

SECONDARY ANALYSIS OF DELAWARE'S CENSUS TRACTS WITH ELEVATED ALL-SITE CANCER INCIDENCE RATES IN 2010-2014

(July 2018)

In July 2018, the Delaware Department of Health and Social Services (DHSS), Division of Public Health (DPH) released its annual *Cancer Incidence and Mortality in Delaware (I&M) Report, 2010-2014*. In accordance with Delaware legislation, DPH calculated 2010-2014 all-site cancer incidence rates for each of Delaware's 214 census tracts and these results are included in the 2010-2014 I&M Report. This report summarizes the secondary analyses for the 16 census tracts with a significantly elevated all-site cancer incidence rate for 2010-2014 (New Castle County: 29, 142.00, 149.03, 163.01, 166.04, 169.01; Kent County: 401.00, 402.03, 417.01, 418.01, 422.02, 428, 430; and Sussex County: 504.08, 507.04, 508.03).

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. Incidence 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. U.S. Census Bureau data were used to estimate populations in each census tract.

The 2010-2014 all-site cancer incidence rate for each of Delaware's 214 census tracts were compared to the all-site cancer incidence rate for the entire state. DPH used standard statistical procedures to determine if the difference between each census tract's all-site cancer incidence rate and the state all-site cancer incidence rate reached the threshold of statistical significance. If a census tract's all-site cancer incidence rate is significantly higher than the state all-site cancer incidence rate, the difference between the rates is interpreted as "larger than would be expected by chance alone." If a census tract's all-site cancer incidence rate is significantly lower from the state all-site cancer incidence rate, the difference is interpreted as "smaller than would be expected by chance alone." If a census tract's all-site cancer incidence rate is not significantly different from the state all-site cancer incidence rate, the difference between the rates is interpreted as "not meaningfully different." Please refer to the 2010-2014 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 cancer incidence data is assessed by census tract, 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, affecting access to health care, including cancer screening services. Population changes, such as residents moving into or out of a census tract, can also affect the cancer rates. 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 all-site cancer incidence rate. Statistically-speaking, 5% of all numerical comparisons are significantly different due to chance alone.

Results for 2010-2014 show that:



- In 16 of Delaware's 214 census tracts, the 2010-2014 all-site cancer incidence rates were statistically significantly higher than Delaware's 2010-2014 all-site cancer incidence rate (506.5 per 100,000).
- In 11 census tracts, the 2010-2014 all-site cancer incidence rates were significantly lower than Delaware's 2010-2014 all-site cancer incidence rate (506.5 per 100,000).

Secondary Analysis of Elevated Census Tracts for 2010-2014

DPH analyzed cancer data within each of the 16 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 rate:

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

Distribution of Cases for 2010-2014 by Sex

To determine if the all-site cancer incidence 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 16 elevated census tracts. Male- and female-specific rates for each census tract were compared to those at the state level. The 16 census tracts fell into one of the following four categories compared to the state of Delaware:

- Sixteen census tracts (100%) had significantly elevated all-site cancer incidence rates <u>for both males</u> and females combined.
- Four census tracts (25%) had a significantly elevated all-site cancer incidence rate for males.
- Seven census tracts (44%) had a significantly elevated all-site cancer incidence rate for females.
- Seven census tracts (44%) 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 all-site
 cancer incidence rates produced a significantly elevated all-site cancer incidence rate for both sexes
 combined.

Age at Diagnosis of Cases for 2010-2014

The median age of diagnosis for all cancer cases diagnosed during 2010-2014 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, since older age is a risk factor for cancer. Of the 16 census tracts analyzed:

- Nine census tracts (56%) had a lower median age of diagnosis (range: 62-65 years) compared to the state's median age at diagnosis (66 years).
- One census tract (6%) had a median age at diagnosis identical to the state's median age at diagnosis (66 years).
- Six census tracts (38%) had a higher median age at diagnosis (67-71 years) compared to the state's median age at diagnosis (66 years).



Significantly-Elevated Site-Specific Cancer Types for 2010-2014

Cancer is a generic term used to describe more than 100 different diseases. Sixteen of Delaware's 214 census tracts had a significantly elevated all-site cancer incidence rate for 2010-2014. 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 16 census tracts with elevated all-site cancer incidence rates, DPH calculated site-specific incidence rates for the 24 most commonly-diagnosed cancers. These analyses helped to determine which cancers, if any, contributed to the higher-than-expected all-site cancer incidence rate. Results for the 16 census tracts are as follows:

- Three census tracts (19%) did not have any cancer type that was significantly elevated.
- Six census tracts (38%) had **one** cancer type that was significantly elevated.
- Four census tracts (25%) had two cancer types that were significantly elevated.
- Three census tracts (19%) had **three** cancer types that were significantly elevated.

The higher-than-expected all-site cancer incidence rates among the 16 elevated census tracts were confined to 13 cancer types (Table 1). Note that the frequencies in Table 1 total 23 because seven of the 16 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 16 CENSUS TRACTS WITH ELEVATED ALL-SITE CANCER INCIDENCE RATES, DELAWARE, 2010-2014

Site-Specific Cancer Type	Number of Occurrences of Significantly Elevated Site-Specific Cancer Type
Lung	4
Colorectal	3
Oral Cavity and Pharynx	3
Kidney and Renal Pelvis	2
Melanoma	2
Prostate	2
Bladder	1
Breast	1
Cervix	1
Hodgkin Lymphoma	1
Larynx	1
Stomach	1
Thyroid	1
TOTAL	23

Source: Delaware Cancer Registry, Delaware Department of Health and Social Services, Division of Public Health, 2017

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 16 census tracts, results related to these seven cancer types are as follows:

- Thirteen census tracts (81%) did not have a significantly elevated rate for any of the seven cancer types with substantiated environmental risk factors.
- Three census tracts (19%) had significantly elevated rates for **one** of the seven cancer types with substantiated environmental risk factors.

TABLE 2: CENSUS TRACTS WITH SIGNIFICANTLY ELEVATED INCIDENCE RATES FOR CANCERS WITH ENVIRONMENTALLY SUSPECTED CAUSES, BY SEX, DELAWARE, 2010-2014

Cancer Site	Male Only	Female Only	Male and Female		
Hodgkin Disease	none	none	428		
Thyroid	418.01	none	none		
Urinary Bladder	none	none	507.04		

Source: Delaware Cancer Registry, Delaware Department of Health and Social Services, Division of Public Health, 2017

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

Tables 3-5 summarize results of the secondary analyses for the census tracts that were significantly elevated for all-site cancer in 2010-2014 for each of the three counties in Delaware. Table 6 summarizes substantiated risk factors for the 23 different site-specific cancers with significantly-elevated all-site cancer incidence rates among the census tracts under review. Table 7 displays census tracts that are consistently elevated over two or more of the nine, five-year time periods from 2001-2005 through 2010-2014.

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.



TABLE 3: CHARACTERISTICS OF NEW CASTLE COUNTY, DELAWARE CENSUS TRACTS WITH STATISTICALLY SIGNIFICANTLY ELEVATED ALL-SITE CANCER INCIDENCE RATES, 2010-2014

Census Tract	Avg. Cases/ year	Overall Age-Adjusted All-Site Cancer Incidence Rates per 100,000, 2010-2014**			Significantly Elevated Cancer Site(s) by Sex	Median Age at Diagnosis DE CT		Area(s) of Concern	
		All	Male	Female					
DELAWARE	5,572	506.5	573.3	458.1					
29	23	667.8	769.8	• Kidney (male, overall) • Lung (overall)		66 63	63	PreventionScreeningSex distributionCancer type	
142	14	673.8	731.1	628.6	• None	66	71	PreventionScreening	
149.03	26	651.1	682.5	623.7	• None	66	62	PreventionScreening	
163.01	34	609.5	698.0	550.5	Oral (male, overall)	66	65	PreventionScreeningSex distributionCancer type	
166.04	52	598.6	757.0	494.9	Colorectal (overall)Lung (male)Prostate	66 62		PreventionScreeningSex distributionCancer type	
169.01	18	661.3	670.3	656.1	• Breast	66	66	PreventionScreeningSex distributionCancer type	

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

CT=Census Trac

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

Source: Delaware Cancer Registry, Delaware Department of Health and Social Services, Division of Public Health, 2017.



TABLE 4: CHARACTERISTICS OF KENT COUNTY, DELAWARE CENSUS TRACTS WITH STATISTICALLY SIGNIFICANTLY ELEVATED ALL-SITE CANCER INCIDENCE RATES, 2010-2014

Census Tract	Tract Cases / Cancer Incid			ates per	Significantly Elevated Cancer Site(s) by Sex	Median Age at Diagnosis		Area(s) of Concern	
Hact	year	100,0	00, 2010-2	014**	Cancer Site(s) by Sex	DE	СТ	Concern	
		All	Male	Female					
DELAWARE	5,572	506.5	573.3	458.1					
401	50	684.0	825.9	544.9	Melanoma (female, overall)	66	65	PreventionScreeningSex distributionCancer type	
402.03	32	608.5	669.1	562.2	• None	66	67	PreventionScreening	
417.01	48	601.8	678.6	542.8	Colorectal (female, overall) Prostate	66	69	PreventionScreeningSex distributionCancer type	
418.01	68	623.7	710.6	552.6	Larynx (overall) Oral (female) Thyroid (male)	66	65	PreventionScreeningSex distributionCancer type	
422.02	62	634.4	689.9	592.3	Kidney (female)	66	64	PreventionScreeningSex distributionCancer type	
428	49	586.2	675.0	514.2	Hodgkin Lymphoma (overall)	66	65	Sex distributionCancer type	
430	40	627.5	693.5	590.6	Cervix Colorectal (male, overall) Lung (male)	66	65	PreventionScreeningSex distributionCancer type	

^{**} Age-adjusted incidence rate in bold indicates that the census tract rate is significantly elevated compared to the state rate. CT=Census Tract

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

Source: Delaware Cancer Registry, Delaware Department of Health and Social Services, Division of Public Health, 2017.



TABLE 5: CHARACTERISTICS OF SUSSEX COUNTY, DELAWARE CENSUS TRACTS WITH STATISTICALLY SIGNIFICANTLY ELEVATED ALL-SITE CANCER INCIDENCE RATES, 2010-2014

Census Tract	Avg. Cases / year	Overall Age-Adjusted All-Site Cancer Incidence Rates per 100,000, 2010-2014**			Nighiticantiv Flevated	Median Age at Diagnosis DE CT		at Diagnosis		Area(s) of
		All Male Female								
DELAWARE	5,572	506.5	573.3	458.1						
504.08	37	640.9	777.0	537.5	Lung (overall) Stomach (overall)	66	67	PreventionScreeningCancer type		
507.04	49	650.7	741.1	568.5	Oral (female) Urinary bladder (overall)	66 70		PreventionScreeningSex distributionCancer type		
508.03	70	607.3	635.1	589.5	Melanoma (female, overall)	66	68	PreventionScreeningSex distribution		

^{**} Age-adjusted incidence rate in bold indicates that the census tract rate is significantly elevated compared to the state rate. CT=Census Tract

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

Source: Delaware Cancer Registry, Delaware Department of Health and Social Services, Division of Public Health, 2017.



TABLE 6: KNOWN RISK FACTORS** OF ELEVATED CANCER TYPES AMONG THE 16 DELAWARE CENSUS TRACTS WITH SIGNIFICANTLY ELEVATED ALL-SITE CANCER INCIDENCE RATES, 2010-2014

CANCER TYPE	KNOWN RISK FACTORS
BLADDER	Age (risk increases with age), arsenic in drinking water, bladder birth defects, chronic bladder irritation and infections, gender (more common in males), not drinking enough fluids, personal history of bladder or other urothelial cancer, prior chemotherapy, race and ethnicity, smoking
BREAST	Age (risk increases with age), alcohol abuse, benign breast conditions, birth to children (giving birth after age 30 or not at all increases risk), breastfeeding (not breastfeeding increases risk), dense breast tissue, exposure to diethylstilbestrol, family history, genes, hormone therapy after menopause, menopause after age 55, menstruation before age 12, overweight or obesity, personal history, physical inactivity, oral contraceptive use, race (African American), radiation to the chest, tobacco use
CERVIX	Diet low in fruits and vegetables, diethylstilbestrol (DES) use, human papilloma virus (HPV) infection, family history of cervical cancer, intrauterine device (IUD) use, long-term use of oral contraceptives, low-income status, multiple full-term pregnancies, overweight or obesity, tobacco use, weakened immune system, younger age at first full-term pregnancy (younger than 17)
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 and late adulthood at higher risk), gender (more common in males), family history, higher socioeconomic status, infection with Epstein-Barr, mononucleosis, or HIV
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, HPV, 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	Age (risk increases with age), fair skin, freckling and light hair, family history of melanoma, gender (males are more at risk), moles on the skin, personal history of melanoma, UV exposure, weakened immune system, Xeroderma pigmentosum (rare inherited condition that affects skin cells' ability to repair damage to their DNA)
ORAL CAVITY AND PHARYNX	Age (55 and older), alcohol use, diet low in fruits and vegetables, gender (male), genetic syndromes (Fanconi anemia, Dyskeratosis congenital), Graft-vs-Host disease (GVHD), Lichen planus (disease that affects the skin mainly in middle-age people), weakened immune system, HPV infection, tobacco use, UV exposure
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)
STOMACH	Age (risk increases with age), Common variable immune deficiency, diet (consumption of smoked foods), Epstein-Barr virus infection, ethnicity (Hispanics, African Americans, Asian/Pacific Islanders are at higher risk), family history of stomach cancer, gender (males at higher risk), geography (more common in Japan, China, and Southern and Eastern Europe), H. pylori infection, Menetrier disease (excess growth of stomach lining), inherited cancer syndromes, overweight or obese, pernicious anemia, previous stomach surgery, some types of stomach polyps, tobacco, Type A blood; work in the coal, metal, and rubber industries
THYROID	Age (younger females and older males at increased risk), diet low in iodine, family history, hereditary conditions, radiation

^{**}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 (<u>www.cancer.org</u>) and National Cancer Institute (<u>www.cancer.gov</u>).

TABLE 7: CONSISTENTLY-ELEVATED** ALL-SITE CANCER INCIDENCE RATES BY DELAWARE CENSUS TRACTS, BY COUNTY AND TIME PERIOD, DELAWARE: 2001-2005 TO 2010-2014

COUNTY	CENSUS TRACT	2001- 2005	2002- 2006	2003- 2007	2004- 2008	2005- 2009	2006- 2010	2007- 2011	2008- 2012	2009- 2013	2010- 2014
	6.02	Х	Х	Х	Х						
	29	Х							Х	Х	Х
	139.01	Х	Х	Х	Х						
	148.10							Х	Х	Х	
	149.03								Х	Х	Х
	149.06	Х	Х								
	156.00			Х	Х	Х					
NEW CASTLE	159.00					Х	Х			Х	
CASTLE	160.00	Х	Х	Х							
	163.01					Х	Х	Х	Х		Х
	166.01								Х	Х	
	166.04								Х	Х	Х
	166.08							Х	Х	Х	
	169.01	Х	Х	Х							Х
	169.04	Х	Х	Х							
	401.00						Х	Х	Х	Х	Х
	402.03									Х	Х
	417.01					Х	Х		Х	Х	Х
	417.02							Х	Х	Х	
KENT	418.01							Х	Х	Х	Х
KENT	421.00				Х	Х	Х				
	422.02						Х	Х			Х
	428.00		Х		Х	Х	Х	Х	Х	Х	Х
	430.00							Х	Х	Х	Х
	432.02							Х	Х	Х	
	501.03						Х	Х	Х	Х	
	501.05			Х	X	Х					
	504.01						Х	Х	Х		
	504.05								Χ	Х	
SUSSEX	506.02	Х	Х								
SUSSEX	507.04								Χ	Х	Χ
	513.02	Х	Х	Х	Х						
	513.05	Х	Х								
	517.01			Χ	Χ		Χ				
	518.01						Х	Х			

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

Source: Delaware Cancer Registry, Delaware Department of Health and Social Services, Division of Public Health, 2017.



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

This report and the full *Cancer Incidence and Mortality in Delaware (I&M) Report, 2010-2014* can be found on the DPH website: http://www.dhss.delaware.gov/dhss/dph/dpc/cancer.html.