Governor's Cancer Research Initiative

Cancer Incidence Report for the East Buffalo/Western Cheektowaga Study Area

Albany, New York

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Executive Summary

This report summarizes cancer patterns and trends and possible contributing factors in the East Buffalo/West Cheektowaga (EBWC) Study Area. This investigation was conducted as part of Governor Cuomo's Cancer Research Initiative announced in October 2017, which examined cancer trends and the potential causes of cancer in four regions of the state that have higher cancer rates, based on 2011-2015 data. New York State Department of Health (DOH) researchers investigated the EBWC area because of higher numbers of colorectal cancer, esophageal cancer, kidney cancer, lung cancer, oral cavity (mouth and throat) cancer, and prostate cancer.

During the EBWC investigation, DOH obtained input from interested members of the community. Researchers met with community members to present the design, goals, and approaches. Community members and stakeholders provided input at meetings and emailed additional feedback.

DOH will use these findings to work with partners to enhance community cancer prevention, recommend appropriate screening efforts, and support access to appropriate high-quality health care.

What was Evaluated

Sociodemographic Data

DOH researchers examined data about the population, such as race, ethnicity, age, income and occupational patterns, to see if these factors could be related to higher cancer rates. These data were obtained from the US Census. Comparisons were made to Erie County, New York State excluding New York City (NYC excluding NYC) and New York State (NYS).

Cancer Data

For each type of cancer that was elevated, the evaluation of Cancer Registry data included cancer trends over time; age and gender of patients diagnosed with cancer; and characteristics of the cancer, such as type of cells that were cancerous, tumor size, and stage of disease at the time of diagnosis. Cancer data were obtained from the New York State Cancer Registry (NYSCR), which contains information on all cases of cancer diagnosed or treated in New York, as mandated by law. Researchers evaluated NYS and NYS excluding NYC as comparison areas for further evaluation of cancer patterns. The difference in expected counts generated from the two comparisons were small, and ultimately the NYS excluding NYC standard was used in subsequent analyses.

Behavioral, Healthcare and Occupational Data

DOH researchers reviewed available data about behavioral, healthcare, and occupational

factors in the community that are known to be related to cancer. These included available information about smoking, obesity, occupation, and medical care access and practices. Data sources included the Behavioral Risk Factor Surveillance System population survey, NYS inpatient and outpatient hospital data, and the American Community Survey of the US Census.

Environmental Data

DOH researchers worked with the Department of Environmental Conservation (DEC) to review available environmental data to look for unusual patterns or trends in the area compared to other areas of NYS. Data included radon concentrations in indoor air, outdoor air pollutants, drinking water contaminants, industrial and inactive hazardous waste disposal sites, access to healthy food, and traffic density.

Findings

Sociodemographic Factors

The total population of the Study Area is about 43,000. While the majority of people in Erie County, NYS excluding NYC and NYS are white, about 70% of the population in EBWC area is black. In 1990, the population was split 51% white and 48% black. By 2010, the population shifted to 25% white and 70% black. The median household income in the EWBC area is also significantly lower than in the three comparison areas. Poverty and unemployment are about double in the study area, with a higher proportion of people on public health insurance versus private insurance. Only a slightly higher proportion of people in the area had no health insurance compared to Erie County.

Cancer Patterns and Risk Factors

Oral Cancer includes cancers of the mouth (including lips and salivary glands) and throat. The EBWC Study Area is part of a larger area that had elevated incidence of oral cancer. However, oral cancers were not statistically significantly elevated in the targeted EBWC study area in 2011-2015.

According to the scientific literature, people at greatest risk for oral cancer are those who use large amounts of both alcohol and tobacco. Family history is also an important risk factor. Infection with the human papillomavirus (HPV) increases a person's risk of oral cancer. People whose diets include large amounts of fruits and vegetables are at lower risk of oral cancer. Sunlight exposure is associated with lip cancers. Cancer of the salivary glands is associated with exposure to ionizing radiation.

Based on review of available data, smoking and alcohol consumption might have contributed to the small excess in cancers that was observed. The results from the environmental investigation did not show any unusual environmental exposures that could be related to the excess in oral cancers in EBWC area.

Esophageal Cancer is cancer of the long, muscular tube that connects the throat to the stomach. Esophageal cancer was 71% higher than expected in 2011-2015 in the EBWC area. The number of cases was statistically higher in men, specifically in men aged 50-64. However, esophageal cancer is relatively rare, and this evaluation was based on a relatively small number of cases.

According to the literature, alcohol, obesity and tobacco use account for about 80% of esophageal cancers. Squamous cell carcinoma and adenocarcinoma are the two most common types of esophageal cancers. Squamous cell carcinomas are strongly associated with tobacco use and alcohol consumption. Being overweight or obese increases the risk of adenocarcinomas. Adenocarcinomas are also associated with gastroesophageal reflux disease (GERD).

Data indicate that people living in the study area were more likely to use tobacco than people in the comparison areas. Approximately 79% of esophageal cancer cases in the EBWC area reported a current or previous history of smoking. Diagnostic codes related to smoking, obesity and alcohol use appeared more often in records of residents from the EBWC area seeking care in hospitals and emergency departments compared to other areas of NYS. Similarly, population survey data suggest that people living in the area's ZIP Codes had significantly higher smoking and higher obesity rates compared to NYS excluding NYC. See more about smoking behavior in *Behavioral, Healthcare System, and Occupational Factors*.

Data were insufficient to evaluate the role of occupational risk factors. Results from the environmental investigation did not show any unusual environmental exposures that could be related to the excess in esophageal cancers in EBWC area.

Lung Cancer was the third most common cancer in NYS and the second most common cancer in Erie County in 2011-2015. Lung cancer was 25% higher than expected in the EBWC area. The excess in lung cancers was statistically significantly higher among men 65 and older. Among women, the excess in lung cancers was statistically significantly higher among those age 50-64.

Lung cancers in the study area were also statistically significantly higher than expected in the non-Hispanic black and other race group taken alone. Lung cancer rates in Erie County have been consistently higher than rates in other areas of the state since 1996.

Approximately 80% of lung cancers have been attributed to smoking, with strongest linkages to squamous cell and small cell carcinoma. There was a history of tobacco use reported in nearly 90% of lung cancer diagnoses in the EWBC study area, with about 48% of those being current smokers. Diagnostic codes related to smoking among people seeking care in hospitals and emergency departments appeared more often in records of residents from the EBWC area compared to other areas of NYS. Similarly, population survey data suggest that people living in the area's ZIP Codes had significantly higher smoking and higher obesity rates compared to NYS excluding NYC. See more about tobacco use in *Behavioral, Healthcare System, and Occupational Factors*.

Radon is considered the second most important risk factor for lung cancer. Overall, evaluation of the radon data for the EBWC Study Area did not provide strong evidence of widespread exposure to unusually high concentrations of radon. However, the total number of radon tests in the area was relatively low. Results from the environmental data review did not show any other environmental exposures that may be related to lung cancer risk in the EBWC area. Other risk factors for lung cancer include family history and genetic factors, exposure to second-hand smoke, and other sources of environmental and occupational exposure.

Occupational patterns and Buffalo's history as an industrial and manufacturing hub suggest that occupational exposures could be a contributing factor in lung cancer in the area. However, data were insufficient to evaluate the role of occupational risk factors.

Colorectal Cancer incidence was 40% higher than expected in the EBWC area and was statistically significantly higher than expected among men in 2011-2015. Numbers of colorectal cancers were greater than expected among men over age 50. Colorectal cancers were also significantly higher than expected among those in the non-Hispanic black and other race category. Distant stage cancers and cancers of the proximal colon were also statistically significantly higher than expected in the EBWC area.

According to the literature, smoking is associated with colorectal cancer, but the association is not as strong as for some other smoking-related cancers. About 48% of the individuals with colorectal cancer in the EBWC area were smokers or had a history of smoking. Alcohol intake, excess body weight, red and processed meat consumption, diets low in dietary fiber and calcium, and lack of physical activity also contribute to colorectal cancer risk. Diagnostic codes related to smoking, obesity and alcohol use among people seeking care in hospitals and emergency departments appeared more often in records of residents from the EBWC area compared to other areas of NYS. Population survey data also suggest that people living in the ZIP Codes including the Study Area had a significantly higher smoking rate, were less likely to engage in leisure time physical activity, and had higher rates of obesity compared to NYS excluding NYC. See more about smoking behavior in *Behavioral, Healthcare System, and Occupational Factors*.

Studies have found colorectal cancers are higher in areas with lower community-level socioeconomic status. Researchers evaluated data available about screening by colonoscopy, which reduces risk of developing colorectal cancer by removing pre-malignant lesions. The U.S. Preventive Services Task Force (USPSTF), an independent, volunteer panel of national experts in disease prevention and evidence-based medicine, recommends screening at ages 50-75. Data were insufficient to fully evaluate whether people with incident colorectal cancer in 2011-2015 were diagnosed as a result of screening. However, review of hospital and emergency department data indicate that the percent of people getting colonoscopies in the area is similar to other areas of NYS. Population survey data also show higher rates of colorectal cancer screening in the ZIP Codes including the Study Area compared to the rest of the state. Elevated incidence of colorectal cancer despite apparently high screening rates may be explained, at least in part, by the finding that proximal colon cancers accounted for a large portion of the

excess. Some studies have suggested that certain colorectal cancer screening techniques are not as effective at reducing occurrence of cancers in the proximal colon.

The literature is less conclusive on environmental and occupational risk factors for colorectal cancer. However, results from the environmental investigation did not show any unusual environmental exposures that could be related to the excess in colorectal cancers in the EBWC area. Data were insufficient to evaluate the role of occupational risk factors.

Prostate Cancer occurs in the prostate, which is part of the male reproductive system, and was 49% higher than expected in the EBWC area in 2011-2015. Prostate cancer was the second most common cancer in NYS and the third most common cancer in Erie County in that time period.

Aside from race and family history, there are few firmly established risk factors for prostate cancer. Rates of prostate cancer are higher among black men than among white men. After adjusting for race, the number of prostate cancers in the EBWC area did not stand out as statistically significantly above what was expected.

It is possible that changes in prostate cancer screening practices played a role in the observed elevation in the EBWC area. An increase in prostate cancer nationally in the 1990s corresponded to an increase in early stage prostate screening capabilities adopted during that time. Some of these detected cancers were not likely to progress in a way to cause clinically meaningful symptoms or require active treatment. Today, the USPSTF does not find enough net benefit to recommend the practice for men 55-69 and finds no net benefit for men older than 70. Prostate cancer rates statewide dropped substantially since 2000, however rates in Erie County have decreased more slowly. It is possible that the higher than expected numbers of local stage prostate cancers may reflect more intensive screening practices in Erie County compared to other areas of NYS.

Kidney Cancer in the EBWC area was 69% higher than expected in 2011-2015. In Erie County, the rate of kidney cancer was higher in men than women and about 20% higher among blacks than whites. In the study area, numbers of kidney cancers were statistically greater than expected in both men and women. Statistically significant excess numbers were observed in the age categories 50-64 and 65 and older, and in both whites and black/other race groups.

Kidney cancers have been increasing in NYS since the late 1970s but have slowed in more recent years. According to the literature, obesity and smoking increase the risk of kidney cancer.

Diagnostic codes related to smoking and obesity among people seeking care in hospitals and emergency departments appeared more often in records of residents from the EBWC area compared to other areas of NYS. Similarly, population survey data suggest that people living in the area's ZIP Codes had significantly higher smoking rates and higher obesity compared to NYS excluding NYC. These data suggest that smoking and obesity may be of concern and may

contribute to kidney cancer in the EBWC area. See more about smoking and obesity in *Behavioral, Healthcare System, and Occupational Factors*.

Occupational exposure to trichloroethylene (TCE) has been associated with kidney cancer based on animal and worker studies in the dry cleaning, aerospace, and uranium industries and in factories that used TCE as a degreasing agent. Occupational patterns and Buffalo's history as an industrial and manufacturing hub suggest that occupational exposures could be contributing to the observed excess. However, data were insufficient to evaluate the role of occupational risk factors in kidney cancer in the area.

Review of industrial and inactive hazardous waste disposal sites did not find clear evidence of widespread exposure to TCE among the general public. Past studies have explored associations between kidney cancer and drinking water contaminants including arsenic, nitrate, disinfection by-products and PFOA. However, researchers found no violations for drinking water contaminants in the EBWC area during the time period evaluated. Studies have not shown strong associations between kidney cancer and outdoor air pollution. Estimates of cancer risk associated with hazardous air pollutants in outdoor air were similar to other areas of NYS.

Behavioral, Healthcare System, Environmental Factors and Occupational Factors

Tobacco Use

Oral, esophageal, lung, colorectal, and kidney cancers are tobacco-related. The population survey and hospital inpatient and outpatient discharge data suggested that people in the study area may be more likely to smoke, although sample size was limited. Results show that nearly 30% of population survey respondents reported being current smokers, compared to about 16.7% in NYS excluding NYC. Similarly, a review of hospital and emergency department visits indicates that a greater proportion of people in the EBWC area had records with billing codes related to smoking compared to other areas of NYS.

Obesity

Esophageal and kidney cancer are associated with obesity. Population survey data suggested that the percent of people aged 18 and older in the study area who are obese is greater than in NYS excluding NYC, although the sample size was limited. Similarly, a review of hospital and emergency department visits indicates that a greater proportion of people in the EBWC study area had records with billing codes related to obesity compared to other areas of NYS.

Healthcare System

The healthcare system itself can influence the likelihood that someone could be diagnosed with certain cancers before any symptoms appear. People with health coverage have better access to healthcare services. Researchers evaluated healthcare coverage and access to care using the

population survey. The results suggested that the area has slightly lower rates of healthcare coverage and a slightly higher rate of colorectal cancer screening compared to other areas of the state.

Environmental Factors

Outdoor Air Pollution. Researchers reviewed air quality monitoring and computer modeled data for air pollutants and air toxics. Criteria air pollutant levels have been trending downward (i.e., cleaner air) over time. The estimated cancer risks from air toxics in the EBWC area are similar to those for other areas of the state.

Radon in Indoor Air. Radon is the second leading cause of lung cancer after smoking. Researchers evaluated radon testing frequency and compared average concentrations in the EBWC Study Area to the US Environmental Protection Agency's (EPA) recommended action level, as well as other areas of the state. Based on a relatively small number of radon tests in the EBWC area, 3.8% were above EPA's radon action level, significantly lower than the proportion for Erie County and other areas of the state.

Public Drinking Water. Researchers reviewed public drinking water data to identify potential drinking water exposures. EBWC is served by two public water systems: the Buffalo Water Authority and the ECWA Direct. The review showed no violations of drinking water standards in the public water supply systems during the time period data were available. Review of unregulated contaminant sampling data identified exceedances of reference concentrations for one chemical. However, sampled concentrations were below those which normally cause health effects in animals.

Industrial and Inactive Hazardous Waste Disposal Sites. Researchers reviewed information about existing sites in the EBWC area. This evaluation found no information suggesting contamination from existing and known remedial sites was causing widespread exposures in the EBWC area.

Access to Healthy Food. The Modified Retail Food Environment Index (mRFEI) measures the number of healthy and less healthy food retailers within census tracts across each state in the US. Researchers evaluated mRFEI data for the census tracts that cross the EBWC area. This provides a screening for adequacy of access to healthy food. There is variation in the mRFEI across the EBWC area. In the portion of the EBWC that falls within the City of Buffalo, where a majority of the study area population lives, the mRFEI scores tend to be lower suggesting a lack of access to healthy food.

Traffic. Researchers assessed available data to compare the proportion of the population living near dense traffic areas compared to other areas of NYS. The most heavily trafficked roads in the EBWC area are Interstate 90 and Kensington Expressway. As in other urban areas, there is likely some exposure to traffic-related pollution in the EBWC Study Area. The proportion of the population living close to roads with the highest traffic density is lower than in NYC but higher

than in NYS excluding NYC, where there are more rural areas.

Occupation. Occupational histories are not typically reported as part of the diagnosis of cancer because most people are older at the time of their diagnosis and do not report job histories from earlier in life.

The EBWC and the Buffalo area were home to several industrial facilities. Some of the workers in these facilities were likely exposed to chemicals associated with cancer, although detailed information on frequency, magnitude and duration of exposure could not be evaluated as part of this study.

Researchers compared changes in EBWC employment trends over time to other areas of the state using the US Census and the American Community Survey data. Results indicate that the number of people in the EBWC area working in occupations that are more likely to have workplace exposure to hazardous substances is declining, although the area has a higher percentage of people working in these occupations than other areas of the state. Data also show a corresponding increase in service employment occupations.

Conclusions

- Overall, few cancers were observed in the 19 or younger and 20-49-year-old age groups and none of the differences between observed and expected counts in these age groups were statistically significant.
- In the analysis by gender, statistically significant excess incidence was observed mainly in men. Men overall had statistically significantly higher than expected incidence of esophageal, lung, colorectal, prostate (male-only), and kidney cancer. Women overall had statistically significantly higher than expected incidence of kidney cancers.
- It is likely that higher rates of tobacco use contributed to the elevated incidence of lung, oral, esophageal, kidney and colorectal cancers in the area. Higher rates of obesity and lack of physical activity also may be playing a role in higher rates of some cancers.
- Historically, the EBWC and the Buffalo area were home to several industrial facilities. Exposures to hazardous substances in the workplace can be important for several cancers, however data were insufficient to evaluate the role of occupational risk factors in cancer incidence.
- Access to healthcare is similar in the EBWC area as in other areas of NYS. However, for several of the higher than expected cancers, significant numbers of cancers were diagnosed at distant stages indicating people in the study area may not have accessed care for routine screening or monitoring that might have identified cancers at an earlier stage.
- Environmental factors evaluated in this study included radon concentrations in indoor air, outdoor air pollutants, drinking water contaminants, industrial and inactive hazardous waste disposal sites, traffic density, and access to healthy food. Based on these evaluations, there were no unusual environmental exposures that would likely explain the higher cancer incidence in the study area. With respect to access to healthy food, further evaluation of grocery options may be helpful to confirm the status of accessibility, or lack of accessibility,

to healthy food, especially in the Buffalo portion of the study area.

Recommendations

The recommendations below are divided into two main sections: 1) recommended actions to address the specific cancers that were elevated in the EBWC Study Area, and 2) recommended actions to address all cancer types throughout New York State. Many of the recommended activities are aligned with two existing State plans that address cancer prevention and control, the *New York State 2018-2023 Comprehensive Cancer Control Plan*, and the *New York State Prevention Agenda 2019-2024*.

Recommended Actions Based on Specific Cancers Elevated in the East Buffalo/West Cheektowaga Study Area

Health Promotion and Cancer Prevention

Tobacco Prevention

Recommendation: Prevent initiation of tobacco use, including combustible tobacco and electronic vaping products by youth and young adults.

Recommendation: Promote tobacco use cessation, especially among populations disproportionately affected by tobacco use including: low socioeconomic status; frequent mental distress/substance use disorder; lesbian, gay, bisexual and transgender; and disability.

Recommendation: Eliminate exposure to secondhand smoke and exposure to secondhand aerosol/emissions from electronic vapor products.

Alcohol Use

Recommendation: Implement environmental approaches, including reducing alcohol access, implementing responsible beverage services, reducing risk of drinking and driving, and restricting underage alcohol access.

Recommendation: Collaborate with partners and key stakeholders to educate the public, including youth and young adults, on cancer risk related to alcohol usage.

Recommendation: Provide personalized feedback about the risks and consequences of excessive drinking through the use of electronic screening and behavioral counseling interventions in healthcare settings, schools, and emergency rooms.

Recommendation: Among persons meeting the diagnostic criteria for alcohol dependence, promote the use of alcohol misuse screening and brief behavioral counseling

interventions via traditional (face to face) or electronic means, and referrals to specialty treatment.

Healthy Nutrition and Physical Activity

Recommendation: Promote healthy eating and food security by:

- Increasing access to healthy and affordable foods and beverages,
- Increasing skills and knowledge to support healthy food and beverage choices,
- Increasing food security, and
- Increasing awareness of DOH sportfish advisories to promote healthier fish consumption choices while reducing chemical exposures (https://www.health.ny.gov/environmental/outdoors/fish/health_advisories/).

Recommendation: Increase physical activity by:

- Improving community environments that support active transportation and recreational physical activity for people of all ages and abilities,
- Promoting school, child care, and worksite environments that support physical activity for people of all ages and abilities, and
- Increasing access, for people of all ages and abilities, to safe indoor and/or outdoor places for physical activity.

Cancer Screening and Early Detection

Lung Cancer Screening.

Recommendation: Educate men and women who meet the criteria for lung cancer screening about the benefits and risks of screening to help them make informed decisions.

Recommendation: Healthcare providers need tools and support to engage with patients who may benefit from screening, and facilities adopting lung cancer screening programs should be following national guidelines for a quality program.

Colorectal Cancer Screening

Recommendation: Educate men and women who meet the criteria for colorectal cancer screening about the benefits and risks of screening to help them make informed decisions.

Recommendation: Educate providers and the public that there are many testing options for colorectal cancer screening including take-home tests.

Recommendation: Reduce cost-related barriers to screening by educating providers and the public that health insurance plans in New York State are required to cover screening, and for those who are uninsured, the New York State Cancer Services Program (CSP) provides

free colorectal cancer screening to men and women age 50 and older.

Recommendation: Support primary care practices and staff to implement evidence-based strategies outlined in the Guide to Community Preventive Services such as the use of patient and provider screening reminders.

Prostate Cancer Screening

Recommendation: Educate men about the benefits and risks of prostate cancer screening to help them make informed decisions, especially men at higher risk for prostate cancer, including Black men and men with a family history of prostate cancer.

Healthy and Safe Environment

Radon Testing and Mitigation

Recommendation: Improve the public's awareness about the relationship between indoor radon exposure and lung cancer by conducting outreach and education about building testing and remediation. Promote the DOH's free and low-cost radon test kit programs, provision of test kits at half price to schools and daycares, and free test kits as part of the DOH's Healthy Neighborhoods Program and other grant-funded programs.

Recommendation: Explore local level policy and/or code adoption to require radon resistant construction in high radon areas.

Recommendation: Increase the number of physicians that ask their patients if they have had their homes tested for radon and refer them to the DOH, as needed. Add radon testing questions to routine electronic medical questionnaires.

Safety in the Workplace

Recommendation: Develop targeted occupational safety and health training programs for employers and workers in high-risk jobs.

Recommendation: Incorporate industry and occupation into electronic health records and other patient-oriented databases.

Recommended Actions to Reduce the Burden of All Cancers Statewide

Below are highlights of what individuals can do and what DOH and its partner organizations are doing. For more information on activities, by type of organization, that New Yorkers can do to help reduce the burden of cancer, see: https://www.health.ny.gov/diseases/cancer/consortium/docs/2018-2023_comp_cancer_control_plan.pdf#page=62.

For All New Yorkers

The following are things that all individuals can do to reduce their risk of cancer:

- If you use tobacco, quit. If you don't use tobacco, don't start.
- Eat nutritious meals that include fruits, vegetables and whole grains.
- Get moving for at least 30 minutes a day on five or more days each week.
- Use sunscreen, monitor sun exposure and avoid tanning salons.
- Limit alcohol use.
- Get cancer-preventive vaccines such as hepatitis B and HPV.
- Learn your family health history (if possible) and discuss with your healthcare provider whether genetic counseling might be right for you.
- Discuss what cancer screening tests might be right for you with your healthcare provider.
- Test your home for radon.
- For women of child-bearing age, know the benefits of breastfeeding and, if possible, breast-feed infants exclusively for at least the first six months of life.

For NYS Department of Health and Partner Organizations

Cancer Surveillance: The New York State Cancer Registry (NYSCR) was designated by the CDC (Centers for Disease Control and Prevention) as a Registry of Excellence and has achieved Gold-level certification since 1998. In 2018, the NYSCR became a member of the National Cancer Institute's Surveillance, Epidemiology and End Results Program (SEER), the nation's preeminent source of population-based cancer data.

> **Recommendation:** Continue to meet the highest cancer registry standards for timeliness, completeness and quality of data, and make these data available to researchers, clinicians, public health officials, legislators, policymakers, community groups and the public.

Environmental Health: DOH's Center for Environmental Health (CEH) works collaboratively with other agencies including the NYS Department of Environmental Conservation, the federal Environmental Protection Agency, the Centers for Disease Control and Prevention (CDC), and the Agency for Toxic Substance and Disease Registry (ATSDR). CEH programs evaluate health effects associated with environmental exposures, develop policies, and maintain a variety of programs to reduce and eliminate exposures.

> **Recommendation:** Continue to identify and assess potential exposures throughout the state and take action to reduce those exposures. NYS will continue to support programs to promote and maintain clean air, clean water and reduce human exposures to environmental hazards, with particular attention to the needs of environmental justice communities.

> **Recommendation:** Promote awareness of programs and initiatives to reduce environmental hazards in our communities.

Statewide Initiatives: The overarching goal of cancer prevention and control efforts in NYS are detailed in two State plans, the *New York State 2018-2023 Comprehensive Cancer Control Plan*, and the *New York State Prevention Agenda 2019-2024*.

Recommendation: Continue to work with partners to implement cancer-related initiatives.

- More details about the NYS Comprehensive Cancer Control Plan can be found at: https://www.health.ny.gov/diseases/cancer/consortium/index.htm.
- More details about the NYS Prevention Agenda can be found at: https://www.health.ny.gov/prevention/prevention_agenda/2019-2024/.

More Information

More details about the Governor's Cancer Research Initiative and this investigation may be found at https://www.health.ny.gov/diseases/cancer/cancer_research_initiative/.

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This report is available online at:
https://health.ny.gov/diseases/cancer/docs/ebwc_final_report_2019.pdf.

For questions and comments please send an email to canmap@health.ny.gov.

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Introduction and Background

About the Governor's Cancer Research Initiative

The Governor's Cancer Research Initiative, announced in October 2017, was undertaken to examine cancer trends and the risk factors for cancer in four regions of the state that have a higher incidence of cancer. The four regions are: Warren County in northeastern New York, Staten Island (Richmond County) in New York City, an area of East Buffalo and West Cheektowaga in western New York, and an area including the communities of Centereach, Farmingville and Selden on Long Island. As part of the initiative, staff from the New York State Department of Health (DOH) conducted a detailed review of cancer data for each area. Staff also examined information on demographic, socioeconomic, behavioral and occupational factors that might be contributing to the higher incidence of specific types of cancer. In addition, DOH staff worked with staff from the New York State Department of Environmental Conservation (DEC) to identify potential sources of environmental contaminants that may be affecting cancer rates. The DOH will use the results of the initiative to enhance community cancer prevention and screening efforts and support access to appropriate high-quality health care.

During the course of the initiative, DOH received input from interested members of the four communities on potential avenues of investigation and possible sources of the elevated cancer rates. In July 2018, DOH and DEC staff met with community members and stakeholders in each study area to present the design, goals and approaches for each investigation. At the meetings and afterwards, community members and stakeholders provided input that was taken into account during the investigation.

Cancer is one of the most common chronic diseases in New York State (NYS), and is second only to heart disease as the leading cause of death. Each year, about 110,000 New Yorkers are diagnosed with cancer. It has been estimated that 40 in 100 men and 38 in 100 women will be diagnosed with cancer at some point in their lives. [1] Cancer is not a single disease, but a collection of over 100 different diseases, each with its own occurrence patterns, effective treatments, outlooks and sets of causes. Incidence patterns for different cancers are affected by a number of factors, including those related to sociodemographics, personal behaviors, occupation and the environment. These patterns may also be affected by differences in how cancer is diagnosed across the state or over time. This report seeks to investigate and provide some insight into potential reasons for the higher than expected incidence of certain cancers in some areas of NYS, based on a review of available data sources.

Selection of study area and types of cancers being studied

The geographic region representing the East Side Buffalo/Western Cheektowaga (EBWC) study area was chosen based on a review of data and statistical analyses performed in the development of the DOH Environmental Facilities and Cancer Mapping application tool, which

is available online at:
https://www.health.ny.gov/statistics/cancer/environmental_facilities/mapping/about/frequently_asked_questions.htm. The maps show the counts for total cancer cases and for 23 types of cancer newly diagnosed from 2011 through 2015 by census block group in NYS. The maps also identify areas where the incidence of cancer was higher or lower than expected. To identify areas of higher or lower than expected cancer incidence, researchers calculated the expected incidence of each cancer type. Expected cancer incidence was calculated using cancer rates for NYS as a whole applied to the population of an area, taking into account that area's age and sex distribution. This shows the number of cases that would be expected to occur in the area if the people there developed cancer at the same rate as people in all of NYS. Highlighted areas are those where the observed cancer incidence differed from the expected cancer incidence by more than 50%. The EBWC study area is a general approximation of the overlap of areas with higher than expected incidence for six different types of cancer for the years 2011-2015: colorectal cancer, esophageal cancer, kidney cancer, lung cancer, oral cavity (mouth and throat) cancer, and prostate cancer.

Approach

The following sections provide an overview of the approach taken to evaluate cancer incidence in the EBWC study area. A number of data sources were evaluated and analyzed to gather information for this report. Summaries of those data sources can be found in Appendix A.

Cancer Incidence Patterns

Staff first reviewed NYS Cancer Registry information on statewide and Erie County-specific trends for the cancers that were elevated in the EBWC study area to better understand general patterns and trends over time. Additional data provided by the NYS Cancer Registry were the basis for all analyses of cancer patterns and prevalence. These data were previously geocoded and assigned a census block ID variable which was used to identify cancer cases occurring in the EBWC study area and comparison areas. The dataset included information on cancer type, patient demographics, summary stage at diagnosis, tumor characteristics and other variables related to the diagnosis. Staff also looked more in-depth at whether higher than expected incidence was focused in specific demographic groups by analyzing data by gender (male, female), age group (0-19, 20-49, 50-64, 65+), and race/ethnicity (non-Hispanic black, non-Hispanic white, Hispanic). Where necessary, gender, age, and race/ethnicity groups were combined to protect patient confidentiality.

Statistical methods used in the review of cancer patterns and prevalence were largely based on comparing observed and expected numbers of cancers in different categories, for example age and sex groups or tumor characteristics. The observed and expected numbers of cases were compared by means of the standardized incidence

What is the expected number of cases?
The expected number of cancer cases is the number of cases of cancer one would expect to find, if cancer rates in the study area were the same as in similar areas of the state. The expected number of cases is calculated by applying cancer incidence rates, by age and sex, for a reference area, to the estimated population of the study area, also by age and sex.

What is statistical testing?
Statistical testing is used to determine the probability that the findings obtained could have occurred by chance. In the evaluations of observed and expected numbers of cancer cases, findings are compared with tables of the Poisson distribution, which describes a process where a rare event occurs in a large population. If the probability of observing an excess or deficit was 0.025 or less, the result was considered to be statistically significant. Non-significant excesses or deficits are considered to represent random variations in observed patterns of disease.

What are confidence intervals?
Confidence intervals are indicators of the stability of a statistical estimate, with wider intervals indicating a less stable estimate. When applied to the ratio of observed to expected numbers of cases, confidence intervals that do not include the value 1.0 indicate that the observed number of cases is statistically different from the expected number.

What is summary stage?
Summary Staging is the most basic way of categorizing how far a cancer has spread from its point of origin. In the simplest form it has three categories: localized, regional, and distant.

- A **localized** cancer is limited to the organ of origin; it has spread no farther than the organ in which it started.
- At **regional** stage, the cancer has extended beyond the limits of the organ of origin. This can be either through spread into adjacent organs or surrounding tissue, or spread into nearby lymph nodes, or both.
- At **distant** stage: the cancer has spread beyond adjacent organs/tissues or nearby lymph nodes. Most commonly this involves distant metastases, that is, tumor cells have broken away from the original tumor, have travelled to other parts of the body, and have begun to grow in the new location.

ratio (SIR). An SIR greater than 1 indicates that there are more cases observed than expected, and an SIR less than 1 indicates fewer cases observed than expected. An SIR of 1.50 means that there were 50% more cases observed than expected. Statistical testing was used to evaluate whether any differences were likely to be due to chance. Results not likely to be due to chance were designated "statistically significant". Confidence intervals around the ratio of observed to expected numbers of cases were also calculated and are shown.

In choosing a comparison area for further analysis, demographic information related to age, race, socioeconomic status and nativity was reviewed, showing that the study area is substantially different from both NYS overall and NYS excluding NYC on a number of demographic factors (see Appendix E, Table 1). Initially, SIRs were calculated using both NYS overall and NYS excluding NYC as comparison areas, each time taking into account age and gender when estimating expected counts. For each of the six cancer types elevated in the EBWC study area, the difference in expected counts generated by comparing the two comparison areas differed by about 10% or less (expected counts for two comparison areas shown in Table 1). Because the differences in expected counts were small, and because the study area has a foreign-born population more similar to NYS excluding NYC, reflecting a higher likelihood of behaviors and exposures commonly experienced in NYS outside of NYC, NYS excluding NYC was used to generate comparisons. For the analysis by race/ethnicity groups, age, gender, and race/ethnicity were taken into account when calculating expected counts. This additional step can affect the expected counts. Therefore, the sum of the expected counts over all race/ethnicity groups may not be the same as the total expected counts in other analyses.

Evaluation of Sociodemographic, Behavioral, and Healthcare Factors

Previous studies show that, in addition to age and gender, cancer incidence rates vary according to community-level sociodemographic characteristics. Community-level socio-demographic characteristics represent the distribution of a particular variable (e.g., ethnicity or

race) in a particular area. This information can be helpful in trying to understand why cancer incidence may be higher in a particular area. In some cases, the sociodemographic variable being analyzed is an indicator of other factors related to the development or diagnosis of cancer. For example, communities with lower socioeconomic status may have higher cancer incidence because of disparities in access to care or differences in health risk behaviors, such as smoking or obesity, which impact their cancer burden. For some cancer types, incidence rates are higher among more affluent populations.[2]

The Environmental Facilities and Cancer Mapping application tool accounted for age and gender in the analyses that identified the EBWC study area. However, differences between the study area population and the population of NYS on other variables could help to explain why the Environmental Facilities and Cancer Mapping analysis showed a higher than expected incidence. Therefore, distributions for other sociodemographic factors, like race and socio-economic status were explored further. Staff reviewed available data from the US Census and the American Community Survey (ACS) to better understand community characteristics and how these characteristics may inform interpretations about cancer incidence in the EBWC study area. More details about the US Census and the ACS can be found at https://www.census.gov/.

Health risk behaviors like smoking, diet and obesity (sometimes called modifiable risk factors) are important in the development of many different types of cancer, including several of those that are elevated in the EBWC study area.[3] Similarly, contact with the health care system can influence the likelihood that someone could be diagnosed with certain cancers, such as thyroid cancer or chronic leukemias, before any symptoms appear. Currently, data related to individual level health risk behaviors are generally reported at the county level, since the sample size needs to be large enough to provide a stable and reliable estimate. This is problematic in the current evaluation, since the EBWC study area is a small part of Erie County. Presentation of information for larger geographic areas (e.g., Erie County) can mask substantial variations in a smaller area (e.g., the EBWC study area) that may be relevant to public health. For example, the median household income in Erie County for the time period 2011-2015 was estimated to be $51,247, but the same measure for individual census tracts within Erie County ranged from greater than $100,000 to less than $20,000.[4] Similarly, the estimated prevalence of a particular health risk behavior for Erie County may not necessarily be representative of the prevalence in the EBWC study area.

Public health professionals have recognized the need to have subcounty data measures to better understand small area trends in health behaviors. However, few datasets are available that provide subcounty estimates for indicators relevant to this study, such as the prevalence of smoking, obesity, healthy eating habits or excessive alcohol consumption, or the proportion of the population that has received colorectal cancer screening services or has access to comprehensive health care. Therefore, as part of this evaluation of the EBWC study area, subcounty estimates of health risk behaviors were sought to better understand possible reasons for higher than expected incidence of certain cancers. For the two data sources outlined below, staff assessed the results and evaluated the degree of consistency among them. Appendix B provides more information about the strengths and limitations of these two

data sources. Also, the analysis of community sociodemographic information was based on census tracts, which reasonably (but not completely) conform to the EBWC study area boundaries, as shown in Appendix C.

NYS Expanded BFRSS Analysis

The BRFSS is an annual survey that gathers information on health risk behaviors. In addition to questions about tobacco use, physical inactivity, diet, use of cancer screening services, and other factors linked to the leading causes of morbidity and mortality, the BRFSS contains a question on whether the respondent has health care coverage, such as health insurance, an HMO, or government plans. During two recent survey cycles, 2013-2014 and 2016, DOH conducted an expanded-BRFSS (eBRFSS) which increased the overall survey sample size to provide representative county-level estimates. Although the eBRFSS was not specifically designed to produce subcounty estimates, BRFSS staff did a special evaluation to derive combined prevalence estimates for the three ZIP codes which overlap the EBWC study area – referred to as the Greater EBWC study area ZIP codes. While ZIP codes provide a better geographic representation of the EBWC study area than county-level data, prevalence estimates may be unreliable due to the relatively small number of people in the survey. Furthermore, large areas of these three ZIP codes fall outside the EBWC study area, as shown in Appendix C. If the population outside the study area is different than the population inside the study area with respect to the health risk behaviors that are being analyzed, the results may not be representative of the study area.

NYS Statewide Planning and Research Cooperative System (SPARCS) Analysis

A second approach used the DOH Statewide Planning and Research Cooperative System (SPARCS) for information about hospitalizations and emergency department (ED) admissions to provide insight into the burden of health risk behaviors in the study area. For this analysis, staff geocoded the residence of people who visited the hospital as either in the study area or in a comparison area. Next, each record was searched for codes related to the health risk behavior of interest. Summary measures were calculated based on the proportion of people who received a hospital service and had a code indicating a health risk behavior divided either by the total number of people who received a hospital service or by the population living in the study area. The numbers in the tables produced by this analysis should not be interpreted as rates for a particular health risk behavior, but as an indicator of the burden associated with that indicator for the specific population of interest. For this analysis, staff reviewed records with codes related to tobacco use, obesity and alcohol use, three important modifiable risk factors associated with cancer incidence, as well as colorectal cancer screening. More details on the methods used in the analysis can be found in Appendix D.

Environmental Data Review

DOH staff worked with DEC staff to review available data related to potential environmental risk factors in the four study areas. DEC and DOH staff evaluated whether environmental

exposures in the EBWC study area seem unusual in comparison to other areas of NYS. These evaluations focused on 1) outdoor air pollution, 2) radon concentrations in indoor air, 3) community drinking water system sampling results and 4) review of remedial sites in each study area. DOH also explored specific environmental concerns raised by community members.

Outdoor Air Pollution

Staff from DOH and the DEC Division of Air Resources examined the available air quality information collected by the DEC. Because these data sources varied in content, their relevance in providing useful exposure information was assessed. Those data sources deemed adequate were used to define current and historical air quality. This section of the report provides a general overview of the air quality data review. Additionally, a description of the approach used to look at historical exposure to air quality information is provided.

An air pollutant is a substance (such as a chemical, dust, smoke, or pollen) that is present in air as a solid (particulate), gas (vapor) or liquid (mist), or a combination of these. Air pollution is the presence of those substances in the air at levels (concentrations) greater than would normally be found or considered desirable. It comes from many different human sources such as cars, buses, trucks, factories, power plants and dry cleaners, as well as natural sources such as vegetation, windblown dust, and wildfires. Although air pollution is typically thought of as an outdoor air problem, sources also exist inside homes and places of work. Examples include tobacco smoke, home heating appliances, new carpeting, household products (such as air fresheners, paints, cleansers, and pest-control agents), and personal care products (such as perfumes, deodorants, lotions, and hair-care products).

New York developed an air pollution control program over 60 years ago. In 1957, the NYS Legislature enacted one of the nation's first comprehensive air pollution control laws by passing the Air Pollution Control Act, formerly Article 12-A of the Public Health Law. The Law recognized the need "to safeguard the air resources of the state from pollution" by controlling or abating air pollutant releases from existing sources and preventing new source releases for the public good. The State's policy was then and remains: "to maintain a reasonable degree of purity of the air resources of the state, which shall be consistent with public health and welfare and the public enjoyment thereof, the industrial development of the state…" By 1962 this policy provided the foundation for an air pollution control program to control emissions from industrial processes and the combustion of fuels in New York.

Since the 1970 Clean Air Act, the US Environmental Protection Agency (EPA) has been regulating "criteria" air pollutants which are carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter, ozone, and lead through National Ambient Air Quality Standards (NAAQS). Two types of Standards were established. The Primary Standards are designed to protect human health with an adequate margin of safety and Secondary Standards are designed to protect public welfare, including protection against decreased visibility and damage to animals, crops, and buildings. Additional information about criteria pollutants is available on the EPA's web site at https://www.epa.gov/criteria-air-pollutants.

In 1990, the Clean Air Act was amended to include a list of "hazardous air pollutants" selected by Congress based on potential health and/or environmental hazard. The original list included 188 hazardous air pollutants (HAPs) such as benzene, which is found in gasoline; tetrachloroethene (PERC), which is emitted from dry cleaning facilities; methylene chloride, which is used as a solvent and paint stripper; and some metals such as cadmium, mercury, and chromium. The current list includes 187 HAPs. The Clean Air Act requires EPA to regulate emissions of HAPs from a list of industrial sources called "source categories" (e.g., boat manufacturing, gasoline distribution, and municipal and hazardous waste combustors). Additional information about HAPs is available on the EPA's web site at https://www.epa.gov/haps.

DEC establishes both short-term and long-term air concentration guideline values for toxic air pollutants (including the subset known as HAPs) by adopting the most health-protective, scientifically valid, value developed by DEC, EPA, DOH or other authoritative agencies. DEC uses these values as part of its strategy to determine the degree of pollutant removal required for sources releasing toxic air pollutants. Short-term air concentration guideline values (SGCs) are derived to protect the general public from adverse exposure to toxic air pollutants during short-term exposures of 1-hour. Long-term (annual) guideline concentrations (AGCs) are derived to protect the general public from chronic health effects during a lifetime of continuous exposure.

Staff from DEC and DOH summarized data from two available sources useful for evaluating outdoor air quality. The data sources identified include the following:

1. **Air Quality Monitoring Data** — EPA's Air Quality System database contains results of air pollutants measured by the DEC in outdoor air.
2. **Air Quality Modeled Concentrations** — EPA's National-scale Air Toxics Assessment (NATA) provides modeled concentrations and estimated risks for outdoor air pollutants for the years of 1996, 1999, 2002, 2005, 2011 and 2014.

Radon in Indoor Air

Radon is present everywhere, but some areas are at a higher risk due to their underlying geology. Radon in homes is the largest source of radiation exposure to the general public. Most inhaled radon is rapidly exhaled, but the decay products can deposit in the lung. These radioactive particles can cause damage to cells lining the airways, increasing the risk of lung cancer. Homes with high radon concentrations increase their occupants' risk of developing lung cancer. According to the EPA, radon is the second leading cause of lung cancer following smoking, and the leading cause of lung cancer among non-smokers. Exposure to radon among tobacco smokers greatly increases the risk of lung cancer, more than exposure to either radon or smoking alone. Nationally, radon is estimated to be responsible for about 21,000 lung cancer deaths every year, about 2,900 of which occur among people who have never smoked.

There are currently no laws in NYS that require residential radon testing or mitigation of elevated radon levels. The only way to determine radon levels in a home is to test. Although the potential for a home to have an elevated radon level can be estimated, testing is the only way to know for sure. When the radon level in the lowest primary living area of the home is above

EPA's action level of 4 pCi/L, the DOH recommends that the homeowner take appropriate corrective action.

For this evaluation, DOH characterized radon test results from 1987 to 2015. Researchers used radon data from tests conducted during this period to estimate various measures for the EBWC study area and comparison areas including Erie County, NYS, and NYS excluding NYC. DOH staff also prepared maps for each study area to display average radon levels by census block group.

Community Drinking Water System Testing

NYS and the federal government regulate drinking water to protect public health. In 1974, Congress passed the Safe Drinking Water Act that standardized the protection of drinking water on a national level. States that previously had established drinking water standards were required to make their standards at least as stringent as the national standards promulgated by the EPA. These national drinking water standards first went into effect in 1977. Regulations have evolved over time for a variety of volatile organic compounds (VOCs), metals, pesticides pathogens, and other contaminants.

For regulated analytes, Maximum Contaminant Levels (MCL) have been established. MCLs are generally determined by the EPA and represent the maximum permissible level of a contaminant in water delivered to any user of a public water system. In some cases, NYS has more stringent protocols, called Guidance Values, than those established at the federal level. For Lead and Copper, the term Action Level is used. Guidance Values and Action Levels also represent the maximum allowable concentrations of an analyte in drinking water.

A violation occurs when the established MCL is surpassed. In certain cases, an MCL is defined as a running average of samples over a quarterly time frame. This means a single exceedance of an MCL may not warrant a violation. Rather, exceedances occurring over a certain time frame that reach an average value above that of the MCL would trigger a violation.

This review evaluated sampling data for finished water at entry points to the distribution system. Staff reviewed exceedances and violations. In cases where violations were issued, details about the violations are provided. Previous studies have found associations between certain analytes and certain cancer types. However, the exposures being measured in these studies generally occur over a long period of time and at much higher analyte concentrations than those that are measured in drinking water systems. [5]

Unregulated Contaminants

The EPA's Unregulated Contaminant Monitoring Rule (UCMR) collects occurrence data for contaminants that do not have health-based standards set under the Safe Drinking Water Act but may be present in drinking water. The monitoring consists of no more than 30 contaminants every five years and is collected from all large public water systems (> 10,000 people) and a representative sample of small public water systems. The data collected help to inform future regulatory determinations.

Remedial Sites

The DEC and DOH each have a role in responding to concerns about contaminated sites. The DEC is responsible for addressing contaminated sites and works to protect public health and the environment of the NYS by: preventing releases to the environment through the regulation of petroleum and chemical bulk storage facilities, hazardous waste facilities, and radiation facilities; and responding to, investigating, and remediating releases of contaminants that have occurred. DOH staff work to investigate the potential for human exposure from environmental contamination, primarily at inactive hazardous waste sites and brownfield sites. For every state, federal superfund, brownfield, and voluntary clean-up site, a specialist is assigned to coordinate and communicate health-related activities. In addition, staff prepare public health assessments for federal superfund sites under an agreement with the federal Agency for Toxic Substances and Disease Registry. Staff also conduct exposure investigations as part of the state's Cancer Surveillance Improvement Initiative.

DOH and DEC staff developed an inventory of major industrial and inactive hazardous waste disposal sites for each study region. Area residents who participated in public meetings also identified sites of concern. DOH evaluated the available information to determine whether people were exposed to any contaminants released from these sites.

Additional Environmental Information

Access to Healthy Food. During the meetings to rollout the Governor's Cancer Research Initiative, elected officials, expert stakeholders, and members of the community expressed concern about the lack of easy access to healthy foods. DOH sought to gather more information about this by analyzing data that were developed by CDC to estimate access to healthy food by census tract.[6] The Modified Retail Food Environment Index (mRFEI) estimates the proportion of food retailers with healthier food options. A score of 10 means there is one healthier food retailer for every 10 retailers in, or within a ½ mile buffer of, the census tract. Data were summarized in a table and census tract mRFEI estimates were mapped. The median was used as a summary measure for comparing the study area to other areas, since the mRFEI distribution was skewed. A map was created by joining the mRFEI scores (available at http://www.cdc.gov/obesity/downloads/2_16_mrfei_data_table.xls) to a 2010 census tract map.

Traffic Density. Members of the community also had concerns about impacts of traffic pollution in the study area, particularly traffic along the Kensington Expressway (State Route 33). NYS Department of Transportation (DOT) operates a traffic monitoring program which collects information on traffic counts at fixed and temporary monitoring locations. This information is processed to create average annual daily counts of traffic for road segments along interstate highways and all NYS routes and roads that are part of the Federal Aid System. DOH staff used these data to assess how traffic in the study area compares to traffic in other areas of NYS. Initially, a map similar to those available on the DOT Traffic Data Viewer (https://gis3.dot.ny.gov/html5viewer/?viewer=tdv) (December 2018), showing traffic density

along the roads in the EBWC study area, was created. Then, US Census population data were used to estimate the number of people living within 500 meters of study area road. These results were compared to similar estimates for comparison areas, including Erie County, NYS, NYC, and NYS excluding NYC.

Findings

Sociodemographic Profile of the EBWC study area

The US Census American Community Survey five-year estimates for 2011-2015 were used to examine demographic distributions in the study area. Comparisons were made with 1) Erie County as a whole, 2) NYS excluding NYC, and 3) NYS. As shown in Appendix E, Table 1, the total population of the study area is about 43,000 people. There is a higher proportion of females and the age distribution of the population is slightly younger in the study area relative to comparison areas. The analysis that identified the higher than expected cancers in the EBWC study area accounted for gender and age and, therefore, any differences between the study area and comparison areas on these variables are not related to the higher than expected incidence. As indicated in Appendix E, Table 2, the current population estimate represents a 13% decrease since 1990, when approximately 50,000 people lived in the study area.

While majorities of the populations of NYS, NYS excluding NYC, and Erie County are white, in the EBWC study area 24.8% of the population is white, which is lower relative to the comparison areas. Approximately 70% of the population of the study area is black, compared to 13.3% in Erie County, 8.9% in NYS excluding NYC, and 15.6% in NYS. Hispanics represent 3.6% of the study area population, similar to the rest of Erie County but less than NYS as a whole. Notably, the distribution by race in census tracts that make up the study area has changed substantially across the last three US Decennial Censuses. As shown in Appendix E, Table 2 and Figure 1, in the 1990 US Decennial Census, the proportion of whites and blacks in study area census tracts was 50.9% and 48.1%, respectively. By 2010, the population had shifted to 25.4% white and 70.1% black. The study area had a smaller proportion of foreign-born population relative to comparison areas.

The median household income was $28,120 in the study area, compared to $51,247 in the rest of Erie County, $62,915 in NYS excluding NYC and $59,269 in NYS overall. Poverty levels and unemployment are both approximately double in the study area relative to comparison areas. The population in the study area had a lower proportion of people with private insurance, but a higher proportion of people with public insurance, such that only a slightly higher proportion of people had no health insurance compared to the rest of Erie County.

Cancer Incidence Patterns

EBWC Higher Than Expected Cancer Types and Associated Risk Factors

Map 1 displays the geographic extent of the areas of higher than expected incidence for the six cancers in the EBWC study area. These areas were identified in the Environmental Facilities and Cancer Mapping analysis. Map 1 also displays the EBWC study area boundaries, illustrating how the areas of higher than expected incidence extend beyond the study area and vary in size, and how the study area is a general approximation of the overlap of these areas. The findings

reported in the following sections will focus specifically on cancers that occurred among people living in the EBWC study area.

Map 1. The EBWC study area and Associated Areas of Higher than expected Incidence for Six Cancers

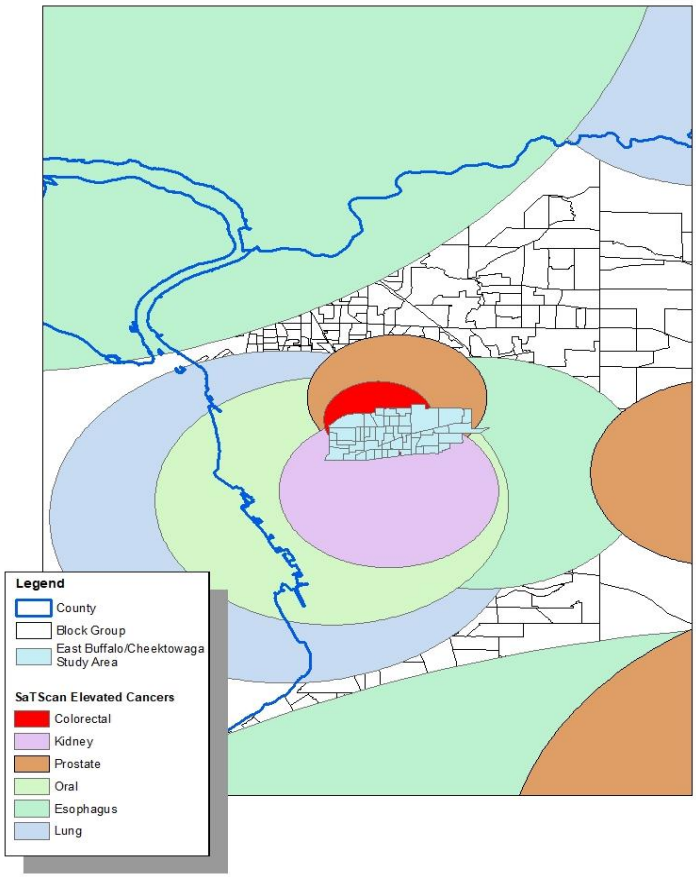


Table 1 displays the actual number of cases that were reported to the NYS Cancer Registry from 2011-2015 (i.e., observed) for the EBWC study area, along with the number of cancers that would be expected in the EBWC study area based on the age and gender distribution of the population (i.e., expected) for the two previously described comparison standards, the NYS Standard and the NYS excluding NYC Standard. For each of the six cancer types, the differences in expected counts generated from the two comparison standards are about 10% or less. Using the NYS excluding NYC Standard, the observed counts ranged from 12% (oral cancer) to 70% (esophageal cancer) higher than the expected count. Elevations for five of the six cancers were statistically more than would be expected from chance alone, with the one exception being oral cancer where the numbers were small and the elevation was

Table 1. Observed and expected counts for EBWC study area for the 6 cancers with higher than expected incidence during 2011-2015 time period.

Cancer	EBWC study area	Comparison Area			
		NYS Standard		NYS excl NYC Standard	
	Observed	Expected[1]	% Increase	Expected[1]	% Increase
Oral	27	22.2	22	24.2	12
Esophagus	19	10.0	90 *	11.2	70 *
Lung	188	135.1	39 *	150.8	25 *
Colorectal	122	88.1	38 *	87.2	40 *
Prostate	190	129.6	47 *	127.5	49 *
Kidney	66	36.2	82 *	39.1	69 *

Source of data: New York State Cancer Registry

[1] Expected values are based on standard rates for New York State or New York State exclusive of New York City, for 2011-2015 and age- and sex-specific block-group populations from the 2010 US Census fitted to county-level populations for 2011-2015 provided by the National Cancer Institute's SEER Program

not different from what we would expect to see. These results are discussed in further detail below.

Oral Cancer Risk Factors and Patterns in EBWC

Oral Cancer Risk Factors

Oral cancers are cancers of the mouth (including lips and salivary glands) and pharynx (commonly called the throat). All forms of tobacco use (including snuff and chewing tobacco) are associated with these cancers.[7] Alcohol consumption is also an important risk factor. In fact, persons who consume five or more drinks per day have five to six times greater risk compared to those who abstain.[8] The greatest risk is among people who use the largest amount of both tobacco and alcohol.[9] Infection with the human papillomavirus (HPV), particularly the HPV-16 subtype, also causes oral cancer.[10] As with many cancers, a positive family history is a risk factor.[11] Persons whose diets include large amounts of fruits and vegetables are at lower risk of oral cancers, suggesting that nutrients from these foods may protect against these diseases.[12] Although rare in the United States, the chewing of betel quid and gutka is common in countries such as India and China and increases the risk of cancer of the oral cavity.[13] In addition, cancer of the lip has been associated with exposure to sunlight,[14] and cancer of the salivary glands has been associated with exposure to ionizing radiation.[15]

Oral Cancer Study Findings

In the study area from 2011-2015, there were 27 cases of oral cancer diagnosed (observed); about 24.2 cases would have been expected based on the age and sex distribution of the population. In other words, there were about 12% more oral cancers in the study area than expected based on comparison with the NYS excluding NYC standard. A review of oral cancer in the EBWC study area, as distinct from the larger area of statistically elevated incidence that the study area is a part of, suggests that the observed number of cases in the study area is not statistically significantly different from what would be expected, based on the incidence of oral cancer for NYS excluding NYC. An analysis of observed and expected patterns by age and gender is provided in Table 2. Reflecting overall trends, more cases were

Table 2. Observed and Expected Oral Cancers in the EBWC study area by Age and Gender, 2011-2015

Group	Males and Females			
	Obs	Exp[1]	Obs/Exp	95% CI
0-19	0	0.1	0	*NA*
20-64	14	13.3	1.1	0.6-1.8
65+	13	10.8	1.2	0.6-2.1
All ages	27	24.2	1.1	0.7-1.6
Males	17	15.9	1.1	0.6-1.7
Females	10	8.3	1.2	0.6-2.2

Source of data: New York State Cancer Registry

[1] Expected values are based on standard rates for New York State exclusive of New York City, for 2011-2015 and age- and sex-specific block-group populations from the 2010 US Census fitted to county-level populations for 2011-2015 provided by the National Cancer Institute's SEER Program

expected for males and older adults, but for all gender-specific and age-specific groups, the observed counts were not statistically significantly higher than expected.

There was no statistically significant excess in oral cancer by race/ethnicity (numbers not shown to protect confidentiality). Additional oral cancer analyses are provided in Appendix F. These analyses did not show statistically significant results.

Esophageal Cancer Risk Factors and Patterns in EBWC

Esophageal Cancer Risk Factors

The esophagus is a long, muscular tube that connects the throat to the stomach. The two most common types of esophageal cancer are squamous cell carcinoma and adenocarcinoma. Historically, squamous cell carcinoma has been the more common type in the United States although the incidence of adenocarcinoma has risen dramatically over the last few decades among white men.[16] It is estimated that tobacco and alcohol use account for as much as 90% of squamous cell carcinomas of the esophagus in developed countries such as the United States.[17] Being overweight or obese increases the risk of adenocarcinoma of the esophagus.[18] Another risk factor for adenocarcinoma of the esophagus is gastroesophageal reflux disease (GERD).[19] GERD occurs when stomach acid frequently flows back into the esophagus, and causes symptoms such as heartburn and regurgitation.[20] Over time, GERD may damage cells in the lower esophagus, a condition known as Barrett's esophagus, which, in turn, may lead to esophageal adenocarcinoma. In fact, Barrett's esophagus is often considered a precursor to this cancer.[21] Some studies suggest that diets low in fruits and vegetables may be associated with esophageal cancer.[22] Exposure to radiation increases the risk of esophageal cancer,[23] and higher risks have also been found among workers in the dry cleaning and rubber industries.[24]

Esophageal Cancer Study Findings

In the study area from 2011-2015, there were 19 cases of esophageal cancer diagnosed (observed); about 11.2 cases would have been expected based on the age and sex distribution of the population. In other words, there were about 70% more esophageal cancers in the study area than expected based on comparison with cancer patterns in NYS excluding NYC. However, because of the very small number of observed esophageal cancer cases, additional categorization and analysis must be interpreted with caution. Results of an analysis of observed and expected patterns by age are provided in Table 3. There was a statistically significant excess

Table 3. Observed and Expected Esophageal Cancers in the EBWC study area by Age, 2011-2015

Group	Obs	Exp[1]	Obs/Exp	95% CI
0-64	**13**	**4.6**	**2.8**	**1.5-4.9**
65+	6	6.6	0.9	0.3-2.0
All ages	19	11.2	1.7	1.0-2.7

Source of data: New York State Cancer Registry

[1] Expected values are based on standard rates for New York State exclusive of New York City, for 2011-2015 and age- and sex-specific block-group populations from the 2010 US Census fitted to county-level populations for 2011-2015 provided by the National Cancer Institute's SEER Program

in esophageal cancers in the 0-64 age group (age groups were combined to protect patient confidentiality. However, very few of the cases occurred among those <50 years old (numbers not shown to protect confidentiality). When assessed by gender, males were expected to have more esophageal cancers than females, and the observed count of esophageal cancers among males was statistically significantly greater than expected (numbers not shown to protect confidentiality). There was not a significant difference between observed and expected counts among females. Most of the excess esophageal cancers were found to be among males aged 50-64 (numbers not shown to protect confidentiality).

Additional esophageal cancer analyses are provided in Appendix G. These additional analyses generally suggest the excess in esophageal cancers was spread across categories of race, histology, and stage at diagnosis. These analyses did not show statistically significant results.

Lung Cancer Risk Factors and Patterns in EBWC

Lung Cancer Risk Factors

Although rates have declined in recent years, lung cancer remains the leading cause of death from cancer for both men and women in the United States.[25] Cigarette smoking is the most important risk factor for this disease; in fact, according to the American Lung Association between 80% and 90% of all lung cancer cases in the United States may be attributed to smoking.[26] Second hand smoke is also a risk factor.[27] It is important to understand, however, that factors other than smoking can cause lung cancer. For example, ionizing radiation to the chest from medical procedures has been associated with lung cancer.[28] As with many cancers, a positive family history is a risk factor.[29] Some studies suggest that dietary factors such as the consumption of fruits and vegetables may protect against lung cancer, but the evidence supporting this idea is uncertain.[30]

Regarding environmental exposures, radon is believed to be an important cause of lung cancer.[31] Radon is a colorless and odorless radioactive gas that is a product of uranium. It occurs naturally in rock and soil, and enters homes through the basement. In fact, the EPA believes that residential exposure to radon may be second only to cigarette smoking as a cause of lung cancer in the United States.[32] Air pollution, including small particles and toxic substances, has been related to lung cancer.[33] Exposure to other chemicals and substances that can cause lung cancer occur primarily (but not exclusively) in the workplace. Most notably, these include asbestos and arsenic, as well as chloromethyl ethers, beryllium, chromium, cadmium, nickel, silica, diesel exhaust, and soot.[34]

Lung Cancer Study Findings

In the study area from 2011-2015, there were 188 cases of lung cancer diagnosed (observed); about 150.8 would have been expected based on the age and sex distribution of the population. This represents a 25% excess in observed versus expected lung cancers. Analysis of observed and expected patterns by age and gender are provided in Table 4. Across all age

groups overall, there was an excess of lung cancer cases among men but not among women. There was not a significantly higher than expected occurrence of lung cancer among younger age groups. Among men specifically, the excess in lung cancers was statistically significant for men 65 and older and elevated but not statistically significant among men 50-64 (numbers not shown to protect confidentiality). Although the excess among women across all ages was not statistically significant, there was an excess among women 50-64 (numbers not shown to protect confidentiality).

Table 4. Observed and Expected Lung Cancers in the EBWC study area by Age and Gender, 2011-2015

Group	Obs	Exp[1]	Obs/Exp	95% CI
0-19	0	0	0.0	*NA*
20-49	7	5.4	1.3	0.5-2.7
50-64	**67**	**43.0**	**1.6**	**1.2-2.0**
65+	114	102.4	1.1	0.9-1.3
All ages	**188**	**150.8**	**1.2**	**1.1-1.4**
Males	**100**	**67.6**	**1.5**	**1.2-1.8**
Females	88	83.3	1.1	0.8-1.3

Source of data: New York State Cancer Registry

[1] Expected values are based on standard rates for New York State exclusive of New York City, for 2011-2015 and age- and sex-specific block-group populations from the 2010 US Census fitted to county-level populations for 2011-2015 provided by the National Cancer Institute's SEER Program

When analyzed by race, the elevation was statistically significant among the non-Hispanic black and other race group (Table 5).

Table 5. Observed and Expected Lung Cancers in the EBWC study area by Race/Ethnicity, 2011-2015

Race/Ethnicity	Obs	Exp[1]	Obs/Exp	95% CI
Non-Hispanic White	62	58.0	1.1	0.8-1.4
Non-Hispanic Black and Other Race	**126**	**77.2**	**1.6**	**1.4-1.9**
Hispanic	0	1.1	0.0	*NA*

Source of data: New York State Cancer Registry

[1] Expected values are based on standard rates for New York State exclusive of New York City, for 2011-2015 and age- and sex-specific block-group populations from the 2010 US Census fitted to county-level populations for 2011-2015 provided by the National Cancer Institute's SEER Program

Table 6. Observed and Expected Lung Cancers in the EBWC study area by Type of Tumor, 2011-2015

Histology	Obs	Exp[1]	Obs/Exp	95% CI
Non-Small Cell Carcinoma (NSCC)	143	121.1	1.2	1.0-1.4
Adenocarcinoma	84	68.3	1.2	1.0-1.5
Large Cell Carcinoma	**18**	**9.1**	**2.0**	**1.2-3.1**
Other specified NSCC and Carcinoma NOS	19	13.7	1.4	0.8-2.2
Squamous Cell Carcinoma	22	30.0	0.7	0.5-1.1
Small Cell Carcinoma	24	17.8	1.3	0.9-2.0

Source of data: New York State Cancer Registry

[1] Expected values are based on standard rates for New York State exclusive of New York City, for 2011-2015 and age- and sex-specific block-group populations from the 2010 US Census fitted to county-level populations for 2011-2015 provided by the National Cancer Institute's SEER Program

Among lung cancer histologic subtypes, adenocarcinomas were expected to be the most common, followed by squamous cell and small cell carcinomas, and observed cases followed these patterns (Table 6). Only the observed excess for large cell carcinomas was statistically significant among lung cancer carcinomas.

Table 7. Observed and Expected Lung Cancers in the EBWC study area by Stage at Diagnosis, 2011-2015

Stage at Diagnosis	Obs	Exp[1]	Obs/Exp	95% CI
Localized	30	33.4	0.9	0.6-1.3
Regional	43	34.5	1.2	0.9-1.7
Distant	**106**	**74.5**	**1.4**	**1.2-1.7**
No information	9	8.3	1.1	0.5-2.1

Source of data: New York State Cancer Registry

[1] Expected values are based on standard rates for New York State exclusive of New York City, for 2011-2015 and age- and sex-specific block-group populations from the 2010 US Census fitted to county-level populations for 2011-2015 provided by the National Cancer Institute's SEER Program

Distribution by stage at diagnosis suggests that more of the excess lung cancers in the EBWC study area are being diagnosed after they have progressed to a distant stage (Table 7).

Colorectal Cancer Risk Factors and Patterns in EBWC

Colorectal Cancer Risk Factors

Colorectal cancers include cancers of the colon (the large intestine) and the rectum (the final section of the large intestine). Colorectal cancer is the second leading cause of death from cancer in the United States, after lung cancer.[35] A number of lifestyle factors are associated with colorectal cancers. These include cigarette smoking,[36] heavy alcohol use,[37] and physical inactivity.[38] Many studies suggest that diet may be important, particularly the high consumption of red or processed meats and the low consumption of fruit, vegetables, and fiber.[39, 40] People who are overweight or obese also have a greater risk of developing colorectal cancer.[41] A family history of colorectal cancer is important,[42] as is a personal history of intestinal polyps or chronic inflammatory bowel disease.[43] The long-term use of low-dose aspirin has been associated with a reduction in the risk of colorectal cancers,[44] as has the use of female hormone replacement therapies that combine estrogen and progestin.[45] Some studies also suggest that calcium intake may protect against colorectal cancer.[46] Regarding environmental exposures, a few studies indicate a higher risk for persons exposed to ionizing radiation or asbestos, but these findings need further confirmation.[47, 48]

Colorectal Cancer Study Findings

In the study area from 2011-2015, there were 122 cases of colorectal cancer diagnosed (observed); about 87.2 cases would have been expected based on the age and sex distribution of the population. In other words, there were about 40% more colorectal cancers in the study area than expected based on comparison with cancer patterns in NYS excluding NYC as a whole.

Breakdowns of observed and expected patterns by age and gender are provided in Table 8. Expected counts were similar for males and females. There was not a significantly higher

than expected occurrence of colorectal cancer in younger age groups, either among those <50 overall or for the specific age groups 0-19 and 20-49 (numbers not shown to protect confidentiality). The observed excess of colorectal cancer was statistically significant among males only, although there was a non-statistically significant elevation among females. For both males and females, there were elevations in the 50 and older age groups, although the excess was only statistically significant in males ages 50-64 years (numbers not shown to protect confidentiality).

Table 8. Observed and Expected Colorectal Cancers in the EBWC study area by Age and Gender, 2011-2015

Group	Males and Females			
	Obs	Exp[1]	Obs/Exp	95% CI
0-49	11	9.8	1.1	0.6-2.0
50-64	**46**	**26.1**	**1.8**	**1.3-2.3**
65+	65	51.3	1.3	1.0-1.6
All ages	**122**	**87.2**	**1.4**	**1.2-1.7**
Males	**66**	**40.7**	**1.6**	**1.3-2.1**
Females	56	46.5	1.2	0.9-1.6

Source of data: New York State Cancer Registry

[1] Expected values are based on standard rates for New York State exclusive of New York City, for 2011-2015 and age- and sex-specific block-group populations from the 2010 US Census fitted to county-level populations for 2011-2015 provided by the National Cancer Institute's SEER Program

Colorectal cancer observed counts were statistically significantly higher than expected among those in the non-Hispanic black and other race category, but not among non-Hispanic whites (numbers not shown to protect confidentiality).

Adenocarcinomas were the histologic subtype with the highest expected count, and the only one for which the observed excess was statistically significant among colorectal cancers (Table 9).

Table 9. Observed and Expected Colorectal Cancers in the EBWC study area by Histology, 2011-2015

Histology	Obs	Exp[1]	Obs/Exp	95% CI
Carcinoma	**119**	**84.6**	**1.4**	**1.2-1.7**
Adenocarcinoma	**111**	**77.2**	**1.4**	**1.2-1.7**
Other Specified Carcinoma	7	5.4	1.3	0.5-2.7
Unspecified Carcinoma	1	1.6	0.6	0.0-3.5
Other Specified Malignant Neoplasm	1	0.2	5.0	0.1-27.9
Unspecified Malignant Neoplasm	2	2.4	0.8	0.1-3.0

Source of data: New York State Cancer Registry

[1] Expected values are based on standard rates for New York State exclusive of New York City, for 2011-2015 and age- and sex-specific block-group populations from the 2010 US Census fitted to county-level populations for 2011-2015 provided by the National Cancer Institute's SEER Program

When assessed by subsite, there was statistically significant elevation for cancers in the proximal colon and a borderline nonsignificant elevation for cancers in the distal colon (Table 10).

Table 10. Observed and Expected Colorectal Cancers in the EBWC study area by Subsite, 2011-2015

Subsite	Obs	Exp[1]	Obs/Exp	95% CI
Rectal	31	25.4	1.2	0.8-1.7
Distal	34	22.9	1.5	1.0-2.1
Proximal	**57**	**38.9**	**1.5**	**1.1-1.9**

Source of data: New York State Cancer Registry

[1] Expected values are based on standard rates for New York State exclusive of New York City, for 2011-2015 and age- and sex-specific block-group populations from the 2010 US Census fitted to county-level populations for 2011-2015 provided by the National Cancer Institute's SEER Program

Table 11. Observed and Expected Colorectal Cancers in the EBWC study area by Stage at Diagnosis, 2011-2015

Stage at Diagnosis	Obs	Exp[1]	Obs/Exp	95% CI
Localized	39	33.5	1.2	0.8-1.6
Regional	43	29.7	1.4	1.0-2.0
Distant	**31**	**18.1**	**1.7**	**1.2-2.4**
No information	9	5.8	1.6	0.7-2.9

Source of data: New York State Cancer Registry

[1] Expected values are based on standard rates for New York State exclusive of New York City, for 2011-2015 and age- and sex-specific block-group populations from the 2010 US Census fitted to county-level populations for 2011-2015 provided by the National Cancer Institute's SEER Program

Distribution by stage at diagnosis suggests that more of the excess colorectal cancers in the EBWC study area are being diagnosed after they have progressed to a regional or distant stage (Table 11).

Prostate Cancer Risk Factors and Patterns in EBWC

Prostate Cancer Risk Factors

The prostate is part of the male reproductive system. Other than skin cancer, prostate cancer is the most common cancer in men in the United States, with an estimated 164,690 new cases and 29,430 deaths expected in 2018.[35] The risk of developing prostate cancer increases dramatically with age,[49] and is higher among black compared to white men at every age.[50] Family history is an important risk factor, with men who had a close male relative such as a father or brother with prostate cancer having twice the risk of other men.[51] Other than age, race and family history, comparatively few risk factors have been established for such a common cancer. Male hormones such as testosterone are required for the normal growth and development of the prostate, and high levels of these hormones have been proposed as possible risk factors for this cancer.[52] However, a recent evaluation of 18 studies found no association between levels of male hormones in the blood of individual men and the risk of prostate cancer,[53] so the relationship between male hormones and prostate cancer remains unclear. Diet may be important, with some studies suggesting that high consumption of animal fat, dairy products and calcium increase the risk.[54, 55] The excessive use of multivitamins has been linked to advanced and fatal prostate cancer,[56] and prostate cancer has also been associated with intake of folic acid (a man-made form of the B vitamin folate).[57] Other risk factors include a medical history of prostatitis (inflammation of the prostate) or of sexually transmitted infections.[58, 59]

Prostate Cancer Study Findings

In the study area from 2011-2015, there were 190 cases of prostate cancer diagnosed

(observed); about 127.5 cases would have been expected based on the age and sex distribution of the population (Table 12). In other words, there were about 49% more prostate cancers in the study area than expected based on comparison with cancer patterns in NYS excluding NYC as a whole.

Table 12. Observed and Expected Prostate Cancers in the EBWC study area by Age, 2011-2015

Age	Obs	Exp[1]	Obs/Exp	95% CI
0-19	0	0.0	0.0	*NA*
20-49	6	3.1	1.9	0.7-4.2
50-64	**94**	**53.3**	**1.8**	**1.4-2.2**
65+	90	71.1	1.3	1.0-1.6
All	**190**	**127.5**	**1.5**	**1.3-1.7**

Source of data: New York State Cancer Registry

[1] Expected values are based on standard rates for New York State exclusive of New York City, for 2011-2015 and age- and sex-specific block-group populations from the 2010 US Census fitted to county-level populations for 2011-2015 provided by the National Cancer Institute's SEER Program

A breakdown of observed and expected patterns by age is provided in Table 12. Elevations were observed for all age groups 20 and older. However, the 20-49 group only had 6 observed cases, primarily among adults older than 45, and the excess was not statistically significant. The excess was statistically significant for men 50-64, and borderline statistically significant among men 65 and older.

While the non-Hispanic black and other race group had higher absolute numbers of cases, reflecting the population demographics of the study area, the magnitude of the increase in observed over expected was similar when comparing non-Hispanic white and non-Hispanic black and other race groups (numbers not shown to protect confidentiality). For both non-Hispanic whites and non-Hispanic black and other race groups, observed counts were about 20% higher than expected and borderline significant.

Adenocarcinomas are by far the most common histologic subtype, and the only one for which the observed excess was statistically significant among prostate cancers (Table 13).

Table 13. Observed and Expected Prostate Cancers in the EBWC study area by Type of Tumor, 2011-2015

Histology	Obs	Exp[1]	Obs/Exp	95% CI
Carcinoma	189	125.7	1.5	1.3-1.7
Adenocarcinoma	**188**	**124.8**	**1.5**	**1.3-1.7**
Unspecified Carcinoma	1	0.7	1.4	0.0-8.0
Unspecified Malignant Neoplasm	1	1.8	0.6	0.0-3.1

Source of data: New York State Cancer Registry

[1] Expected values are based on standard rates for New York State exclusive of New York City, for 2011-2015 and age- and sex-specific block-group populations from the 2010 US Census fitted to county-level populations for 2011-2015 provided by the National Cancer Institute's SEER Program

In an analysis by stage at diagnosis, there was a statistically significant elevation in prostate cancers diagnosed at an early, localized stage and a statistically significant elevation in prostate cancers diagnosed at a distant stage, although as expected localized cases accounted for a

much larger proportion of the total (Table 14). For 21 cases of prostate cancers no information on stage at diagnosis was available.

Table 14. Observed and Expected Prostate Cancers in the EBWC study area by Stage at Diagnosis, 2011-2015

Stage at Diagnosis	Obs	Exp[1]	Obs/Exp	95% CI
Localized	**139**	**89.4**	**1.6**	**1.3-1.8**
Regional	10	14.4	0.7	0.3-1.3
Distant	**20**	**6.7**	**3.0**	**1.8-4.6**
No stage information	21	17.1	1.2	0.8-1.9

Source of data: New York State Cancer Registry

[1] Expected values are based on standard rates for New York State exclusive of New York City, for 2011-2015 and age- and sex-specific block-group populations from the 2010 US Census fitted to county-level populations for 2011-2015 provided by the National Cancer Institute's SEER Program

Kidney Cancer Risk Factors and Patterns in EBWC

Kidney Cancer Risk Factors

The kidneys are two reddish-brown organs, shaped like beans, located above the waist on each side of the spine. The kidneys filter blood and produce urine to remove waste products from the body. Kidney cancer rates in the United States rose until the mid-2000s but have now leveled off. Much of the increase was due to early-stage tumors, suggesting that greater detection may play a role.[60]

Obesity is the most important risk factor for kidney cancer, accounting for one-third of all cases.[3] Cigarette smoking has been associated with this cancer,[60, 61] as has physical inactivity.[60, 62] Medical conditions including high blood pressure,[60, 63] end stage renal disease,[64] and possibly diabetes[65] have been linked to kidney cancer. Family history and some rare inherited conditions are also important, with persons who have a close relative with kidney cancer having twice the risk of other persons.[66] Some studies have found a greater risk of developing kidney cancer among women who have given birth compared to women who have not had children.[60, 67] The role of diet is unclear, with some studies indicating that fruits and vegetables may protect against kidney cancer,[68] but animal fat and protein do not appear to increase the risk.[69] Exposure to trichloroethene (TCE) is another risk factor. TCE is a solvent that has been widely used as metal degreaser and chemical additive. Several studies indicate that workers exposed to TCE have higher risk of kidney cancer.[70] Workplace exposures to metals such as cadmium, lead, and arsenic may also increase the risk of this cancer,[71] but the results of these studies have been inconsistent.

Kidney Cancer Study Findings

In the study area from 2011-2015, there were 66 kidney cancers observed, although about 39.1

would have been expected based on the age and sex distribution of the population (Table 15). In other words, there were about 69% more kidney cancers in the study area than expected based on a comparison with the NYS excluding NYC standard.

Breakdowns of observed and expected cases by age and gender are provided in Table 15. Because of the relatively small number of observed kidney cancer cases, additional categorization and analysis must be interpreted with caution. Few cases were observed among younger age groups. There was not a statistically significantly higher than expected occurrence of colorectal cancer in younger age groups, either among those <50 overall or for the specific age groups 0-19 and 20-49 (numbers not shown to protect confidentiality). There was a statistically significant excess of cases in the 50-64 and 65+ age groups overall and among both males and females. For both males and females, the excess was limited to the 50 and older age groups, although only statistically significant in males ages 50-64 years (numbers not shown to protect confidentiality).

Table 15. Observed and Expected Kidney Cancers in the EBWC study area by Age and Gender, 2011-2015

Group	Males and Females			
	Obs	Exp[1]	Obs/Exp	95% CI
0-49	8	5.6	1.4	0.6-2.8
50-64	**26**	**14.6**	**1.8**	**1.2-2.6**
65+	**32**	**18.9**	**1.7**	**1.2-2.4**
All ages	**66**	**39.1**	**1.7**	**1.3-2.1**
Males	**36**	**23.4**	**1.5**	**1.1-2.1**
Females	**30**	**15.6**	**1.9**	**1.3-2.7**

Source of data: New York State Cancer Registry

[1] Expected values are based on standard rates for New York State exclusive of New York City, for 2011-2015 and age- and sex-specific block-group populations from the 2010 US Census fitted to county-level populations for 2011-2015 provided by the National Cancer Institute's SEER Program

Kidney cancer observed counts were significantly higher than expected among both non-Hispanic whites and non-Hispanic black and other race groups (Table 16).

Table 16. Observed and Expected Kidney Cancers in the EBWC study area by Race/Ethnicity, 2011-2015

Race/Ethnicity	Obs	Exp[1]	Obs/Exp	95% CI
Non-Hispanic White	**26**	**13.9**	**1.9**	**1.2-2.7**
Non-Hispanic Black and Other Race	**40**	**23.2**	**1.7**	**1.2-2.3**
Hispanic	0	0.5	0.0	*NA*

Source of data: New York State Cancer Registry

[1] Expected values are based on standard rates for New York State exclusive of New York City, for 2011-2015 and age- and sex-specific block-group populations from the 2010 US Census fitted to county-level populations for 2011-2015 provided by the National Cancer Institute's SEER Program

Renal cell carcinomas, the most common histologic subtype for kidney cancer, had the highest count of expected cases, and the observed excess was statistically significant (Table 17). The observed excess was also statistically significant for unspecified malignant neoplasms, although the observed count was small.

Table 17. Observed and Expected Kidney Cancers in the EBWC study area by Type of Tumor, 2011-2015

Histology	Obs	Exp[1]	Obs/Exp	95% CI
Carcinoma	**61**	**37.7**	**1.6**	**1.2-2.1**
Renal Cell Carcinoma	**59**	**33.9**	**1.7**	**1.3-2.2**
Transitional Cell Carcinoma	1	2.6	0.4	0.0-2.1
Other Specified Carcinoma	1	0.9	1.1	0.0-6.2
Other Specified Malignant neoplasm	1	0.6	1.7	0.0-9.3
Unspecified Malignant Neoplasm	**4**	**0.8**	**5.0**	**1.4-12.8**

Source of data: New York State Cancer Registry

[1] Expected values are based on standard rates for New York State exclusive of New York City, for 2011-2015 and age- and sex-specific block-group populations from the 2010 US Census fitted to county-level populations for 2011-2015 provided by the National Cancer Institute's SEER Program

In an analysis by stage at diagnosis, there was a statistically significant elevation in kidney cancers diagnosed at an early and regional stage, with a larger proportion of the excess occurring in the group diagnosed at a localized stage (Table 18). There was a higher than expected number of cancers with no stage information in the EBWC study area, which could impact these results.

Table 18. Observed and Expected Kidney Cancers in the EBWC study area by Stage at Diagnosis, 2011-2015

Stage at Diagnosis	Obs	Exp[1]	Obs/Exp	95% CI
Localized	**39**	**26.1**	**1.5**	**1.1-2.0**
Regional	**13**	**6.5**	**2.0**	**1.1-3.4**
Distant	6	5.0	1.2	0.4-2.6
No stage information	**8**	**1.4**	**5.7**	**2.5-11.3**

Source of data: New York State Cancer Registry

[1] Expected values are based on standard rates for New York State exclusive of New York City, for 2011-2015 and age- and sex-specific block-group populations from the 2010 US Census fitted to county-level populations for 2011-2015 provided by the National Cancer Institute's SEER Program

Lifestyle and Behavioral Risk Factors and Medical Utilization

NYS eBFRSS

The combined sample size for the Greater EBWC study area ZIP Codes across the 2013-2014 and 2016 eBRFSS surveys was 151, with sample sizes for particular questions even lower. The small sample size means that there is uncertainty in the estimates. This is reflected in the wide confidence intervals around the study area specific estimates. However, estimates for the reference areas are quite precise due to the large overall sample size, and statistical tests were performed using Rest of State excluding NYC as the reference. Prevalence estimates were available for current smoking, binge drinking, obesity, physical activity, health care coverage, and colorectal cancer screening. Results are provided in Table 19.

Regarding health risk behaviors, respondents from the Greater EBWC study area ZIP Codes had significantly higher prevalence of current smoking and significantly lower prevalence of physical activity than respondents from NYS excluding NYC. Greater EBWC study area ZIP Codes

Table 19. Summary of eBRFSS responses[1] to questions related to cancer risk factors in the Greater EBWC study area ZIP codes, Rest of State excluding NYC, and Rest of State

Region[2]	BRFSS Question	N	Percent	95% CI
Greater EBWC study area	Current Smoker?	143	29.6*	19.3-39.9
	Binge Drinker?	139	21.6	13.1-30.2
	Obese?	139	35.6	24.8-46.4
	Get leisure time physical activity?	146	62.4*	52.0-72.7
	Has health care coverage?[a]	122	83.2	72.7-93.6
	Fully Met USPSTF CCRs? [b]	58	79.3	68.1-90.4
Rest of State excluding NYC	Current Smoker?	58,039	16.7	16.0-17.4
	Binge Drinker?	56,893	16.9	16.1-17.7
	Obese?	56,064	27.1	26.3-28.0
	Get leisure time physical activity?	59,373	74.3	73.4-75.1
	Has health care coverage?[a]	38,445	88.3	87.5-89.1
	Fully Met USPSTF CCRs? [b]	29,350	70.4	69.1-71.7
Rest of State	Current Smoker?	62,996	14.8	13.9-15.8
	Binge Drinker?	61,676	17.2	16.0-18.3
	Obese?	60,861	25.1	24.1-26.2
	Get leisure time physical activity?	64,679	73.3	72.1-74.4
	Has health care coverage?[a]	42,508	86.9	85.7-88.2
	Fully Met USPSTF CCRs? [b]	31,175	69.3	67.6-71.0

[1] Includes combined responses from 2013-2014 and 2016 eBRFSS surveys

[2] Greater EBWC study area includes the 3 ZIP codes (14211, 14215 and 14225) which cross into the EBWC study area boundaries. 'Rest of State excluding NYC' is all areas of state outside of Greater EBWC study area excluding NYC. 'Rest of State' is all areas of state outside of Greater EBWC study area

** 95% CI for result does not overlap with 'Rest of State excluding NYC' comparison*

[a] Among those aged 18-64 years

[b] USPSTF CCSRs: US Preventive Services Task Force Colorectal Cancer Screening Recommendations, among those aged 50-75 years

Table 20. Prevalence of records with tobacco-related codes[1] among people who visited hospitals, 2011-2015

Region	Tobacco use/history codes recorded on hospitalization records, by age group[2]			
	18 and up	18-49	50-64	65 and up
EBWC study area	**45.2**[3]	**47.2**	**45.5**	**37.6**
Erie County	**27.4**	**24.7**	**27.4**	**34.6**
NYS	17.4	13.5	19.7	27.3
NYS excluding NYC	21.2	17.5	21.7	31.1
NYC	12.3	8.7	16.4	21.0

Source of data: New York Statewide Planning and Research Cooperative System (SPARCS)

[1] Includes hospital visits and admissions related to smoking cessation, history of tobacco use, and health problems due to tobacco use

[2] Per 100 study area population, based on 2010 Census

[3] Bold numbering indicates cell is at least 25% more than comparable statewide measure 'NYS excluding NYC'

respondents also had a higher prevalence of obesity and a slightly higher prevalence of reported binge drinking, although neither of these results was statistically significant. Regarding indicators of access to care and medical utilization, respondents reported a slightly lower prevalence of health care coverage, and a slightly higher attainment of colorectal cancer screening recommendations, both of which were not statistically significant.

NYS SPARCS Analysis

NYS SPARCS data were used to estimate health risk behaviors among people in the EBWC study area compared to Erie County, NYS as a whole, NYS excluding NYC, and NYC. The results of the analysis of tobacco-related hospitalizations or ED admissions are provided in Table 20. General trends for NYS excluding NYC and NYC follow a pattern seen in other evaluations of tobacco use, where NYC tends to have a lower prevalence of smoking than NYS excluding NYC. For adults 18 and up, as well as the age groups 18-49 and 50-64, the proportion of patients whose records include a code indicating tobacco use is nearly double or more in the study area compared to referent areas. In the age group 65 and up, the difference is attenuated but is still higher in the study area.

The results of the analysis of alcohol-related hospitalizations or ED admissions are provided in Table 21. For adults 50-64, the prevalence of hospital records which include a code indicating alcohol use is more than double in the study area compared to referent areas for both indicator definitions. In the age group 65 and up, the difference is smaller but still higher in the study area.

Table 21. Prevalence of records with alcohol-related codes[1] among people who visited hospitals, 2011-2015

Region	Alcohol codes recorded on hospitalization records, by age group[2]	
	50-64	65 and up
EBWC study area	**10.3**[3]	**4.0**
Erie County	5.3	3.0
NYS	**5.5**	3.0
NYS excl NYC	4.4	2.6
NYC	**7.4**	**3.6**

Source of data: New York Statewide Planning and Research Cooperative System (SPARCS)

[1] Includes hospital visits and admissions with diagnosis codes for conditions related to chronic alcohol use and alcohol dependency

[2] Per 100 study area population, based on 2010 Census

[3] Bold numbering indicates cell is at least 25% more than comparable statewide measure 'NYS excluding NYC'

The results of the analysis of hospitalizations or ED admissions with records having codes for obesity are provided in Table 22. For adults 21 and over, the prevalence of hospital records that include a code indicating obesity is more than 70% higher in the study area compared to the reference areas. In the specific age group categories, the difference attenuates with increasing age group. Among those 21-49, the prevalence of obesity-related codes is more than double in the study area compared to NYS excluding NYC. In the 50-64 age group, the prevalence is around 50% higher in the study area, but this difference decreases to 15% in the 65 and up age group.

Table 22. Prevalence of records with obesity-related codes[1] among people who visited hospitals, 2011-2015

Region	Obesity codes recorded on hospitalization records, by age group[2]			
	21 and up	21-49	50-64	65 and up
EBWC study area	**14.2**[3]	**13.4**	**16.5**	12.9
Erie County	8.3	6.0	10.3	11.1
NYS	8.0	6.0	10.1	10.8
NYS excluding NYC	8.0	5.8	9.8	11.2
NYC	7.9	6.2	10.5	10.2

Source of data: New York Statewide Planning and Research Cooperative System (SPARCS)
[1] Includes visits and admissions with diagnosis codes for obesity or, for adults, BMI 30 or higher
[2] Per 100 study area population, based on 2010 Census
[3] Bold numbering indicates cell is at least 25% more than comparable statewide measure 'NYS excluding NYC'

Table 23. Prevalence of records with colonoscopy-related codes[1] among people who visited hospitals, 2011-2015

Region	Colonoscopy codes recorded on hospitalization records, by age group[2]		
	Less than 50	50-74	75 and up
EBWC study area	1.5	28.5	10.5
Erie County	2.2	37.5	11.4
NYS	1.4	22.7	8.6
NYS excl NYC	1.6	24.8	9.5
NYC	1.1	19.4	7.1

Source of data: New York Statewide Planning and Research Cooperative System (SPARCS)
[1] Includes hospital visits with procedure codes related to colonoscopy
[2] Per 100 study area population, based on 2010 Census

The results of the analysis of hospital visits with procedures codes for colonoscopy are provided in Table 23. Current USPSTF recommends screening for colorectal cancer beginning at age 50.[72] As such, the prevalence of codes for colonoscopy for hospital records is low in the under 50 age group. And it follows that prevalence should increase substantially in the age group 50-74. The prevalence of records with colonoscopy codes is slightly higher in the study area than in NYS or NYS excluding NYC. However, prevalence is higher in Erie County than in the study area. This pattern is similar for the 75 and older age group.

The results of the eBRFSS and SPARCS analyses are broadly consistent for health risk behaviors that are common between both analyses. Collectively, the results of the eBRFSS and SPARCS analysis suggest that smoking and obesity are more common in the study area than in the rest of NYS excluding NYC. The qualitative trends are also consistent for alcohol consumption, although the magnitude of the difference is greater in the SPARCS analysis than the eBRFSS analysis. This may be a result of the indicators measuring different domains of alcohol use. While the eBRFSS analysis asked survey respondents about binge drinking, the SPARCS analysis sought to identify codes for alcohol dependency and alcohol-related chronic illnesses. The proportion of people getting leisure time physical activity was only available in the eBRFSS, and was significantly lower in the study area than in comparison areas.

There was also consistency between the eBRFSS and SPARCS on colorectal cancer screening. Both analyses suggest that the population in the study area and its surrounding areas have a higher prevalence of colorectal cancer screening compared to reference areas. Across NYS, the most commonly reported colorectal cancer screening method in eBRFSS was colonoscopy. Since colonoscopy detects and removes pre-malignant lesions,[73] adherence to colorectal cancer screening would be expected to decrease the incidence of colorectal cancer. Health insurance status was only available from eBRFSS, but those data suggest that the population in the Greater EBWC study area ZIP codes does not have a significantly lower proportion of people with health insurance. Access to health care, enabled through provision of health insurance, would also be expected to enhance the chances of prevention (i.e., through health care provider education efforts) or early detection of cancers in general.

These results have implications for several of the cancers which occur at higher than expected rates in the EBWC study area than in the rest of NYS. Modifiable risk factors are thought to account for a much greater proportion of the cancer burden than environmental factors. [74] A recent study estimated the proportion of all incident cancer cases diagnosed among adults aged 30 and older in the United States in 2014 that were attributable to modifiable risk factors.[3] The results of that study suggest modifiable risk factors are implicated in 85.8% of lung cancers, 77.9% of oral/pharynx/nasal cancers, 73.2% of esophageal cancers, 54.6% of colorectal cancers, and 53.8% of kidney/renal pelvis/ureter cancers. A previous DOH report on tobacco-related cancers identifies five (oral, esophageal, lung, kidney, colorectal) of the six cancer types that are elevated in the EBWC study area,[75] while a second on the links between obesity and cancer identifies three (esophageal, colorectal, kidney) of the six cancer types that are elevated in the EBWC study area.[76]

The strongest overall risk factor for cancer is smoking. A large majority of lung cancers are attributable to smoking, and over half of esophageal and oral cancers may also be linked with smoking. As shown in Table 24, these estimates of the proportion of cancers attributable to smoking from the NYS report referenced above are generally similar to smoking-specific results estimated for the United States as a whole.[3] Given the results suggesting that the burden of smoking may be higher in the EBWC study area compared to reference areas, smoking cessation could, with time, reduce some of the excess incidence.

Table 24. Estimates of the proportion of EBWC study area cancers attributable to smoking, based on analyses from previous reports

Cancer Type	NYS[1]	United States[2]
Lung	79.9%	81.7%
Esophageal	67.3%	50.0%
Oral	63.5%	49.2%
Kidney	23.9%	17.4%
Colorectal	No estimate[3]	11.7%
Prostate	Not strongly associated with smoking	

[1] NYS estimate is from reference [1]

[2] United States estimate is from reference [2]

[3] Estimate for colorectal not included because at the time the report was published the association with smoking was not well established

Environmental Data Review Findings

Outdoor Air Pollution

Modeled Data: National Air Toxics Assessment (NATA)

DOH researchers used the NATA modeled estimates released in 2011 and 2014 to evaluate whether cancer risk, based on exposures to HAPs, in the study area was unusual as compared to other comparison areas of NYS (Note: Because of time and resources necessary to produce modeled estimates, the 2011 NATA release was based upon emissions data from 2005, while the 2014 NATA release was based upon emissions data from 2011). Direct comparison of the cancer risk estimates in 2014 relative to 2011 needs to be interpreted with caution due to changes in the air modeling and emissions inventory. The comparison areas used were Erie County, NYS, NYC, and NYS excluding NYC.

All HAPs were initially screened to identify pollutants estimated to have more than a one-in-one million cancer risk.[1] This resulted in a selection of a subset of five pollutants. Next, a ratio comparing the mean cancer risk estimate for the study area to the mean cancer risk estimate for each comparison area was calculated for each of the five HAPs. A ratio greater than one indicates the estimated cancer risk was higher in the study area than in the comparison area. It should be noted that an increase in exposure to either a trace amount of an air pollutant or a pollutant with very low carcinogenic risk, is unlikely to elicit an increase in adverse health effects that can be detected epidemiologically.

Table 25 shows the risk estimates and the comparison ratios for the five HAPs included in the evaluation for NATA 2011. Table 26 shows the same information for NATA 2014. In general, cancer risk estimates in the study area were slightly higher than comparison groups which included non-urban areas (*i.e.*, Erie County, NYS excluding NYC), but similar to or lower than estimates from NYC, and ratios were similar for 2011 and 2014 NATA estimates. The pollutant with the largest absolute cancer risk was formaldehyde, although the estimate was not unusually different than any of the comparison areas. The pollutant with the largest comparison ratio was 1,3-butadiene, which was higher in the EBWC study area in comparison to the rest of Erie County and NYS excluding NYC. All other comparison ratios suggest even smaller relative increases in cancer risk for the study area compared to reference areas. None of the elevated risks in the study area were more than 50% higher than any of the comparison areas (i.e. comparison ratios were all less than 1.50), and because the absolute risks were for the most part relatively low overall this translated to less than one-in-one million additional cancer risk. The burden of the estimated cancer risk associated with these HAPs does not appear to be differentially impacting the study area.

[1] According to the EPA, "a cancer risk level of 1-in-1 million implies that, if 1 million people are exposed to the same concentration of a pollutant continuously (24 hours per day) over 70 years (an assumed lifetime), one person would likely contract cancer from this exposure. This risk would be in addition to any cancer risk borne by a person not exposed to these air toxics." (https://www.epa.gov/national-air-toxics-assessment/nata-frequent-questions#risk1)

Table 25. NATA 2011 Comparison Ratios and Risk Estimates for EBWC study area Census Tracts

	1,3-Butadiene	Acetaldehyde	Benzene	Carbon Tetrachloride	Formaldehyde
Comparison Ratios					
study area/Erie County	1.49	1.06	1.10	1.00	1.10
study area/NYS excl NYC	1.19	0.98	1.00	1.00	0.95
study area/NYC	0.41	0.60	0.48	1.00	0.52
study area/NYS	0.66	0.77	0.68	1.00	0.71
Total Cancer Risk (per million)					
EBWC study area	2.33	3.25	5.80	3.28	14.54
Erie County	1.56	3.07	5.25	3.28	13.23
NYS excluding NYC	1.96	3.31	5.81	3.28	15.26
NYC	5.65	5.42	12.12	3.28	27.70
NYS	3.51	4.20	8.47	3.28	20.51

Table 26. NATA 2014 Comparison Ratios and Risk Estimates for EBWC study area Census Tracts

	1,3-Butadiene	Acetaldehyde	Benzene	Carbon Tetrachloride	Formaldehyde
Comparison Ratios					
study area/Erie County	1.45	1.04	1.12	1.00	1.06
study area/NYS excl NYC	1.26	0.98	1.16	1.01	0.97
study area/NYC	0.39	0.66	0.59	1.00	0.61
study area/NYS	0.65	0.81	0.83	1.00	0.78
Total Cancer Risk (per million)					
EBWC study area	1.20	1.72	4.10	3.30	12.13
Erie County	0.83	1.65	3.66	3.28	11.49
NYS excluding NYC	0.95	1.75	3.52	3.28	12.49
NYC	3.07	2.60	6.92	3.30	19.74
NYS	1.85	2.11	4.96	3.29	15.55

Since modeled data require assumptions that can add error to results, DEC researchers evaluated the accuracy of both the NATA model years by comparing the modeled concentrations to monitored concentrations measured in DEC's air toxics monitoring network. The modeled concentration for the census tract in which the monitor was stationed was compared to the measured annual average for the five air pollutants. The median ratio across all monitoring stations and ratios for individual stations for Erie County are shown in Appendix H, Tables 1 and 2, for NATA 2011 and 2014, respectively. Modeling concentrations within a factor of two (ratios between 0.50 – 2.0) of measured concentrations are generally considered good. As shown in Appendix H, Tables 1 and 2, the ratios are within this range and generally much closer to one for these five air pollutants. This analysis indicates that the modeled results can be used with confidence to evaluate exposures in places where there were no monitors.

Air Quality Monitored Data

The criteria air pollutants database provides the longest history of air pollution measurements in New York. Although there are a few air monitoring locations within the study region, we used all available air monitoring data for criteria pollutants in Erie County to develop summaries and charts. Measured concentrations for many of the criteria pollutants reflect long-range transport of pollutants. Long-term trends for criteria pollutants (carbon monoxide, nitrogen dioxide, particulate matter ($PM_{2.5}$ and PM_{10}), and sulfur dioxide) can be found in Appendix I. Even though toxicological data do not indicate that these pollutants are environmental risk factors for cancer, DOH researchers used the criteria pollutants since they provide the longest historical measurements of air pollution. The criteria pollutants have been co-released with other air pollutants that could be potential carcinogens for which there are no historical measurements. As illustrated in these figures, the pollutant concentrations across the monitors is consistent, reflecting the regional nature of these pollutants. Criteria air pollutant concentrations have decreased substantially over time, and currently this region complies with EPA NAAQS for all criteria pollutants. Information about ozone has not been presented in this report for a number of reasons. It's not a carcinogen and it's not released from sources. It's formed from the release of VOCs in the presence of sunlight. Therefore, concentrations are measured much farther downwind from the source releasing VOCs.

The statewide air toxics network was established in 1990, therefore measurements of air toxics reflect concentrations for more recent years. Trends calculated using the available data in the study area for select air toxics data known to be "risk-drivers" can be found in Appendix J. All air toxics presented, with the exception of carbon tetrachloride, are predominantly from mobile sources. However, coke ovens are known to be a significant source of benzene and, as such, DEC has taken regulatory actions to reduce emissions over time. Although air toxic concentrations are higher than DEC's AGC, this pattern is not unique to these monitors. Similar patterns can be observed for other monitoring locations across the State. Therefore, exposures to these concentrations would not be unique to the EBWC study area or Erie County.

Assessment of Findings

Historically, the Buffalo and Erie County area was one of the most industrialized areas of New York, and industrial emissions adversely affected the air quality. With the enactment of Federal and State regulatory actions under the Clean Air Act and its Amendments, along with the closure of numerous industries in the area, air quality has improved significantly over the past fifty years, as is evident in the Appendix I, presenting decreasing trends of criteria pollutant concentrations in Erie County. Currently, the study area is in attainment for the NAAQS for all criteria pollutants.

Because of the limited air toxics monitoring information in the study area, we are unable to evaluate historical exposures to air toxic pollutant concentrations. The measured results for the recent monitoring show concentrations consistent with measurements in other urban areas of the State. Toxicological information and graphs of annual concentrations of the five key HAPs

are provided in Appendix J.

Overall, for this study area, based on the readily available outdoor air pollution data, DOH researchers estimate that each of the chemicals examined pose a "low" risk of cancer assuming a lifetime of inhalation of exposure. In this context, the descriptor of "low" is used to describe an estimated lifetime excess cancer risk (probability) of one-in-ten-thousand or less. This level of cancer risk is small compared to the background rate of cancer. The cancer risk estimate is a theoretical estimate and does not estimate the risk for any individual or group of people.

Limitations in Air Quality Evaluation

DOH researchers acknowledge that there are significant limitations to this analysis of exploring outdoor air quality as risk factors for cancer. Although everybody is exposed to chemicals in the air, DOH researchers are unable to fully characterize people's individual inhalation exposures to chemicals through activities such as smoking, use of consumer products, occupational exposures and hobbies. DOH, in consultation with DEC, focused on expected "risk drivers" rather than every EPA-designated HAP. The NATA model corroborates this list of "risk drivers." People are usually exposed to mixtures of chemicals rather than to a single chemical. Evaluating the health risks of mixtures is difficult for several reasons, including the lack of information on chemical mixtures' effects on human health. As such, DOH researchers did not consider any modifications to a chemical's potency for any additive, antagonistic, or synergistic effects. DOH and DEC researchers also lack comprehensive information on historical outdoor air concentrations that could be relevant to cancer due to latency considerations.

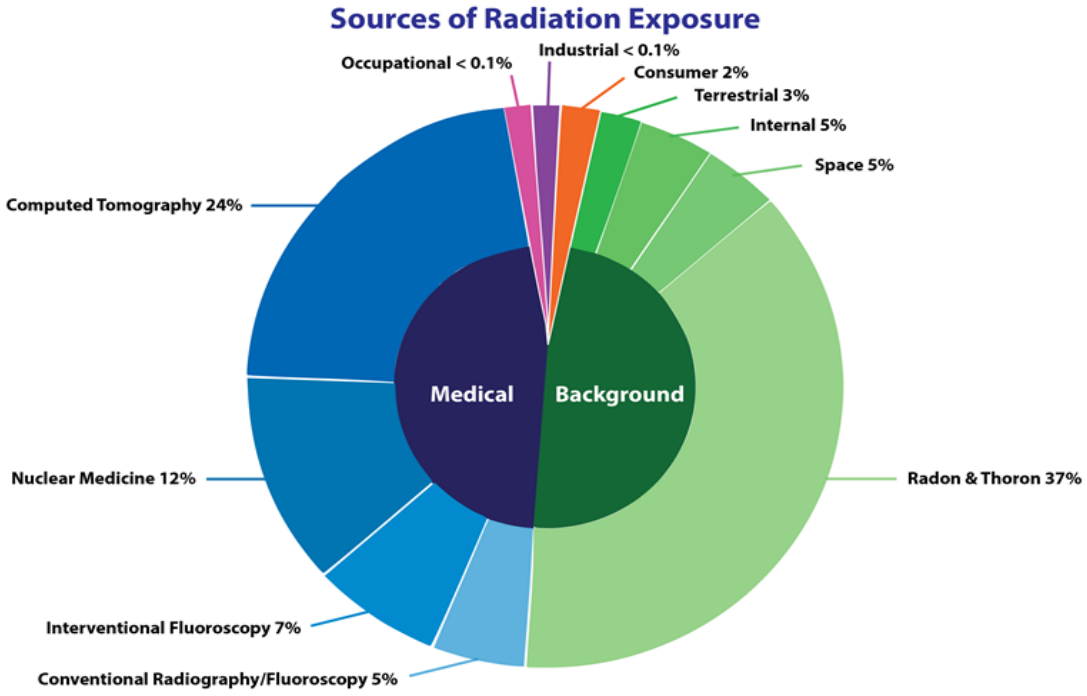
Conclusion on Air Quality Evaluation

Air quality in this region continues to improve due to Federal and State regulatory actions under the Clean Air Act and its Amendments. This study region complies with NAAQS for criteria pollutants of lead, ozone, particulate matter, carbon monoxide, oxides of sulfur and nitrogen. The available air quality monitoring and modeling data do not suggest that people living in this study area are currently exposed to unusual levels of air pollution. In the more distant past, people were likely exposed to higher levels of air pollution. In the recent past, these levels were below the levels for which toxicological evidence suggests that there is an elevated cancer risk. DOH researchers estimate that inhalation exposure to the levels of these listed chemicals in the outdoor air poses a low risk of cancer.

Radon

Approximately 9% of the tests in the statewide radon database were conducted in Erie County, although only a small fraction of homes were tested. Radon test values for Erie County averaged 5.89 pCi/L with a maximum value of 507.0 pCi/L (Table 27). The average radon concentrations in the basement and first floor were 6.47 pCi/L (range 0.2 to 507.0) and 4.11 pCi/L (range 0.2- 150.2), respectively. Approximately 24% of test results in Erie County were higher than the EPA action level. Erie County has been identified by the DOH Radon Program as

A Note About Radiation Exposure



Average Annual Radiation Dose

Sources	Radon & Thoron	Computed Tomography	Nuclear Medicine	Interventional Fluoroscopy	Space	Conventional Radiography/ Fluoroscopy	Internal	Terrestrial	Consumer	Occupational	Industrial
Units											
mrem (United States)	228 mrem	147 mrem	77 mrem	43 mrem	33 mrem	33 mrem	29 mrem	21 mrem	13 mrem	0.5 mrem	0.3 mrem
mSv (International)	2.28 mSv	1.47 mSv	0.77 mSv	0.43 mSv	0.33 mSv	0.33mSv	0.29 mSv	0.21 mSv	0.13 mSv	0.005 mSv	0.003 mSv

(Source: National Council on Radiation Protection & Measurements, Report No. 160)

The average annual radiation dose to the US population is approximately 620 millirem (6.2 millisievert). In the United States, about half of that is from exposure to background ionizing radiation, mainly radon gas and its decay products. Human beings are exposed to natural background radiation every day from the ground, building materials, air, food, the universe, and even elements in their own bodies. Humans are also exposed to man-made radiation. On average, the major source of man-made radiation exposure is medical procedures (x-rays, CT scans, etc.)

The most thoroughly studied individuals for determination of the health effects of exposure to ionizing radiation are the survivors of the Hiroshima and Nagasaki atomic bombs. Increased cancer rates have been seen at radiation dose levels of about 10 to 400 rem (100 to 4000 millisievert), or about 40 to 1600 times the average annual exposure to background ionizing radiation.

At a radiation dose of 10 rem (100 millisievert), approximately 1 person in 100 would be expected to develop cancer from radiation, while approximately 42 of the 100 individuals would be expected to develop cancer from other causes. Lower radiation doses would produce proportionally lower risks, i.e., approximately one individual per thousand would develop cancer from an exposure to 10 millisievert.

a high-risk radon county. However, a review of the existing radon maps by town, previously published by DOH, suggests that towns in the southern part of Erie County tend to have the highest proportion of test results above the EPA action level. As shown in Table 27, a total of 212 residential building test results for the EBWC study area were available for the years 1987-2015. Of this total, 84% were from tests in basement areas. The average radon level for these tests was 0.9 (0.2 to 11.1 pCi/L). Approximately 3.8% of the tests in the EBWC study area were at or higher than the EPA action level. Overall, the total number of tests performed within the EBWC study area was also relatively low, but based on the available data the average concentrations were lower than Erie County and other reference areas statewide.

Table 27. Radon test results for EBWC study area, Erie County, NYS, and NYS excluding NYC, 1987-2015

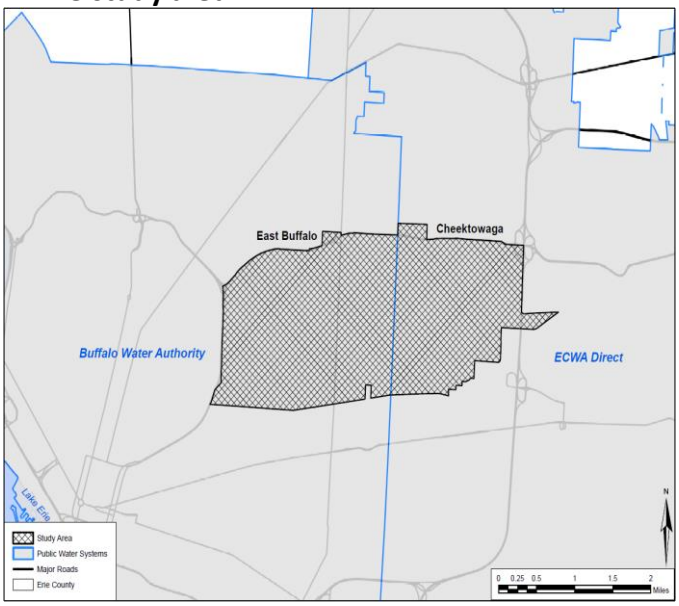
Area	Number of tests	Mean Concentration (pCi/L)			Max Concentration (pCi/L)	% test results ≥ 4 pCi/L
		All floors	Basement	First Floor		
EBWC study area	212	0.90	0.94	0.70	11.1	3.79
Erie County	12,016	5.89	6.47	4.11	507.0	23.83
NYS excl. NYC	129,645	6.70	7.06	3.85	601.4	34.30
NYS	131,914	5.99	6.96	3.81	601.4	33.83

Staff also looked at the census block groups which had average radon concentrations above 4 pCi/L. As shown in the Table and Map in Appendix K, there were two such census block groups in the EBWC study area. In one, there was only one test which makes it difficult to determine whether widespread exposures are occurring. In the other, the results were based upon twelve tests and a total population of 692. The average value was slightly over EPA's recommended threshold for remediation. Even at these relatively low levels, a lifetime exposure would be expected to add to the cancer risk. However, it is unlikely to explain a large number of the excess lung cancers in the study area.

Public Drinking Water Systems

The EBWC study area is serviced by two public water systems, as shown in Map 2. Water for these systems is sourced from Lake Erie and the Niagara River. The western area of the study area, East Buffalo, is serviced by the Buffalo Water Authority. It is a community resource for drinking water and can supply a population of around 276,000 people. On average, this system provides 80,000,000 gallons of drinking water per

Map 2. Public drinking water systems serving EBWC study area



day. The Buffalo Water Authority, a surface water system, sources its drinking water from Lake Erie. An intake draws water from the lake, which is sent to the Colonel Ward Pump Station and Filtration Plant before entering the distribution system.

The Erie County Water Authority (ECWA) Direct supplies water to Cheektowaga, in the eastern portion of the study area. ECWA Direct is a community water source, capable of servicing a population of over 532,000. On average, this public water system produces 63,000,000 gallons of drinking water per day. Like the Buffalo Water Authority, ECWA Direct sources all its water through surface intakes. Water from Lake Erie is sent to the Sturgeon Point Water Treatment Plant for sanitation before distribution throughout the service area. One other intake draws water from the Niagara River as it flows out of Lake Erie, about five miles northwest of the project area. Water from this intake is then sent to the Van De Water Treatment Plant for sanitation and distribution. The drinking water within the study area served by ECWA Direct would likely have a blending of the two sources, which can vary based on demand, seasonality, or pressure fluctuation.

Analytes Measured

Based on their properties, analytes monitored in drinking water samples were grouped into seven categories: Principal Organic Compounds (POCs), Nitrates (NITs), Primary Inorganic Compounds (PICs), Synthetic Organic Compounds (SOCs), Radiological Samples (RADS), Disinfection Byproducts (DBPs), and Lead and Copper (PBCU). A full list of analytes in these groupings that were reviewed in this study can be found in Appendix L, Table 1. This assessment used data going back to 1997, the earliest year for which relevant electronic records were available.

Sampling data for these two water systems is taken at the entry point to the water distribution system, and is a representation of what is delivered to individual residences. It does not represent water within the distribution itself or at individual taps, and therefore the study area can only be characterized by sample results which were taken at each filtration plant.

Drinking Water Findings

Regulated Contaminants
Staff first reviewed testing results for all regulated analytes. Appendix L, Table 1 shows the list of analytes that were reviewed. There were no violations of Maximum Contaminant Levels (MCLs) in the study area's waters supplies. The evaluation showed that both water systems, ECWA Direct and the Buffalo Water Authority, provide high quality drinking water.

Unregulated Contaminants
Staff also reviewed information available for unregulated contaminants. Sampling done under EPA's Second (UCMR 2), Third (UCMR 3), and Fourth (UCMR 4) Unregulated Contaminant Monitoring Rule occurred between 2008 and 2018. The list of UCMR 2, UCMR 3, and UCMR 4 contaminants can be found in Appendix L, Table 2.

One contaminant, chlorate, was detected in EBWC public water systems at levels above the reference concentration, as shown in Appendix L, Table 3. Reference concentrations are health guidelines estimated from animal studies with a level of uncertainty factored in, and they provide context for a result but do not represent an "action level". Chlorate can be present in drinking water as a disinfection byproduct or as an impurity in chemicals used for disinfection. Exposure to elevated levels of chlorate can cause changes in the blood of animals and humans, and cause adverse effects on the thyroid gland in animals. Exposure to chlorate at the levels detected in the EBWC study area are below exposures that cause health effects in animals, and the risk for adverse health effects is small compared to the risks associated with drinking inadequately disinfected water.

Limitations for drinking water

Data reviewed for this evaluation were collected for monitoring purposes. These data were not collected for the purpose of evaluating exposures that might be associated with cancer rates in a specific study area. The EBWC study area represents a small subsection of both the Buffalo Water Authority and ECWA Direct. Sampling data were not available for the exact locations associated with this cancer study area, but rather at points of entry for the water systems' distribution networks. For some analyte concentrations, e.g., disinfection by-products, concentrations may vary based on where a sample was taken within these networks.

Remedial Sites

Based on a review of available data, there is no information suggesting that contamination from existing and known remedial sites is causing widespread exposures in the EBWC study area population. In some cases, on-site contamination exists but is not causing off-site exposure. For other sites, information continues to be gathered. For many sites, actions to identify, control, and/or remove existing contamination have been implemented and completed. More information about the status of each site can be found in Appendix M. For additional information about any of these sites listed below, contact DOH staff at (518) 402-7860 or visit the DEC environmental site remediation database website at https://www.dec.ny.gov/cfmx/extapps/derexternal/index.cfm?pageid=3 and enter the site code provided in Appendix M.

Additional Environmental Information

Access to Healthy Food

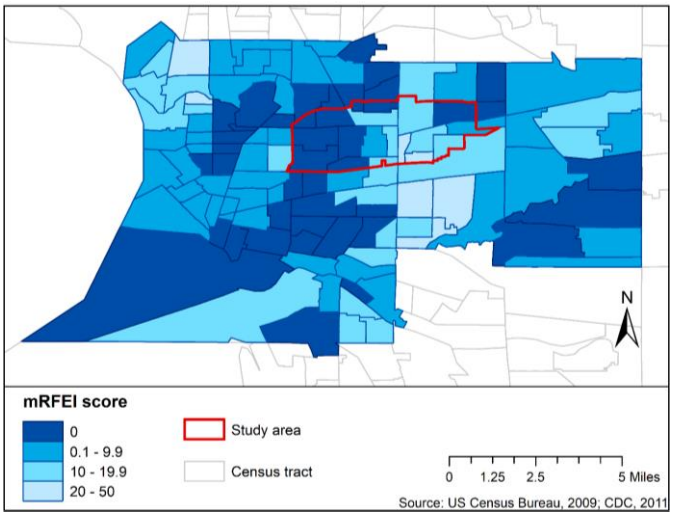
As shown in Table 28, the median mRFEI (modified retail food environment index) for the census tracts which cross the EBWC study area is similar to the rest of NYS as a whole, and higher than the mRFEI of Erie County. However, as shown in Map 3, there is variation in the mRFEI across the study area. In the portion of the study area which falls in the City of Buffalo, where a majority of the study area population lives, the mRFEI scores tend

Table 28. Median mRFEI in the EBWC study area and comparison areas

Geographic Area	Median mRFEI
EBWC study area	7.50
Erie County	5.88
NYS	7.76

to be lower. This suggests there may be parts of the EBWC study area where further investigation is warranted to better understand food access issues.

Map 3. mRFEI by census tract for Buffalo and Cheektowaga, and showing boundaries for EBWC study area



The mRFEI is generally used as an initial screen to identify areas for more in-depth work. This can provide a better local perspective and confirm what the data suggest. In previous studies, investigations have included ground-truthing (walkthroughs of the area of interest).[77, 78] However, this method is time-consuming and resource-intensive. For the mRFEI, the CDC used existing government and proprietary commercial databases to identify fast-food restaurants, convenience stores, and grocery stores.

There are limitations associated with the development of mRFEI numbers. The CDC did not verify store locations or the types of food sold, which means some stores may have been placed in the wrong census tract or misclassified. Although the data are an accurate reflection of analytic databases as of 2011, it is not known whether this snapshot in time is accurate for years before or after 2011. The mRFEI is not representative of all food options available. Unclassified businesses, such as sit-in restaurants, and non-commercial food venues, such as school cafeterias and community gardens, were excluded from their analysis. Because the raw data were not available, we could not create composite scores for the study area or Erie County. Instead, the median of the census tract scores was used as a summary measure.

Traffic Density

As shown in Map 4, the most heavily trafficked roads were Interstate 90, which forms the eastern boundary of the study area, and the Kensington Expressway (State Route 33), which forms the northern and western boundary of the study area. Staff looked at the proportion of people who live within 500 m of roads with traffic counts in the study area. As in other urban areas of the state, there is likely some exposure to traffic-related pollution in the EBWC study area. As shown in Table 29, in the study area, 23% live within 500 meters of roads with an annual average daily traffic (AADT) volume of 75,000-300,000 vehicles, 2% within 500 meters of roads with an annual average daily traffic volume of 25,000-75,000 vehicles, and 75% live near roads with less annual average daily traffic. NYC, being an urban area with substantial traffic, provides the closest comparison to the EBWC study area. Compared to the EBWC study area, in NYC a higher percentage of people (29%) live within 500 meters of roads with an annual average daily traffic volume of 75,000-300,000 vehicles, but a much higher proportion of people (30%) live within 500 meters of roads with an annual average daily traffic volume of

Map 4. Traffic density pattern of roads in the EBWC study area

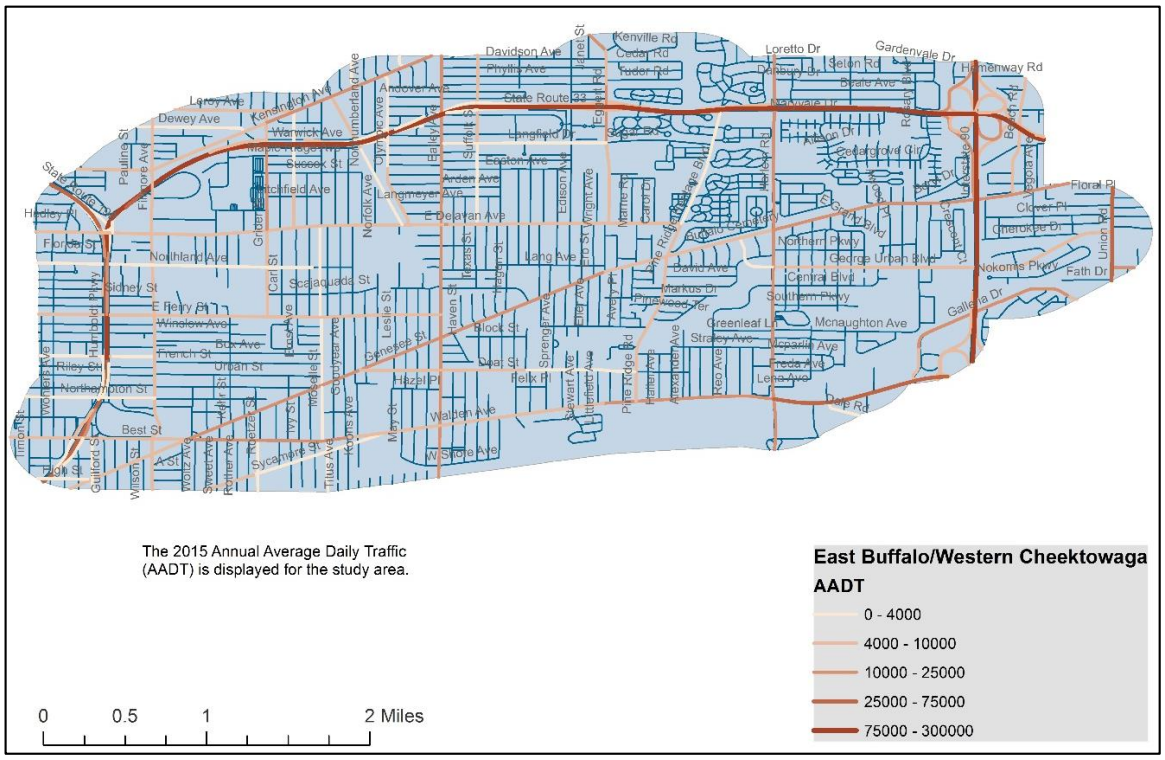


Table 29. Percent population living within 500 meters of DOT-monitored road segments by annual average daily traffic volume (AADT) for EBWC study area, 2015

Geographic Area	75,000 - 300,000 AADT	25,000 - <75,000 AADT	<25,000 ADDT
EBWC study area	23%	2%	75%
NYS excluding NYC	5%	14%	81%
NYC	29%	30%	41%
NYS	15%	21%	64%

75,000-300,000 vehicles, and 41% live near roads with less annual average daily traffic. Compared to NYS and NYS excluding NYC, the study area has more people living next to the most heavily trafficked roads, which makes sense since these comparison areas include large rural areas.

Occupation and Cancer

Occupational exposures have been important historically for identifying links between chemicals and cancer. Suspicions about the links between occupation and cancer have existed for centuries, and the first confirmed occupation-cancer link is generally described as scrotal cancer among chimney sweeps in 18th century London (at the time the causative agent, later identified to be coal tar, was not known).[79] Previous studies have variously concluded that occupational exposures are key risk factors for between 2%-20% of all cancers,[79, 80]

depending upon when the study was performed, the population studied, and prevalence of other risk factors in the population. A relatively recent study concluded that about 4% of cancers in the United Kingdom were caused by occupational exposures.[81] That study estimated that the proportion of occupationally-related cancers vary by cancer type, but males had about twice the proportion of occupational cancers as women. For those cancers that were also elevated in the EBWC study area, the United Kingdom study estimates that 20.5% of lung cancers, 3.3% of esophageal cancers, and 0.04% of kidney cancers have some occupational risk factors. Estimates for oral cancer, colorectal cancer and prostate cancer, for which there is less evidence of an occupational etiology, were not provided. A previous article proposed that policy changes have likely impacted the overall cancer burden associated with occupational exposures, citing as examples Occupational Safety and Health Administration recommendations to reduce carcinogenic exposures in the workplace.[82]

It is important to maintain existing efforts to understand the links between occupational exposures and cancer, as most chemicals have not been fully evaluated for their carcinogenic potential.[79] However, occupational history data are not routinely collected. Although current occupation at the time of diagnosis is reportable to the NYS Cancer Registry as part of reporting incident cancer cases, since most people are older at the time of their diagnosis there is generally not information available on job histories from earlier in life. Buffalo was historically part of the Midwest and Great Lakes region that employed thousands in the manufacturing and industrial sector throughout the 20th century.[83] The EBWC study area itself was home to several industrial facilities. Some workers at facilities that operated in Erie County were probably exposed to chemicals classified as carcinogens, although detailed information on the frequency, magnitude and duration of historical occupational exposures associated with these pollutants is not available. It is reasonable to think that some of the cancers in the EBWC study area may be attributable to previous occupational exposures. But given the lack of data and the inability to reconstruct detailed occupational, lifestyle, and personal histories for people in the study area, it is difficult to know the magnitude of the impact of occupational exposures.

Data on community level occupational patterns are available in US Census data products, which can help to broadly characterize the types of occupations in a particular area. Table 30 displays a summary of the employment distribution by occupational group for the census tracts that overlap the EBWC study area and comparison areas. Separate displays are provided for data from the 2000 US Census and the 2011-2015 American Community Survey. Although comparing these two data sources must done with caution because of differences in the methods for collecting the data, the results suggest that, for each of the geographic areas, the proportion of people working in occupations more likely to experience workplace exposures has decreased between the two time periods, with almost all of the decrease reflected in a similar increase in employment in “service occupations”. Similarly, the total proportion of people working in “All other occupations” was similar for both time periods. In both time periods, the EBWC study area had a higher proportion of its population employed in occupations more likely to experience workplace exposures that could increase the risk for certain types of cancers.

Table 30. Percent of the Population in Selected Occupational Groups, Civilian Employed Population age 16 and Over, 2000 and 2011-2015, EBWC study area, Erie County, NYS excluding NYC, and NYS

Occupational Group	Time Period	EBWC study area CT[1] (%)	Erie County (%)	NYS excl. NYC (%)	NYS (%)
Groups with higher probability of workplace exposures[2]	2000	25.3	21.55	21.04	19.58
	2011-2015	20.67	17.56	18.22	16.73
Service Occupations	2000	22.72	15.6	15.3	16.6
	2011-2015	27.18	18.64	18.28	20.31
All other occupations[3]	2000	51.98	62.85	63.66	63.82
	2011-2015	52.15	63.8	63.5	62.96

Source of data: 2000 US Decennial Census, Summary File 3; US Census American Community Survey 2011-2015, Table S2401: OCCUPATION BY SEX FOR THE CIVILIAN EMPLOYED POPULATION 16 YEARS AND OVER

[1] Data are for 18 census tracts which cross into the EBWC study area

[2] Includes occupations in the Census categories Natural resources, construction, and maintenance occupations; and Production, transportation and material moving occupations

[3] Includes occupations in the Census categories Management, business, and arts occupations; and Sales and office occupations

Discussion

Key Points

- Overall, few cancers were observed in the 19 or younger and 20-49 year old age groups and none of the differences between observed and expected counts in these age groups were statistically significant.
- In the analysis by gender, statistically significant excess incidence was observed mainly in males. Males overall had statistically significantly higher than expected incidence for esophageal cancer, lung cancer, colorectal cancer, prostate cancer (male-only), and kidney cancer. Females overall had statistically significantly higher than expected incidence only for kidney cancer. It's possible that this reflects an effect of previous occupational exposures.
- For several of the health risk behavior indicators, especially smoking and obesity, the burden in the EBWC study area seems to be higher than in the comparison areas.
- Based on a review of available environmental data, there are no clearly evident unusual patterns or trends which explain the excess numbers of cancers, for the six types that were elevated.

Oral Cancer

In the study area from 2011-2015, there were 27 oral cancers diagnosed or observed and about 24.2 were expected, translating to an approximate 12% increase in the study area. The EBWC study area was part of a relatively large area where oral cancer incidence was higher than expected (see Map 1). By design, the analysis used to produce the circular areas in Map 1 (performed using SaTScan software) tests differences in observed versus expected counts based on circles of varying size. While each circle shown in Map 1 (along with the circles shown in the Environmental Facilities and Cancer Mapping tool) represents an area of higher than expected incidence for a particular cancer type, there may be variation in incidence within these circular areas. That seems to be the case for oral cancer within the EBWC study area. The entire higher than expected area covers most of the city of Buffalo, and parts of the towns of Lackawanna, West Seneca and Cheektowaga. Since at least 1996, Erie County oral cancer incidence has been slightly higher than NYS incidence and NYS excluding NYC incidence, as shown in Appendix N, Figure 1. However, analysis of oral cancer in the EBWC study area suggests that the observed number of cases was not significantly different than what would be expected, based on the NYS excluding NYC standard. For both gender and age, the observed counts were not significantly higher than expected. Nor were oral cancer observed counts significantly higher than expected among any of the race/ethnicity groups that were studied. Despite this finding, a brief discussion of oral cancer follows.

Oral cancer was the fifteenth most commonly occurring cancer type, in terms of average annual cases, in NYS and in Erie County during the time period 2011-2015 (including gender-specific cancers). Previous studies of national data for the United States have reported that nearly 80% of oral cancers may be attributable to modifiable risk factors, with smoking and excessive

alcohol consumption being the strongest risk factors.[3] Along with esophageal cancers and lung cancers, oral cancers are among the cancers most strongly linked with smoking in NYS.[75] Approximately 74% of oral cancer cases in the study area reported a current or previous history of smoking. In the analysis of eBRFSS data, nearly 30% of survey respondents from the Greater EBWC study area ZIP codes reported being current smokers, compared to only 15% of survey respondents from the rest of NYS. Similarly, the analysis of SPARCS data found that a greater proportion of hospitalizations and emergency department visit records in the study area had smoking-related ICD-9/ICD-10 codes compared to other areas of NYS. In the analysis of alcohol consumption, the eBRFSS analysis suggests that there was a small, non-significant increase in binge drinking in the study area compared with the rest of NYS. However, hospitalization or ED visit records with codes for conditions related to chronic alcohol use and alcohol dependence were nearly double in the study area compared to NYS.

These analyses suggest the EBWC study area, although part of a larger area with higher than expected incidence of oral cancer, did not itself have statistically significantly higher than expected incidence of oral cancer during the time period 2011-2015. Based on a review of available data, smoking and alcohol consumption could have contributed to the cases that were observed.

Esophageal Cancer

Esophageal cancer is relatively rare, being the twenty-first most commonly occurring cancer type, in terms of average annual cases, in NYS and in Erie County during the time period 2011-2015 (including gender-specific cancers). The 2011-2015 age-adjusted incidence rate in Erie County was 6.0 per 100,000, about 33% higher than the statewide rate.[84] Erie County esophageal cancer incidence has been higher than NYS incidence and NYS excluding NYC incidence since 2006, although the total rates decreased for each area in the most recent time period, as shown in Appendix N, Figure 2. The EBWC study area was part of a relatively large area where esophageal cancer incidence was higher than expected (see Map 1). The entire higher than expected area covers nearly all of Cheektowaga, and parts of Buffalo, West Seneca, Lancaster, and Amherst. However, the EBWC study area itself also had significantly higher than expected incidence. In the study area from 2011-2015, there were 19 esophageal cancers diagnosed or observed, although about 11.1 would have been expected based on the age and sex distribution of the population. There were about 71% more esophageal cancers than expected in the study area.

Because of the very small number of observed esophageal cancer cases, additional categorization and analysis must be interpreted with caution. The expected count for males was nearly three times higher than the expected count for females, reflecting broader trends in NYS where esophageal cancer rates among men are two to three times higher than among women. The observed excess was specific to men. There was not a significant difference between observed and expected counts among females. Among people less than 50 years old, very few cases of esophageal cancer were observed in the study area during the 2011-2015

time period. The age group 50-64 included a large proportion of the higher than expected numbers, with observed counts 3.5 times greater than expected counts. The observed excess was not statistically significantly higher than expected when evaluated by race/ethnicity group.

Along with oral cancers and lung cancers, esophageal cancer is among the cancers most strongly linked with smoking.[75] Besides smoking, obesity and excessive alcohol consumption are also risk factors for esophageal cancer, with previous studies reporting that 80-90% of these cancers may involve these risk factors.[3, 17] Previous studies suggest clear differences in risk factors associated with esophageal cancer types.[85] Squamous cell carcinomas are associated with tobacco use and alcohol consumption.[86] Adenocarcinomas are associated with obesity and gastroesophageal reflux disease (GERD), the latter also being related to obesity.[87] In the study area, approximately 58% of the esophageal cancers were adenocarcinomas and 37% were squamous cell carcinomas, similar to the distribution for the rest of NYS. There was an excess of both in the study area, with a borderline statistically significant excess for squamous cell carcinoma.

Approximately 79% of esophageal cancer cases in the study area reported a current or previous history of smoking. In the analysis of eBRFSS data, nearly 30% of survey respondents from the three Greater EBWC study area ZIP Codes reported being current smokers, compared to only 15% of survey respondents from the rest of NYS. Similarly, the analysis of SPARCS data found that a greater proportion of hospitalizations and emergency department visit records in the study area had smoking-related ICD-9/ICD-10 codes compared to other areas of NYS. In the analysis of alcohol consumption, the eBRFSS analysis suggests there was a small, non-significant increase in binge drinking in the study area compared with the rest of NYS. However, hospitalization or ED visit records with codes for conditions related to chronic alcohol use and alcohol dependence were nearly double in the study area compared to NYS. In the analysis of obesity, the eBRFSS analysis suggests that there was an increased prevalence of obesity reported from respondents in the three Greater EBWC study area ZIP Codes compared to the rest of NYS. Similarly, the analysis of hospitalization records suggests that there was a larger proportion of records with obesity-related codes among people from the study area compared to the rest of NYS.

Due to the lack of historical occupational information for people with cancer diagnoses, it is not clear to what extent occupational factors might have contributed to incidence of esophageal cancer in the study area. A review article assessing the body of evidence regarding cancer risks due to occupational exposures in the rubber industry reported inconsistent findings from previous studies of esophageal cancer.[88] A large study of associations between occupation and cancer in Northern Europe found the highest risks of esophageal cancer among waiters/waitresses, beverage manufacture workers, cooks and stewards, chimney sweeps and seamen, attributing these increased risks more to an increased likelihood of excess alcohol consumption and smoking than specific occupational exposures.[89]

This evaluation did not identify any studies that have explored associations between esophageal cancer and exposures to public drinking water or outdoor ambient air pollution.

Evaluation of public drinking water data did not identify any MCL violations of concern. Similarly, risks associated with ambient air pollution or traffic density do not appear to be substantially different than other areas, especially urban areas, of NYS. As can be viewed on the Environmental Facilities and Cancer Mapping tool, in NYC, another large urban area of NYS with high traffic density, there are a number of areas of lower than expected esophageal cancer incidence which would be unlikely if traffic were a strong risk factor for esophageal cancer.

These analyses suggest there may be a greater burden from smoking, obesity, and excessive alcohol consumption in the study area compared to other areas. These health risk behaviors could have contributed to the excess esophageal cancers.

Lung Cancer

Lung cancer was the third most commonly occurring cancer type, in terms of average annual cases, in NYS and second most common cancer type in Erie County during the time period 2011-2015 (including gender-specific cancers). In the study area from 2011-2015, there were 188 lung cancers observed compared to about 150.7 that would have been expected, representing a 25% excess incidence. The EBWC study area was part of a relatively large area where lung cancer incidence was higher-than-expected (see Map 1). The entire higher than expected area covers nearly all of the city of Buffalo, and parts of the towns of Cheektowaga, Lackawanna, and West Seneca. Erie County incidence has been generally higher than both NYS and NYS excluding NYC incidence since at least since 1996, as shown in Appendix N, Figure 3, and did not show a significant decline in the most recent time period. The 2011-2015 age-adjusted lung cancer incidence rate for Erie County (74.6 per 100,000) was statistically significantly higher (by about 8%) than the rate for NYS excluding NYC, while the same rate for Buffalo (90.2 per 100,000) was 31% higher than the rate for NYS excluding NYC.[84] Among men in the EBWC study area, the excess in lung cancers was statistically significant for those 65 and older. Among women, the excess in lung cancers was statistically significant among those 50-64. Historically, differences in lung cancer rates by gender have been attributed, at least in part, to variation in the adoption and cessation of smoking among males and females. [90] While lung cancer rates among men have consistently been higher than women, the disparity between the two has decreased substantially, as male lung cancer incidence rates have been decreasing by 1-2% per year since 1988 in NYS excluding NYC, while rates among women increased until the mid-2000's and have been decreasing by about 0.6% per year since 2006.

For 2011-2015, lung cancer rates overall and by demographic variables were higher in NYS excluding NYC than in NYS overall. In NYS excluding NYC, the rate among non-Hispanic whites was 69.6 per 100,000, which was higher than the rate of 55.9 per 100,000 in the non-Hispanic black and other race group. This trend was reversed for Erie County, mostly attributable to excess lung cancer burden among the non-Hispanic black and other race group. The Erie County rate of 73.9 per 100,000 among non-Hispanic whites was within 6% of the rate for NYS excluding NYC, but the Erie County rate of 80.8 per 100,000 among the non-Hispanic black and other race group was 45% higher than the same rate for NYS excluding NYC. In the EBWC study

area, lung cancer incidence was statistically significantly higher than expected only in the non-Hispanic black and other race group.

It has been proposed that differences in lung cancer incidence by race primarily reflect differences in the prevalence of smoking, the strongest risk factor for lung cancer. [91] Previous studies of national data for the United States have reported that over 80% of lung cancers may be attributable to smoking. [3] A study of lung cancer cases in NYS similarly attributed approximately 80% of lung cancers to smoking. [75] The most recent Surgeon General's report on smoking suggests that at least 69 chemicals in tobacco smoke can cause cancer. [92] For nearly 90% of the lung cancer diagnoses from the study area, there was a history of tobacco use, with about 48% being current smokers and 41% former smokers. Results of the analysis of eBRFSS data and SPARCS data provide additional information about the burden of smoking in the study area. In the analysis of eBRFSS data, nearly 30% of survey respondents from the three Greater EBWC study area ZIP Codes reported being current smokers, compared to only 15% of survey respondents from the rest of NYS and 17% of survey respondents in NYS excluding NYC. Similarly, the analysis of SPARCS data found that a greater proportion of hospitalizations and emergency department visit records in the study area had smoking-related ICD-9/ICD-10 codes compared to other areas of NYS. Although detailed individual-level historical data on the prevalence of smoking from a time period that would better account for lung cancer latency is not available for the study area, this provides support for there being a greater burden from smoking in the study area compared to other areas and that smoking continues to be the risk factor of greatest concern. Additionally, people who live with smokers also have some level of increased risk from environmental tobacco smoke compared to people who are not exposed. Although it would be expected to pose a relatively lower risk (compared to smoking), exposure to secondhand tobacco smoke, which is classified as a carcinogen independently of tobacco smoke, [93] may also contribute to the lung cancer burden in the study area.

Smoking is associated with all types of lung cancer, and has generally been most strongly linked with squamous cell carcinoma and small cell carcinoma. [92] In a recent multi-country analysis, for both these types the odds ratio for lung cancer was estimated to be at least 40 times higher among current heavy smokers compared to never smokers. [94] Squamous cell carcinoma and small cell carcinoma accounted for approximately 25% of cancers in the study area. In the EBWC study area, there was a history of tobacco use indicated for 95% of the squamous cell carcinomas and 100% of the small cell carcinomas, although squamous cell carcinoma occurred less frequently than expected. Large cell carcinomas, although less common than other histological forms of lung cancer, have also been linked with smoking, with a recent study suggesting the magnitude of the effect estimate was between those found for squamous and small cell lung cancers and those found for adenocarcinoma lung cancers. [95] Approximately 94% of the large cell carcinomas indicated a history of tobacco use.

The higher than expected incidence of large cell carcinoma in the study area may be at least partially explained by the race distribution, as historically black men have had higher rates of large cell carcinoma than white men, although large cell carcinoma rates overall have been decreasing. [96] Historically, adenocarcinomas have been less strongly linked with smoking,

although the odds of lung cancer are still more than 5 times higher among current smokers compared to never smokers.[94] In the current evaluation of the EBWC study area data, 93% of the lung adenocarcinoma cases indicated a history of tobacco use. The 50th Anniversary Surgeon General's Report on Smoking concluded that the risk associated with developing adenocarcinoma from cigarette smoking increased over the second half of the 20th century and suggested this increase may be linked with the shift to filter ventilated cigarettes. [92] A study of this issue outlined biologic mechanisms associated with adenocarcinomas, summarized studies which have explored changes in chemical composition of filter ventilated cigarettes related to combustion efficiency, and provided data from the tobacco industry suggesting that mutagenicity of cigarette smoke increased as filter ventilation increased.[97]

Despite the strong links between smoking and lung cancer and data that suggest it was a contributing factor for many of the lung cancers in the EBWC study area, smoking is not the only risk factor for lung cancer. In fact, studies of non-smokers have shown age- and sex-adjusted rates for lung cancer that are higher than the rates for other cancer types, highlighting the importance of more research among this group.[98] These studies have explored alternative exposures that may be responsible for lung cancer among non-smokers, including family history and genetic factors, exposure to second-hand smoke, radon, and other sources of environmental and occupational exposure.

Radon is generally considered to be the second strongest risk factor for lung cancer. Radon is a naturally occurring radioactive gas that has no color, odor or taste and is formed during decay of uranium in soil, rock and water. It can get into indoor air from soil under homes and other buildings through cracks, openings and various penetrations in the building foundation. Rarely, radon can be found dissolved in ground water and enter indoor air through use of well water in washing machines, showers etc. Radon concentrations in a home are dependent on many factors including type of soil under the home, and ventilation rate and air flow patterns within a house. For example, radon levels can be higher in homes that are well insulated, tightly sealed, and/or built on soil rich in the elements uranium, thorium, and radium. Due to their closeness to the ground, lower levels of a building (e.g., basements) typically have the highest radon concentrations.

Although the association between radon and lung cancer is not as strong as that seen with smoking, previous studies also suggest that the combination of radon and smoking has a multiplicative effect on lung cancer risk.[99] Radon tends to be highest in the Southern Tier of NYS, and available data suggest that in towns in the southern part of Erie County the proportion of test results above the EPA action level is relatively higher than northern parts of Erie County. However, evaluation of the radon data for the EBWC study area did not provide strong evidence of widespread exposure to unusually high concentrations of radon. Approximately 3.8% of the tests in the EBWC study area were observed to be at or higher than the EPA action level, and two census block groups had average radon levels between 4 and 20 pCi/L. However, in one block group the information was based on only one test and in the other block group the population accounted for less than 2% of the study area population. In comparison, approximately 24% of tests in Erie County as a whole and 34% of tests in NYS excluding NYC

were at or above the EPA action level. Even at these relatively low radon concentrations observed in the study area, indoor exposure may contribute a small amount of additional lung cancer risk, especially in households with co-occurring smoking. However, based upon the available data it is unlikely that radon is contributing to a significant portion of the lung cancer excess in the EBWC study area.

Previous studies have found associations between certain chemicals and lung cancer, and the International Agency for Research on Cancer has identified a number of chemicals associated with manufacturing and other industrial processes as carcinogens.[100] These designations are based upon evidence from epidemiologic studies of occupational cohorts, experimental animal studies, or both. There is not a comprehensive, available source of occupational data and DOH staff are not able to say whether the lung cancers that are occurring in the study area are the result of occupational exposures. However, Buffalo's industrial history,[83] and the fact that the EBWC study area itself was home to several industrial facilities suggests that some of the lung cancers observed in this study may be attributable to previous occupational exposures.

While concerns about the role of the environment and lung cancer are valid, it should be noted that environmental exposures tend to be much lower than those experienced in occupational or experimental settings.[101] Environmental exposures from ambient air and drinking water are generally not thought to be a significant contributing cause for most lung cancer cases. [101] This is due at least in part to regulations to protect the air we breathe and water we drink.

Studies from other countries have found associations between arsenic in drinking water and lung cancer.[102] However, the arsenic concentrations in these studies were much higher than those in NYS, and a recent study concluded that exposures to arsenic in drinking water experienced by the US population are unlikely to increase cancer risks substantially.[103] The EBWC study area, served by two public drinking water systems, did not have any arsenic-related MCL exceedances during the time period that was evaluated. Based on this information, arsenic exposures are not expected to explain the excess lung cancers in the study area.

The IARC recently classified particulate matter as a carcinogen based on a review of epidemiologic and toxicologic studies that have evaluated its association with lung cancer.[104] Particulate matter includes other pollutants that IARC has categorized as carcinogenic, and most people are exposed to one or more of these pollutants at some point, but generally at concentrations which present a relatively low cancer risk.[104] It is not completely clear that particulate matter is the key exposure of concern or whether, due to the high correlation between ambient air pollutants, it is an indicator of other carcinogenic pollutants. Some researchers have focused on exposure to traffic-related air pollutants and lung cancer. Specific air pollutants as well as urban air pollution in general have been associated with lung cancer, but studies are limited. In reviewing modeled estimates of air toxics that are considered the primary drivers of cancer risk in outdoor ambient air, the EBWC study area was not unusual in relation to Erie County or other urban areas of NYS. Air toxics monitoring at Dingens St., just south of the study area, showed levels of traffic-related air pollutants that were similar to other

monitoring locations throughout New York State. Available data on air quality do not indicate an unusual impact in the EBWC study area.

This data review suggests there may be a greater burden from smoking in the study area compared to other areas and that this contributes to the excess lung cancers. Indoor exposure to radon may contribute a small amount of additional risk, although the total number of radon tests from the EBWC study area was relatively low and available test results suggest that radon concentrations tended to be lower on average than in comparison areas. The available information does not suggest that other environmental exposures contribute are unusual. The evaluation cannot rule out the possibility that occupational exposures have contributed to the lung cancer excess in the study area.

Colorectal Cancer

In the study area from 2011-2015, there were 122 colorectal cancers diagnosed or observed compared to 87.1 expected based on the age and sex distribution of the population, representing an approximately 40% (122/87.1) increase in the study area. When assessed by gender, the observed counts of colorectal cancer were statistically more than expected among males only. Observed colorectal cancer numbers among people under 50 were similar to expected numbers. The largest discrepancies between observed and expected counts for colorectal cancer by age were among adults in the age categories 50-64 years and 65 and older. Colorectal cancer observed numbers were significantly higher than expected among those in the non-Hispanic black and other race category, but not among non-Hispanic whites.

Colorectal cancer was the fourth most frequently occurring cancer type, in terms of average annual cases, in males and females in NYS and Erie County during the time period 2011-2015. The 2011-2015 NYS rate was similar to the national age-adjusted incidence rate of 39.4 per 100,000.[105] The colorectal cancer incidence rate in Erie County has been similar to rates in NYS and NYS excluding NYC since at least 1996, as shown in Appendix N, Table 4. Rates in all areas declined steadily during this time period. Therefore, the increase seen in the EBWC study area does not appear to be a trend seen in Erie County as a whole, as illustrated in the relatively small area of higher than expected incidence for colorectal cancer seen in Map 1. Although colorectal cancer is rare among people under age 50, incidence among this age group has been rising even as rates among people 50 or older have been falling, a pattern which has been attributed to shifting cultural and lifestyle habits, especially those related to diet.[106] Despite these trends that suggest colorectal cancer incidence is increasing among those who are younger,[107] this review did not yield evidence of a significant excess of colorectal cancer among the under 50 age groups in the study area.

A number of modifiable risk factors have been implicated in the development of colorectal cancers, which together may explain more than 50% of the overall incidence.[3] With additional consideration of the role of screening, some studies have concluded that a majority of these cancers are preventable.[108] About 48% of the colorectal cancer cases in the EBWC study area

had a current or previous history of smoking. This is consistent with other studies that suggest the association between smoking and colorectal cancer is not as strong as for other cancers.[36] A recent study estimated that approximately 12% of colorectal cancer cases may be attributable to smoking.[3] Alcohol intake, excess body weight, red meat consumption, processed meat consumption, low dietary fiber intake, low calcium intake, and lack of physical activity are estimated to be factors in an additional 12.8%, 5.2%, 5.4%, 8.2%, 10.3%, 4.9%, and 16.3% (colon only) of all colorectal cancer cases, respectively. Analysis of the eBRFSS and SPARCS data provided insight into current trends related to these behavioral risk factors.

In the analysis of eBRFSS data, nearly 30% of survey respondents in the three Greater EBWC study area ZIP Codes reported being current smokers, compared to only 15% of survey respondents from the rest of NYS and 17% of survey respondents from NYS excluding NYC. Similarly, the analysis of SPARCS data found that a greater proportion of hospitalizations and emergency department visit records in the study area had smoking-related ICD-9/ICD-10 codes compared to other areas of NYS. In the analysis of obesity, the eBRFSS analysis suggests that there was an increased prevalence of obesity reported from respondents in the three Greater EBWC study area ZIP Codes compared to the rest of NYS excluding NYC, while the analysis of hospitalization records suggests that there was a larger proportion of records with obesity-related codes among people from the study area compared to the rest of NYS. Furthermore, the eBRFSS analysis also suggests that the respondents in the three Greater EBWC study area ZIP Codes were significantly less likely than respondents from the rest of NYS to engage in leisure time physical activity.

Previous studies have found associations between community-level socioeconomic status and colorectal cancer incidence, with higher incidence in areas with lower SES.[2, 109] Some studies have suggested that differences in colon cancer incidence by race can be explained by these SES differences.[110] Socioeconomic status affects access to screening, diagnosis and treatment. A study that explored the associations between colorectal cancer, SES, and health risk behaviors concluded that health risk behaviors partly explained the association.[111] Access to screening was also an important factor that varied by SES in that study. Definitive information on screening was not available for the EBWC study area. The analysis of eBRFSS data suggests that the population of people living in the Greater EBWC study area ZIP Codes had a similar adherence to USPSTF colorectal cancer screening recommendations as the rest of NYS. Similarly, the results of the SPARCS analysis suggest that the prevalence of colonoscopy procedure codes on hospital outpatient visit records is similar in the study area as in the rest of NYS. Based on previous findings regarding associations with community SES, it might be expected that the higher rate of colorectal cancer in the study area is related to lower screening prevalence. Furthermore, there was a statistically significant excess in distant-stage colorectal cancers, which could tend to contradict a finding of adequate access to health care in the study area. Staff assessed the observed and expected counts for colorectal cancer subtypes, including proximal colon, distal colon and rectum. Observed counts were greater than expected counts for each of the subtypes, although the increase was only statistically significant for cancers of the proximal colon. Some previous studies have suggested that certain colorectal cancer screening techniques are not as effective at detecting cancers in the proximal colon,[112] while

other studies have found that African Americans are more likely to be diagnosed with tumors of the proximal colon.[113, 114] These factors could help explain some of the observed excess and the specific finding for distant-stage cancers.

A small number of previous studies have explored links between colorectal cancer and nitrate in drinking water, but while a recent review indicated that many of these studies found positive associations it cautioned that firm conclusions about risk are premature.[115] More importantly in regards to the evaluation of drinking water in the EBWC study area, nitrate does not appear to be a contaminant of concern in the drinking water as no violations occurred. Few studies have evaluated associations between colorectal cancer and air pollution, but published studies have generally used colorectal cancer mortality as an endpoint. A recent study found a small elevated risk for colorectal cancer mortality associated with $PM_{2.5}$ and NO_2, but pointed out that the few previous studies that have been published have yielded inconsistent results and recommended further investigation.[116] Additionally, although mortality endpoints can be indicators of incidence when survival time is low, the 5-year survival for colorectal cancer is 66% which is relatively high.[117] Therefore, the mortality endpoint reflects incidence as well as management of the cancer, which complicates interpretation of exposures as causal factors in the occurrence of the disease. While colorectal cancer has been associated with certain occupations, previous studies have not always adjusted for important risk factors, and existing evidence has not been consistent.[118]

These analyses of factors associated with colorectal cancer suggest that the study area has an increased prevalence or burden associated with a number of modifiable risk factors that have been linked with this type of cancer.

Prostate Cancer

Prostate cancer was the second most common cancer type, in terms of average annual cases, in NYS and third most common cancer type in Erie County during the time period 2011-2015. In the time period 1996-2000, prostate cancer incidence in Erie County was similar to rates in NYS and NYS excluding NYC. Prostate cancer incidence increased in Erie County in the next five-year time period, while in NYS excluding NYC it did not change and in NYS it began to decline. It declined in all three areas in 2006-2010 and 2011-2015, although less steeply in Erie County as in the comparison areas, as shown in Appendix N, Figure 5. In the study area from 2011-2015, there were 190 prostate cancers diagnosed or observed compared to about 127.5 that would have been expected based on the age and sex distribution of the population. There were about 49% more prostate cancers than expected in the study area.

Aside from race and family history, there are few firmly established risk factors for prostate cancer. Large racial disparities exist in the incidence of prostate cancer in NYS. Rates among black men are currently about 71% higher than rates among white men (NYS Cancer Registry stats). Although racial disparities are not as large in Erie County as in the rest of the state, prostate cancer incidence among black men in Erie County is still 35% higher than among white

men in Erie County. Since the Environmental Facilities and Cancer Mapping analysis that identified the EBWC study area did not account for race differences, and since the majority of the EBWC study area is black based on US Census data from 2010, it is not surprising that the original analysis found higher than expected incidence of prostate cancer. A substantial portion of the higher than expected incidence was accounted for after adjusting for race. While the non-Hispanic black and other race group had a much higher expected numbers of cases, reflecting the population demographics of the study area, the magnitude of the increase in observed over expected was similar in non-Hispanic whites and non-Hispanic black and other race groups, where for each group the observed counts were about 20% higher than expected. These increases were at the borderline of statistical significance. In other words, after accounting for race-related differences in prostate cancer, the excess in the EBWC study area was reduced and could have been a chance finding.

Staff also explored access-related explanations for the excess cancers. As a cancer type for which screening options are available, differential patterns in screening across the state can impact cancer incidence patterns. For prostate cancer, screening tends to pick up early stage cancers, many of which are of no clinical significance in terms of survival. Sharp increases in the incidence rate in the 1990's have been attributed to adoption of screening practices. As screening recommendations were adjusted, rates decreased again.

Screening recommendations should take into account the effectiveness of available screening options along with the risks and benefits of screening. A good screening test not only identifies cancer at an early stage, but shows long-term benefit in terms of lives saved.[119] Information reported by the United States Preventive Services Task Force regarding prostate cancer screening suggests that, in men aged 55-69, PSA-based screening programs prevent approximately 1.3 deaths from prostate cancer over approximately 13 years per 1000 men screened and approximately 3 cases of metastatic prostate cancer per 1000 men screened.[120] Prostate cancer screening based upon prostate specific antigen (PSA) testing has been called into question due to concerns about the rate of "overdiagnosis" resulting from the test,[121] since a substantial proportion of prostate cancers that are identified are unlikely to progress to a lethal form and may be considered overdiagnosed cases. [122] Even with effective PSA screening, the risks associated with testing and subsequent treatment following a "positive" PSA test are not negligible.[122-124]

Potential harms of screening and treatment include frequent false-positive results and psychological harms, erectile dysfunction (2 in 3 men), urinary incontinence (in 1 in 5 men who undergo radical prostatectomy), and bowel symptoms.[120, 125] The United States Preventive Services Task Force currently assigns prostate cancer screening a "C" grade for men 55-69 years old, meaning that that group's review of the evidence deems the magnitude of the benefit to be small and the balance of benefits and harms to be close.[120] The same group does not recommend screening for men 70 and older, with the associated "D" grade implying no net benefit and potentially greater harm than good. More information about prostate cancer screening recommendations can be found at

https://www.uspreventiveservicestaskforce.org/Page/Document/RecommendationStatementFinal/prostate-cancer-screening1.

The excess observed prostate cancers in the EBWC study area still may be impacted by screening and associated overdiagnosis. To explore this question further staff calculated observed and expected counts by stage of diagnosis. Early-stage diagnoses were expected to account for more than 80% of the prostate cancer cases where staging information was known. The excesses in both local-stage and distant-stage diagnoses were statistically significant. The excess in local-stage cancers could reflect a screening effect. The analysis of time trends provides additional evidence to support this possibility. As prostate cancer incidence rates in NYS and NYS excluding NYC dropped substantially after the year 2000, the rate in Erie County has decreased more slowly. The EBWC study area finding of higher than expected local-stage diagnoses may reflect a wider trend in screening practices that has maintained Erie County rates at higher levels than other areas of the state. This is reflected in NYS Cancer Registry maps which show Erie County to have high prostate cancer incidence overall in relation to other NYS counties, but low incidence of the subset of prostate cancers diagnosed at a regional or distant stage.[84] The excess in distant-stage cancers could suggest a lack of access to care. Although the total number of distant-stage prostate cancers was relatively low, the magnitude of the excess in observed prostate cancers was higher than for local-stage cancers.

When race, in addition to age, was accounted for in the analysis of prostate cancer, the magnitude of the excess prostate cancer incidence in the EBWC study area was reduced. When analyzed by stage at diagnosis, there was an increase in both localized and distant stage prostate cancers. It is possible that screening practices may be contributing to the increase in localized diagnoses.

Kidney Cancer

In the study area from 2011-2015, there were 66 kidney cancers diagnosed or observed compared to about 39.1 that would have been expected based on the age and sex distribution of the population. There were about 69% more kidney cancers than expected in the study area. At the county level, the kidney cancer incidence rate in Erie County has been similar to rates in NYS and NYS excluding NYC since at least 1996, even as rates have collectively risen for each area. In the most recent years where data are available, rates in Erie County and NYS excluding NYC were slightly higher than the NYS rate, as shown in Appendix N, Figure 6. The 2011-2015 age-adjusted incidence rate in Erie County was 18.4 per 100,000, about 11% higher than the statewide rate. Because of the relatively small number of observed kidney cancer cases, additional categorization and analysis must be interpreted with caution. When assessed by gender, the observed counts of kidney cancer were statistically more than expected among both females and males. The largest discrepancies between observed and expected counts for kidney cancer by age were among adults in the age categories 50-64 years and 65 and older. Kidney cancer observed counts were significantly higher than expected among non-Hispanic whites and those in the non-Hispanic black and other race groups.

Kidney cancer was the eleventh most frequently occurring cancer type in NYS and ninth most common cancer type in Erie County during the time period 2011-2015. Kidney cancer incidence has been increasing in NYS since at least 1976. After a period from 1976-2007 where the average annual increase was 2.8% per year, the rate of increase has slowed to 0.7% per year from 2006 to 2015. In this evaluation, the higher than expected incidence of kidney cancer was seen in males and females, and the magnitude of the elevation was similar. Very few cases occurred in the 0-19 and 20-49 age groups. Incidence was only greater than expected in the 50-64 and 65 and older age groups, and the magnitudes of the elevations were similar. Both non-Hispanic whites and those in the non-Hispanic black and other race groups had higher than expected incidence.

A previous study estimated that modifiable risk factors were implicated in over half of kidney cancers, with obesity and smoking being the primary risk behaviors. [3, 126] Both of these risk factors have been independently associated with a doubling of risk for kidney cancer. [126] In the analysis of obesity, the eBRFSS analysis suggests that there was an increased prevalence of obesity reported from respondents in the three Greater EBWC study area ZIP Codes compared to the rest of NYS, while the analysis of hospitalization records suggests that there was a larger proportion of records with obesity-related codes among people from the study area compared to the rest of NYS. Nearly 30% of survey respondents from the three Greater EBWC study area ZIP Codes reported being current smokers. Similarly, the analysis of SPARCS data found that a greater proportion of hospitalizations and emergency department visit records in the study area had smoking-related ICD-9/ICD-10 codes, both in comparison to Erie County and NYS. The eBRFSS analysis also suggests that the respondents in the three Greater EBWC study area ZIP Codes were significantly less likely than respondents from the rest of NYS to engage in leisure time physical activity. These more recent data suggest that these modifiable risk factors may be of concern and contribute to the kidney cancer burden in the study area.

Occupational exposure to trichloroethylene has also been associated with kidney cancer. [60] A year 2000 review of existing literature supported the categorization of trichloroethylene as a carcinogen, further concluding that evidence of associations with particular cancer types was strongest for kidney cancer, based on data available up to that point. [127] A 2014 IARC monograph judged the weight of evidence to be sufficient for classifying trichloroethylene as a cause of kidney cancer, based upon a review of available epidemiologic and experimental data. [128] In many cases, the evidence that is being reviewed is from experimental animal studies, epidemiologic studies of occupational cohorts, or both. Studies in laboratory animals and occupational cohorts generally involve exposures at much higher concentrations than those experienced by the general public. The cohort studies that were reviewed included workers in the dry cleaning, aerospace, and uranium industries, and in factories where TCE was used as a degreasing agent. A more recent study found associations between exposure to metal-working fluids and renal cell carcinoma among white male autoworkers (sample sizes were too small to analyze female and black male workers). [129] A limiting factor in the interpretation of this study is the lack of quantitative control for potential confounders (e.g., trichloroethylene, smoking), even though some qualitative evidence suggested their influence was limited. Other studies have reported small associations between kidney cancer and

occupational exposure to traffic-related air pollutants.[130] The NYS Cancer Registry does not collect occupational history information and, therefore, it is not clear to what extent occupational factors might have contributed to incidence of kidney cancer in the study area. It is possible that some of the kidney cancers observed in this study may be attributable to previous occupational exposures.

Past studies have explored associations between kidney cancer and drinking water contaminants, including arsenic, nitrate, disinfection by-products, and PFOA.[131-133] No violations for any drinking water analytes were issued for the drinking water systems serving the EBWC study area for the years that were evaluated. Regarding other potential exposure routes, TCE has also been the focus of investigations of remedial sites which have found sub-soil plumes of the chemical in its vapor form. TCE has been associated with kidney cancer. [134] However, in this evaluation there was no clear evidence or documentation of off-site TCE exposure to the general public in the study area.

Previous studies have explored associations between kidney cancer and ambient air pollution.[130] The studies have generally found small, non-statistically significant elevations in risk. More work is needed to better understand the role of ambient air pollution as a risk factor for kidney cancer. Overall, levels of air pollution have decreased over the last several decades. Modeled estimates of cancer risk associated with exposure to hazardous air pollutants in ambient air were generally similar in the EBWC study area to those in other areas of NYS.

These analyses suggest that there may be a greater burden from smoking, obesity, and lack of physical activity in the study area compared to other areas, which could contribute to excess kidney cancers. The evaluation cannot rule out the possibility of occupational exposures that contributed to kidney cancer. It is unlikely drinking water exposures or ambient air pollution exposures were primary factors in the excess seen in the EBWC study area.

Limitations

General Considerations

When attempting to draw conclusions from the data presented, there are certain considerations that should be kept in mind. One important issue is residential migration, that is, movement of people into or out of the study area. Cancer cases were identified among persons who resided in the study area when their cancers were diagnosed. Former residents of the study area who moved away prior to being diagnosed with cancer could not be included, while persons who developed cancer shortly after moving into the area were included. This issue is particularly important in view of the long latency period of many cancers. Cancer latency refers to the time between first exposure to a cancer-causing agent and the appearance of cancer symptoms. For many cancers in adults, latency can be 10 years or more. This long latency gives people ample time to relocate in the time between exposure and the diagnosis of cancer.

When evaluating the possible contribution of environmental factors, it is important to consider exposure. Exposure is contact. For any substance to have an effect on human health, people have to be exposed to it. People may be exposed to a chemical substance by breathing it in (inhalation), consuming it in food or water (ingestion), or getting it on their skin (dermal exposure). Even with exposure, not all hazardous substances cause cancer. The risk of developing cancer upon exposure to a cancer-causing substance depends on the amount of the substance people are exposed to, the length of time they are exposed to it, and how often they are exposed to it.

With the conventional standard for statistical significance used in this study, approximately one out of every 20 statistical tests (5%) will be statistically significant due to chance alone. In this study, a large number of comparisons were made between incidence in the EBWC study area and reference areas (e.g., NYS excluding NYC). When many statistical tests are done, the probability is high that at least one statistically significant difference will occur entirely by chance.

Limitations of Specific Data Sources

Cancer Registry

The cancer-related analyses in this study were based on data contained in the New York State Cancer Registry. Variation in cancer incidence among different geographic areas reflects not only true differences in cancer incidence, but also differences in how cancer is diagnosed, treated, and recorded in different areas of the state. The completeness and accuracy of the Cancer Registry depend upon reporting from hospitals, laboratories, other healthcare facilities, physicians and other sources. The Cancer Registry has been certified as more than 95 percent complete by the North American Association of Central Cancer Registries. In addition, the

Cancer Registry has received gold certification from the Association since 2000 (data year 1996), the highest certification given to central cancer registries.

Behavioral, Lifestyle, Medical Care Utilization

Information obtained from the ***eBRFSS*** is subject to the limitations of any survey, where results are impacted by the types of questions that are asked and how they are asked. Smoking was assessed based on the percentage who were current cigarette users, while former smokers are also at increased risk of many cancers. Binge drinking is not the same as heavy drinking. Even moderate drinkers are at increased risk of many cancers. In addition, the accuracy of the data depends on the accuracy of people's answers to the survey questions, which may vary based on the question. However, there is no evidence that the accuracy of data is different in the EBWC study area than in other parts of the State. In terms of this evaluation in particular, the three Greater EBWC study area ZIP Codes covered an area that was larger than the study area, and added substantial additional population. If the additional population was different than the population of the study area on the behavioral factors of interest, this may bias conclusions about the study area. Finally, the total sample size for the Greater EBWC study area ZIP Codes survey data was small, resulting in wide confidence intervals around some of the estimates.

Regarding the use of ***SPARCS*** data, this approach has not generally been used for information about behavioral risk factors, although one previous study which focused specifically on smoking suggested that this type of approach has some utility.[135] Moreover, it was the most efficient approach to quickly explore the potential burden of behavioral risk factors specifically in the EBWC study area. Previous research suggests that when information about a behavioral risk factor is reported on a hospital record it is generally accurate, but that lack of reporting does not mean the behavioral risk factor was not present. This evaluation assumes that the bias from lack of reporting is similar across NYS. The way in which people access health care may also impact the results, for example if in a particular place people are more likely to visit an emergency department for a health problem that people in another area might visit their primary care physician for. Staff assessed this by evaluating the proportion of people visiting the ED or hospital for any reason, and found this proportion to be similar in the study area versus the comparison areas (Appendix D, Table 1).

Occupation

Data on occupations were obtained from the Decennial Census and the American Community Survey (ACS) of the US Census. For both sources of data, occupation is generally tabulated into broad categories, and a large concentration of people in a specific occupation within a broad category might not be apparent. Regarding the ACS, since it is a sample survey it has a wide margin of error in small areas, so small differences between areas may not be meaningful.

Environmental Data Sources

Aside from ignoring the role of individual hereditary and behavioral factors, there are limitations associated with examining environmental factors and their relationship to cancer

development. The availability of environmental data is limited across space and time. For example, prior to the Clean Air and Water Acts of the 1970s, identification and control of sources of pollution released into the environment was not systematically enforced or recorded. Similarly, environmental monitoring networks are frequently sparsely located and do not provide complete insight into all areas of NYS. Even now, data are not always readily available in digital or geographical formats. The models which are used to estimate pollutant concentrations in places without monitors reflect assumptions that can also introduce uncertainty.

Many of the environmental data sets that are available have not been developed specifically to evaluate human exposures to chemicals in the environment (e.g., compliance/monitoring data and permit information). The amount and length of an individual's exposure as well as the likelihood of an environmental hazard to cause cancer are critical considerations in assessing the significance of environmental risk factors. Therefore, although this review could potentially identify questions that warrant further investigation, it could not quantify individual exposures to an environmental hazard.

Although environmental data have become more available over time, past exposures (as much as 40 years in the past) are generally more important for a full understanding of an individual's cancer risk. Available data do not include information about an individual's historical patterns regarding personal behaviors and specific exposures related to occupations and other activities.

Additionally, people are usually exposed to mixtures of chemicals rather than to a single chemical. Evaluating the health risks of mixtures is difficult for several reasons, including the lack of information on chemical mixtures' effects on human health. As such, DOH researchers did not consider any modifications to a chemical's potency for any additive, antagonistic, or synergistic effects.

Despite these challenges, DOH and DEC collaborated to summarize the readily available current and historical environmental data for each study region.

Conclusions

This review of cancers with elevated incidence in the EBWC study area evaluated available data related to socioeconomic status, health risk behaviors, access to care, and environmental and occupational factors. For several of the cancers, especially lung cancer, oral cancer, and esophageal cancer, previous studies have found strong links with health risk behaviors, especially tobacco use. Kidney cancer, and to a lesser extent colorectal cancer, are also associated with tobacco use. A review of indicators related to health risk behaviors is consistent with the previous research, and suggests that there may be a higher burden of tobacco use in the EBWC study area compared to other areas of NYS. It is likely that a portion of the excess cancer in the study area is related to tobacco use. Other health risk behaviors, such as obesity, lack of physical activity, and alcohol consumption, which were also more common in the study area, may also have contributed.

Although some of the data that were reviewed indicate that health care coverage in the EBWC study area is similar to other areas of NYS, for several of the cancers that were reviewed an excess was seen in distant stage diagnoses. This suggests that individuals in the study area did not or may not have been able to access health care for screening or routine monitoring which could potentially identify precursors to cancer or cancers at an earlier stage. Of the cancers that were elevated in the study area, lung cancer and colorectal cancer currently have screening options which can provide moderate to substantial benefit according to the USPSTF, while prostate cancer screening does not provide clear benefit.

A review of the available environmental data suggests that radon concentrations in indoor air, outdoor air pollution, and drinking water contaminants do not stand out from those in other parts of the state. Hazardous waste sites in the EBWC study area have been remediated or are in the process of being remediated, and there is no indication in the available information that widespread offsite exposures to the general public are occurring. Access to healthy food options is one avenue of further exploration, especially in the East Buffalo portion of the study area.

Recommendations

The recommendations below are divided into two main sections: 1) recommended actions to address the specific cancers that were elevated in the EBWC study area, and 2) recommended actions to address all cancer types throughout New York State. Actions to address the specific cancers that were elevated in the EBWC study area are organized around three categories: health promotion and cancer prevention; cancer screening and early detection; and healthy and safe environment. Many of these recommended activities are aligned with two existing State plans that address cancer prevention and control, the *New York State 2018-2023 Comprehensive Cancer Control Plan*, and the *New York State Prevention Agenda 2019-2024*. Details about these two plans are also described at the end.

Recommended Actions Based on Specific Cancers Elevated in the EBWC study area

Health Promotion and Cancer Prevention

Tobacco Prevention: More work is needed to build on the progress NYS achieved as a result of tobacco- and smoke-free environments, high cigarette excise taxes, and health communication campaigns. While NYS lung cancer incidence and smoking rates are at record lows, further declines will only be achieved with a continued focus on eliminating tobacco as a major cancer risk factor.

> **Recommendation:** Prevent initiation of tobacco use, including combustible tobacco and electronic vaping products by youth and young adults.
>
> **Recommendation:** Promote tobacco use cessation, especially among populations disproportionately affected by tobacco use including: low socioeconomic status; frequent mental distress/substance use disorder; lesbian, gay, bisexual and transgender; and disability.
>
> **Recommendation:** Eliminate exposure to secondhand smoke and exposure to secondhand aerosol/emissions from electronic vapor products.

Alcohol Use: Many people may not know that drinking alcohol, including red and white wine, beer, cocktails, and liquor, increases the risk of some cancers. More work is needed to educate New Yorkers about alcohol and the risk of cancer, and to prevent underage drinking and excessive alcohol consumption by adults.

> **Recommendation:** Implement environmental approaches, including reducing alcohol access, implementing responsible beverage services, reducing risk of drinking and driving, and restricting underage alcohol access.

Recommendation: Collaborate with partners and key stakeholders to educate the public, including youth and young adults, on cancer risk related to alcohol usage.

Recommendation: Provide personalized feedback about the risks and consequences of excessive drinking through the use of electronic screening and behavioral counseling interventions in healthcare settings, schools, and emergency rooms.

Recommendation: Among persons meeting the diagnostic criteria for alcohol dependence, promote the use of alcohol misuse screening and brief behavioral counseling interventions via traditional (face to face) or electronic means, and referrals to specialty treatment.

Healthy Nutrition and Physical Activity: It is estimated that up to one-third of all cancers may be attributed to excess weight, physical inactivity, and unhealthy diet. Adopting an active lifestyle, eating a healthy diet and maintaining a healthy weight can help lower the risk of cancer and improve cancer mortality rates.

Recommendation: Promote healthy eating and food security by:

- Increasing access to healthy and affordable foods and beverages,
- Increasing skills and knowledge to support healthy food and beverage choices,
- Increasing food security, and
- Increasing awareness of DOH sportfish advisories to promote healthier fish consumption choices while reducing chemical exposures (https://www.health.ny.gov/environmental/outdoors/fish/health_advisories/).

Recommendation: Increase physical activity by:

- Improving community environments that support active transportation and recreational physical activity for people of all ages and abilities,
- Promoting school, child care, and worksite environments that support physical activity for people of all ages and abilities, and
- Increasing access, for people of all ages and abilities, to safe indoor and/or outdoor places for physical activity.

HPV Vaccination: The human papillomavirus (HPV) is one of the most common sexually transmitted infections. Almost all cervical cancer is caused by HPV. HPV is also associated with vaginal, vulvar, penile, anal, and oropharyngeal (head/neck) cancers. The HPV vaccine is recommended for: males and females at ages 11 to 12 years; females through age 26, if not previously vaccinated; and males through age 21, if not previously vaccinated. It is recommended through age 26 for men who have sex with men.

Recommendation: Develop and implement educational campaigns targeted to adolescents and adults regarding the benefits and risks of HPV vaccine.

Recommendation: Maximize use of the New York State Immunization Information System

(NYSIIS) and the Citywide Immunization Registry (CIR) for vaccine documentation, assessment, decision support, reminders and recall.

Recommendation: Adopt local HPV policies which support HPV vaccination in adolescents and expand vaccine availability to new venues such as more healthcare settings and schools.

Cancer Screening and Early Detection

The Centers for Disease Control and Prevention (CDC) and DOH support the screening recommendations of the U.S. Preventive Services Taskforce (USPSTF). The USPSTF is an independent panel of national experts that makes recommendations about the effectiveness of cancer screening and other preventive care services for patients without signs or symptoms. The panel examines the benefits and harms of the screening or service and does not consider costs as part of the assessment. The USPSTF recommends routine screening for breast, cervical, colorectal, and lung cancers.

Lung Cancer Screening: Since 2013, the U.S. Preventive Services Task Force has recommended lung cancer screening by low-dose CT scan for high-risk individuals between ages 55 and 80 years who have a history of heavy smoking and either currently smoke or have quit within the past 15 years. However, studies have shown very few heavy smokers who meet these criteria receive lung cancer screening.

Recommendation: Educate men and women who meet the criteria for lung cancer screening about the benefits and risks of screening to help them make informed decisions.

Recommendation: Healthcare providers need tools and support to engage with patients who may benefit from screening, and facilities adopting lung cancer screening programs should be following national guidelines for a quality program.

Colorectal Cancer Screening: The U.S. Preventive Services Task Force recommends that adults age 50 to 75 be screened for colorectal cancer. The decision to be screened after age 75 should be made on an individual basis; individuals older than 75 should talk with their health care providers. People at an increased risk of developing colorectal cancer should talk to their health care providers about when to begin screening, which test is right for them, and how often to get tested. There are several types of screening tests that can be used to find polyps or colorectal cancer.

Recommendation: Educate men and women who meet the criteria for colorectal cancer screening about the benefits and risks of screening to help them make informed decisions.

Recommendation: Educate providers and the public that there are many testing options for colorectal cancer screening including take-home tests.

Recommendation: Reduce cost-related barriers to screening by educating providers and the public that health insurance plans in New York State are required to cover screening, and for those who are uninsured, the New York State Cancer Services Program (CSP) provides free colorectal cancer screening to men and women age 50 and older.

Recommendation: Support primary care practices and staff to implement evidence-based strategies outlined in the Guide to Community Preventive Services such as the use of patient and provider screening reminders.

Prostate Cancer Screening: The U.S. Preventive Services Task Force recommends that men ages 55-69 talk to their health care provider about their risk for prostate cancer and whether screening is the best choice for them. Risks for prostate cancer include family history, race or ethnicity, and other medical conditions. Cancer screening has risks and benefits. The choice to be screened for prostate cancer is an individual one and should be made after talking to a health care provider. The Task Force does not recommend routine screening for men age 70 and older.

Recommendation: Educate men about the benefits and risks of prostate cancer screening to help them make informed decisions, especially men at higher risk for prostate cancer, including Black men and men with a family history of prostate cancer.

Healthy and Safe Environment

Radon Testing and Mitigation: Radon is a naturally occurring, radioactive gas found in soil and rock. It seeps into homes through cracks in the foundation, walls, and joints. Radon comes from the breakdown of uranium in soil, rock and water and gets into the air people breathe. Radon is the second leading cause of lung cancer. Many individuals may not be aware that radon is the second leading cause of lung cancer.

Recommendation: Improve the public's awareness about the relationship between indoor radon exposure and lung cancer by conducting outreach and education about building testing and remediation. Promote the DOH's free and low-cost radon test kit programs, provision of test kits at half price to schools and daycares, and free test kits as part of the DOH's Healthy Neighborhoods Program and other grant-funded programs.

Recommendation: Explore local level policy and/or code adoption to require radon resistant construction in high radon areas.

Recommendation: Promote healthcare provider screening for radon testing particularly in high-risk radon areas. Increase the number of physicians that ask their patients if they have had their homes tested for radon and refer them to the DOH, as needed. Add radon testing questions to routine electronic medical questionnaires.

Safety in the Workplace: Exposure to substances in the workplace may increase cancer risk.

This includes prolonged or intense exposure (in higher concentrations than typically found outside the workplace) to UV radiation, toxic wastes, agricultural pesticides, some industrial and manufacturing products, some outdoor landscaping materials, and hazardous substances such as asbestos, arsenic, benzene, chromium, vinyl chloride, and silica.

Recommendation: Develop targeted occupational safety and health training programs for employers and workers in high-risk jobs.

Recommendation: Incorporate industry and occupation into electronic health records and other patient-oriented databases.

Recommended Actions to Reduce the Burden of All Cancers Statewide

Preventing and controlling cancer requires individuals and organizations of all kinds to get involved and make contributions. Below are highlights of what individuals can do and what DOH and its partner organizations are doing. For more information on activities, by type of organization, that New Yorkers can do to help reduce the burden of cancer, see: https://www.health.ny.gov/diseases/cancer/consortium/docs/2018-2023_comp_cancer_control_plan.pdf#page=62.

For All New Yorkers

Different cancers have different causes and there are many factors that affect a person's chances of getting different types of cancer. It is not always possible to know why one person develops cancer while another person does not. But the following are things that all individuals can do to reduce their risk of cancer:

- If you use tobacco, quit. If you don't use tobacco, don't start.
- Eat nutritious meals that include fruits, vegetables and whole grains.
- Get moving for at least 30 minutes a day on five or more days each week.
- Use sunscreen, monitor sun exposure and avoid tanning salons.
- Limit alcohol use.
- Get cancer-preventive vaccines such as hepatitis B and HPV.
- Learn your family health history (if possible) and discuss with your healthcare provider whether genetic counseling might be right for you.
- Discuss what cancer screening tests might be right for you with your healthcare provider.
- Test your home for radon.
- For women of child-bearing age, know the benefits of breastfeeding and, if possible, breast-feed infants exclusively for at least the first six months of life.

For NYS Department of Health and Partner Organizations

Cancer Surveillance: The New York State Cancer Registry (NYSCR) was designated by the CDC (Centers for Disease Control and Prevention) as a Registry of Excellence and has achieved Gold-level certification since 1998. In 2018, the NYSCR became a member of the National Cancer

Institute's Surveillance, Epidemiology and End Results Program (SEER), the nation's preeminent source of population-based cancer data.

> **Recommendation:** Continue to meet the highest cancer registry standards for timeliness, completeness and quality of data, and make these data available to researchers, clinicians, public health officials, legislators, policymakers, community groups and the public.

Environmental Health: DOH's Center for Environmental Health (CEH) works collaboratively with other agencies including the NYS Department of Environmental Conservation, the federal Environmental Protection Agency, the Centers for Disease Control and Prevention (CDC), and the Agency for Toxic Substance and Disease Registry (ATSDR). CEH staff investigate the potential for human exposures from chemicals, radiation, microbes, or anything in the physical world at home, school, work or play that might affect health. CEH programs evaluate health effects associated with environmental exposures, develop policies, and maintain a variety of programs to reduce and eliminate exposures.

> **Recommendation:** Continue to identify and assess potential exposures throughout the state and take action to reduce those exposures. NYS will continue to support programs to promote and maintain clean air, clean water and reduce human exposures to environmental hazards, with particular attention to the needs of environmental justice communities.

> **Recommendation:** Promote awareness of programs and initiatives to reduce environmental hazards in our communities. Several state agencies promote programs and publish educational materials to reduce environmental exposures and improve health in our communities:
> - DEC, Office of Environmental Justice: http://www.dec.ny.gov/public/333.html
> - DOH, Health and Safety in the Home, Workplace and Outdoors: https://www.health.ny.gov/environmental/
> - DOH, Healthy Neighborhoods Program: https://www.health.ny.gov/environmental/indoors/healthy_neighborhoods/
> - DOH, Reducing Environmental Exposures - The Seven Best Kid-Friendly Practices: https://www.health.ny.gov/publications/2818/
> - DEC, Green Living: http://www.dec.ny.gov/public/337.html
> - NYSERDA's change-out incentive program for high-efficiency, low-emission wood heating systems: https://www.nyserda.ny.gov/All-Programs/Programs/Renewable-Heat-NY
> - DOH, Protect and test your private drinking water wells: https://www.health.ny.gov/publications/6628.pdf

Statewide Initiatives: The overarching goal of cancer prevention and control efforts in New York State (NYS) is to reduce the burden of cancer by decreasing the number of new cancer

cases, decreasing the number of cancers diagnosed at late stages, improving the quality of life of those diagnosed with cancer, and decreasing the number of deaths caused by cancer. These efforts are detailed in two State plans, the *New York State 2018-2023 Comprehensive Cancer Control Plan*, and the *New York State Prevention Agenda 2019-2024*.

- **New York State 2018-2023 Comprehensive Cancer Control Plan (NYS CCCP)**

The *NYS 2018-2023 Comprehensive Cancer Control Plan* (Plan) was developed by the NYS Cancer Consortium and serves as a guide for community members, policy makers, advocates, healthcare professionals and others to use as they engage in efforts in their local communities and across the state. The NYS Cancer Consortium is a network of the Department of Health and over 200 individuals and organizations in NYS that collaborate to address the burden of cancer in NYS.

The 2018-2023 Plan is organized around seven priority areas: 1) Cancer-Related Health Equity; 2) Health Promotion and Cancer Prevention; 3) Early Detection; 4) Treatment; 5) Survivorship; 6) Palliative Care; and 7) Health Care Workforce. Each priority area contains background information about the status of work in the area; objectives with which to measure improvements; suggested evidence-based or promising practices to make improvements; and other related resources. More details about the NYS Cancer Consortium and the Plan can be found at: https://www.health.ny.gov/diseases/cancer/consortium/index.htm.

- **New York State Prevention Agenda 2019-2024 (NYS PA)**

The *NYS Prevention Agenda 2019-2024* (Prevention Agenda) is New York's six-year state health improvement plan; it is the blueprint for state and local action to improve the health of New Yorkers and to reduce health disparities. The Prevention Agenda was developed by the Department of Health and an Ad Hoc Committee made up of a diverse set of stakeholders including local health departments, health care providers, health plans, community-based organizations, academia, employers, state agencies, schools and businesses.

The Prevention Agenda has five priorities: 1) Prevent Chronic Diseases; 2) Promote a Healthy and Safe Environment; 3) Promote Healthy Women, Infants and Children; 4) Promote Well-Being and Prevent Mental and Substance Use Disorders; and 5) Prevent Communicable Diseases. Each priority area has an action plan that identifies goals and indicators to measure progress and recommended policies and evidence-based interventions.

Cancer-related goals are found throughout the Prevention Agenda, including promoting healthy eating, physical activity, tobacco prevention, and cancer screening; ensuring outdoor air quality and quality drinking water; and mitigating public health risks from hazardous exposures from contaminated sites. More details about the NYS Prevention Agenda can be found at: https://www.health.ny.gov/prevention/prevention_agenda/2019-2024/.

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Appendix A - Data sources evaluated and analyzed for the EBWC study area Report

The New York State Cancer Registry is a population-based cancer incidence registry responsible for the collection of demographic, diagnostic and treatment information on all patients diagnosed with and/or treated for cancer at hospitals, laboratories and other health care facilities throughout New York State. Submission of data is mandated under New York State Public Health Law, section 2401. The Cancer Registry collects a wide variety of information that can be used for research and public health planning and evaluation. Cancer Registry data are routinely used by programs within the Department of Health, county and local health departments, patient advocacy groups, public interest groups, researchers and the public. Because the Registry has collected statewide data since 1976, it can be used to monitor cancer incidence patterns and trends for all areas of New York State. (http://www.health.ny.gov/statistics/cancer/registry/about.htm)

The New York State Behavioral Risk Factor Surveillance System (BRFSS) is an annual statewide telephone surveillance system designed by the Centers for Disease Control and Prevention (CDC). New York State has participated annually since 1985. The BRFSS is a random-digit-dialed telephone survey of adults 18 years of age and older representative of the non-institutionalized civilian population with landline and cellular telephones living in New York State. The goal of the BRFSS is to collect data on preventive health practices, risk behaviors, injuries and preventable chronic and infectious diseases. Topics assessed by the survey include tobacco use, physical inactivity, diet, use of cancer screening services, and other factors linked to the leading causes of morbidity and mortality. New York State's BRFSS sample represents the non-institutionalized adult household population, aged 18 years and older. Data from the BRFSS are useful for planning, initiating, and supporting health promotion and disease prevention programs at the state and federal level, and monitoring progress toward achieving health objectives for the state and nation. (http://www.health.ny.gov/statistics/brfss/)

The Expanded Behavioral Risk Factor Surveillance System (eBRFSS**)**, is a county-level survey that augments the CDC Behavioral Risk Factor Surveillance System (BRFSS). [1] The eBRFSS is a random-digit-dialed telephone survey of adults 18 years of age and older representative of the non-institutionalized civilian population with landline and cellular telephones living in New York State. The goal of the eBRFSS is to collect county-specific data on preventive health practices, risk behaviors, injuries and preventable chronic and infectious diseases. Topics assessed by the survey include tobacco use, physical inactivity, diet, use of cancer screening services, and other factors linked to the leading causes of morbidity and mortality. The 2013-14 eBRFSS was designed with a sampling plan to generate statistically valid county-level estimates for all 57 counties outside New York City and New York City. The sampling plan resulted in a sufficient sample size to enable calculation of health indicators for several cities in Upstate New York (n=31,690). In 2016, the eBRFSS was sampled to produce valid estimates for all 62 counties (n =34,058). Weights were developed for both the 2013-14 and 2016 eBRFSS to enable the calculation of estimated population rates using a two-stage method developed by

CDC.[2] During the first stage, weights reflecting the probability of selection were developed. The sample design yields a complex probability sample because different sampling fractions were used for each county landline frame and region cell phone frame. During the second stage, the weights were raked to US Census county- and region-level administrative control totals for sex, age, race, ethnicity, educational attainment, marital status, owner/renter status, and telephone usage group to help minimize bias due to differential nonresponse patterns (refusal and noncontact) among demographic categories associated with important health risks. For the 2013-14 eBRFSS, weighting was completed by Clearwater Research.[3] For the 2016 eBRFSS, CDC calculated the weights. To support the calculation of sub-county units, data collected in the 2013-14 and 2016 eBRFSS were combined. A common weight was developed to enable the calculation of population estimates from the sample of New York residents responding to the survey. To support small area estimation for the study communities, eBRFSS data from residents in selected zipcodes were aggregated and weighted to generate population estimates for the zipcode area using direct estimation methods. The ability for eBRFSS data to calculate reliable small area estimates for sub-county units was established during a pilot funded by the Robert Wood Johnson Foundation County Health Rankings and Roadmaps Program.[4]

References:

1. New York State Expanded Behavioral Risk Factor Surveillance System https://www.health.ny.gov/statistics/brfss/expanded/
2. Pierannunzi C, Town M, Garvin W, Shaw FE, Balluz L. Methodologic changes in the Behavioral Risk Factor Surveillance System in 2011 and potential effects on prevalence estimates. MMWR Morb Mortal Wkly Rep 2012;61(22):410-3.
3. 2013-14 New York Expanded BRFSS Survey: Technical Report https://www.health.ny.gov/statistics/brfss/expanded/2013/docs/technical_report.pdf
4. Sub-County Health Data Report For County Health Rankings- Related Measures 2016 http://www.nysachoinfo.org/Sub-County-Health-Data-Report/Albany.pdf

The American Community Survey, conducted by the US Census Bureau, is an ongoing nationwide survey that gathers information on social, economic, housing and demographic characteristics of a population which can be used at many geographic levels such as states, counties, and cities. The data are used by a variety of communities including state and local governments, nongovernmental organizations, and researchers. The data are collected using four methods: paper questionnaires through the mail, phone interviews, personal visits with a Census Bureau coordinator, and an internet response option. Annually, a sample size of about 3.5 million addresses are randomly selected for participation. Data from the surveys are released in the year immediately following the year in which they are collected. In order to make the data more stable, the Census Bureau combines five consecutive years of ACS data to produce estimates at lower geographic levels, such as census tracts and small towns. (https://www.census.gov/programs-surveys/acs/)

Air quality monitoring data – The ***EPA's Air Quality System*** database contains data from air quality monitoring stations across the State in operation at various locations and times since

1965. The database contains measurements for criteria pollutants as far back as 1965 and toxic air pollutants starting in the late 1980s. DOH began the measurements of pollutants in New York State in the mid-1960s and DEC assumed responsibility for the air quality monitoring network after the agency was established in the early 1970s. The criteria air pollutants measured include sulfur dioxide, ozone, carbon monoxide, nitrogen dioxide, and lead, total suspended particulates and particulate matter less than 2.5 and 10 microns ($PM_{2.5}$ & PM_{10}) in diameter. Even though toxicological data do not indicate that these pollutants are environmental risk factors for cancer, they provide the longest historical measurements of air pollution. The criteria pollutants have been co-released with other air pollutants that could be potential carcinogens for which there are no historical measurements. Further work could be conducted to determine the utility of using historical measurements of criteria pollutants as surrogates or indicators of exposure to potential carcinogens. For the purposes of this evaluation, staff looked at trends over time for each of the criteria air pollutants. DEC has been operating a ***statewide air toxics monitoring network*** since 1990. Currently, there are 11 sites statewide collecting 24-hour canister samples for a full suite of volatile organic chemicals in a 1 in 6-day interval. This network has measured air pollutants that are known or likely known to be human carcinogens which will be included in this assessment. The initial development of this network was part of the Staten Island/New Jersey Urban Air Toxics Assessment Project which began in 1987 on Staten Island. Information from this early study has been compiled for review as part of this Initiative. In some cases, monitor data may not be available for the study areas. In these cases, staff reviewed and, where appropriate, summarized data from nearby monitors as an indicator of exposures in the study area. More information on DEC's air monitoring program and data can be found on-line at: http://www.dec.ny.gov/chemical/8406.html.

National Air Toxics Assessment (Air quality modeled concentrations) – For NATA, the EPA estimated chemical-specific air concentrations for small geographic areas known as census tracts across the US. Over the years the number of HAPs included in the model has varied from 32 for the 1996 NATA to 180 plus diesel particulate matter for the 2014 NATA. The EPA obtained emissions data (*i.e.*, for the years 2011 and 2014) from state sources, the Toxic Release Inventory, the National Emissions Inventory, and other databases. EPA developed outdoor air concentrations using a complex computer program (called a dispersion model) that merges the emissions data with meteorological data, such as wind speed and wind direction, to estimate pollutant concentrations in ambient air. This model accounted for emissions from large industrial facilities, such as power plants and manufacturing facilities, and smaller facilities, such as dry cleaners and gas stations. The EPA included emissions from mobile sources such as motor vehicles, trains, planes/airports, ports and boats, and emissions from farming and construction equipment in the modeling estimates. The EPA also accounted for secondary formation of pollutants through photochemical mechanisms and pollution due to residential wood burning, wildfires, agricultural burning, and structural fires. For this evaluation, DOH researchers evaluated HAPs from the 2011 and 2014 NATA. Moving forward, DOH researchers could apply the same approach to earlier versions of NATA. However, it should be noted that earlier versions of NATA do not have the same data quality as the 2011 and 2014 versions. First, HAPs which are considered known or likely human

carcinogens based on authoritative review from agencies such as the International Agency for Research on Cancer, EPA's Integrated Risk Information and US Department of Health and Human Services' National Toxicology Program, were selected for consideration. Next, HAPs, for which the NATA cancer risk estimate was above the theoretical (probability-based) cancer risk level of "one excess cancer case in a population of one-million" or "one-in-one-million" were selected for consideration. Because many of the pollutants evaluated in NATA have low modeled concentrations and small cancer risks, the list of HAPs for consideration was reduced to five: 1,3-butadiene, acetaldehyde, benzene, carbon tetrachloride and formaldehyde.

The **NYS Radon Testing Database** collects information on radon concentrations measured via DOH-provided testing kits. For this evaluation, DOH characterized radon test results from 1987 to 2015. Researchers used radon data from tests conducted during this period (excluding tests performed at schools and day care centers), to estimate various measures for the study area and comparison areas including Erie County, NYC and NYS excluding NYC. The summary measures of radon test results evaluated for the study area and comparison areas include: total number of tests conducted, mean and maximum test values and percent of tests that were at or above the action level of 4 pCi/L. DOH staff also prepared maps for each study area to display average radon levels by census block group.

The **Safe Drinking Water Information System (1999-2018)** contains information about public water systems and their violations of the EPA's drinking water regulations. The purpose of SDWIS is to ensure public water systems remain in compliance with EPA regulations. These guidelines establish Maximum Contaminant Levels, treatment techniques, and monitoring and reporting requirements that ensure water systems provide safe water to their customers. SDWIS is a massive database providing explicit details of drinking water facilities and public water systems. As such, this dataset was a primary source of information for this study.

Unregulated Contaminant Occurrence Data (2013-2016) is provided through the 3rd Unregulated Contaminant Monitoring Rule (UCMR 3), which was published by the EPA on May 2, 2012. It required monitoring for 30 contaminants in drinking water for all systems serving a population over 10,000 people and a randomly selected representative number of systems serving less than 10,000. Unregulated contaminant occurrence data are gathered by observing public water systems for contaminants, providing the EPA and other interested parties with nationally representative data on the occurrence of contaminants in drinking water. Additionally, this dataset shows the number of people potentially being exposed and an estimate of that exposure. This information provides the basis for future regulatory actions to protect public health.

CDC developed the ***Modified Retail Food Environment Index (mRFEI)*** to help assess accessibility to healthy food options. The mRFEI estimates the proportion of food retailers with healthier options by dividing the number of food retailers with healthier food options by the total number of food retailers (food retailers with healthier options + food retailers with less healthy options) in, or within a ½ mile buffer of, the census tract. This proportion is multiplied by 100. Food retailers with healthier food options include supermarkets, larger grocery stores,

supercenters, and produce stores. Food retailers with less healthy options include fast food restaurants, small grocery stores, and convenience stores. Stores were identified based upon North American Industry Classification Codes (NAICS) provided through proprietary datasets of store listings. More information on the development of the mRFEI index can be found at ftp://ftp.cdc.gov/pub/Publications/dnpao/census-tract-level-state-maps-mrfei_TAG508.pdf.

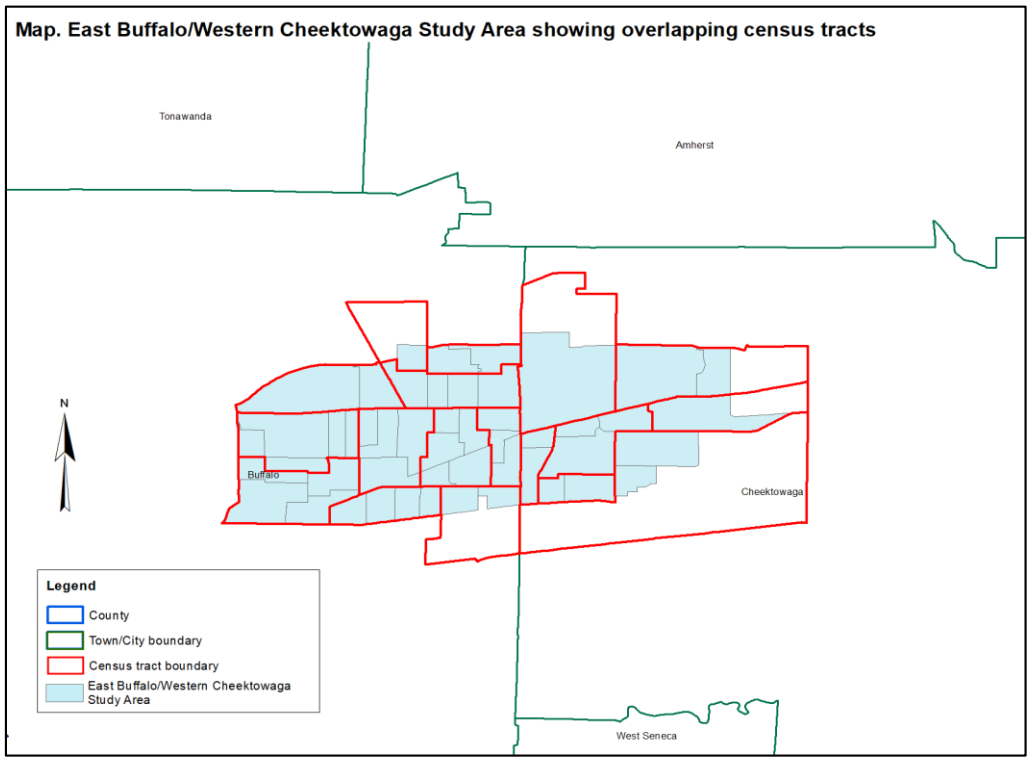
The New York State Department of Transportation operates a ***Traffic Monitoring Program*** which collects information on traffic counts at fixed and temporary monitoring locations. This information is processed to create average annual daily traffic (AADT) counts for road segments along interstate highways and all NYS routes and roads that are part of the Federal Aid System. Computer software is used to link datasets with AADT with road segment locations.

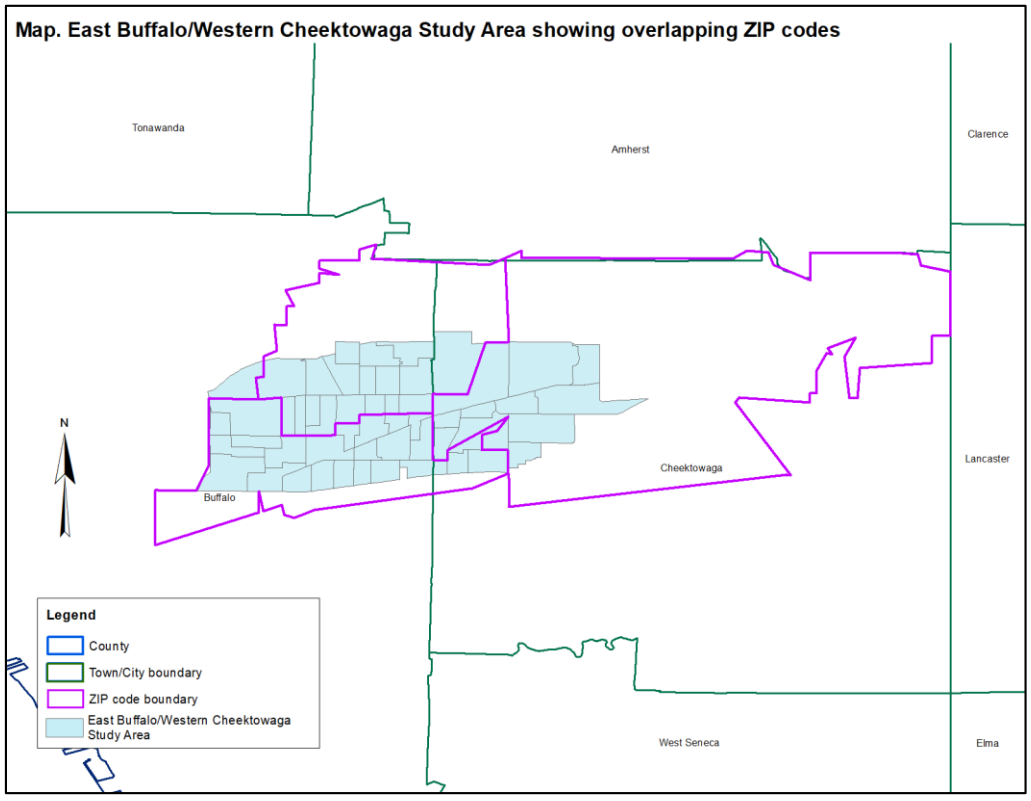
Appendix B - Comparison of data sources used to assess health risk behaviors in the EBWC study area

Table. Comparison of data sources used to generate health risk behavior estimates for the EBWC study area.

Dataset and Years of Analysis	Geographic Resolution	Metric used in the report	Strengths	Limitations
2013-2014 and 2016 NYS eBRFSS combined sample	3 ZIP Codes which cover the majority of EBWC study area (population=~90,000)	$\frac{\text{total number of affirmative responses}}{\text{total number of responses from ZIP Codes of interest}}$	Provides a survey-based estimate of indicators of interest	Small survey sample size; ZIP Code-based sample includes a large population outside study area
2011-2015 SPARCS Hospital Discharge and Emergency Department Visit Records	EBWC study area (population=~43,000)	$\frac{\text{people who visited hospital with condition of interest from study area}}{\text{Census 2010 population of study area}}$	Provides a study area-specific estimate for indicator of interest	SPARCS-based measures of health risk behaviors have not generally been used previously

Appendix C - Maps showing census tract and ZIP Code overlap with the EBWC study area





Appendix D - Methods for SPARCS analysis of health risk behaviors

All indicators:

Those with an out-of-state county code (88) were excluded.

Those with a homeless/unknown county code (99) were assigned to the county of the hospital they visited or were admitted to.

For geocoding to the EBWC study area, we selected those with any diagnosis age 50 and up, and those with a health risk factor related diagnosis of any age in these ZIP Codes: 14211, 14214, 14215, 14225, or these towns/cities: 'BUFFALO' 'CHEEKTOWAGA' (including spelling variations on these places names)

To avoid double-counting people who visited hospitals or EDs more than once during the Study Period (2011-2015), only the earliest visit for each individual was retained in the dataset.

Individuals were identified using the enhanced unique personal identifier created by SPARCS. There may be situation where a person was still counted twice if they changed their name and so they may have two different enhanced unique personal identifiers. It is also possible that two different people, by chance, could have the same enhanced unique personal identifier, although this would be rare.

Otherwise, county codes were used to delineate areas.

Indicator definitions:

- Numerator: Sum of all people who were hospitalized or visited the ED visit with health risk behavior-specific codes, as listed below
- Denominator: study area population from 2010 US Census

Tobacco

Data source:

- Hospital Outpatient data from 2011-2015
- Hospital Inpatient data admitted from 2011-2015 and discharged between 2011 to the first three quarters of 2017

Tobacco users are those with visits/admissions related to smoking cessation, history of tobacco use, and health problems due to tobacco use.

- CPT/HCPS codes: G0436, G0437, 99406, 99407, S9075, S9453
- Diagnosis codes: ICD-9: V1582, 3051, 6490, 98984

- ICD-10: Z87891, Z720, F172, O9933, T6522, T6529
- Excluded: toxic effect of chewing tobacco

Age groups: 0-17, 18+, 18-49, 50-64, 65+

Obesity

Data source:
- Hospital Outpatient data from 2011-2015
- Hospital Inpatient data admitted from 2011-2015 and discharged between 2011 to the first three quarters of 2017

The obese are those with diagnosed obesity, adults BMI 30 or higher, and children at 95% percentile or higher for weight.
- ICD-9 codes 27800, 27801, 27802, V853, V854, V8554;
- ICD-10 codes E6601, E6609, E661, E662, E668, E669, Z683 (and associated sub-codes), Z684 (and associated sub-codes), Z6854 (and associated sub-codes)

Age groups used: 5 and up, 21 and up, 5-20, 21-49, 50-64, 65+

Alcohol Use

Data source:
- Hospital Outpatient data from 2011-2015
- Hospital Inpatient data admitted from 2011-2015 and discharged between 2011 to the first three quarters of 2017

Alcohol users are those who are reported to abuse or be dependent on alcohol, or who have a pregnancy affected by alcohol, or who have an alcohol related medical condition. Those with only a finding of alcohol in the blood, toxic effect of alcohol, or Fetal Alcohol Syndrome were not included.
- ICD-9 codes: 291, 3050, 303, 3575, 4255, 5353, 5710, 5711, 5712, 5713
- ICD-10 codes: F10, G621, G312, G721, I426, K292, K70, Z7141, E244, K860, K852, O354, O9931

Age groups used: 0-14, 15-17, 18-24, 25-49, 50-64, 65 and up, 21 and up, 18 and up

Colon Cancer Screening

Data source:
- Hospital Outpatient data from 2011-2015
- Excludes emergency department visits

Incudes those screened by colonoscopy or other methods, using HCPS/CPT codes:

- Other screening: G0104, G0105, G0106, G0120, G0121, G0122, G0328, G0464, 74263, 82270
- Colonoscopy: 45378
- Procedure modifier code PT
- Or a diagnosis of colon cancer with intent to screen:
  - Other screening codes: 74261, 74262,
  - Colonoscopy codes: 45379, 4538, 45390, 45391, 45392, 45393, 45398
  - with procedure modifier code 33

Age groups used: 0-49, 50-74, 75+

Assessing Hospital Utilization

To help assess whether variations in health risk behavior-related visits and admissions in the population were due to variations in the rate of hospital visits and admissions, the percentage of people who visited or were admitted to the hospital in the 5-year period were calculated. This indicator is fairly consistent across different comparisons, suggesting that patterns in health risk behaviors reported in this report are not due to variation in the use of hospitals for medical care.

Table 1. Evaluation of hospital utilization patterns in the EBWC study area and comparison areas

Region	People seeking medical care at hospitals[1] per 100 person years[2], by age group	
	50-64 years	65 years and up
EBWC study area	24.6	20.8
Erie County	23.1	23.5
NYS	23.4	24.6
NYS excluding NYC	22.0	24.1
NYC	25.6	25.4

[1] Includes all people who were admitted to the hospital or visited the ED for medical reasons
[2] 2010 Census used as the source of population data

Appendix E - Distribution of community level sociodemographic variables for the EBWC study area and comparison areas

Table 1. Distribution of community level sociodemographic variables for EBWC study area[1] and comparison areas

Demographic Characteristic	study area	Erie County	NYS excl. NYC	NYS
Total population (N)	~43,000	921,584	11,246,431	19,673,174
Gender (%)				
Male	44.5	48.4	49.1	48.5
Female	55.5	51.6	50.9	51.5
Race (%)				
White race alone	24.8	78.7	80.5	64.6
Black race alone	70.2	13.3	8.9	15.6
Asian race alone	0.8	3.2	3.8	8
American Indian or Alaska Native race alone	0.4	0.5	0.4	0.4
Native Hawaiian or other Pacific Islander race alone	0	0	0	0
Some other race alone	1.4	2.2	3.7	8.6
Two or more races	2.5	2.3	2.6	2.9
Ethnicity (%)				
Hispanic[2]	3.6	5	10.5	18.4
Age (%)				
< 5 years old	7.4	5.4	5.5	6
5 to 19 years old	27.2	21	22.2	21.3
20 to 64 years old	57.1	60	59.5	61.3
65 years old and over	11.9	16.2	15.5	14.3
Nativity				
% foreign born	4.2	6.5	10.7	22.4
Socioeconomic Status				
Household Median Income ($)	28120	51247	62915	59269
% living below poverty line	33.7	15	11.9	15.7
% unemployed	14.8	7	7.2	8.2
Health Insurance (%)				
Private health insurance only	32.3	57.7	60.2	54.7
Public health insurance coverage only	47.8	22.4	18.7	24.7
Both private and public health insurance	9.7	10.8	10.7	8.9
No health insurance coverage	7.6	5.7	7.6	9.7

Source: 2011-2015 American Community Survey, 5-year estimates

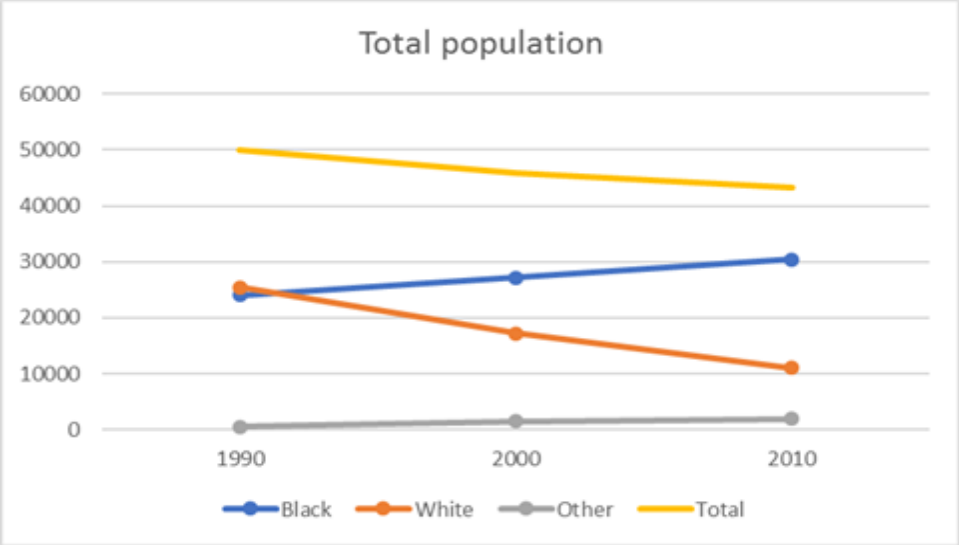
[1] Data are for 18 entire census tracts, including census block groups that are not in the study area

[2] People of Hispanic ethnicity can be of any race

Table 2. Percent population by race and total population in the EBWC study area across 1990, 2000, and 2010 U.S. Decennial Census

Race	1990	2000	2010
Black (%)	48.1%	59.3%	70.1%
White (%)	50.9%	37.5%	25.4%
Other (%)	1.0%	3.2%	4.5%
Total Population (N)	50,020	45,884	43,328

Figure 1. Total population and population by race in the EBWC study area across 1990, 2000, and 2010 U.S. Decennial Census



Appendix F - Additional tables for oral cancer in the EBWC study area

For each of the cancer types that were evaluated, a number of analyses were performed but not always included in the body of the report. Those tables are provided in Appendices for further reference.

Table 1. Observed and Expected Oral Cancers in the EBWC study area by Histology, 2011-2015

Histology	Obs	Exp[1]	Obs/Exp	95% CI
Carcinoma	27	23.6	1.1	0.8-1.7
Adenocarcinoma	5	2.6	1.9	0.6-4.5
Squamous Cell Carcinoma	22	20.5	1.1	0.7-1.6

Source of data: New York State Cancer Registry

[1] Expected values are based on standard rates for New York State exclusive of New York City, for 2011-2015 and age- and sex- specific block-group populations from the 2010 US Census fitted to county-level populations for 2011-2015 provided by the National Cancer Institute's SEER Program

- There was no statistically significant excess in any histologic subgroups of oral cancer.

Table 2. Observed and Expected Oral Cancers in the EBWC study area by Stage at Diagnosis, 2011-2015

Histology	Obs	Exp[1]	Obs/Exp	95% CI
Localized	9	8.0	1.1	0.5-2.1
Regional	11	10.9	1.0	0.5-1.8
Distant	6	3.9	1.5	0.6-3.3
No stage information	1	1.4	0.7	0.0-4.0

Source of data: New York State Cancer Registry

[1] Expected values are based on standard rates for New York State exclusive of New York City, for 2011-2015 and age- and sex- specific block-group populations from the 2010 US Census fitted to county-level populations for 2011-2015 provided by the National Cancer Institute's SEER Program

- There was no statistically significant excess in oral cancer by stage at diagnosis.

Appendix G - Additional tables for esophageal cancer in the EBWC study area

For each of the cancer types that were evaluated, a number of analyses were performed but not always included in the body of the report. Those tables are provided in Appendices for further reference.

Table 1. Observed and Expected Esophageal Cancers in the EBWC study area by Race/Ethnicity, 2011-2015

Histology	Obs	Exp[1]	Obs/Exp	95% CI
Non-Hispanic White	9	4.4	2.0	0.9-3.9
Non-Hispanic Black and Other Race	10	5.7	1.8	0.8-3.2
Hispanic	0	0.1	0.0	*NA*

Source of data: New York State Cancer Registry

[1] Expected values are based on standard rates for New York State exclusive of New York City, for 2011-2015 and age- and sex- specific block-group populations from the 2010 US Census fitted to county-level populations for 2011-2015 provided by the National Cancer Institute's SEER Program

- An excess of esophageal cancers was observed among both the non-Hispanic white and those in the non-Hispanic black and other race groups, although for neither of these groups was the excess statistically higher than expected.

Table 2. Observed and Expected Esophageal Cancers in the EBWC study area by Histology, 2011-2015

Histology	Obs	Exp[1]	Obs/Exp	95% CI
Carcinoma	18	10.8	1.7	1.0-2.6
Adenocarcinoma	11	7.3	1.5	0.8-2.7
Squamous Cell Carcinoma	7	2.8	2.5	1.0-5.2
Unspecified Malignant Neoplasm	1	0.3	3.3	0.1-18.6

Source of data: New York State Cancer Registry

[1] Expected values are based on standard rates for New York State exclusive of New York City, for 2011-2015 and age- and sex- specific block-group populations from the 2010 US Census fitted to county-level populations for 2011-2015 provided by the National Cancer Institute's SEER Program

- Although there were elevations in different histologic subtypes of esophageal cancer, these elevations were not statistically significant for either of the primary histologies (i.e., adenocarcinoma and squamous cell carcinoma).

Table 3. Observed and Expected Esophageal Cancers in the EBWC study area by Stage at Diagnosis, 2011-2015

Histology	Obs	Exp[1]	Obs/Exp	95% CI
Localized	5	2.1	2.4	0.8-5.6
Regional	4	3.8	1.1	0.3-2.7
Distant	9	4.1	2.2	1.0-4.2
No stage information	1	1.2	0.8	0.0-4.6

Source of data: New York State Cancer Registry

[1] Expected values are based on standard rates for New York State exclusive of New York City, for 2011-2015 and age- and sex- specific block-group populations from the 2010 US Census fitted to county-level populations for 2011-2015 provided by the National Cancer Institute's SEER Program

- There were no statistically significant excesses in esophageal cancer diagnosed at any stage, although there was a borderline significant increase in esophageal cancer diagnosed at a distant stage. However, the observed counts were small which adds uncertainty to the finding.

Appendix H - Monitor to NATA model air toxics comparisons

Table 1. Model-to-monitor comparison ratios*, NATA 2011

Monitor location	1,3-Butadiene	Acetaldehyde	Benzene	Carbon Tetrachloride	Formaldehyde
Median result across all comparison	1.65	1.79	1.34	1.13	0.78
Tonawanda – Residential (Erie County)	1.06	1.78	0.95	1.13	0.78
Tonawanda – Source (Erie County)	0.57	1.91	0.42	1.14	0.78

** This ratio compares the NATA 2011 census tract HAP estimate with the mean HAP concentration measured at a monitor located in the same census tract. This provides an indication of how well the NATA model estimates actual HAP concentrations.*

Table 2. Model-to-monitor comparison ratios*, NATA 2014

Monitor location	1,3-Butadiene	Acetaldehyde	Benzene	Carbon Tetrachloride	Formaldehyde
Median result across all comparison	1.15	0.94	1.16	0.97	1.21
Tonawanda – Residential (Erie County)	1.01	0.95	1.09	0.95	1.14
Tonawanda – Source (Erie County)	0.87	0.72	0.72	0.95	0.86

** This ratio compares the NATA 2014 census tract HAP estimate with the mean HAP concentration measured at a monitor located in the same census tract. This provides an indication of how well the NATA model estimates actual HAP concentrations.*

Appendix I - Historical trends in criteria air pollutant concentrations

Figure 1.

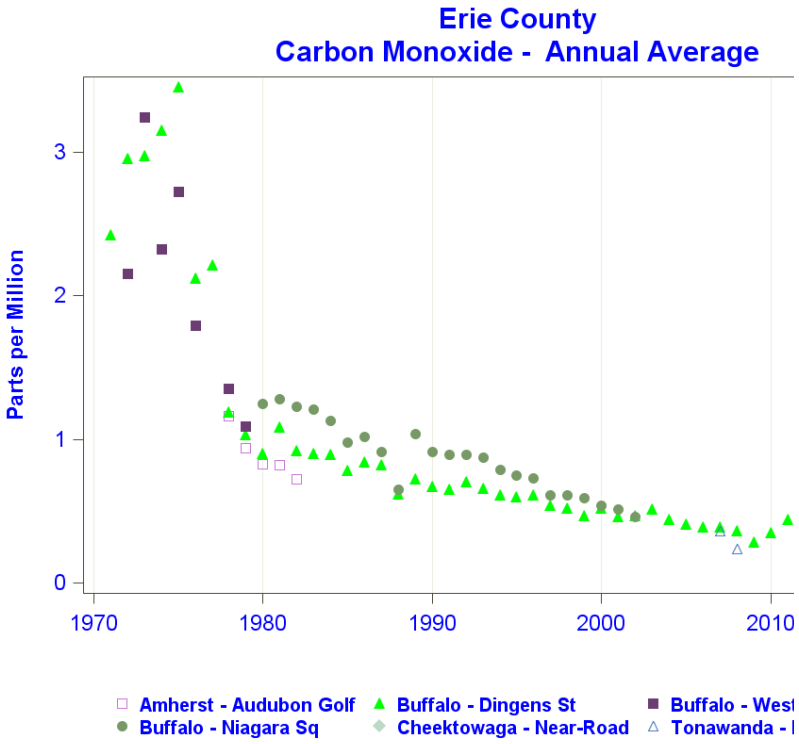


Figure 2.

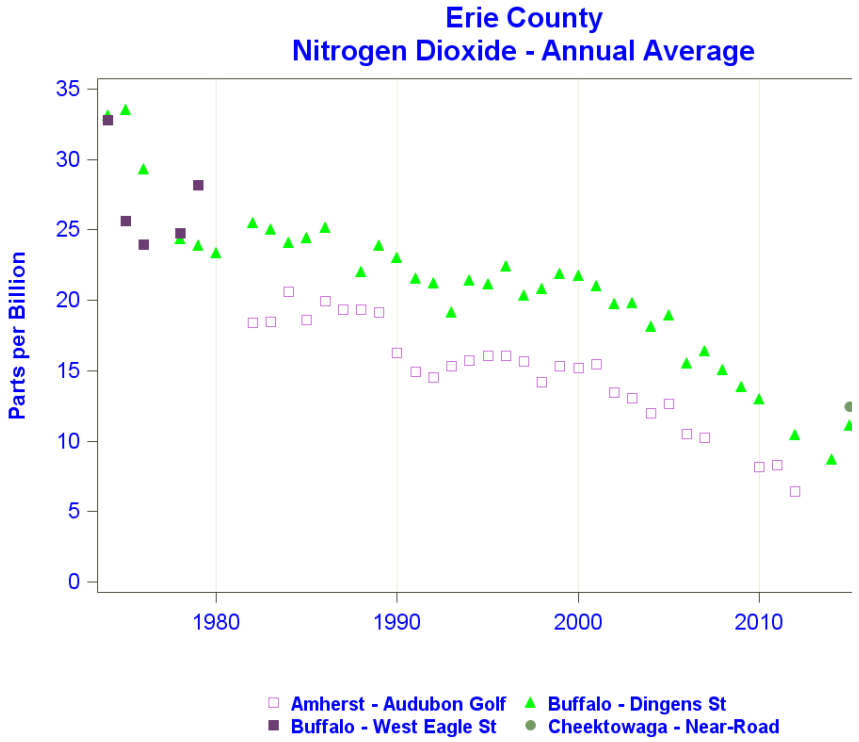


Figure 3.

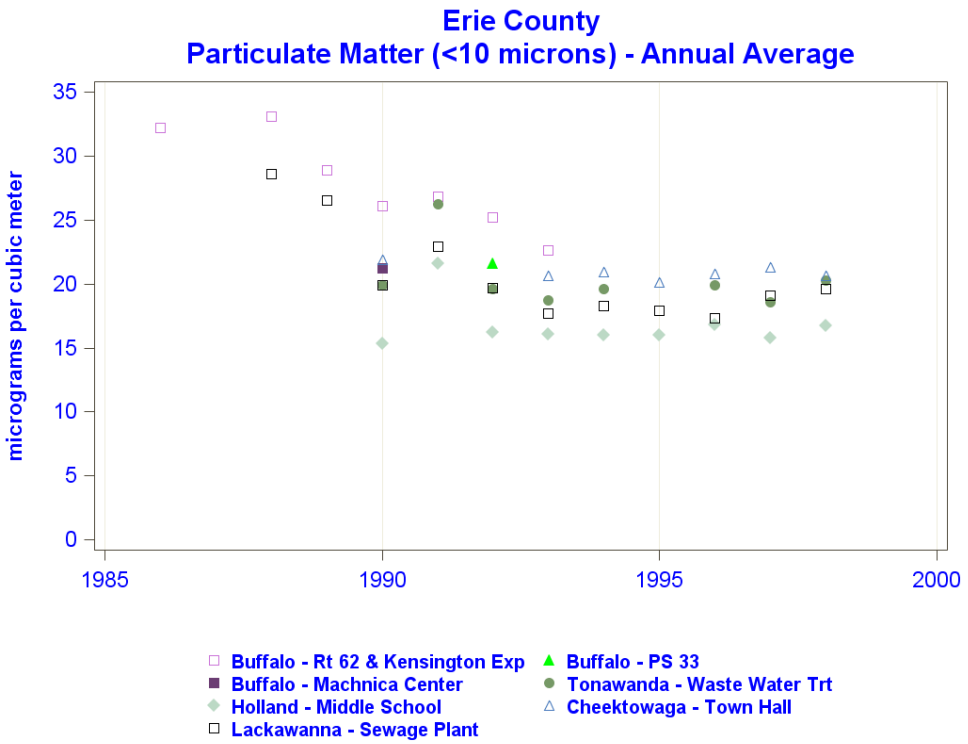


Figure 4.

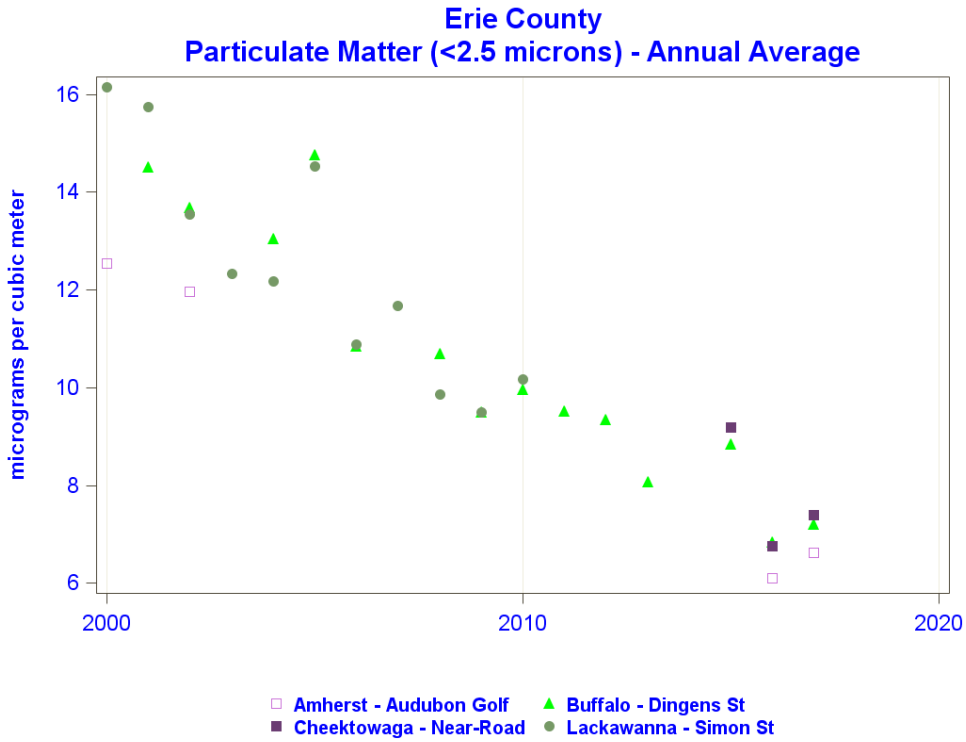
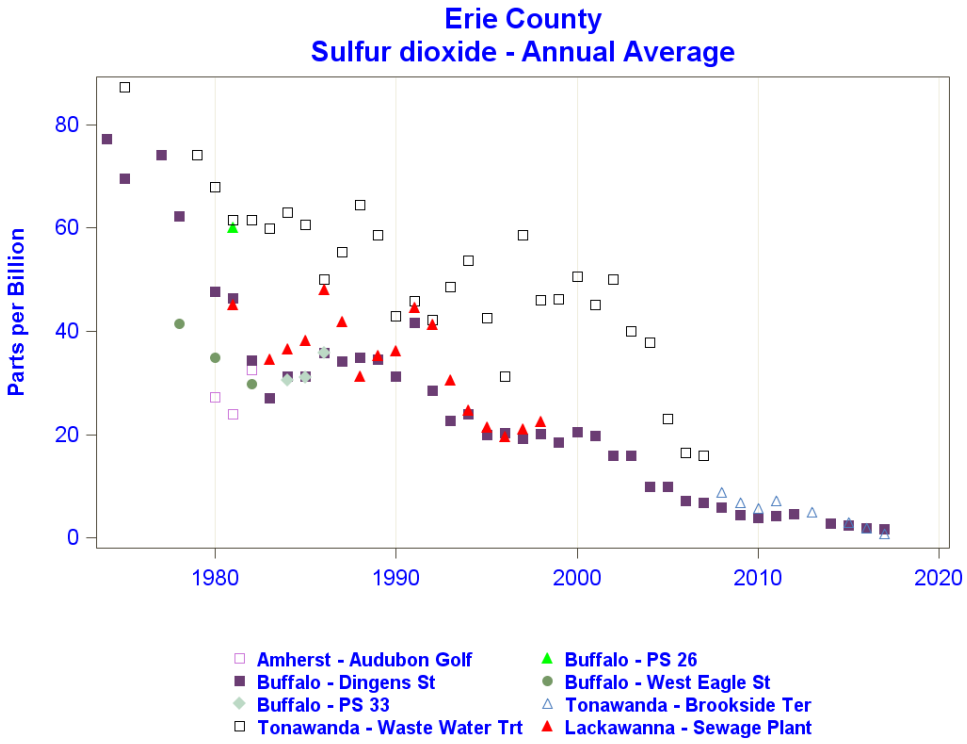


Figure 5.


Erie County
Sulfur dioxide - Annual Average
Parts per Billion
80
60
40
20
0
1980
1990
2000
2010
2020
Amherst - Audubon Golf
Buffalo - Dingens St
Buffalo - PS 33
Tonawanda - Waste Water Trt
Buffalo - PS 26
Buffalo - West Eagle St
Tonawanda - Brookside Ter
Lackawanna - Sewage Plant

Appendix J - Monitor trends and toxicologic information for five primary risk drivers from NATA estimates

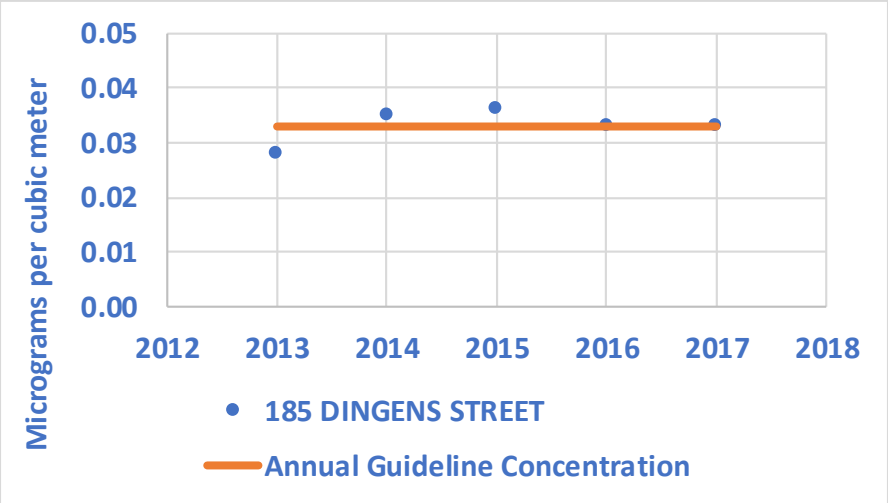
1,3-Butadiene

According to the Toxicological Profile for 1,3-butadiene published by the Agency for Toxic Substances and Disease Registry (ATSDR), 1,3-butadiene is released from industrial sources, automobile exhaust, cigarette smoke and the burning of wood and rubber/plastic.[1]

The EPA, NTP and IARC classify this chemical as carcinogenic to humans. This classification is based on sufficient evidence from epidemiologic studies of workers exposed to 1,3-butadiene that show an increased incidence of cancers of the blood and lymphatic system but exposure information for these studies is lacking.[1] Animal studies provide additional evidence of carcinogenicity. 1,3-butadiene is associated with several non-cancer effects as well.

The annual average concentrations of 1,3-butadiene across New York's monitoring network in 2017 ranged from 0.013 to 0.069 mcg/m^3. The 2017 average level for urban areas was 0.047 mcg/m^3 and in the study area it was 0.033 mcg/m^3. DEC's AGC (0.033 mcg/m^3) is based on the air concentration associated with a one-in-one-million excess cancer risk for long-term exposure. The levels measured in Erie County are below the urban average and at the level of DEC's AGC. Historical measurements of 1,3-butadiene show concentrations decreasing over time and for the past 17 years the annual averages have been below the "low" descriptor for cancer risk of one-in-ten-thousand. Thus, exposure to this chemical in outdoor air is estimated to pose a low risk of cancer over a lifetime.

Figure 1. Ambient Air Measurements of 1,3-Butadiene in the study area



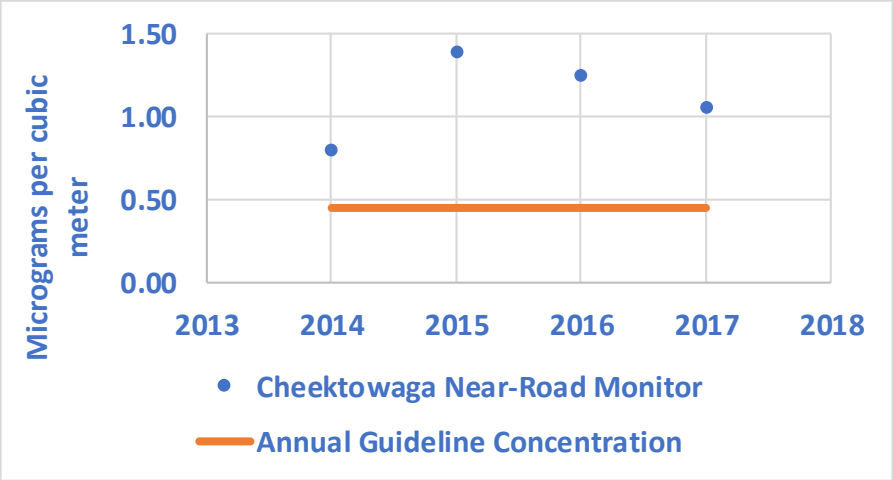
Acetaldehyde

People are exposed to small amounts of acetaldehyde each day. Acetaldehyde is used in the chemical manufacturing industry and in numerous consumer products, including perfumes. It is found in tobacco, wood smoke and vehicle exhaust. It is also used as a flavoring agent, as allowed by the Food and Drug Administration and is found in trace amounts in many plant products that people eat.[2] According to NTP, most people's exposure to acetaldehyde is through the consumption of alcoholic beverages.

The NTP states that acetaldehyde is reasonably anticipated to be a human carcinogen based on sufficient evidence in animal studies. Similarly, EPA classifies acetaldehyde as a probable human carcinogen based on sufficient evidence in animals.[3] Whether or not acetaldehyde causes cancer in humans is unknown. Animal studies have identified increased incidence of nasal and laryngeal tumors caused by long-term inhalation of high concentrations of acetaldehyde.

The annual average concentrations of acetaldehyde across New York's monitoring network in 2017 ranged from 0.53 to 3.3 mcg/m^3. The 2017 average level for urban areas was 1.5 mcg/m^3 and in the study area it was 1.0 mcg/m^3. DEC's AGC (0.45 mcg/m^3) is based on the air concentration associated with a one-in-one-million excess cancer risk for long-term exposure. Although the measured levels are above DEC's AGC, the average is below what is found in other urban areas of the State. Acetaldehyde is above the AGC even in rural locations of the State. A large contribution of acetaldehyde comes from secondary formation of this air toxics from VOCs in the presence of sunlight. Concentrations in New York State are primarily attributed to mobile source emissions forming acetaldehyde. Thus, exposure above the AGC is common. Historical measurements of acetaldehyde show concentrations decreasing overtime and for the past 17 years the annual averages have been below the "low" descriptor for cancer risk of one-in-ten-thousand. Thus, exposure to this chemical in outdoor air is estimated to pose a low risk of cancer over a lifetime.

Figure 2. Ambient Air Measurements of Acetaldehyde in the study area



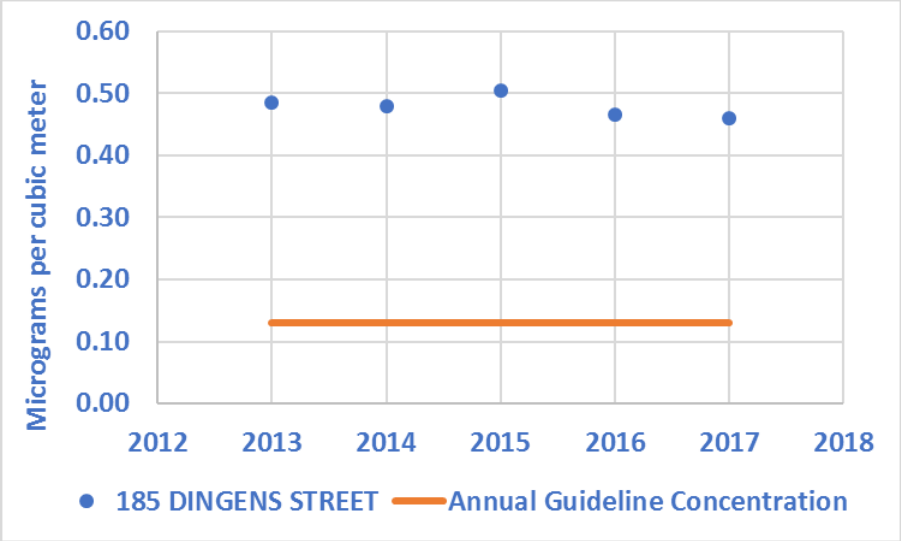
Benzene

Benzene is widely used in the US and ranks in the top 20 chemicals for US production volume, according to the ATSDR's Toxicological Profile.[4] ATSDR reports that the major sources of benzene exposure are tobacco smoke, automobile service stations, exhaust from motor vehicles, and industrial emissions, including petrochemical plants and coke ovens. There are also natural sources of benzene. People living in urban environments are exposed to more benzene that those residing in rural areas. ATSDR's 2007 ToxGuide for benzene indicates that the mean benzene concentration in urban air is 0.58 ppb (equivalent to 1.9 mcg/m^3). Benzene levels indoors are usually higher than outdoors.[4]

Benzene has been classified as a known human carcinogen by NTP, EPA and IARC. Toxicologists at these agencies conclude that benzene is a human carcinogen based on sufficient inhalation data in humans that is also supported by animal evidence. According to the ATSDR, the human cancer caused by inhalation exposure to benzene is predominantly leukemia, especially acute nonlymphocytic (myelocytic) leukemia, whereas benzene exposure in animal studies causes multiple cancer sites by both the inhalation and oral routes of exposure. Long-term inhalation of high levels of benzene can also cause hematological, immunological and neurological effects.

The annual average concentrations of benzene across New York's monitoring network in 2017 ranged from 0.22 to 0.89 mcg/m^3 which is above DEC's health-based AGC (0.13 mcg/m^3). In 2009, the average across all monitors was 0.76 mcg/m^3 with a range of 0.25 – 1.1 mcg/m^3. The benzene air concentrations measured at 185 Dingens St. are within this range which suggests the area is not unusual given the amount of urbanization and density of roadways. DEC's AGC is based on the air concentration associated with a one-in-one-million excess cancer risk for long-term exposure. Therefore, the measured levels of benzene are estimated to pose a low risk of cancer over a lifetime.

Figure 3. Ambient Air Measurements of Benzene in the study area



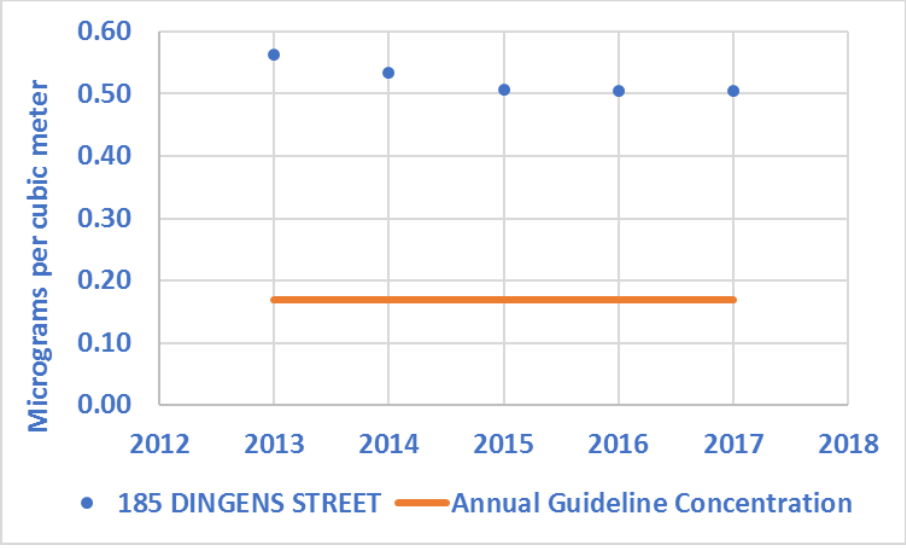
Carbon Tetrachloride

Carbon tetrachloride is an industrial chemical that doesn't occur naturally. According to the ATSDR, it was used primarily as a refrigerant and aerosol propellant but also as a pesticide, degreaser, cleaning agent, in fire extinguishers and as a spot remover. Because of its ozone-depleting potential, manufacture and use of carbon tetrachloride was banned (phased-out) with the Montreal Protocol (adopted in 1987). Because the chemical is very stable, it stays in the air for long periods of time without breaking down. Carbon tetrachloride is found in outdoor and indoor air.[5]

Occupational studies of carbon tetrachloride indicate that human exposure to high levels of this chemical can cause neurological effects (*e.g.*, intoxication, dizziness, headache, sleepiness) and can damage the liver and kidney.[5] High levels of exposure to carbon tetrachloride in air causes an increased incidence of liver tumors in animal studies.[5] As such, the EPA, IARC and NTP have classified this chemical as "likely to be carcinogenic," "possibly carcinogenic," and "reasonably anticipated to be a human carcinogen," respectively. Whether or not carbon tetrachloride causes cancer in humans is unknown.

The annual average concentrations of carbon tetrachloride across New York's monitoring network in 2017 ranged from 0.49 to 0.51 mcg/m^3. The 2017 average level for urban areas was 0.50 mcg/m^3 and in the study area it was 0.50 mcg/m^3. DEC's AGC (0.17 mcg/m^3) is based on the air concentration associated with a one-in-one-million excess cancer risk for long-term exposure. The average concentration is the same in all locations of the State due to the long atmospheric half-live of carbon tetrachloride (45-50 years). Historical measurements of carbon tetrachloride show concentrations decreasing overtime and for the past 17 years the annual averages have been below the "low" descriptor for cancer risk of one-in-ten-thousand. Thus, exposure to this chemical in outdoor air is estimated to pose a low risk of cancer over a lifetime.

Figure 4. Ambient Air Measurements of Carbon Tetrachloride in the study area



Formaldehyde

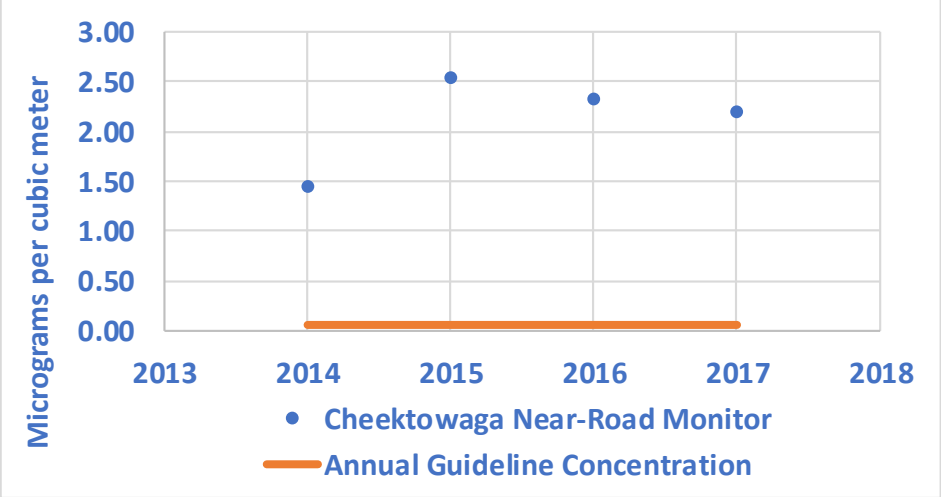
According to the ATSDR, everyone is exposed to small amounts of formaldehyde in air and in some foods and consumer products (ATSDR, 1999). The main source of formaldehyde in the atmosphere is believed to be from photo-oxidation of hydrocarbon combustion products and studies have demonstrated that daily variations in outdoor formaldehyde concentrations correlate with traffic conditions (ATSDR, 1999; ATSDR, 2010).

Formaldehyde irritates the eyes, throat and respiratory system and also can cause neurological effects if people are exposed to sufficient amounts. An increased incidence of respiratory tract tumors, including squamous cell tumors, is seen in animals exposed to high levels of formaldehyde. As such, the EPA classifies formaldehyde as a probable human carcinogen; the NTP reasonably anticipates the chemical to be a human carcinogen; and, IARC classifies formaldehyde as a human carcinogen. Whether or not formaldehyde causes cancer in humans is unknown.

According to ATSDR, urban air contains more formaldehyde than rural areas; summertime outdoor air concentrations are higher than wintertime; and indoor air often contains higher amounts of formaldehyde than outdoor air (ATSDR, 1999; ATSDR, 2010).

The annual average concentrations of benzene across New York's monitoring network in 2017 ranged from 1.1 to 4.7 mcg/m^3. The 2017 average level for urban areas was 2.9 mcg/m^3 and in the study area it was 2.2 mcg/m^3. DEC's AGC (0.06 mcg/m^3) is based on the air concentration associated with a one-in-one-million excess cancer risk for long-term exposure. Although the measured levels are above DEC's AGC, the average is below what is found in other urban areas of the State. Formaldehyde is above the AGC even in rural locations of the State. A large contribution of formaldehyde comes from secondary formation of this air toxics from VOCs in the presence of sunlight. Concentrations in New York State are primarily attributed to mobile source emissions forming formaldehyde. Thus, exposure above the AGC is common. Historical measurements of formaldehyde show concentrations decreasing over the past 17 years but leveling out in the more recent years. For the past 17 years the annual averages have been below the "low" descriptor for cancer risk of one-in-ten-thousand. Thus, exposure to this chemical in outdoor air is estimated to pose a low risk of cancer over a lifetime.

Figure 5. Ambient Air Measurements of Formaldehyde in the study area



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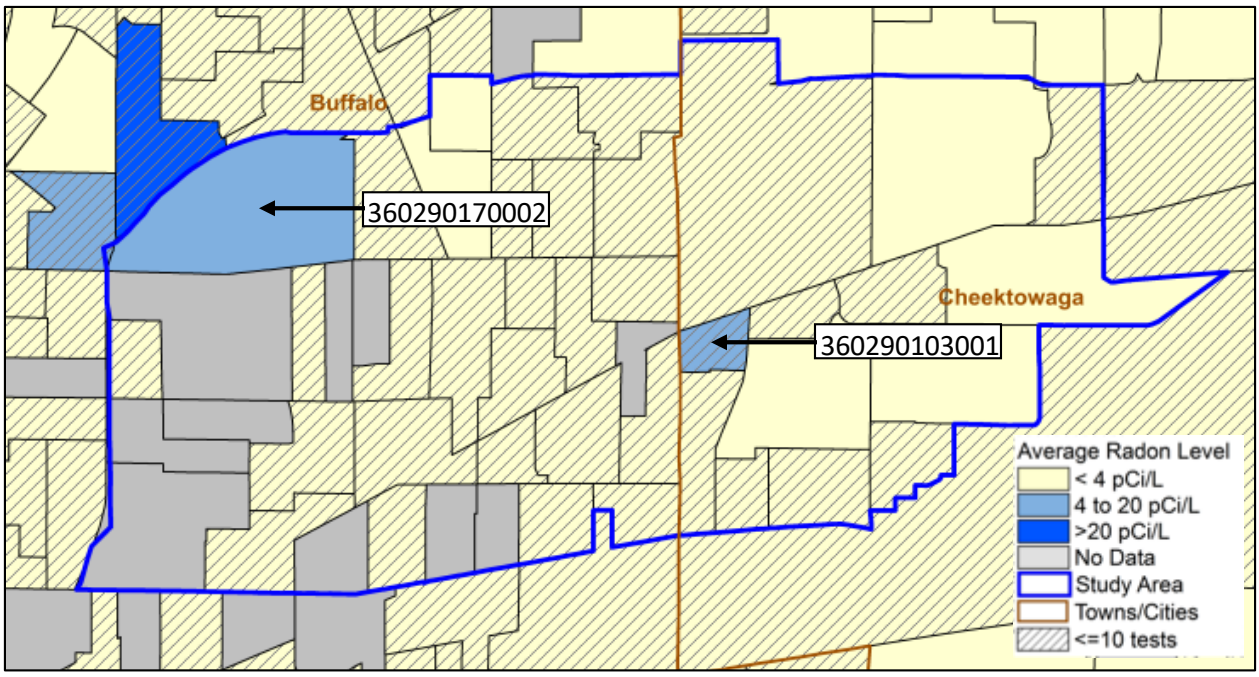
5. ATSDR (Agency for Toxic Substances and Disease Registry). 2005. Toxicological Profile for Carbon Tetrachloride. US Department of Health and Human Services, Public Health Service, ATSDR. Atlanta, GA: August 2005. Available at https://www.atsdr.cdc.gov/toxprofiles/tp30.pdf.

Appendix K - Summary of radon testing results by census block group

Table. Radon test results for census block groups with mean concentrations ≥4 in the EBWC study area

Census block group ID	Population	Number of tests	% tests ≥4 pCi/L	Mean	Minimum	Maximum
360290103001	1877	1	1	5.7	5.7	5.7
360290103002	692	12	0.5	4.69	0.7	11.1

Map. Average radon test levels by census block for EBWC study area, 1987-2015



Appendix L - Drinking water data summaries

Table 1. List of analytes evaluated for study area

Principal Organic Compounds (POCs)	
1,1-DICHLOROETHANE	DICHLOROMETHANE
1,1-DICHLOROETHYLENE	ETHYLBENZENE
1,1-DICHLOROPROPENE	HEXACHLOROBUTADIENE
1,1,1-TRICHLOROETHANE	ISOPROPYLBENZENE
1,1,1,2-TETRACHLOROETHANE	M-DICHLOROBENZENE
1,1,2-TRICHLOROETHANE	META-XYLENE
1,1,2,2-TETRACHLOROETHANE	METHYL TERT-BUTYL ETHER
1,2-DICHLOROETHANE	N-BUTYLBENZENE
1,2-DICHLOROPROPANE	N-PROPYLBENZENE
1,2,3-TRICHLOROBENZENE	O-CHLOROTOLUENE
1,2,3-TRICHLOROPROPANE	O-DICHLOROBENZENE
1,2,4-TRICHLOROBENZENE	ORTHO-XYLENE
1,2,4-TRIMETHYLBENZENE	P-CHLOROTOLUENE
1,3-DICHLOROPROPANE	P-DICHLOROBENZENE
1,3,5-TRIMETHYLBENZENE	P-ISOPROPYLTOLUENE
2,2-DICHLOROPROPANE	PARA-XYLENE
BENZENE	SEC-BUTYLBENZENE
BROMOBENZENE	STYRENE
BROMOCHLOROMETHANE	TERT-BUTYLBENZENE
BROMOMETHANE	TETRACHLOROETHYLENE
CARBON TETRACHLORIDE	TOLUENE
CHLOROBENZENE	TRANS-1,2-DICHLOROETHYLENE
CHLOROETHANE	TRANS-1,3-DICHLOROPROPENE
CHLOROMETHANE	TRICHLOROETHYLENE
CIS-1,2-DICHLOROETHYLENE	TRICHLOROFLUOROMETHANE
CIS-1,3-DICHLOROPROPENE	VINYL CHLORIDE
DIBROMOMETHANE	XYLENE, META AND PARA
DICHLORODIFLUOROMETHANE	XYLENES, TOTAL
Nitrates (NITs)	
NITRATE	NITRITE
NITRATE-NITRITE	
Primary Inorganic Compounds (PICs)	
ANTIMONY, TOTAL	MANGANESE
ARSENIC	IRON + MANGANESE
BARIUM	MERCURY
BERYLLIUM, TOTAL	NICKEL
CADMIUM	ODOR
CHLORIDE	SELENIUM

CHROMIUM	SILVER
COLOR	SULFATE
CYANIDE	THALLIUM, TOTAL
FLUORIDE	ZINC
IRON	
Synthetic Organic Compounds (SOCs)	
2,3,7,8-TCDD	DINOSEB
2,4-D	ENDRIN
2,4,5-TP	ETHYLENE DIBROMIDE
3-HYDROXYCARBOFURAN	HEPTACHLOR
ALDICARB	HEPTACHLOR EPOXIDE
ALDICARB SULFONE	HEXACHLOROBENZENE
ALDICARB SULFOXIDE	HEXACHLOROCYCLOPENTADIENE
ALDRIN	LASSO
ATRAZINE	METHOMYL
BENZO(A)PYRENE	METHOXYCHLOR
BHC-GAMMA	METOLACHLOR
BUTACHLOR	METRIBUZIN
CARBARYL	OXAMYL
CARBOFURAN	PENTACHLOROPHENOL
CHLORDANE	PICLORAM
DALAPON	PROPACHLOR
DI(2-ETHYLHEXYL) ADIPATE	SIMAZINE
DI(2-ETHYLHEXYL) PHTHALATE	TOTAL POLYCHLORINATED BIPHENYLS (PCB)
DICAMBA	TOXAPHENE
DIELDRIN	
Radiological Samples (RADs)	
COMBINED RADIUM (-226 & -228)	RADIUM-228
GROSS ALPHA PARTICLE ACTIVITY	THORIUM
GROSS BETA PARTICLE ACTIVITY	URANIUM
RADIUM-226	
Disinfection by Products (DBP9)	
TOTAL HALOACETIC ACIDS (HAA5)	TOTAL TRIHALOMETHANES (TTHM)
Lead and Copper (PBCU)	
COPPER	LEAD

Table 2. Contaminants and Frequency (N) of Sampling under UCMR2, UCMR3 and UCMR4 (2008-20018) for the EBWC study area

Contaminant	N	Contaminant	N	Contaminant	N
1-butanol	2	BDE-99	12	NDEA	24
1,1-dichloroethane	12	bromomethane	12	NDMA	24
1,2,3-trichloropropane	12	butylated hydroxyanisole	4	NDPA	24
1,3-butadiene	12	chlorate	24	NMEA	24
1,3-dinitrobenzene	12	chloromethane	12	NPYR	24
1,4-dioxane	12	chromium	24	o-toluidine	4
17-alpha-ethynylestradiol	12	chromium-6	24	PFBS	12
17-beta-estradiol	12	cobalt	24	PFHpA	12
2-methoxyethanol	2	cylindrospermopsin	12	PFHxS	12
2-propen-1-ol	2	Dimethoate	12	PFNA	12
4-androstene-3,17-dione	12	equilin	12	PFOA	12
Acetochlor	12	estriol	12	PFOS	12
Acetochlor ESA	12	estrone	12	quinoline	4
Acetochlor OA	12	Halon 1011	12	RDX	12
Alachlor	12	HBB	12	strontium	24
Alachlor ESA	12	HCFC-22	12	Terbufos sulfone	12
Alachlor OA	12	Metolachlor	12	testosterone	12
anatoxin-a	12	Metolachlor ESA	12	TNT	12
BDE-100	12	Metolachlor OA	12	total microcystin	6
BDE-153	12	molybdenum	24	vanadium	24
BDE-47	12	NDBA	24	**TOTAL**	**840**

Table 3. UCMR samples above the Reference Concentration Level in the EBWC study area

PWS name	PWS Type	Facility Type	Source Type	City Served	Analyte	Result (µg/L)	Year
ECWA - Direct	C	DS	SW	BUFFALO	Chlorate	650	8/12/2014
ECWA - Direct	C	DS	SW	BUFFALO	Chlorate	650	11/5/2014

** C = Community, DS = Distribution System, SW = Surface Water.*

Appendix M - Summary of status of remedial sites in the EBWC study area

318 Urban Street (site code # 915151)

This former industrial property served as the location of General Electric's service shop where electrical equipment, transformers and machine parts were repaired from 1921 to 1968. Pyramid Steel Corporation (a.k.a. Sweeney Steel Service, Corp.) purchased the site in 1985 and used the building as a machine shop and warehouse for steel fabrication and supply. Pyramid vacated the property in the 2000s where it sat idle for several years. Several industrial tenants have used the building and site intermittently in the ensuing years. During an environmental assessment in the early 1990s, polychlorinated biphenyls (PCBs) were found to have contaminated on-site soils and the backyards of adjacent residential properties showed evidence of PCB contamination. Volatile organic compounds also were found in onsite groundwater. In December 1992, GE implemented an offsite Interim Remedial Measure and excavated PCB contaminated soils from the affected residential yards and restored the yard surfaces. In March of 1995, a Record of Decision required the removal of PCB contaminated soils and sediments at the site, decontaminating PCB impacted interior building surfaces, and cleaning impacted sewers of PCB contaminated sediments. These remedial activities were completed in 1999. Some low-level PCB-contaminated soils remain below the asphalt cover but a deed restriction and site management plan are in place so that the contaminated soils would be managed properly if disturbed. Since the site is covered by asphalt, buildings, and clean backfill, people will not contact site-related soil or groundwater contamination that remains unless they dig below the surface. This area is served by public drinking water. Because there are some volatile chemicals on-site, any future on-site building should evaluate the potential for vapor intrusion so that steps can be taken to mitigate any exposure, if necessary.

664-690 Northland (site code # 915329)

The site was previously owned by Niagara Machine and Tool, and appears to have been used for employee parking. The site is currently owned by NORDEL II LLC. It is anticipated that the site will be used as parking for the Western New York Workforce Training Center, directly south of the site, for the foreseeable future. Elevated concentrations of trichloroethene (TCE) have been detected in soil vapor and sub-slab soil vapor samples from adjacent sites. As information for this site becomes available, it will be reviewed by the DOH to determine if site contamination presents public health exposure concerns.

858 East Ferry Street (site code # B000079/915175)

Historical maps indicate that this site was once adjacent to a zinc and lead smelting and refining facility operated by the Michael Heyman Company. A 1958 aerial photo shows a path leading from the Heyman property to this site providing evidence that this site was used to dispose lead-contaminated ash. Under the Environmental Restoration Program (ERP), the City of Buffalo completed an investigation in 1997-1998. The results from this investigation showed significant

lead contamination in soil. Based on the results of this investigation, a Record of Decision (ROD) was signed by DEC in March 1999. The selected remedy included the excavation and off-site disposal of hazardous waste and contaminated soil. An additional investigation was completed in 2001 by the DEC at adjacent properties and the results indicated that the soil is contaminated with lead on adjacent properties. The March 1999 ROD was amended in August 2005 based on a significant increase in volume of lead contaminated soil. The amended remedy included the excavation of surface and subsurface contaminated soil from onsite and offsite properties and disposal to a permitted landfill. The site remedial actions were successful and the site is currently residential housing.

1001 East Delavan Avenue Site (site code # C915196B)

The site is situated within a large former manufacturing facility located at the intersection of East Delavan Ave. and Cornwall Ave. in the City of Buffalo, Erie County. The site is part of a former General Motors automobile drivetrain manufacturing facility, which operated from 1924 to 1994. The contamination at the site is due to spills of hydraulic oils and heat transfer fluids containing PCBs. Under the Brownfields Cleanup Program, the site is undergoing further characterization and assessment.

1071 Walden Avenue (site code # B00171)

This site was a former gasoline and automotive repair station. The Town of Cheektowaga submitted an application to the Environmental Restoration Program in 2001 to assess the possible contamination at this site. In 2003 the Town withdrew their application. Although the on-site soil is contaminated with petroleum products, there is no evidence of hazardous waste disposal at this location. Contamination at this site was addressed under Spill 0750949, now closed

1279 Walden Avenue (site code # B00170)

On-site soil is contaminated with petroleum products. The Town of Cheektowaga submitted an application to the Environmental Restoration Program in 2001 to assess the possible contamination at this site. In 2003 the Town withdrew their application. Although the on-site soil is contaminated with petroleum products, there is no evidence of hazardous waste disposal at this location. Contamination at this site was addressed under Spill 0075372, now closed

1281 Walden Avenue UST Removal (site code # B00169)

This site is believed to have been a gas station since the 1930s. The Town of Cheektowaga submitted an application to the Environmental Restoration Program in 2001 to assess the possible contamination at this site. In 2003 the Town withdrew their application. Although the on-site soil is contaminated with petroleum products, there is no evidence of hazardous waste disposal at this location. Contamination at this site was addressed under Spill 0075341, now closed.

1827 Fillmore Avenue (site code # C915279)

This site is located in the City of Buffalo and consists of mostly vacant land with green areas, asphalt paved areas, former roadways and one vacant seven story brick building that was built in 1958 and used as apartments. Five identical apartment buildings were demolished betwe en 2012 and 2014. From approximately 1917, it was used as stone quarry. At some time between 1940 and 1950, the quarry was backfilled prior to the development of Kensington Heights Towers in 1958. Previous investigations indicate that on-site soils and fill materials are contaminated with polycyclic aromatic hydrocarbons and metals. Under the Brownfields Cleanup Program, the site is undergoing final cleanup and a site certificate of complete is expected shortly.

American Axle Plant (site code # 915196)

The site is situated within the larger former General Motors automobile drivetrain manufacturing facility located at the intersection of East Delavan Ave. and Cornwall Ave. in the City of Buffalo. The facility was operated by General Motors from the 1920s to 1994 where initially automobiles were assembled, and later automobile drivetrain components were manufactured. The site, along with the balance of the property and adjoining parcels, and axle manufacturing business was sold to American Axle in 1994. American Axle ceased its manufacturing operations at this facility in 2008 and sold the site and balance of property and adjoining parcels to East Delavan Property, LLC (EDP) in September 2008. Oils containing polychlorinated biphenyls seeped into the subsurface via surface pits, sumps, and trenches. This spilled oil has migrated to a 5x9 foot sewer that bisects the site. Oil seepage into the brick lined sewer is evident and the sewer overflows into Scajaquada Creek during wet weather. People can contact site-related contaminants by contacting subsurface soils or groundwater and sediment within the sewer. The area is served by public drinking water. Existing interim remedial measures are currently being augmented with a pump and treat system aimed at preventing oil from migrating to the sewer and potentially off-site to Scajaquada Creek.

Leica, Inc. (site code # 915156)

This site is located in the Town of Cheektowaga and is bounded by residential properties and a cemetery. From 1938 to 1993, this site was used by various corporations to manufacture scientific instruments and optical devices. Leica operated on this site from 1990 to 1993. In 1993, Leica ceased its operations and sold most of the land including the main building to Sam-Son Distribution/Calypso Development Corporation. Leica retained title of a small southeast corner portion of the site, which contains majority of the contamination. Chemicals found in the soil and groundwater include 1,1-dichloroethene, 1,1,1-trichloroethane, trichloroethene, vinyl chloride, and xylene. Remedial actions have been completed and groundwater contamination levels have substantially improved. Remedial actions have successfully achieved remedial objectives. Residual contamination is being managed under a Site Management Plan. Measures are in place to control the potential for coming in contact with subsurface soil and groundwater contamination remaining on the site. People are not drinking the contaminated groundwater because the area is served by a public water supply that is not contaminated by

the site. Volatile organic compounds in the groundwater may move into the soil vapor (air spaces within the soil), which in turn may move into overlying buildings and affect the indoor air quality. Sub-slab depressurization systems (systems that ventilate/remove the air beneath the building have been installed in a portion of the on-site building and will be expanded to other areas of the building to prevent the indoor air quality from being affected by the contamination in soil vapor beneath the building. Prior sampling indicates soil vapor intrusion is not a concern for off-site buildings.

Otis Elevator (site code # 915073)

Disposal of foundry sand was reportedly made on this site in the past, but is undetectable now. The site is soil covered, graded and planted. In 1983, US Geological Survey (USGS) completed eight test borings and seven of them hit refusal at three feet below grade. There are no indications of hazardous waste disposal at this site. A site investigation for this site has been completed.

Saginaw – Buffalo (site code # 915152)

The Saginaw Site is located at 320 Scajaquada Street in the City of Buffalo. The Scajaquada Creek once flowed through a portion of the site but was relocated through a conduit underground. Ash from the City of Buffalo was disposed in the former creek bed and the Buffalo Gravel Corporation operated a concrete plant at this location from 1947 to 1966. General Motors purchased the site in the 1960s and built a parking lot in this location. The site was sold to American Axle Manufacturing in 1994 and a deed restriction was placed on the property limiting its use to industrial purposes only. No other development occurred on this site until 1994 when American Axle constructed a Parts Coating Facility on the northern portion of the site. Through a series of legal and administrative actions, PCB and lead contaminated soil, water and oil was removed from the site and the pavement must remain in-tact as a barrier to the contaminated soil beneath and to prevent water infiltration. Remedial activities were completed in 1998 and a long-term operations and maintenance plan is in effect which requires pavement inspections, groundwater and sewer monitoring for PCBs and lead. There is little potential for exposure to contaminated soils because access to the site is restricted and the contaminated soils are covered by a paved parking lot.

Vibratech Incorporated (site code # 915165)

This site is located at 537 East Delavan Street in Buffalo. This site was used for the manufacture of vibration dampeners and rotary shock absorbers for the truck and railroad industry from 1927 to the mid-1990s. The site is currently covered by buildings and asphalt and the sub-surface contains several feet of cinders and ash. Based on investigations completed to date, the primary contaminants of concern are trichloroethene (TCE), 1,1,1-trichloroethane and petroleum products. Remedial activities and removal of contaminated soils have decreased the concentrations of TCE in the on-site groundwater. EPA remedial actions in 2009 also removed asbestos and PCBs from light ballasts, capacitors and associated contamination throughout the facility. Additionally, mercury containing switches and lamps were removed and disposed. Site

investigations are on-going throughout the site which have identified additional site areas for remediation. In 2012, an off-site investigation of soil vapor intrusion (i.e., indoor air soil and sub-slab sampling) determined no significant impacts are occurring due to existing groundwater contamination. No off-site impacts have been identified to date. Direct contact with contaminants in the soil is unlikely because most of the site is covered with buildings and pavement. People are not drinking the contaminated groundwater because the area is served by a public water supply that is not contaminated by the site.

Western New York Workforce Training Center (site code # C915310)

This site is located at 683 Northland Ave in Buffalo. Beginning in 1911, the property had a machine and tool works facility. The facility used hydraulic equipment, electrical equipment, and other industrial equipment (i.e., cranes, foundry, etc.) that led to the present site contamination. Site investigations found three underground storage tanks (USTs) at the site that reportedly contained No. 6 fuel oil. Polycyclic aromatic hydrocarbons (PAHs) and metals were also found in surface soils; and, petroleum products, PAHs, polychlorinated biphenyls and metals were found in sub-surface soils and groundwater. Hydraulic oil was observed seeping into test pits from the top of subsurface bedrock. Based on the information collected to date, the contamination on-site is not contaminating surrounding off-site properties. Because of concern for vapor intrusion from on-site contamination, any occupied structures will have sub-slab depressurization systems installed. Remediation of the site has been completed and measures are in place to address potential human exposures to residual contamination.

Appendix N - Trends over time, Erie County and comparison areas, for six cancers elevated in the EBWC study area

Figure 1

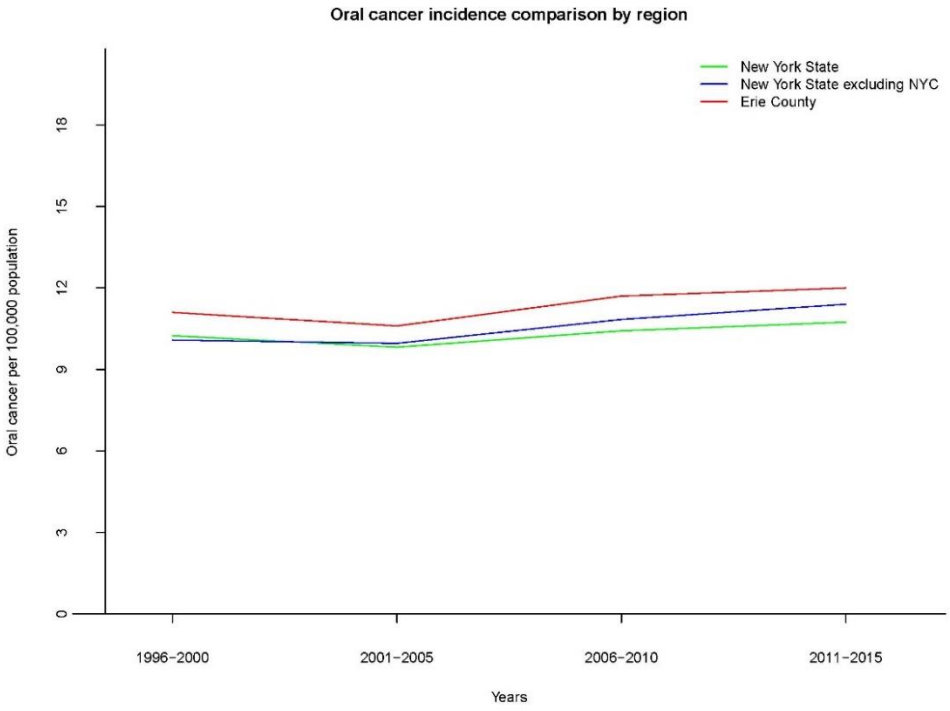


Figure 2

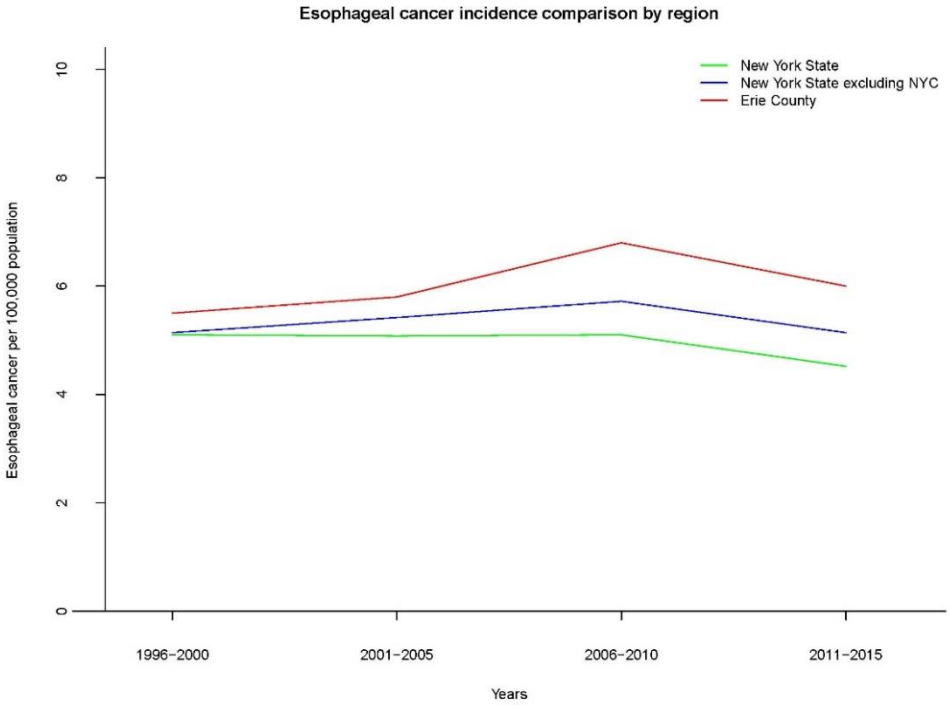


Figure 3

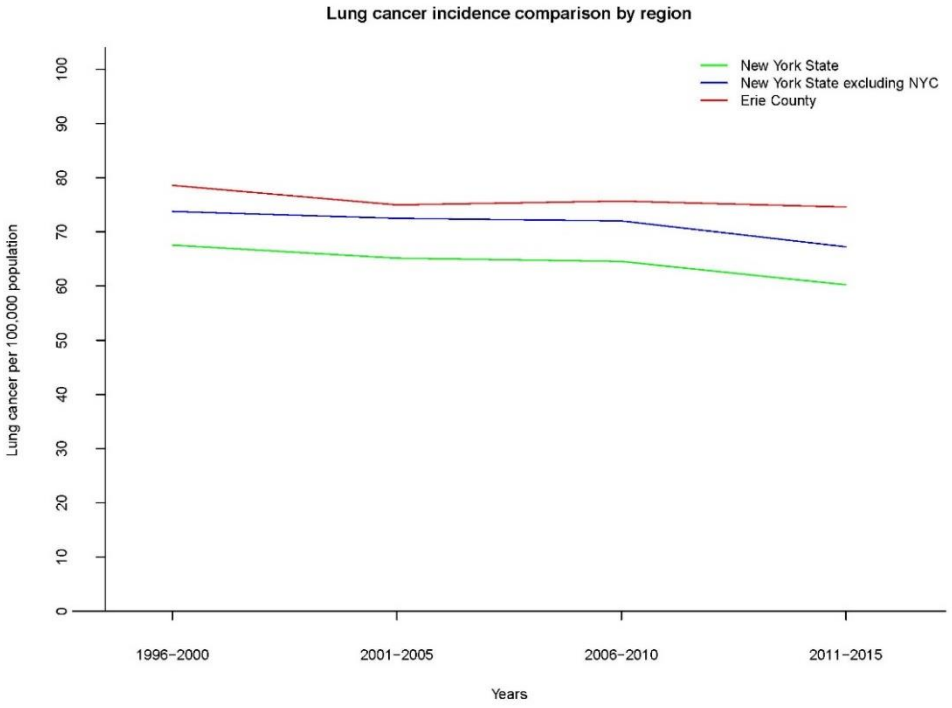


Figure 4

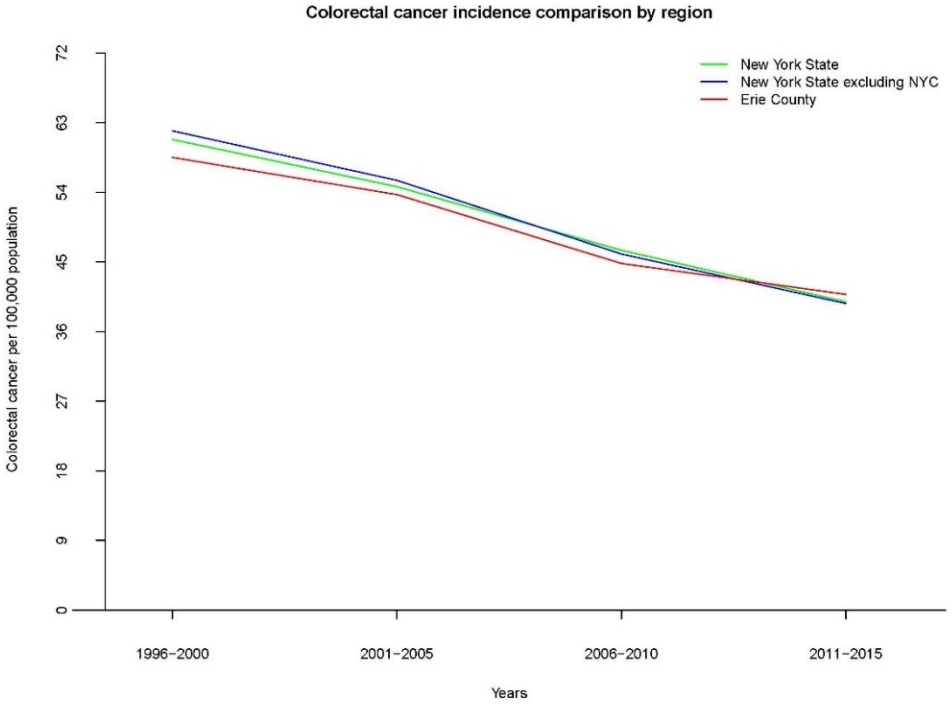


Figure 5

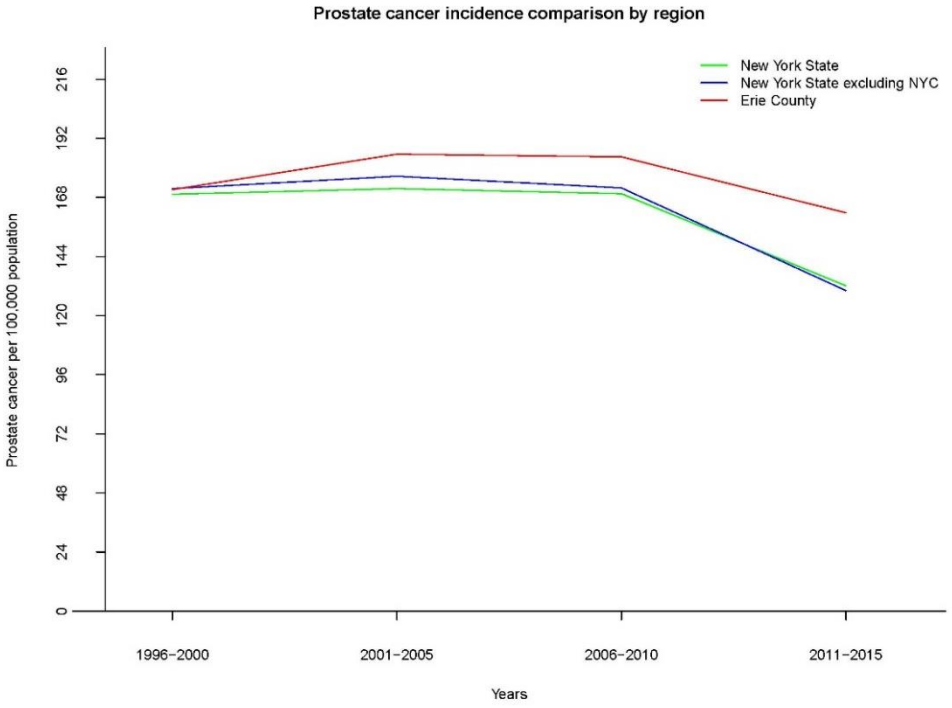


Figure 6