Secondary Analysis of Delaware's Census Tracts with Elevated Overall Cancer Rates in 2006–2010, February 2014

In December 2013, the Delaware Division of Public Health (DPH) released its annual *Cancer Incidence & Mortality (I&M) Report, 2006 – 2010.* In accordance with Delaware legislation, DPH calculated 2006–2010 overall cancer incidence rates for each of Delaware's census tracts and these results are included in the 2006-2010 I&M Report. This report summarizes the secondary analyses for census tracts with a significantly elevated overall cancer rate in 2006–2010.

In Delaware, overall cancer incidence rates measure the total 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 overall cancer incidence rate for each of Delaware's census tracts was compared to the overall cancer incidence rate for the entire state. 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: "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.

There is an inherent instability in calculating cancer incidence rates at the census tract level. In a small group, such as a census tract, the snapshot changes considerably from year to year. If one case of cancer is diagnosed in a census tract one year, and three cases of cancer are diagnosed in the same census tract the next year, the cancer rate for that census tract will change dramatically from one year to the next. These large fluctuations do not typically occur in larger populations. If we compare the cancer rate for a census tract to the cancer rate for the whole state of Delaware for a given time period, it would not be unusual to find the comparison different (perhaps even reversed) in the following time period.

When assessing cancer incidence data by census tract, it should be kept in mind that the occurrence of cancer may differ across census tracts for a variety of reasons. For example, lifestyle behaviors may cluster in a homogeneous community. In addition, the presence or absence of exposure to environmental or occupational carcinogen(s) is often limited to a defined geographic area. In addition, residents in certain geographic areas may be more impoverished than other residents, which will affect their availability of health insurance coverage as well as their level of access to health care, particularly cancer screening services. Finally, chance or random variation can play a role, since approximately five percent of all comparisons would be significantly different due to chance alone.

Results for 2006–2010 show that:

- In 11 of Delaware's 214 census tracts, the overall cancer incidence rate was statistically significantly higher than Delaware's average 2006–2010 incidence rate (511.1 per 100,000).
- In 11 census tracts, the overall cancer incidence rate was significantly lower than Delaware's average 2006-2010 incidence rate (511.1 per 100,000).

Secondary Analysis of Elevated Census Tracts for 2006–2010

DPH analyzed cancer data within each of the 11 elevated census tracts to determine unique patterns which could suggest an environmental, occupational, or other unusual cause. The following analyses were conducted on census tracts with an elevated overall cancer incidence:

- Sex distribution
- Age at diagnosis
- Types of cancers elevated
- Cancer sites with environmentally suspected cause(s)

Sex Distribution of Cases for 2006–2010

To determine if the elevated overall cancer rate in a census tract affected males and females differently, age-adjusted overall 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 the state of Delaware:

- One census tract (9%) had a significantly elevated overall cancer incidence rate for both males and females.
- Seven census tracts (64%) had a significantly elevated overall cancer incidence rate for males only.
- Two census tracts (18%) had a significantly elevated overall cancer incidence rate for females only.
- One census tract (9%) did not have a significantly elevated overall cancer incidence rate for either males or females. Rather, minor (i.e.; not statistically significant) elevations in male and female cancer rates produced a significantly elevated overall cancer rate for both sexes combined.

Age at Diagnosis of Cases for 2006–2010

The median age of diagnosis for all cancer cases diagnosed during 2006–2010 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 65 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 lower median age at diagnosis than the state's median age at diagnosis.
- No census tract had a significantly higher median age at diagnosis than the state's median age 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 2006–2010

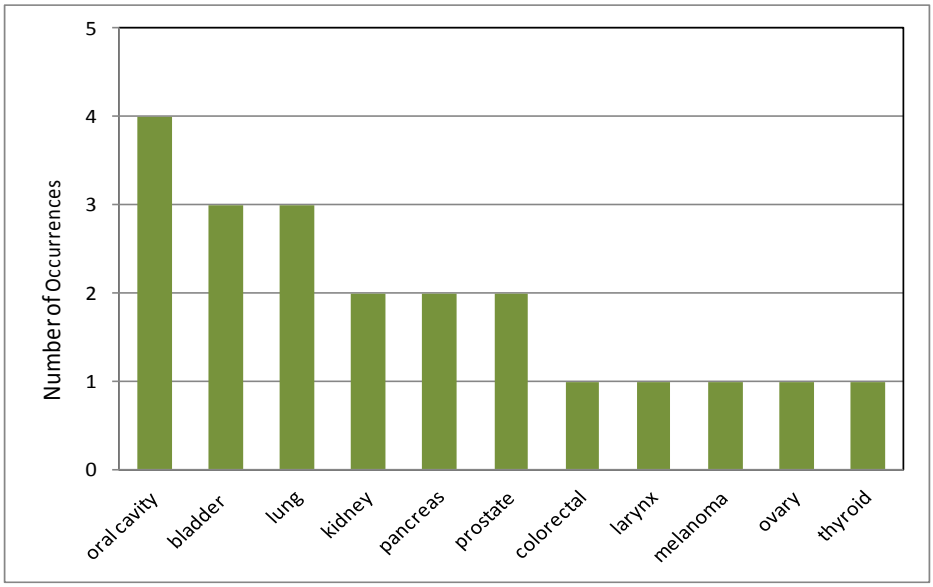
Cancer is a generic term used to describe more than 100 different diseases. For each of the census tracts with a significantly elevated overall cancer incidence rate, incidence rates were calculated for the 24 most commonly diagnosed cancers. These analyses helped to determine which cancers, if any,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

- One census tract (9%) did not have any cancer type that was significantly elevated.
- Four census tracts (36%) had one cancer type that was significantly elevated.
- Three census tracts (27%) had two cancer types that were significantly elevated.
- One census tract (9%) had three cancer types that were significantly elevated.
- Two census tracts (18%) had four cancer types that were significantly elevated.

Types of Cancers Elevated for 2006–2010

Although 11 of Delaware's 214 census tracts had a significantly elevated overall cancer incidence rate during 2006–2010, 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 several cancer types. Figure 1 below shows which cancer types were most often significantly elevated within the 11 census tracts analyzed in this report. Note that the frequencies in Figure 1 sum to 21 because six of the 11 census tracts under review had two or more cancer types that were significantly elevated.

Figure 1. Number of Occurrences of Elevated Cancer Types within Eleven Census Tracts, Delaware 2006–2010



SOURCE: Delaware: Delaware Cancer Registry, Delaware Division of Public Health, 2013.

Oral cancer is the most frequently elevated cancer in these 11 census tracts. Cancers of the urinary bladder and lung are each elevated in three of the 11 census tracts. Kidney, pancreas and prostate cancers are each elevated in two census tracts. Cancers of the colon/rectum, larynx and ovary, and malignant melanoma are each elevated in one census tract.

Risk factors for the cancers that were elevated in one or more of the 11 census tracts are listed in Table 1. 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 2006–2010

The Delaware Cancer Consortium identified seven cancer types with substantiated environmental risk factors:

- brain/central nervous system cancer
- 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:

- Four census tracts (36%) had significantly elevated rates for **one** of the seven cancer types with substantiated environmental risk factors.
- Seven census tracts (64%) 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:

- Thyroid cancer was elevated among males in census tract 421.00.
- Urinary bladder cancer was elevated among males in census tracts 401.00 and 428.00; and among all in census tract 518.01.

While some of the elevated cancer types in these census tracts were those with environmental risk factors, some other cancer types without these risk factors were also significantly 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.

Table 1 summarizes results of secondary analyses for the 11 census tracts that were significantly elevated for all cancer sites combined during 2006–2010.

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

Table 3 displays census tracts that are consistently elevated over two or more of the six five-year time periods from 2001-2005 through 2006-2010. Census tracts that were added based on 2006-2010 results are highlighted in yellow.

Table 1. Characteristics of Eleven Census Tracts with Statistically Significantly Elevated Cancer Rates; Delaware, 2006–2010

Census Tract	Avg. Cases / year	Overall Age-Adjusted Cancer Incidence Rates per 100,000, 2006–2010[1]				Significantly Elevated Cancer Site(s) and Sex[2]	Median Age at Diagnosis		Area(s) of Concern
							DE	CT[3]	
159.00	26		**All**	**Male**	**Female**	Kidney – M	66	68	Prevention Sex distribution
		DE	511.1	599.8	443.5				
		CT	***685.6***	***816.1***	573.0				
163.01	33		**All**	**Male**	**Female**	Oral cavity – All	66	***64***	Prevention Screening Sex distribution
		DE	511.1	599.8	443.5				
		CT	***661.9***	***804.0***	557.5				
401.00	39		**All**	**Male**	**Female**	Colorectal – M Lung – M Pancreas – M ***Urinary bladder–M***	66	65	Cancer type Prevention Screening Sex distribution
		DE	511.1	599.8	443.5				
		CT	***660.3***	***883.6***	536.4				
417.01	44		**All**	**Male**	**Female**	none	66	68	Prevention Sex distribution
		DE	511.1	599.8	443.5				
		CT	***631.4***	***760.3***	528.5				
421.00	29		**All**	**Male**	**Female**	***Thyroid – M***	66	67	Cancer type Prevention Sex distribution
		DE	511.1	599.8	443.5				
		CT	***639.9***	721.3	***586.0***				
422.02	52		**All**	**Male**	**Female**	Lung – All Prostate	66	***63***	Prevention Screening Sex distribution
		DE	511.1	599.8	443.5				
		CT	***629.5***	***769.9***	506.6				
428.00	49		**All**	**Male**	**Female**	Kidney – F Larynx – All ***Urinary bladder – M***	66	65	Cancer type Prevention
		DE	511.1	599.8	443.5				
		CT	***670.9***	***768.8***	***591.2***				
501.03	35		**All**	**Male**	**Female**	Oral cavity – All Ovary	66	67	Prevention Sex distribution
		DE	511.1	599.8	443.5				
		CT	***620.6***	660.6	***570.1***				
504.01	28		**All**	**Male**	**Female**	Pancreas – All	66	66	Prevention Sex distribution
		DE	511.1	599.8	443.5				
		CT	***633.9***	***781.8***	485.0				
517.01	28		**All**	**Male**	**Female**	Melanoma – F Oral cavity – All	66	67	Prevention Screening
		DE	511.1	599.8	443.5				
		CT	***629.2***	751.5	541.4				
518.01	35		**All**	**Male**	**Female**	Lung – M Oral cavity – All Prostate ***Urinary bladder – All***	66	***64***	Cancer type Prevention Sex distribution
		DE	511.1	599.8	443.5				
		CT	***661.1***	***915.4***	449.0				

SOURCE: Delaware Cancer Registry, Delaware Division of Public Health, 2013.

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

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

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

Table 2. Known Risk Factors among Elevated Cancer Types, 2006–2010[4]

Cancer Type	Known Risk Factors
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 with 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
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
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)
ovary	age 63 and older, obesity, family history of ovarian, breast or colorectal cancer, personal history of breast cancer, never giving birth (risk decreases as number of children increases), estrogen therapy after menopause, inherited mutation in BRCA1 or BRCA2 genes, early start to menses or late menopause
pancreas	age 45 and older, gender – male, race – African American, family history, chronic pancreatitis (particularly in smokers), cigarette smoking (risk is two to three times higher among smokers), obesity, lack of physical activity, type 2 diabetes, heavy occupational exposure to petroleum and certain chemicals, pesticides and dyes
prostate	race – African American, age 50 and older, diet high in red meat and high-fat dairy, ethnicity – non-Hispanic, family history, gene mutations, inherited DNA changes, obesity, workplace exposures
thyroid	age 40–50 in women; age 60 and older in men, diet low in iodine, gender – female, genetic conditions, lack of iodine, race – Caucasian, radiation – environmental and medical
urinary bladder	age 55 and older, arsenic in drinking water, chemotherapy (alkylating agents), cigarette smoking, ethnicity – Hispanic, family history, gender – male, genetic syndromes, race – Caucasian, radiation therapy to bladder, workplace exposures

SOURCES: American Cancer Society (www.cancer.org) and National Cancer Institute (www.cancer.gov).

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

Table 3. Consistently Elevated Census Tracts by County and Time Period, Delaware**

County	Census Tract	2001–2005	2002–2006	2003–2007	2004–2008	2005–2009	2006–2010
Kent	417.01					X	X
	421.00				X	X	X
	428.00		X		X	X	X
New Castle	6.02	X	X	X	X		
	139.01	X	X	X	X		
	149.06	X	X				
	156.00			X	X	X	
	159.00					X	X
	160.00	X	X	X			
	163.01					X	X
	169.01	X	X	X			
	169.04	X	X	X			
Sussex	501.05			X	X	X	
	506.02	X	X				
	513.02	X	X	X	X		
	513.05	X	X				
	517.01			X	X		X

** – i.e.; two or more adjacent time periods with a significantly elevated overall cancer incidence rate.
Census tracts shaded in yellow indicate newly-added as of 2006-2010.
SOURCE: Delaware Cancer Registry, Delaware Division of Public Health, 2013.