

Understanding Standardized Incidence Ratio (SIR) Procedure

To assess whether the incidence of cancer was higher than expected in Merrimack, the New Hampshire Department of Health and Human Services (NHDHHS) used the New Hampshire State Cancer Registry (NHSCR) to review cancer diagnoses in the town of Merrimack, NH from January 2009 through December 2018. 2018 is the most recent year for which cancer data are at least 95% completely reported to the NHSCR. The NHSCR is a population-based registry of cases of cancer diagnosed in New Hampshire residents. NHSCR receives reports from medical facilities within the State including hospitals, laboratories, physicians, and other health care facilities. The reported (or “observed”) number of cancer cases in Merrimack residents were compared to a calculated “expected” number of cancer cases (by cancer type) for Merrimack assuming the town’s rate of cancer was similar to the NH State rate. Statistical methods are then used to determine whether the difference between the observed number of cancer cases in Merrimack are similar or different (either higher or lower) than the calculated expected number of cancer cases.

What is a Standardized Incidence Ratio (SIR)?

- ▶ It provides NHDHHS with a “signal” to look closer.
- ▶ Calculated to provide an estimate of the likelihood that an excess of cases exists in the population of concern
- ▶ Since cancer rates vary by age the SIR calculates “age-specific” rates which takes into account the actual age distribution of a population
- ▶ The SIR is the recommended measure for comparison of cancer in small areas with small numbers of cases rather than comparison of “age-adjusted” rates

How do you interpret a Standardized Incidence Ratio (SIR)?

- ▶ An SIR of 1.00 means that observed cases are the same as expected, while an SIR of 1.20 means that observed cases are 1.20 times expected
 - SIR of 1.20 also means that observed cases are 20% greater than expected
- ▶ The SIR is accompanied by a confidence interval to assess statistical significance. If the SIR does not cover the base value of 1, then it is significant
 - e.g. An interval of (1.10, 1.30) indicates significance, while an interval of (0.90, 1.50) does not

What isn’t the SIR?

- ▶ Proof of correlation or causation between an exposure and a health outcome
- ▶ An indication of a cluster of cancers caused by an environmental exposure
- ▶ The end of an investigation

What factors should be considered in computing and interpreting SIR?

- ▶ Types of cancer
- ▶ Choice of reference population (e.g., cancer incidence in the larger reference population)
- ▶ Time period of concern
- ▶ Geographic area of concern
- ▶ Demographic characteristics of cases in reference population

What are the limitations of this statistical procedure?

- ▶ Analogously to disease testing, false positive and false negatives can occur
- ▶ Specificity of a test is related to “Type I error” in statistics
- ▶ Sensitivity of a test is related to “Type II error”
- ▶ The more statistical tests or intervals you compute, the greater the chance that some significant results will be due merely to chance

Glossary of Terms:

Age adjusted rate: A measure that has been statistically modified to minimize the effect of different age distributions in the different populations.

Age-specific rate: A measure used to compare a specific age-group to the population of that age-group. The measure is calculated by dividing the total number of cases for the age-group by the total population for the same age-group.

Confidence interval: (CI): Expressed as a percentage and used to determine how large the random error for an estimate is likely to be.

Statistical Significance: The likelihood that a result is caused by something other than chance.

Standardized Incidence Ratios (SIRs) for cancer in Merrimack, NH 2009-2018

Cancer Type ¹	Observed	Expected ²	SIR	Lower Confidence Interval ⁵	Upper Confidence Interval
Brain and Other Nervous System	20	21.1	0.95	0.58	1.47
Colon and Rectum	122	101.8	1.20	1.00	1.43
Esophagus	19	19.8	0.96	0.58	1.50
Gall Bladder ⁴					
Hodgkin Lymphoma	7	7.7	0.91	0.37	1.88
Kaposi Sarcoma ⁴					
Kidney and Renal Pelvis	66	46.5	1.42	1.10	1.81
Larynx	8	10.0	0.80	0.35	1.58
Leukemia	39	37.9	1.03	0.73	1.41
Liver and Intrahepatic Bile Duct	16	18.5	0.86	0.49	1.40
Lung and Bronchus ³	167	181.0	0.92	0.79	1.07
Melanoma of Skin	77	83.5	0.92	0.73	1.15
Mesothelioma ⁴					
Myeloma	22	16.9	1.30	0.82	1.97
Non-Hodgkin Lymphoma	73	59.0	1.24	0.97	1.56
Oral Cavity and Pharynx	35	37.3	0.94	0.65	1.30
Pancreas	30	34.4	0.87	0.59	1.24
Stomach	11	15.5	0.71	0.35	1.27
Thyroid	44	42.9	1.03	0.75	1.38
Urinary Bladder, invasive and in situ	91	74.8	1.22	0.98	1.49
Prostate ³	207	185.0	1.12	0.97	1.28
Testis	10	8.6	1.16	0.55	2.13
Breast (Female)	231	221.7	1.04	0.91	1.19
Cervix Uteri	7	6.9	1.02	0.41	2.09
Ovary	17	16.8	1.01	0.59	1.62
Uterus	55	53.3	1.03	0.78	1.34
Other	118	113.4	1.04	0.86	1.25

Table Notes:

1. Cancer types are listed in the order of their assigned diagnostic codes in the International Classification of Disease for Oncology, 3rd Edition.
2. The expected number is calculated by multiplying each age-specific cancer incidence rate of the reference population by each age-specific population of the community in question and then adding up the results.
3. Cancer cases are likely higher than reflected for all of New Hampshire due to a delay in receiving cancer data from the Veterans Administration. Based on previous analysis we think Lung and Bronchus and Prostate cancer types are impacted by these missing data.
4. Data are suppressed for all cancer types where the observed number of cases was less than 5.
5. For an SIR to be considered statistically significant the lower confidence interval must be above 1.0