

ABSTRACT

Background: Recently the Saskatchewan Cancer Agency (SCA) was contacted regarding a possible cancer cluster occurring among residents in a small area of one of Saskatchewan's major cities. The SCA's Epidemiology Department is responsible for investigating possible cancer clusters in the province. Between 1930 and 1979, there was an operational oil refinery located in this neighborhood. In 1980, the refinery was removed from the land, and the surrounding area became commercial and residential property owned by the city.

Purpose: Using Saskatchewan cancer registry (SCR) information and Centre for Disease Control and Prevention (CDC) methodology, investigate the possibility of a cancer cluster in this residential area of the city.

Methods: The SCR was established in 1932 and is the oldest cancer registry in Canada and has comprehensive follow up (less than 2% loss to follow-up). The SCR has electronic data records of all cancer sites dating back to 1969. Standardized cancer incidence ratios with 95% confidence intervals were calculated using data from the SCR and Saskatchewan Health Covered Population.

Results: Between 1995 and 2006, 135 invasive cancer cases were diagnosed among residents of this area. The expected site-specific cancer cases in this area were calculated using the age and site-specific rates for the whole province. 95% CI and p-values show there was no statistically significant difference in cancer incidence between the expected cancer cases and observed cancer cases for 13 oil refinery risk-related cancer sites in this area.

Conclusion/Implications: The results of the statistical analysis concluded that the cases identified in this specific population did not constitute a cancer cluster. An investigation such as this can only be conducted with registry data that has comprehensive follow-up and a long existence. These are two of the major strengths of the SCR.

INTRODUCTION

The SCA was contacted to investigate a possible cancer cluster in a residential area of a city in Saskatchewan.

A cancer cluster is defined as 'the occurrence of a greater than expected number of cases of a particular disease within a group of people, a geographic area, or a period of time.'¹

Between 1930 and 1979, an operational oil refinery was located near this neighborhood. After the refinery was removed in 1980, the nearby area became commercial and residential property.

The objective of this study was to investigate a possible cancer cluster based on standard guidelines published by the Center for Disease Control and Prevention (CDC).¹

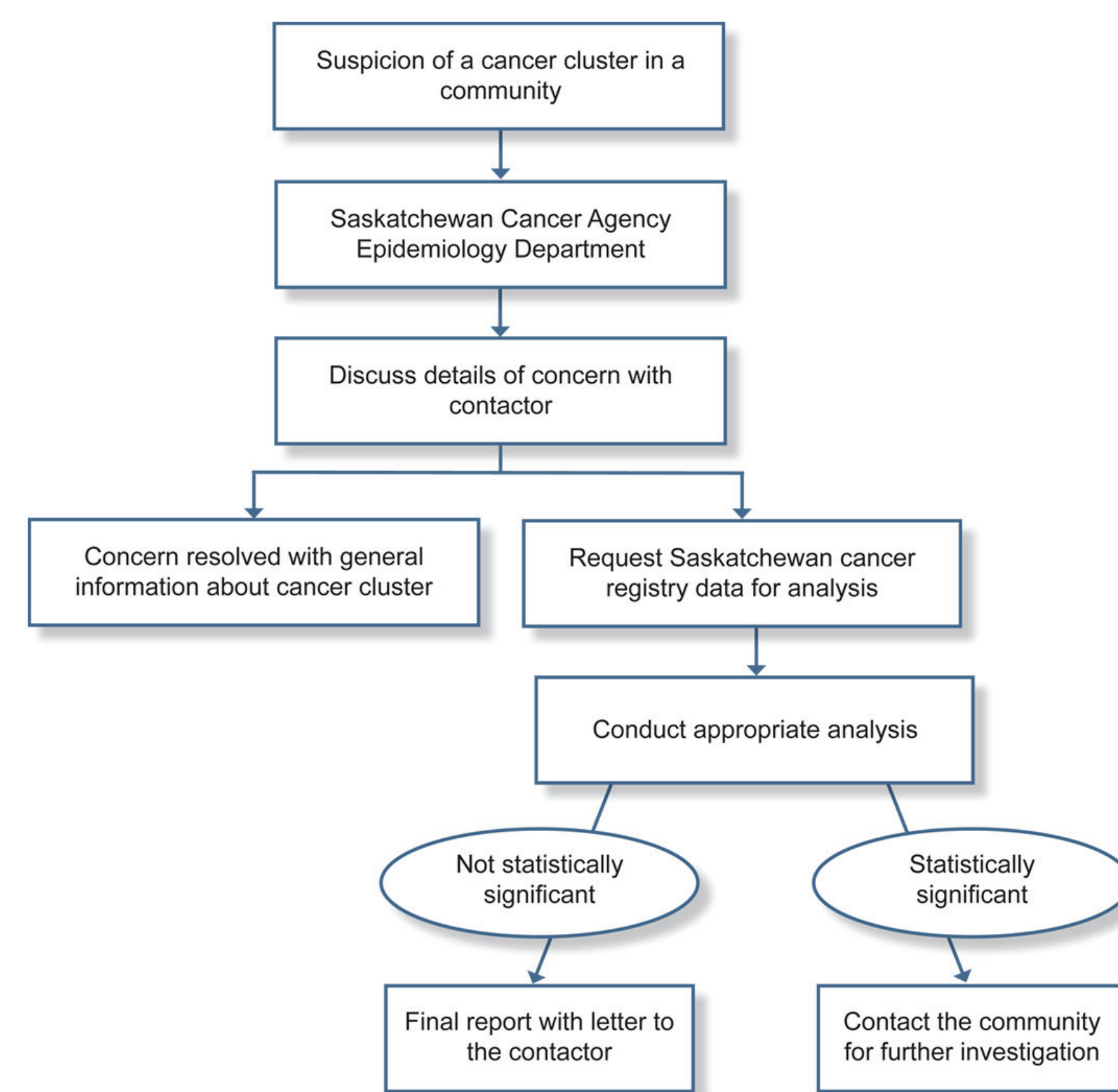
Figure 1: Photo of the oil refinery near the area of interest



http://en.wikipedia.org/wiki/File:Imperial_Oil_Refinery.jpg

METHODS

Figure 2: Process for requesting a cancer cluster investigation

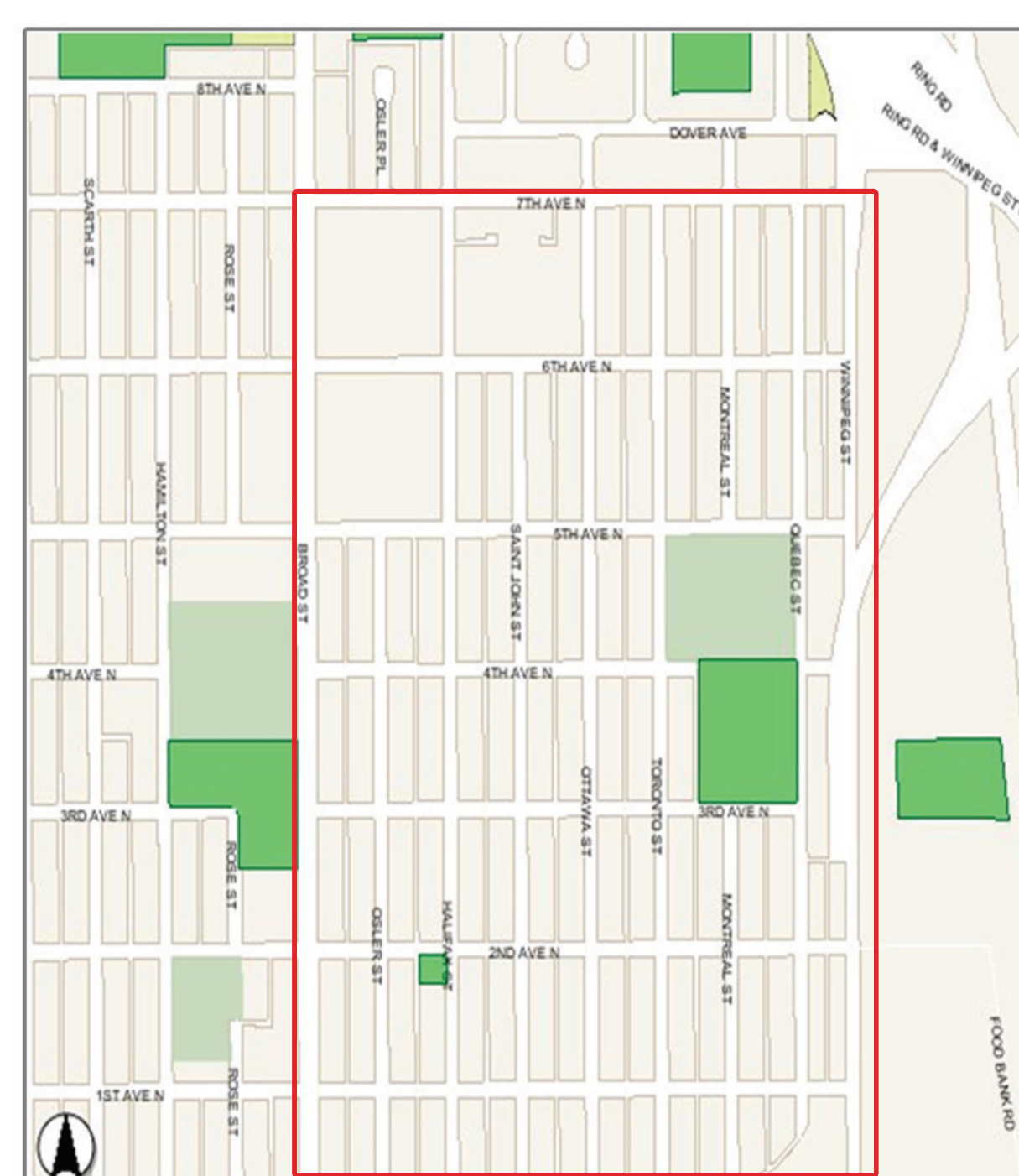


All cases of invasive cancer were retrieved from the SCR (1995-2006). The SCR was established in 1932 and is the oldest cancer registry in Canada with comprehensive follow up (less than 2% loss to follow-up).²

Between 1930 and 1979, an operational oil refinery was located in this neighborhood. The "area of interest" includes a residential area that is eight blocks to the east, three blocks to the north, and four blocks to the south of the oil refinery (Figure 3).

We followed accepted CDC guidelines and processes to communicate the results to the contactor.

Figure 3: Map of area of interest



The focus of this investigation was on cancer sites identified in the literature as being related to increased risk from exposure to oil refinery chemicals. In addition to these exposure-related cancers, the most common cancers in the general population were also analyzed. As a result 13 cancer sites were chosen for this cancer cluster investigation.³⁻¹²

$$\text{Standardized Incidence Ratio (SIR; \%)} = \frac{\text{Observed Cases}}{\text{Expected Cases}} \times 100$$

Standardized cancer incidence ratios with 95% confidence intervals (CI)¹³ were calculated using SCR data and covered population from the Saskatchewan Ministry of Health.

RESULTS

135 invasive cancer cases were diagnosed among residents of the area of interest between 1995 and 2006. The 13 types of cancers investigated were stomach, colorectal, pancreas, lung, leukemia, breast, corpus uteri, prostate, kidney, brain, bladder, thyroid, and melanoma skin.

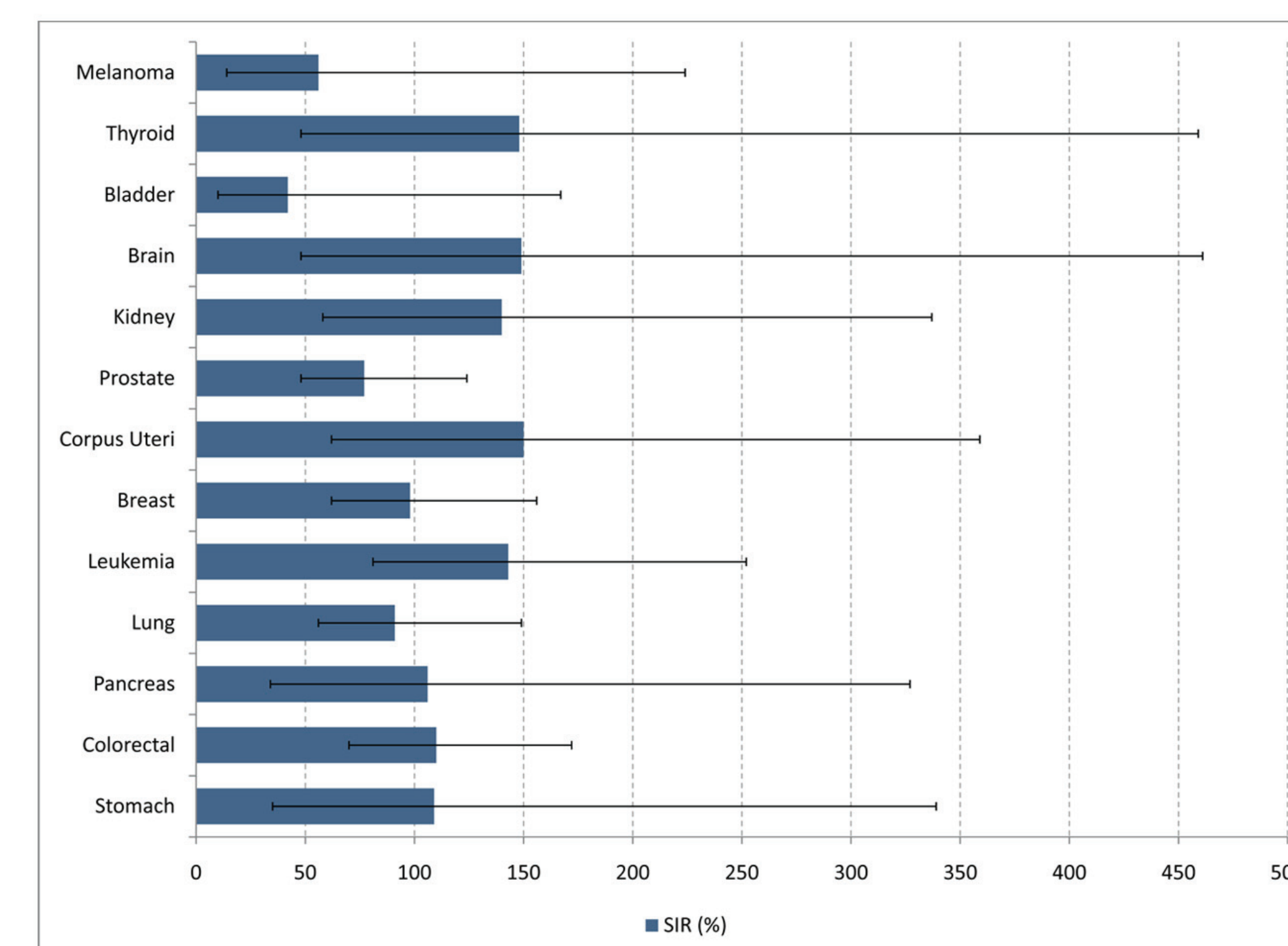
All calculations were based on the following assumptions:

1. Incidence rates for each of the 13 cancer sites considered are the same for whole province and for the area of interest.
2. The expected number of cancer cases for each site was calculated from age and site-specific rates for each site across the whole province.

As the 95% CI and p-values show, there was no statistically significant difference in cancer incidence between the expected and observed cancer cases for all sites in the area of interest. (Figure 4)

This investigation was different than other cancer clusters that the SCA has received in the past. Typically, cancer clusters are brought to the SCA's attention by citizens observing an apparent increase in cancer in their community. This cancer cluster investigation was initiated by a suspicion of an increased exposure of harmful chemicals associated with the oil refinery.

Figure 4: Standardized incidence ratios with thirteen cancer sites



CONCLUSIONS

The SCA's Epidemiology Department investigated a possible cancer cluster within a neighborhood of a major city. Based on a standardized incidence ratio analysis, there were no statistically significant differences found between expected and observed cancer cases for all sites studied (1995-2006).

A cancer cluster may be due to chance alone, like the clustering of balls on a pool table. The term cancer refers not to a single disease, but instead to a group of related yet different diseases. There were a small number of cases in a small area for several cancer sites resulting in wide confidence intervals. Therefore, it is not possible to rule out a cancer cluster due to chance.

An apparent cancer cluster is more likely to be genuine if the cases consist of one type of cancer, a rare type of cancer, or a type of cancer that is not usually found in an age group. We did not find any of these to be the case from our analysis.

Therefore, considering the information that is available, cancer cases within the area of interest do not comprise a cancer cluster.

STRENGTHS

High accuracy of data.

The numerator for SIR calculation was sourced from the SCR which has a low loss to follow-up and is highly complete. The denominator consists of covered population data that is a complete and accurate population count based on postal code.

Since both data sources are complete and accurate, the resulting SIR measure was high quality.

LIMITATIONS

There was no information regarding other risk factors for each of the cancer cases identified in the study population, i.e. genetic, occupational, nutritional, lifestyle factors.

Location of each cancer case in the SCR is determined at the time of diagnosis. Where the patients lived prior to diagnosis or how long they lived in the area of interest were unknown.

Small cases at this small area for several cancer sites cause wide confidence interval.

It is not possible to determine the presence of a cancer cluster in the area of interest for the entire time period of interest. Covered population data for the area of interest defined by postal code was only available from 1995 to 2006; therefore, rather than being able to investigate cancer incidence from 1980 to 2006, we were only able to analyze cases occurring from 1995 to 2006.

WHAT WE LEARNED FROM THE INVESTIGATION

- Respond to a requestor as soon as possible.
- Keep in contact with the requestor and assure him/her that we are investigating the cluster, however it will take time.
- Appropriately communicate with a requestor who may not be willing to accept the investigation conclusion.
- Involve partners within healthcare and government sectors to help communicate the results.

References

1. MMWR Guidelines for Investigating Clusters of Health Events CDC. 1990 July 27. 39 (RR-11); 1-16.
2. Tonita J, Alvi R, Watson F, Robson D. Saskatchewan Cancer Control Report: Profiling Trends in Cancer, 1970-2001. Regina: Saskatchewan Cancer Agency; 2003.
3. Schottenfeld D. Fraumeni JF (edited). Cancer Epidemiology and Prevention (third edition) Oxford University Press 2006 p322-354.
4. Lewis RJ, Schnatter AR, Drummond I et al. Mortality and cancer morbidity in a cohort of Canadian petroleum workers. Occu Environ Med 2003;60:918-928.
5. Wong O, Raabe GK. A critical review of cancer epidemiology in the petroleum industry with a Meta-analysis of a combined database of more than 350,000 workers. Regulatory Toxicology and Pharmacology 2000;32:78-98.
6. Glass DC, Gray CN, Jolley DJ et al. Leukemia risk associated with low-level Benzene exposure. Epidemiology 2003;14:569-577.
7. Mackerer CR, Griffis LC, Grabowski JS, Reitman FA. Petroleum mineral oil refining and evaluation of cancer hazard. Applied Occupational and Environmental Hygiene. 2003;18:890-901.
8. Rybicki BA, Nock NL, Saveria AT, et al. Polycyclic aromatic hydrocarbon-DNA adduct formation in prostate carcinogenesis. Cancer letters. 2006;239:157-167.
9. IARC Summaries & Evaluations Occupational exposures in petroleum refining (Group 2A) International Agency for Research on Cancer 1989;45:page.39.
10. Shukla VK, Prakash A, Tripathi BD et al. Biliary heavy metal concentrations in carcinoma of the gall bladder: case-control study. British Medical Journal 1998;317:1288-1289.
11. Rousseau MC, Parent ME, Nadon L et al. Occupational Exposure to Lead compounds and risk of cancer among men: A population-based case-control study. Am J Epidemiol 2007;166:1005-1014.
12. Rajaraman P, Stewart PA, Samet JM et al. Lead, Genetic Susceptibility, and risk of adult brain tumours. Cancer Epidemiol Biomarkers Pre 2006;15:2514-20.
13. Greenland S, Rothman KJ. Modern Epidemiology (second edition) editor: Rothman KJ, Greenland S 1998 by Lippincott-Raven Publishers. Page 231-252.