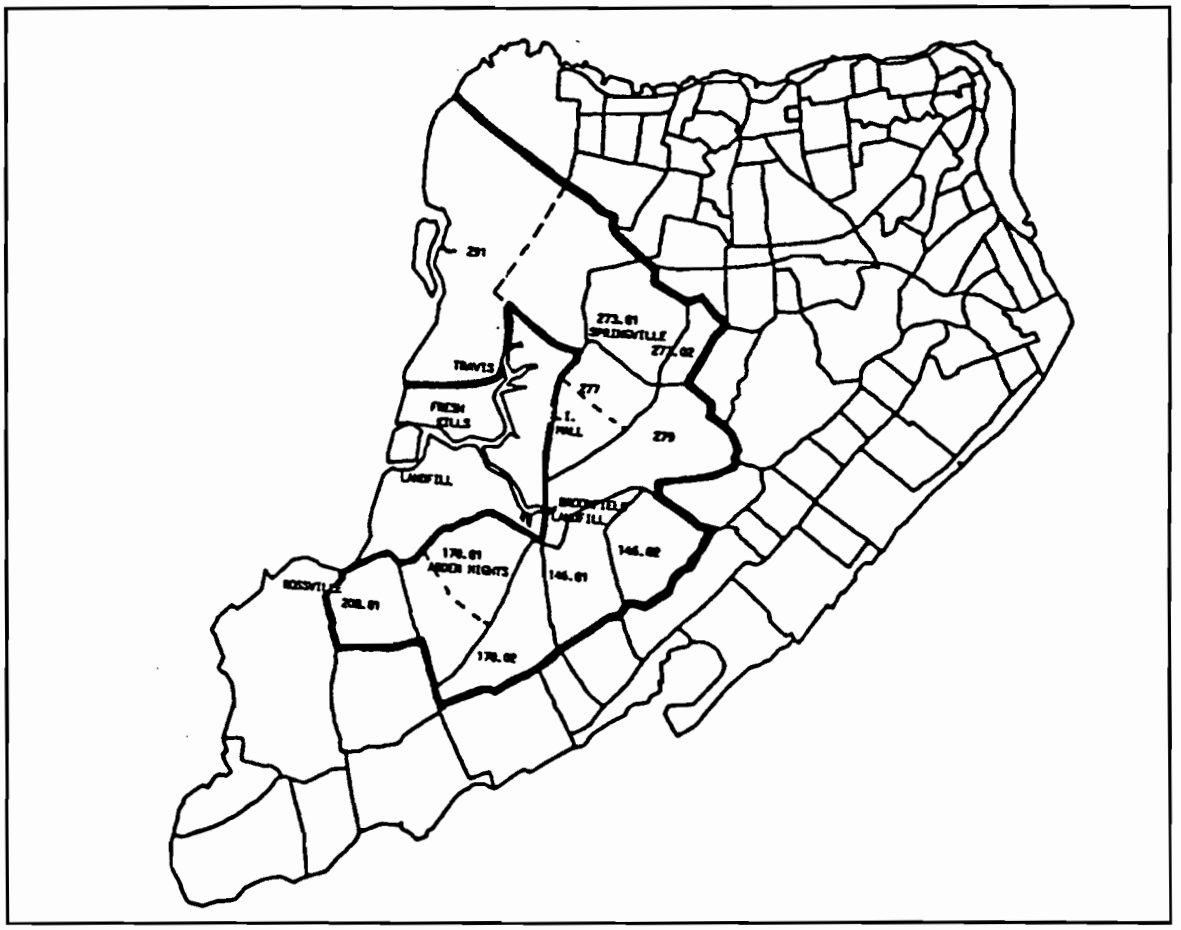
STATEN ISLAND
CANCER INCIDENCE STUDY
Addendum: Cancer Rates 1989-1992 and Cancer Trends 1978-1992

March 2000



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EXECUTIVE SUMMARY

BACKGROUND

In March 1996, the New York City Department of Health issued a report about cancer incidence in Staten Island. The study, evaluated cancer incidence for 1979-1988 in a study area comprised of the census tracts adjacent to the Fresh Kills and Brookfield landfills and also in the Borough of Staten Island as a whole. Fourteen adult and 3 childhood cancers were evaluated. The 1996 study found:

- Among people living in the Study Area, cancer incidence was generally lower than among residents of the rest of Staten Island. In addition, for most cancer sites, cancer incidence in a demographically similar comparison community (the combined Bay Ridge and Flushing Health Districts) was similar to that in the Study Area. The one exception was lung cancer in both men and women, which was moderately and statistically significantly elevated compared with Bay Ridge and Flushing. However, this elevation is reflective of an elevation in lung cancer throughout Staten Island and is not indicative of something specific to the communities nearest the landfills.

- On Staten Island, the incidence of most types of cancer was similar to that of the rest of NYC and to the combined Bay Ridge/Flushing Health Districts. Slight to moderate, statistically significant elevations ranging from 10-55% were noted for lung, bladder, colon and pharynx cancers in men; and lung, bladder, colon, breast, pharynx cancer and lymphoma in women. There were no elevations in the childhood cancers evaluated (leukemia, lymphoma, and central nervous system cancers).

These findings provide some reassurance that there was no increase in cancer incidence in the Study Area during the 1980's. There were also no statistically significant increases for the majority of cancer types on Staten Island. While certain cancers were slightly to moderately elevated, the data do not suggest a common underlying cause (these cancers do not all share common known risk factors), nor do the pattern and magnitude of the elevations raise undue cause for alarm (generally, in studies of this type, several criteria should be present to warrant serious cause for concern. These include: at least a doubling of the cancer rate, a statistically significant elevation in rates, or consistent upward trends in rates).

Because these findings raised questions about the incidence of certain cancers on Staten Island, the Department of Health sought advice from a panel of nationally recognized experts as to the appropriate next steps. The panel -- along with representatives of the New York State Department of Health and the Staten Island Cancer Study Scientific Advisory Committee -- recommended that DOH analyze more recent cancer incidence data, evaluate trends in cancer incidence for Staten Island and the Study Area and explore funding opportunities for in-depth study of cancer risk factors on Staten Island.

OBJECTIVES

The objectives of these analyses are:

1. Evaluate more recent cancer incidence data (1989-1992) for the Study Area and for Staten Island as a whole.

3. Determine if there are overall trends of increasing or decreasing cancer incidence rates in Staten Island and the Study Area over the 15 year period (1978-1992) and if trends in these areas are significantly different from trends elsewhere.

METHODS

Calculation of Cancer Incidence Rates and Rate Ratios

The methods of this study are similar to the March 1996 study. Both studies examined the number of new cases of cancers (cancer incidence) among residents who live in census tracts near the two landfills on Staten Island (the Study Area) and also among residents of Staten Island as a whole. Cancer incidence data for 1989-1992 were obtained from the NYSDOH Cancer Registry for the 14 adult and 3 childhood cancers evaluated. Age adjusted, sex specific cancer incidence rates and rate ratios for each area were calculated using the same methods as in the *Staten Island Cancer Incidence Study*. Ninety-five percent confidence intervals and power were calculated using the same methods as the 1996 study.

Cancer rates were calculated separately for children ($\leq$ 14 years old), men, and women. Four-year, age adjusted, sex specific cumulative cancer incidence rates (the number of new cases of cancer during the four years from 1989 to 1992 in an area divided by the 1990 population in the same area) and rate ratios were calculated for the Staten Island population(s) and the populations in the comparison areas.

Incidence rates in the Study Area were compared to incidence rates in the rest of Staten Island and to the combined Bay Ridge/Flushing Health Districts. The borough of Staten Island was compared to the rest of New York City (NYC) and also to the combined Bay Ridge and Flushing Health Districts.

Trend Analysis for the Years 1978-1992

Trend analyses were used to determine how cancer incidence rates changed over the 15-year time period (1978-1992). For the study and comparison areas, annual age-adjusted cancer incidence rates were calculated for each year from 1978-1992. These analyses were designed to assess the overall or "average" trends over the 15 year time period but do not measure fluctuations in cancer rates from year to year.

Regression analysis was used to determine:

1) Whether there was a statistically significant trend of increasing or decreasing cancer incidence rates in the Study Area or Staten Island over time.

2) Whether the trends observed in cancer incidence rates in the Study Area or Staten Island were the same as or statistically significantly different from the trends observed in the comparison areas.

RESULTS

Cancer Incidence 1989-1992

Cancer Incidence in the Study Area

- Among Study Area men and women, there were no cancer types which were statistically significantly elevated when compared to the incidence among men and women in the rest of Staten Island.
- The breast cancer rate in women and the bladder cancer rate in men were statistically significantly elevated in the Study Area compared to rates in Bay Ridge/Flushing. The rate for nervous system cancer in women was 2.2 times higher in the Study Area than in the rest of Staten Island. However, this elevation was not statistically significant.
- The leukemia rate in children was 2.5 times higher in the study area than in the rest of Staten Island. However, this elevation was also not statistically significant. No other cancer rates for children were statistically significantly higher or lower in the Study Area than in the rest of Staten Island or the Bay Ridge/Flushing comparison area.

- For the majority of the Study Area comparisons there was very poor power to detect the slight-moderate elevations in RR's as statistically significant.

Cancer Incidence on Staten Island

- Lung cancer was statistically significantly elevated among both men and women compared to either the rest of NYC or the combined Bay Ridge/Flushing communities. This is consistent with the findings of the previous study.
- Breast cancer rates were statistically significantly elevated on Staten Island compared to both the rest of the City and Bay Ridge/Flushing.
- For the majority of other cancer sites evaluated, the RR's remained about the same during this time period as during the previous time period.
- Children in Staten Island had significantly lower rates of cancer than children in the rest of New York City.
- There was low power to detect some of the slightly-moderately elevated RR's as statistically significant. This was primarily true for RR's that were only very slightly elevated or RR's for cancer sites that are relatively rare.

Cancer Incidence Trend over Time (1978-1992)

Trend analysis was used to determine

1) Whether there was a statistically significant linear trend of increasing or decreasing cancer incidence rates in the Study Area or Staten Island over time.

2) Whether the trends observed in cancer incidence rates in the Study Area or Staten Island were different from the trends observed in the comparison areas (i.e.: was there a significant difference between the trends).

The Beta value shown in the tables indicates whether there was an increasing or decreasing trend in cancer incidence over time. Cancer rates fluctuate from year to year. The Beta value represents how steep the slope of a straight line that "best fits" all 15 yearly plotted points was. For the trend analyses a positive Beta value indicates that the overall incidence rates were increasing over time. A negative Beta value represents an overall decrease in rates over time (although the rates may have varied slightly up or down from year to year).

Trends in Cancer Incidence in Study Area

- Among males, there were no significant trends for increasing cancer incidence rates.
- There was a statistically significant trend for decreasing stomach cancer incidence rates over the 15 year time period evaluated.
- Among Study Area women there was no significant trend of either increasing or decreasing cancer incidence rates for 12 of 14 sites.
- There were statistically significant trends for increasing breast and lung cancer rates among Study Area women–these trends are similar to trends noted for all of Staten Island.
- Among Study Area children cancer incidence rates stayed about the same during the 15 year period from 1978-1992.

Trends in Cancer Incidence in Staten Island

- Among men, there was a statistically significant trend of decreasing larynx cancer rates over time.
- There were statistically significant trends for increasing rates for cancers of the pancreas, prostate, liver, CNS and lymphoma among men during 1978-1992.
- Among women, 4 cancers had statistically significant trend for increasing rates over time (lung, breast, pancreas and lymphoma).
- Colon cancer rates among Staten Island women have decreased significantly over the 15 years evaluated.
- Childhood cancer rates remained essentially unchanged over the period of 1978-1992 in Staten Island.

CONCLUSIONS and RECOMMENDATIONS:

Conclusions

This investigation allowed for a continuing assessment of cancer rates and patterns on Staten Island. The addition of trend analyses in this update provided important information about the direction of cancer incidence rates during the 15 year period from 1978-1992 and how they compared to other areas.

Taken together, when cancer incidence trends are evaluated in combination with the patterns of findings for the RR's in this investigation and the prior investigation, these analyses do not indicate consistent evidence of elevated cancer rates specific to the landfill area. For the majority of cancer sites, rates in the Study Area were lower than, or equivalent to, rates in the rest of Staten Island. The moderate elevations noted for leukemia among children and CNS cancers among men and women during this time period were of an opposite pattern from those noted during the previous study period, so they could represent natural variation in rates over time.

These additional analyses also indicate that cancer incidence for most cancers on Staten Island as a whole was not significantly different than elsewhere in the City. Also, trends in cancer incidence on Staten Island are not significantly different from those elsewhere in the City for most sites. Importantly, children on Staten Island had significantly lower rates of cancer than children in the rest of the City. However, for the time period evaluated in these analyses there continue to be statistically significant elevations for some adult cancer types on Staten Island and several of these cancers also have trends that are statistically significantly different from the comparison areas for the 15 year time period evaluated.

In conjunction with the prior study findings, these analyses provide fairly consistent evidence of a continuing moderate elevations in lung and bladder cancer among men and women and breast cancer in women in Staten Island. These analyses also point out other areas of potential concern, primarily pancreatic cancer and to a lesser degree, adult leukemia. Because of the limitations of the study approach it is impossible to rule in or out with 100% certainty the role of environmental, lifestyle or other cancer risk factors.

Recommendations

The New York City Department of Health makes the following recommendations:

1) Risk assessment and Risk reduction:

- Study past risk factors to better understand current cancer incidence patterns in Staten Island.
- Assess current exposure to risk factors among Staten Island residents.
- Based on the findings of this assessment, take measures that will reduce risk exposure and

prevent cancer occurrence. Create screening programs for Staten Island residents that will allow detection of cancer early.

Toward these goals, in accordance with the recommendations of Staten Island Expert Panel and Scientific Advisory Committee, NYCDOH is currently seeking a consultant to work with the Department to develop a comprehensive cancer risk profile, a cancer health promotion and risk reduction program for Staten Island residents, and an in-depth epidemiologic study of lung cancer to determine causal factors for lung cancer on Staten Island.

2) NYCDOH will continue to assess rates and trends of leukemia, lymphoma and CNS cancer in proximity to the landfills when new census data are available and the Cancer Registry has made available at least five additional years of cancer data.

3) NYCDOH will also continue to update cancer analyses for Staten Island as a whole as additional data become available. The development of a number of nation- and citywide programs is in progress which will also serve Staten Island communities. Under the Turning Point Initiative, a national initiative sponsored by Robert Wood Johnson and W.K. Kellogg Foundations to foster partnership between community and government for the improvement of public health, NYCDOH has conducted analyses for selected cancer types up to the year 1993 by ZIP code and HSA Neighborhood. Further, NYCDOH is analyzing more recent disease data for community health profiles. Analyses of data for selected types of cancer for the years 1992 to 1996 for NYC boroughs and neighborhoods will be included in the first series of profiles. These profiles will be updated in the future. In addition, NYCDOH has started to analyze cancer incidence data up to the year 1996 for a Citywide cancer incidence profile.

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I. INTRODUCTION

A. Background

In response to concerns about the incidence of cancer among residents living near the landfills on Staten Island, the New York City Department of Health evaluated the incidence of 14 different types of cancers in adults and 3 types in children diagnosed among residents of Staten Island as a whole and in a Study Area comprised of the 13 census tracts adjacent to the Brookfield and Fresh kills Landfills during the years 1979-1988. The background, methods, and results of that study are presented in the March, 1996 *Staten Island Cancer Incidence Study* report.

In summary, the 1996 study found:

- The most common types of cancer among adults and children in Staten Island are also the most common types which occur among adults and children in New York City and New York State. (men: lung, prostate, colon; women: breast, lung, colon; children: leukemias).

- There were no statistically significantly elevated types of cancers among men and women living in the Study Area (census tracts near the S.I. landfills) compared to men and women living in the rest of Staten Island.

- In the Study Area (census tracts near the S.I. landfills), lung cancer in both men and women was the only type of cancer which was moderately and statistically significantly elevated (RR = 1.32) compared to the Bay Ridge and Flushing Health District area.

- Among Study Area and Staten Island children, overall cancer incidence was about the same or lower than cancer incidence in the rest of NYC or in the combined Bay Ridge and Flushing Health Districts. Lymphoma was moderately but not significantly elevated for children living in the Study Area compared to the rest of Staten Island and to the Bay Ridge and Flushing Health Districts.

- In Staten Island as a whole, slight to moderate, statistically significant elevations ranging from 12-36% were noted for both men and women in cancers of the lung, bladder and colon compared to the rest of NYC. In women only, the rates of lymphoma and breast cancer were slightly and statistically significantly higher compared to the rest of NYC. Among men, larynx cancer incidence was statistically significantly elevated.

This addendum presents the analysis of cancers that occurred among Staten Island residents during the years 1989-1992, and evaluates the trends in cancer incidence over the 15 year time period from 1979-1992.

B. Study Development

This study addendum was developed based on the results of the DOH *Staten Island Cancer Incidence Study* (March 1996) with input and guidance from the Staten Island Cancer Study Scientific Advisory Committee (SAC) and the New York State Department of Health (NYSDOH). Upon completion of the 1996 study, the SAC reviewed the results and made the following recommendations.

1. Continue evaluation of more recent (post 1988) cancer incidence in the Study Area and in Staten Island.

2. Evaluate trends in cancer incidence in both areas to determine whether cancer incidence has increased, decreased or remained about the same during the years 1978-1992 and evaluate if trends in cancer incidence in the Study Area or Staten Island are different from trends in the comparison communities.

3. Convene a panel of experts in cancer epidemiology to review the study and available literature to determine whether or not an analytic study would provide valuable information as to the possible causes of elevated cancer incidence rates on Staten Island.

In July of 1996, the DOH convened an Expert Panel (Appendix D) to discuss the study results and determine if the findings supported ongoing or additional analyses and/or other public health undertakings. The Panel agreed with the recommendations of the SAC that analysis of more recent cancer incidence data should be conducted.

The Expert Panel also recommended other public health programs which would require additional resources to undertake (e.g.: a cancer risk factor survey or an analytic study of selected cancer types).

C. Objectives

The objectives of these analyses are:

1. Evaluate more recent cancer incidence data (1989-1992) for the Study Area and for Staten Island as a whole.

3. Determine if there are overall trends of increasing or decreasing cancer incidence rates in Staten Island and the Study Area over the 15 year period (1978-1992) and if trends in these areas are significantly different from trends elsewhere

II. METHODS

The methods of this study are similar to those of the March 1996 study. Both studies examined the number of new cases of cancers (cancer incidence) that occurred among residents who live in census tracts near the two Landfills on Staten Island (Study Area) and also among residents of Staten Island as a whole, compared to the rest of New York City (NYC) and to a demographically similar area of NYC (combined Bay Ridge and Flushing Health Districts). In addition, this study presents the trends in cancer incidence rates for each area and evaluates how those trends compare to the trends observed in each comparison area.

A. Sources of Data

1. *Cancer Incidence Data*

DOH obtained cancer incidence data for 1989-1992 (the latest year cancer incidence data are considered complete for the analysis of small geographic areas) from the New York State Department of Health (NYSDOH) Cancer Registry.

The cancer types evaluated in this report are the same as those evaluated in the previous report and are presented in table 1.

Table 1
Cancer Types Evaluated in Staten Island Cancer Incidence Study

pharynx/ oral cavity	(ICD* 140-149)	prostate (ICD 185)	
		bladder (ICD 188)	
stomach	(ICD 151)	kidney (ICD 189)	
colon	(ICD 153)	CNS**√	(ICD 190-192)
liver	(ICD 155)	lymphoma √	(ICD 200-202)
pancreas	(ICD 157)	mult. myeloma	(ICD 203)
larynx	(ICD 161)	leukemias√	(ICD 204-208)
lung	(ICD 162)		
female breast	(ICD 174)		

* ICD = international classification of diseases
** CNS = central nervous system (including brain) cancers
those cancers indicated by a" √" were also evaluated in children

2. Demographic Data

Demographic data for this study, including population size, age, sex, race, and income based on the 1980 and 1990 US Census was provided by the New York City Department of City Planning.

B. Analysis

1. Calculation of Cancer Incidence Rates and Rate Ratios

Age adjusted, sex specific cancer incidence rates and rate ratios for different areas were calculated using the same methods as in the *Staten Island Cancer Incidence Study*.

Population data from the 1990 US Census was used to calculate incidence rates.

Cancer rates were calculated separately for children ($\leq$ 14 years old), men, and women. Four-year, age adjusted, sex specific cumulative cancer incidence rates (the number of new cases of cancer during the four years from 1989 to 1992 in an area divided by the 1990 population in the same area) and rate ratios were calculated for the Staten Island population(s) and the populations in the comparison areas. The Rate Ratio (RR) shows how the cancer incidence rate in one area compares to the incidence rate in another area. If the rate in one area is exactly the same as the rate in the comparison area the RR would be 1.00. This is rarely the case, however, and the number of cases of cancer (and hence, the rate) in any given area will vary from one year to the next in an unpredictable way due to unknown factors. These variations will be reflected in the RR and for most comparisons the RR will either be greater than or lower than 1.00. A statistical test is used to determine if the deviation from 1.0 is meaningful (or "statistically significant") or could be due to the natural variation in cancer rates. In this report, the statistical test used is the 95% confidence interval. A complete discussion of the statistical methods used for these analyses is presented in the 1996 report.

2. Trend Analysis for the Years 1978-1992

Trend analyses were used to determine how cancer incidence rates changed over the 15-year time period (1978-1992). For the study and comparison areas, annual age-adjusted cancer incidence rates were calculated for each year from 1978-1992. For the years 1978 to 1982, the rates were calculated using the 1980 census population. Yearly rates for the years 1983 to 1987 were calculated using an estimated 1985 census population (calculated assuming a linear increase in population between the 1980 and 1990 census). Rates for the years 1988 to 1992 were calculated using the 1990 census population.

Regression analysis was used to determine:

1) Whether there was a statistically significant trend of increasing or decreasing cancer incidence rates in the Study Area or Staten Island over time.

2) Whether the trends observed in cancer incidence rates in the Study Area or Staten Island were the same as or statistically significantly different from the trends observed in the comparison areas.

Rates for cancers fluctuate from year to year, with rates in one year being higher or lower than rates in the next. These differences do not necessarily indicate that there has been a change in rates. When the rates are plotted on a graph, they are generally scattered along a straight line. However, the line may show an overall increase or decrease in rates over time. The Beta value represents the steepness of the slope of this straight line. For the trend analyses a positive Beta value indicates that the overall incidence rates were increasing over time. A negative Beta value represents an overall decrease in rates over time (although the rates may have varied slightly up or down from year to year). For example, a Beta of 1.8 means that for every year, on average, the incidence rate increased by 1.8 cases /100,000 persons. The larger the Beta value, the steeper the slope of the line. A Beta value equal to or close to "0" means that the trend was neither increasing nor decreasing. A p value of 0.05 or less ($p \leq 0.05$) indicates that the overall increase or decrease in rates over time is statistically significant.

P values were also calculated to determine whether the trends observed in cancer incidence rates in the Study Area or Staten Island were different from the trends observed in the comparison areas. A p value of 0.05 or less ($p \leq 0.05$) indicates a significant difference between trends.

III. RESULTS

The results of this investigation are presented in two sections.

I) The analyses of cancer incidence from 1989-1992.
II) The analyses of the 15 year cancer incidence trends from 1978-1992.

A. CANCER INCIDENCE 1989-1992

The age adjusted cancer rate ratios (RR's) for each set of comparisons are summarized in tables and presented in Appendix "A" tables A1-A12 . The results are presented separately for men, women and children.

An indication of the statistical significance of the RR is provided with "$p \leq 0.05$" indicating that the cancer incidence rate in the area of concern was statistically significantly different from the rate in the comparison area, or "ns" indicating that the rate in the area of concern was not statistically different from the rate in the comparison area.

1. Cancer Incidence in the Study Area (tables A1-A6)

Summary

- Among Study Area men and women, there were no cancer types which were statistically significantly elevated when compared to the incidence among men and women in the rest of Staten Island.
- The breast cancer rate in women and bladder cancer rate in men were statistically significantly elevated among the Study Area residents compared to men and women residents of the Bay Ridge/Flushing comparison area.
- Cancer rates were not statistically significantly higher or lower among children in the Study Area compared to either the rest of Staten Island or the Bay Ridge/Flushing comparison area.
- For the majority of the Study Area comparisons there was very poor power to detect the slight-moderate elevations in RR's as statistically significant.

a. *Cancer Incidence in Study Area Compared to the Rest of Staten Island*

Men:
Cancer incidence rates among Study Area men were generally the same or lower than cancer incidence rates among men in the rest of Staten Island for 11 of 14 cancer types evaluated. As in the previous study, pharynx cancer rates were statistically significantly lower among Study Area men when compared to men in the rest of Staten Island. Lung cancer and leukemia rates were also

significantly lower among Study Area men. No cancer types were statistically significantly higher among Study Area men compared with men in the rest of Staten Island.

Women:
For 13 of 14 cancer types evaluated, cancer incidence rates among Study Area women were generally the same or lower than cancer incidence rates among women in the rest of Staten Island. As in the previous study, pharynx cancer rates were statistically significantly lower among Study Area women when compared to women in the rest of Staten Island. Moderate, non-significant elevations were noted for stomach cancer (RR 1.54, ns) and central nervous system (CNS) cancers (RR 2.21, ns). No cancer types were statistically significantly higher among Study Area women when compared to women in the rest of Staten Island.

Children:
There were no cases of nervous system cancers among children living in the Study Area during the 1989-1992 time period. Th RR for lymphoma was moderately elevated (1.25, ns). An RR of 2.5 (ns) was noted for leukemia when Study Area children were compared to children in the rest of Staten Island. This RR is based on a very small number of cases (< 6) occurring and was not statistically significant.

b. ***Cancer Incidence in the Study Area Compared to the Combined Bay Ridge and Flushing Health Districts.***

Men:
Cancer incidence rates among men in the Study Area were not significantly different from those in Bay Ridge/Flushing for 13 of 14 cancer types evaluated. The RR for lung cancer, which had been statistically significantly elevated during the period from 1978-1989 (RR=1.32, $p<0.05$) was not statistically significant (RR=1.10, ns) during the 1989-1992 study period. Bladder cancer rates were moderately and statistically significantly higher in the Study Area than in this comparison area (RR=1.70, $p<0.05$). Moderate elevations in pancreatic, CNS cancers, larynx cancers and multiple myeloma were not statistically significant.

Women:
Cancer incidence rates among Study Area women were not statistically significantly different from cancer incidence rates among women in the combined Bay Ridge/Flushing Health Districts for 13 of 14 cancer types. The RR for breast cancer was moderately elevated (1.29, $p<0.05$). The RR for lung cancer which was statistically significant for the previous time period (RR=1.32, $p<0.05$) was not significantly elevated during the 1989-1992 time period (RR=1.20 ns). Moderate elevations for stomach, bladder, pancreatic, CNS cancers and multiple myeloma were not statistically significant.

Children:
During the four years from 1989-1992, children in the Study Area had similar or lower cancer rates than children in the Bay Ridge and Flushing communities. The rate ratio for lymphoma was 0.83. The rate of leukemia was the same in the Study Area as in Bay Ridge and Flushing (RR=1.0). As noted previously, there were no cases of CNS cancer in the Study Area.

2. Cancer Incidence on Staten Island (tables A7-A12)

Summary

- Lung cancer was statistically significantly elevated among both men and women compared to either the rest of NYC or the combined Bay Ridge/Flushing communities. This is consistent with the findings of the previous study.
- Breast cancer rates were statistically significantly elevated on Staten Island compared to both the rest of the City and Bay Ridge/Flushing.
- For the majority of other cancer sites evaluated, the RR's remained about the same during this time period as compared to the previous time period.
- Children in Staten Island had significantly lower rates of cancer than children in the rest of New York City.
- There was low power to detect some of the slightly-moderately elevated RR's as statistically significant, this was primarily true for RR's that were only very slightly elevated or RR's for cancer sites that are relatively rare.

a. *Cancer Incidence on Staten Island Compared to the Combined Bay Ridge and Flushing Health Districts*

Men:
Among men on Staten Island cancer incidence was similar to that among men in the combined Bay Ridge/Flushing Health Districts for 8 of 14 sites. As in the evaluation of cancer incidence for 1978-1989, RR's for cancers of the pharynx and lung were statistically significantly elevated ($RR_{(pharynx)} = 1.45$, $p<0.05$, $RR_{(lung)} = 1.41$ $p<0.05$). These elevations were of a similar magnitude to those noted for the previous time period. Moderately elevated, statistically significant RR's were also noted for cancers of the prostate (RR=1.23, $p<0.05$), bladder (RR 1.29, $p<0.05$) and leukemia (RR 1.68, $p<0.05$).

Women:
For the majority of cancer sites (11 of 14), cancer incidence among women in Staten Island was similar to cancer incidence among women in the combined Bay Ridge/Flushing Health Districts. Similar to the previous time period, the incidence of lung cancer was significantly higher among Staten Island women than women in the Bay Ridge/Flushing Health Districts. In addition, there were moderate, statistically significant elevations in the RR's for breast (RR=1.21, $p<0.05$) and pancreatic (RR=1.46, $p<0.05$) cancers.

Children:
The rates of lymphoma and CNS cancers among Staten Island children were not significantly different and were generally lower than the rates for children in the combined Bay Ridge and Flushing area. The rate of childhood leukemia was significantly lower in Staten Island (RR=0.57, $p<0.05$). These findings are similar to the findings of the previous study.

b. *Cancer Incidence on Staten Island Compared to the Rest of NYC*

Men:
Cancer incidence for 8 of 14 cancer types was not statistically significantly different when men in Staten Island were compared to men in the rest of New York City. The RR's for cancers of the colon (RR 1.16, $p<0.05$), lung (RR 1.27, $p<0.05$) and bladder (RR 1.44, $p<0.05$) were comparable to those in the previous investigation and statistically significantly elevated. In addition, there were statistically significant elevations in the RR's for cancers of the prostate (RR=1.12, $p<0.05$), pancreas (RR=1.42, $p<0.05$) and leukemia (RR=1.52, $p<0.05$).

Women:
For the majority of cancer types (11 of 14), cancer rates among Staten Island women are similar to cancer rates for women elsewhere in the City. Statistically significant elevations were noted in the RR's for cancers of the lung (1.43, $p<0.05$), breast (1.25, $p<0.05$), and bladder (1.43, $p<0.05$). Similar, statistically significant elevations were noted during the previous time period.

Children:
The rates for lymphoma, leukemia, and nervous system cancers in children were all statistically significantly lower in Staten Island than in the rest of New York City.

B. CANCER INCIDENCE TRENDS OVER TIME (1978-1992)

Cancer Incidence trends and comparisons of trends between the Study Area or Staten Island and the comparison areas are presented in Appendix B, tables B1 to B12. In addition, appendix C contains graphs for cancer types for which there was a significant increase in incidence rates in the Study Area or Staten Island or for which there was a significantly different trend in the Study Area or Staten Island than in the respective comparison areas.

1. Trends in Cancer Incidence in Study Area (tables B1-B6, figures 1-4)

Summary

- Among males, there were no significant trends for increasing cancer incidence rates.
- There was a statistically significant trend for decreasing stomach cancer incidence rates among males over the 15 year time period evaluated.
- Among Study Area women there was no significant trend of either increasing or decreasing cancer incidence rates for 12 of 14 sites.
- There were statistically significant trends for increasing breast and lung cancer rates among Study Area women–these trends are similar to trends noted for all of Staten Island.
- Among Study Area children cancer incidence rates stayed about the same during the 15 year period from 1978-1992.

a. Trends in Cancer Incidence in Study Area compared to the Rest of Staten Island and the Bay Ridge/Flushing Health Districts

Men:
Trends in cancer incidence were not significantly different for men in the Study Area compared to men in either Bay Ridge/ Flushing or men in the rest of Staten Island for 13 of 14 cancer types evaluated. As noted above, there was a statistically significant trend for decreasing stomach cancer incidence rates over time among Study Area men. The trend for decreasing stomach cancer rates was significantly different from the trend observed for men in the rest of Staten Island.

Women:
Trends in cancer incidence in the Study Area were not significantly different from trends noted for the rest of Staten Island for any cancer sites or for 13 of 14 cancer sites when compared to trends in the combined Bay Ridge/Flushing Health Districts. In the Study Area, the rest of Staten Island, and Bay Ridge/Flushing there were similar, statistically significant trends for increasing lung cancer rates among women. This indicates that lung cancer incidence rates among women have increased significantly in all three areas during the 15 years between 1978-1992.

There were similar, statistically significant trends for increasing breast cancer incidence rates noted in both the Study Area and in the rest of Staten Island. Breast cancer rates in the combined Bay Ridge/Flushing Health Districts did not increase significantly over the 15 years evaluated and there was a statistically significant difference in trends when the Study Area was compared to Bay Ridge/Flushing. This difference indicates that during the time period evaluated, breast cancer incidence had increased in the Study Area at almost 6 times the rate of that in Bay Ridge/Flushing.

Children:
Trends in childhood cancer incidence in the Study Area were not statistically significantly different from trends noted in Bay Ridge and Flushing. There was a significant difference in the trends for CNS cancers when the Study Area was compared to the rest of Staten Island–while Study Area rates tended to decrease somewhat over time, rates in the rest of SI tended to increase slightly.

2. Trends in Cancer Incidence in Staten Island (tables B7 to B12, figures 5-25)

- Among men, there was a statistically significant trend of decreasing larynx cancer rates over time.
- There were statistically significant trends for increasing rates for cancers of the pancreas, prostate, liver, CNS and lymphoma among men during 1978-1992.
- Among women, 4 cancers had a statistically significant trend for increasing rates over time (lung, breast, pancreas and lymphoma).
- Colon cancer rates among Staten Island women have decreased significantly over the 15 years evaluated.
- Childhood cancer rates remained essentially unchanged over the period of 1978-1992 in Staten Island.

a. Trend in Cancer Incidence in Staten Island compared to the combined Bay Ridge and Flushing Health Districts.

Men:
For 10 of 14 cancer types trends in cancer incidence were similar in Staten Island and the combined Bay Ridge/Flushing Health Districts (i.e.: there were no statistically significant differences in trends between areas). In both areas, there were similar, statistically significant trends of increasing prostate and liver cancer rates. Trends in lymphoma, pancreatic and CNS cancer incidence rates among Staten Island men were statistically significantly different from those in Bay Ridge/Flushing. These differences indicate that incidence rates for these cancers were increasing at a more pronounced rate in Staten Island then in Bay Ridge/Flushing where the rates remained relatively unchanged. There was a statistically significant difference in the trends for leukemia incidence between Staten Island men and men in Bay Ridge/Flushing. This difference indicates that leukemia rates were decreasing in Bay Ridge/Flushing while they were staying about the same in Staten Island.

Women:
There were no significant differences in cancer incidence trends for 9 of 14 sites when women in Staten Island were compared to women in the combined Bay Ridge/Flushing Health Districts. In both areas there were similar, statistically significant trends for decreasing colon cancer rates. As noted above, there was a statistically significant trend for increasing lung cancer incidence rates over the 15 year period from 1978-1992. A parallel statistically significant trend was noted for lung cancer incidence among women in Bay Ridge/Flushing. However, there was a statistically significant difference in the magnitude of the trends between the two areas which indicated that the rate of lung cancer among women was increasing more steeply in Staten Island than in Bay Ridge/Flushing. Similarly, breast cancer incidence rates also increased more steeply among Staten Island women than among women in Bay Ridge/Flushing, and the difference between the trends in the two areas was statistically significant.

There were statistically significant differences in the trends noted for pancreatic cancer, lymphoma and leukemia when women in Staten Island were compared to those in Bay Ridge/Flushing. For pancreatic cancer and lymphoma these differences indicate that rates in Staten Island were increasing over the 15 year time period while rates in Bay Ridge/Flushing decreased (pancreatic cancer) or remained about the same (lymphoma) during the same time period. For leukemia this difference indicates that rates in Bay Ridge/Flushing were decreasing over time while rates in Staten Island remained about the same.

Children:
Trends in childhood cancer rates were not significantly different for children in Staten Island from trends for children in the combined Bay Ridge/Flushing Health Districts.

b. Trends in Cancer Incidence in Staten Island compared to Rest of New York City.

Men:
There were no statistically significant differences in trends for 12 of 14 cancer sites when Staten Island was compared to the rest of New York City. In both areas, there were statistically significant trends for increasing rates of lymphoma, prostate, liver and CNS cancers. With the exception of CNS cancers, the magnitude of the trends is comparable (i.e.: rates in both areas appear to be changing at a similar pace). Lung cancer incidence rates among men decreased significantly over time in the rest of the City. This pattern was not noted in Staten Island, where rates remained about the same over time. The difference in lung cancer trends between areas was not statistically significant.

As noted previously, the rates of larynx cancer decreased significantly over time in Staten Island, this trend was significantly different from that noted for the rest of the City, indicating that larynx cancer rates decreased more sharply in Staten Island than in the rest of the City.

Women:
For the majority of cancer types (10 of 14), trends in cancer incidence were not statistically significantly different in Staten Island than in the rest of New York City. The pattern of findings was very similar to that noted in the comparison of Staten Island to Bay Ridge/Flushing for cancers of the lung, breast, pancreas and leukemia. Similarly, there was a statistically significant trend for increasing lymphoma and decreasing colon cancer rates over time for women in the rest of New York City which was comparable to the trends noted in Staten Island.

Children:
Trends in childhood cancer rates were not statistically significantly different for children in Staten Island than children in the rest of the City.

IV. DISCUSSION

This addendum presented analyses of cancer incidence data for 1989-1992 for adults and children as well as an assessment of trends in cancer incidence for 1978-1992 in communities adjacent to the Fresh Kills and Brookfield Avenue landfills and in Staten Island as a whole. These analyses were conducted in accord with recommendations made by the Staten Island Scientific Advisory Committee and Expert Panel to further examine the burden of cancer and cancer incidence patterns on Staten Island. The purposes of these analyses were:

1) Continued assessment of cancer rates and patterns of cancer in the Study Area surrounding the landfills and in Staten Island as a whole and;

2) Assessment of trends in cancer incidence in Staten Island and the Study Area and how those trends compare to trends in the different comparison communities.

Below, the patterns of cancer incidence found in this study and cancer incidence trends are summarized and critically evaluated.

A. Cancer Rates Ratios 1989-1992

Patterns in cancer incidence RR's during this time period were similar to those noted in the previous study for all areas. Generally where elevations were noted in cancer rate ratios they tended to be slight to moderate (RR's <1.7).

1. Study Area

Adults

For the majority of sites, cancer incidence rates in the Study Area generally tended to be lower than in the rest of Staten Island among adults. These results are similar to those from the previous investigation. Cancer incidence rates in several sites were significantly lower among adults in the Study Area compared to the rest of Staten Island and none were statistically significantly elevated. There was very low power to detect the slight-moderate elevations in the Study Area as statistically significant.
When compared to Bay Ridge/Flushing, moderate, statistically significant elevations were noted for bladder cancer among Study Area men and breast cancer among Study Area women. Other, slight-moderate elevations were not statistically significant.

Among children, cancer rates were not statistically significantly different from either the rest of Staten Island or Bay Ridge/Flushing. An elevation in the childhood leukemia rate in the Study Area compared to the rest of Staten Island was based on a very small number of cases occurring and was not noted when the Study Area was compared to the combined Bay Ridge/Flushing Health Districts. It is likely that this elevation represents natural variation in rates.

2. Staten Island

Again, patterns of cancer incidence RR's were similar during this time period compared to the previous study time period. Lung Cancer was statistically significantly elevated in all comparisons. Bladder Cancer was statistically significantly elevated in both men and women when Staten Island was compared to the rest of the City and in women when Staten Island was compared to Bay Ridge/Flushing. Breast cancer rates in women, and leukemia and prostate cancer in men were elevated when compared to either area. Pancreatic cancer was statistically significantly elevated in men when Staten Island was compared to the rest of the City and in women when Staten Island was compared to Bay Ridge/Flushing. Statistically significant elevations were noted in two additional comparisons for men.

Cancer rates for children on Staten Island were significantly lower than those in the rest of NYC.

B. Trend Analyses 1978-1992

1. Study Area

The findings of the trend analyses for the Study Area show that cancer incidence trends were generally no different from those noted in the rest of Staten Island. These findings underscore the point that for the time period investigated there do not appear to be elevations in cancer incidence rate ratios or statistically significant trends of increasing cancer incidence among adults or children that are specific to the landfill area.

2. Staten Island

Statistically significant trends for increasing or decreasing cancer incidence rates were noted for several sites in men and women on Staten Island. For many of these sites, similar trends were noted for the rest of the City. However, for some cancer sites the trends were significantly different from those noted in either Bay Ridge/Flushing or the rest of New York City or both. In most cases, the trend differences indicate that rates in Staten Island were increasing at a steeper rate than rates elsewhere. However, the absolute magnitude of most trends was small–less than 1 case/100,000 persons per year

C. Patterns of Cancer Incidence and Consistency of Findings

As noted in the previous investigation of cancer incidence rates on Staten Island, it is useful to evaluate not only the magnitude of the RR's and whether they are statistically significant, but also how the findings of this study compare with past studies and how findings within the different subgroups (e.g.: men, women) compare with each other (i.e.: how consistent the findings are). The more consistent findings are, the more compelling the evidence may be in support of or repudiation of a cancer problem.

1. Study Area

Overall, the cancer patterns noted in the Study Area and in Staten Island as a whole are similar to the patterns noted in the previous study–that is, cancer rates in proximity to the landfills are generally not elevated when compared to the rest of Staten Island, but there were significant elevations in the rates of certain cancers in Staten Island as a whole. This is consistent with the findings of the previous study. During this time period no new patterns of cancer incidence emerged that would indicate a cancer problem specific to the Study Area.

The incidence of leukemia, lymphoma and CNS cancers were of great interest to residents of the Study Area. These cancers were among those about which the community had originally voiced concern. The analyses presented here provide no consistent evidence of an increase in adult leukemia, lymphoma or CNS cancer rates exclusive to the landfill communities. In fact, rates of leukemia among men in the Study Area were significantly lower than elsewhere on Staten Island and rates among women were also lower, though not significantly so. In addition, leukemia rates for Study Area adults were generally on a par with adult leukemia rates in Bay Ridge/ Flushing. In the Study Area there was no significant trend for increasing or decreasing leukemia incidence, (though the trends for adult leukemia in the Study Area were generally negative (or decreasing)).

The incidence of lymphoma among men and women in the Study Area was about the same as or lower than that in Bay Ridge Flushing or the rest of Staten Island.

An elevation (not statistically significant) in leukemia and lymphoma noted for children when the Study Area was compared to the rest of Staten Island was not noted for the comparison to the Bay Ridge and Flushing communities. Leukemia incidence was generally lower in the Study Area during the 1979-1988 time period than in the 1989-1992 time period. This elevation probably indicates natural variation in rates over time. There were no significant trends for increasing rates of any of the childhood cancers over time. However, there was a insignificant trend of decreasing leukemia rates among children in the rest of Staten Island (.13 fewer cases on average per year) and Bay Ridge Flushing (.17 fewer cases on average per year) while the general trend for leukemia rates was increasing (not significantly) in the Study Area (an increase of .28 cases on average per year with wide yearly fluctuations). There were no CNS cancers among children in the Study Area during the five years from 1989-1992.
CNS cancers were moderately elevated for Study Area women for both comparisons and for men when compared to Bay Ridge/Flushing. Among women, the RR for the comparison of the Study Area to the rest of Staten Island represents a doubling of the CNS cancer rate. None of these elevations was statistically significant. However, during the previous study time period (1979-1988), CNS cancer incidence was significantly lower among women and somewhat lower among men for both comparisons. The apparent moderate elevations during the 1989-1992 time period may represent natural variation in rates and/or an equilibration of CNS cancer rates over time.

Recently, the NYSDOH released an investigation of cancer incidence among persons living in close proximity (most were within 250 ft) to landfills throughout the state. Landfills were included in the study if they showed evidence of landfill gases (e.g.: methane or volatile organic compounds) migrating through the soil off the landfill site. No NYC landfills were considered for inclusion in the study. Study results indicated a four fold increase (i.e.: RR=4.0) in bladder cancer and leukemia among women who lived near the landfills. Although the findings of the NYSDOH study for female bladder cancer and leukemia were statistically elevated, the results do not "prove" that these cancers were caused by chemical exposures from the landfills. Limitations of the study included that no information was available about an individual's past exposure to known and suspected cancer risk factors. Also, the findings were based on a very small number of cases. The NYSDOH is currently updating the investigation and reviewing the medical histories of those cases identified to determine if other factors were present which may account for increased individual cancer risk.

Trend analyses indicated that bladder cancer rates did not increase significantly over time in the Study Area. However, bladder cancer rates were moderately elevated in men and women in the Study Area when compared to either comparison community. The elevation was statistically significant only when men in the Study Area were compared to men in the Bay Ridge/Flushing Health Districts. These findings are probably indicative of the overall elevation in bladder cancer rates on Staten Island as a whole and do not indicate a specific problem in the Study Area per se. Bladder cancer was slightly, though not significantly elevated in some but not all geographic comparisons in the prior study.

As summarized above and in light of the recent NYSDOH study, the results of this investigation and the previous investigation provide no consistent evidence of ongoing or current elevations in these cancer sites in the Study Area. In fact, adult leukemia rates were lower in the Study Area than in the rest of Staten Island. The moderate elevations noted in bladder cancer were of a much smaller magnitude than in the NYSDOH study (RRs of 1.0 to 1.7 compared to an RR of 4.0 in the NYSDOH study). In addition, testing conducted in the basements of 25 homes near the Brookfield Landfill found no evidence of off-site gas migration from the landfill. A landfill gas capture system has recently been completed for the Fresh Kills Landfill. This system will capture 99% of landfill gases. However, there are no homes in the immediate vicinity of the Fresh Kills Landfill, and soil gas migration is not considered a risk factor for residents. Nonetheless, it will be important to re-evaluate the NYSDOH findings once NYSDOH has completed the update of its initial study.

2. Staten Island

Here, as in the earlier investigation, the findings for Staten Island as a whole are more consistent across comparisons.

In the prior study, results indicated that cancers of the lung, and to a lesser extent, larynx, and bladder cancers were the primary cancers of concern in Staten Island. The analyses presented here indicate that lung cancer continues to be moderately and significantly elevated among both men and women in Staten Island when compared to either Bayridge/Flushing or the rest of the City. These findings are consistent with the findings of the previous investigation and underscore the reason for continued concerns regarding lung cancer on Staten Island. Moreover, while there was a statistically significant trend for increasing lung cancer incidence among women Citywide (ie: in Staten Island, New York City and Bay Ridge/Flushing) , the trend in lung cancer incidence among Staten Island women was significantly different from either comparison community. Lung cancer rates among women in Staten Island increased at a rate twice that of women in the rest of the City and 1.5 times that of women in the combined Bay Ridge/Flushing Health Districts. Similarly, while lung cancer rates decreased significantly among men in the rest of the City and generally decreased (though the trend was not statistically significant) in Bay Ridge/Flushing, similar trends were not noted for men in Staten Island.

There continue to be moderate, statistically significant elevations in bladder cancer among both men and women when compared to the rest of the City and in men only when compared to Bay Ridge and Flushing. The trends in bladder cancer incidence over time, however, were not statistically significantly different when Staten Island was compared to either Bay Ridge/ Flushing or the rest of the City.

In contrast to the prior investigation, there were no consistent elevations in the RR's for larynx cancer during this time period. In fact, there was a trend for significantly decreasing larynx cancer rates among men in Staten Island that was also significantly different from trends noted for men in the rest of the City (where larynx cancer rates stayed about the same), during the 15 year time period evaluated. Trend analyses indicated that larynx cancer rates stayed about the same in women during the same time period.

For many cancer sites, cancer incidence trends in Staten Island mirror trends elsewhere in the City. For example, statistically significant trends noted for some cancer sites evaluated for Staten Island (e.g.: increasing breast and decreasing colon cancer in women and increasing prostate and liver cancer in men) were also noted in both comparison areas. This pattern indicates that the increase or decrease in these cancers was a City-wide phenomenon during the time period evaluated. For colon, prostate and liver cancers there was no statistically significant difference between the trends noted in Staten Island and the trends noted in either of the comparison communities.

In contrast, similar to the patterns and trends noted for female lung cancer, while there was a statistically significant Citywide trend of increasing breast cancer incidence, breast cancer rates among Staten Island women increased at a significantly greater pace during the time period evaluated than rates elsewhere–almost 4 times greater than the rest of the City and almost 6 times greater than the Bay Ridge/Flushing combined Health Districts.

Pancreatic cancer was statistically significantly elevated in men when compared to the rest of the City and in women when compared to Bay Ridge/Flushing. Additionally there was a statistically significant trend for increasing pancreatic cancer rates during the 15 year time period among both men and women in Staten Island. These trends were significantly different from trends noted for men and women in the rest of the City (where pancreatic cancer rates decreased significantly over time) and trends in Bay Ridge/Flushing (where rates for men and women decreased over time, but only significantly for women). Pancreatic cancer incidence rates were not elevated in any comparison in the earlier evaluation of cancer incidence rates.

Leukemia incidence rates did not increase or decrease significantly over time among Staten Island adults. There were trends for significantly decreasing leukemia rates among men and women in the rest of the City and in the combined Bay Ridge/Flushing community. The trends for Bay Ridge/Flushing were statistically significantly different from trends among both men and women in Staten Island. The trend of decreasing leukemia rates noted for the rest of the City was significantly different from the trends noted for women but not men in Staten Island. The statistically significant differences in these trends appears to indicate that while leukemia rates were decreasing City wide, they were not decreasing on Staten Island.

Overall, these findings and those of the previous investigation do not provide conclusive evidence of an elevation in cancer incidence in the census tracts adjacent to the Fresh Kills or Brookfield landfills. In Staten Island, there is consistent evidence of continued moderate elevations of lung cancer and bladder cancer. In addition, there was evidence in support of moderate elevations in breast cancers among women, and to a lesser extent pancreatic cancer and leukemia. As with the prior investigation there is no evidence from these data to indicate why the elevations in cancer incidence noted for Staten Island exist. Furthermore, the limitations (summarized below) inherent to these types of analyses make it difficult to draw conclusions about cancer incidence and cancer causation with 100% certainty.

D. Limitations

Descriptive analyses such as those presented here are limited by several factors. A detailed assessment of these limitations and how they impact the interpretation of the findings was presented in the previous report, but a few bear noting here:

1) In general, the elevations in RR's noted in this study were modest and often (particularly in the Study Area) based on a small number of cases. As discussed in the previous study usually RR's of a much larger magnitude are required (often, for example, a tripling or quadrupling of risk) to provide compelling evidence of elevated disease rates. This is especially true in a small area such as the Study Area where low statistical power makes it difficult to interpret modestly elevated RR's. The ability to detect modest differences as statistically significant was even more difficult in these analyses because the time period evaluated was shorter (4 vs 10 years) which resulted in fewer cancer cases. As a result, although some of the RR's in this investigation were of a similar or greater magnitude than those in the prior study (e.g.: colon cancer among men), the interpretation of the RR's was made more difficult because of low power. As a result, using the RR alone, it is uncertain whether some of the moderately elevated RR's are in fact indicative of a true increase in the rate of cancer or simply due to natural variation in cancer rates over time.

Patterns in the RR's, the consistency of findings, and the trend analyses help somewhat in the interpretation of cancer incidence rates and RR's as they point out areas where there has been either a persistent elevation relative to other areas from one time period to the next or a significant change over time. As noted previously, the patterns of cancer incidence in Staten Island do not indicate that rates of cancer in communities nearer the landfill are elevated. Trend analyses, however, are probably not sensitive enough to detect recent changes (for example in the past 2-3 years) in cancer incidence patterns unless they are relatively large.

2) No information was available about individual risk factors for cancer, such as environmental, lifestyle or occupational risk factors, or family history of cancer. Cancers can be caused by a variety of factors. It is usually necessary to know about each of these factors for each individual in order to judge the environmental relatedness of cancer. In the absence of detailed information about environmental exposures, the distance from the landfill was used as a proxy measure for exposure. Based on this measure, there was no evidence that persons nearer the landfill had significantly higher cancer rates or different cancer incidence trends than those further away.

Overall, smoking related cancers (lung, bladder, pancreas) were again among those cancers with the strongest (those with the highest RR's) and most consistent (seen in many comparisons) findings. Some of the patterns and trends noted, particularly in lung, bladder and pancreatic cancers, may be indicative of either a differential distribution of smoking patterns across the City (for example Staten Islanders may smoke more or may have ceased smoking later–which may explain some of the differences in trends noted between Staten Island and the Rest of the City) or of some additional risk factor for these cancers which is not present elsewhere in the City. However, it is not possible to rule out smoking as a significant factor in cancer causation on Staten Island.

3) Changes in the population over time through in and out migration effects the estimation of cancer rates in an area, the estimation of latency periods, and, hence, the subsequent estimates of who was potentially exposed to the landfills and for how long. Latency is the period of time that elapses between a carcinogenic exposure or event and the development of cancer. In adults, the latency periods for most cancers are thought to be at least 20 years–and for many cancers is much longer. Childhood cancers are thought to have shorter latency periods. To take into account the exposure and latency period for cancers in the Study Area, for example, it would be necessary to be sure that persons who developed cancer in the Study Area had lived there well prior to the development of their cancers. The data used in this investigation only records the address where a person lived when he/she was diagnosed In reality, persons may have moved into the Study Area and been diagnosed with cancer shortly thereafter or moved from the Study Area and been diagnosed with cancer shortly thereafter As noted above, since information about individual histories was not available in this study, it was not possible to take latency into account.

Population estimates, migration shifts and the underlying socio-demographic factors that accompany them not only play a significant role in the calculation of cancer incidence rates, but in the observed variation in cancer rates around the City. As noted in the previous study, Staten Island in general and the Study Area in particular have a much higher proportion of white non- Hispanic population than the rest of the City, and a somewhat higher proportion than Bay Ridge/Flushing. White populations historically have higher rates of bladder cancer and breast cancer. Therefore, differences in race/ethnicity between Staten Island and the comparison communities could be partially responsible for elevated RR's noted in these cancers. It is interesting to note that data for New York City from the NYSDOH 1995 Statewide Behavioral Risk Factor Survey (BRFS) indicate that white residents of New York City are 70% more likely to report a history of smoking than black residents. The differences in reported smoking histories between white City residents and black City residents could account for much of the moderate excesses noted in smoking related cancers[1]. Unfortunately, because the survey was Citywide, it was not possible to obtain borough-specific estimates of smoking history.

[1]Axelson, O. Steenland, K. Indirect methods of assessing the effects of tobacco use in occupational studies *Am J Ind Med*; 13(1):105-18

V. CONCLUSIONS & RECOMMENDATIONS

A. Conclusions

This investigation allowed us to continue the assessment of cancer rates and patterns on Staten Island. The addition of trend analyses in this update provided important information about the direction of cancer incidence rates during the 15 year period from 1978-1992 and how they compared to other areas.

Taken together, when cancer incidence trends are evaluated in combination with the patterns of findings for the RR's in this investigation and the prior investigation, these analyses do not indicate consistent evidence of an elevation in cancer rates that is specific to the landfill area. For the majority of cancer sites, rates in the Study Area were lower than, or equivalent to, rates in the rest of Staten Island. The moderate elevations noted for leukemia among children and CNS cancer among men and women during this time period were of an opposite pattern from those noted during the previous study period, so could represent natural variation in rates over time.

These additional analyses also indicate that cancer incidence for most cancers on Staten Island as a whole was not significantly different than elsewhere in the City. Also, trends in cancer incidence on Staten Island are not significantly different from those elsewhere in the City for most sites. Importantly, children on Staten Island had significantly lower rates of cancer than children in the rest of the City. However, for the time period evaluated in these analyses there continue to be statistically significant elevations for some adult cancer sites on Staten Island and several of these cancers also have trends that are statistically significantly different from the comparison areas for the 15 year time period evaluated.

In conjunction with the prior study findings, these analyses provide fairly consistent evidence of a continuing moderate elevation in lung and bladder cancer among men and women and breast cancer in women in Staten Island. These analyses also point out other areas of potential concern, primarily pancreatic cancer and to a lesser degree, adult leukemia. Because of the limitations of the study approach it is impossible to rule in or out with 100% certainty the role of environmental, lifestyle or other cancer risk factors.

B. Recommendations

The New York City Department of Health makes the following recommendations:

1) Risk assessment and Risk reduction:

- Study past risk factors to better understand current cancer incidence patterns in Staten Island.

- Assess current exposure to risk factors among Staten Island residents.
- Based on the findings of this assessment, take measures that will reduce risk exposure and prevent cancer. Create screening programs for Staten Island residents that will allow detection of cancer early.

Toward these goals, in accordance with the recommendations of Staten Island Expert Panel and Scientific Advisory Committee, NYCDOH is seeking a consultant to work with the Department to develop a comprehensive cancer risk profile, a cancer health promotion and risk reduction program for Staten Island residents, and an in-depth epidemiologic study of lung cancer to determine causal factors for lung cancer on Staten Island.

2) NYCDOH will continue to assess rates and trends of leukemia, lymphoma and CNS cancer near the Landfills when new census data are available and the Cancer Registry has made available at least five additional years of cancer data.

3) NYCDOH will also continue to update cancer analyses for Staten Island as a whole as additional data become available. The development of a number of nation- and Citywide programs is in progress which will also serve Staten Island communities. Under the Turning Point Initiative, a national initiative sponsored by Robert Wood Johnson and W.K. Kellogg Foundations to foster partnership between community and government for the improvement of public health, NYCDOH has conducted analyses for selected cancer types up to the year 1993 by ZIP code and HSA Neighborhood. Further, NYCDOH is analyzing more recent disease data for community health profiles. Analyses of data for selected types of cancer for the years 1992 to 1996 for NYC boroughs and neighborhoods will be included in the first series of profiles. These profiles will be updated in the future. In addition, NYCDOH has started to analyze cancer incidence data up to the year 1996 for a Citywide cancer incidence profile.

APPENDIX A

TABLES A1-A12

CANCER INCIDENCE 1989-1992

Table A1
STATEN ISLAND CANCER INCIDENCE

MEN IN THE STUDY AREA COMPARED TO MEN IN THE REST OF STATEN ISLAND
SELECTED CANCER TYPES: RATE RATIOS (RRs) FOR 1979-1988, AND RRs FOR 1989-92 WITH 95% CONFIDENCE INTERVALS, ACTUAL POWER TO ASCERTAIN STATISTICAL DIFFERENCE AND RRs THAT WOULD BE STATISTICALLY SIGNIFICANT WITH AT LEAST 80 PERCENT CERTAINTY

STUDY PERIOD		1979-1988		1989-1992			
POPULATION	CANCER TYPE	RATIO OF RATES	95% CONFIDENCE INTERVAL	RATIO OF RATES	95% CONFIDENCE INTERVAL	% POWER	RR NEEDED FOR 80% POWER
MEN (ages 15 and older)	Pharynx	0.57-	0.44-0.72	0.52-	0.38-0.71	-	-
	Stomach	0.95	0.64-1.39	0.72	0.47-1.12	-	-
	Colon	0.97	0.79-1.19	0.86	0.65-1.14	-	-
	Pancreas	1.04	0.68-1.60	1.20	0.67-2.15	12	1.80 - 1.85
	Lung	0.90	0.78-1.03	0.75-	0.63-0.89	-	-
	Prostate	0.96	0.79-1.15	0.99	0.81-1.22	-	-
	Bladder	1.00	0.79-1.27	1.41	0.90-2.20	55	1.55 - 1.60
	Kidney	1.31	0.78-2.18	1.06	0.62-1.80	4	1.85
	Lymphoma	0.94	0.70-1.26	0.86	0.60-1.22	-	-
	Leukemia	0.88	0.57-1.37	0.64-	0.44-0.94	-	-
	Liver	0.99	0.52-1.89	0.75	0.39-1.42	-	-
	Larynx	0.93	0.63-1.36	1.04	0.54-2.01	3	2.00 - 2.05
	Nervous System	0.85	0.54-1.34	0.85	0.48-1.50	-	-
	Multiple Myeloma	0.50-	0.33-0.75	1.19	0.42-3.43	7	2.65

* Statistically significantly elevated ratio - Statistically significantly lower rate ratio

Table A2
STATEN ISLAND CANCER INCIDENCE

WOMEN IN THE STUDY AREA COMPARED TO WOMEN IN THE REST OF STATEN ISLAND SELECTED CANCER TYPES: RATE RATIOS (RRs) FOR 1979-1988, AND RRs FOR 1989-92 WITH 95% CONFIDENCE INTERVALS, ACTUAL POWER TO ASCERTAIN STATISTICAL DIFFERENCE AND RRs THAT WOULD BE STATISTICALLY SIGNIFICANT WITH AT LEAST 80 PERCENT CERTAINTY

STUDY PERIOD		1979-1988		1989-1992			
POPULATION	CANCER TYPE	RATIO OF RATES	95% CONFIDENCE INTERVAL	RATIO OF RATES	95% CONFIDENCE INTERVAL	% POWER	RR NEEDED FOR 80% POWER
Women (Ages 15 and over)	Pharynx	0.48 -	0.36-0.65	0.48 -	0.32-0.74	-	-
	Stomach	1.14	0.70-1.86	1.54	0.63-3.74	34	2.15
	Colon	0.92	0.76-1.11	1.01	0.75-1.36	-	-
	Pancreas	0.90	0.62-1.31	1.09	0.63-1.87	6	1.80 - 1.85
	Lung	1.09	0.88-1.35	0.85	0.69-1.05	-	-
	Breast	0.97	0.86-1.10	1.09	0.93-1.29	25	1.20 - 1.25
	Bladder	1.08	0.72-1.63	1.21	0.66-2.22	11	1.90
	Kidney	0.83	0.50-1.36	1.08	0.53-2.23	5	2.15
	Lymphoma	1.18	0.84-1.66	0.89	0.61-1.28	-	-
	Leukemia	1.24	0.72-2.14	0.68	0.41-1.13	-	-
	Liver	0.98	0.45-2.14	0.77	0.30-1.95	-	-
	Larynx	1.01	0.48-2.13	0.58	0.27-1.24	-	-
	Nervous System	0.57 -	0.38-0.86	2.21	0.51-9.56	63	2.55
	Multiple Myeloma	0.71	0.41-1.22	1.04	0.43-2.52	3	2.50

* Statistically significantly elevated ratio

\- Statistically significantly lower rate ratio

Table A3

STATEN ISLAND CANCER INCIDENCE

CHILDREN IN THE STUDY AREA COMPARED TO CHILDREN IN THE REST OF STATEN ISLAND
SELECTED CANCER TYPES: RATE RATIOS (RRs) FOR 1979-1988, AND RRs FOR 1989-92 WITH 95% CONFIDENCE INTERVALS, ACTUAL POWER TO ASCERTAIN STATISTICAL DIFFERENCE AND RRs THAT WOULD BE STATISTICALLY SIGNIFICANT WITH AT LEAST 80 PERCENT CERTAINTY

STUDY PERIOD		1979-1988		1989-1992			
POPULATION	CANCER TYPE	RATIO OF RATES	95% CONFIDENCE INTERVAL	RATIO OF RATES	95% CONFIDENCE INTERVAL	% POWER	RR NEEDED FOR % POWER
CHILDREN	Lymphoma	1.38	0.26 - 7.19	1.25	0.06 - 25.27	1	11.5
	Leukemia	0.80	0.41 - 1.58	2.50	0.08 - 80.45	20	5.5
	Nervous System	0.92	0.36 - 2.32	No cases in Study Area	N/A	-	-

Table A4
STATEN ISLAND CANCER INCIDENCE

MEN IN THE STUDY AREA COMPARED TO MEN IN BAY RIDGE AND FLUSHING COMBINED
SELECTED CANCER TYPES: RATE RATIOS (RRs) FOR 1979-1988, AND RRs FOR 1989-92 WITH 95% CONFIDENCE INTERVALS, ACTUAL POWER TO ASCERTAIN STATISTICAL DIFFERENCE AND RRs THAT WOULD BE STATISTICALLY SIGNIFICANT WITH AT LEAST 80 PERCENT CERTAINTY

STUDY PERIOD		1979-1988		1989-1992			
POPULATION	CANCER TYPE	RATIO OF RATES	95% CONFIDENCE INTERVAL	RATIO OF RATES	95% CONFIDENCE INTERVAL	% POWER	RR NEEDED FOR 80% POWER
MEN (ages 15 and older)	Pharynx	0.91	0.62-1.34	0.84	0.52-1.36	-	-
	Stomach	0.85	0.61-1.18	0.75	0.49-1.16	-	-
	Colon	1.05	0.85-1.29	0.94	0.70-1.26	-	-
	Pancreas	1.04	0.69-1.57	1.59	0.76-3.30	54	1.90
	Lung	1.32*	1.09-1.60	1.10	0.87-1.41	14	1.30 - 1.35
	Prostate	0.96	0.80-1.14	1.21	0.95-1.55	45	1.30 - 1.35
	Bladder	1.08	0.85-1.38	1.70*	1.04-2.79	91	-
	Kidney	1.18	0.77-1.83	1.04	0.64-1.68	4	1.80
	Lymphoma	0.90	0.69-1.17	1.04	0.69-1.56	5	1.60
	Leukemia	0.85	0.57-1.27	1.16	0.60-2.25	9	2.05
	Liver	1.26	0.58-2.75	0.74	0.41-1.34	-	-
	Larynx	1.46	0.82-2.62	1.31	0.60-2.89	17	2.05
	Nervous System	0.93	0.58-1.50	1.25	0.56-2.81	11	2.20
	Multiple Myeloma	0.58-	0.37-0.93	1.47	0.43-5.01	17	2.70 - 2.75

* Statistically significantly elevated ratio - Statistically significantly lower rate ratio

Table A5
STATEN ISLAND CANCER INCIDENCE

WOMEN IN THE STUDY AREA COMPARED TO WOMEN IN BAY RIDGE AND FLUSHING COMBINED SELECTED CANCER TYPES: RATE RATIOS (RRs) FOR 1979-1988, AND RRs FOR 1989-92 WITH 95% CONFIDENCE INTERVALS, ACTUAL POWER TO ASCERTAIN STATISTICAL DIFFERENCE AND RRs THAT WOULD BE STATISTICALLY SIGNIFICANT WITH AT LEAST 80 PERCENT CERTAINTY

STUDY PERIOD		1979-1988		1989-1992			
POPULATION	CANCER TYPE	RATIO OF RATES	95% CONFIDENCE INTERVAL	RATIO OF RATES	95% CONFIDENCE INTERVAL	% POWER	RR NEEDED FOR 80% POWER
Women (Ages 15 and over)	Pharynx	0.73	0.47-1.14	0.62	0.36-1.05	-	-
	Stomach	1.04	0.69-1.59	1.46	0.67-3.17	31	2.00
	Colon	1.03	0.84-1.25	1.14	0.83-1.56	17	1.45 - 1.50
	Pancreas	0.87	0.62-1.23	1.58	0.75-3.33	51	1.90 - 1.95
	Lung	1.32 *	1.04-1.69	1.20	0.90-1.59	33	1.40
	Breast	0.95	0.85-1.06	1.29 *	1.08-1.55	94	-
	Bladder	1.18	0.77-1.79	1.32	0.71-2.45	21	1.85
	Kidney	0.78	0.50-1.22	0.99	0.54-1.83	-	-
	Lymphoma	1.11	0.82-1.50	1.05	0.70-1.59	4	1.65 - 1.70
	Leukemia	1.31	0.76-2.25	1.04	0.50-2.17	5	2.20
	Liver	1.22	0.48-3.11	0.78	0.32-1.93	-	-
	Larynx	1.58	0.52-4.81	0.92	0.29-2.97	-	-
	Nervous System	0.64	0.41-1.00	1.70	0.65-4.47	42	2.20 - 2.25
	Multiple Myeloma	0.80	0.45-1.44	1.53	0.45-5.17	21	2.70 - 2.75

* Statistically significantly elevated ratio

Table A6

STATEN ISLAND CANCER INCIDENCE

CHILDREN IN THE STUDY AREA COMPARED TO CHILDREN IN BAY RIDGE AND FLUSHING COMBINED

SELECTED CANCER TYPES: RATE RATIOS (RRs) FOR 1979-1988, AND RRs FOR 1989-92 WITH 95% CONFIDENCE INTERVALS, ACTUAL POWER TO ASCERTAIN STATISTICAL DIFFERENCE AND RRs THAT WOULD BE STATISTICALLY SIGNIFICANT WITH AT LEAST 80 PERCENT CERTAINTY

STUDY PERIOD		1979-1988		1989-1992			
POPULATION	CANCER TYPE	RATIO OF RATES	95% CONFIDENCE INTERVAL	RATIO OF RATES	95% CONFIDENCE INTERVAL	% POWER	RR NEEDED FOR 80% POWER
CHILDREN	Lymphoma	1.10	0.34 - 3.62	0.83	0.14 - 4.84	-	-
	Leukemia	0.67	0.39 - 1.13	1.00	0.34 - 2.92	-	-
	Nervous System	0.73	0.37 - 1.44	No cases in Study Area	N/A	-	-

Table A7
STATEN ISLAND CANCER INCIDENCE

MEN IN STATEN ISLAND COMPARED TO MEN IN BAY RIDGE AND FLUSHING COMBINED SELECTED CANCER TYPES: RATE RATIOS (RRs) FOR 1979-1988, AND RRs FOR 1989-92 WITH 95% CONFIDENCE INTERVALS, ACTUAL POWER TO ASCERTAIN STATISTICAL DIFFERENCE AND RRs THAT WOULD BE STATISTICALLY SIGNIFICANT WITH AT LEAST 80 PERCENT CERTAINTY

STUDY PERIOD		1979-1988		1989-1992			
POPULATION	CANCER TYPE	RATIO OF RATES	95% CONFIDENCE INTERVAL	RATIO OF RATES	95% CONFIDENCE INTERVAL	% POWER	RR NEEDED FOR 80% POWER
MEN (Ages 15 and older)	Pharynx	1.48*	1.19-1.85	1.45*	1.05-2.02	90	-
	Stomach	0.89	0.77-1.02	0.99	0.78-1.25	-	-
	Colon	1.07	0.98-1.17	1.07	0.92-1.24	10	1.20 - 1.25
	Pancreas	1.00	0.85-1.19	1.38	0.99-1.91	79	-
	Lung	1.44*	1.32-1.57	1.41*	1.23-1.61	100	-
	Prostate	1.00	0.92-1.08	1.23*	1.10-1.39	99	-
	Bladder	1.09	0.98-1.21	1.29*	1.05-1.59	88	-
	Kidney	0.94	0.80-1.11	1.00	0.79-1.28	-	-
	Lymphoma	0.94	0.83-1.07	1.18	0.95-1.47	51	1.30
	Leukemia	0.94	0.79-1.13	1.68*	1.09-2.59	97	-
	Liver	1.27	0.90-1.79	0.94	0.66-1.32	-	-
	Larynx	1.55*	1.18-2.02	1.29	0.88-1.88	43	1.50 - 1.55
	Nervous System	1.07	0.84-1.37	1.43	0.90-2.27	62	1.55 - 1.60
	Multiple Myeloma	1.09	0.80-1.48	1.30	0.75-2.24	25	1.75 - 1.80

* Statistically significantly elevated ratio

Table A8
STATEN ISLAND CANCER INCIDENCE

WOMEN IN STATEN ISLAND COMPARED TO WOMEN IN BAY RIDGE AND FLUSHING COMBINED SELECTED CANCER TYPES: RATE RATIOS (RRs) FOR 1979-1988, AND RRs FOR 1989-92 WITH 95% CONFIDENCE INTERVALS, ACTUAL POWER TO ASCERTAIN STATISTICAL DIFFERENCE AND RRs THAT WOULD BE STATISTICALLY SIGNIFICANT WITH AT LEAST 80 PERCENT CERTAINTY

STUDY PERIOD		1979-1988		1989-1992			
POPULATION	CANCER TYPE	RATIO OF RATES	95% CONFIDENCE INTERVAL	RATIO OF RATES	95% CONFIDENCE INTERVAL	% POWER	RR NEEDED FOR 80% POWER
Women (Ages 15 and over)	Pharynx	1.39*	1.04-1.85	1.16	0.79-1.69	14	1.55
	Stomach	0.93	0.79-1.09	1.04	0.78-1.40	5	1.45
	Colon	1.10*	1.01-1.20	1.14	0.98-1.33	54	1.20 - 1.25
	Pancreas	0.95	0.81-1.10	1.46 *	1.03-2.06	85	-
	Lung	1.23*	1.11-1.37	1.37 *	1.17-1.60	100	-
	Breast	0.98	0.93-1.03	1.21 *	1.11-1.33	100	-
	Bladder	1.10	0.92-1.32	1.16	0.88-1.53	21	1.40
	Kidney	0.92	0.74-1.14	0.91	0.69-1.21	-	-
	Lymphoma	0.97	0.85-1.10	1.17	0.92-1.48	28	1.30 - 1.35
	Leukemia	1.08	0.87-1.33	1.50	0.95-2.38	73	1.55
	Liver	1.24	0.82-1.88	0.96	0.60-1.54	-	-
	Larynx	1.56	0.92-2.65	1.48	0.62-3.51	27	2.15
	Nervous System	1.04	0.80-1.35	0.98	0.68-1.41	-	-
	Multiple Myeloma	1.08	0.80-1.45	1.43	0.80-2.56	43	1.75

* Statistically significantly elevated ratio

Table A9

STATEN ISLAND CANCER INCIDENCE

CHILDREN IN STATEN ISLAND COMPARED TO CHILDREN IN BAY RIDGE AND FLUSHING COMBINED

SELECTED CANCER TYPES: RATE RATIOS (RRs) FOR 1979-1988, AND RRs FOR 1989-92 WITH 95% CONFIDENCE INTERVALS, ACTUAL POWER TO ASCERTAIN STATISTICAL DIFFERENCE AND RRs THAT WOULD BE STATISTICALLY SIGNIFICANT WITH AT LEAST 80 PERCENT CERTAINTY

STUDY PERIOD		1979-1988		1989-1992			
POPULATION	CANCER TYPE	RATIO OF RATES	95% CONFIDENCE INTERVAL	RATIO OF RATES	95% CONFIDENCE INTERVAL	% POWER	RR NEEDED FOR 80% POWER
CHILDREN	Lymphoma	0.88	0.47 - 1.67	0.71	0.27 - 1.91	-	-
	Leukemia	0.79	0.56 - 1.11	0.57 -	0.36 - 0.91	-	-
	Nervous System	0.77	0.51 - 1.18	0.61	0.34 - 1.10	-	-

Table A10
STATEN ISLAND CANCER INCIDENCE

MEN IN STATEN ISLAND COMPARED TO THE REST OF NEW YORK CITY
SELECTED CANCER TYPES: RATE RATIOS (RRs) FOR 1979-1988, AND RRs FOR 1989-92 WITH 95% CONFIDENCE INTERVALS, ACTUAL POWER TO ASCERTAIN STATISTICAL DIFFERENCE AND RRs THAT WOULD BE STATISTICALLY SIGNIFICANT WITH AT LEAST 80 PERCENT CERTAINTY

STUDY PERIOD		1979-1988		1989-1992			
POPULATION	CANCER TYPE	RATIO OF RATES	95% CONFIDENCE INTERVALS	RATIO OF RATES	95% CONFIDENCE INTERVAL	% POWER	RR FOR 80% POWER
MEN (Ages 15 and older)	Pharynx	1.02	0.90-1.16	1.07	0.87-1.30	7	1.25 - 1.30
	Stomach	0.83 -	0.74-0.94	0.91	0.75-1.10	-	-
	Colon	1.12*	1.03-1.22	1.16*	1.01-1.33	63	1.20
	Pancreas	0.99	0.85-1.14	1.42*	1.07-1.88	87	-
	Lung	1.36*	1.27-1.46	1.27*	1.15-1.41	100	-
	Prostate	0.90 -	0.84-0.96	1.12*	1.02-1.23	63	1.10 - 1.15
	Bladder	1.34*	1.19-1.51	1.44*	1.18-1.76	100	-
	Kidney	1.04	0.88-1.22	1.17	0.92-1.49	26	1.35
	Lymphoma	0.95	0.85-1.06	1.04	0.89-1.22	9	1.20 - 1.25
	Leukemia	0.95	0.81-1.12	1.52*	1.11-2.09	93	-
	Liver	0.92	0.74-1.13	0.79	0.62-1.02	-	-
	Larynx	1.30*	1.08-1.57	1.03	0.80-1.33	6	1.35 - 1.40
	Nervous System	1.23	0.97-1.57	1.36	0.95-1.94	58	1.45 - 1.50
	Multiple Myeloma	0.84	0.68-1.04	1.01	0.71-1.43	-	-

* Statistically significantly elevated rate ratio - Statistically significantly lower rate ratio

Table A11
STATEN ISLAND CANCER INCIDENCE

WOMEN IN STATEN ISLAND COMPARED TO WOMEN IN THE REST OF NEW YORK CITY
SELECTED CANCER TYPES: RATE RATIOS (RRs) FOR 1979-1988, AND RRs FOR 1989-92 WITH 95% CONFIDENCE INTERVALS, ACTUAL POWER TO ASCERTAIN STATISTICAL DIFFERENCE AND RRs THAT WOULD BE STATISTICALLY SIGNIFICANT WITH AT LEAST 80 PERCENT CERTAINTY

STUDY PERIOD		1979-1988		1989-1992			
POPULATION	CANCER TYPE	RATIO OF RATES	95% CONFIDENCE INTERVAL	RATIO OF RATES	95% CONFIDENCE INTERVAL	% POWER	RR FOR 80% POWER
Women (Ages 15 and over)	Pharynx	1.18	0.96-1.44	0.97	0.74-1.26	-	-
	Stomach	0.88	0.77-1.01	0.85	0.69-1.04	-	-
	Colon	1.14 *	1.05-1.23	1.11	0.98-1.26	37	1.15 - 1.20
	Pancreas	0.99	0.86-1.14	1.20	0.95-1.52	45	1.30 - 1.35
	Lung	1.22 *	1.11-1.33	1.43 *	1.25-1.63	100	-
	Breast	1.10 *	1.05-1.16	1.25 *	1.16-1.36	100	-
	Bladder	1.25 *	1.05-1.49	1.43 *	1.07-1.93	86	-
	Kidney	0.98	0.80-1.19	1.05	0.79-1.40	5	1.40 - 1.45
	Lymphoma	1.17 *	1.02-1.34	1.17	0.96-1.42	38	1.25 - 1.3
	Leukemia	0.98	0.83-1.16	1.16	0.87-1.54	21	1.40
	Liver	1.04	0.77-1.40	0.83	0.58-1.17	-	-
	Larynx	1.30	0.91-1.87	0.89	0.59-1.34	-	-
	Nervous System	1.16	0.90-1.49	0.99	0.72-1.36	-	-
	Multiple Myeloma	0.85	0.69-1.04	0.97	0.70-1.34	-	-

* Statistically significantly elevated rate ratio

Table A12

STATEN ISLAND CANCER INCIDENCE

CHILDREN IN STATEN ISLAND COMPARED TO CHILDREN IN THE REST OF NEW YORK CITY

SELECTED CANCER TYPES: RATE RATIOS (RRs) FOR 1979-1988, AND RRs FOR 1989-92 WITH 95% CONFIDENCE INTERVALS, ACTUAL POWER TO ASCERTAIN STATISTICAL DIFFERENCE AND RRs THAT WOULD BE STATISTICALLY SIGNIFICANT WITH AT LEAST 80 PERCENT CERTAINTY

STATEN ISLAND COMPARED TO THE REST OF NEW YORK CITY							
STUDY PERIOD		1979-1988		1989-1992			
POPULATION	CANCER TYPE	RATIO OF RATES	95% CONFIDENCE INTERVAL	RATIO OF RATES	95% CONFIDENCE INTERVAL	% POWER	RR FOR 80% POWER
CHILDREN (Ages 0 to 14)	Lymphoma	0.93	0.54 - 1.60	0.44 -	0.26 - 0.72	-	-
	Leukemia	0.89	0.64 - 1.22	0.43 -	0.32 - 0.59	-	-
	Nervous System	0.84	0.58 - 1.02	0.58 -	0.36 - 0.92	-	-

- Statistically significantly lower ratio

APPENDIX B

TABLES B1-B12

TRENDS IN CANCER INCIDENCE 1978-1992

Table B1

STATEN ISLAND CANCER INCIDENCE
TIME TRENDS FOR YEARLY RATES FROM 1978 TO 1992

		TREND IN STUDY AREA RATES		TREND IN REST OF STATEN ISLAND		SIGNIFICANCE OF DIFFERENCE BETWEEN SLOPES
	Cancer Type	Beta	p	Beta	p	p
Men	Pharynx	0.41551	0.4241	0.68019	0.0738	0.6695
	Stomach	*-1.46210	0.0434	0.49362	0.0731	0.0097
	Colon	-0.58218	0.6483	-1.11000	0.2109	0.7287
	Pancreas	0.76214	0.3251	*0.83777	0.0028	0.9234
	Lung	-1.54057	0.4896	0.51496	0.6364	0.4022
	Prostate	4.98479	0.1231	*5.92602	0.0078	0.7938
	Bladder	1.52140	0.3555	-0.54540	0.2126	0.2192
	Kidney	-0.05653	0.9395	0.22571	0.3953	0.7186
	Lymphoma	0.81777	0.2585	*1.30589	0.0015	0.5288
	Leukemia	-0.46361	0.4519	0.57322	0.2112	0.1729
	Liver	0.28263	0.4994	0.33014	0.0687	0.9147
	Larynx	-0.98285	0.1597	-0.34074	0.1558	0.3652
	Nervous System	0.33337	0.2659	*0.34299	0.0333	0.9763
	Multiple Myeloma	0.43916	0.2699	0.05581	0.07341	0.3625

* indicates significant change

Table B2

STATEN ISLAND CANCER INCIDENCE
TIME TRENDS FOR YEARLY RATES FROM 1978 TO 1992

		TREND IN STUDY AREA RATES		TREND IN BAY RIDGE AND FLUSHING COMBINED		SIGNIFICANCE OF DIFFERENCE BETWEEN SLOPES
	Cancer Type	Beta	p	Beta	p	p
Men	Pharynx	0.41550	0.4241	0.12224	0.4842	0.5857
	Stomach	*-1.46210	0.0434	-0.06917	0.7425	0.0524
	Colon	-0.58218	0.6483	-0.23609	0.6938	0.8036
	Pancreas	0.76214	0.3251	-0.08572	0.4241	0.2701
	Lung	-1.54057	0.4896	-0.68530	0.1253	0.7014
	Prostate	4.98479	0.1231	*3.45191	0.0029	0.6324
	Bladder	1.52140	0.3555	*-1.05255	0.0009	0.1213
	Kidney	-0.05653	0.9395	*0.47714	0.0117	0.4825
	Lymphoma	0.81777	0.2585	0.25584	0.3774	0.4584
	Leukemia	-0.46361	0.4519	*-0.63512	0.0063	0.7872
	Liver	0.28263	0.4994	0.23198	0.1149	0.9070
	Larynx	-0.98285	0.1597	-0.10683	0.4167	0.2033
	Nervous System	0.33337	0.2659	-0.02020	0.8263	0.2502
	Multiple Myeloma	0.43916	0.2699	-0.07768	0.3484	0.1959

*indicates significant change

Table B3

STATEN ISLAND CANCER INCIDENCE
TIME TRENDS FOR YEARLY RATES FROM 1978 TO 1992

		TREND IN THE STUDY AREA		TREND IN THE REST OF STATEN ISLAND		SIGNIFICANCE OF DIFFERENCE BETWEEN SLOPES
	Cancer Type	Beta	p	Beta	p	p
Women	Pharynx	0.08915	0.7812	0.14423	0.4398	0.8805
	Stomach	-0.47847	0.5010	-0.28802	0.1772	0.7935
	Colon	0.09592	0.9450	*-1.28619	0.0067	0.3398
	Pancreas	0.70195	0.2278	*0.49899	0.0145	0.7302
	Lung	*2.18169	0.0458	*2.79071	0.0001	0.5792
	Breast	*6.54040	0.0001	*4.60211	0.0007	0.2307
	Bladder	0.02344	0.9703	0.13810	0.2733	0.8567
	Kidney	0.49486	0.1006	0.12208	0.3986	0.2444
	Lymphoma	0.80623	0.2448	*0.74251	0.0098	0.9288
	Leukemia	-0.09177	0.7557	0.17216	0.2651	0.4233
	Liver	-0.19222	0.4271	0.03054	0.7399	0.3832
	Larynx	-0.26425	0.2293	0.05352	0.5402	0.1717
	Nervous System	0.60865	0.0565	-0.00277	0.9859	0.0745
	Multiple Myleoma	0.22437	0.3332	0.10700	0.4257	0.6535

* indicates significant trend

Table B4

STATEN ISLAND CANCER INCIDENCE
TIME TRENDS FOR YEARLY RATES FROM 1978 TO 1992

		TREND IN THE STUDY AREA		TREND IN BAY RIDGE AND FLUSHING		SIGNIFICANCE OF DIFFERENCE BETWEEN SLOPES
Study Group	Cancer Type	Beta	p	Beta	p	p
Women	Pharynx	0.08915	0.7812	0.06001	0.4068	0.9286
	Stomach	-0.47847	0.5010	-0.10504	0.4971	0.6021
	Colon	0.09592	0.9450	*-0.72793	0.0224	0.5592
	Pancreas	0.70195	0.2278	*-0.31508	0.0409	0.0869
	Lung	*2.18169	0.0458	*1.80504	0.0001	0.7106
	Breast	*6.54040	0.0001	0.93586	0.0947	0.0002
	Bladder	0.02344	0.9703	0.16452	0.1081	0.8230
	Kidney	0.49486	0.1006	*0.31687	0.0005	0.5424
	Lymphoma	0.80623	0.2448	-0.02317	0.9127	0.2425
	Leukemia	-0.09177	0.7557	*-0.23657	0.0069	0.6312
	Liver	-0.19222	0.4271	*0.15898	0.0094	0.1557
	Larynx	-0.26425	0.2293	0.01669	0.7839	0.2084
	Nervous System	0.60865	0.0565	0.14802	0.1472	0.1445
	Multiple Myeloma	0.22437	0.3332	-0.04932	0.4568	0.2495

* indicates significant trend

Table B5

STATEN ISLAND CANCER INCIDENCE
TIME TRENDS FOR YEARLY RATES FROM 1978 TO 1992

		TREND IN STUDY AREA RATES		TREND IN REST OF STATEN ISLAND		SIGNIFICANCE OF DIFFERENCE BETWEEN SLOPES
	Cancer Type	Beta	p	Beta	p	p
Children	Lymphoma	-0.05844	0.7514	-0.10394	0.2052	0.8189
	Leukemia	0.28199	0.2951	-0.13319	0.3085	0.1605
	CNS	-0.25434	0.1502	*0.15770	0.0411	0.0307

*indicates significant change

Table B6

STATEN ISLAND CANCER INCIDENCE
TIME TRENDS FOR YEARLY RATES FROM 1978 TO 1992

		TREND IN STUDY AREA RATES		TREND IN BAY RIDGE AND FLUSHING COMBINED		SIGNIFICANCE OF DIFFERENCE BETWEEN SLOPES
	Cancer Type	Beta	p	Beta	p	p
Children	Lymphoma	-0.05844	0.7514	0.03039	0.6392	0.6464
	Leukemia	0.28199	0.2951	-0.17628	0.2258	0.1303
	CNS	-0.25434	0.1502	0.13034	0.2117	0.0577

Table B7

STATEN ISLAND CANCER INCIDENCE
TIME TRENDS FOR YEARLY RATES FROM 1978 TO 1992

		TREND IN STATEN ISLAND RATES		TREND IN BAYRIDGE/FLUSHING		SIGNIFICANCE OF DIFFERENCE BETWEEN SLOPES
	Cancer Type	Beta	p	Beta	p	p
Men	Pharynx	0.54932	0.1090	0.11379	0.5231	0.2414
	Stomach	0.20687	0.3435	-0.07742	0.7108	0.3412
	Colon	-1.04900	0.1901	-0.24821	0.6841	0.4143
	Pancreas	*0.86949	0.0023	-0.07625	0.4962	0.0010
	Lung	0.16993	0.8625	-0.66378	0.1422	0.4350
	Prostate	*5.80335	0.0093	*3.39857	0.0029	0.2664
	Bladder	-0.16714	0.7078	*-1.05374	0.0010	0.0892
	Kidney	0.23518	0.3719	*0.47791	0.0130	0.4315
	Lymphoma	*1.20260	0.0020	0.27460	0.3453	0.0360
	Leukemia	0.39058	0.3191	*-0.64086	0.0047	0.0214
	Liver	* 0.30242	0.0381	*0.25664	0.0371	0.7915
	Larynx	*-0.40730	0.0220	-0.12766	0.3096	0.1693
	Nervous System	*0.34609	0.0079	-0.01638	0.8616	0.0181
	Multiple Myeloma	0.09754	0.4487	-0.06976	0.4052	0.2714

* indicates significant change

Table B8

STATEN ISLAND CANCER INCIDENCE
TIME TRENDS FOR YEARLY RATES FROM 1978 TO 1992

		TREND IN STATEN ISLAND RATES		TREND IN BAYRIDGE/FLUSHING		SIGNIFICANCE OF DIFFERENCE BETWEEN SLOPES
	Cancer Type	Beta	p	Beta	p	p
Women	Pharynx	0.12548	0.4144	0.06232	0.3816	0.7032
	Stomach	-0.26743	0.1074	-0.09495	0.5582	0.4424
	Colon	*-1.07603	0.0240	*-0.71480	0.0299	0.4877
	Pancreas	*0.52171	0.0095	*-0.30766	0.0463	0.0009
	Lung	*2.74510	0.0001	*1.83337	0.0001	0.0340
	Breast	*4.99501	0.0002	0.88317	0.1318	0.0010
	Bladder	0.14556	0.3334	0.16811	0.1116	0.8986
	Kidney	0.15498	0.2270	*0.31222	0.0006	0.2733
	Lymphoma	*0.79239	0.0081	-0.03353	0.8738	0.0181
	Leukemia	0.20698	0.0991	*-0.25742	0.0035	0.0023
	Liver	0.01343	0.8647	*0.15950	0.0092	0.1294
	Larynx	0.01523	0.8526	0.02027	0.7413	0.9604
	Nervous Stystem	0.13503	0.5685	0.15265	0.1414	0.9038
	Multiple Myeloma	0.11876	0.3144	-0.05568	0.3836	0.1885

* indicates significant change

Table B9

STATEN ISLAND CANCER INCIDENCE
TIME TRENDS FOR YEARLY RATES FROM 1978 TO 1992

		TREND IN STATEN ISLAND RATES		TREND IN BAYRIDGE/FLUSHING		SIGNIFICANCE OF DIFFERENCE BETWEEN SLOPES
	Cancer Type	Beta	p	Beta	p	p
Children	Lymphoma	-0.09106	0.2560	0.03039	0.6392	0.2328
	Leukemia	-0.02257	0.8702	-0.17628	0.2258	0.4349
	CNS	0.04413	0.5133	0.13034	0.2117	0.4752

*indicates significant change

Table B10

STATEN ISLAND CANCER INCIDENCE
TIME TRENDS FOR YEARLY RATES FROM 1978 TO 1992

		TREND IN STATEN ISLAND		TREND IN NYC		SIGNIFICANCE OF DIFFERENCE BETWEEN SLOPES
	Cancer Type	Beta	p	Beta	p	p
Men	Pharynx	0.54932	0.1090	0.08326	0.5504	0.1907
	Stomach	0.20687	0.3435	-0.15769	0.0673	0.1169
	Colon	-1.04900	0.1901	*-0.98416	0.0008	0.9354
	Pancreas	*0.86949	0.0023	*-0.26643	0.0001	0.0001
	Lung	0.16993	0.8625	*-0.45323	0.0471	0.5320
	Prostate	*5.80335	0.0093	*3.64766	0.0006	0.3065
	Bladder	-0.16714	0.7078	*-0.72046	0.0001	0.2366
	Kidney	0.23518	0.3719	*0.27489	0.0001	0.8795
	Lymphoma	*1.20260	0.0020	*1.15234	0.0001	0.8795
	Leukemia	0.39058	0.3191	*-0.22807	0.0192	0.1216
	Liver	*0.30242	0.0381	*0.33299	0.0001	0.8330
	Larynx	*-0.40730	0.0220	-0.01083	0.8573	0.0256
	Nervous System	*0.34609	0.0079	*0.12224	0.0004	0.0589
	Multiple Myeloma	0.09754	0.4487	-0.02577	0.5196	0.3545

* indicates significant trend

Table B11

STATEN ISLAND CANCER INCIDENCE
TIME TRENDS FOR YEARLY RATES FROM 1978 TO 1992

		TREND IN STATEN ISLAND RATES		TREND IN NYC		SIGNIFICANCE OF DIFFERENCE BETWEEN SLOPES
Study Group	Cancer Type	Beta	p	Beta	p	p
Women	Pharynx	0.12548	0.4144	*0.11102	0.0310	0.9268
	Stomach	-0.26743	0.1074	*-0.13156	0.0120	0.4067
	Colon	*-1.07603	0.0240	*-0.65945	0.0003	0.3555
	Pancreas	*0.52171	0.0095	-0.00772	0.8468	0.0058
	Lung	*2.74510	0.0001	*1.33096	0.0001	0.0008
	Breast	*4.99501	0.0002	*1.36764	0.0001	0.0011
	Bladder	0.14556	0.3334	*-0.11625	0.0284	0.0976
	Kidney	0.15498	0.2270	*0.19445	0.0001	0.7571
	Lymphoma	*0.79239	0.0081	*0.31889	0.0028	0.0893
	Leukemia	0.20698	0.0991	*-0.12176	0.0166	0.0139
	Liver	0.01343	0.8647	*0.11584	0.0044	0.2356
	Larynx	0.01523	0.8526	*0.07413	0.0307	0.4993
	Nervous System	0.13503	0.2273	*0.10650	0.0141	0.8026
	Multiple Myeloma	0.11876	0.3144	0.01603	0.6300	0.3921

* indicates significant trend

Table B12

STATEN ISLAND CANCER INCIDENCE
TIME TRENDS FOR YEARLY RATES FROM 1978 TO 1992

		TREND IN STATEN ISLAND RATES		TREND IN NYC		SIGNIFICANCE OF DIFFERENCE BETWEEN SLOPES
	Cancer Type	Beta	p	Beta	p	p
Children	Lymphoma	-0.09106	0.2560	0.05766	0.0588	0.0796
	Leukemia	-0.02257	0.8702	0.09824	0.0825	0.4129
	CNS	0.04413	0.5133	*0.06718	0.0458	0.7526

*indicates significant change

APPENDIX C

Figures 1 - 25

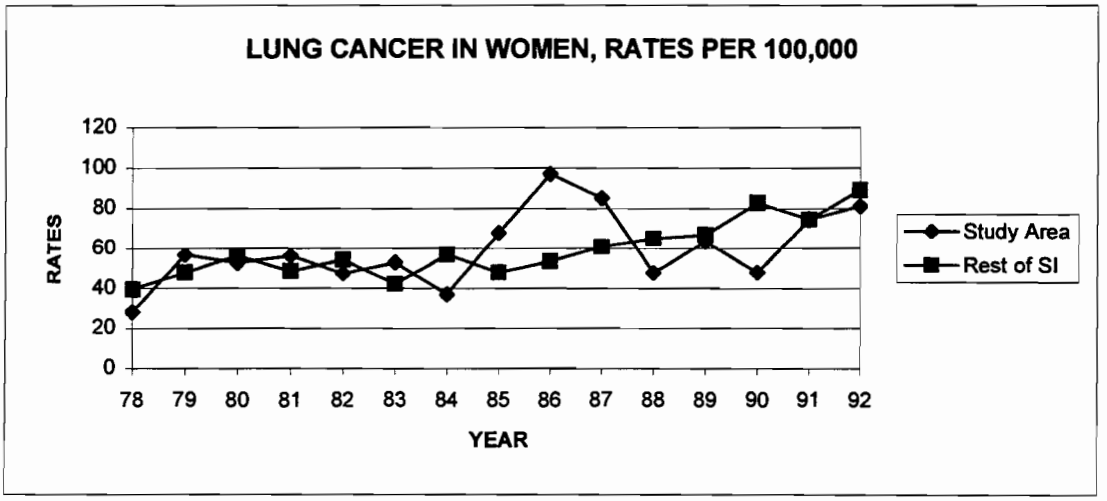
Graphic Presentations of Yearly Trend Data

Figure 1

STATEN ISLAND CANCER INCIDENCE 1978-1992, TREND ANALYSIS
ANNUAL AGE-ADJUSTED RATES FOR THE STUDY AREA AND THE REST OF STATEN ISLAND

LUNG CANCER IN WOMEN AGES 15 AND OLDER

Year	Study Area	Rest of SI
78	28.16	39.4
79	56.61	47.98
80	52.72	56.12
81	56.22	48.57
82	47.37	54.35
83	52.91	42.14
84	36.97	56.77
85	68	47.94
86	97.15	53.54
87	85.14	60.76
88	47.74	65.1
89	63.32	66.96
90	47.92	82.8
91	74.67	74.71
92	81.35	89.08



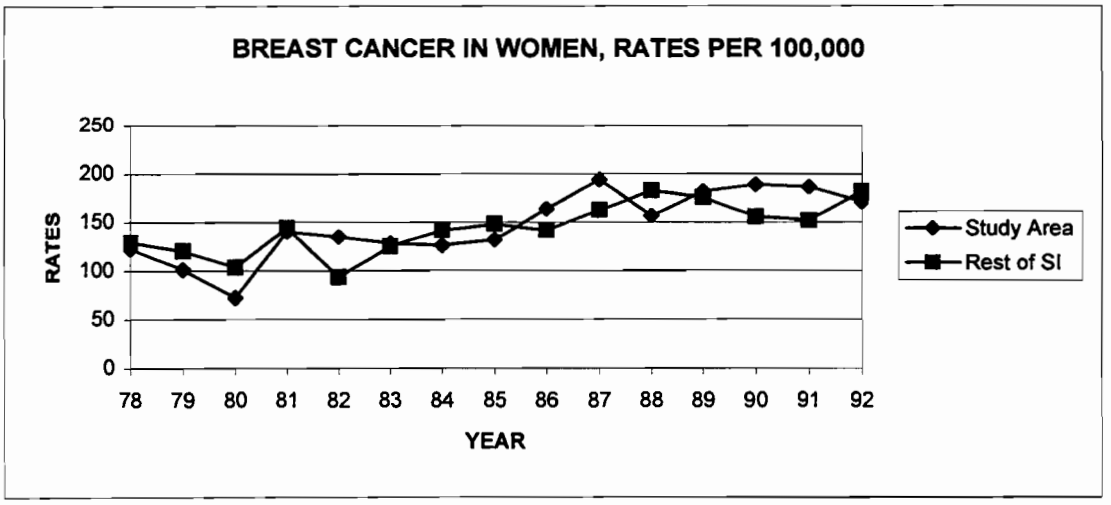
Trends: Study Area: beta=*2.18169, p=0.0458
Rest of Staten Island: beta=*2.79071, p=0.0001
Significance of difference between the two slopes: p=0.5792

Figure 2

STATEN ISLAND CANCER INCIDENCE 1978-1992, TREND ANALYSIS
ANNUAL AGE-ADJUSTED RATES FOR THE STUDY AREA AND THE REST OF STATEN ISLAND

BREAST CANCER IN WOMEN AGES 15 AND OLDER

Year	Study Area	Rest of SI
78	122.65	129.21
79	101.26	120.41
80	72.31	103.53
81	140.48	144.19
82	134.92	93.26
83	128.4	125.26
84	126.2	141.85
85	131.96	148.17
86	163.8	141.82
87	194.08	162.46
88	156.59	182.66
89	181.87	175.66
90	188.71	155.53
91	186.51	152.12
92	170.98	182.05



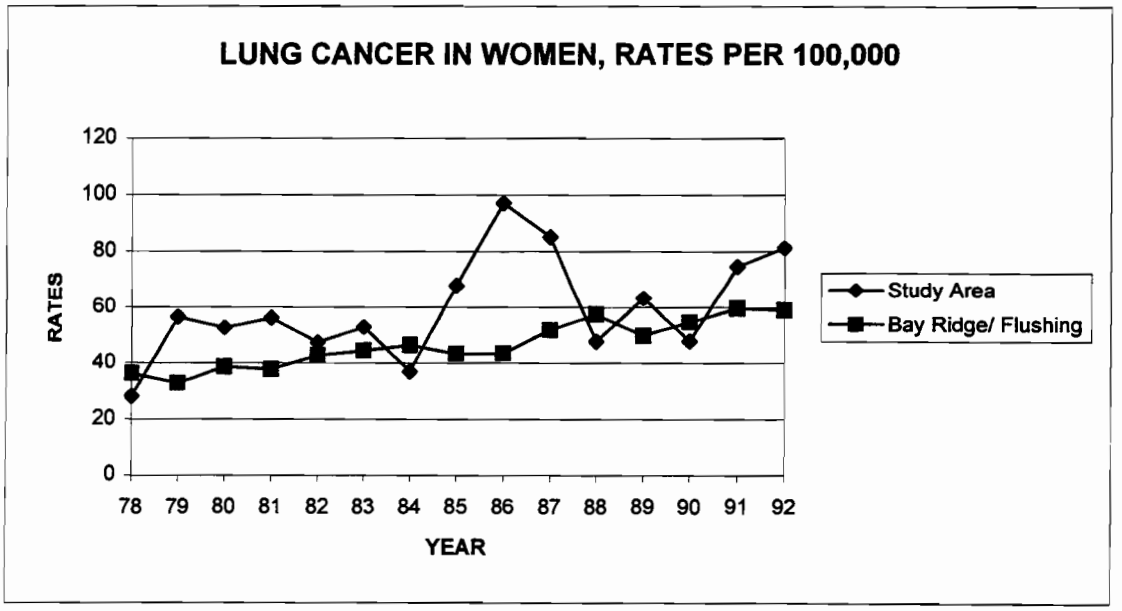
Trends: Study Area: beta=*6.54040, p=0.0001
Rest of Staten Island: beta=*4.60211, p=0.0007
Significance of difference between the two slopes: p=0.2307

Figure 3

STATEN ISLAND CANCER INCIDENCE 1978-1992, TREND ANALYSIS
ANNUAL AGE-ADJUSTED RATES FOR THE STUDY AREA IN BAY RIDGE AND FLUSHING

LUNG CANCER IN WOMEN AGES 15 AND OLDER

Year	Study Area	Bay Ridge/ Flushing
78	28.16	36.36
79	56.61	32.86
80	52.72	38.64
81	56.22	37.76
82	47.37	42.82
83	52.91	44.45
84	36.97	46.44
85	68	43.34
86	97.15	43.43
87	85.14	51.92
88	47.74	57.47
89	63.32	49.85
90	47.92	54.75
91	74.67	59.82
92	81.35	59.05



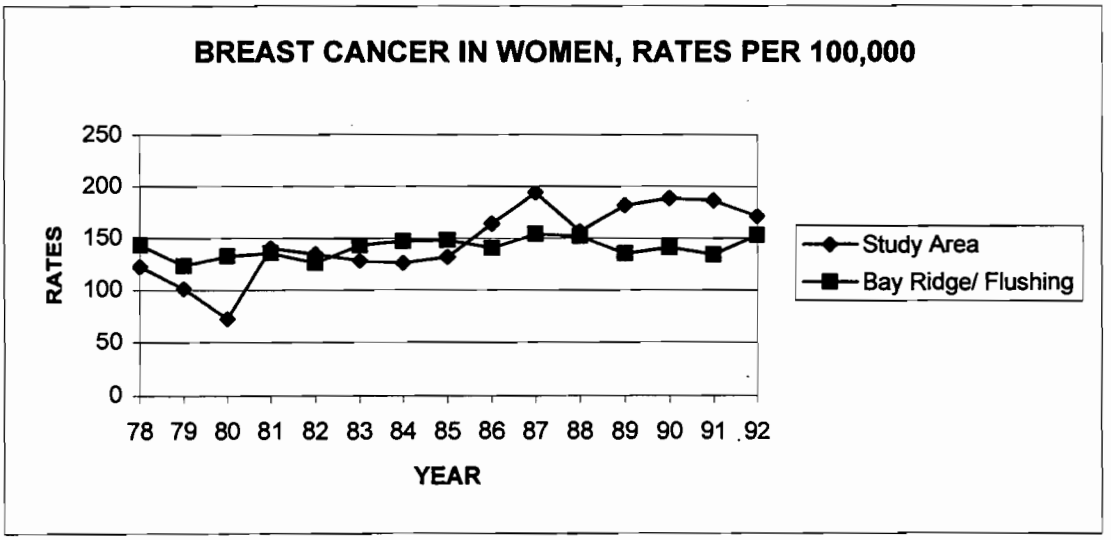
Trends: Study Area: beta=*2.18169, p=0.0458
Bay Ridge/Flushing: beta=*1.80504, p=0.0001
Significance of difference between the two slopes: p=0.7106

Figure 4

STATEN ISLAND CANCER INCIDENCE 1978-1992, TREND ANALYSIS
ANNUAL AGE-ADJUSTED RATES FOR THE STUDY AREA IN BAY RIDGE AND FLUSHING

BREAST CANCER IN WOMEN AGES 15 AND OLDER

Year	Study Area	Bay Ridge/ Flushing
78	122.65	143.37
79	101.26	123.37
80	72.31	132.59
81	140.48	135.7
82	134.92	126.22
83	128.4	143.25
84	126.2	147.12
85	131.96	148
86	163.8	140.44
87	194.08	153.98
88	156.59	151.76
89	181.87	135.18
90	188.71	140.98
91	186.51	134.19
92	170.98	152.78



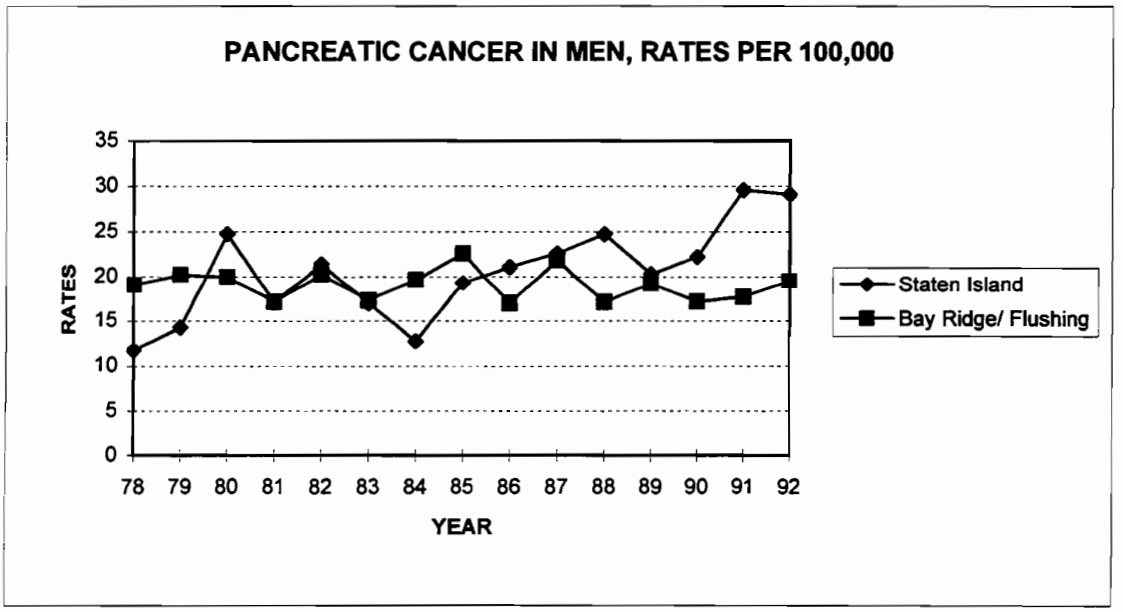
Trends: Study Area: beta=*6.54040, p=0.0001
Bay Ridge/Flushing: beta=0.93586, p=0.0947
Significance of difference between the two slopes: p=0.0002

Figure 5

STATEN ISLAND CANCER INCIDENCE 1978-1992, TREND ANALYSIS
ANNUAL AGE-ADJUSTED RATES FOR STATEN ISLAND AND BAY RIDGE/FLUSHING

PANCREATIC CANCER IN MEN AGES 15 AND OLDER

Year	Staten Island	Bay Ridge/ Flushing
78	11.76	19.06
79	14.29	20.24
80	24.76	19.97
81	17.04	17.14
82	21.39	20.27
83	16.99	17.29
84	12.74	19.66
85	19.29	22.57
86	21.07	16.96
87	22.62	21.81
88	24.74	17.08
89	20.3	19.15
90	22.2	17.15
91	29.62	17.69
92	29.13	19.52



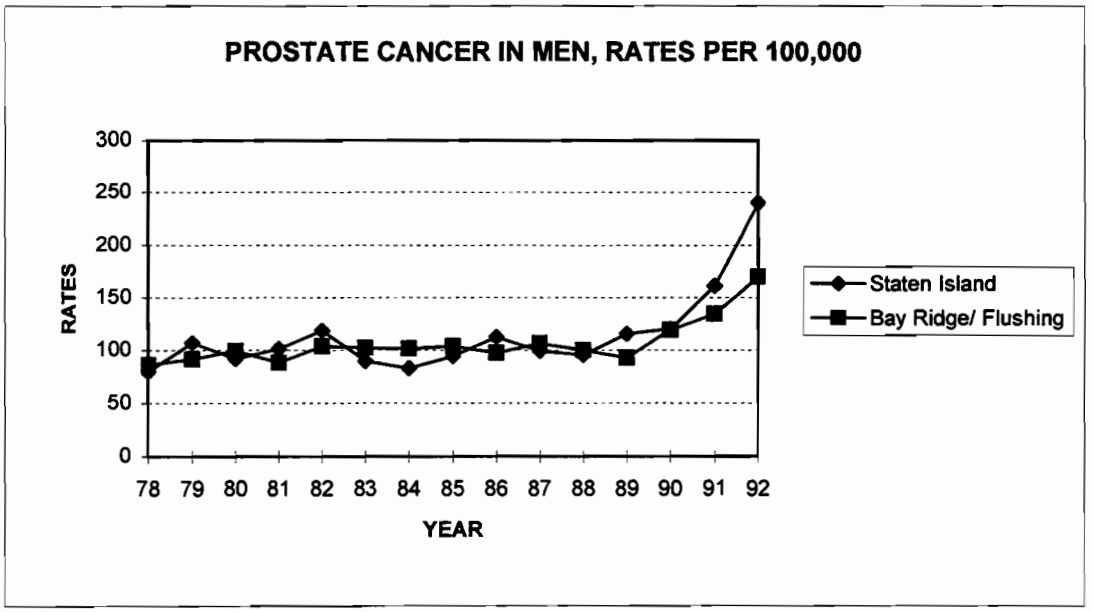
Trends: Staten Island: beta=*0.86949, p=0.0023
Bay Ridge/Flushing: beta=-0.07625, p=0.4962
Significance of difference between slopes: p=0.0010

Figure 6

STATEN ISLAND CANCER INCIDENCE 1978-1992, TREND ANALYSIS
ANNUAL AGE-ADJUSTED RATES FOR STATEN ISLAND AND BAY RIDGE/FLUSHING

PROSTATE CANCER IN MEN AGES 15 AND OLDER

Year	Staten Island	Bay Ridge/ Flushing
78	79.86	86.44
79	107.14	91.64
80	91.82	99.61
81	101.45	88.31
82	118.63	103.71
83	89.7	102.33
84	83.07	101.59
85	94.26	103.7
86	112.65	97.27
87	99.34	106.35
88	95.41	100.14
89	115.54	92.74
90	120.12	119.15
91	161.2	134.59
92	240.36	170.07



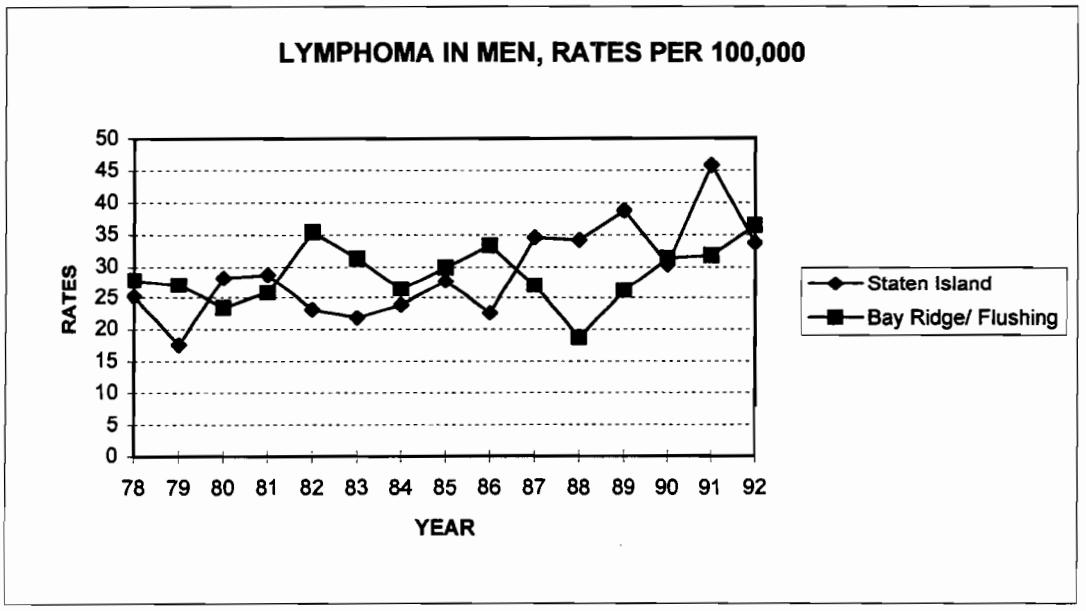
Trends: Staten Island: beta=*5.80335, p=0.0093
Bay Ridge/Flushing: beta=*3.39857, p=0.0029
Significance of difference between slopes: p=0.2664

Figure 7

STATEN ISLAND CANCER INCIDENCE 1978-1992, TREND ANALYSIS
ANNUAL AGE-ADJUSTED RATES FOR STATEN ISLAND AND BAY RIDGE/FLUSHING

LYMPHOMA IN MEN AGES 15 AND OLDER

Year	Staten Island	Bay Ridge/ Flushing
78	25.27	27.86
79	17.55	27.09
80	28.25	23.42
81	28.78	25.87
82	23.15	35.48
83	21.85	31.28
84	23.89	26.42
85	27.73	29.87
86	22.61	33.34
87	34.61	26.96
88	34.21	18.66
89	38.78	26.14
90	30.36	31.32
91	45.8	31.78
92	33.73	36.48



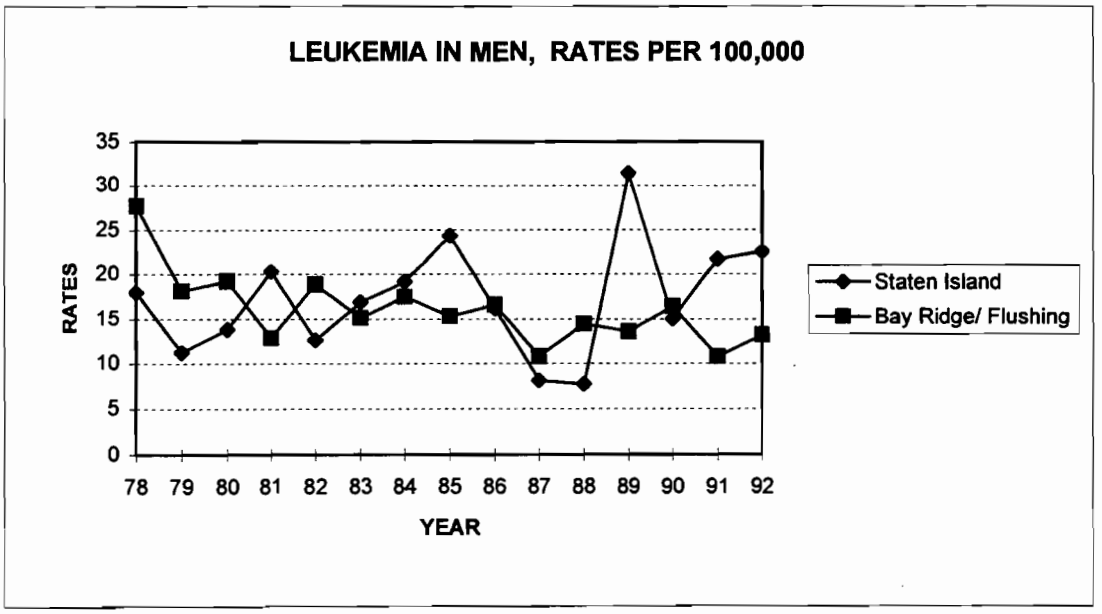
Trends: Staten Island: beta=*1.20260, p=0.0020
Bay Ridge/Flushing: beta= 0.27460, p=0.3453
Significance of difference between slopes: p=0.0360

Figure 8

STATEN ISLAND CANCER INCIDENCE 1978-1992, TREND ANALYSIS
ANNUAL AGE-ADJUSTED RATES FOR STATEN ISLAND AND BAY RIDGE/FLUSHING

LEUKEMIA IN MEN AGES 15 AND OLDER

Year	Staten Island	Bay Ridge/ Flushing
78	17.99	27.68
79	11.27	18.17
80	13.85	19.24
81	20.32	12.87
82	12.65	18.9
83	16.9	15.14
84	19.18	17.49
85	24.34	15.3
86	16.22	16.61
87	8.1	10.78
88	7.71	14.46
89	31.35	13.6
90	15.04	16.44
91	21.73	10.78
92	22.55	13.23



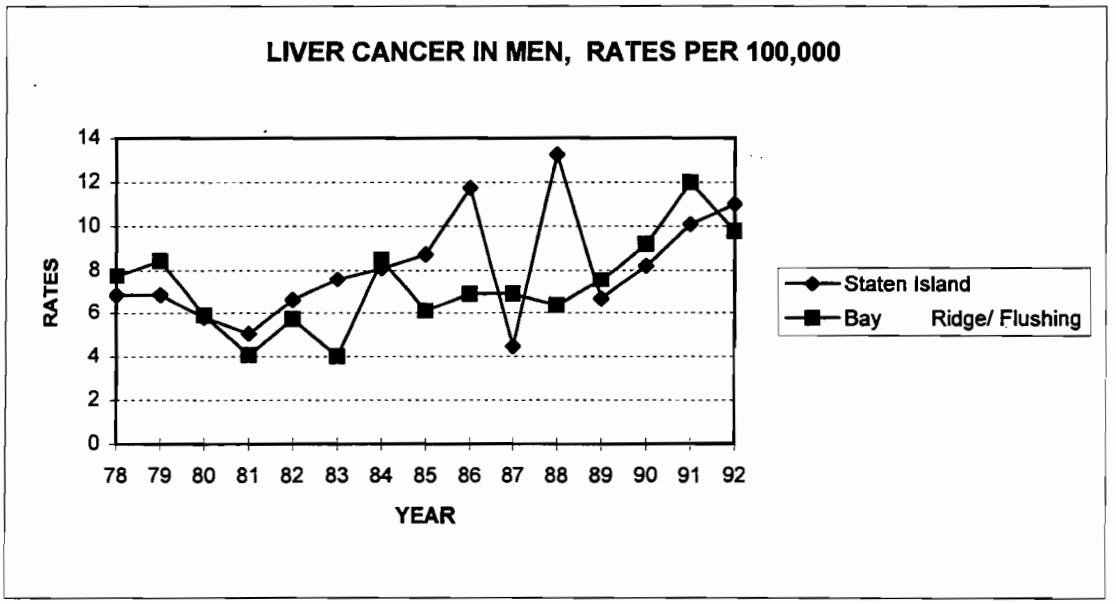
Trends: Staten Island: beta= 039058, p=0.3191
Bay Ridge/Flushing: beta=*-0.64086, p=0.0047
Significance of difference between slopes: p=0.0214

Figure 9

STATEN ISLAND CANCER INCIDENCE 1978-1992, TREND ANALYSIS
ANNUAL AGE-ADJUSTED RATES FOR STATEN ISLAND AND BAY RIDGE/FLUSHING

LIVER CANCER IN MEN AGES 15 AND OLDER

Year	Staten Island	Bay Ridge/ Flushing
78	6.83	7.74
79	6.84	8.43
80	5.8	5.89
81	5.06	4.06
82	6.6	5.73
83	7.57	4
84	8.08	8.48
85	8.73	6.11
86	11.73	6.88
87	4.47	6.89
88	13.26	6.36
89	6.66	7.52
90	8.2	9.18
91	10.09	11.98
92	11.01	9.76



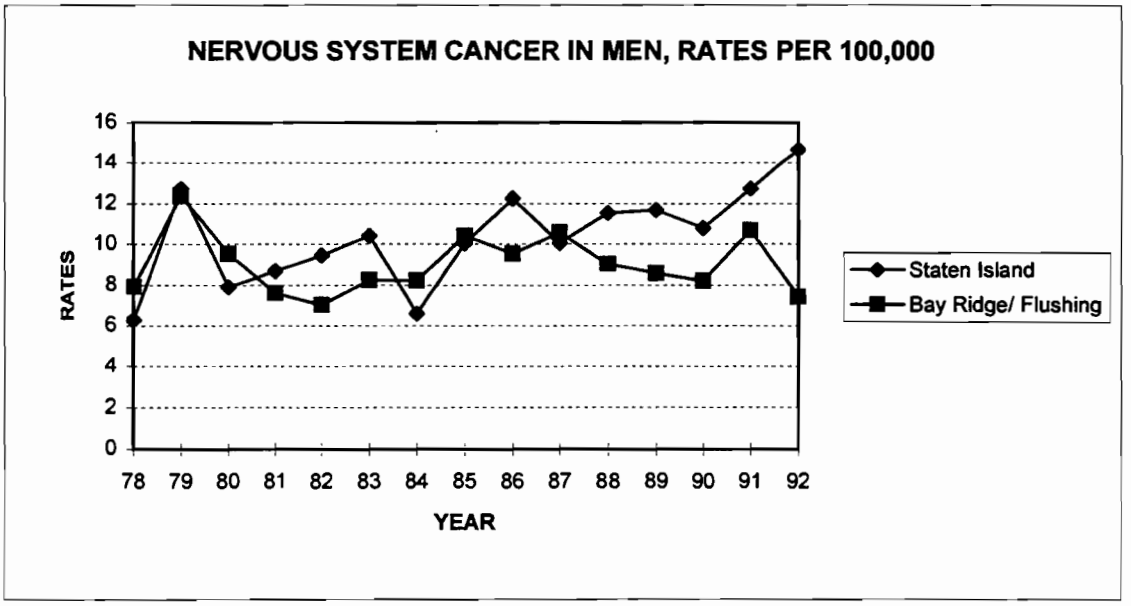
Trends: Staten Island: beta=*0.30242, p=0.0381
Bay Ridge/Flushing: beta=*0.25664, p=0.0371
Significance of difference between slopes: p=0.7915

Figure 10

STATEN ISLAND CANCER INCIDENCE 1978-1992, TREND ANALYSIS
ANNUAL AGE-ADJUSTED RATES FOR STATEN ISLAND AND BAY RIDGE/FLUSHING

CANCER OF THE CENTRAL NERVOUS SYSTEM IN MEN AGES 15 AND OLDER

Year	Staten Island	Bay Ridge/ Flushing
78	6.27	7.91
79	12.72	12.4
80	7.9	9.54
81	8.69	7.6
82	9.45	7.02
83	10.42	8.25
84	6.59	8.22
85	10.04	10.42
86	12.25	9.53
87	10.05	10.58
88	11.55	9.03
89	11.69	8.57
90	10.8	8.19
91	12.74	10.68
92	14.7	7.43



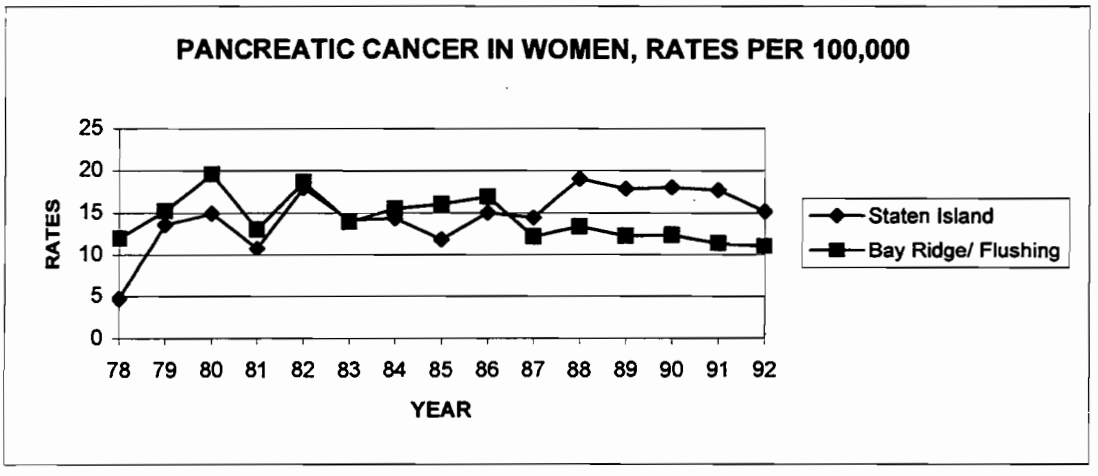
Trends: Staten Island: beta=*0.34609, p=0.0079
Bay Ridge/Flushing: beta=-0.01638, p=0.8616
Significance of difference between slopes: p=0.0181

Figure 11

STATEN ISLAND CANCER INCIDENCE 1978-1992, TREND ANALYSIS
ANNUAL AGE-ADJUSTED RATES FOR STATEN ISLAND, AND BAY RIDGE AND FLUSHING COMBINED

PANCREATIC CANCER IN WOMEN AGES 15 AND OLDER

Year	Staten Island	Bay Ridge/ Flushing
78	4.75	11.98
79	13.6	15.21
80	14.91	19.57
81	10.8	13.06
82	17.94	18.64
83	14.15	13.95
84	14.37	15.5
85	11.87	16.03
86	15.03	16.92
87	14.45	12.2
88	19.06	13.38
89	17.85	12.28
90	18	12.4
91	17.7	11.41
92	15.2	11.05



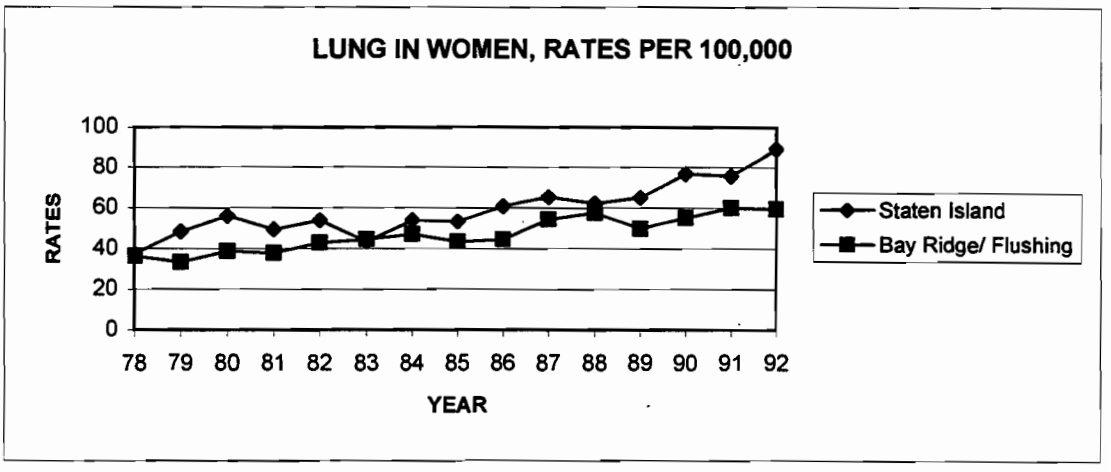
Trends: Staten Island: beta=*0.52171, p=0.0095
Bay Ridge/Flushing: beta=-*-0.30766, p=0.0463
Significance of difference between the two slopes: p=0.0009

Figure 12

STATEN ISLAND CANCER INCIDENCE 1978-1992, TREND ANALYSIS
ANNUAL AGE-ADJUSTED RATES FOR STATEN ISLAND, AND BAY RIDGE AND FLUSHING COMBINED

LUNG CANCER IN WOMEN AGES 15 AND OLDER

Year	Staten Island	Bay Ridge/ Flushing
78	37.51	36.38
79	48.25	33.4
80	55.92	38.64
81	49.42	37.76
82	53.75	42.82
83	43.47	44.45
84	53.9	47.24
85	53.23	43.34
86	60.85	44.54
87	65.31	54.35
88	62.21	57.72
89	65.1	49.85
90	76.88	55.1
91	75.77	60.03
92	88.94	59.37



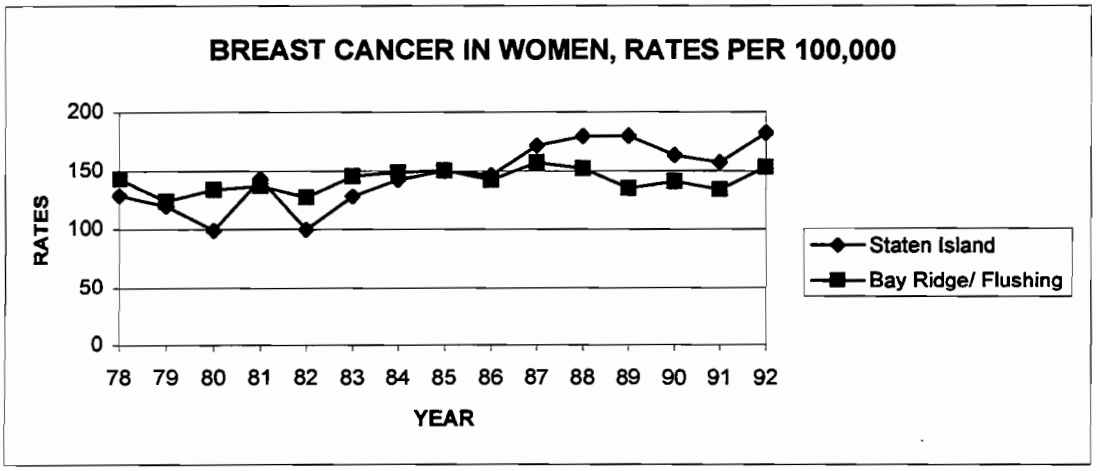
Trends: Staten Island: beta=*2.74510, p=0.0001
Bayridge/Flushing: beta=-*1.83337, p=0.0001
Significance of difference between the two slopes: p=0.0340

Figure 13

STATEN ISLAND CANCER INCIDENCE 1978-1992, TREND ANALYSIS
ANNUAL AGE-ADJUSTED RATES FOR THE REST OF STATEN ISLAND, AND BAY RIDGE AND FLUSHING COMBINED

BREAST CANCER IN WOMEN AGES 15 AND OLDER

Year	Staten Island	Bay Ridge/ Flushing
78	128.85	143.37
79	119.91	123.86
80	98.79	134.25
81	143.17	137.17
82	99.59	127.5
83	128.32	145.38
84	142.55	148.79
85	149.83	150.54
86	146.25	142.11
87	171.67	157.25
88	179.56	152.04
89	179.99	135.39
90	163.28	140.98
91	157.17	134.19
92	182.43	153.1



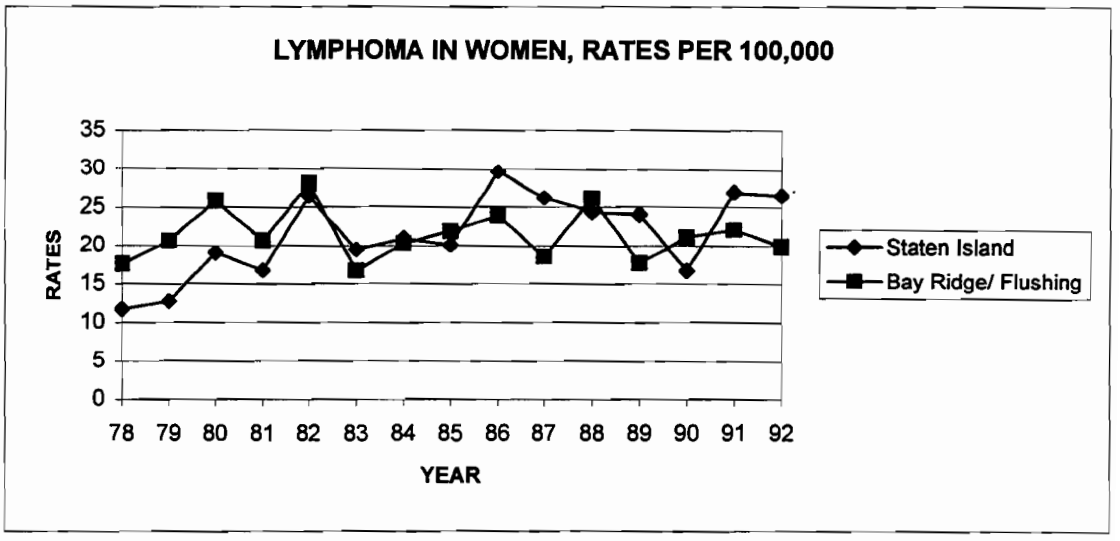
Trends: Staten Island: beta=*4.99501, p=0.0002
Bay Ridge/Flushing: beta=-0.88317, p=0.1318
Significance of difference between the two slopes: p=0.0010

Figure 14

STATEN ISLAND CANCER INCIDENCE 1978-1992, TREND ANALYSIS
ANNUAL AGE-ADJUSTED RATES FOR STATEN ISLAND, AND BAY RIDGE AND FLUSHING COMBINED

LYMPHOMA IN WOMEN AGES 15 AND OLDER

Year	Staten Island	Bay Ridge/ Flushing
78	11.74	17.62
79	12.79	20.62
80	19.09	25.87
81	16.78	20.59
82	26.41	28.05
83	19.49	16.76
84	20.94	20.26
85	20.12	21.88
86	29.61	23.91
87	26.24	18.57
88	24.42	26.17
89	24.06	17.75
90	16.74	21.1
91	26.95	22.04
92	26.5	19.87



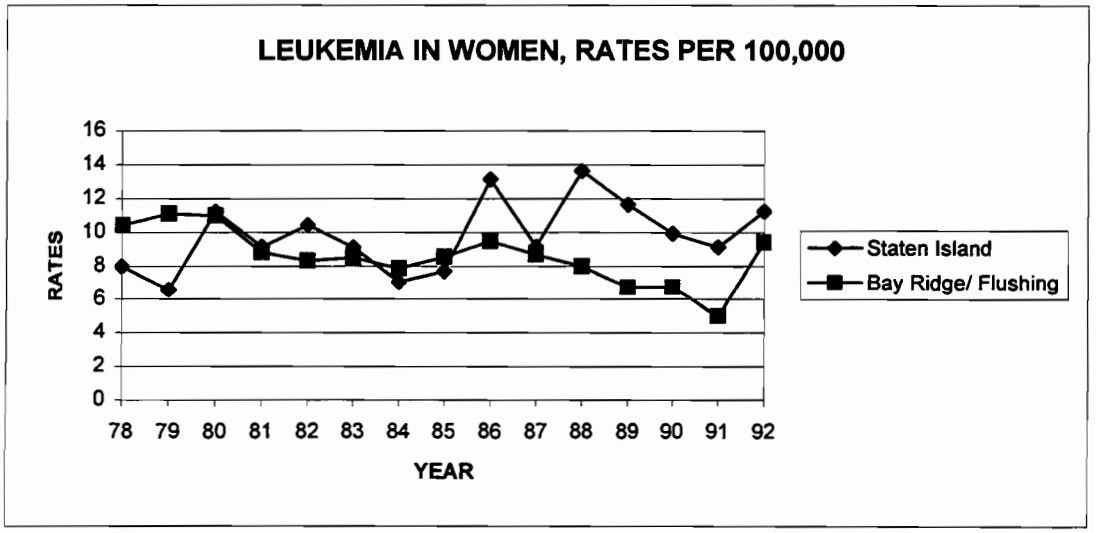
Trends: Staten Island: beta=*0.79239, p=0.0081
Bay Ridge/Flushing: beta=-0.03353, p=0.8738
Significance of difference between the two slopes: p=0.0181

Figure 15

STATEN ISLAND CANCER INCIDENCE 1978-1992, TREND ANALYSIS
ANNUAL AGE-ADJUSTED RATES FOR STATEN ISLAND, AND BAY RIDGE AND FLUSHING COMBINED

LEUKEMIA IN WOMEN AGES 15 AND OLDER

Year	Staten Island	Bay Ridge/ Flushing
78	7.97	10.42
79	6.57	11.1
80	11.23	10.99
81	9.14	8.82
82	10.43	8.31
83	9.12	8.51
84	7.06	7.86
85	7.71	8.55
86	13.14	9.47
87	9.16	8.68
88	13.64	7.99
89	11.66	6.73
90	9.94	6.76
91	9.14	5
92	11.26	9.43



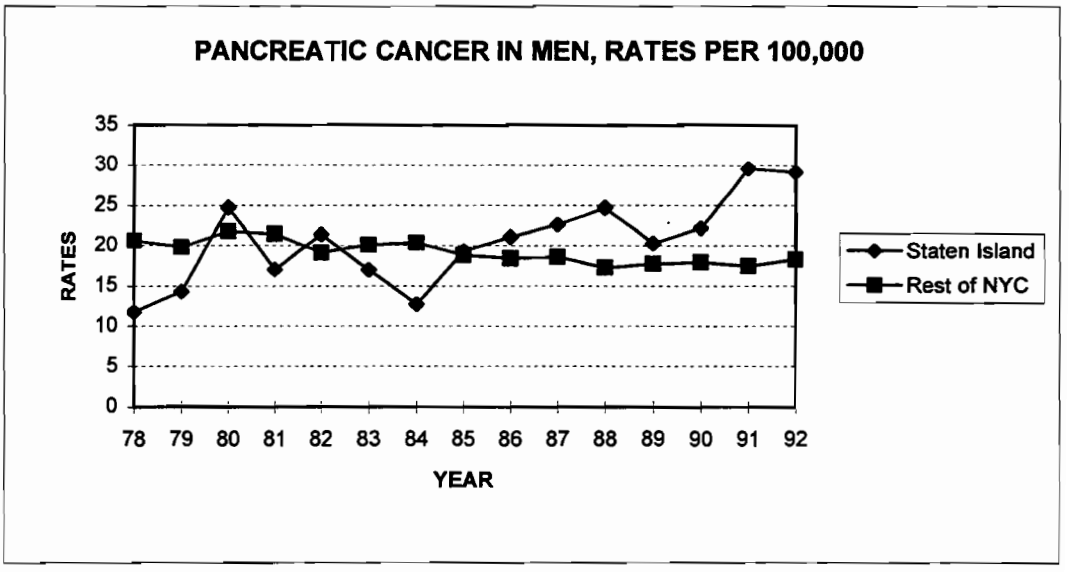
Trends: Staten Island: beta=0.20698, p=0.0991
Bay Ridge/Flushing: beta=*-0.25742, p=0.0035
Significance of difference between the two slopes: p=0.0023

Figure 16

STATEN ISLAND CANCER INCIDENCE 1978-1992, TREND ANALYSIS
ANNUAL AGE-ADJUSTED RATES FOR THE STATEN ISLAND AND THE REST OF NEW YORK CITY

PANCREATIC CANCER IN MEN AGES 15 AND OLDER

Year	Staten Island	Rest of NYC
78	11.76	20.65
79	14.29	19.82
80	24.76	21.79
81	17.04	21.45
82	21.39	19.15
83	16.99	20.1
84	12.74	20.37
85	19.29	18.83
86	21.07	18.44
87	22.62	18.63
88	24.74	17.29
89	20.3	17.74
90	22.2	17.96
91	29.62	17.5
92	29.13	18.33



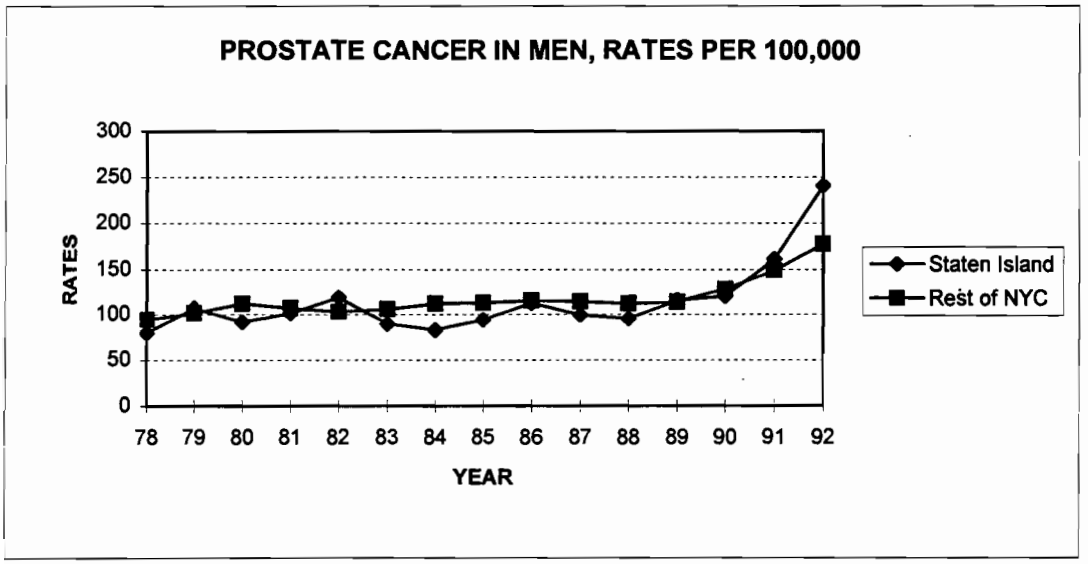
Trends: Staten Island: beta=*0.86949, p=0.0023
Rest of NYC: beta=*-0.26643, p=0.0001
Significance of the difference between the two slopes: p=0.0001

Figure 17

STATEN ISLAND CANCER INCIDENCE 1978-1992, TREND ANALYSIS
ANNUAL AGE-ADJUSTED RATES FOR THE STATEN ISLAND AND THE REST OF NEW YORK CITY

PROSTATE CANCER IN MEN AGES 15 AND OLDER

Year	Staten Island	Rest of NYC
78	79.86	94.37
79	107.14	101.58
80	91.82	111.89
81	101.45	106.96
82	118.63	103.39
83	89.7	105.89
84	83.07	111.93
85	94.26	112.7
86	112.65	115.26
87	99.34	114.19
88	95.41	112.08
89	115.54	113.89
90	120.12	128.19
91	161.2	148.89
92	240.36	177.55



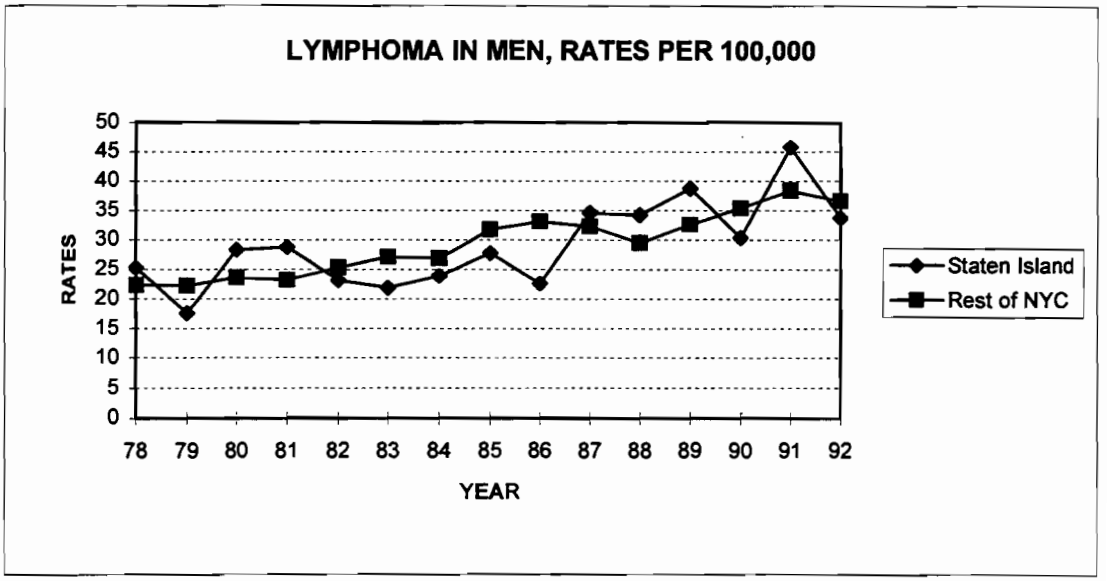
Trends: Staten Island: beta=*5.80335, p=0.0093
Rest of NYC: beta=*3.64766, p=0.0006
Significance of difference between slopes: p=0.3065

Figure 18

STATEN ISLAND CANCER INCIDENCE 1978-1992, TREND ANALYSIS
ANNUAL AGE-ADJUSTED RATES FOR THE STATEN ISLAND AND THE REST OF NEW YORK CITY

LYMPHOMA IN MEN AGES 15 AND OLDER

Year	Staten Island	Rest of NYC
78	25.27	22.35
79	17.55	22.2
80	28.25	23.57
81	28.78	23.21
82	23.15	25.3
83	21.85	27.1
84	23.89	26.85
85	27.73	31.72
86	22.61	33.15
87	34.61	32.27
88	34.21	29.46
89	38.78	32.61
90	30.36	35.41
91	45.8	38.4
92	33.73	36.57



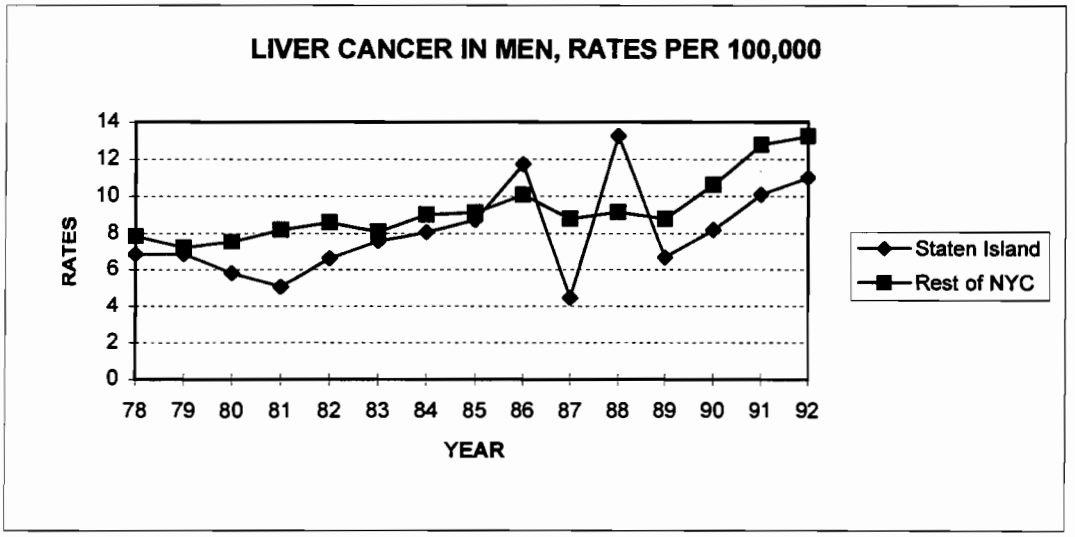
Trends: Staten Island: beta=*1.20260, p=0.0020
Rest of NYC: beta=*1.15234, p=0.0001
Significance of the difference between the two slopes: p=0.8795

Figure 19

STATEN ISLAND CANCER INCIDENCE 1978-1992, TREND ANALYSIS
ANNUAL AGE-ADJUSTED RATES FOR THE STATEN ISLAND AND THE REST OF NEW YORK CITY

LIVER CANCER IN MEN AGES 15 AND OLDER

Year	Staten Island	Rest of NYC
78	6.83	7.85
79	6.84	7.21
80	5.8	7.53
81	5.06	8.19
82	6.6	8.59
83	7.57	8.09
84	8.08	9.02
85	8.73	9.13
86	11.73	10.08
87	4.47	8.78
88	13.26	9.16
89	6.66	8.78
90	8.2	10.62
91	10.09	12.78
92	11.01	13.25



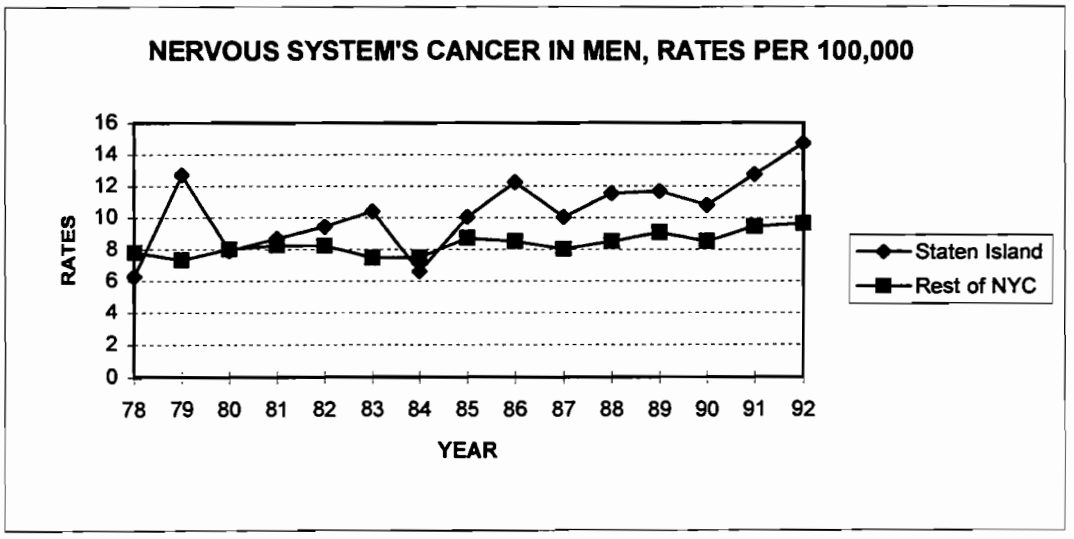
Trends: Staten Island: beta=*0.30242, p=0.0381
Rest of NYC: beta=*0.33299, p=0.0001
Significance of the difference between the two slopes: p=0.8330

Figure 20

STATEN ISLAND CANCER INCIDENCE 1978-1992, TREND ANALYSIS
ANNUAL AGE-ADJUSTED RATES FOR THE STATEN ISLAND AND THE REST OF NEW YORK CITY

CANCER OF THE CENTRAL NERVOUS SYSTEM MEN AGES 15 AND OLDER

Year	Staten Island	Rest of NYC
78	6.27	7.81
79	12.72	7.33
80	7.9	8.01
81	8.69	8.25
82	9.45	8.23
83	10.42	7.47
84	6.59	7.48
85	10.04	8.72
86	12.25	8.51
87	10.05	8.04
88	11.55	8.51
89	11.69	9.07
90	10.8	8.52
91	12.74	9.45
92	14.7	9.62



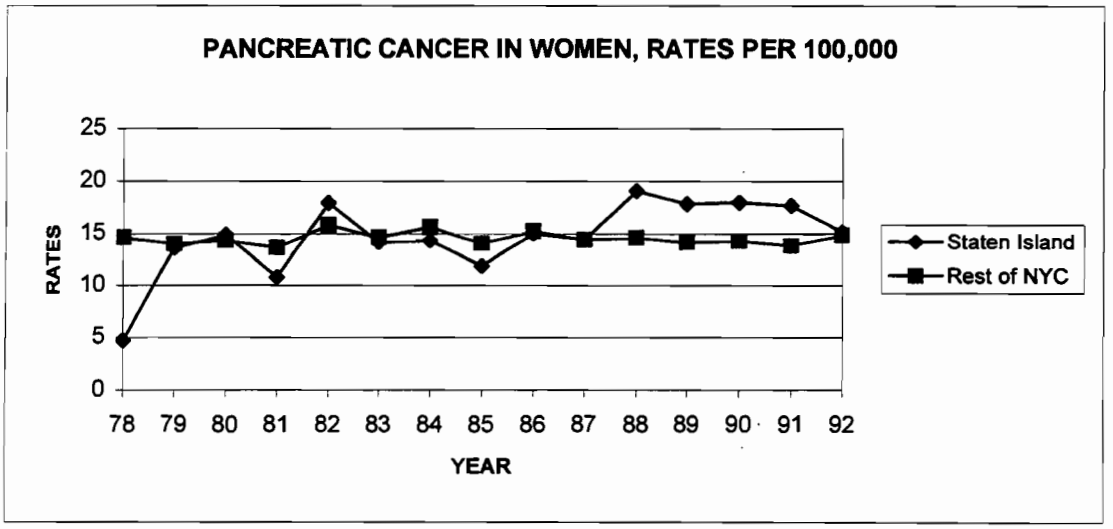
Trends: Staten Island: beta=*0.34609, p=0.0079
Rest of NYC: beta=*0.12224, p=0.0004
Significance of the difference between the two slopes: p=0.0589

Figure 21

STATEN ISLAND CANCER INCIDENCE 1978-1992, TREND ANALYSIS
ANNUAL AGE-ADJUSTED RATES FOR THE STATEN ISLAND AND THE REST OF NEW YORK CITY

PANCREATIC CANCER IN WOMEN AGES 15 AND OLDER

Year	Staten Island	Rest of NYC
78	4.75	14.65
79	13.6	14.02
80	14.91	14.35
81	10.8	13.65
82	17.94	15.82
83	14.15	14.64
84	14.37	15.66
85	11.87	14.06
86	15.03	15.25
87	14.45	14.43
88	19.06	14.62
89	17.85	14.16
90	18	14.29
91	17.7	13.83
92	15.2	14.88



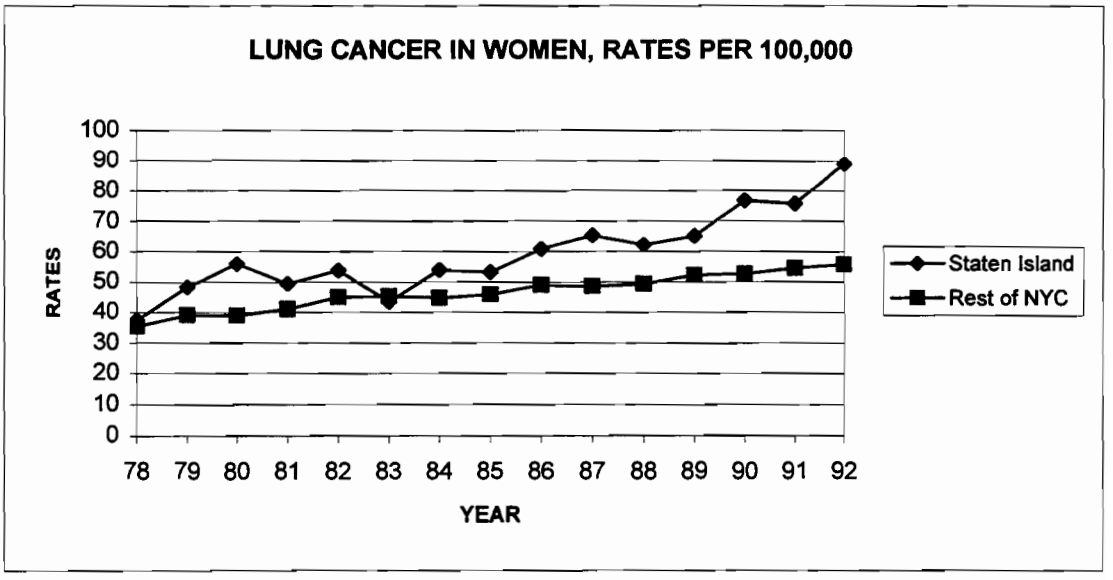
Trends: Staten Island: beta=*0.52171, p=0.0095
Rest of NYC: beta=-0.00772, p=0.8468
Significance of difference between the two slopes: p=0.0058

Figure 22

STATEN ISLAND CANCER INCIDENCE 1978-1992, TREND ANALYSIS
ANNUAL AGE-ADJUSTED RATES FOR THE STATEN ISLAND AND THE REST OF NEW YORK CITY

LUNG CANCER IN WOMEN AGES 15 AND OLDER

Year	Staten Island	Rest of NYC
78	37.51	35.37
79	48.25	39.01
80	55.92	39
81	49.42	41
82	53.75	44.89
83	43.47	45.37
84	53.9	44.7
85	53.23	45.83
86	60.85	49.05
87	65.31	48.56
88	62.21	49.33
89	65.1	52.26
90	76.88	52.63
91	75.77	54.58
92	88.94	55.66



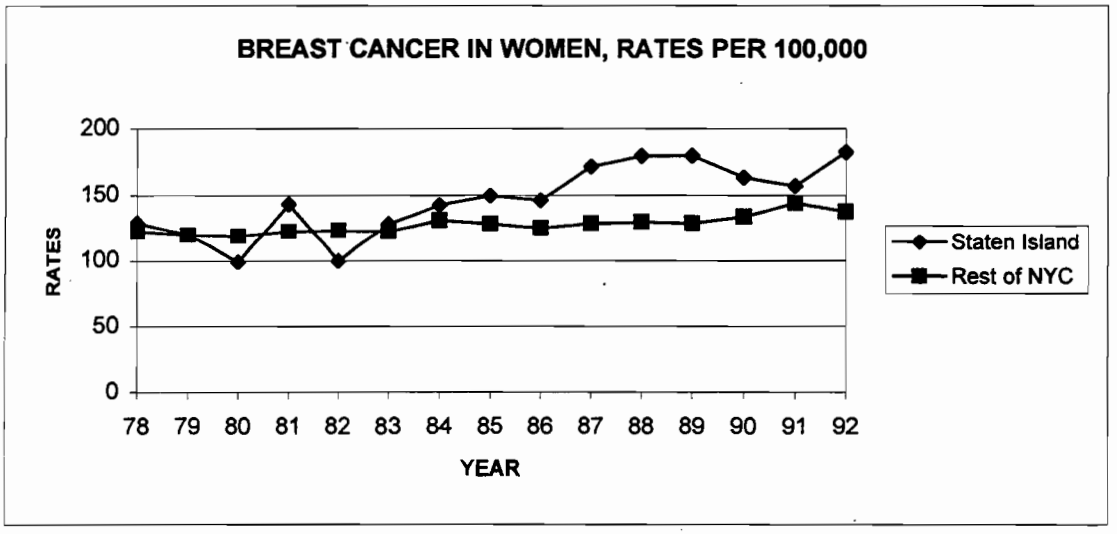
Trends: Staten Island: beta=*2.74510, p=0.0001
Rest of NYC: beta=*1.33096, p=0.0001
Significance of difference between the two slopes: p=0.0008

Figure 23

STATEN ISLAND CANCER INCIDENCE 1978-1992, TREND ANALYSIS
ANNUAL AGE-ADJUSTED RATES FOR THE STATEN ISLAND AND THE REST OF NEW YORK CITY

BREAST CANCER IN WOMEN AGES 15 AND OLDER

Year	Staten Island	Rest of NYC
78	128.85	122.46
79	119.91	119.81
80	98.79	118.78
81	143.17	122.41
82	99.59	123.24
83	128.32	122.5
84	142.55	131.11
85	149.83	128.46
86	146.25	125.17
87	171.67	128.81
88	179.56	129.87
89	179.99	129.05
90	163.28	133.93
91	157.17	144.25
92	182.43	137.81



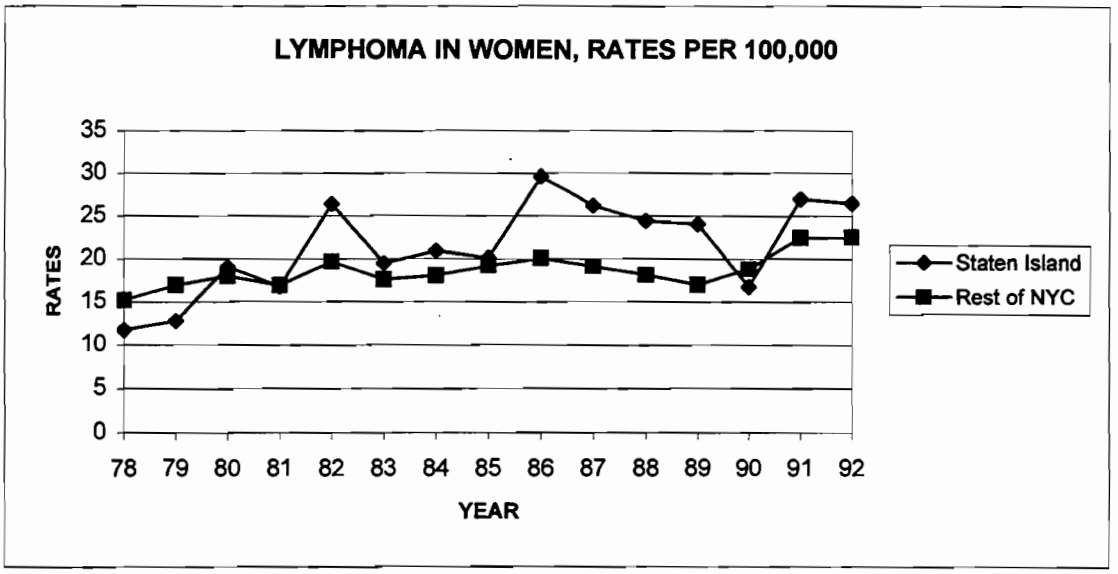
Trends: Staten Island: beta=*4.99501, p=0.0002
Rest of NYC: beta=*1.36764, p=0.0001
Significance of difference between the two slopes: p=0.0011

Figure 24

STATEN ISLAND CANCER INCIDENCE 1978-1992, TREND ANALYSIS
ANNUAL AGE-ADJUSTED RATES FOR THE STATEN ISLAND AND THE REST OF NEW YORK CITY

LYMPHOMA IN WOMEN AGES 15 AND OLDER

Year	Staten Island	Rest of NYC
78	11.74	15.2
79	12.79	16.96
80	19.09	18.01
81	16.78	16.92
82	26.41	19.68
83	19.49	17.6
84	20.94	18.09
85	20.12	19.2
86	29.61	20.1
87	26.24	19.15
88	24.42	18.16
89	24.06	17
90	16.74	18.82
91	26.95	22.47
92	26.5	22.53



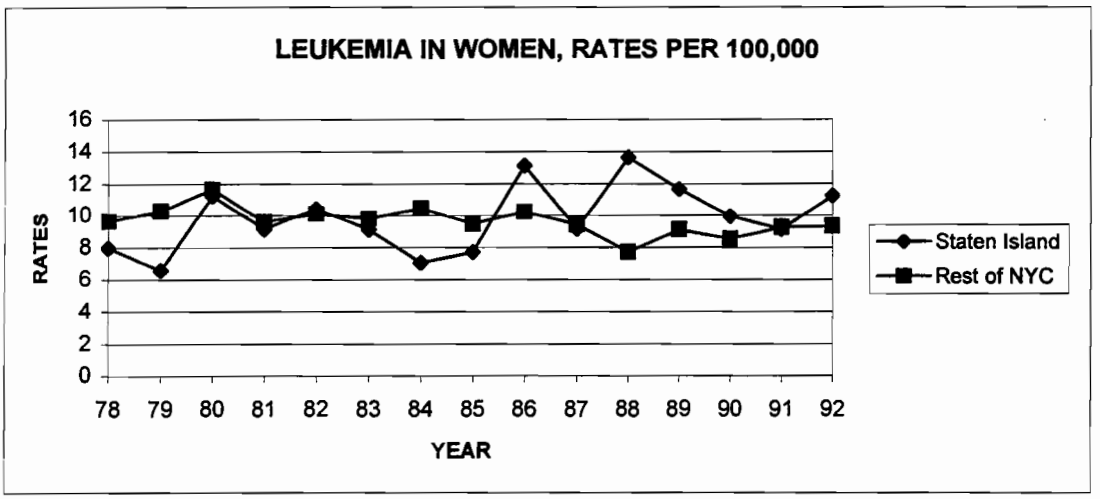
Trends: Staten Island: beta=*0.79239, p=0.0081
Rest of NYC: beta=*0.31889, p=0.0028
Significance of difference between the two slopes: p=0.0893

Figure 25

STATEN ISLAND CANCER INCIDENCE 1978-1992, TREND ANALYSIS
ANNUAL AGE-ADJUSTED RATES FOR THE STATEN ISLAND AND THE REST OF NEW YORK CITY

LEUKEMIA IN WOMEN AGES 15 AND OLDER

Year	Staten Island	Rest of NYC
78	7.97	9.64
79	6.57	10.29
80	11.23	11.66
81	9.14	9.61
82	10.43	10.1
83	9.12	9.81
84	7.06	10.46
85	7.71	9.47
86	13.14	10.23
87	9.16	9.42
88	13.64	7.72
89	11.66	9.11
90	9.94	8.54
91	9.14	9.26
92	11.26	9.35



Trends: Staten Island: beta=0.20698, p=0.0991
Rest of NYC: beta=*-0.12176, p=0.0166
Significance of difference between the two slopes: p=0.0139

APPENDIX D
Staten Island Expert Panel Members

Expert Panel Members

Person	Position	Affiliation
Ken Cantor, PhD	Epidemiologist, Occupational Epidemiology Branch	National Cancer Institute, MD
David Christiani,MD MA	Prof., Occup. Medicine & Epidemiology	Harvard School of Public Health, Boston
Henry Falk, MD	Director, Evironmental Hazards & Health Effects	Centers for Disease Control, Atlanta, GA
Maureen Hatch, PhD	Director, Div. of Epidemiology Assoc. Prof., Community Health and Social Medicine	Mt. Sinai School of Medicine, NYC
Phil Landrigan, MD	Chair, Dept. of Community Medicine	Mt. Sinai Medical Center, NYC
David Michaels, PhD	Prof. , Community Health & Social Medicine Assistant Secretary of Energy	CUNY Medical School, NYC US Dept. of Energy
Joel Schwartz, PHD	Prof., Dept. of Environmental Health	Harvard School of Public Health Boston, MA
John Spengler, PhD	Akira Yamaguchi Prof. of Env. Health & Human Habitation Director of Env. Science & Engineering Program	Harvard School of Public Health, Boston, MA
Steven Stellman, PhD	Scientist	American Health Foundation, NYC
Sheila Hoar Zahm, SCD	Deputy Director, Div. of Cancer Epidemiology and Genetics	National Cancer Institute, MD
Steven Zoloth, PhD	Provost	Hunter College, NYC