



Secondary Analysis of Delaware's Census Tracts with Elevated Overall Cancer Rates in 2007-2011 (June 2015)

In June 2015, Delaware Health and Social Services, Division of Public Health (DPH) released its annual *Cancer Incidence and Mortality in Delaware (I&M) Report, 2007-2011*. In accordance with Delaware legislation, DPH calculated 2007-2011 overall cancer incidence rates for each of Delaware's census tracts and these results are included in the 2007-2011 I&M Report. This report summarizes the secondary analyses for the nine census tracts with a significantly elevated all-site (i.e., overall) cancer incidence rate for the 2007-2011 period (New Castle County: 148.10, 163.10; Kent County: 401.00, 418.01, 422.02, 428.00, 430.00; and Sussex County: 501.03, 504.01).

In Delaware, all-site 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. Rates are age-adjusted to the 2000 U.S. standard population and expressed as the average annual number of new cases diagnosed per year per 100,000 people. Census 2000 and Census 2010 data were used to interpolate census tract population totals for intervening years 2001-2009. Data for 2011 was extrapolated using the most recent Census 2010 data. Beginning with the 2010 Census, Delaware was divided into 214 census tracts. (Previously, Census 2000 had divided Delaware into 197 census tracts).

The 2007-2011 all-site cancer incidence rate for each of Delaware's 214 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 higher from the state rate, the difference between the rates is interpreted as "larger than would be expected by chance alone". If a census tract rate is significantly lower from the state rate, the difference is interpreted as "smaller than would be expected by chance alone". If a census tract rate is not significantly different from the state rate, the difference between the rates is interpreted as "not meaningfully different." Please refer to the 2007-2011 I&M Report for additional details pertaining to rate calculation methodology and testing for statistical significance.

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. This may affect their access to health care, including cancer screening services. Finally, chance or random variation can also influence whether a census tract's all-site cancer incidence



rate is significantly different from the overall state rate. Statistically-speaking, 5 percent of all numerical comparisons are significantly different due to chance alone.

Results for 2007-2011 show that:

- In nine of Delaware's 214 census tracts, the 2007-2011 all-site cancer incidence rates were statistically significantly higher than Delaware's 2007-2011 all-site cancer incidence rate (510.5 per 100,000).
- In 14 census tracts, the 2007-2011 all-site cancer incidence rates were significantly lower than Delaware's 2007-2011 incidence rate (510.5 per 100,000).

Secondary Analysis of Elevated Census Tracts for 2007-2011

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

- Sex distribution
- Age at diagnosis
- Types of cancers elevated
- Cancer sites with substantiated environmental risk factors

Sex Distribution of Cases for 2007-2011

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

- Zero census tracts (0 percent) had significantly elevated all-site cancer incidence rates for both males and females.
- Three census tracts (33 percent) had a significantly elevated all-site cancer incidence rate for males only.
- Three census tracts (33 percent) had a significantly elevated overall cancer incidence rate for females only.
- Three census tracts (33 percent) did not have a significantly elevated all-site 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 2007-2011

The median age of diagnosis for all cancer cases diagnosed during 2007-2011 in Delaware was 66. Therefore, 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. Of the nine census tracts analyzed:



- Six census tracts (66 percent) had a lower median age of diagnosis (range: 61-65 years) compared to the state’s median age at diagnosis (66 years).
- Two census tracts (22 percent) had a median age at diagnosis identical to the state’s median age at diagnosis (66 years).
- One census tract (11 percent) had a higher median age at diagnosis (67 years) compared to the state’s median age at diagnosis (66 years).

Significantly-Elevated Site-Specific Cancer Types for 2007-2011

Cancer is a generic term used to describe more than 100 different diseases. Although nine of Delaware’s 214 census tracts had a significantly elevated all-site cancer incidence rate for 2007-2011, it is important to note that these census tracts were not elevated for every individual cancer type. To investigate specific patterns of cancer diagnoses within the nine census tracts with elevated all-site cancer incidence rates, DPH calculated incidence rates 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 for the nine census tracts are as follows:

- One census tract (11 percent) did not have any cancer type that was significantly elevated.
- Three census tracts (33 percent) had one cancer type that was significantly elevated.
- Four census tracts (44 percent) had two cancer types that were significantly elevated.
- One census tract (11 percent) had three cancer types that were significantly elevated.

The higher-than-expected cancer incidence rates among the nine elevated census tracts were confined to 10 cancer types (Table 1, below). Note that the frequencies in Table 1 total 14 because five of the nine census tracts under review were significantly elevated for more than one cancer type.

Table 1. Number of Occurrences of Significantly-Elevated Site-Specific Cancer Types within the Nine Delaware Census Tracts with Elevated All-Site Cancer Incidence Rates, 2007-2011

Site-Specific Cancer Type	Number of Occurrences of Significantly Elevated Site-Specific Cancer Type
Kidney	2
Lung	2
Oral	2
Prostate	2
Colorectal	1
Hodgkin Lymphoma	1
Larynx	1
Liver	1
Non-Hodgkin Lymphoma	1
Pancreatic	1
TOTAL	14

SOURCE: Delaware Cancer Registry, Delaware Health and Social Services, Division of Public Health, 2015.

Kidney, lung, oral, and prostate cancers were significantly elevated in two of the nine census tracts under review. Colorectal, laryngeal, liver, and pancreatic cancers, as well as Hodgkin and non-Hodgkin lymphoma, were each significantly elevated in one of the nine census tracts under review.



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, and/or unidentified 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), and 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. 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 acting separately. For example, research shows that while alcohol use and tobacco use are both individual risk factors for laryngeal cancer, their joint effect is greater than the sum of the two risk factors acting separately (i.e., when they occur together, the two risk factors exert a multiplicative, rather than additive, effect).¹

Site-Specific Cancer Types with Environmentally-Based Risk Factors

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

- a. Brain/Central Nervous System (CNS) cancer
- b. Hodgkin lymphoma
- c. Leukemia
- d. Liver cancer
- e. Non Hodgkin lymphoma
- f. Thyroid cancer
- g. 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 nine census tracts, results related to these seven cancer types are as follows:

- One census tract (11 percent) had significantly elevated rates for **two** of the seven cancer types with substantiated environmental risk factors.
- One census tract (11 percent) had a significantly elevated rate for **one** of the seven cancer types with substantiated environmental risk factors.
- Seven census tracts (78 percent) 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 significantly-elevated among females in census tract 163.01.
- Hodgkin lymphoma was significantly-elevated among males and non-Hodgkin lymphoma was significantly elevated among females in census tract 430.00.

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

¹ Pelucchi, C., Gallus, S., Garavello, W., Bosettie, C., & La Vecchia, C. (2008). Alcohol and tobacco use, and cancer risk for upper aerodigestive tract and liver. *European Journal of Cancer Prevention*, 17(4), 340-4.



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 2 summarizes results of the secondary analyses for the nine census tracts that were significantly elevated for all-site cancer for the 2007-2011 time period. Table 3 summarizes substantiated risk factors for the 14 different site-specific cancers with significantly-elevated incidence rates among the nine census tracts under review. Table 4 displays census tracts that are consistently elevated over two or more of the seven five-year time periods from 2001-2005 through 2007-2011.



Table 2. Characteristics of the Nine Delaware Census Tracts with Statistically Significantly-Elevated 2007-2011 All-Site Cancer Incidence Rates

Census Tract (County)	Avg. Cases / year	Overall Age-Adjusted Cancer Incidence Rates per 100,000, 2007–2011**			Significantly Elevated Cancer Site(s) by Sex	Median Age at Diagnosis		Area(s) of Concern
		All	Male	Female		DE	CT	
Delaware	5,184	510.5	591.5	446.5				
148.10 (NCC)	36	610.8	740.3	518.4	<ul style="list-style-type: none"> • None 	66	61	<ul style="list-style-type: none"> • Prevention • Screening
163.01 (NCC)	33	638.0	695.8	594.3	<ul style="list-style-type: none"> • Liver: female only • Oral: male & female combined • Oral: male only 	66	64	<ul style="list-style-type: none"> • Prevention • Screening • Sex distribution • Cancer Type
401.00 (Kent)	41	637.7	812.7	521.6	<ul style="list-style-type: none"> • Colorectal: male & female combined • Colorectal: male only • Lung: male only 	66	65	<ul style="list-style-type: none"> • Prevention • Screening • Sex distribution
418.01 (Kent)	60	617.7	744.6	512.4	<ul style="list-style-type: none"> • Prostate 	66	65	<ul style="list-style-type: none"> • Prevention • Screening • Sex distribution
422.02 (Kent)	53	614.4	718.3	523.5	<ul style="list-style-type: none"> • Kidney: male & female combined • Kidney: female only • Prostate 	66	64	<ul style="list-style-type: none"> • Prevention • Screening • Sex distribution • Cancer Type
428.00 (Kent)	50	673.7	718.8	631.3	<ul style="list-style-type: none"> • Kidney: female only • Larynx: female only 	66	66	<ul style="list-style-type: none"> • Prevention • Screening • Sex distribution • Cancer Type
430.00 (Kent)	36	615.2	610.6	603.2	<ul style="list-style-type: none"> • Hodgkin Lymphoma: male only • Lung: male & female combined • Lung: male only • Non-Hodgkin Lymphoma: female only 	66	65	<ul style="list-style-type: none"> • Prevention • Screening • Sex Distribution • Cancer Type
501.03 (Sussex)	38	628.9	715.2	548.8	<ul style="list-style-type: none"> • Oral: male & female combined • Oral: male 	66	67	<ul style="list-style-type: none"> • Prevention • Screening
504.01 (Sussex)	28	633.8	750.6	513.7	<ul style="list-style-type: none"> • Pancreatic: male & female combined 	66	66	<ul style="list-style-type: none"> • Prevention

** Age-adjusted incidence rate in bold indicates that the census tract rate is significantly elevated compared to the state rate.

Note: NCC=New Castle County; CT=Census Tract

Rates are per 100,000 and age-adjusted to 2000 U.S. standard population

SOURCE: Delaware Cancer Registry, Delaware Health and Social Services, Division of Public Health, 2015.



Table 3. Known Risk Factors among Elevated Cancer Types, 2007-2011**

Cancer Type	Known Risk Factors
Colorectal	Age (50 and older), alcohol abuse, diabetes (type 2), family history, high-fat diet, history of bowel disease, overweight or obesity, physical inactivity, smoking (cigarettes, cigars, or pipes)
Hodgkin Lymphoma	Age (early adulthood (15-40 years) and later adulthood (after age 55)), family history, gender (male), HIV infection, previous occurrence of infectious mononucleosis (caused by the Epstein-Barr virus)
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, diet, gastroesophageal reflux disease, gender (male), genetic syndromes, human papilloma virus, poor nutrition, secondhand smoke, smoking (cigarettes, cigars, or pipes), workplace exposure
Liver	Alcohol use, anabolic steroid use, diabetes (type 2) gender (male), hepatitis B or C (chronic infection), liver cirrhosis, obesity, previous exposure to certain chemicals (including arsenic and vinyl chloride), race (especially Asian Americans and Pacific Islanders), tobacco use
Lung	Asbestos, diet low in fruits and vegetables, family history, radiation therapy, radon exposure, secondhand smoke, smoking (cigarettes, cigars, or pipes), tuberculosis, workplace exposures
Non-Hodgkin Lymphoma	Age (60 and older), certain autoimmune disorders (e.g., rheumatoid arthritis, lupus), chronic immune stimulation (e.g., H. pylori, hepatitis C), gender (male), immune system deficiency, overweight or obesity, previous exposure to radiation and certain chemicals (including benzene and certain herbicides and insecticides), race (Caucasian)
Oral	Alcohol abuse, diet low in fruits and vegetables, gender (male), genetic syndromes, human papilloma virus, poor nutrition, smoking (cigarettes, cigars, or pipes), snuff or chewing tobacco, ultraviolet light (lip cancer)
Pancreatic	Age (45 and older), chronic pancreatitis (particularly in smokers), cigarette smoking (risk is two to three times higher among smokers), diabetes (type 2), family history, gender (male), lack of physical activity, obesity, previous occupational exposure to petroleum and certain chemicals, pesticides and dyes, race (African American)
Prostate	Age (50 and older), diet high in red meat and high-fat dairy, ethnicity (non-Hispanic), family history, gene mutations, inherited DNA changes, obesity, race (African American)

**Cancer-specific risk factors are listed in descending alphabetical order and do not necessarily represent descending order of relative risk factor strength.

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



Table 4. Consistently-Elevated Delaware Census Tracts by County and Time Period, Delaware: 2001-2005 to 2007-2011**

County	Census Tract	2001-2005	2002-2006	2003-2007	2004-2008	2005-2009	2006-2010	2007-2011
Kent	417.01					X	X	
	421.00				X	X	X	
	428.00		X		X	X	X	X
New	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	X
	169.01	X	X	X				
	169.04	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	

**Two or more adjacent time periods with a significantly elevated overall cancer incidence rate.

SOURCE: Delaware Cancer Registry, Delaware Health and Social Services, Delaware Division of Public Health, 2015.

For questions or comments related to any information found in this report, please call the Delaware Comprehensive Cancer Control Program at 302-744-1020.

This report as well as the full *2007-2011 Delaware Cancer Incidence and Mortality Report* can be found at the following link: <http://www.dhss.delaware.gov/dhss/dph/dpc/cancer.html>