

# Yakutat Cancer Study



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# Study Background

- Ankau Saltchucks used by Yakutat residents for subsistence harvesting and a Culture Camp
- Also location of US military installations and dump sites from WWII, used by federal government agencies through 1970s
- Health concerns due to pollution from military installations led to change in harvest locations and closure of Culture Camp

# Cancer Study: 3 Reports

- ❑ Observed vs. Expected number of cancer cases
- ❑ Observed vs. Expected number of cancer deaths
  - ▣ Are the number of observed cancers greater than the number of expected cancers (cases & deaths)?
- ❑ Number & types of cancer cases and cancer deaths
  - ▣ Are the number and types of cancers reported in the community unusual (cases & deaths)?

# First Report: Observed vs. Expected Cancer Cases

- ❑ Determine the number of reported cancer cases for the community of Yakutat
- ❑ Calculate the number of expected cancers
- ❑ Is observed greater than expected?
- ❑ If so, is the difference statistically significant?

# Observed Number of Cases

- ❑ Alaska Cancer Registry is data source
- ❑ Contains information about all cancer patients in AK since 1996 reported by their healthcare providers
- ❑ Hospitals, physicians, pathology labs, & other state's cancer registries
- ❑ Observed cases in Yakutat 1996-2011 is 44

# Expected Number of Cases

- Involves a calculation
- Need to know:
  - ▣ Cancer rate for the entire state of Alaska
  - ▣ Population of Yakutat

# Calculating Expected Number of Cases

- If population demographics were identical throughout Alaska, then this would be easy!

$$\begin{array}{rcl} \text{AK Incid} & & \text{Expected No} \\ \text{Rate} & & \text{of Cases} \\ \text{-----} & = & \text{-----} \\ 100,000 & & \text{Community} \\ & & \text{Population} \end{array}$$

- Need to account for the difference in age distribution between the state and the community
- Do calculation for each age group
- Add each age group up to get expected cases per year

For 1996-2005, Yakutat

| Age Category           | Alaska Incid Rate, 1996-2005 | Yakutat Population, 2000 US Census | Expected No. of Cases |
|------------------------|------------------------------|------------------------------------|-----------------------|
| 00-04 years            | 24.5                         | 38                                 | 0.009                 |
| 05-09 years            | 9.6                          | 70                                 | 0.007                 |
| 10-14 years            | 8.6                          | 62                                 | 0.005                 |
| 15-19 years            | 18.8                         | 58                                 | 0.011                 |
| 20-24 years            | 34.3                         | 25                                 | 0.009                 |
| 25-29 years            | 63.3                         | 32                                 | 0.020                 |
| 30-34 years            | 79.9                         | 53                                 | 0.042                 |
| 35-39 years            | 124.8                        | 65                                 | 0.081                 |
| 40-44 years            | 198.8                        | 63                                 | 0.125                 |
| 45-49 years            | 340.1                        | 76                                 | 0.258                 |
| 50-54 years            | 538.3                        | 51                                 | 0.275                 |
| 55-59 years            | 848.8                        | 26                                 | 0.221                 |
| 60-64 years            | 1373.0                       | 22                                 | 0.302                 |
| 65-69 years            | 1977.4                       | 14                                 | 0.277                 |
| 70-74 years            | 2437.0                       | 14                                 | 0.341                 |
| 75-79 years            | 2764.7                       | 10                                 | 0.276                 |
| 80-84 years            | 2799.9                       | 0                                  | 0.000                 |
| 85+ years              | 2408.7                       | 1                                  | 0.024                 |
| <b>TOTAL</b>           |                              | <b>680</b>                         | <b>2.284</b>          |
| Expected over 10 years |                              |                                    | 22.8                  |



- Need to account for changes in population over time
- Use both 2000 and 2010 population data from US Census

For 2006-2011, Yakutat

| Age Category                 | Alaska Incid Rate, 2006-2011 | Yakutat Population, 2010 US Census | Expected No. of Cases |
|------------------------------|------------------------------|------------------------------------|-----------------------|
| 00-04 years                  | 24.9                         | 40                                 | 0.010                 |
| 05-09 years                  | 13.1                         | 42                                 | 0.006                 |
| 10-14 years                  | 12.0                         | 41                                 | 0.005                 |
| 15-19 years                  | 21.2                         | 53                                 | 0.011                 |
| 20-24 years                  | 34.6                         | 34                                 | 0.012                 |
| 25-29 years                  | 51.6                         | 42                                 | 0.022                 |
| 30-34 years                  | 91.1                         | 36                                 | 0.033                 |
| 35-39 years                  | 118.8                        | 46                                 | 0.055                 |
| 40-44 years                  | 210.4                        | 48                                 | 0.101                 |
| 45-49 years                  | 351.3                        | 56                                 | 0.197                 |
| 50-54 years                  | 540.9                        | 54                                 | 0.292                 |
| 55-59 years                  | 799.9                        | 60                                 | 0.480                 |
| 60-64 years                  | 1155.0                       | 46                                 | 0.531                 |
| 65-69 years                  | 1688.3                       | 23                                 | 0.388                 |
| 70-74 years                  | 2208.8                       | 20                                 | 0.442                 |
| 75-79 years                  | 2444.0                       | 9                                  | 0.220                 |
| 80-84 years                  | 2482.6                       | 7                                  | 0.174                 |
| 85+ years                    | 2416.0                       | 5                                  | 0.121                 |
| <b>TOTAL</b>                 |                              | <b>662</b>                         | <b>3.098</b>          |
| Expected over 6 years        |                              |                                    | 18.6                  |
| Total expected over 16 years |                              |                                    | 41.4                  |

# Calculating Expected Number of Cases

- ❑ Assumes proportion of race groups in Yakutat is the same as Alaska statewide
- ❑ Each race group has different top ranked cancers
- ❑ Expand each of the two tables for Alaska Native, White, Black, Asian/Pacific Islander



For 1996-2005, Yakutat

| Age Category  | White                        |                             |                       | Black                        |                             |                       | AK Native                    |                             |                       | Asian/PI                     |                             |                       |
|---------------|------------------------------|-----------------------------|-----------------------|------------------------------|-----------------------------|-----------------------|------------------------------|-----------------------------|-----------------------|------------------------------|-----------------------------|-----------------------|
|               | Alaska Incid Rate, 1996-2005 | Yakutat Pop, 2000 US Census | Expected No. of Cases | Alaska Incid Rate, 1996-2005 | Yakutat Pop, 2000 US Census | Expected No. of Cases | Alaska Incid Rate, 1996-2005 | Yakutat Pop, 2000 US Census | Expected No. of Cases | Alaska Incid Rate, 1996-2005 | Yakutat Pop, 2000 US Census | Expected No. of Cases |
| 00-04 yrs     | 23.8                         | 10                          | 0.002                 | 12.5                         | 0                           | 0.000                 | 28.7                         | 26                          | 0.007                 | 30.2                         | 2                           | 0.001                 |
| 05-09 yrs     | 9.8                          | 22                          | 0.002                 | 0                            | 0                           | 0.000                 | 10.3                         | 48                          | 0.005                 | 14.7                         | 0                           | 0.000                 |
| 10-14 yrs     | 10.2                         | 18                          | 0.002                 | 0                            | 0                           | 0.000                 | 5.5                          | 44                          | 0.002                 | 10.1                         | 0                           | 0.000                 |
| 15-19 yrs     | 19.7                         | 12                          | 0.002                 | 0                            | 0                           | 0.000                 | 19.3                         | 45                          | 0.009                 | 18.1                         | 1                           | 0.000                 |
| 20-24 yrs     | 37.5                         | 7                           | 0.003                 | 15.6                         | 0                           | 0.000                 | 32.2                         | 17                          | 0.005                 | 11.9                         | 2                           | 0.000                 |
| 25-29 yrs     | 65.6                         | 17                          | 0.011                 | 45.1                         | 0                           | 0.000                 | 64.7                         | 14                          | 0.009                 | 34.3                         | 1                           | 0.000                 |
| 30-34 yrs     | 83.4                         | 29                          | 0.024                 | 76.6                         | 1                           | 0.001                 | 71.9                         | 21                          | 0.015                 | 45.7                         | 2                           | 0.001                 |
| 35-39 yrs     | 119                          | 39                          | 0.047                 | 123.6                        | 0                           | 0.000                 | 146.8                        | 25                          | 0.036                 | 114.9                        | 1                           | 0.001                 |
| 40-44 yrs     | 194.4                        | 31                          | 0.060                 | 197                          | 0                           | 0.000                 | 242.6                        | 32                          | 0.078                 | 135                          | 0                           | 0.000                 |
| 45-49 yrs     | 337.3                        | 45                          | 0.150                 | 381.2                        | 0                           | 0.000                 | 372.2                        | 30                          | 0.113                 | 262.8                        | 1                           | 0.003                 |
| 50-54 yrs     | 531.3                        | 31                          | 0.163                 | 680.1                        | 0                           | 0.000                 | 635.8                        | 17                          | 0.106                 | 327.3                        | 4                           | 0.012                 |
| 55-59 yrs     | 830.4                        | 16                          | 0.135                 | 974                          | 0                           | 0.000                 | 1024.5                       | 9                           | 0.088                 | 499.5                        | 1                           | 0.006                 |
| 60-64 yrs     | 1375.4                       | 9                           | 0.124                 | 1665.2                       | 0                           | 0.000                 | 1518.9                       | 11                          | 0.167                 | 722.2                        | 2                           | 0.014                 |
| 65-69 yrs     | 2031.5                       | 8                           | 0.152                 | 2311.2                       | 0                           | 0.000                 | 1812.6                       | 6                           | 0.100                 | 1424.9                       | 1                           | 0.014                 |
| 70-74 yrs     | 2519.3                       | 7                           | 0.176                 | 2383.1                       | 0                           | 0.000                 | 2375.1                       | 7                           | 0.166                 | 1402.4                       | 0                           | 0.000                 |
| 75-79 yrs     | 2775.6                       | 6                           | 0.167                 | 3579.1                       | 0                           | 0.000                 | 2834.7                       | 4                           | 0.113                 | 1859.3                       | 0                           | 0.000                 |
| 80-84 yrs     | 2755.5                       | 0                           | 0.000                 | 2567.1                       | 0                           | 0.000                 | 3294.7                       | 0                           | 0.000                 | 1934.9                       | 0                           | 0.000                 |
| 85+ yrs       | 2442.1                       | 0                           | 0.000                 | 1067.6                       | 0                           | 0.000                 | 2397.9                       | 1                           | 0.024                 | 2400                         | 0                           | 0.000                 |
| TOTAL         |                              | 306                         | 1.221                 |                              | 1                           | 0.001                 |                              | 355                         | 1.044                 |                              | 18                          | 0.052                 |
| OVER 10 YEARS |                              |                             | 12.214                |                              |                             | 0.009                 |                              |                             | 10.444                |                              |                             | 0.523                 |

For 2006-2011, Yakutat

| Age Category | White                        |                             |                       | Black                        |                             |                       | AK Native                    |                             |                       | Asian/PI                     |                             |                       |
|--------------|------------------------------|-----------------------------|-----------------------|------------------------------|-----------------------------|-----------------------|------------------------------|-----------------------------|-----------------------|------------------------------|-----------------------------|-----------------------|
|              | Alaska Incid Rate, 2006-2011 | Yakutat Pop, 2010 US Census | Expected No. of Cases | Alaska Incid Rate, 2006-2011 | Yakutat Pop, 2010 US Census | Expected No. of Cases | Alaska Incid Rate, 2006-2011 | Yakutat Pop, 2010 US Census | Expected No. of Cases | Alaska Incid Rate, 2006-2011 | Yakutat Pop, 2010 US Census | Expected No. of Cases |
| 00-04 yrs    | 23.2                         | 23                          | 0.005                 | 9.9                          | 0                           | 0.000                 | 32.7                         | 17                          | 0.006                 | 44.7                         | 0                           | 0.000                 |
| 05-09 yrs    | 11.1                         | 18                          | 0.002                 | 10.4                         | 0                           | 0.000                 | 21.3                         | 21                          | 0.004                 | 26.2                         | 3                           | 0.001                 |
| 10-14 yrs    | 11.6                         | 16                          | 0.002                 | 5.8                          | 0                           | 0.000                 | 14.4                         | 19                          | 0.003                 | 21.2                         | 6                           | 0.001                 |
| 15-19 yrs    | 19.2                         | 18                          | 0.004                 | 18                           | 0                           | 0.000                 | 31.7                         | 33                          | 0.011                 | 25.2                         | 1                           | 0.000                 |
| 20-24 yrs    | 41.1                         | 14                          | 0.006                 | 5.5                          | 0                           | 0.000                 | 33.3                         | 20                          | 0.007                 | 21.2                         | 0                           | 0.000                 |
| 25-29 yrs    | 46.6                         | 22                          | 0.010                 | 57.9                         | 0                           | 0.000                 | 88.5                         | 16                          | 0.014                 | 40.6                         | 4                           | 0.001                 |
| 30-34 yrs    | 86.4                         | 20                          | 0.017                 | 68.2                         | 0                           | 0.000                 | 134.4                        | 12                          | 0.017                 | 86.3                         | 3                           | 0.003                 |
| 35-39 yrs    | 113.8                        | 32                          | 0.036                 | 94.8                         | 0                           | 0.000                 | 178.6                        | 12                          | 0.021                 | 151.6                        | 2                           | 0.004                 |
| 40-44 yrs    | 211                          | 26                          | 0.055                 | 221.4                        | 0                           | 0.000                 | 256.2                        | 16                          | 0.041                 | 192.3                        | 6                           | 0.012                 |
| 45-49 yrs    | 344                          | 33                          | 0.113                 | 260.9                        | 1                           | 0.003                 | 486.3                        | 18                          | 0.085                 | 333.7                        | 4                           | 0.015                 |
| 50-54 yrs    | 532                          | 27                          | 0.141                 | 712.2                        | 1                           | 0.007                 | 739.9                        | 22                          | 0.166                 | 480.3                        | 4                           | 0.019                 |
| 55-59 yrs    | 805.6                        | 33                          | 0.267                 | 929.5                        | 0                           | 0.000                 | 971.9                        | 25                          | 0.240                 | 619.5                        | 2                           | 0.013                 |
| 60-64 yrs    | 1153                         | 22                          | 0.252                 | 1588.7                       | 0                           | 0.000                 | 1558.3                       | 22                          | 0.342                 | 824.7                        | 2                           | 0.018                 |
| 65-69 yrs    | 1693.9                       | 8                           | 0.141                 | 2058.7                       | 0                           | 0.000                 | 2001.8                       | 10                          | 0.200                 | 1410.5                       | 5                           | 0.066                 |
| 70-74 yrs    | 2250.6                       | 7                           | 0.165                 | 2227.7                       | 0                           | 0.000                 | 2755.8                       | 11                          | 0.312                 | 1418.2                       | 1                           | 0.019                 |
| 75-79 yrs    | 2461.2                       | 3                           | 0.074                 | 1929.5                       | 0                           | 0.000                 | 2883.3                       | 4                           | 0.115                 | 2115.8                       | 1                           | 0.021                 |
| 80-84 yrs    | 2500.3                       | 2                           | 0.050                 | 2547.8                       | 0                           | 0.000                 | 3158.3                       | 5                           | 0.158                 | 1918.5                       | 0                           | 0.000                 |
| 85+ yrs      | 2464.4                       | 4                           | 0.099                 | 3505.5                       | 0                           | 0.000                 | 2436.8                       | 1                           | 0.024                 | 2193.6                       | 0                           | 0.000                 |
| TOTAL        |                              | 329                         | 1.439                 |                              | 2                           | 0.010                 |                              | 285                         | 1.767                 |                              | 45                          | 0.194                 |
| OVER 6 YEARS |                              |                             | 8.635                 |                              |                             | 0.060                 |                              |                             | 10.599                |                              |                             | 1.162                 |

# Observed vs. Expected

| Cancer Type               | Location | Number of Observed Cancer Cases 1996-2011 | Number of Expected Cancer Cases 1996-2011 | Difference (Observed minus Expected) |
|---------------------------|----------|---|---|--------------------------------------|
| All Cancer Sites Combined | Yakutat  | 44  | 44  | 0                                    |

# Calculating Standard Incidence Ratio

- If number of observed cases is greater than number of expected cases, then calculate Standard Incidence Ratio (SIR)
- $(\# \text{ Observed} / \# \text{ Expected}) \times 100$
- Calculate SIR upper and lower confidence intervals
- If confidence interval does not include 100, then the # observed is statistically significantly different from # expected



# Observed vs. Expected

| Cancer Type               | Location | Number of Observed Cancer Cases 1996-2011 | Number of Expected Cancer Cases 1996-2011 | Difference (Observed minus Expected) |
|---------------------------|----------|---|---|--------------------------------------|
| All Cancer Sites Combined | Yakutat  | 44  | 44  | 0                                    |

| Location | Standard Incidence Ratio (SIR) | Lower Confidence Interval | Upper Confidence Interval |
|----------|--------------------------------|---------------------------|---------------------------|
| Yakutat  | 100.9                          | 71.1                      | 130.7                     |

# Second Report: Observed vs. Expected Cancer Deaths

- ❑ Determine the number of reported cancer deaths for the community of Yakutat
- ❑ Calculate the number of expected cancer deaths
- ❑ Is observed greater than expected?
- ❑ If so, is the difference statistically significant?



# Observed Number of Deaths

- Alaska Bureau of Vital Statistics is data source
- Contains information about all cancer deaths in AK as determined by the healthcare provider filling out the death certificate
- Observed cancer deaths in Yakutat 1996-2012 is 19

# Expected Number of Cancer Deaths

- Involves a calculation
- Need to know:
  - ▣ Cancer death rate for the entire state of Alaska
  - ▣ Population of Yakutat

# Observed vs. Expected

| Cancer Type               | Location | Number of Observed Cancer Deaths 1996-2012 | Number of Expected Cancer Deaths 1996-2012 | Difference (Observed minus Expected) |
|---------------------------|----------|--|--|--------------------------------------|
| All Cancer Sites Combined | Yakutat  | 19   | 16   | 3                                    |

| Location | Standard Mortality Ratio (SMR) | Lower Confidence Interval | Upper Confidence Interval |
|----------|--------------------------------|---------------------------|---------------------------|
| Yakutat  | 115.5                          | 63.6                      | 167.4                     |

# Third Report: Number and Types of Cancers

- ❑ Alaska Cancer Registry for reported cancer cases
- ❑ Bureau of Vital Statistics' State Mortality Database for reported cancer deaths
- ❑ Number of cancers per year
- ❑ Compare Yakutat cancers to top-ranked statewide cancers

# Cancer Cases Per Year

- 44 cases between 1996-2011
- About 3 new cases per year
- Change from year to year appears to be random

| DxYear | Count |
|--------|-------|
| 1996   | 5     |
| 1997   | 6     |
| 1998   | 5     |
| 1999   | 2     |
| 2000   | 3     |
| 2001   | 3     |
| 2002   | 1     |
| 2003   | 1     |
| 2004   | 2     |
| 2005   | 2     |
| 2006   | 5     |
| 2007   | 1     |
| 2008   | 2     |
| 2009   | 3     |
| 2010   | 2     |
| 2011   | 1     |
| TOTAL  | 44    |

# Cancer Types

- ❑ Top 4 most common are lung, colorectal, prostate, female breast
- ❑ Top 4 are 52% of total cases
- ❑ They are also the 4 most common cancers state-wide

| Cancer Type          | Count |
|----------------------|-------|
| Lung                 | 8     |
| Colorectal           | 6     |
| Prostate             | 5     |
| Breast               | 4     |
| Hypopharynx          | 2     |
| Leukemia             | 2     |
| Non-Hodgkin Lymphoma | 2     |
| Stomach              | 2     |
| Testis               | 2     |
| Uterus               | 2     |
| Anus                 | 1     |
| Bladder              | 1     |
| Brain                | 1     |
| Esophagus            | 1     |
| Hodgkin Lymphoma     | 1     |
| Kidney               | 1     |
| Melanoma             | 1     |
| Nasopharynx          | 1     |
| Thyroid              | 1     |

# Cancer Deaths Per Year

- 19 deaths between 1996-2012
- About 1 new case per year
- Change from year to year appears to be random

| Death Year | Count |
|------------|-------|
| 1996       | 0     |
| 1997       | 4     |
| 1998       | 3     |
| 1999       | 0     |
| 2000       | 2     |
| 2001       | 0     |
| 2002       | 2     |
| 2003       | 1     |
| 2004       | 1     |
| 2005       | 1     |
| 2006       | 0     |
| 2007       | 3     |
| 2008       | 0     |
| 2009       | 0     |
| 2010       | 0     |
| 2011       | 1     |
| 2012       | 1     |
| TOTAL      | 19    |

# Cancer Death Types

- Top 3 most common are lung, prostate, leukemia
- Top 3 are 58% of total cases
- Lung is the most common cancer death state-wide

| Cancer Type             | Count |
|-------------------------|-------|
| Lung                    | 7     |
| Prostate                | 2     |
| Leukemia                | 2     |
| Brain                   | 1     |
| Breast                  | 1     |
| Colorectal              | 1     |
| Esophagus               | 1     |
| Extrahepatic Bile Ducts | 1     |
| Pancreas                | 1     |
| Testis                  | 1     |
| Stomach                 | 1     |
| TOTAL                   | 19    |



# Third Report Conclusion

- There does not appear to be an unusually high number of cases in a large cluster of years and the distribution by year appears to be random
- There does not appear to be a high number of uncommon cancers

# Community Dialog

- ❑ ACR staff presented study at community meeting in Yakutat via teleconference
- ❑ Joe Sarcone of ATSDR in Yakutat as moderator
- ❑ Q&A period after the presentation
- ❑ Positive reception by community

# Positive Outcomes

- Tribal leaders of Yakutat Tlingit Tribe shifted from searching for cancer causes to screening and early detection
- SEARHC was contacted to check on availability of screening technology for Yakutat. Mammography unit shipped from Fairbanks via road and ferry.
- Provided 41 women with mammograms in May 2015

# Positive Outcomes

- ACR invited by Yakutat Tlingit Tribe leaders to present the study with them at 2 conferences in Anchorage
  - ▣ Alaska Tribal Conference on Environmental Management
  - ▣ Alaska Forum on the Environment

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