder incidence, lung and bronchus incidence and mortality, and lymphoma mortality in the Spring Valley area. The increasing trend for lung and bronchus cancer mortality in Spring Valley was a statistically significant finding.
- Small positive correlations were found for lung and bronchus and lymphoma mortality in the Chevy Chase area.

Literature Search on Other FUDS – Findings

- There was little peer-reviewed literature on community health near FUDS
- Only Former Camp Sibert in Alabama was found to have contamination issues clearly similar to those of Spring Valley

- The potential for community exposure is likely lower in the Former Camp Sibert area because it has not been heavily residential and has been under development only in recent years
- Population characteristics of the Former Camp Sibert area were not comparable to the Spring Valley area
- There was little community health information to draw on but what was available suggested poorer community health in the Former Camp Sibert area than in the Spring Valley area.

Community Health Assessment Discussion

Study Limitations and Challenges

This study utilized community-level data, and therefore was not designed to evaluate individual-level exposures and outcomes. Community-level data allowed us to examine the question of potential health impacts of AUES-related contamination by making comparisons between the Spring Valley area (potentially "exposed") and the Chevy Chase area ("unexposed").

Some outcomes of interest such as anemias and neuropathies are not reportable conditions, thus there was no surveillance data available for them to be formally evaluated in this study. Further research on such outcomes could be conducted through other approaches, such as identification and tracking of individual patients with these conditions.

Residents in the 20016 ZIP code area are more mobile with about 44% reporting being in their current home only since 2005 (US Census 2010); in the 20015 area this proportion is 31%. Higher mobility likely means that there are more new residents in the 20016 area without contact with AUES-related contaminants. Having an increased unexposed population would tend to bias results toward the null or finding no differences between study areas, which must be taken into consideration in the interpretation of community health status results.

Interpretation of findings

In the context of healthy communities with strong health-protective attributes (e.g., affluence and high educational attainment) it is difficult to determine how the impacts of environmental hazards might appear. As observed in both the current and the 2007 Scoping Study the 20015 and 20016 areas mortality and cancer rates were highly variable over time and some rate calculations were based on very small numbers. Where it was possible to do so, statistical differences between the study area's health data were noted.

In data on the top 15 causes of mortality, the statistical differences all favored the Spring Valley area; the Chevy Chase rates were higher for heart disease, accidents and homicide. For most of the top 15 causes of death, there were no discernable differences between rates in Spring Valley and Chevy Chase.

In the cancer data analysis, there were two statistically significant findings: differences in lymphoma incidence rates for 2005-2009 (Spring Valley rates were higher); and the lung and bronchus mortality rate trend for Spring Valley. Regarding lymphoma, a review of risk factors compiled by the American Cancer Society showed that lymphoma is not strongly linked to arsenic or other AUES-related chemicals.[3]

[3] Risk factors for Hodgkin's and Non-Hodgkin's Lymphoma, Available: http://www.cancer.org/cancer/index

Lung and bronchus cancer mortality rates were lower in Spring Valley than the US on average[4], however, the increasing rate trends for lung and bronchus mortality are concerning. We examined the underlying data to see if factors such as age or gender might have contributed to the increasing trend.

The median age for the lung and bronchus cancer deaths reported from 1994-2009 was 78 years for Spring Valley, 76 years for Chevy Chase; and 72 years in the US for the period 2005-2009 (SEER 2012b). US lung and bronchus cancer death rates are higher for older patients (National Vital Statistics System 2010). Rates of lung and bronchus mortality are declining in men but continue to increase in women (American Lung Association 2013). Women represent about 55% of the lung and bronchus cancer deaths in the Spring Valley and Chevy Chase areas from 1994-2009. Thus, age and gender may explain part of the rate increase.

Latency period estimates for lung cancer range from 20 - 30 years meaning that cancers observed in recent years may have developed from exposures many years ago (Polednak 1974; Baldini 2013). Lung and bronchus cancer is an arsenic-related cancer, although smoking is the most common cause accounting for about 90% of cases (American Lung Association 2013). Arsenic exposure and smoking rates were beyond the scope of this study.

Given the significant limitations resulting from lack of exposure data, disease latency, and time lag (approaching 100 years since AUES activities) it is not possible to made a definitive determination of cause and effect for health outcomes observed in surveillance data or reported by residents. However, the findings are reassuring – community health has remained strong over the years examined in the current and 2007 studies (2002-2010 for top causes of mortality and 1994 – 2009 for incidence and mortality for selected cancers). There were few findings consistent with a hypothesis that residents of the Spring Valley area may have had increased exposure to arsenic or other AUES-related chemicals.

The findings warrant continued monitoring. However, given the limitations identified above and the findings of continued good health of the study areas further epidemiologic investigation is not recommended. The study recommendations focus on 'tracking' or regular monitoring and reporting of community and environmental health, to provide information needed to follow and update community health status over time.

Public Health Concerns and Recommendations

The findings that some cancer incidence and mortality rate trends were running counter to US trends raise a general public health concern for both the Spring Valley and Chevy Chase areas. Understanding these trends may require further review of existing data on patient-level factors, disease characteristics (e.g., type, site and stage of disease at diagnosis or death) as well as availability, access and usage of appropriate treatment.

The types of cancer evaluated in this community health assessment included arsenic-related cancers as well as cancers of community concern. These selected cancers account for about 36% of cancer incidence

[4] Rates in Spring Valley were 70% lower than US rates in the 1994-2004 period (Scoping Study) and 40% lower than US rates in the 2005-2009 period (see Table 5 above).

and about 45% of cancer deaths overall[5] but did not include the most common cancers (colon, breast, and prostate). A complete profile of cancer for the study areas would include the most common cancers as well as those selected on the basis of site-specific or other community concerns.

Recommendation

- Develop a complete cancer incidence and mortality profile for both study areas including rates and time trends of all the major cancers, as well as cancers selected for site-related or other community concerns.

[5] American Cancer Society 2012. Cancer Facts and Figures. Available: http://seer.cancer.gov/csr/1975_2009_pops09/results_single/sect_01_table.01.pdf

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Community Health Assessment Supplemental Data

A. Main findings of 2007 Scoping Study

B. Maps showing Spring Valley and Chevy Chase area ZIP codes and census tracts in relation to the Spring Valley FUDS boundary

C. Top 15 causes of mortality rate tables for 2004-07 and 2008-10

D. Cancer rates by year plotted in Figures CH-4 to CH-7 (bladder incidence, lung and bronchus incidence and mortality, lymphoma mortality)

Community Health Supplement A – Findings from 2007 Scoping Study (excerpted from the Executive Summary)[6]

Findings

- Community health status of Spring Valley is very good. Mortality rates for most of the top 15 causes of death compare favorably with national rates and are lower than those of Chevy Chase, D.C., a comparison community with similar demographic characteristics.

- Spring Valley age-adjusted cancer incidence and mortality rates for selected cancers of concern (bladder, kidney and renal pelvis, leukemias, lung and bronchus, lymphomas and skin) are generally much lower than the U.S. rates. In recent years (2000 – 2004) rates of skin cancer incidence are the same as the U.S. rates.

- The examination of cancer incidence and mortality data indicated that rates of cancer known to be associated with arsenic exposure (bladder, kidney and renal pelvis, lung and bronchus, and skin) are slightly higher in Spring Valley than in Chevy Chase. This finding should be interpreted with caution since the numbers of cases and deaths are low and rates calculated are likely to be highly variable.

- There persists a lack of information on the long-term effects of chemical weapon exposures. However, the available scientific literature on the health effects of chemicals (including some chemical weapon breakdown products) sampled for in soils in Spring Valley is consistent with some anecdotally reported health outcomes in the community, such as cancers, blood disorders, neurological and skin conditions.

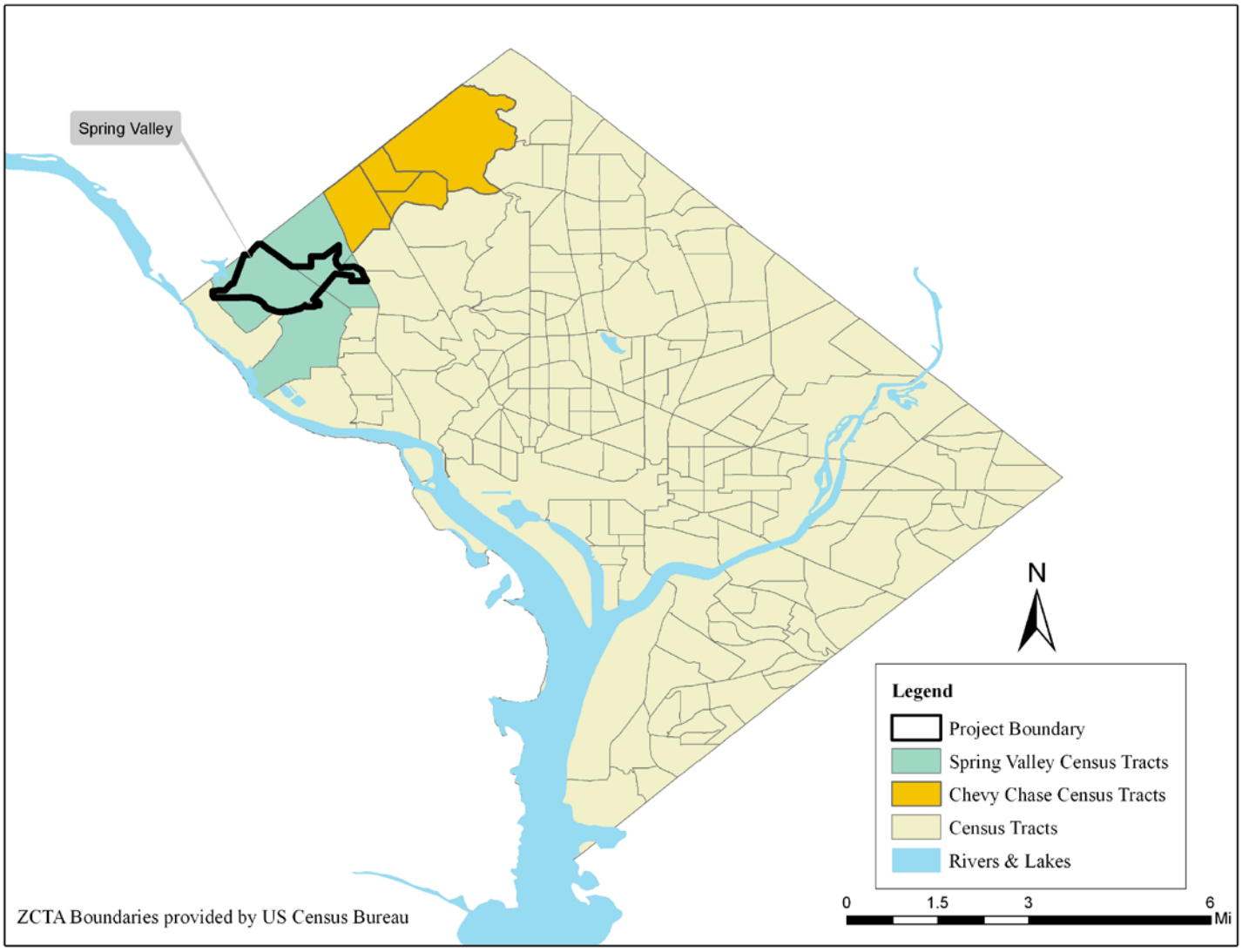
- A spatial analysis of cancer incidence did not indicate a relationship between cancer incidence and proximity to known contaminated areas. A similar analysis of anecdotal health outcomes did reveal a spatial relationship with known contaminated areas. This finding may reflect the limitations of the anecdotally reported data.

- The risk assessment examined average community and worst-case exposure scenarios for both adults and children. Risks are generally low for adults, including workers (e.g., landscapers). In the worst case, for children's exposures to unremediated soil, cancer and non-cancer risks are elevated, but the probability of adverse effects is small.

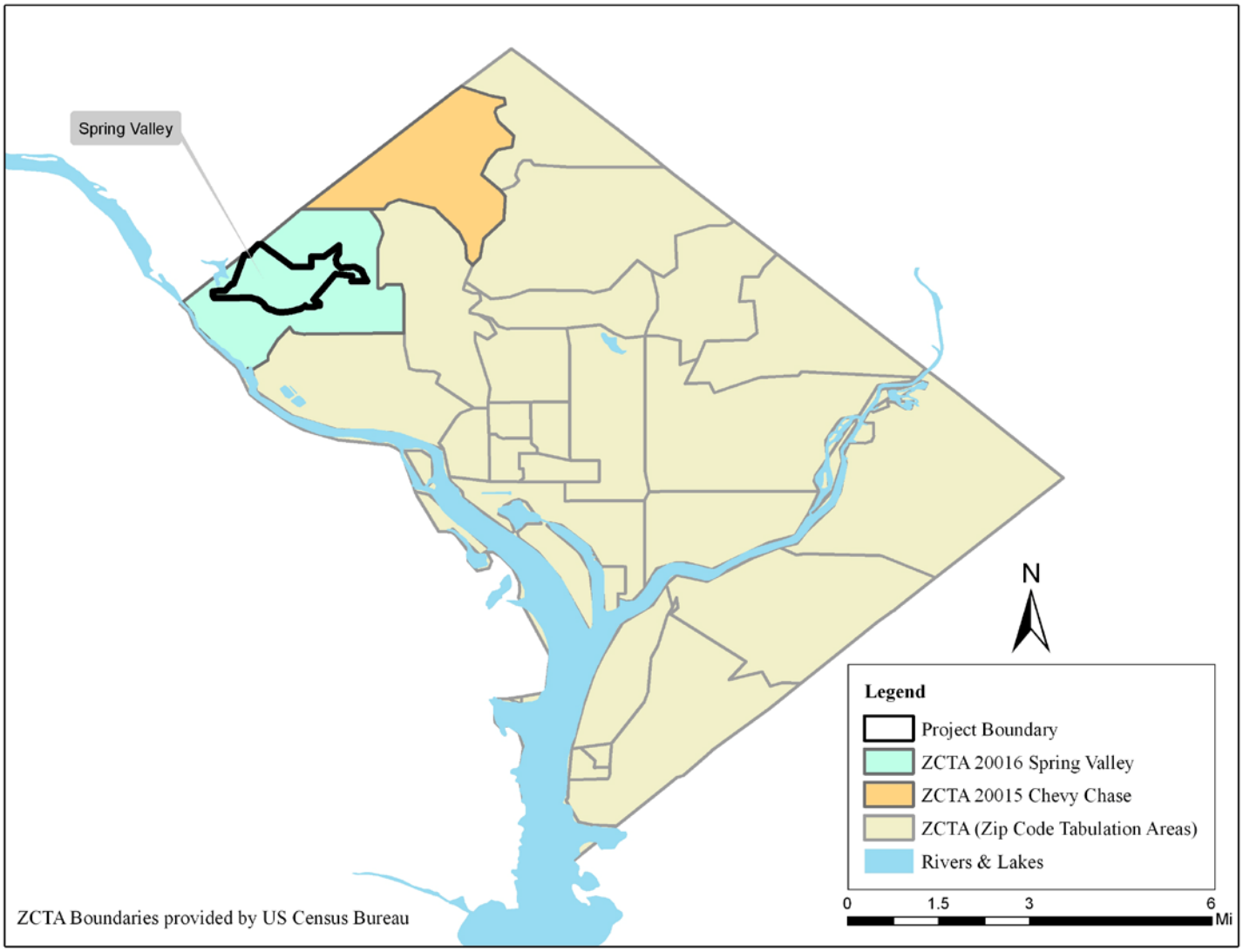
These findings are consistent with those from previous studies done by ATSDR and DCDOH and should provide reassurance to the Spring Valley community. These findings support continued remedial activities, monitoring, and evaluation of potential exposures and health outcomes in the community. The study was limited to the available environmental monitoring data, and community level reportable health outcome data. It was beyond the scope of the study to evaluate individual health outcomes and exposures. Similarly, the study could not consider past community exposures over the 90 years since active weapons testing at the site.

[6] http://www.nab.usace.army.mil/Projects/Spring%20Valley/Other/HopkinsHealthStudy.pdf

Community Health Supplement B1 - Census tracts corresponding to descriptive health analysis of selected causes of cancer
Spring Valley census tracts: 801, 901, 1001, 1002
Chevy Chase census tracts: 1100, 1401, 1402, 1500



Community Health Supplement B2 - ZIP Codes corresponding to descriptive health analysis of the top 15 causes of mortality



Community Health Supplement C – Top 15 Causes of Mortality for 2004-07, 2008-10

Table C1. Annual Average Age-Adjusted Mortality Rates per 100,000 for Spring Valley (ZIP Code 20016), Chevy Chase (ZIP Code 20015) (2004-2007) and US 2006 whites and all races.

Top 15 Causes of Death	20016 04-07 (CI)	20015 04-07 (CI)	US Whites 2006	US All 2006	SV/US Ratio	CC/US Ratio
Diseases of Heart	244.0 (232.0, 255.0)	250.0 (235.0, 264.0)	225.5	211.0	1.16	1.18
Malignant Neoplasms	↑ 105.0 (97.0, 113.0)	↓ 83.0 (7.4, 91.0)	199.3	187.0	0.56	0.44
Cerebrovascular Diseases	15.0 (13.0, 18.0)	20.0 (16.0, 24.0)	47.9	45.8	0.33	0.44
Chronic Lower Respiratory Diseases	15.0 (12.0, 18.0)	11.0 (8.0, 14.0)	47.5	41.6	0.36	0.26
Accidents	↓ 10.0 (8.1, 13.0)	↑ 18.1 (13.7, 22.5)	42.9	40.6	0.25	0.45
Diabetes Mellitus	5.2 (3.5, 6.8)	5.3 (3.1, 7.4)	23.6	24.2	0.21	0.22
Influenza and Pneumonia	9.6 (7.4, 12.0)	6.6 (4.6, 8.6)	20.4	18.8	0.51	0.35
Alzheimer's Disease	21.0 (17.0, 24.0)	20.0 (16.0, 24.0)	27.7	24.2	0.87	0.83
Nephritis, nephrotic syndrome, nephrosis	3.7 (2.3, 5.1)	2.7* (1.4, 4.1)	14.8	15.1	0.25	0.18
Septicemia	3.1 (1.9, 4.4)	3.8 (2.3, 5.4)	11.3	11.4	0.27	0.33
Intentional Self-harm (Suicide)	2.2* (0.9, 3.5)	2.4* (0.7, 4.0)	12.4	11.1	0.20	0.22
Chronic Liver Disease and Cirrhosis	2.3* (1.1, 3.4)	0.5* (0.0, 1.1)	10.0	9.2	0.25	0.05
Essential Hypertension and Related Kidney Disease	↑ 13.0 (10.0, 15.0)	↓ 4.9 (2.9, 6.9)	7.5	8.0	1.63	0.61
Parkinson's Disease	↑ 5.3 (3.5, 6.9)	↓ 1.6* (0.5, 2.8)	7.6	6.5	0.82	0.25
Assault (Homicide)	↑ 1.6* (0.5, 2.7)	↓ 0.0* (0.0, 0.0)	3.7	6.2	0.26	0.00

'*' Rates based on fewer than 5 deaths
'↓' Rate statistically different (lower) than comparison area
'↑' Rate statistically different (higher) than comparison area

Comparing Spring Valley and Chevy Chase (04-07)

- Rates for 10 of the 15 top causes of mortality are similar in Spring Valley and Chevy Chase.
- Rates for accidents are lower in Spring Valley (and higher in Chevy Chase).
- Rates for cancers, essential hypertension and related kidney disease, Parkinson's Disease and homicide are higher in Spring Valley (and lower in Chevy Chase)

Comparing study areas to the US overall (04-07)

- Rates for 13 of 15 top causes of death in Spring Valley are lower than US rates.
- Mortality rates for heart disease and essential hypertension and related kidney disease in Spring Valley are higher than US rates.
- 14 of 15 Chevy Chase rates are lower than US rates.
- Deaths from heart disease in Chevy Chase are higher than the US rate.

Table C2. Annual Average Age-Adjusted Mortality Rates per 100,000 for Spring Valley (ZIP Code 20016), Chevy Chase (ZIP Code 20015) (2008-2010) and US 2008 whites and US 2008 all races.

Top 15 Causes of Death	SV 08-10 (CI)	CC 08-10 (CI)	US Whites 2008	US All 2008	SV/US Ratio	CC/US Ratio
Diseases of Heart	↓ 111.0 (102.0, 119.0)	↑ 150.0 (138.0, 162.0)	217.1	186.5	0.60	0.80
Malignant Neoplasms	139.0 (129.0, 150.0)	151.0 (136.0, 165.0)	198.1	175.3	0.79	0.86
Cerebrovascular Diseases	22.0 (18.0, 26.0)	23.0 (18.0, 27.0)	46.2	40.7	0.54	0.57
Chronic Lower Respiratory Diseases	20.0 (17.0, 24.0)	27.0 (21.0, 33.0)	53.1	44.0	0.45	0.61
Accidents	13.0 (9.8, 16.0)	21.0 (15.0, 27.0)	43.1	38.8	0.34	0.54
Diabetes Mellitus	5.6* (3.5, 7.8)	9.2 (6.0, 12.0)	22.8	21.8	0.26	0.42
Influenza and Pneumonia	11.0 (8.3, 14.0)	12.0 (8.3, 15.0)	20.0	16.9	0.65	0.71
Alzheimer's Disease	26.0 (22.0, 30.0)	24.0 (19.0, 29.0)	31.1	24.4	1.07	0.98
Nephritis, nephrotic syndrome, nephrosis	4.4 (2.6, 6.2)	8.5 (5.5, 12.0)	15.6	14.8	0.30	0.57
Septicemia	4.6 (2.7, 6.5)	4.6 (2.6, 6.7)	11.7	11.1	0.41	0.41
Intentional Self-harm (Suicide)	6.0 (3.5, 8.4)	5.2* (1.5, 9.0)	13.3	11.6	0.52	0.45
Chronic Liver Disease and Cirrhosis	↓ 2.6* (1.1, 4.2)	↑ 9.7 (5.4, 14.0)	10.7	9.2	0.28	1.05
Essential Hypertension and Related Kidney Disease	↓ 1.2 (0.3, 2.0)	↑ 5.8 (3.2, 8.4)	8.1	7.7	0.16	0.75
Parkinson's Disease	5.4 (3.2, 7.6)	7.6 (4.9, 10.0)	7.9	6.4	0.84	1.19
Assault (Homicide)	↓ 0.0 (0.0, 0.0)*	↑ 7.3 (4.1, 11.0)	3.6	5.9	0.00	1.24

'*' Rates based on fewer than 5 deaths
↓ Spring Valley rate statistically different (lower) than Chevy Chase
↑ Chevy Chase rate statistically different (higher) than Spring Valley

Comparing Spring Valley and Chevy Chase (08-10)

- Rates for 11 of the 15 top causes of mortality are similar in Spring Valley and Chevy Chase.
- Rates for heart diseases, chronic liver disease and cirrhosis, essential hypertension and related kidney disease and homicide are lower in Spring Valley (and higher in Chevy Chase).

Comparing study areas to the US overall (08-10)

- Rates for 14 of 15 top causes of death in Spring Valley are lower than US rates.
- Mortality rates for Alzheimer's Disease in Spring Valley are higher than US rates.
- 13 of 15 Chevy Chase rates are lower than US rates.
- Deaths from Parkinson's Disease and homicide in Chevy Chase are higher than US rates.

Community Health Supplement D - Data presented below are plotted in Figures 4 – 7 of the community health report

Table D-1 Age-adjusted Bladder Incidence Rates per 100,000 for the Study Areas and US, 1994-2009

Year	Spring Valley	Chevy Chase	US
1994	7.9	35.8	20.8
1995	3.4	6.2	20.7
1996	7.2	12.6	20.8
1997	21.3	2.9	21.1
1998	0	19.3	21.6
1999	11.9	12.8	21.8
2000	11.3	4.2	21.8
2001	31.2	10.6	21.7
2002	12.4	15.6	21.2
2003	20.0	11.8	21.5
2004	11.6	4.8	21.4
2005	21.7	3.8	21.8
2006	4.3	8.5	21.2
2007	29.0	16.3	21.7
2008	18.9	8.8	21.0
2009	2.6	22.0	20.5

Table D-2 Age-adjusted Lung and Bronchus Incidence Rates per 100,000 for the Study Areas and US, 1994-2009

Year	Spring Valley	Chevy Chase	US
1994	35.6	50.6	67.2
1995	25.7	28.2	66.8
1996	26.8	30.6	66.4
1997	28.7	28.4	66.6
1998	30.8	52.0	67.5
1999	23.2	24.4	65.8
2000	33.3	12.4	64.1
2001	46.3	12.7	64.1
2002	66.9	13.7	63.9
2003	33.3	13.8	64.5
2004	15.3	4.3	62.0
2005	21.7	21.1	62.6
2006	47.2	57.4	61.9
2007	32.9	33.4	61.4
2008	39.1	19.6	59.6
2009	22.2	26.3	58.8

Table D-3 Age-adjusted Lung and Bronchus Mortality Rates per 100,000 for the Study Areas and US, 1994-2009

Year	Spring Valley	Chevy Chase	US
1994	8.3	21.7	58.5
1995	4.1	15.9	58.4
1996	8.9	20.2	57.9
1997	11.5	7.4	57.5
1998	14.4	23	57.1
1999	15.1	25.8	55.4
2000	1.3	21.7	55.9
2001	35.0	3.4	55.3
2002	8.1	5.1	55.0
2003	29.8	6.3	54.2
2004	12.1	0	53.4
2005	17.0	11.1	52.9
2006	30.4	29.6	51.8
2007	51.9	18	50.7
2008	22.1	48.3	49.6
2009	23.6	27.6	48.5

Table D-4 Age-adjusted Lymphoma Mortality Rates per 100,000 for the Study Areas and US, 1994-2009

Year	Spring Valley	Chevy Chase	US
1994	3.4	4.3	9.19
1995	0	4.8	9.27
1996	0	9.3	9.28
1997	13.6	0	9.41
1998	0	4.3	9.17
1999	3.7	4.2	8.83
2000	0	0	8.63
2001	10.1	15.6	8.37
2002	17.5	0	8.1
2003	11.7	4.1	7.82
2004	3.7	0	7.49
2005	0	24.4	7.33
2006	12.1	1.8	7.15
2007	2.6	10.1	6.96
2008	10.8	1.8	6.74
2009	2.5	12.8	6.65