Secondary Analysis of Delaware's Census Tracts with Elevated All-Site Cancer Rates in 2004-2008,
April, 2013

In April, 2013, the Delaware Division of Public Health (DPH) released its annual Cancer Incidence & Mortality Report, 2005 - 2009. This report includes updated cancer statistics for the two most recently available five-year time periods, 2004-2008 and 2005-2009. As part of the report, and in accordance with Delaware legislation, DPH calculated both 2004-2008 and 2005-2009 all-site cancer incidence rates for each of Delaware's census tracts. This report summarizes the 2004-2008 cancer incidence analyses of the census tracts.

In Delaware, all-site cancer incidence rates measure the overall cancer burden for an area over a five-year time period. Cancer incidence rates are calculated by dividing the total number of cancer cases in an area by the total number of people living in that area and are expressed as the average annual number of new cases diagnosed per year per 100,000 people. Since Census 2010 population data were available, DPH was able to compute census tract population totals for the intervening years 2001-2009 by extrapolating between the Census 2000 and Census 2010 population estimates. As of the 2010 Census, Delaware was reorganized into 214 census tracts, rather than the 197 tracts in effect as of the Census 2000.

The all-site cancer incidence rate for each census tract was compared to the all-site cancer incidence rate for Delaware as a whole. DPH used standard statistical procedures to determine if the difference between each census tract rate and the state rate reached the threshold of statistical significance. If a census tract rate is significantly different from the state rate, the difference between the rates would be interpreted as statistically significant; i.e. "larger than would be expected by chance alone" or "smaller than would be expected by chance alone." If a census tract rate is not significantly different from the state rate, it is interpreted as "no meaningful difference" between the two rates.

Results for 2004-2008 show that:

> In 11 of Delaware's 214 census tracts, the overall cancer incidence rate was statistically significantly higher than Delaware's average 2004-2008 incidence rate (515.6 per 100,000).

> In 17 census tracts, the overall cancer incidence rate was significantly lower than Delaware's average incidence rate (515.6 per 100,000).

Secondary Analysis of Elevated Census Tracts for 2004-2008

DPH analyzed cancer data within each of the 11 elevated census tracts to determine the local need for screening and prevention services. Further, unique patterns could suggest an environmental, occupational or other unusual cause.   The following analyses were conducted on the census tracts with elevated all-site cancer incidence:
> Sex distribution
> Age at diagnosis
> Types of cancers elevated
> Cancers with suspected environmental or chemical etiology

Sex Distribution of Cases for 2004-2008

To determine if the elevated overall cancer rate in a census tract affected males and females differently, age-adjusted all-site cancer incidence rates were calculated separately by sex for each of the 11 census tracts. Male-

and female-specific rates for each census tract were compared to those at the state level. The 11 census tracts fell into one of the following four categories compared to Delaware as a whole:

> Three census tracts (27%) had a significantly elevated all-site cancer incidence rate <u>for both males and females</u>.
> Two census tracts (18%) had a significantly elevated all-site cancer incidence rate <u>for males only</u>.
> Three census tracts (27%) had a significantly elevated all-site cancer incidence rate <u>for females only</u>.

Three census tracts (27%) did not have a significantly elevated all-site cancer incidence rate for either males or females. Rather, minor (non-significant) elevations in the male and female cancer rates produced a significantly-elevated overall cancer rate for both sexes combined.

Age at Diagnosis of Cases for 2004-2008

Median age of diagnosis for all cancer cases diagnosed during 2004-2008 in Delaware was 66. In other words, half of all Delawareans diagnosed with cancer during this time period were younger than 66 years; the other half were older than 66 years. The median age of cancer cases in each census tract was compared to the median age of cancer cases at the state level for the same time period. A younger median age at diagnosis in the census tract could suggest a unique exposure, such as from the environment or an occupation. Statistical significance was determined by the "sign test." Of the 11 census tracts analyzed:

> Three census tracts (27%) had a significantly <u>lower median age</u> at diagnosis.
> No census tract had a significantly <u>higher median age</u> at diagnosis.

Eight census tracts (73%) had a median age at diagnosis that did not differ significantly from the state's median age at diagnosis.

Number of Significantly Elevated Cancer Types for 2004-2008

Cancer is a generic term used to describe more than 100 different diseases. For each of the census tracts with a significantly elevated all-site cancer incidence rate, incidence rates were calculated for the 24 most-commonly diagnosed cancers. These analyses helped to determine which specific cancers, if any, contributed to the higher-than-expected overall cancer rate. Results are as follows:

- Three census tracts (27%) did not have any cancer type that was significantly elevated.
- One census tract (9%) had <u>one</u> specific cancer type that was significantly elevated.
- Two census tracts (18%) had <u>two</u> specific cancer types that were significantly elevated.
- Five census tracts (45%) had <u>three</u> specific cancer types that were significantly elevated.

None of the 11 census tracts had significantly elevated incidence rates for more than three specific cancer types.

Types of Cancers Elevated for 2004-2008

Although these 11 census tracts had a significantly elevated all-site cancer incidence rate during 2004-2008, it is important to note that these census tracts were not elevated for every individual cancer type. The higher-than-expected cancer incidence rates are confined to specific cancer types. Figure 1 shows which cancer types were significantly elevated within the 11 census tracts analyzed in this report. Note that the frequencies in the figure sum to more than 11 because seven of the census tracts under review had two or more cancer types that were significantly elevated.

Figure 1. Number of Occurrences of Elevated Cancer within Consistently Elevated Census Tracts by Cancer Type, Delaware 2004-2008
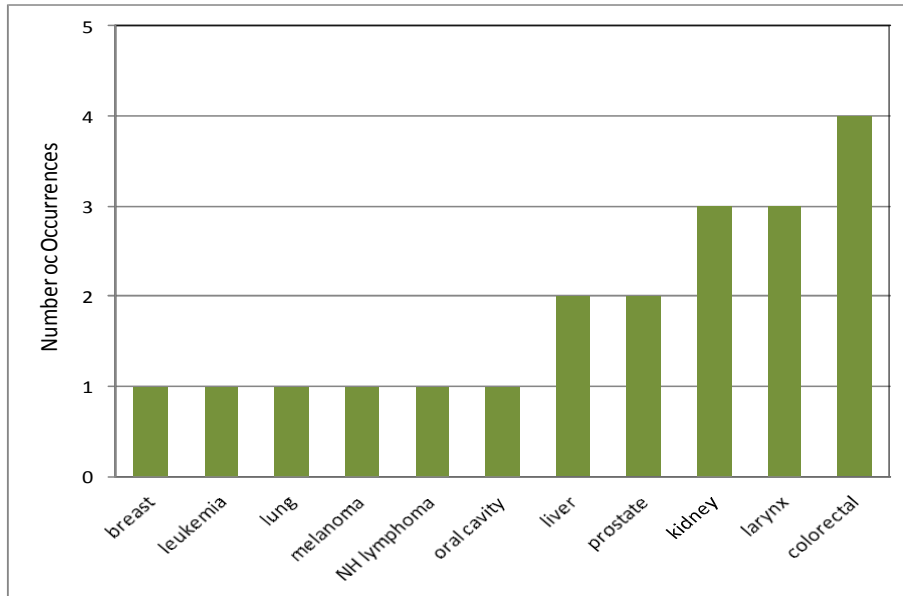
Colorectal cancer, the most frequently-elevated cancer in these 11 census tracts, as well as breast and prostate cancers, can be detected in their early stages via reliable screening tests (i.e. colonoscopy/sigmoidoscopy, mammogram, and prostate-specific antigen (PSA) test). Research has identified a primary modifiable risk factor, tobacco use, for lung cancer, elevated in one census tract, and laryngeal cancer, elevated in three census tracts. Approximately 87 percent of lung cancers are known to be caused by smoking cigarettes, cigars or pipes.[1]

With the exception of liver cancer, the most-commonly elevated cancer types shown in Figure 1 are those believed not to be caused by environmental risk factors. For example, colorectal cancer was significantly elevated in four of the 11 census tracts under review. Two census tracts had a significantly elevated rate of prostate cancer. One of the census tracts had a significantly elevated lung cancer rate and cancer of the larynx was elevated in three census tracts.

When a census tract has an elevated rate for a cancer type with many risk factors, it is difficult to pinpoint any single causal factor. Rather, the elevated cancer rate is likely due to a mix of non-modifiable, modifiable or unidentified risk factors. Adding to the complexity is that the interaction of several risk factors may increase a person's cancer risk more than the sum of the individual risk factors. For example, the American Cancer Society cites 19 substantiated risk factors for breast cancer alone: 12 of these risk factors are non-modifiable (e.g., age, family history); the remaining seven are modifiable (e.g., lack of exercise, being overweight/obese). The impact of other potential breast cancer risk factors is still under scientific review.

Cancer sites with environmentally-suspected cause(s) for 2004-2008

The Delaware Cancer Consortium identified seven cancer types with substantiated environmental risk factors:
                brain/central nervous system cancer

---

[1] U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health. (2004). The Health Consequences of Smoking: A report of the Surgeon General. Washington, D.C.

> Hodgkin lymphoma
> leukemia
> liver cancer
> non-Hodgkin lymphoma
> thyroid cancer
> urinary bladder cancer

It is important to note that while these seven malignancies have been known to be associated with environmental risk factors, they may also be related to modifiable risk factors. For example, in addition to chemical exposures in the manufacturing of dyes, rubber and leather, tobacco use is the primary risk factor for bladder cancer.

Among the 11 census tracts, results related to these seven cancer types are:
- One census tract (9%) had significantly elevated rates for <u>two</u> of the seven cancer types with substantiated environmental risk factors.
- Two census tracts (18%) had significantly elevated rates for <u>one</u> of the seven cancer types with substantiated environmental risk factors.
- Eight census tracts (72%) did not have a significantly elevated rate for any of the seven cancer types with substantiated environmental risk factors.

Of the seven cancers with environmentally–suspected causes,
> Liver cancer was elevated among females in two census tracts (131.00 and 139.02).
> Leukemia was elevated in census tract 131.00 among males and females combined.
> Non-Hodgkin lymphoma was elevated among males in census tract 428.00.

While some of the elevated cancer types in these census tracts were those with environmental risk factors, some cancer types without these risk factors were also higher compared to the state average. These may simply be statistical aberrations resulting from the very small number of cancer cases in these communities, or, especially when combined with unusual sex and age distributions, there may be underlying occupational or environmental causes. Further investigation of these concerns cannot be conducted with data routinely collected by DPH.

In Table 1 is a summary of the results of secondary analyses for the 11 census tracts that were significantly elevated for all cancer sites combined during 2004-2008.

Known risk factors associated with the cancer types that are elevated in these secondary analyses are in Table 2.

DPH will work with communities to address risk factors for the elevated cancer types and address any concerns. In summary, DPH will:
> Educate residents about findings in this report.
> Seek guidance from the Environment Committee of the Delaware Cancer Consortium regarding the policy implications of this report.
> Ensure awareness of and access to screening and prevention services, including promotion of healthy lifestyles that decrease risk of cancer.
> Address environmental and occupational concerns of residents or other agencies, including exploration of possible known sources of environmental carcinogens.
> Where appropriate, collect and analyze additional information, as feasible.

Table 1. Characteristics of 11 Census Tracts with Statistically Significantly Elevated Cancer Rates: Delaware, 2004-2008

Census Tract	Ave. Cases / year	All-Site Age-Adjusted Cancer Incidence Rates per 100,000, 2004-2008[2]				Significantly Elevated Cancer Site(s) and Sex[3]	Median Age at Diagnosis		Area(s) of Concern
			All	**Male**	**Female**		**DE**	**CT**[4]	
6.02	21	DE	515.1	611.4	443.3	Colorectal - M Larynx - M Prostate - M	66	68	Sex distribution Screening Prevention
		CT	*683.4*	*1070.7*	441.9				
131.00	19	DE	515.1	611.4	443.3	Colorectal - All *Leukemia - All* *Liver - F*	66	68	Sex distribution Screening Prevention Cancer type
		CT	*664.0*	652.8	*720.7*				
139.01	18	DE	515.1	611.4	443.3	Kidney - F *Liver - F* Lung - M	66	*62*	Cancer type Prevention
		CT	*668.6*	755.3	596.4				
156.00	19	DE	515.1	611.4	443.3	none	66	*63*	Sex distribution
		CT	*697.8*	743.1	*648.2*				
421.00	29	DE	515.1	611.4	443.3	none	66	66	
		CT	*683.0*	*841.8*	*586.1*				
428.00	44	DE	515.1	611.4	443.3	Larynx - M *Non-Hodgkin lymphoma-M*	66	*63.5*	Prevention Cancer type
		CT	*658.1*	*783.4*	*557.4*				
501.05	30	DE	515.1	611.4	443.3	Kidney - All	66	66.5	Prevention
		CT	*622.4*	700.4	572.6				
503.02	28	DE	515.1	611.4	443.3	Breast – F Oral cavity - F	66	64	Sex distribution Screening Prevention
		CT	*633.4*	679.4	*591.9*				
507.01	29	DE	515.1	611.4	443.3	None	66	66	
		CT	*628.5*	697.9	571.6				
513.02	25	DE	515.1	611.4	443.3	Colorectal - All Kidney - M Melanoma - All	66	68	Sex distribution Screening Prevention
		CT	*649.2*	*793.7*	530.2				
517.01	28	DE	515.1	611.4	443.3	Colorectal - M Larynx - M Prostate - M	66	67	Screening Prevention
		CT	*999.7*	*1418.9*	*750.5*				

[2] Age-adjusted incidence rate in bold and italics indicates that the census tract rate is significantly elevated compared to the state rate.

[3] A cancer type in bold and italics represents one of the seven cancer types considered by the Delaware Cancer Consortium to have environmentally-substantiated risk factors.

[4] A median age at diagnosis in bold and italics indicates that the census tract's median age at diagnosis is significantly lower than that of the state.

April 23, 2013

Table 2. Known Risk Factors among Elevated Cancer Types, 2004-2008[5]

Cancer Type	Known Risk Factors
breast	age - increasing, alcohol abuse, family history, genetic mutations, benign breast conditions, early menarche, hormone therapy, high-fat diet, recent birth control pills, smoking (cigarettes, cigars or pipes), secondhand smoke
colon/rectum	age 50 and older, alcohol abuse, diabetes – type 2, family history, high-fat diet, history of bowel disease, physical inactivity, smoking (cigarettes, cigars or pipes), overweight or obesity
kidney	advanced kidney disease w long-term dialysis, cigar or cigarette smoking, family history, gender – male, hypertension, certain medications, overweight or obesity, workplace exposures
larynx	alcohol abuse, combined alcohol and tobacco use, diet , gastroesophageal reflux disease, gender – male, genetic syndromes, human papilloma virus, poor nutrition, secondhand smoke, smoking (cigarettes, cigars or pipes),workplace exposure
leukemia	alcohol abuse, blood disorders, chemical exposure, chemotherapy, cigarette smoking, diet, genetic conditions, ionizing radiation, ultraviolet light
liver	alcohol abuse, arsenic in drinking water, cirrhosis of liver, diabetes – type 2, genetics, infection with hepatitis B or hepatitis C virus, obesity, race – Asian American or Pacific Islander, steroids, viral hepatitis, workplace exposures
lung	asbestos, diet low in fruits and vegetables, family history, radiation therapy, radon exposure, secondhand smoke, smoking (cigarettes, cigars or pipes), tuberculosis, workplace exposures
melanoma	excessive ultraviolet light, fair skin, family history, having many moles, history of sunburn before age 20, increasing age, race – Caucasian, weakened immune system
non-Hodgkin lymphoma	autoimmune diseases, certain infections, chemotherapy (alkylating agents), diet high in fat and meats, exposure to benzene race – Caucasian, radiation, weakened immune system
oral cavity	alcohol abuse, diet low in fruits and vegetables, gender – male, genetic syndromes, heavy drinking and smoking, human papilloma virus, poor nutrition, smoking (cigarettes, cigars or pipes), snuff or chewing tobacco, ultraviolet light (lip cancer)
prostate	African American race, age – over 50, diet high in red meat and high-fat dairy, ethnicity - non-Hispanic, family history, gene mutations, inherited DNA changes, obesity, workplace exposures

---

[5] Listed in alphabetical order, not by priority or magnitude of impact.