

**Cancer Incidence: Residents of
Bethlehem, Grafton County, New Hampshire
1991-2005**

Prepared by
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Introduction

This report was prepared as part of the response to community health concerns expressed by some residents of Bethlehem NH related to the NCES landfill. It is being provided to the Bethlehem Board of Selectmen prior to the public meeting scheduled for October 7, 2008 and will be made available to the general public on October 3, 2008. This document is separate from the report from the Department of Environmental Services that addresses potential environmental exposures from the landfill.

This report focuses on cancer incidence in the Town of Bethlehem. Cancer rates for the 1991-2005 period were calculated for 24 major cancer types taking into account the age and gender composition of the population. Bethlehem cancer statistics were compared with those of the State of New Hampshire as a whole.

Cancer incidence data for 1991-2005 were provided by the New Hampshire State Cancer Registry (NHSCR). Data were analyzed with the Standardized Incidence Ratio (SIR) technique, which is used to investigate disease incidence in small areas, and is the first step in NH's disease cluster investigation protocol. The purpose of the SIR is to identify unusually high (or low) disease rates in an area and determine whether or not they are amenable to public health intervention.

Bethlehem is a Town of 2422 residents (2006 US Census estimate) located in Grafton County in northeastern NH immediately south of the border of Coos County.

Methods

Data Sources

Cancer became a reportable disease in New Hampshire in 1985, and since 1986 the NHSCR has been charged with identifying all new cases of cancer occurring among New Hampshire residents. Health Statistics and Data Management (HSDM), under the New Hampshire Department of Health and Human Services (DHHS), Division of Public Health Services (DPHS) has overall responsibility for the NHSCR, which it funds through a state contract. Dartmouth Medical School has continuously held the contract to operate the NHSCR since its inception. The registry is administratively located in the Norris Cotton Cancer Center. The US Centers for Disease Control and Prevention (CDC) currently provides a grant to DHHS, and these funds have been used to help increase the scope of registry information and to assure the quality of the data collected. Cancer data is collected in accordance with NH Administrative Rules. HSDM receives the cancer data set from the NHSCR. NHSCR currently collects reports from hospital registrars operating in all the large hospitals in NH. Hospitals with relatively smaller caseloads of cancer (fewer than 105 cases per year) generally do not have their own cancer registrar, so NHSCR staff assists these hospitals with their reporting duties. NHSCR also receives reports of cases from physician practices, freestanding radiation oncology centers, out-of-state pathology laboratories and other sources, as required by NH Administrative Rules. In addition, the NHSCR receives reports for NH residents who are diagnosed outside of NH, based on agreements of information exchange with other states.

The time period 1991-2005 was selected for evaluation of cancer incidence data because it was the most recent data available, and because multiple years of data are needed to provide large enough numbers to yield meaningful statistics for smaller areas such as individual cities or towns. An incident case was defined as an individual residing within the Town of Bethlehem who was diagnosed with a new primary malignant cancer during the evaluation period. The variables analyzed included: city/town of residence at time of diagnosis, primary cancer type, date of diagnosis, age at diagnosis, and sex. Information on other risk factors, such as health-related behaviors, environmental and occupational exposures, or access to medical care, is not available in the data used in this review.

Population estimates for 1991-2005 are from the Census, NH Office of Energy Planning and Management and Claritas Corporation for the Town of Bethlehem and the State of New Hampshire.

Data Analysis

A descriptive epidemiological analysis of cancer incidence for the Town of Bethlehem was conducted using the Standardized Incidence Ratio (SIR) technique. The SIR is used to analyze disease incidence in small areas, and is the first step in NH's disease cluster investigation protocol. The SIR compares the actual (observed) number of cancer cases in the study population (residents of Bethlehem) to the number that would be expected to occur if Bethlehem had the same age- and sex-specific cancer rates as the State of NH. An SIR is the ratio of the observed number of cases to the "expected" number of cases in the study population. These ratios were calculated for all 24 major cancer types.

The purpose of an SIR study is to identify unusually high (or low) disease rates in an area. Once identified, an assessment is made as to whether the disease in question might be amenable to public health intervention. It is important to emphasize that the term "expected" as used in this study is based only on the characteristics of age and gender. It does not take into account other determinants of disease rates such as health-related behaviors (e.g., tobacco and alcohol use, diet), environmental or occupational exposures, or access to health care (e.g., insurance status, other financial and personal barriers).

The SIR tells us how much higher or lower Bethlehem cancer rates are than those of the comparison population (State of New Hampshire) based on age and sex. If the observed number of cases is the same as the age-sex expected number, the SIR will equal 1. If there are more observed cases than would be expected, then the SIR will be greater than 1. If there are fewer observed cases than expected, the SIR will be less than 1. For example, if 10 cases are observed in the study population, but 5 cases were expected, then the $SIR = 10/5 = 2.0$ and the area has twice the number of cancer cases as expected. But if 20 cases were expected, then the $SIR = 10/20 = 0.5$, meaning that the area has half the expected number.

Caution should be exercised when interpreting the SIR. The interpretation must take into account the actual number of cases observed and expected, not just the ratio. Two SIRs can have the same ratio, but represent very different scenarios. For example, an SIR of 1.5 could mean 3 cases were observed and 2 were expected ($3/2 = 1.5$). Or it could mean 300 cases were observed and 200 were expected ($300/200 = 1.5$). In the first instance, only 1 "excess" cancer case

occurred, which would most likely have been due to chance. But, in the second instance, 100 excess cancers occurred, which would most likely not be a chance occurrence. This elevated ratio would then be investigated further to determine if it can be linked to any known cause or set of causes.

To help interpret the SIR, the statistical significance of the difference between state and local disease rates is calculated. In other words, the number of observed cases can be determined to be significantly different from the age-sex expected number of cases or the difference can be due to chance alone. "Statistical significance" for this review means that there is less than 5 percent chance (p-value <0.05) that the observed difference is merely the result of random fluctuation in the number of observed cancer cases. If the SIR is found to be statistically significant, then the difference between the expected and observed cases is probably due to some set of factors that influences the rate of that disease.

New Hampshire's average annual age-sex specific cancer incidence rates were used to derive the expected number of cancer cases for Bethlehem. SIRs were calculated for each cancer type.

Results

Table 1 presents cancer incidence statistics based on the SIR analysis for the Town of Bethlehem. The data are presented for each of the 24 major cancer types. Statistics include:

- 1) **Observed** number of cancer cases in Bethlehem for the 1991-2005 period;
- 2) **Expected** number of cases based on the State age-sex average;
- 3) Ratio of Observed-to-Expected cases (**SIR**) for each cancer type; and
- 4) **95% confidence intervals** for each SIR.

Our study shows a statistically significant elevation in pancreatic cancer rates for the Town of Bethlehem for the 1991-2005 period. The SIR of 1.09 for "TOTAL" cancer indicates that Bethlehem had about 9% more cancer cases than "expected" over the 15-year period.

For pancreatic cancer, the National Cancer Institute cites the following risk factors:

1. **Age** -- The likelihood of developing pancreatic cancer increases with age. Most pancreatic cancers occur in people over the age of 60.
2. **Smoking** -- Cigarette smokers are two or three times more likely than nonsmokers to develop pancreatic cancer.
3. **Diabetes** -- Pancreatic cancer occurs more often in people who have diabetes than in people who do not.
4. **Being male** -- More men than women are diagnosed with pancreatic cancer.
5. **Being African American** -- African Americans are more likely than Asians, Hispanics, or whites to get pancreatic cancer.
6. **Family history** -- The risk for developing pancreatic cancer triples if a person's mother, father, sister, or brother had the disease. Also, a family history of colon or ovarian cancer increases the risk of pancreatic cancer.

7. **Chronic pancreatitis** -- Chronic pancreatitis is a painful condition of the pancreas. Some evidence suggests that chronic pancreatitis may increase the risk of pancreatic cancer.

Conclusions

Unfortunately, cancer is a very common disease; it is the cause of approximately 20% of all deaths in the United States and nearly 23% of all deaths in New Hampshire. One out of every three Americans will develop some form of cancer in their lifetime. The vast majority of cancer cluster investigations do not reveal a common link between the cases in question. There are many possible explanations for the elevated rate of pancreatic cancer over the study period. First, because the number of cases is relatively small in statistical terms (9 cases over 15 years), the elevation may have occurred by chance. If it is caused by a systematic difference between Bethlehem residents and those of the rest of the state, that difference is likely due to a higher incidence of one or more of the risk factors listed above. Cancer registries across the nation do not generally capture most of the information that would enable us to explore these individual risk factors in more detail. Another data limitation common to almost all US cancer registries is that the person's residence is based solely on the place he or she lived at the time of diagnosis. There is no residential history available, so we do not know from existing information whether the pancreatic cancer cases are long-time Bethlehem residents or have recently moved to town. It is important to point out that, regardless of the cause of the elevated rate of pancreatic cancer in Bethlehem, there are no known environmental pollutants associated with this particular cancer.

Our plan moving forward is, first, to take a more in-depth look at information available in the cancer registry to develop a more detailed understanding of similarities and differences between the Bethlehem pancreatic cancer cases and those statewide. We also plan to go beyond cancer registry data to include a review of the medical records of the pancreatic cancer cases in order to better understand additional factors that may have been involved.

For further information, contact:

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Table 1. Cancer Incidence by type: Residents of Bethlehem NH, 1991-2005.

Cancer Type	Observed Number	Age-Sex Expected Number	Observed minus Expected	SIR (Obs/Exp)	95% CI Lower	95% CI Upper
Bladder	12	8.4	3.6	1.43	0.74	2.50
Brain & Other CNS	0	0.9	-0.9	0.00	na	na
Breast (Female)	33	23.2	9.8	1.42	0.98	2.00
Cervical	2	1.1	0.9	1.74	0.20	6.29
Colorectal	18	15.6	2.4	1.16	0.68	1.83
Esophagus	3	2.0	1.0	1.47	0.30	4.30
Hodgkins Disease	3	1.0	2.0	2.95	0.59	8.61
Kidney & Renal Pelvis	2	4.1	-2.1	0.49	0.05	1.76
Larynx	0	1.2	-1.2	0.00	na	na
Leukemia	8	4.0	4.0	2.00	0.86	3.93
Liver	0	1.2	-1.2	0.00	na	na
Lung & Bronchus	24	20.7	3.3	1.16	0.74	1.72
Melanoma of the Skin	7	9.2	-2.2	0.76	0.30	1.56
Multiple Myeloma	2	1.7	0.3	1.16	0.13	4.20
Non-Hodgkins Lymphoma	10	6.4	3.6	1.57	0.75	2.88
Oral Cavity & Pharynx	1	3.5	-2.5	0.28	0.00	1.58
Other	10	12.1	-2.1	0.83	0.40	1.52
Ovary	2	2.2	-0.2	0.91	0.10	3.27
Pancreas	9	3.2	5.8	2.85	1.30	5.42
Prostate	15	23.7	-8.7	0.63	0.35	1.05
Stomach	1	1.7	-0.7	0.60	0.01	3.32
Testis	0	1.1	-1.1	0.00	na	na
Thyroid	4	2.9	1.1	1.37	0.37	3.51
Uterine	4	4.5	-0.5	0.89	0.24	2.27
TOTAL	170	155.7	14.3	1.09	0.93	1.27