

# The Burden of Asthma in Delaware



## Update May 2016

*Revised March 2017*



**DELAWARE HEALTH AND SOCIAL SERVICES**  
Division of Public Health  
Health Promotion and Disease Prevention



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## Executive Summary

The prevalence of “current asthma” among adults, both nationally and in Delaware, has remained relatively constant over the past 10 years, since the first *Burden of Asthma in Delaware* report was published in 2005.

Although the reasons are not completely clear, adult women are more likely to report having been diagnosed with “current asthma” than are adult men. The same gender difference does not exist among middle and high school students. In Delaware, adult women with asthma could become a primary intervention target, given this disparity. Because some of these women are likely to be mothers of children with asthma, such interventions might have a high impact.

There is a correlation between adults who report being overweight or obese and a higher prevalence of “current asthma.” Adults who have a Body Mass Index (BMI) considered to be overweight or obese are twice as likely to report currently having asthma.

Adults with disabilities are 2.75 times more likely to have current asthma. Adults with disabilities are also more likely to be overweight or obese, which may partially account for the higher prevalence of asthma.

While there is no statistically significant difference in asthma prevalence by county, there is a significantly higher prevalence in Wilmington than in suburban New Castle, Kent, or Sussex counties.

The number of asthma hospitalizations and the number of asthma deaths among the state’s black population is disproportionately high. This may indicate a need for improvements in education and health care for the black population with asthma.

Smoking prevalence has decreased significantly among both youth and adults in the past decade, which contributes to a healthier environment for people with asthma. However, the use of e-cigarettes is quickly rising among students, and is a new cause of concern for people with asthma.

The Air Quality Index, which measures a number of pollutants that trigger asthma attacks, has generally been improving in Delaware. However, New Castle County has the most days in categories defined as unhealthy, compared to the other Delaware counties.

The American Academy of Allergy, Asthma and Immunology estimates that the total cost of asthma in the United States – including medical expenses, medication, lost work and school days, and costs of premature death – is about \$3,300 per person with asthma per year. If that estimate is accurate, the total cost of asthma in Delaware would be more than \$200 million a year.

# Introduction

The Division of Public Health (DPH), working with the Delaware Asthma Consortium and the Department of Natural Resources and Environmental Control (DNREC), published the first report on *The Burden of Asthma in Delaware* in 2005. These parties met again 2015 to update the report. This document is the result of that process.

Asthma remains a significant burden on our state, for our health care system, for employers, and for many Delawareans and their families. Because asthma is a chronic condition, it requires lifestyle changes for asthma sufferers and their families. People with asthma usually adopt a regimen of self-management, with the help of a physician. Some uses of the organized health care system – especially hospital inpatient stays and emergency room visits – may represent breakdowns in the management of asthma.

This update seeks to answer a number of questions about asthma in Delaware:

- Has the prevalence changed significantly in the past 10 years? Does asthma affect some people more than others? How does Delaware differ from national trends?
- How much does asthma impact our health care system?
- How does our environment impact asthma? Has the environment improved or changed?

Answering these questions will help provide a context for action. If it is clear that some Delawareans suffer more than others, then efforts should be targeted to eliminate such disparities. Both the providers of care and those affected by the disease have some control over the outcomes highlighted in this report.

Asthma is a common, long-term inflammatory disease of the airways in the lungs. It is characterized by airflow obstruction and bronchospasms. Symptoms include episodes of wheezing, coughing, chest tightness, and shortness of breath.

Because environmental factors can trigger asthma symptoms, efforts to reduce smoking in public environments or in the home can help reduce episodes of asthma. Continued monitoring of air quality and attempts to reduce airborne irritants also can have a widespread impact upon those with asthma and their families. Efforts to reduce other known irritants such as pet dander, dust mites, and some chemicals in homes and public places also can reduce the burden of asthma.

People affected by asthma live with wheezing, coughing, and shortness of breath; and they live with anxiety about whether this attack will escalate into a real health emergency. For them, this vulnerability and anxiety are the real burdens of asthma.

## Data Resources and Methodologies

To address asthma in Delaware, it is important to know the prevalence of the condition. Prevalence is the percentage of a population that has a condition at a specific point in time or time interval, usually a year. Prevalence data for asthma in Delaware are available from surveys, primarily the Behavioral Risk Factor Survey of adults, and the Youth Risk Behavior Survey of public high school students.

### **National Data: National Health Interview Survey (NHIS)**

The National Center for Health Statistics (NCHS) conducts its National Health Interview Survey (NHIS) on a yearly basis. As a face-to-face household interview, the NHIS is not subject to some of the limitations of telephone interview surveys. To better estimate prevalence rates for minority populations and to provide a large enough pool of cases for separate analysis, both African Americans and Hispanics are over-sampled. To estimate prevalence rates by age group, parents are asked about their children and responses for each parent and child are entered separately. NHIS provides national estimates only.

The NHIS captures prevalence rates for lifetime and for the current year by first asking, “Has a doctor or other health professional ever told you that you have asthma?” A “yes” to this question triggers two additional questions:

1. “During the past 12 months, have you had an episode of asthma or asthma attack?”
2. “During the past 12 months, have you had to visit an emergency room or urgent care center because of asthma?”

### **Delaware Behavioral Risk Factor Survey (BRFS)**

To assist states in monitoring public health problems and programs, the Centers for Disease Control and Prevention (CDC) sponsors the nation’s largest ongoing telephone survey, the Behavioral Risk Factor Survey (BRFS). This telephone survey interviews a random sample of residents 18 years or older. Since 2000, the annual sample in Delaware is about 4,000 Delaware adults. The survey is multi-mode, using landline and cell phone samples. The BRFS is conducted on an ongoing basis, interviewing every month of every year, and reporting data on a calendar-year basis. BRFS data are weighted, using iterative proportional fitting (or “raking” weights). This reduces the potential for bias and increases the representativeness of estimates. BRFS data are self-reported, and the landline sample does not include institutionalized populations.

The survey questions used in this report are similar to those asked in the NHIS. First, respondents are asked, “Have you ever been told by a doctor or health professional that you have asthma?” This question generates the lifetime prevalence. People who respond “yes” are asked, “Do you still have asthma?” That response generates the “current asthma” prevalence for the adult population.

## **Youth Risk Behavior Survey (YRBS)**

This survey of public middle and high school students is sponsored by the Division of Adolescent and School Health at the CDC. The YRBS asks two asthma questions: 1) “Has a doctor or nurse ever told you that you have asthma?” and 2) “Do you take any medication for your asthma?” The survey is administered to a random sample of about 3,000 students in 36 Delaware public high schools (grades 9 to 12). Their responses are anonymous and confidential. The survey is conducted for DPH by the University of Delaware Center for Drug and Health Studies (CDHS). The YRBS is conducted every other year, in odd-numbered years.

The CDHS also conducts a Delaware Middle School YRBS, funded by Nemours Health and Prevention Services, using the same methodology and asthma question. The middle school survey includes about 3,000 students in grades six, seven and eight.

## **Health Care Utilization and Mortality**

For hospital inpatient services – the most intense and costly encounter – DPH collects and compiles hospital discharge information from all Delaware hospitals. Using these data, it is possible to estimate usage for those discharges with a diagnosis of asthma. Mortality data are recorded by the DPH Health Statistics Center. Data collected over a number of years are included in this report.

## **Chief Complaint Data and Syndromic Surveillance**

The Division of Public Health collects chief complaint data daily from emergency departments throughout the state. These data are captured in the Delaware Electronic Reporting and Surveillance System (DERSS) and analyzed using the Early Aberration Reporting System (EARS) developed by the CDC. The analysis of these chief complaint data, also known as syndromic surveillance, parses chief complaints into syndromes. Once individual chief complaints are organized into syndromes, it is possible to determine the burden the syndrome has on the emergency departments. However, because personally identifiable information is not attached to each complaint, it is not possible to determine the number of emergency department chief complaints per person.

## **Environmental Impact**

A number of environmental factors – including tobacco smoke, particulate matter, and ground-level ozone – affect people with asthma.

Smoking, vaping, and environmental tobacco smoke aggravate asthma symptoms. The Delaware BRFSS estimates smoking



prevalence of adults. The YRBS provides smoking prevalence data for public middle and high school students.



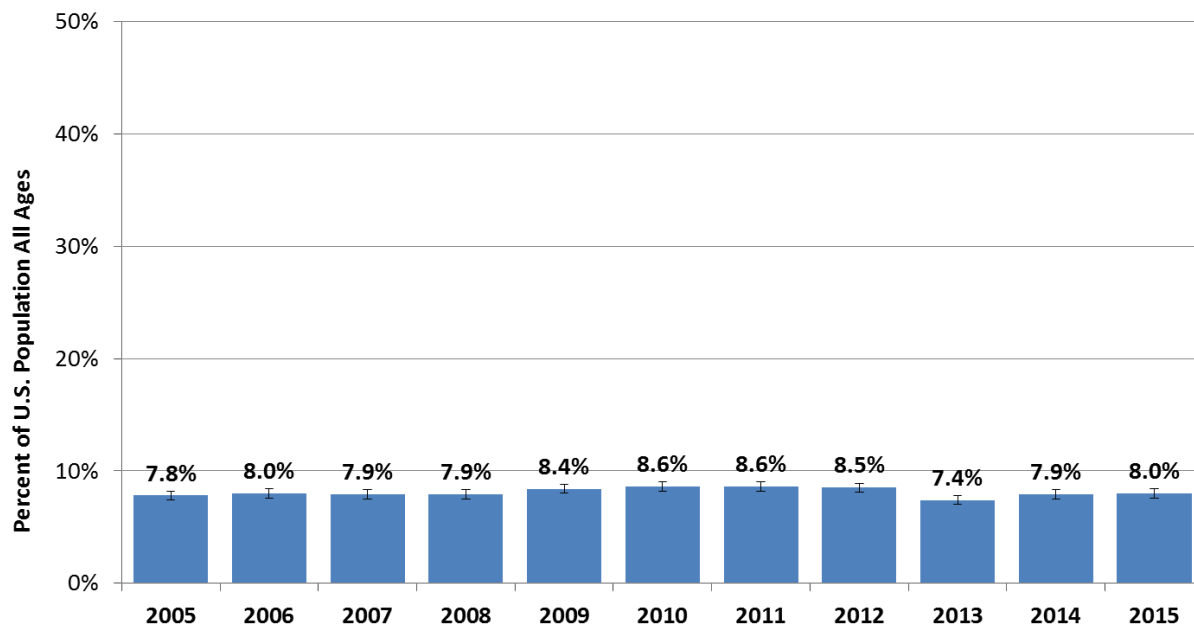
DNREC tracks and reports airborne pollutants, which can cause increased distress for asthma sufferers. The goal is to reduce such pollutants to acceptable levels. This report includes air quality levels by county and when air quality standards were not met in each county.

# How Many People Are Affected by Asthma?

## National Prevalence Estimates

For context, we first provide the national prevalence of current asthma episodes, derived from the NHIS.

**Figure 1**  
**Persons of All Ages Who Reported Current Asthma,**  
**U.S. 2005-2015**



Source: CDC/NCHS, National Health Interview Survey, 2005 - 2015, combined adult and sample child core components.

Figure 1 shows that the all-ages prevalence of current asthma does not indicate any clear trend since the 2005 *Burden of Asthma in Delaware* report.

Prevalence may be slightly higher among children. In 2015, the NHIS asthma prevalence among children under 15 was 8.7 percent. The prevalence was 7.8 percent for people ages 15-34 and for those 35 and older.

Nationally in 2015, males under 15 have higher asthma prevalence (10.2 percent) than young females (7.1 percent). However, among adults that situation is reversed. Adult women 35 and older (10.1 percent) report being diagnosed with asthma almost twice as much as adult men (5.3 percent), according to the NHIS.

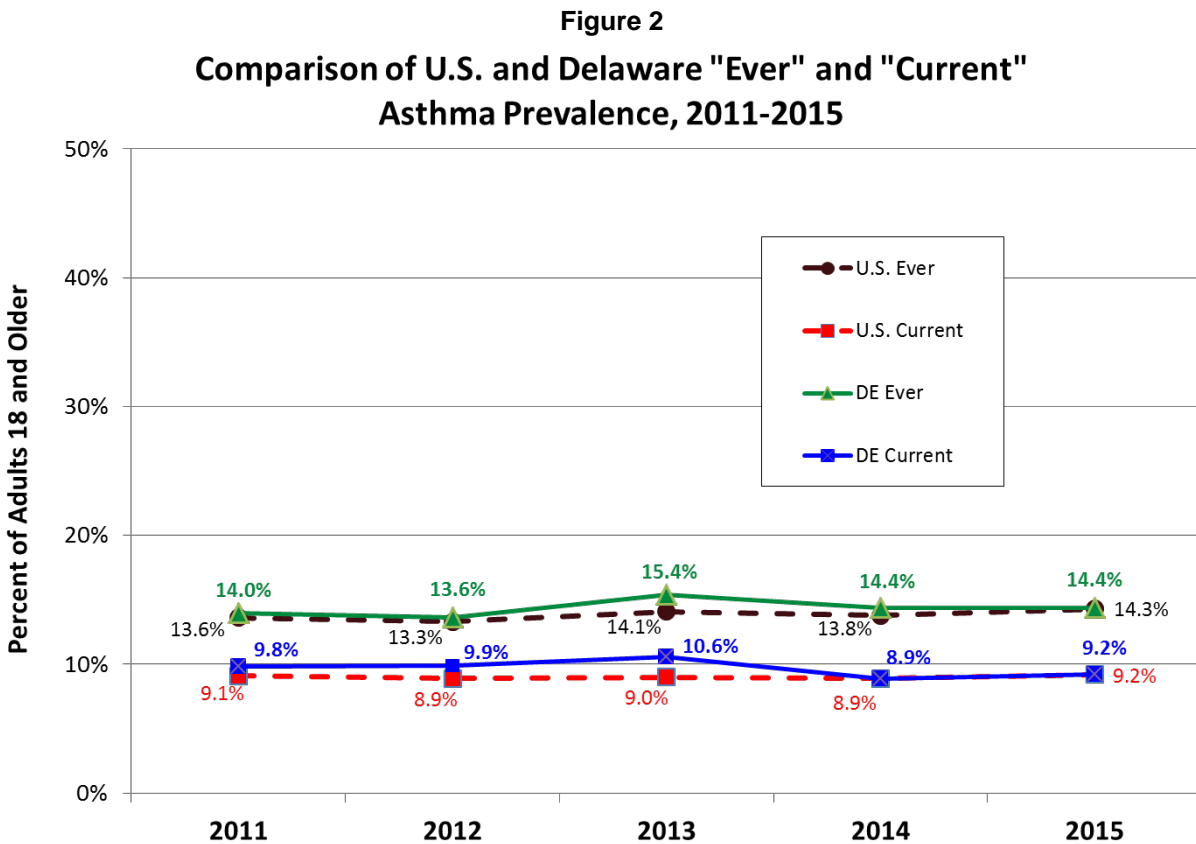


# Delaware Prevalence Estimates

## Adults

The Delaware Behavioral Risk Factor Survey (BRFS) includes a set of asthma questions, which are used to estimate asthma prevalence among Delaware adults (residents 18 years and older). In 2015, about 14.4 percent of adult Delawareans had asthma at some time during their lives; and 9.2 percent (an estimated 66,600 adults) reported that they currently have asthma.

Figure 2 shows the prevalence for Delaware and the U.S. from 2011 to 2015.



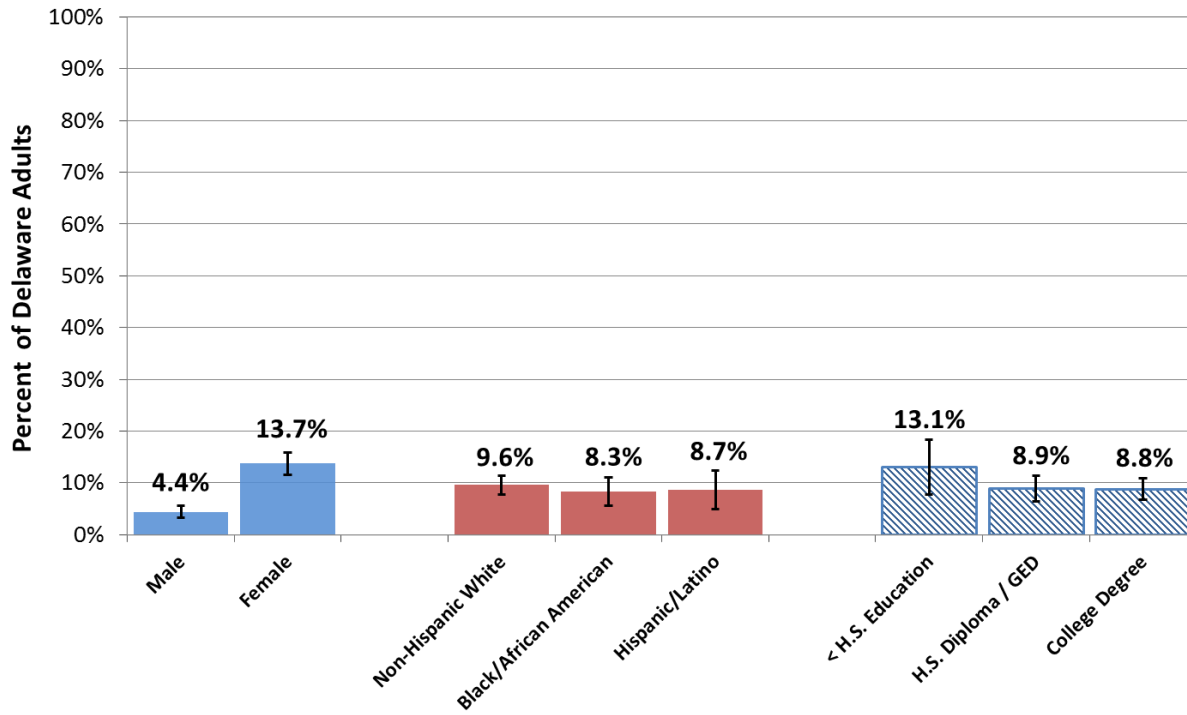
Source: DHSS, Division of Public Health, Behavioral Risk Factor Survey (BRFS), 2011-2015.

Delaware and U.S. prevalence – both lifetime and current – have tracked quite closely during this five-year period, and are relatively stable. There is no statistically significant difference by year, nor is there any significant difference between the Delaware and U.S. prevalence.

Figure 3 presents current asthma data for Delaware adults by gender, education, and race or ethnicity. As with the national NHIS data, Delaware women have significantly higher prevalence of current asthma than men in Delaware. There are no significant differences by age group, education, race, or income.

Figure 3

**Current Asthma Among Delaware Adults By Gender, Race/Ethnicity, and Education, 2015**



Source: DHSS, Division of Public Health, Behavioral Risk Factor Survey (BRFS), 2015

The 2005 *Burden of Asthma Report* used 2003 BRFS data, and the adult asthma prevalence in 2003 was 7.5 percent. Figure 4 indicates the prevalence of adults with current asthma has been remarkably stable over the past decade. Between 2005 and 2015, there is no statistically significant difference between any two years.

There also is no statistically significant difference among adults by county, although the population of Wilmington consistently has a higher prevalence. Table 1 shows current asthma prevalence in each of Delaware’s three counties:

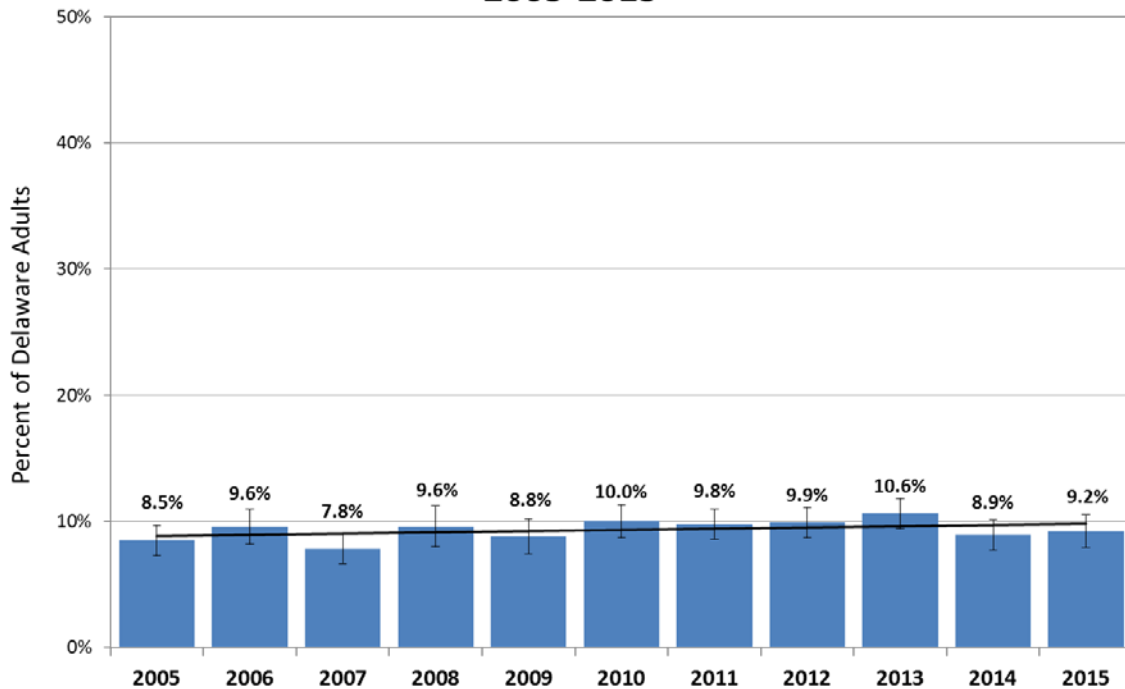
Table 1

<b>“Current Asthma” Prevalence in Delaware by County, 2015</b>		
<b>County</b>	<b>Prevalence</b>	<b>Confidence Interval</b>
New Castle County	9.5%	7.4 – 11.6%
Kent County	10.2%	7.9 – 12.5%
Sussex County	7.5%	5.7 – 9.3%

Source: DHSS, Division of Public Health, Behavioral Risk Factor Survey (BRFS), 2015.

Although the BRFs normally does not provide data below the county level, it is possible by aggregating two years of data and three ZIP Codes (19901, 19902, and 19905) to provide an estimate for the City of Wilmington. For the two-year period of 2013-2014, Wilmington had a significantly higher prevalence of “current asthma” than suburban New Castle County, Kent County, or Sussex County. The prevalence of current asthma in Wilmington was 13.6 percent, compared with 9.3 percent in suburban New Castle County, 9.9 percent in Kent County, and 8.9 percent in Sussex County.

**Figure 4**  
**"Current Asthma" Among Delaware Adults,**  
**2005-2015**



Source: DHSS, Division of Public Health, Behavioral Risk Factor Survey (BRFS), 2005-2015.

The Delaware BRFs also includes questions about other risk and demographic factors that could be related to asthma prevalence. Two demographic factors stand out as significant: weight and disability status.

Adults who have a Body Mass Index (BMI) considered to be overweight or obese are twice as likely to report having current asthma. Overweight or obese adults have a current asthma prevalence of 10.8 percent (CI = 8.8-12.8%), and adults with normal or healthy BMIs report current asthma prevalence of 5.9 percent (CI = 4.2-7.8%).

Adults with disabilities also are more likely to have current asthma – in fact, 2.75 times more likely. Delaware adults with disabilities have a current asthma prevalence of 17.8 percent (CI = 13.9-21.7%), compared to adults without disabilities whose current asthma prevalence is 6.6 percent (CI = 5.3-7.8%).

## Youth Asthma Prevalence

The Youth Risk Behavior Survey (YRBS) is the primary source of Delaware prevalence data for public high school students. The YRBS generates a lifetime (“have you ever been told . . .”) estimate of asthma prevalence, and prevalence of students who take medication for their asthma. Data for young children are available from the 2014 Delaware Survey of Children’s Health (DSCCH), conducted for Nemours Health and Prevention Services.



A secondary source for Delaware data is the National Survey of Children’s Health (NSCH). The NSCH has a sample in Delaware large enough to provide a statewide estimate, and it covers a wider age group of children than the YRBS. Unfortunately, the survey is not conducted regularly; the most recent data are from the 2011-12 survey. The NSCH asks two questions: “Have you had asthma at some point, but not currently?” and “Do you currently have asthma?”

Based on its 2011-12 survey, the NSCH estimated that 12 percent of Delaware children from birth to age 17 had current asthma. Another 7.8 percent had the condition at some time, but no longer had asthma at the time of the survey. Therefore, 19.8 percent of Delaware children in the survey had been told at some time they had asthma.

The Delaware Youth Risk Behavior Survey provides more recent data, and also asks if students take any medications for their asthma. Although about 25.4 percent of Delaware public high school students report having been told they had asthma, only **17.1** percent say they are currently taking medication (regular or emergency) for their asthma. This is a more accurate indication of current asthma prevalence among high school students.

**Table 2**

<b>Delaware Student “Lifetime Asthma” by Race/Ethnicity, 2015</b>				
<b>Survey</b>	<b>Total</b>	<b>White</b>	<b>Black</b>	<b>Latino</b>
Public Middle School YRBS	22%	18.7%	27.2%	19.6%
Public High School YRBS	25.4%	23.6%	28.9%	25.5%

Source: DHSS, DPH, CDHS, and Nemours, Youth Risk Behavior Surveys (YRBS), 2015.

One of the most interesting results from the YRBS is that – unlike adult prevalence – there are no statistically significant differences between male and female students. If anything, the male students have a slightly higher prevalence.

**Table 3**

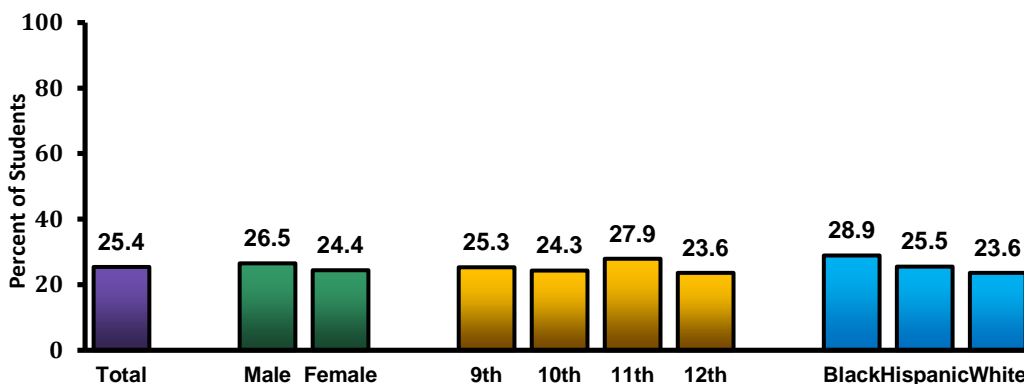
<b>Delaware Student “Lifetime Asthma” by Gender, 2015</b>			
<b>Survey</b>	<b>Total</b>	<b>Male</b>	<b>Female</b>
Public Middle School YRBS	22%	22.1%	21.8%
Public High School YRBS	25.4%	26.5%	24.4%

Source: DHSS, DPH, CDHS, and Nemours, Youth Risk Behavior Surveys (YRBS), 2015.

Nationwide, 22.8 percent of public high school students had “ever been told” they had asthma, according to the 2015 YRBS. Prevalence of ever having asthma was slightly higher among black students (27.8 percent) than among white (22.1 percent) or Hispanic (22.5 percent) nationally. Across participating states, the prevalence of ever having asthma ranged from 19.3 percent to 31.3 percent. Delaware’s prevalence is near the middle of that range, but slightly higher than the national prevalence.

**Figure 5**

**Percent of Delaware High School Students Who Had Ever Been Told by a Doctor They Had Asthma, by Sex, Grade, and Race/Ethnicity, 2015**



Source: DHSS, Division of Public Health, Youth Risk Behavior Survey (YRBS), 2015.

Figure 5 shows the total prevalence of “ever told you have asthma” among public high school students, by gender, by grade, and by race or ethnicity. Although none of the differences are statistically significant, it appears that the Delaware data on asthma by race mirrors the national data, with African American or black students having the highest prevalence.

When comparing current youth and adult prevalence, it is important to remember that the YRBS questions are different than the adult BRFS questions. While the BRFS asks respondents who report lifetime asthma if they “still have asthma,” the YRBS follow-up question asks if they currently take any medication for their asthma. The prevalence (17.1 percent) of high school students who take medication for their asthma is significantly higher than the 9.2 percent of adults who report they “still have asthma.” This difference between students and adults is common in other surveys.

**ADDENDUM: Delaware Survey of Children’s Health (DSCH) – Childhood Asthma in Delaware**

The DSCH, sponsored by Nemours Children’s Health System, added questions about asthma to its most recent survey in 2014. About 2,600 Delaware parents, interviewed by telephone, were asked, “Has a doctor, nurse, or other health professional ever told you that your child has asthma?” Responses show that 17 percent of Delaware children from birth through age 17 had “ever been diagnosed with asthma.”

As with high school students in the YRBS, male children had a slightly higher prevalence (20 percent) than female children (15 percent). Adolescents 12 to 17 years old (23 percent) were more likely to have lifetime asthma than children 6 to 11 (18 percent) or children under 5 (12 percent).

The prevalence of “lifetime asthma” among high school students is similar in both the 2015 YRBS (25.4 percent) and the 2014 DSCH (23 percent). It is important to remember that these surveys were conducted at different times, and used different methodologies.

Parents in the DSCH reported that 65 percent of children under age 18 with “lifetime asthma” had an asthma-related visit with a doctor or health professional in the past year. Most of these children (93 percent) were prescribed medicine for their asthma.

# Health Care Impacts of Asthma

## *How do people with asthma impact the health care system? How many deaths does asthma cause?*

People with asthma use physicians' offices, pharmacies, hospitals, and emergency departments to meet their needs. The preferred sources of treatment are the physician and pharmacy. Appropriate use of these sources can eliminate or substantially reduce the need for emergency room visits or hospital admissions. In fact, many emergency room and inpatient asthma encounters can be viewed as provider and patient management breakdowns. Because these two service locations are the most expensive encounters, minimizing their use represents the most efficient use of the health care system.

Hospital utilization data for Delaware are available from all Delaware hospitals because the state collects and compiles hospital discharge data on a yearly basis.

Data on visits to physicians' offices and use of prescription medications are not collected by the state.

## Hospital Inpatient Services

The following tables highlight Delaware hospital discharge rates for asthma compared to national rates; rates for primary and non-primary diagnosis of asthma; and discharge rates by age, gender, race, and county.



**Table 4**

Number of Hospital Discharges with Asthma as Primary Diagnosis, Delaware 2000-2012.														
Year	RACE				COUNTY OF RESIDENCE				GENDER		AGE GROUP			TOTAL
	White	Black	Other	Unknown	Kent	New Castle	Sussex	Unknown	Male	Female	Under 18	18 & older	Unknown	
2000	606	470	64	28	292	676	196	4	472	696	519	649	0	1168
2001	664	516	91	24	273	813	206	3	540	755	620	675	0	1295
2002	602	504	82	30	281	761	175	1	528	690	565	643	10	1218
2003	687	581	116	51	247	965	221	2	614	821	707	728	0	1435
2004	634	544	96	36	238	862	209	1	575	735	650	660	0	1310
2005	668	582	116	40	277	914	210	5	604	802	675	731	0	1406
2006	683	687	137	32	272	1062	205	0	690	849	844	695	0	1539
2007	617	680	133	19	270	997	182	0	646	803	727	722	0	1449
2008	592	584	121	10	195	959	152	1	596	711	680	627	0	1307
2009	634	735	177	16	217	1198	147	0	747	815	884	678	0	1562
2010	548	586	152	9	217	934	144	0	612	683	697	598	0	1295
2011	510	439	114	2	197	718	147	3	417	648	400	665	0	1065
2012	464	559	127	10	210	799	149	2	462	698	464	696	0	1160

Source: DHSS, Division of Public Health, Health Statistics Center, 2000-2012

**Table 5**

Number of Hospital Discharges with Asthma as Non-primary Diagnosis, Delaware 2000-2012.														
Year	RACE				COUNTY OF RESIDENCE				GENDER		AGE GROUP			TOTAL
	White	Black	Other	Unknown	Kent	New Castle	Sussex	Unknown	Male	Female	Under 18	18 & older	Unknown	
2000	1666	770	100	35	510	1525	533	3	780	1791	426	2145	0	2571
2001	1823	827	147	34	453	1860	511	7	805	2026	452	2379	0	2831
2002	2137	1015	158	32	542	2223	570	7	968	2374	489	2846	7	3342
2003	2274	1129	208	68	575	2399	692	13	1042	2637	513	3166	0	3679
2004	2422	1242	203	33	620	2529	745	6	1085	2815	668	3232	0	3900
2005	2500	1384	247	30	620	2700	832	9	1279	2882	791	3370	0	4161
2006	2653	1541	258	42	655	3032	807	0	1285	3209	693	3801	0	4494
2007	2607	1503	322	29	737	3062	662	0	1321	3140	832	3629	0	4461
2008	2460	1491	328	34	675	3098	540	0	1325	2988	803	3509	1	4313
2009	2615	1667	363	31	694	3379	603	0	1452	3224	865	3811	0	4676
2010	2475	1670	336	14	680	3222	590	3	1337	3158	813	3680	2	4495
2011	2545	1778	428	15	670	3527	563	6	1410	3356	871	3895	0	4766
2012	2835	1842	382	40	675	3703	697	24	1437	3662	712	4387	0	5099

Source: DHSS, Division of Public Health, Health Statistics Center, 2000-2012

These tables show that Delaware’s discharges for asthma held relatively steady from 2000 through 2012, as they had in the previous report. That trend may suggest that Delaware residents and health care providers are doing relatively well at controlling hospital admissions related to asthma. However, the data also show a disproportionately high number of asthma hospitalizations among the state’s black population.

In every year represented in Table 4, women with asthma used hospital inpatient services more than men in Delaware, reflecting national experience. In Delaware, adult women with asthma could become a primary intervention target, given this disparity. Because some of these women are likely to be mothers of children with asthma, such interventions might have a high impact.

To highlight an indirect impact of asthma upon health care utilization, Table 5 shows non-primary (usually secondary) diagnoses upon discharge. While people with such multiple diagnoses may not have been admitted for their asthma, often the asthma co-morbidity represents an additional medical management problem when they are admitted to the hospital. This is particularly true for patients with heart or pulmonary problems.

The increasing trend of these co-morbidity discharges may represent increased health management pressures upon hospitals. As noted in the first *Burden of Asthma Report*, “Because listing co-morbid diagnoses may increase hospital payment, however, this rising trend of noting asthma as a non-primary diagnosis may simply be the result of more sophisticated billing processes by hospitals.”<sup>i</sup>

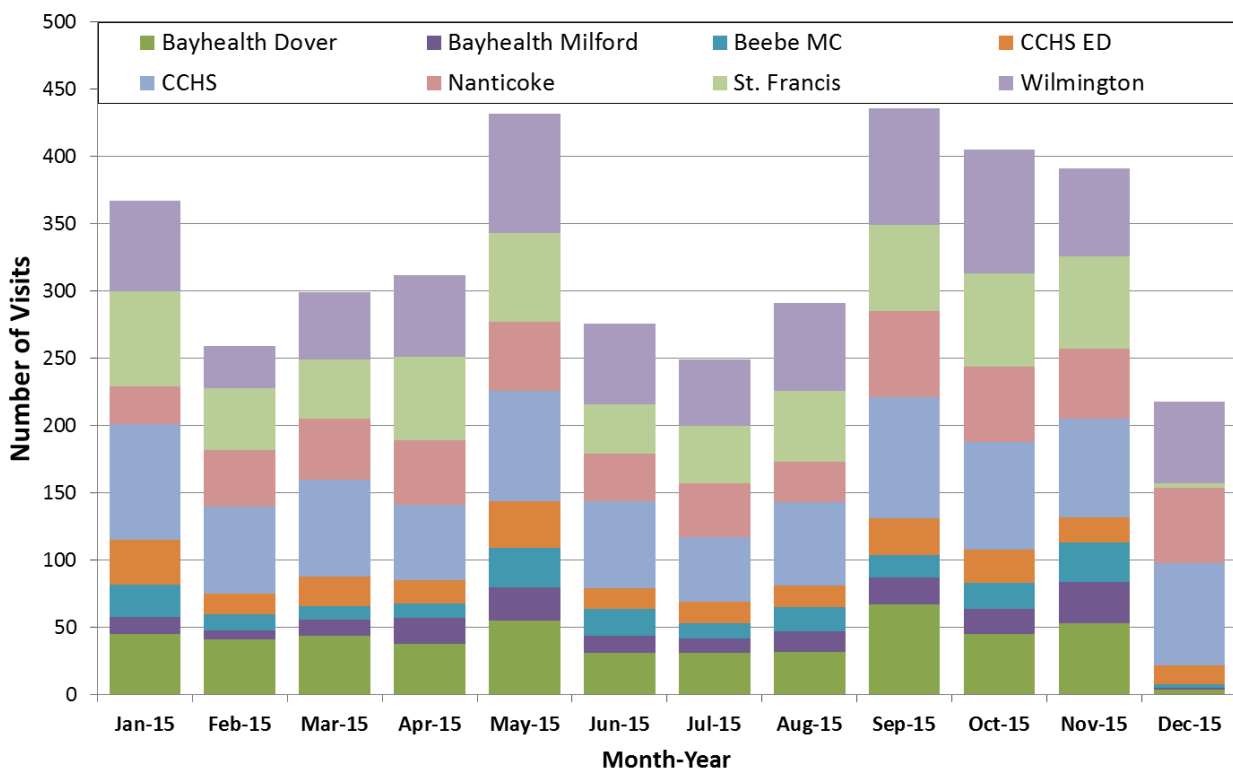
## Emergency Room Services

Emergency room visits for asthma, as shown in Figure 6 are another indicator of the state of asthma self-care and asthma management between physicians and patients. The preferred sources of treatment are physicians and pharmacies. Appropriate use of these sources can eliminate or substantially reduce the need for emergency room visits or hospital admissions.



Figure 7 shows some changes by month, which may – in some cases – be a result of seasonal asthma triggers. However, this graph indicates a relatively high number of hospital emergency department visits, and the number is still higher if neighboring hospitals in Maryland are included. These numbers indicate the need for better management of asthma by physicians, pharmacists, clinics, and patients.

**Figure 6**  
**Delaware Emergency Department Visits with a Chief Complaint of "Asthma Syndrome" by Hospital and by Month, 2015**



Source: DHSS, Division of Public Health, Health Statistics Center, 2015.

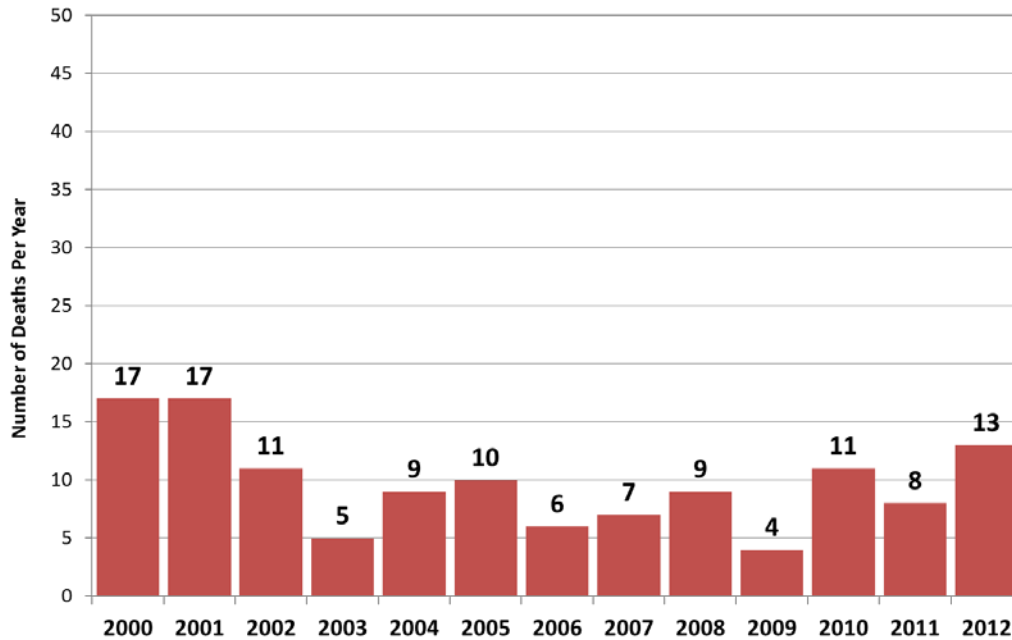
## Asthma’s Ultimate Impact: Mortality Data

Asthma mortality is relatively rare, but it is important to monitor its occurrence, to establish trends, and to help assess the effectiveness of the asthma management system in Delaware.

The mortality data in Table 6 on the next page are from 2000 to 2012 (the most recent data available). Figure 7 shows that there is no real trend, although it appears that asthma deaths may have declined somewhat in the 2000s, which could indicate improved asthma control.

Figure 7

Annual Asthma Deaths in Delaware, 2000 - 2012



Source: DHSS, Division of Public Health, Health Statistics Center, *Vital Statistics Annual Report, 2000-2012*.

Numbers in Table 6 are too small to draw any conclusions about asthma deaths in the state. As expected, asthma deaths are higher in New Castle County, where the majority of the state’s population lives. The number of asthma deaths, as well as hospital admissions, among black Delawareans is disproportionate to the population, which may indicate a need for more education and improvements in health care for the black population with asthma.

Table 6

Number of Deaths Due to Asthma by County, Race, and Gender, Delaware 2000-2012.										
Year of Death	County of residence			Race of decedent				Sex of decedent		Total
	Kent	New Castle	Sussex	White	Black	Other	Unknown	Male	Female	
2000	3	12	2	11	6	0	0	8	9	17
2001	4	11	2	9	8	0	0	6	11	17
2002	1	10	0	6	5	0	0	6	5	11
2003	0	5	0	3	1	1	0	1	4	5
2004	2	6	1	4	4	1	0	5	4	9
2005	3	6	1	5	5	0	0	2	8	10
2006	0	6	0	3	3	0	0	3	3	6
2007	1	3	3	5	2	0	0	2	5	7
2008	2	6	1	7	2	0	0	2	7	9
2009	1	3	0	3	1	0	0	3	1	4
2010	3	4	4	8	2	0	1	2	9	11
2011	2	4	2	3	4	1	0	6	2	8
2012	5	6	2	8	5	0	0	6	7	13

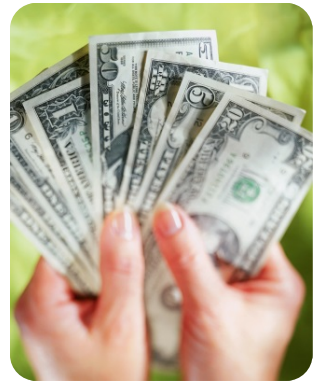
Source: DHSS, DPH, Health Statistics Center

## Economic Impact of Asthma

What is the economic impact of asthma on the health care system in Delaware?

The short answer to this question is that it is impossible to tell.

Productivity and quality of life are very difficult to measure. Nevertheless, asthma does impact them. Lost days from work – due to asthma or care for a child with asthma – have physical and psychological costs.



Asthma also affects the productivity of children through lost days of school, difficulty participating in sports, or other restrictions on activities. While these incidents have a limited economic impact because children are not part of the working marketplace, they have a developmental cost. Growing up with a sense of limits and physical constraints leads to uncounted and unpredictable later cost.

Resources were not available to do an analysis of health care costs related to asthma in Delaware since the first *Burden of Asthma Report*. That report looked at asthma costs from two sources: the state employee health plan and Medicaid. Total asthma-related claims from the state employee health plan in 2003 were \$2,627,200, according to the analysis by Quality Insights of Delaware (QID). Medicaid in 2003 had about six times more total charges for asthma than the state plan. Combined, the two health plans had direct asthma-attributable charges of more than \$16 million. Using data from these two plans, QID estimated a statewide total of direct charges related to asthma at \$25 to \$30 million a year.

Those estimates represent health care charges, not necessarily actual costs. They also do not account for additional costs like time away from work or school, loss of productivity, and family care costs.

Because the prevalence of asthma in Delaware has increased slightly since 2003, and health care costs also have increased, the economic burden of asthma in Delaware is probably even higher now.

The American Academy of Allergy, Asthma and Immunology estimates<sup>ii</sup> that the total cost of asthma in the United States – including medical expenses, medication, lost work and school days, and costs of premature death – is about \$3,300 per person with asthma. If that estimate is accurate, the total cost of asthma in Delaware would be more than \$200 million a year.

# Environmental Factors



## Smoking and Airborne Pollution

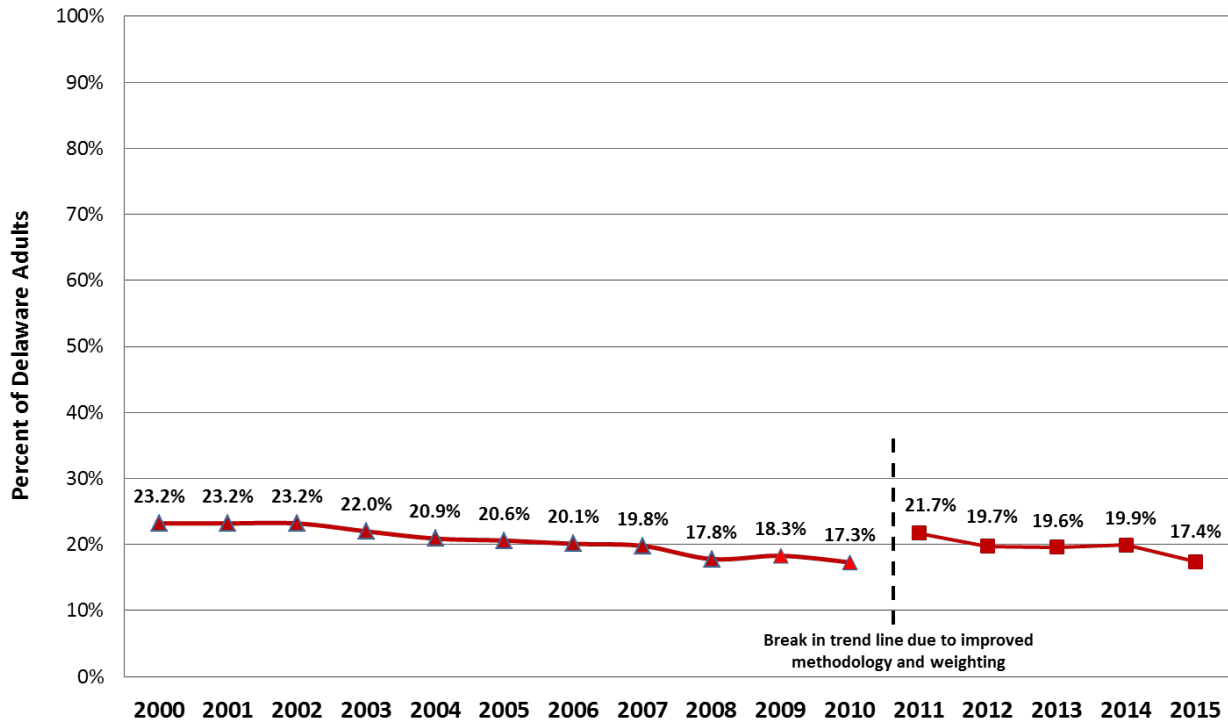
Smoking and environmental phenomena such as airborne pollution can trigger asthma symptoms, particularly among the group with “current asthma.” Surveillance of these external factors is a critical part of asthma control and prevention. The hope is that these factors decline over time, benefiting Delaware residents who have asthma.

## Smoking and “Vaping”

In the graphs that follow, we present the trends of some of these key environmental factors. The graph below tracks the percentage of adult Delawareans who smoke.

Figure 8

### Delaware Adult Cigarette Smoking Trend: 2000-2015

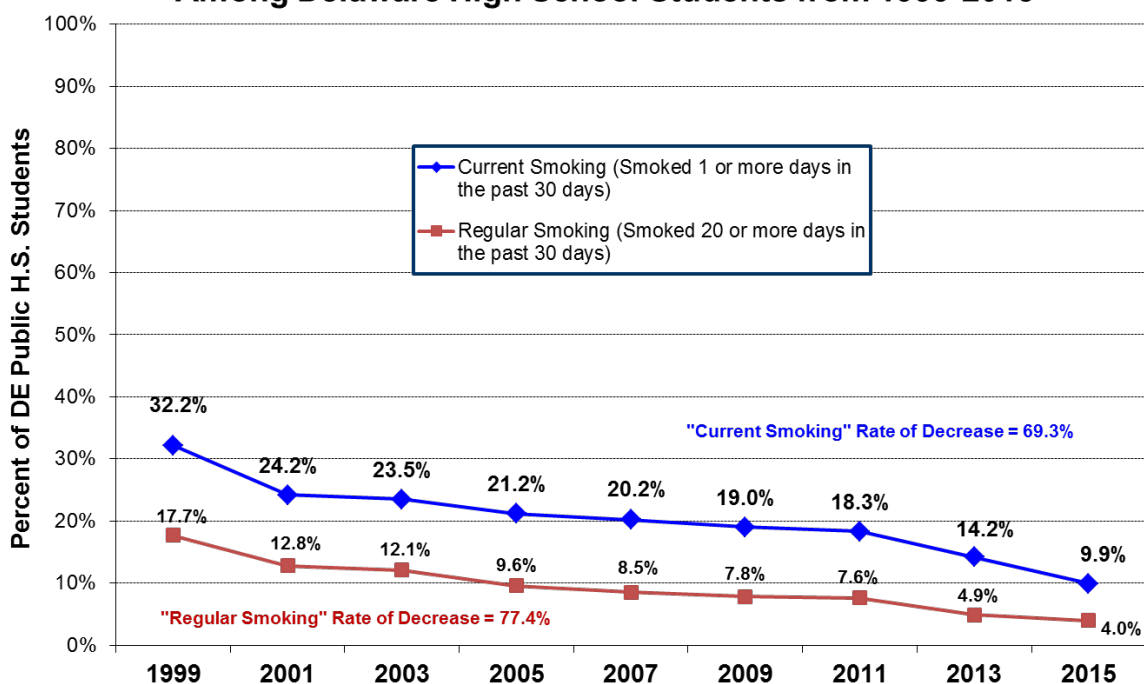


Source: DHSS, Division of Public Health, Behavioral Risk Factor Survey (BRFS), 2000-2015.

Figure 9 presents a snapshot of the smoking patterns of high school students in Delaware.

Figure 9

**Prevalence of Current Cigarette Smoking Decreased Steadily Among Delaware High School Students from 1999-2015**



Sources: CDC/DOE/DPH, Youth Risk Behavior Survey (YRBS), 1999-2015

Although cigarette use has declined dramatically among high school students in recent years, the measure “cigarette smoking” doesn’t show the complete picture. Some students also use traditional smokeless products like chewing tobacco and snuff. Little cigars or cigarillos are growing in popularity among some young people. Little cigars are less expensive because they are sold in smaller packs and they are not taxed as much as cigarettes.

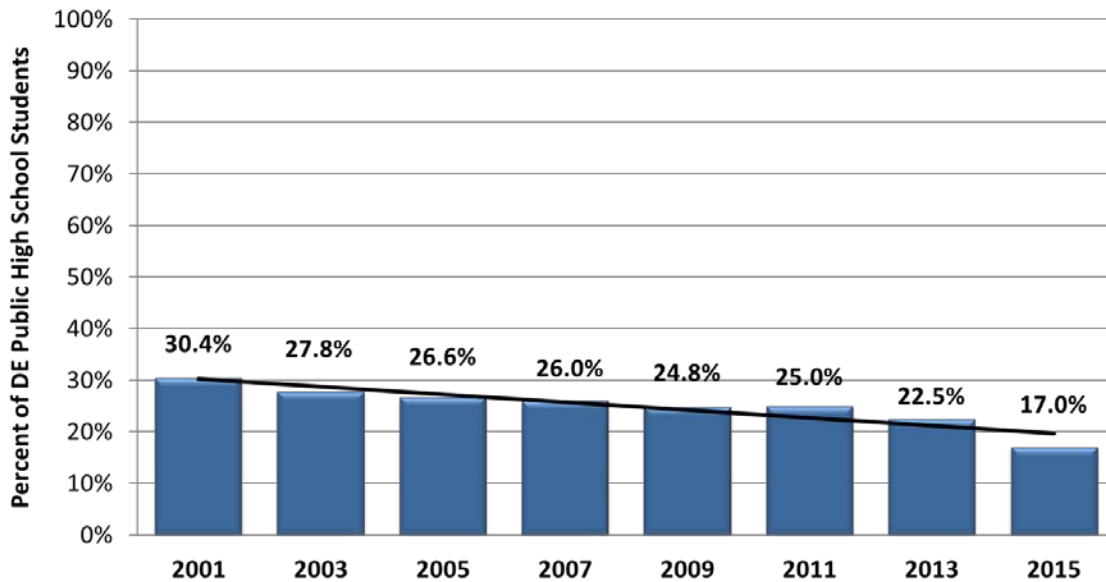
The tobacco industry has introduced new smokeless tobacco products, such as snus (flavored, ground tobacco in teabag-like pouches), and dissolvable strips and orbs that are packaged like gum or mints. So while “current smoking” among high school students was down to about 10 percent in 2015, total tobacco use including smokeless and other new tobacco products was significantly higher at 17 percent. Total tobacco use (see Figure 10), excluding e-cigarettes, is still declining.

The biggest challenge comes from the introduction of electronic vaporizing devices, or e-cigarettes. Although e-cigarettes have been available in the United States for nearly a decade, recent marketing campaigns by the tobacco industry have resulted in an explosion of popularity among students since 2014. E-cigarettes are a tobacco product, and most contain addicting drugs like nicotine and acetaldehyde.<sup>iii</sup> They contain other toxic chemicals, but long-term health effects are not yet fully known. What is currently known is that most e-cigarettes are addicting, and they contribute to cardiovascular and lung diseases, most likely including asthma<sup>iv</sup>. They have not been approved as an effective method of smoking cessation.<sup>v</sup>

Figure 10

### "Total Tobacco Use" Declining Among Delaware Public High School Students, 2001-2015

[Cigarettes, Cigars and Little Cigars, Smokeless Tobacco]

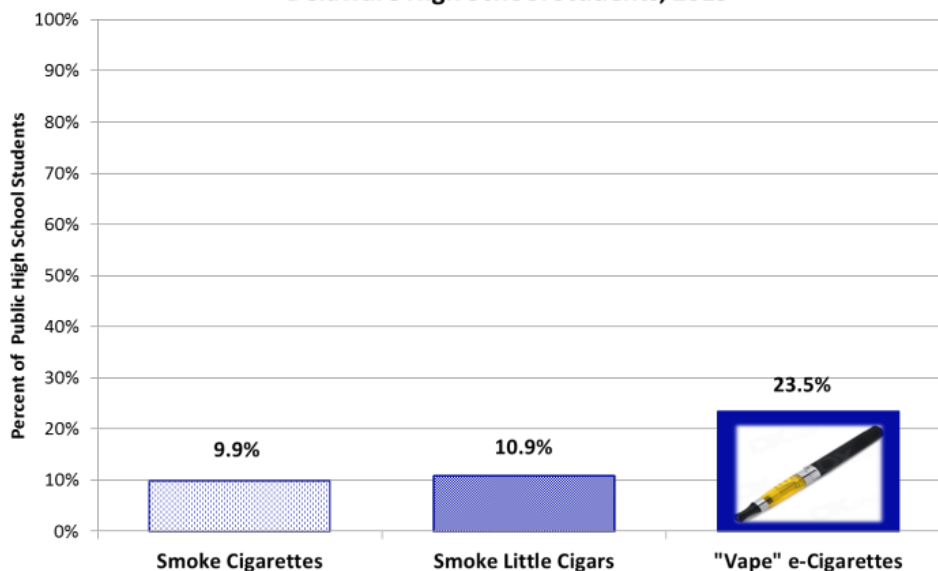


Source: DOE/DPH, Youth Risk Behavior Survey (YRBS), 2001-2015.

Figure 11 shows the prevalence of e-cigarette "current use" (use during past month) among Delaware public high school students in 2015. This was the first year the YRBS measured e-cigarette use in Delaware.

Figure 11

### Cigarette Smoking Prevalence Compared to Other Products, Delaware High School Students, 2015



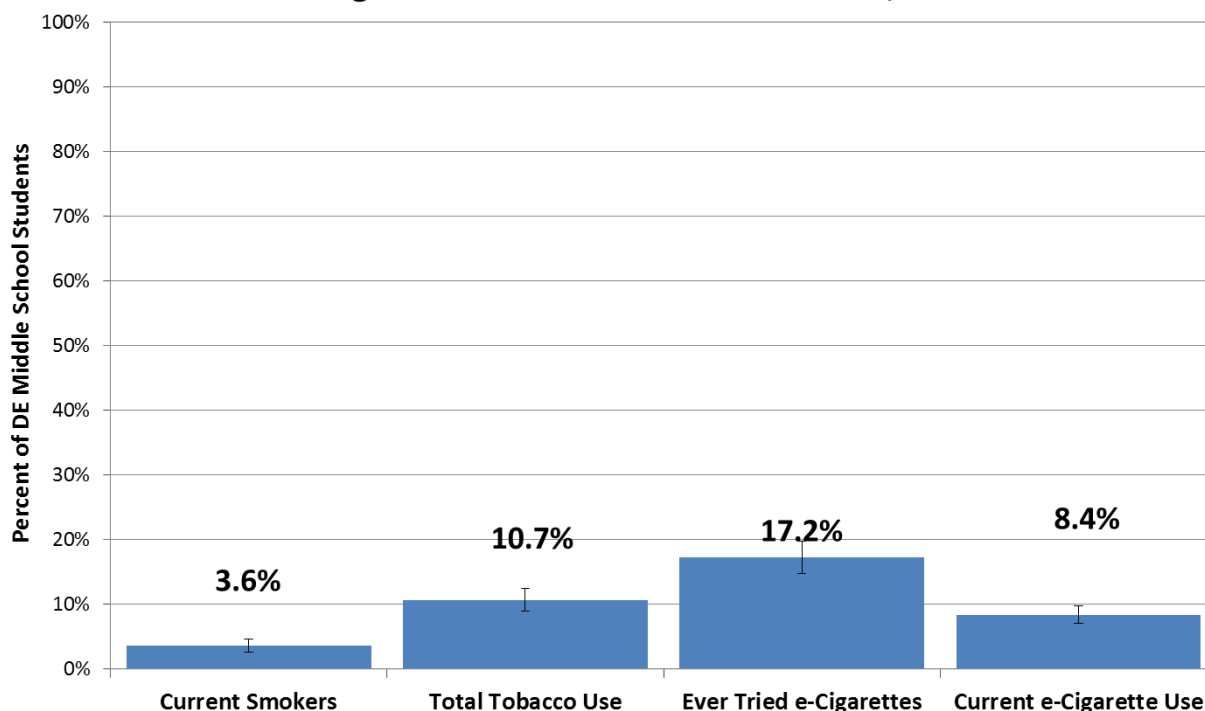
Source: DHSS, Division of Public Health, Youth Risk Behavior Survey (YRBS), 2015.

Another study, the Youth Tobacco Survey (YTS), conducted for the DPH Tobacco Prevention and Control Program, measured e-cigarette use in 2012 and 2014, using similar methodology, but with a smaller sample size. According to the YTS, only about 2.1 percent of high school students said they “currently used” e-cigarettes in 2012; prevalence more than doubled to 5.6 percent in 2014. The big increase, however, was seen in 2015, when “current use” among Delaware high school students jumped to 23.5 percent (YRBS). This compares to 24.1 percent of high school students nationally in 2015 (YRBS).

About 40.5 percent of public high school students say they have tried e-cigarettes. Again, Delaware is slightly lower than the national median prevalence of 44.9 percent. Of most concern, perhaps, is that 37 percent of students who smoke or “vape” e-cigarettes have never smoked regular cigarettes.

Delaware middle school students, as expected, smoke significantly less than high school students – and also use e-cigarettes less (see Figure 12). However, as with high school students, the middle school prevalence of e-cigarette use was surprisingly high in 2015.

**Figure 12**  
**Cigarette Smoking, Total Tobacco Use, and e-Cigarette Use**  
**Among Delaware Middle School Students, 2015**



Source: DHSS, Division of Public Health, Youth Risk Behavior Survey (YRBS) Middle School Sample, 2015.

In 2014, the Delaware General Assembly prohibited sale of electronic vapor devices to minors under age 18. They amended Delaware’s Clean Indoor Air Act (CIAA) in 2015 to prohibit use of e-cigarettes and other electronic vapor devices in workplaces and indoor public places. These

changes help make the state more hospitable for people with asthma. However, there is still no excise tax on e-cigarettes in Delaware.

While it is good news for Delawareans with asthma that smoking prevalence in Delaware has declined, the increase in popularity of electronic vaping devices creates new concerns. This suggests the importance of addressing emerging tobacco issues with adequate enforcement, counter-marketing, and health education.

Another strategy – included in the IMPACT Tobacco Prevention Coalition’s strategic plan – is to conduct campaigns to prevent second-hand smoke exposure in non-public places. Campaigns can be developed to encourage the public, especially those with children and asthma sufferers in their households, to reduce second-hand smoke exposure in their homes and vehicles. Parents can adopt personal policies of no smoking in their homes and vehicles. Public Health and other allied agencies can conduct campaigns urging smokers to “take it outside” and avoid exposing others with asthma to tobacco smoke or vapor.

## Airborne Pollution

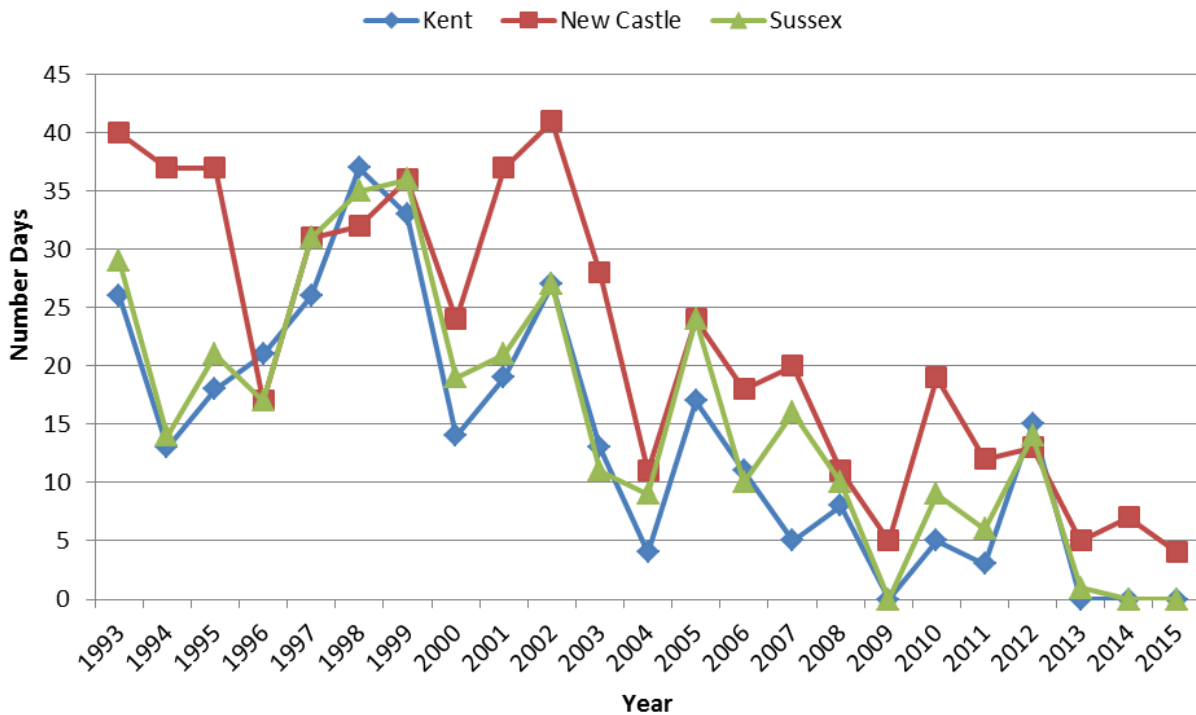
Public agencies, including the federal Environmental Protection Agency (EPA) and the Delaware Department of Natural Resources and Environmental Control (DNREC), systematically monitor air quality. In accordance with the federal Clean Air Act, DNREC continuously monitors six pollutants: carbon monoxide (CO), oxides of nitrogen (NO<sub>x</sub>), ozone (O<sub>3</sub>), sulfur dioxide (SO<sub>2</sub>), and two types of particulate matter – particles smaller than 10 micrometers (PM<sub>10</sub>) and smaller than 2.5 micrometers (PM<sub>2.5</sub>). States provide the data values to EPA using the Air Quality System database from which EPA compiles reports.

The EPA created a combined measure of all these pollutants called the Air Quality Index (AQI) that it reports on its website and in a variety of reports. The AQI is a series of banded values, with higher values being detrimental. Below is the EPA data of the AQI for the three Delaware counties, for the top two bands only – *Unhealthy for sensitive groups* (which would include those with asthma), values 101 through 150, and *Unhealthy*, values above 151. This graph (Figure 13) maps the number of days in each Delaware county for which the AQI was in these potentially adverse categories. According to DNREC’s 2014 *Annual Air Quality Report*, ozone is the primary driver of these higher values.

The AQI is based on the pollutant that is the highest concentration on any given day. While ozone and particulate matter are the pollutants most frequently driving the AQI, other pollutants are present in lower concentrations. These other pollutants, such as sulfur dioxide (SO<sub>2</sub>) and nitrogen dioxide (NO<sub>2</sub>), may be important triggers of asthma, even when not reflected in the AQI value for a particular day.



**Figure 13**  
**Number of Days AQI Unhealthy for Sensitive Groups and Above**



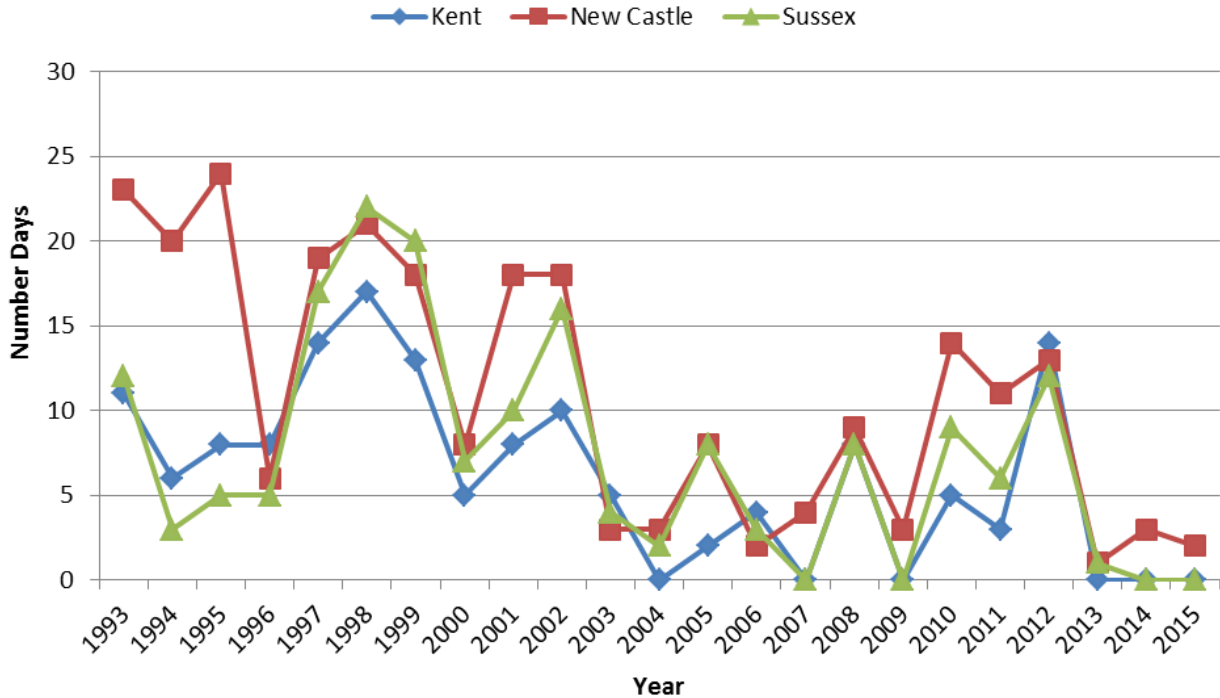
Source: DNREC, Division of Air Quality, Air Quality System (AQS) data, 1993 – 2015

Figure 13 shows that New Castle County has the most days in categories defined as unhealthy compared to the other Delaware counties. It also shows that the number of days in the unhealthy to sensitive groups and higher categories in all counties has been decreasing since 1993.

DNREC also tracks the number of days that ozone (O<sub>3</sub>) exceeds the National Ambient Air Quality Standard (NAAQS) measured as an eight-hour average. Figure 14 shows that the trend in “number of exceedances of the standard” has been downward since 1993 for all three counties.

Figure 14

## Number of Days Exceeding 8-hour Ozone Standard



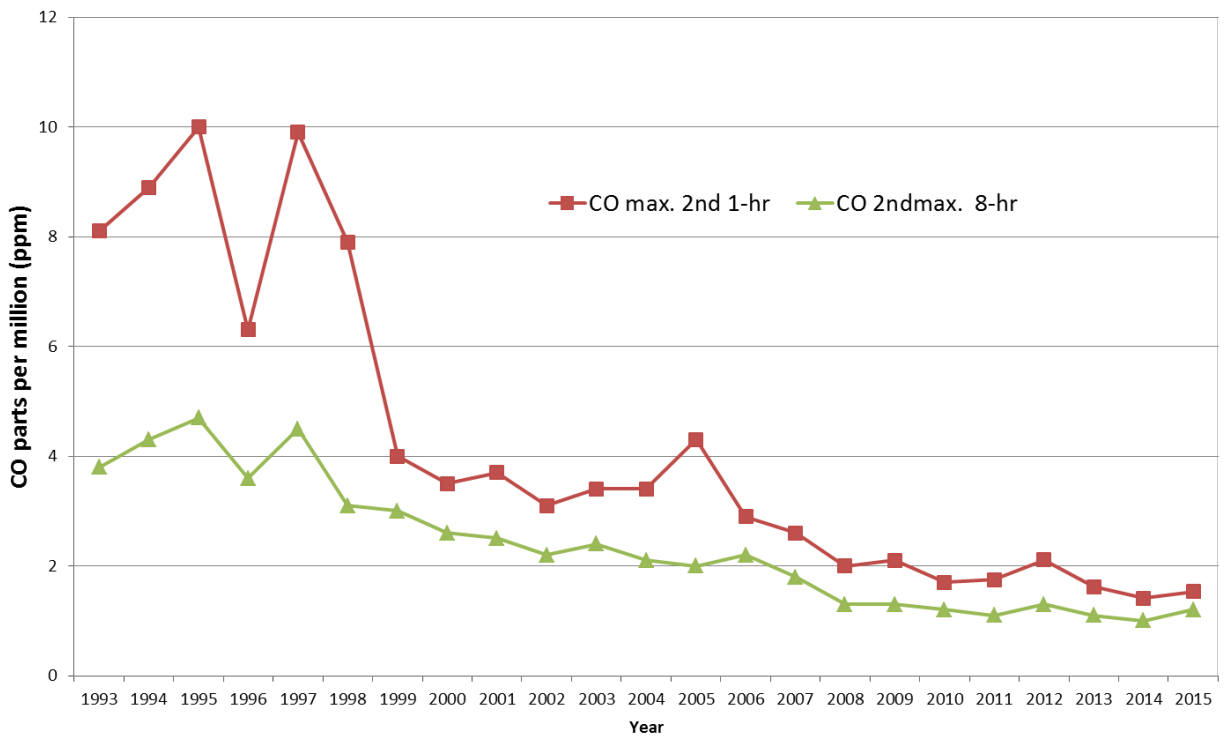
Source: DNREC, Division of Air Quality, Air Quality System (AQS) data, 1993 – 2015

There is evidence that air pollutants from traffic emissions may have an impact on asthma. One indicator of air pollution from traffic is carbon monoxide (CO). Figure 15 shows trends in CO concentrations measured as the second highest one-hour and eight-hour averages in each year at the Wilmington monitoring site from 1993 to 2015.

These data also show decreasing concentrations of pollution from traffic emissions since 1993, although the trend has flattened in recent years.

Figure 15

### Indicators of Emissions from Traffic, Delaware 1993-2015

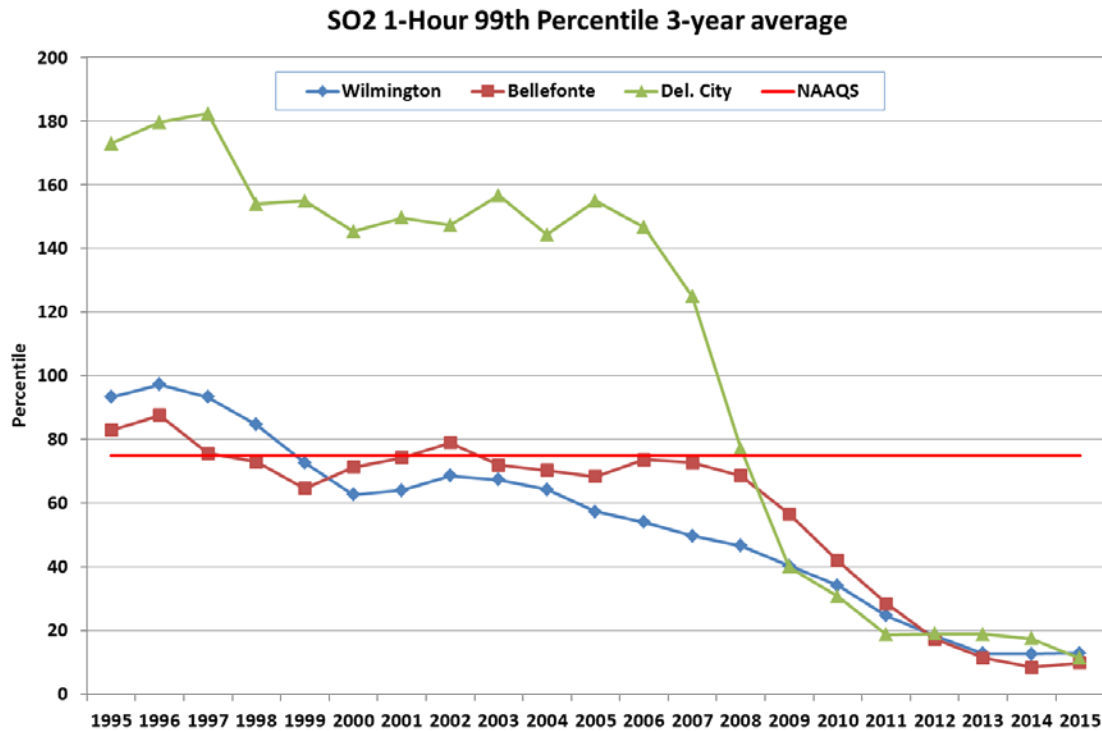


Source: DNREC, Division of Air Quality, Air Quality System (AQS) data, 1993 - 2015.

In its *Integrated Science Assessment for Sulfur Oxides — Health Criteria* document of 2008, EPA concluded that there is evidence of a causal relationship between short-term SO<sub>2</sub> exposure and respiratory effects, particularly in individuals with asthma. Figure 16 shows the trend in ambient SO<sub>2</sub> concentrations at three monitoring sites in New Castle County with respect to the current 1-hour National Ambient Air Quality Standard (NAAQS).

The trend at all sites is downward, and although there is some flattening of the trend in recent years, ambient concentrations are well below the NAAQS.

Figure 16



Source: DNREC, Division of Air Quality, Air Quality System (AQS) data, 1993 - 2015.

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“Long-term exposure to close-proximity air pollution and asthma and allergies in urban children,” Pe´nard-Morand, Raheison, Charpine, Kopferschmitt, Lavaud, Caillaud and Annesi-Maesano, *Eur Respir J*, 36: 33–40, 2010.

“Integrated Science Assessment for Sulfur Oxides-Health Criteria,” EPA/600/R-08/047F, 2008.

## Additional Resources:

The American Lung Association has information about asthma and about state-level air quality at the following two websites:

<http://www.lung.org/lung-health-and-diseases/lung-disease-lookup/asthma/>

State of The Air report:

<http://www.lung.org/our-initiatives/healthy-air/sota/>



Additional data on asthma in the United States are available from the American Academy of Allergy, Asthma and Immunology:

<http://www.aaaai.org/about-aaaai/newsroom/asthma-statistics>

A variety of educational information and data about asthma is available from the U.S. Centers for Disease Control and Prevention (CDC) at:

<http://www.cdc.gov/asthma/>

Adult Behavioral Risk Factor Survey (BRFS) data are at:

<http://dhss.delaware.gov/dph/dpc/brfsurveys.html>

Youth Risk Behavior Survey data online are at:

<https://www.cdhs.udel.edu/seow/school-surveys/>

Asthma data for children in Delaware are available from the Nemours Health and Prevention Services Data Center:

<http://datacenter.nemours.org/>

Data on morbidity and mortality in Delaware are available from the Division of Public Health's *Vital Statistics Annual Report*:

<http://www.dhss.delaware.gov/dhss/dph/hp/healthstats.html>

The original *Burden of Asthma in Delaware* report from 2005 is available online at:

<http://dhss.delaware.gov/dph/dpc/asthma.html>

**Contact Information:** If you have questions about this report, or wish to obtain more information about asthma in Delaware, contact the Office of Health Education, Division of Public Health, Thomas Collins Building, Suite 7, 540 S. DuPont Highway, Dover, DE 19901-4523.

**Giving Credit:** When referencing this report, acknowledgement should be given to the Division of Public Health, and the Department of Natural Resources and Environmental Control. The reference should read: "Source: Delaware Health and Social Services Division of Public Health, and Department of Natural Resources and Environmental Control Division of Air Quality, *The Burden of Asthma in Delaware: 2015 Update*, May 20, 2016."

# Acknowledgements

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<sup>i</sup> *The Burden of Asthma in Delaware*, Delaware Health and Social Services, Division of Public Health, Document Control Number 35/05/20/05/08/01, August 2005. <http://dhss.delaware.gov/dph/dpc/asthma.html>

<sup>ii</sup> "Asthma Statistics," American Academy of Allergy, Asthma and Immunology, <http://www.aaaai.org/about-aaaai/newsroom/asthma-statistics>

<sup>iii</sup> Rachel Grana, PhD, MPH, Neal Benowitz, MD, and Stanton Glantz, PhD, "E-cigarettes: A Scientific Review," *Circulation*. American Heart Association. 129: 1972-1986; 2014.

<sup>iv</sup> Wolfgang Schober, Katalin Szendrei, *et al*, "Use of electronic cigarettes impairs indoor air quality and increases FeNO levels of e-cigarette consumers," *International Journal of Hygiene and Environmental Health*. 217:6: 628-637: July 2014.

<sup>v</sup> On May 5, 2016, the U.S. Food and Drug Administration (FDA) issued a rule, under the Family Smoking Prevention and Tobacco Control Act of 2009, deeming e-cigarettes and other new tobacco products subject to the statute. E-cigarettes will now be regulated for the first time by the FDA.