PORT COLBORNE

CHAP

COMMUNITY HEALTH
ASSESSMENT PROJECT

Study C Report:

A comparison of hospital discharge patterns among Port Colborne residents to those in a series of Ontario reference communities

Unapproved Final Report

19 October, 2004

Study C Report: Hospital Discharge Patterns

Principal Investigator: **Paul J. Villeneuve, PhD**

Co-Investigator: **Edward M. Sellers, MD, PhD**

Project Director: **Linda M. Kasprzak, BA, MBA**

Contributing Authors: **Debbie A. Gibson, MSc**
Amy T. Barrette, MHSc

Ventana Clinical Research Corporation
340 College Street, Suite 400
Toronto, ON
M5T 3A9

Tel. 416.963.9338
Fax. 416.963.9732

www.ventana-crc.com

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FOREWORD

In December, 2003, the draft report entitled "A comparison of hospital discharge patterns among Port Colborne residents to those in a series of Ontario reference communities" was released by Ventana Clinical Research Corporation. The design and methods used in the preparation of that report followed a research protocol that had been developed with the assistance of an independent expert advisory committee and external consultants, and which was approved by the Technical Sub-Committee (TSC). The research protocol also underwent a thorough ethics review and approval process, and was received by the Public Liaison Committee of Port Colborne.

While Ventana Clinical Research Corporation followed the agreed upon protocol, the report released in December, 2003 had not been subject to review by the TSC, the community or other interested parties. The TSC coordinated this review process. Comments were received from the Ministry of the Environment, Regional Niagara Public Health Department, Stantec Consulting and the Ontario Ministry of Health. A review was also performed by INCO consultants including Dr. David Andrews, Dr. James Heller, and Mr. Don Carmichael. These individuals have expertise in biostatistics, public health, and hospital discharge records, respectively.

At the request of the TSC, and in consultation with Ventana, revisions have been made to the draft report in order to satisfy comments received from all stakeholders. The most important of these changes include:

1) A comparison of Port Colborne hospital discharge rates to rates in the 11 other Niagara communities.
2) Boxplots of the rate ratios generated from the analysis for each of Port Colborne, the comparison and the Niagara communities to show the distribution of rate ratios.
3) Two-sample t-tests of the individual community rate ratios estimated from the analysis were performed comparing Port Colborne to the group of comparison communities and Port Colborne to the group of Niagara communities.
4) The calculation of standardized discharge ratios for comparisons to Ontario.

We recommend that the findings from this study be integrated with those from the self-administered general health mail-out survey conducted among Port Colborne residents in 2003 (CHAP A Report: A Self-Reported Health Assessment of the Port Colborne Community (2003); *currently in preparation*). While the findings from both these studies are unable to determine causal relationships between environmental exposure to the chemicals of concern and human health in Port Colborne, they are useful tools in generating hypotheses for future research.

ACKNOWLEDGEMENTS

The authors thank the Canadian Institute of Health Information (CIHI) for the use of data from the Discharge Abstract Database. We also gratefully acknowledge the Surveillance and Risk Assessment Division, Centre for Chronic Disease Prevention and Control at Health Canada for providing us aggregate counts of hospital discharges and, in particular, the technical assistance provided by Robert Semenciw. We are grateful to those who assisted in providing data concerning potential confounders, including Laine Ruus of the Data Library Service at the University of Toronto, Neil Johnston at the Ontario Physicians Human Resources Data Centre and the staff at the Gerstein Science Reference Library at the University of Toronto. We appreciate the help of the Ontario Ministry of the Environment in advising us on environmental contamination issues in Ontario communities. The authors thank the members of the Expert Advisory Committee for their input and support, and Dr. Doug Schaubel (Department of Biostatistics, University of Michigan) for his reviews and comments. We also acknowledge the technical assistance provided by Micheline Mistruzzi (CIHI).

The authors would also like to express their gratitude to the following members of the Community Health Assessment Project for their invaluable work on this report: Laurel Brown, Lawrence Giraudi, Kelley Scott, Lawrence Stevenson and Christine Watters. Finally, the authors would like to thank Dr. Howard Kaplan and the Biostatistics & Data Management group of Ventana Clinical Research Corporation for their valued input.

The opinions and conclusions expressed in this report have not been endorsed by any of the above-mentioned parties.

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ABBREVIATIONS

CBRA	Community-Based Risk Assessment
CHAP	Community Health Assessment Project
CI	Confidence Interval
CIHI	Canadian Institute for Health Information
CoC	Chemical of Concern
COPD	Chronic Obstructive Pulmonary Disease
CSD	Census Subdivision
DAD	Discharge Abstract Database
GLM	Generalized Linear Model
ICD-9	International Classification of Diseases 9th Revision
MRDx	Most Responsible Diagnosis
MOE	Ontario Ministry of the Environment
MOH	Ontario Ministry of Health
OHS	Ontario Health Survey
SAS	Statistical Analysis System
TSC	Technical Sub-Committee

LIST OF EXHIBITS

EXECUTIVE SUMMARY

Background

The city of Port Colborne, Ontario is located on the northern shore of Lake Erie with a population of approximately 18,500 residents. Soil sampling conducted in the city by the Ontario Ministry of the Environment has found elevated levels of four chemicals of concern (CoCs): nickel, arsenic, cobalt and copper. This contamination has been attributed to the operation of an INCO nickel refinery between 1918 and 1984. Although a previous Ministry of the Environment report suggested that it is unlikely the observed levels of contamination could affect the health of Port Colborne residents, no study has directly evaluated the health of all residents. Continued community concerns about the potential human health effects resulting from this contamination led to the development of the Community Health Assessment Project (CHAP), an integrated series of health assessment studies. In this report, we characterize hospital discharge patterns for Port Colborne and compare these to what was reported for a group of Ontario communities and for the province of Ontario. The comparison was performed to determine whether hospital discharge patterns in Port Colborne are different than what may be expected, and to generate hypotheses to be addressed in possible subsequent research.

Methods

Our primary reference population consisted of a series of 35 Ontario communities. They were selected based on similarity to Port Colborne with respect to the joint distribution of a number of sociodemographic variables measured in four Canadian censuses (1981, 1986, 1991 and 1996). Many of these variables are recognized determinants of health, and have been previously used to identify regions for the purposes of comparing health outcomes between areas with similar sociodemographic characteristics. Those communities that were in close proximity to Port Colborne (<50 km) were excluded in the selection of comparison communities as we sought to restrict our reference group to communities whose residents were unlikely to have spent any time in Port Colborne. However, aside from this rationale, additional post hoc comparisons were undertaken in this study to compare discharge patterns among Port Colborne residents to those in nearby communities in the Niagara region, in order to put the results of the comparison to the 35 communities into a regional context. Communities with environmental concerns relevant to respiratory conditions were identified and assessed for their potential impact on the results obtained from the comparison communities. Although comparisons were also made to overall provincial rates, the use of the comparison communities allowed us to better evaluate the potential confounding role of several socio-demographic variables, albeit at an ecological level.

Aggregate counts of hospital discharges were extracted from the Discharge Abstract Database of the Canadian Institute for Health Information. These counts were tabulated for 18 different health conditions across strata defined by age group, sex, calendar year and

community. Provincial summary counts across these same strata were also obtained, and in conjunction with the discharge counts, are used to estimate discharge rates. Hospital discharges for the following health conditions, listed by ICD-9 chapters, were examined:

- All causes (001-999)
- Malignant neoplasms of respiratory and intrathoracic organs (160-165)
- Diseases of the nervous system and sense organs (320-389)
- Diseases of the circulatory system (390-459)
- Non-malignant diseases of the respiratory system (460-519)
- Diseases of the digestive system (520-579)
- Diseases of the genitourinary system (580-629)
- Diseases of the skin and subcutaneous tissue (680-709)
- Injury and poisoning (800-999).

Additional comparisons were performed for selected conditions contained within the defined disease groupings.

The aggregate number of hospital discharges for each health condition was provided for residents of 1) Port Colborne, 2) 35 comparison communities, 3) 11 communities in the Niagara region and 4) the province of Ontario.

Discharge counts were compared using annual age- and sex-specific population census estimates that were obtained for each community and for Ontario. For each health condition, Poisson regression, with correction for correlation in the data (where possible), was used to estimate the ratio of disease-specific discharge rates between the following regions:

- Port Colborne and the combined discharges from 35 Ontario comparison communities
- Port Colborne and the combined discharges from the 11 communities in the Niagara region
- Port Colborne and Ontario.

The comparison of primary interest was that which used the comparison communities as the referent group. This is mainly because these communities were matched to Port Colborne on several socio-demographic variables, and thus were better able to adjust for the potential confounding role that differences in these characteristics may have had on rate ratios.

One of the assumptions of Poisson-distributed data is that events occur independently of one another. However, hospital discharge events are not likely to be independent as an individual who is sick may be more likely to return to hospital for the same condition. In other words, hospital discharge events are likely to be correlated among individuals. Data analysis confirmed that there was correlation within the data, or that the data were overdispersed. In order to adjust the model for this overdispersion, a dispersion factor was included in the model (i.e. the dscale option). This option tends to widen confidence intervals, providing a more reasonable estimation of the standard error of the rate ratio.

All rate ratios were adjusted for the effects of age, sex and year. The 95% confidence intervals were calculated to assess statistically significant differences between regions. The regression models further evaluated the potential confounding role of other community level variables, including income, education, smoking prevalence and population-to-physician ratio. Although comparison communities were selected based on variables describing income and education, among others, variability between the comparison communities remained. Therefore, mean income and education were included in the regression analysis to account for residual effects not accounted for in the selection of comparison communities.

Age-, period- and sex-specific analyses were conducted and results are presented overall, across four age groupings (<20, 20-44, 45-64 and 65+ years of age), for males and females and for two calendar periods (1980 to 1989 and 1990 to 2000).

Additional box plot distributions were created post hoc to describe differences in hospital discharge rate ratios that existed between individual communities and to provide additional information for the interpretation of the study results. Box plots were constructed to illustrate the spread of the distribution of rate ratios obtained from comparing discharge rates in Port Colborne and each of the 35 comparison communities relative to the other communities combined. Similarly, separate box plots were created to describe the distribution of rate ratios for Port Colborne and each of the Niagara communities relative to the other communities combined. Two-sample t-tests, weighted by community size, were conducted with these rate ratios comparing Port Colborne to the comparison communities and Port Colborne to the Niagara communities.

Standardized discharge ratios were calculated post hoc for comparisons of hospital discharge rates among Port Colborne residents to Ontario residents. This standardized discharge ratio is the ratio of the observed rate in Port Colborne compared to the rate expected in Port Colborne if residents of this community had the same rates as those observed in Ontario. The standardized discharge ratio was calculated for hospital data including and excluding day surgeries. This analysis provided additional information for interpreting the results of the regression analysis, which is limited in its utility for comparing Port Colborne discharge rates to Ontario discharge rates.

Results

For the Port Colborne to comparison community analysis, overall and stratified analyses indicated that for several of the disease categories investigated, Port Colborne hospital discharge rates were lower than the rates in the comparison communities. A statistically significant adjusted rate ratio of less than one was found for the following disease categories in the overall analysis:

- all causes combined
- malignant neoplasms of the respiratory and intrathoracic organs
- diseases of the nervous system
- diseases of the circulatory system

- cerebrovascular disease
- diseases of the digestive system
- diseases of the genitourinary system
- non-malignant diseases of the respiratory system
- other diseases of the respiratory tract
- chronic obstructive pulmonary disease and allied conditions
- diseases of the skin and subcutaneous tissue
- injury and poisoning.

Stratified analysis of these conditions were consistent with the above and had either lower discharge rates or rates that did not have a statistically significant rate ratio. One exception was chronic obstructive pulmonary disease and allied conditions, which had a higher rate ratio in the youngest age group (<20 years).

Only a few of the disease categories investigated showed that Port Colborne hospital discharge rates were higher than the rates in the comparison communities. In the overall results, these conditions were:

- ischemic heart disease
- acute respiratory infections.

Stratified analyses indicated that Port Colborne had higher rates than those in the comparison communities for:

- ischemic heart disease (20-44 years, ≥65 years, both sexes and both periods)
- acute respiratory infections (≥20 years, both sexes and both periods)
- COPD and allied conditions (<20 years)
- asthma (<20 years, ≥65 years and 1990 to 2000).

The overall analysis of Port Colborne and the Niagara discharge rates showed that for most conditions, there was no difference in the rates between the two groups.

The overall analysis showed that Port Colborne hospital discharge rates were lower than the rates observed in the Niagara communities for four of the 18 disease categories:

- diseases of the nervous system
- diseases of the genitourinary system
- other diseases of the respiratory tract
- diseases of the skin and subcutaneous tissue.

Stratified analyses of these four conditions were consistent with the above, and indicated Port Colborne rates were either no different or lower than the other Niagara communities.

Port Colborne hospital discharge rates overall were found to be higher than the rates observed for the Niagara communities for three of the 18 disease categories:

- ischemic heart disease
- acute respiratory infections
- pneumonia/influenza.

Stratified analysis indicated higher rate ratios for several disease categories, including:

- all causes (1990 to 2000)
- malignant diseases of the respiratory system (20-44 years, 1980 to 1989)
- diseases of the circulatory system (≥20 years)
- ischemic Heart Disease (≥20 years, both sexes, both periods)
- acute mycocardial infarction (45-64 years, males)
- cerebrovascular disease (males)
- acute respiratory infections (≥45 years, females, 1980 to 1989)
- pneumonia and influenza (20-44 years, females, 1990 to 2000)
- chronic obstructive pulmonary disease and allied conditions (<20 years)
- asthma (<20 years)
- injury and poisoning (20-44 years).

Box plots created post hoc show that Port Colborne rate ratios fall within the box encompassing the middle 50% of the rate ratios for all the comparison communities. In many instances, the Port Colborne rate ratios fell below the median rate ratio. This is consistent with the analysis results reported above. Two-sample t-tests comparing rate ratios indicate that Port Colborne's rate ratios for all disease categories, overall and stratified by age group, sex and study period were not statistically significantly different than those of the comparison communities. Similar results were observed for box plots and two-sample t-tests including data for the Niagara communities. T-tests, however, lack the sample size required for sufficient power to detect differences.

Ontario comparisons were varied. Over half of the results indicated that Port Colborne had a higher rate of discharges than the Ontario population. These results, however, were not adjusted for several potential confounding variables and the confidence intervals likely underestimate the error associated with the rate ratios, as they have not been adjusted for overdispersion in the data. Many of the results of the Ontario comparisons were consistent with the other comparisons.

Summary

Several study design limitations are considered in the interpretation of the results. These methodological considerations include the lack of data at an individual level and the inability to control for the effects of disease-specific risk factors. Regional differences in the treatment or management of disease likely contribute to important differences in hospital discharge rates. The data do not allow us to take into account residential mobility

patterns and, therefore, cannot identify those discharges that occurred among long-term residents in a given community. Finally, while we were able to control for the prevalence of smoking at a health region level, such adjustments were crude and it is possible that individual differences in smoking behaviours and exposure to environmental tobacco smoke may have contributed to some of our observed differences.

In general, hospital discharge rates for Port Colborne were found to be lower or no different than the comparison communities and the Niagara communities. Post hoc analyses are consistent in most instances with the initial results. Higher rates of hospital discharges were observed in both comparisons for ischemic heart disease and acute respiratory infections. Stratified analysis of chronic obstructive pulmonary disease and asthma identified higher rates of hospital discharges for the <20 years age group. The findings of these four disease categories were consistent across all methods of analysis, including the Ontario comparison.

The limitations within the study design (e.g., residual effects of important confounding variables) may contribute in part to the observed findings. Further, although the issue of multiple comparisons was not adjusted for in this study, it has been reported that observational studies that consider several exposures, outcomes and subgroups may be prone to finding spurious results. In many studies, 20% or more of the findings may be erroneous, rather than the expected 5% false positive associations ($p < 0.05$).

Finally, this study was designed to investigate whether hospital discharge rates for Port Colborne are different from what may be expected based on comparisons to suitable referent populations. In so keeping, differences observed highlight the need for considering these results in conjunction with those results from CHAP Study A and with the purpose of this study in the context of the entire suite of proposed CHAP studies.

Recommendations

Higher hospital discharge rates observed for Port Colborne for ischemic heart disease, acute respiratory infections, chronic obstructive pulmonary disease and allied conditions and asthma should be evaluated as potential candidates for further research.

Keywords: hospital discharge rates, environmental pollution, ecological study

1. INTRODUCTION

1.1 Background

The City of Port Colborne is located on the northern shore of Lake Erie in the province of Ontario. The city is the southern-most port of the Welland Canal, and has long been associated with traditional shipping lanes along the St. Lawrence Seaway. With a population of approximately 18,500 (as of 2001), Port Colborne encompasses a land area of 123 square kilometres.[1] Based on previous censuses, the size of this community has remained relatively stable over the last 15 years, with the population increasing by fewer than 500 people between 1986 and 2001.

In the past 100 years, several industrial processes have operated within Port Colborne, including flour mills, grain mills, iron works, cement manufacturers and metal foundries. According to reports issued by the Ontario Ministry of the Environment (MOE), the operation of a nickel refinery owned by INCO Ltd. during the period from 1918 to 1984 contributed to environmental contamination in the area.[2]

The association between public health and environmental contamination has been a recurring issue for Port Colborne. There has been a significant level of community involvement in the design and development of a process to determine whether human health is associated with industrial contamination. Community members initially requested an environmental risk assessment, the Community-Based Risk Assessment (CBRA), and remain actively involved through participation in meetings of the Public Liaison Committee. The design of the present study was based on community concerns and the health conditions associated with occupational exposures to the chemicals of concern (CoCs), which include nickel, arsenic, copper and cobalt.

As defined by the CBRA,[3] a CoC is a chemical found in Port Colborne that:

- originates from an industrial source in which the chemical was used or was generated by industrial processes
- shows a scientific linkage to the historical operations of that industrial source
- is present within the community at concentrations greater than generic-based guidelines.

Through extensive soil sampling studies conducted in Port Colborne by the MOE, the four CoCs (nickel, arsenic, copper and cobalt) have been identified as having arisen from refining operations.[4] These sampling studies have also concluded that the primary route of human exposure to these CoCs in Port Colborne occurs through soil.[2]

The CBRA does not include human health studies that directly measure medical health status, and is therefore unable to address the community's concerns regarding the potential for the CoCs to affect human health. To address these medical health status concerns, the Community Health Assessment Project (CHAP) was developed.

To identify those health outcomes of concern to the community, the CHAP began by surveying a random sample of adult community members (n=959). The top health concerns among survey respondents were cancer (86.3%) and respiratory problems (73.6%). These outcomes, as well as the identification of other health outcomes based on scientific literature, were used in the development of the CHAP framework.

This report summarizes data from existing registry databases to characterize hospital discharge patterns for Port Colborne. The study was conducted to generate hypotheses to be addressed in possible subsequent research.

1.1.1 Framework for Community Health Assessment

The research objectives of the CHAP encompass converging health assessment strategies, including population-based registry databases, general and comprehensive health questionnaires, and possible medical testing. The integration of the findings from this series of studies will allow for an improved understanding of whether potential exposure to the CoCs may affect the health of the community of Port Colborne. The four planned CHAP studies are listed below.

Study A: A self-reported health assessment of the Port Colborne community

Study B: Case-control study(ies) of selected health conditions using a population-based sample of Port Colborne residents [if warranted]

Study C: A comparison of hospital discharge patterns among Port Colborne residents to those in a series of Ontario reference communities

Study D: Cancer incidence and mortality in a historical cohort of Port Colborne residents

The overall objectives of the CHAP body of research are to:

- determine whether the health of the Port Colborne community is different from that of the general population
- improve our understanding about the relationship between the health of Port Colborne residents and their potential environmental exposure to nickel, arsenic, cobalt and copper (the CoCs).

1.2 Research Objectives

This study was undertaken to determine whether Port Colborne residents have different hospital discharge rates for selected diseases relative to normative data. Two sets of comparisons were performed:

1) Overall, hospital discharge rates for Port Colborne residents were compared to rates among Ontario residents between 1980 and 2000.
2) Hospital discharge rates for Port Colborne residents between 1980 and 2000 were compared to rates from a series of Ontario comparison communities; these comparison communities were similar to Port Colborne with respect to several sociodemographic variables.

Where possible, these comparisons were adjusted for differences in age, sex, smoking prevalence and access to health care facilities in the different populations.

Post hoc analyses included additional comparisons to the communities in the Niagara region, and were added for additional context.

1.3 Rationale

The CHAP series of studies was designed to examine the health effects of possible exposure to CoC contamination in the community of Port Colborne. The present study (CHAP C) was planned to determine whether hospital discharge rates for selected health conditions among Port Colborne residents were different than expected. CHAP C was designed to generate hypotheses that could be evaluated in subsequent research examining the relationship between exposure to the CoCs and health status. In this way, if the health of the community were different than expected concerning those health issues plausibly related to the CoCs, then further research would be required to collect detailed information on exposure, along with objective assessments of medical health status.

To determine whether hospital discharge rates for selected health conditions among Port Colborne residents were different than expected, hospital discharge rates reported for Port Colborne residents over a 21-year period (1980 to 2000) were compared to those rates for residents of a number of Ontario communities. These communities were selected based on their similarity to Port Colborne with respect to an extensive listing of sociodemographic characteristics as measured in Canadian censuses.

Given that this study was not intended to draw conclusions about whether exposure to the CoCs is directly related to hospital discharges, we have not included a detailed review of the toxicological properties of the CoCs and associated findings obtained from animal and human studies. However, given the relevance of the CoCs to the overall objective of the CHAP, this section provides a brief summary on:

- environmental (i.e. non-occupational) sources of exposure to the CoCs in Port Colborne
- health conditions for which associations with the CoCs have been reported (primarily in occupational settings), and an identification of other risk factors for these conditions
- a summary of previously conducted research in Port Colborne relevant to the objectives of this study.

1.3.1 Chemicals of concern

Human exposure to the CoCs (nickel, arsenic, cobalt and copper) is possible through several routes, including inhalation, ingestion (oral) and dermal contact. An individual's relevant exposure to environmental contaminants may be the function of several characteristics, including age, gender, route of exposure and both the duration and intensity of exposure.

The MOE conducted a number of investigations to document the impact of pollution from the INCO nickel refinery on soil and vegetation in Port Colborne. The source of the contamination was found to be historic atmospheric deposition associated with refining

procedures.[4] With plant closures in 1984 and the elimination of refining processes in Port Colborne, recent deposition has been reduced substantially and newly landscaped properties have not become re-contaminated.

The majority of the Port Colborne exposure assessment studies focused on measuring CoCs in soils. Extensive sampling throughout Port Colborne has found levels of nickel, cobalt and copper that are above the phytotoxicity soil guidelines of 43 µg/g.[4] In a few areas, soil concentrations of arsenic exceeded background ranges; increased levels of arsenic are believed to be associated with emissions from INCO and sintering operations conducted by Algoma Steel Inc.[4]

The MOE has concluded that the primary source of potential exposure to CoCs in Port Colborne is through soils. Specifically, it has been estimated that ambient air and drinking water exposures account for less than 1% of the total exposure from nickel, cobalt and copper.[5]

1.3.2 Health conditions associated with the CoCs

Exhibit A1 and Exhibit A2 present the health conditions for which associations with the CoCs have been reported. This list was produced from a review of the scientific literature and abridged toxicological reports previously assembled for local area physicians.[6-9] The evidence linking CoC exposure and adverse health outcomes has come largely from occupational cohorts, where the exposures are recognized to be considerably higher than those obtained from environmental sources. By consulting relevant review articles, known or suspected risk factors have also been listed for each condition.

1.3.3 Previous research conducted in Port Colborne

Few studies have investigated the prevalence of adverse human health effects arising from CoC exposure either at the levels that have recently been observed in Port Colborne soils or from potential air exposure occurring greater than 20 years ago. More commonly, epidemiological studies have been carried out in occupational settings where exposure levels are considerably higher. For example, the relationship between exposure to the CoCs and mortality has been evaluated in a historical cohort study of INCO workers engaged in the mining, smelting and refining of nickel.[10] In the scientific literature, diseases found to be associated with the CoCs have included non-malignant and malignant respiratory disease, diseases of the circulatory system, diseases of the nervous system and sense organs, diseases of the skin and subcutaneous tissue, and reproductive outcomes.

The MOE and the Niagara Department of Health conducted an environmental risk assessment in Port Colborne in 1997. Based on measured soil levels and the existing scientific literature, this study concluded that "no adverse health effects are anticipated to result from exposure to nickel, copper or cobalt in soils in the Port Colborne area."[5] This conclusion was augmented in the same study with a review of population health data that did not indicate any adverse health effects resulting from environmental exposures. The evaluation of the population-based registry data focused on adverse reproductive outcomes and cancer incidence. No direct measures of health status among residents were used.

Two phytotoxicology soil investigations were conducted within Port Colborne in 1998 and 1999.[11,12] Because of community concern over the findings of these studies, an additional environmental risk assessment was conducted specifically for the Rodney Street community.[4] This community is defined as the residential area east of the Welland Canal to the INCO refinery and south of Louis Street to Rodney Street. The study made use of environmental monitoring data and toxicological information to estimate exposures and potential health effects from the CoCs and included no direct measures of health status.

The only studies that directly involved community members were (i) a biological monitoring survey of a limited number of Rodney Street residents (65 in total)[13] and (ii) a blood lead screening study of the same population.[14] These studies did not measure health status among participants.

1.4 Study Strengths and Limitations

At a community level, this study will identify those health conditions for which there are a higher or lower number of hospital discharges in Port Colborne. The use of a population-based registry allows for the near-complete identification of hospitalizations and the examination of trends in hospitalization over an extended period (1980 to 2000). Furthermore, patterns of hospitalization can be simultaneously examined for several different diseases. Finally, the study design allows for the comparison of hospital discharge patterns between residents of Port Colborne and those of several other regions (comparison communities, the Niagara region and Ontario).

A number of limitations are associated with this study, the most important of which include:

- only those conditions that are severe enough to warrant hospitalization are captured in this study; findings from this work should therefore be used to complement other health outcome measures (i.e. incidence and prevalence)
- data were analysed at an aggregate level rather than at an individual level and, therefore, the study is subject to several forms of ecological bias
- the rate ratios could not be fully adjusted for community differences in:
  - access to care, cigarette smoking, diet, physical activity, obesity
  - underlying mortality rates
  - hospital admission policies and disease management
- the aggregate data provided do not allow for determining whether observed differences in rates are due to higher numbers of individuals being hospitalized or higher rates of readmission
- the coding of the discharge based on the MRDx is subject to misclassification; if differential coding errors exist between regions, this could bias the presented rate ratios in either direction
- no analysis was done on the role of air pollution or the effects of residential mobility
- the interpretation of standard errors and confidence intervals should be done cautiously due to limitations inherent in the data analysis techniques.

2. METHODS

2.1 Overview of Study Design

CHAP Study C makes use of annual hospitalization data collected in the Discharge Abstract Database (DAD) maintained by the Canadian Institute for Health Information (CIHI). Aggregate hospitalization data were provided for 18 health conditions across strata defined by calendar year (1980 to 2000), sex, age group and residence code. The residence code represents the census subdivision (CSD) where the patient lived at the time of discharge. Community-level population estimates were obtained from Statistics Canada in order to calculate hospital discharge rates.[15]

The health conditions were defined by the International Classification of Disease, 9th revision (ICD-9) codes that describe the most responsible diagnosis at the time of discharge. Some of these health conditions have been identified in the scientific literature as being associated with occupational and environmental exposure to the CoCs (see Exhibit A1 and Exhibit A2).

The health conditions included in this study are listed below:

Disease Group	ICD-9 Code
All causes	001-999
Malignant neoplasms of the respiratory and intrathoracic organs	160-165
Diseases of the nervous system and sense organs	320-389
Diseases of the circulatory system	390-459
Ischemic heart disease	410-414
Acute myocardial infarction	410
Heart failure	428
Cerebrovascular disease	430-438
Non-malignant diseases of the respiratory system	460-519
Acute respiratory infections	460-466
Other diseases of the upper respiratory tract	470-478
Pneumonia and influenza	480-487
Chronic obstructive pulmonary disease and allied conditions	490-494 and 496
Asthma	493
Diseases of the digestive system	520-579
Diseases of the genitourinary system	580-629
Diseases of the skin and subcutaneous tissue	680-709
Injury and poisoning	800-999

A complete listing of the health conditions that are contained within each ICD-9 disease group can be found in Exhibit A3.

Hospital discharge rates for Port Colborne were compared to the 35 comparison communities and the province of Ontario. These analyses were conducted for data based

on discharges that both included and excluded day surgeries. Emphasis in this report is placed on the analyses that excluded day surgeries (inpatients only), because day surgeries are not considered to be related to the health conditions being investigated as possibly associated with the CoCs.

Post hoc analyses requested by the Technical Sub-Committee included:

1) A comparison of Port Colborne hospital discharge rates to rates in the 11 other Niagara communities.
2) Boxplots of the rate ratios generated from the analysis for each of Port Colborne, the comparison and the Niagara communities to show the distribution of rate ratios.
3) Two-sample t-tests of the individual community rate ratios estimated from the analysis were performed comparing Port Colborne to the group of comparison communities and Port Colborne to the group of Niagara communities.
4) The calculation of standardized discharge ratios for comparisons to Ontario.

2.2 The Selection of Comparison Communities

The method of matching Port Colborne to communities with similar socio-economic characteristics was designed to reduce the potential confounding effect that these characteristics might have on regional comparisons of hospital discharge rates. Primarily, a single comparison of discharge rates among Port Colborne and Ontario residents cannot adequately control for considerable variability in the socio-economic characteristics.[16] The influence of socio-economic status on an individual's health status[17] and health care utilization is well documented.[18-21] Socio-economic measures such as income, employment, education and ethnicity have been associated with lifestyle factors known to affect health including smoking, stress, diet and exercise.[17] These lifestyle factors are predictors of morbidity for health conditions including coronary heart disease,[22] obesity,[23,24] psychological distress[25] and respiratory illness.[26] Geographical area characteristics have also been associated with morbidity and hospital utilization.[27-29]

The degree of comparability between Port Colborne and the comparison communities created by the matching method is determined by the relevance of the array of variables used in the matching process. In this case, the variables are those representing several of the socio-economic characteristics known to be important determinants of health. Matching on these factors balances the comparison groups (i.e. Port Colborne vs. comparison communities) with respect to the prevalence of these factors. This consequently reduces the potential for bias in comparisons to an unmatched comparison community group. Although the groups have been matched on several important factors, there exists the potential for groups to remain unbalanced with respect to other factors that may contribute to the health status of the communities. In addition, groups may be partially balanced for those factors on which they were matched.

The methods used to identify the comparison communities are briefly discussed below. A more detailed description is available in a separate document.[30]

2.2.1 Inclusion criteria of Ontario communities

The socio-economic characteristics of Ontario communities are captured in the Canadian census, which is administered every five years. Four censuses were conducted during the study period: 1981, 1986, 1991 and 1996. On average, there were approximately 900 CSDs in Ontario in each census.[1] Municipalities or CSDs were considered eligible for selection as a comparison community if they were listed in each of these four censuses. First Nations reserves were excluded from the candidate list of comparison communities due to known differences in the health status of these populations.[31] Furthermore, risk factor data for these populations are not readily available as they are typically excluded from provincial and national survey sampling frames. Among the 728 CSDs that satisfied the above inclusion criteria, one community was dropped because it lacked data for some of the key socio-economic characteristics. Thus, a total of 727 CSDs were considered as candidates for the series of comparison communities.

2.2.2 Selection of socioeconomic variables

The socio-economic characteristics used for the selection of comparison communities were identified based on the associations observed in the literature (see Section 2.2). Similar variables were used by Statistics Canada to construct health region peer groups.[16] A total of 24 variables were identified for selecting the comparison communities, including age distribution, household income, population and rate of growth, population density, unemployment rate, immigration, proportion of English speakers, proportion of high school graduates (≥15 years of age) and male-to-female ratio. For each variable, estimates of the average value for each community across all four censuses were calculated. Also calculated were estimates of the annual rate of change (i.e. the slope) for all variables excluding "population change," as this variable itself represents change. Comparison communities were selected using a total of 47 predictor variables (i.e. 24 census + 23 annual rate-of-change variables), which are listed in Exhibit A4.

2.2.3 Statistical methods

Discriminant analysis was used to identify which of the 727 Ontario communities were most similar to Port Colborne with respect to the 47 census-derived predictor variables. The discriminant analysis was applied to the 728 communities (including Port Colborne) using two membership groupings: Port Colborne or not. The Mahalanobis Distance was calculated from each community to Port Colborne using parameter estimates obtained from the discriminant analysis. Those communities with the smallest Mahalanobis Distance were considered to be most similar to Port Colborne.

Among those communities with the smallest Mahalanobis Distance, a subset were removed that were within 50 kilometres of Port Colborne (Niagara-on-the Lake, Niagara Falls, Welland, Thorold, Fort Erie, St. Catharine's and Grimsby). These communities were excluded because their residents may have worked or spent a significant amount of time in Port Colborne.

2.2.4 List of communities used in the analysis

The final listing of the 35 comparison communities is provided in Exhibit A5. The number of comparison communities selected ensured that the combined population would provide the power necessary for their combined rates to be compared to Port Colborne. The socio-economic characteristics of Port Colborne were more similar to the overall average of the comparison communities than to the Ontario average (see Exhibit 1). For example, the mean community income values were formally compared by using a Student's t-test. The mean income for Port Colborne across the four Canadian census years was significantly different from the corresponding mean across all Ontario communities ($p<0.05$), yet not significantly different from the mean value across the 35 comparison communities. It is possible that there was insufficient power to detect a statistically significant difference between Port Colborne and the comparison communities, although the mean values appear very similar. Therefore, our selection process of comparison communities had the desired feature of choosing those communities with income levels similar to those of Port Colborne. Nonetheless, considerable variability in community income across the comparison communities existed. To account for this variation, our regression models have presented rate ratios that have been adjusted for community levels of income. As examples, the range of values for individual comparison communities for education and average income variables is shown in Exhibit A13.

Exhibit 1: Sociodemographic characteristics for residents of Port Colborne, the comparison communities and Ontario

Socio-economic characteristic	Port Colborne[a]	Comparison Communities[b]	Ontario[a]
Population	18,600	17,605	12,301[c]
Population over 65 years of age	16%	15%	11%
Population under 15 years of age	19%	20%	21%
Residents speaking English	81%	80%	77%
Average family income	$37,736	$37,021	$46,688
Proportion of lone parent families	12%	11%	12%
Unemployment rate	11%	11%	8%
Proportion of the population (≥15 years) who did not complete high school	50%	53%	40%

a All values are based on an average of data from the 1981, 1986, 1991 and 1996 censuses.
b All values are based on an average of the 35 comparison communities, using data from the 1981, 1986, 1991 and 1996 censuses.
c Based on the average population size of all Ontario communities in the 1981, 1986, 1991 and 1996 Canadian censuses (excluding Port Colborne and the comparison communities).

Comparison communities with environmental concerns

Environmental pollution and contamination may be linked to patterns of respiratory conditions in some Ontario communities. For example, residential proximity to pulp and paper mills, such as in Thunder Bay, has been linked to an excess of cough and respiratory infections.[32] In mining towns, excess rates of several respiratory conditions have been observed among community residents for asthma,[33] decreases in maximal expiratory flow rates[34] and respiratory cancer.[35-37] This evidence prompted the need for evaluating whether environmental contamination in the comparison communities might affect the rate ratios for respiratory conditions.

Investigators from the MOE were approached to provide expert advice as to environmental contamination issues in Ontario communities. The investigators based their assessment of the comparison communities on previous investigations of suspected impacts of atmospheric emissions on soil and vegetation in any of these communities.[38] This discussion identified the following comparison communities and their associated environmental concerns:

Community	Exposure
Matachewan	gold mining activity
Sault Ste. Marie	polycyclic aromatic hydrocarbon emissions from Algoma Steel Inc.
Sudbury	elevated soil levels of nickel, arsenic and copper
Kirkland Lake	gold mine tailings
Thunder Bay	large pulp and paper industry
Red Lake	historic mining activity, tailings with low arsenic levels
Nairn	INCO smelter at nearby Copper Cliff
Stoney Creek	dioxin and furan emissions from the Soil and Waste Reduction Unit incinerator

Many of the exposures identified in the above list are localized, and are therefore unlikely to affect the respiratory health of the entire community. These communities are identified in subsequent box plots.

2.3 The Discharge Abstract Database

Background

The DAD has been used by many researchers to examine population-based health care information on various health conditions.[39-45] It was initially developed in 1963 to collect information on hospital discharges in Ontario, but now includes all acute care hospital discharges in participating provinces. Discharges can be categorized into those for acute/active (inpatient) treatment, day surgeries, rehabilitation, chronic care and other. In 2001, inpatient stays and day surgeries accounted for the vast majority of discharges, at

48.8% and 49.6% of all discharges, respectively. This database does not contain records of outpatient or emergency events in instances when a patient is not admitted. In its current form, the DAD includes data from the fiscal years 1979/1980 to the present. At the time this study began, data were only available until 1999/2000.

Over four million records are submitted to the DAD annually. Approximately 75% of all inpatient records across Canada are recorded in this database.[46] The DAD contains all abstracted acute inpatient data for seven provinces, 85% of data for Prince Edward Island, and 40% of data for Manitoba. Quebec does not contribute any data directly to the DAD. However, the level of services received by Ontario residents outside of Ontario has been estimated to constitute less than 1% of all procedures performed.[47] As such, for comparisons within Ontario, hospital discharges that occur in other provinces are unlikely to affect our findings.

The coverage of the DAD is thought to be excellent. Hospitals have been mandated by their respective provincial or territorial Ministry of Health to submit all discharge abstracts to the DAD each fiscal year. Furthermore, hospitals are bound by legislation to maintain a record for all patients seen in hospital and, for most provinces, the level of hospital funding is dependent on the comprehensive submission of data by that hospital.[46,48]

Abstraction and submission of data in the DAD

CIHI has summarized the information flow for the DAD in a flowchart (see Exhibit A37). Each facility submits an abstract to CIHI for each patient that is discharged, such that the DAD reflects the degree of hospital activity rather than the volume of patients. The abstract describes the demographic characteristics of the discharged patient in terms of age, sex, date of discharge and place of residence at the time of hospitalization. The reason for hospitalization is captured in the MRDx code that is assigned by the patient's physician using an ICD-9 code.[49,50] The abstract also records up to 15 secondary diagnoses associated with the patient's stay.[50] Secondary diagnoses include conditions that the patient had prior to admission or that arose during the hospital observation or treatment. In either case, these co-morbidities are considered to have a significant influence on the length of stay in hospital or influence the course of treatment of the patient while in hospital. The attending physician is required by law to assign both the MRDx and the secondary diagnoses associated with the medical reasons for hospital stay. In keeping with the practices of similar studies,[51,52] this study only considered the MRDx.

Determination of place of residency using the hospital discharge data

Discharges in the abstract database are based on the Ministry of Health (MOH) residence codes. For the purposes of our analyses, each residence code was converted to a Statistics Canada 1996 standard geographic code in the form of a CSD. In most cases, the conversion from residence code to CSD code was a one-to-one match. In the case where the MOH residence code was missing but the postal code or Forward Sortation Area was available, this information was converted to the 1996 CSD code using the Statistics

Canada Postal Code Conversion File[53] (see below). This conversion was performed at Health Canada.

Boundary changes were considered in these conversions. Because 12 communities were amalgamated after the 1996 census, no 1996 standard geographic code, and consequently no CSD, could be assigned and they were censored from the analyses at the year of amalgamation. These communities were: McCrosson and Tovell, Harrow, Leamington, Sudbury, Atwood, West Lorne, Red Lake, Mersea, South Gosfield, North Monaghan, Oakland and Airy. In two communities, The Archipelago and Sherwood Jones and Burns, residence codes were not available until the early to mid 1980s due to delays in the implementation of the MOH residence codes. Thus, the entry of these two communities into the analysis dataset was delayed by two and five years, respectively. The interval that each community contributes to the data is listed in Exhibit A5.

The completeness of the MOH residency code is high. For example, only approximately 2% of all hospital discharge abstracts in the DAD in 1985 were missing these codes. In this study, the effect of discharge data that were lacking MOH residency codes was minimized. This was accomplished by using postal code information that was available for some of these records. Such data were available for only of a portion of records. For example, in 1985, postal codes were used to impute community of residence for 17% of those records that were missing MOH residency codes.

MOH residency codes, rather than postal codes, were used to define residence at the time of discharge in this study given that, prior to 1985, the completeness of postal code data in the DAD was low, with 1980 postal code data essentially missing.[54] Moreover, for more recent years, a CIHI re-abstraction study revealed that postal codes were incorrectly coded in 5% of the discharge abstracts examined. Although there has been no abstraction study that has evaluated error rates for the MOH residence codes, they likely have smaller error rates. This is due in part to the implementation of strict edits for the MOH residence codes, and the provision of tables that contain the residence codes to each hospital (M. Mistruzzi. Personal Communication, March, 2004). Furthermore, hospital staff who complete the discharge abstracts are more familiar with residence codes. A standard catchment area is represented by a relatively small number of MOH residence codes. By contrast, there are a substantially higher number of postal codes for any given community. For example, in Ontario there are approximately 260,000 postal codes while there are less than 1,000 MOH residence codes. Because the objective of this study was to evaluate patterns of hospitalization in the entire community, the MOH residency variable was the preferred method to determine the place of residence for hospital discharges.

The use of day surgery data

The discharges included in the DAD can be classified into four main categories: inpatient acute care, day surgeries, rehabilitation and chronic care stays. In Ontario, most discharges fall into the day surgery or acute care categories. For example, in 2001, of the approximately total 2.3 million discharges, 49.6% were day surgeries and acute/active

treatment and 48.8% were acute care discharges. Rehabilitation (1.1%), chronic care (0.1%) and other types of stays (1.2%) accounted for the remainder of the discharges. Therefore, the acute care and day surgery discharges determine whether there are regional variations in discharge patterns.

Discharges for day surgery events are less complete. For several surgical procedures, reporting of day surgery events is not mandatory. The annual counts of day surgery events suggest that reporting of these events has not been consistent over time, and undercoverage occurred in the 1980s. For example, in 1980, there were only 70,780 day surgery events recorded in the data whereas in 1990 there were 600,567 (see Exhibit A15). In Ontario, day surgery events are now captured in the National Ambulatory Reporting System. Based on these reasons, including day surgery events in the calculation of rate ratios is important in determining the extent of their influence on such calculations.

Day surgeries accounted for 24% of all discharges in Ontario in the DAD between 1980 and 2000. For some of the conditions examined, day surgeries contributed very little in terms of the overall counts and, as a result, dropping these counts did not change the rate ratios substantially. For diseases of the nervous, digestive and genitourinary systems, day surgeries accounted for a sizeable proportion of discharges at 63%, 41% and 53%, respectively. Frequent day surgery procedures contained within these disease groupings include cataract surgery, upper urinary tract procedures, hernia and endoscopic procedures.

Despite issues with the coverage of day surgery events in the DAD, there are advantages to including them in study comparisons. Hospital discharges are related to changes in health services over time. Over the course of the study period, the rates of inpatient separations increased during the 1980s, while in the 1990s they decreased (see Exhibit A15). The decline in the rate of hospital separations was largely due to restructuring of the health care system in Ontario that resulted in the downsizing of hospitals and changes in management practices designed to reduce the use of hospital beds. For several procedures, same-day surgery practices were implemented to reduce the need for inpatient surgeries. By using all discharges over the study period instead of only impatient stays, one could better account for such changes in health services by community that occurred between 1980 and 2000.

Another important reason for presenting rate ratios based on both day surgery and inpatient stay results from differences in communities with respect to their access to outpatient services. As a result, communities that have less access to outpatient services may have an increased reliance on inpatient admissions.

In summary, it is possible that regional differences in the completeness of day surgery events may contribute to regional differences in discharge rates. Because of this potential bias, analyses were conducted that excluded day surgery events. For many of the health conditions examined, day surgeries accounted for only a small portion of total discharges.

The results of analyses excluding day surgeries are presented in the body of the report and are used as the focus for the interpretation of the results.

Individual-level data in the DAD

In 1992, CIHI began collecting personal identifying information from hospital morbidity in order to enable the linkage of individual-level data files with other databases. Many researchers prefer using data at this level because it allows for an estimation of how many individuals in a given region were hospitalized, in addition to providing an estimate of the total number of health service events. Some advocate using 'first hospitalization' as a means of controlling for non-independence in the data. However, the interpretation of such data can be difficult, especially when an individual is discharged for two different conditions that are related to each other.

Individual-level data were not used in this study for two reasons. Primarily, individual-level data are available only for recent years, thus it would not have been possible to investigate patterns of hospitalization going back to 1980, a time when CoC levels were higher. Due to Canadian privacy laws, permission to obtain individual level data is subject to an extensive review by CIHI that does not guarantee access to such data. Therefore, to avoid considerable delay in conducting this study, aggregate level data were used.

2.3.1 Population estimates

Annual population estimates of Port Colborne and each of the comparison communities were used to calculate discharge rates from the hospital discharge counts provided in the DAD. Population estimates were available from each of the Canadian censuses. For non-census years between 1980 and 1985, the population estimates for CSDs and the province of Ontario were based on linear interpolation of population estimates obtained from the 1981 and 1986 Canadian censuses. Between 1986 and 2000, Statistics Canada provided annual population estimates at the CSD level. Population data were tabulated by sex and five-year age groupings for Port Colborne, all of Ontario and each of the comparison communities.[54]

2.4 Statistical Analyses

All statistical analyses were conducted using the Statistical Analysis System (SAS) software.[55] The SAS procedure GENMOD was used to perform the regression analyses that compared discharge rates between regions and to generate the rate ratios for each community used in the construction of the box plots. The methodology is described below in greater detail.

2.4.1 Descriptive statistics

For each health condition, the total number of hospital discharges was calculated for four regions: Port Colborne, the comparison communities, Ontario and the Niagara communities. These counts are provided by age group (<20, 20-44, 45-64 and 65+ years of age), by sex and by period (1980 to 1989 and 1990 to 2000). The periods were created

because they divide the study period into two approximately equal time intervals. The counts are provided across each of these strata for data that includes and excludes day surgeries. Counts by individual community for each condition are presented in Exhibit A16 through Exhibit A18.

To illustrate hospital discharge trends over time, line graphs were constructed using age-standardized discharge rates for each health condition on an annual basis for Port Colborne, the comparison communities, the Niagara region and Ontario. The graphs present a three-year moving average of each annual rate based on inpatients only. For example, the 1981 rate is presented as an average of the 1980, 1981 and 1982 rates. The three-year moving average was applied in order to present a more stable estimate of the discharge rates, which vary from year to year. Age-standardization was to the 1991 Canadian census population.

2.4.2 Comparison of discharge rates in Port Colborne to other reference populations

Generalized linear models

Generalized linear models (GLMs) were used to compare hospital discharge rates among Port Colborne residents to rates for residents of the 35 comparison communities, the 11 Niagara communities and all residents of Ontario. Since the comparison communities are similar to Port Colborne on a number of socio-economic characteristics known to affect health status, this report focuses on the findings obtained from the comparison community analyses.

GLMs were used as they extend the traditional linear model to allow for the modelling of outcomes that are not normally distributed, such as the count data used in this study. The output of regression analysis provided estimates of the rate ratio.

Generation of rate ratios

For each health condition under study, rate ratios were estimated using GLMs. The standard errors used to construct the 95% confidence intervals (CIs) of the rate ratios were adjusted for overdispersion by using a scaled deviance. These intervals were examined in order to assess statistically significant differences between regions. Specifically, those intervals that contain the value 1.0 imply that discharge rates in Port Colborne are not statistically significantly different than those observed in the comparison population. Confidence intervals that have lower and upper limits that are both above 1.0 indicate that a statistically significant higher rate of hospital discharges for these types of hospital discharges in Port Colborne was observed. If both the lower and upper confidence intervals are below 1.0, this indicates a statistically significant lower rate of hospital discharge in Port Colborne than in the comparison population.

For the comparison community analyses, communities were classified into one of two regions: Port Colborne or the comparison communities. This dichotomous region variable was the independent variable of primary interest in the regression model. A separate

model was fit for each health condition, with the model containing terms for the interaction of region, sex, period and age group, and additional terms for continuous age, quadratic age and a 7-level period variable (i.e. with each level representing three years). These rate ratios are referred to here as the 'minimally adjusted rate ratio.'

Regressions were also performed in order to compare Port Colborne hospital discharge rates to Ontario. For this comparison, a dichotomous variable was created where the two regions were Port Colborne and Ontario. In this analysis, the rate ratio was adjusted for age and sex only, and the DSCALE option was not applied (see *Count Data and Overdispersion* section below). Although there are limitations with the use of this type of analysis for the Ontario comparisons, this analysis was performed in accordance with the original research objectives, and in the interest of comparing Port Colborne to the province of Ontario as a whole. Additional post hoc analyses comparing Port Colborne to Ontario were included to address concerns associated with this analysis (see Section 2.5.3).

For some health conditions, there were few discharges. For example, there were an extremely small number of discharges ($n \leq 5$) that occurred among those aged <20 for five of the 18 health conditions. These conditions were respiratory malignancies, ischemic heart disease, acute myocardial infarction, heart failure and cerebrovascular disease. These small counts did not allow the multivariable regression models, with adjustment for age categories, to converge. Moreover, in keeping with established CIHI policies, we were unable to report any rate ratios or counts based on such a small number.[56] As a result, the analysis of these five health conditions included only those discharges that occurred among residents 20 years of age and older.

Adjustment of rate ratios for other confounding variables

Variables that were considered potentially confounding were subsequently included in the model. A confounder is a risk factor that is related to the outcome (number of hospital discharges) and the exposure (residence in Port Colborne or not). Potential confounding factors are those identified in the scientific literature as being related to the health outcomes under study. The confounding variables available at a community level and that were included in the statistical analyses were average family income, proportion of residents 15 years and older who did not complete high school, proportion of smokers in the community and population-to-physician ratios. These four variables were added to the model to calculate the adjusted rate ratios. The data sources and methods used for collecting data on potential confounding variables are described in Section 2.4.3 for indices of health care utilization and smoking and Section 2.5.4 for income and education.

Count data and overdispersion

Overdispersion is an important concept in the analysis of count data. Overdispersion, also called extra-Poisson variability, may occur due to correlated errors in time or space, or other forms of non-independence of the observations. If overdispersion is present in a dataset, the standard errors and test statistics will be estimated by ignoring such overdispersion, and adjustments should therefore be made. Specifically, failure to adjust

for overdispersion will result in estimated standard errors that are too small, while providing too much confidence in the results.

We determined whether overdispersion was present in our data by dividing the deviance obtained from the fitting of the Poisson regression model by the corresponding degrees of freedom. Because these ratios were significantly higher than one, study data were overdispersed. To adjust for this extra-Poisson variability we adjusted the standard error of our rate ratios using the scaled deviance. The introduction of a dispersion parameter by using the scaled deviance, however, does not introduce a new probability distribution, but just gives a correction term for testing the parameter estimates under the Poisson model. The models are fit in the usual way, and the parameter estimates are not affected by the value of dispersion parameter, rather the estimated covariance matrix is inflated by this factor.

This method produces an appropriate inference if overdispersion is modest and it has become the conventional approach in Poisson regression analysis. As suggested by McCulagh and Nelder (1989),[57] SAS has implemented the approach to estimate the dispersion parameter as a ratio of the deviance to its associated degrees of freedom by introducing an option "SCALE=" in the model statement of PROC GENMOD. Estimation of the dispersion (scale) parameter is specified by the SCALE=DEVIANCE (=D, or just DSCALE) to appropriately adjust standard errors of regression coefficients. Ignoring overdispersion in the analysis can lead to underestimation of standard errors, and consequent over-statement of significance in hypothesis testing.[58]

2.4.3 Data on confounding variables

Indices of health care utilization

Data on access to health care were acquired from the Canadian Healthcare Association and the Ontario Physicians Human Resources Data Centre (1992 to 1998). A list of the approximate number of hospitals and hospital beds in Port Colborne and in each of the comparison communities is provided in Exhibit A9. Population-to-active physician ratios for Ontario were available at a health planning region level from 1981 to 1983, and at a county level for the years 1984 to 1989 and 1992 to 1998. Active physicians are defined as physicians with a valid and active license from the College of Physicians and Surgeons of Ontario. Physicians who practise out of province and retired physicians with active billing numbers are excluded from these estimates.[59]

A health-planning region is a group of counties. County-level estimates of population-to-physician ratios were at the smallest geographic level available, although larger geographic regions have been identified as suitable levels to approximate the number of physicians available to community residents.[60] This is mainly because residents may sometimes visit a physician whose office or residence is outside of their immediate community but still within their county. This is likely to occur in some of our comparison communities, many of which are small, rural towns. The population-to-physician and population-to-specialist ratios for Ontario, Port Colborne, the Niagara communities and

the comparison communities are provided as an average over the study period in Exhibit A10.

Respondents to the Canadian Community Health Survey (2000/2001) were asked about whether they had any unmet health care needs. These data were reported at the public health unit level and are presented in Exhibit A11 with the comparison communities that correspond to each health unit. These statistics were not used in the regression model, but give context to the varying perception of health care access across Ontario.

Smoking data

The Ontario Health Survey (OHS), conducted in 1990 and 1996/97, was selected for obtaining regional smoking prevalence estimates within Ontario. The data were available by five-year age group and sex. As the data were not available annually, the two sets of estimates were used to impute smoking prevalence estimates between 1980 and 2000. Specifically, the 1990 OHS data were used to represent smoking prevalence between 1980 and 1993, and the 1996/97 OHS data were used to represent prevalence between 1994 and 2000. It should be noted that the 1990 and 1996/97 data used different geographic definitions. The 1990 OHS surveyed all public health units in Ontario, whereas the 1996/97 OHS grouped counties, represented by public health units, into derived health areas. To make the survey data correspond to comparable geographies during the study interval, a new health region variable that represented the same counties in each OHS was developed. Thus, the smoking prevalence in Port Colborne and each comparison community was estimated based on the prevalence of 'never smokers' in the corresponding health region. These health region estimates were weighted by the age and sex distribution of each community. The smoking prevalence estimates are presented by health region in Exhibit A12. The weighted community estimates are presented in Exhibit A6 and Exhibit A7 for each of the comparison and Niagara communities, respectively.

2.4.4 Adjustment for multiple comparisons

With this study, numerous statistical comparisons were conducted. Specifically, rate ratios have been calculated across 18 different health conditions, across two periods (1980 to 1989 and 1990 to 2000), by age group (<20, 20-44, 45-64 and 65+ years of age) and by sex in relation to three populations (Ontario, Niagara communities and comparison communities).

When calculating rate ratios, a 5% level of significance implies that the effects of chance alone could explain the difference five percent of the time. Therefore, when a large number of comparisons are made, many false positive associations will arise simply by chance. Traditionally, the statistical approach to this problem has been to make the level of significance more stringent, such as using a 1% level of significance instead of 5%. However, as succinctly pointed out by Rothman, this approach can create more problems than it was intended to solve.[61]

For one reason, it is not clear why we should assume that chance is a likely explanation for the observed differences. The probability of a Type II error increases as real non-null

associations may go undetected because they fail to meet more stringent criteria. The traditional statistical approach to reduce the p-value reduces false positive findings at the expense of false negatives.[61] Rothman and others recommend that no adjustments be made for multiple comparisons.[62] Rather, each finding should be reported as if it were the sole focus of the analysis, while it should be made clear to the reader how many comparisons are being made, and care should be taken to describe negative findings. Any new finding should be interpreted as being suggestive, while findings that address previously reported associations should not be weaker simply because they are accompanied by many other unrelated comparisons. Rothman provides the following compelling argument for not adjusting for multiple comparisons:

> "The theoretical basis for advocating a routine adjustment for multiple comparisons is the 'universal null hypothesis' that 'chance' serves as the first-order explanation for observed phenomena. This hypothesis undermines the basic premises of empirical research, which hold that nature follows regular laws that may be studied through observations. A policy of not making adjustments for multiple comparisons is preferable because it will lead to fewer errors of interpretation when the data under evaluation are not random numbers but actual observations on nature. Furthermore, scientists should not be so reluctant to explore leads that may turn out to be wrong that they penalize themselves by missing possibly important findings."[61]

Given the exploratory nature of this study, significance levels have not been adjusted for multiple comparisons.

2.5 Post Hoc Analyses

Overdispersion in the data affects the precision of the confidence intervals of the rate ratios, which may be overstated. To provide additional information for interpretation of the results, post hoc analyses were suggested.

2.5.1 Niagara rate ratio analyses

The primary reason for conducting this research was to determine whether Port Colborne had different hospital discharge rates for selected health conditions. These differences could be due to regional trends in access to care and other environmental exposures. As a whole, the Niagara region is known to have higher levels of air pollution. Many of the hospitals in Niagara service patients from several nearby communities and, therefore, admission practices and disease management in acute care settings may be more similar between Port Colborne residents and those of other Niagara communities. For these reasons, and aside from the original rationale for excluding these communities (see Section 2.2.3), post hoc analyses were conducted to compare hospital discharge rates among Port Colborne residents to rates among residents of Niagara communities. Apart from Port Colborne, there are 11 communities in the Niagara region: Pelham, Fort Erie, Niagara Falls, Wainfleet, Welland, Lincoln, Grimsby, West Lincoln, Niagara-on-the-Lake, Thorold and St. Catharines. The calculations of minimally adjusted and adjusted rate ratios were conducted in an identical fashion to the calculations for the rate ratios in the comparison community analysis, as described in Section 2.4.2.

2.5.2 Box plots and two-sample t-tests: Comparison of discharge rates between individual communities

A series of box plots were constructed to demonstrate the distribution of disease-specific rate ratios among the 35 comparison and 11 Niagara communities, and to summarize the variability in discharge rates across the individual communities. The data points in the box plots represent the rate ratio of a given comparison or Niagara community relative to the remaining comparison communities. These rate ratios, based on inpatients only, were estimated using the regression methods described earlier and were adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio. This calculation was performed for each community (including Port Colborne) and health condition, yielding approximately 36 rate ratios per health condition in the comparison community analysis and approximately 12 rate ratios in the Niagara analysis. The number of rate ratios fluctuated across health conditions, as the model would not converge for small communities where hospital counts were low. The communities that are missing from the box plots are provided in Exhibit A56.

Once the rate ratios were calculated, standard methods were used to generate the box plots.[63,64] The Port Colborne ratio is represented with a large black solid circle, while the comparison or Niagara communities are represented with a solid grey diamond. Communities with environmental contamination concerns are represented by a hollow triangle. The 25th and 75th percentiles (Quartile 1 and 3, respectively) of all rate ratios define the lower and upper limits of the box. The short horizontal line within the box represents the median. The vertical line extending to adjacent values on either side of the box indicate the largest and smallest observed rate ratios that are no greater than one-and-a-half times the difference between the 75th and 25th percentiles from the ends of the box. Any value that falls above or below these adjacent values are considered outliers and are not considered typical of the other values in the data set. Each graph was examined to determine where the estimate for Port Colborne fell among the distribution of rate ratios. For rate ratios above the 75th percentile, it was determined that Port Colborne had an excess discharge rate. Conversely, values that fell below the 25th percentile identified where Port Colborne had a lower discharge rate.

Two-sample t-test

It was suggested that a two-sample t-test be applied in order to test whether the rate ratio for Port Colborne was different from the ratios observed for the comparison and the Niagara communities. T-tests were performed using the log of the rate ratios. In order to account for the instability of some of the rates due to small populations, each t-test was weighted by the average population size of each community. This weight ensured that larger communities with more stable rate estimates would have a greater contribution to the outcome.

It should be noted that the comparison communities were not selected for this analysis, but were selected for the initial comparison of Port Colborne to all of the comparison

communities (combined). A greater number of communities would have been selected if this type of analysis was initially proposed to provide the power needed to perform a fair assessment of the rates between communities. In the current analysis of the comparison communities, a p-value of less than 0.05 (indicating statistical significance) would only occur if 33 of the 35 communities had lower rates than Port Colborne.

2.5.3 Standardized discharge ratio

An additional suggestion made by an expert advisory committee was to use standardized morbidity ratios in the Ontario analyses. This method, a standard approach in epidemiology,[65] produces the expected number of discharges that would be observed in Port Colborne if residents of this community experienced the same rates as those observed in Ontario. The ratio of the observed rate to the expected rate in Port Colborne provides a standardized morbidity-type measure, referred to here as the standardized discharge ratio. The standardized discharge ratio was calculated for hospital data including and excluding day surgeries.

These standardized discharge ratios are calculated to provide an alternative method of comparing Port Colborne discharge rates to Ontario rates. Ontario data violate the assumption of the Poisson distribution, which may not be corrected for using the DSCALE option of SAS. This analysis is used to indicate consistencies in results across comparison groups and data analysis methods. However, interpretation of the standardized discharge ratios must be made with caution as they are not adjusted for important confounders.

2.5.4 Adjusting for residual effects of income and education

The selection of comparison communities incorporated matching the communities on factors including income and education, among others. However analyses were adjusted for residual confounding by these factors for two primary reasons: (1) variability of income and education among communities remained after the selection process, and (2) these factors are significant confounders of the determination of health status.

Income

Income is regarded as one of the most important determinants of health and has been shown to be an important predictor of hospital utilization.[27,66,67] There was considerable variation in the average family income across the selected comparison communities, with Port Colborne having a value close to the median (Exhibit A13). To control for the effect that community differences in average family income may have had on our findings, we included a continuous variable in the regression model that represented the average family income for each community. We then examined whether this variable confounded the rate ratios by applying the 10% rule.[68] We also evaluated other income measures, such as the incidence of low income for sensitivity analyses.

The continuous variable for average family income was created using data from the 1981, 1986, 1991, and 1996 Canadian censuses. Income information from each of these censuses was used to assign a mean community income value that varied over the course of the

study period. Specifically, the community income values for the period between 1980 and 1983 were based on data from the 1981 Canadian census, while values for the periods 1984 to 1988, 1989 to 1993, and 1994 to 2000 were based on the three subsequent censuses, respectively.

Education

Education is also considered to be an influence on health status and, subsequently, hospitalization.[66,69] There was considerable variation in our education measure, which was the proportion of residents 15 years of age and over who had not completed high school across the selected comparison communities. Again, the proportion in Port Colborne was close to the median (Exhibit A13). We adjusted for the effects of education using the same methods as for income. Namely, the potential confounding role for education was evaluated by examining the change in the rate ratio that resulted from adding this term to the regression model. The education level for each community was measured in the Canadian census as the proportion of residents ≥15 years of age who had not completed high school. For each community, the proportion for the period between 1980 and 1983 was based on data from the 1981 Canadian Census, while values for the periods 1984 to 1988, 1989 to 1993, and 1994 to 2000 were based on the three subsequent censuses, respectively (see Exhibit A13).

3. RESULTS

3.1 Time Trends of Hospital Discharge Rates in Study Areas

Temporal trends in discharge rates between 1980 and 2000 for the disease categories under study are presented by region (i.e. Port Colborne, the comparison communities, the Niagara communities and Ontario as a whole) in Exhibit 4 through Exhibit 21. Because age-standardized discharge rates are presented as a three-year moving average, data points are available for 1981 (mean of 1980, 1981 and 1982) through 1999 (mean of 1998, 1999 and 2000).

For all causes combined, rates in Port Colborne show a gradual increase over the period from 1980 to 1990 (approximately 20,000 to 24,000 per 100,000), with a slight decline over the subsequent decade (approximately 22,000 per 100,000). A similar pattern is observed for the rates of other regions.

For several disease categories under study, small numbers of discharges and highly variable rates were observed over the time period. These include malignant neoplasms of the respiratory and intrathoracic organs, heart failure, pneumonia/influenza, chronic obstructive pulmonary disease (COPD) and allied conditions, and asthma. For example, the rates observed in Port Colborne for malignant neoplasms of the respiratory and intrathoracic organs ranged from approximately 100 to 160 per 100,000 and fluctuated between similar lows and highs that cycled approximately every two to three years (see Exhibit 5). For COPD and allied conditions, marked increases in rates for Port Colborne were observed between 1985 and 1989 (see Exhibit 18), however increases during this period were not observed in the other study regions, where rates have been declining gradually since 1986. A dramatic increase was observed for asthma discharges among Port Colborne residents between 1981 and 1990, in contrast to the fairly stable rates in the other regions during this time period (see Exhibit 19). After 1990, discharge rates for asthma have been gradually declining in all regions.

Relatively stable rates for Port Colborne and the other regions were observed over the study period for several disease categories, including diseases of the circulatory system, ischemic heart disease, acute myocardial infarction and injury and poisoning.

Declining rates for Port Colborne and the other regions were observed over the study period for cerebrovascular disease, non-malignant diseases of the respiratory system, acute respiratory infections and other diseases of the respiratory tract. Decreases were also observed for diseases of the skin after 1990.

Over the study period, increasing rates were observed for diseases of the nervous system, diseases of the digestive system and diseases of the genitourinary system in Port Colborne and the other regions. For diseases of the nervous system in Port Colborne, decreases in discharge rates were noted between 1991 and 1994, while increases continued during this period for the other regions (see Exhibit 6). For diseases of the digestive system, a peak

occurred in Port Colborne in 1996, where the rate was approximately 3,600 per 100,000 (see Exhibit 12). Hospital discharge rates for diseases of the genitourinary system were observed to increase slightly among Port Colborne residents, with a peak in 1986 (see Exhibit 13).

3.2 Comparisons of Port Colborne Hospital Discharge Rates

3.2.1 Port Colborne vs. comparison communities

Exhibit 22 through Exhibit 39 present both the minimally adjusted and adjusted rate ratios estimated from regression analyses, which compared the hospital discharge rates between Port Colborne and all of the comparison communities combined. The minimally adjusted rate ratios have been adjusted for sex, age and study period, while the adjusted rate ratios have been adjusted for the same variables with the addition of average family income, proportion of residents 15 years and older who did not complete high school, proportion of non-smokers in the community and the population-to-physician ratios. This section presents the adjusted rate ratios, with additional data provided in the appendix. The additional data consist of rate ratios that include day surgery discharges (see Exhibit A19 through Exhibit A36). The differences between the rate ratios that include and exclude day surgery data is provided for each health condition in Exhibit 58.

Rate ratios

Port Colborne hospital discharge rates were lower than the rates of the comparison communities, overall, for 12 of the 18 disease categories investigated (see Exhibit 58). A statistically significant adjusted rate ratio of less than one was found for the following disease categories:

- all causes combined
- malignant neoplasms of the respiratory and intrathoracic organs
- diseases of the nervous system and circulatory system
- cerebrovascular disease
- diseases of the digestive system and genitourinary system
- non-malignant diseases of the respiratory system
- other diseases of the respiratory tract
- chronic obstructive pulmonary disease and allied conditions
- diseases of the skin and subcutaneous tissue
- injury and poisoning.

Adjusted rate ratios ranged from 0.50 (95% CI=0.42, 0.60; see Exhibit 34) for other diseases of the respiratory tract to 0.91 (95% CI=0.88, 0.93; see Exhibit 22) for all causes combined.

When examining hospital discharge rates by age group, sex and study period, Port Colborne rates were lower compared to the comparison communities for a number of conditions. Lower rates for Port Colborne were observed for all age groups (excluding in

some instances those less than 20 years of age), both sexes and both study periods for the following disease categories:

- diseases of the nervous system (see Exhibit 24)
- diseases of the digestive system (see Exhibit 30)
- non-malignant diseases of the respiratory system (see Exhibit 32)
- other diseases of the respiratory tract (see Exhibit 34)
- diseases of the skin and subcutaneous tissue (see Exhibit 38).

In few instances, Port Colborne hospital discharge rates were higher than those of the comparison communities:

- ischemic heart disease, overall, for age groups 20-44 years and 65 years and older, for both males and females and for the two study periods (see Exhibit 26)
- acute respiratory infections, overall, for those aged 20-44 years, 45-64 years and 65 years and older, for both males and females and for the two study periods (see Exhibit 33)
- asthma among those aged less than 20 years and those 65 years and older and during the 1990 to 2000 study period (see Exhibit 37).

Post hoc analysis: Box plots and two-sample t-tests

Box plots showing the distribution of the rate ratios for Port Colborne and each of the comparison communities are consistent with the results of the analysis described above. For many of the health conditions, Port Colborne hospital discharge rates were lower than those reported for the comparison communities. Box plots show that Port Colborne rate ratios fall within the box, encompassing the middle 50% of the rate ratios for all the communities and, in many instances, fall below the median rate ratio (see Exhibit 60 and Exhibit 61).

Regression analysis indicated that Port Colborne hospital discharge rates were higher than the comparison communities overall for ischemic heart disease and acute respiratory infections. Box plots show that Port Colborne rate ratios for these disease categories fall on or near the top of the box, corresponding to the line below which 75% of the data are included. Therefore, Port Colborne's rate ratios for these conditions are close to or among the highest 25% of the rate ratios for all communities.

However, two-sample t-tests comparing Port Colborne's rate ratios with those of the comparison communities (as illustrated in the box plot distributions) do not indicate that Port Colborne's rate ratios for ischemic heart disease and acute respiratory infections are statistically significantly different than those of the comparison communities. Two-sample t-tests comparing rate ratios stratified by age group, sex and study period indicate that Port Colborne's rate ratios for all disease categories are not statistically significantly different than those of the comparison communities (see Exhibit 64 and Exhibit 65).

The impact of 'polluted' communities

Box plots for Port Colborne and the comparison communities also identify those comparison communities that were considered to have potential contamination concerns that would affect the respiratory health of residents (see Exhibit 60 and Exhibit 61). These communities are identified by an open triangle and, for many of the disease categories under study, the rate ratios fall within the box, representing the middle 50% of the data (i.e. Sault Ste Marie, Sudbury, Kirkland Lake, Red Lake and Thunder Bay). For two of the smaller communities, Matachewan and Nairn, rate ratios in most cases are included in the highest 25% of the rate ratios for all communities and are often outliers. Since most of the rate ratios estimated for the larger polluted communities are similar to those of the remaining comparison communities and Port Colborne, the inclusion of these data in the analyses are unlikely to affect the results.

3.2.2 Port Colborne vs. Ontario

Exhibit 40 through Exhibit 57 present standardized discharge ratios for Port Colborne overall and by age group, sex and study period. Standardized ratios were based on expected rates calculated from hospital discharge rates obtained for the province of Ontario as a whole. Rates are presented that are based on data including and excluding day surgeries. This section presents results based on counts of discharges that exclude day surgeries.

Post hoc analysis: Standardized discharge ratios

In contrast to the analysis including the selected comparison communities, there were few disease groups where the standardized discharge ratio demonstrated that Port Colborne hospital discharge rates were lower than expected when compared to Ontario rates. These included:

- malignant respiratory disease for those 65 years and older, for females and during the 1990 to 2000 study period (see Exhibit 41)
- diseases of the nervous system, overall, among those less than 20 years and those 65 years and older, for females and for the 1980 to 1989 study period (see Exhibit 42)
- other diseases of the respiratory system, overall, for those 20 years and older, for both sexes and for the 1980 to 1989 study period (see Exhibit 52)
- diseases of the skin and subcutaneous tissue for the 1980 to 1989 study period (see Exhibit 56).

Overall, for 13 of the 18 disease groups under study, standardized discharge ratios indicated that discharges among Port Colborne residents were higher than expected when compared to Ontario rates (Exhibit 59). These disease groups included:

- all causes combined
- diseases of the circulatory system
- ischemic heart disease
- acute myocardial infarction

- cerebrovascular disease
- diseases of the digestive system
- diseases of the genitourinary system
- diseases of the respiratory system
- acute respiratory infections
- pneumonia/influenza
- COPD and allied conditions
- asthma
- injury and poisoning.

For the overall analysis, most standardized discharge ratios were only slightly higher, ranging from 1.14 (95% CI=1.13, 1.15; see Exhibit 40) for all causes combined to 1.40 (95% CI=1.36, 1.44; see Exhibit 44) for ischemic heart disease. The number of discharges for these disease categories in Port Colborne over the entire study period was 61,933 and 4,631, respectively. Of the 13 disease categories with a higher number of discharges, nine had discharge rates between 1.10 and 1.20. Higher rates were observed for acute respiratory infections (1.78 (95% CI=1.68, 1.88); see Exhibit 51) and asthma (1.52 (95% CI=1.43, 1.61); see Exhibit 55).

The higher standardized discharge ratios were observed for the above conditions across most age groups, generally for both sexes and during both study periods. Exceptions included diseases of the respiratory system, pneumonia/influenza, COPD and allied conditions, and injury and poisoning among those 65 years and older.

These ratios represent a crude measure and are not adjusted for any factors that may contribute to disease occurrence and that may be different between Port Colborne and Ontario as a whole.

Rate ratios

The rate ratios for the Port Colborne to Ontario comparison are adjusted for age and sex. They have not, however, been adjusted for differences in socioeconomic status that exist between Port Colborne and residents of the province, nor have the rate ratios been adjusted for the overdispersion that is known to occur with this type of count data. These tables, reflecting the rate ratio across age group, sex and period, are provided in the appendix (see Exhibit A38 through Exhibit A55).

Results indicate that there are minimal differences between the standardized discharge ratio and the rate ratio. For most disease groups, differences demonstrated with the standardized discharge ratio were also observed with the rate ratio. In several disease groups, the rate was observed to increase after adjustment for age and sex. Exhibit 59 presents both the standardized discharge ratios and the rate ratios only adjusted for age and sex for disease conditions overall.

3.2.3 Post hoc analysis: Port Colborne vs. Niagara communities

References to the Niagara region refer to the 11 communities in the area, excluding Port Colborne. Exhibit 22 through Exhibit 39 present both the minimally adjusted and adjusted rate ratios estimated from regression analyses, which compared the hospital discharge rates between Port Colborne and the Niagara communities (combined). The minimally adjusted rate ratios have been adjusted for sex, age and study period, while the adjusted rate ratios have been adjusted for the same variables with the addition of average family income, proportion of residents 15 years and older who did not complete high school, proportion of non-smokers in the community and the population-to-physician ratios. This section presents the adjusted rate ratios, with additional data provided in the appendix. The additional data consist of rate ratios that include day surgery discharges (see Exhibit A19 through Exhibit A36). The differences between the rate ratios that include and exclude day surgery data is provided for each health condition in Exhibit 58.

Box plots include overall adjusted rate ratios for each of the disease categories under study. These box plots are presented as Exhibit 62 and Exhibit 63.

Rate ratios

For the majority of comparisons of hospital discharge rates between Port Colborne and the Niagara communities, no differences were found.

Overall, Port Colborne hospital discharge rates were found to be lower than the rates observed for the Niagara communities for four of the 18 disease categories investigated. A statistically significant adjusted rate ratio of less than one was found for the following disease categories:

- diseases of the nervous system
- diseases of the genitourinary system
- other diseases of the respiratory tract
- diseases of the skin and subcutaneous tissue.

Adjusted rate ratios ranged from 0.82 (95% CI=0.68, 0.98) for other diseases of the respiratory tract (see Exhibit 34) to 0.90 (95% CI=0.84, 0.96) for diseases of the nervous system (see Exhibit 24).

When examining hospital discharge rates by age group, sex and study period, Port Colborne rates were found to be lower compared to the Niagara communities for:

- diseases of the nervous system among those less than 20 years of age and 65 years and older, among females and during the 1980 to 1989 study period (see Exhibit 24)
- heart failure among those 65 years and older (see Exhibit 28)
- diseases of the digestive system during the 1980 to 1989 study period (see Exhibit 30)
- diseases of the genitourinary system among those 45 and older, among females and during the 1980 to 1989 study period (see Exhibit 31)
- acute respiratory infections among those less than 20 years of age (see Exhibit 33)

- other diseases of the respiratory tract during the 1980 to 1989 study period (see Exhibit 34)
- diseases of the skin and subcutaneous tissue for those aged 20-44 years, among females and during the 1980 to 1989 study period
- injury and poisoning for those aged 65 years and older (see Exhibit 38).

Overall, Port Colborne hospital discharge rates were found to be slightly higher than the rates observed for the Niagara communities for three of the 18 disease categories. A statistically significant adjusted rate ratio of greater than one was found for ischemic heart disease (1.34 (95% CI=1.24, 1.44); see Exhibit 26), acute respiratory infections (1.19 (95% CI=1.07, 1.32); see Exhibit 33) and pneumonia/influenza (1.13 (95% CI=1.05, 1.21); see Exhibit 35). Stratified analysis revealed that higher discharge rates were observed for Port Colborne compared to the Niagara communities for:

- ischemic heart disease for all age groups, both males and females and during both study periods (see Exhibit 26)
- acute respiratory infections among those age 45 years and older, among females and during the 1980 to 1989 study period (see Exhibit 33)
- pneumonia/influenza among those aged 20-44 years, among females and for the 1990 to 2000 study period (see Exhibit 35).

Box plots and two-sample t-tests

Box plots showing the distribution of the rate ratios for Port Colborne and each of the Niagara communities are consistent in some instances with the results of the regression analysis described in Section 3.2.3 (see Exhibit 62 and Exhibit 63). Regression analysis indicated that Port Colborne hospital discharge rates were higher than the Niagara communities overall for ischemic heart disease, acute respiratory infections and pneumonia/influenza. Box plots show that Port Colborne rate ratios for these disease categories fall above or near the top of the box, corresponding to the line below which 75% of the data is included. Therefore, Port Colborne's rate ratios for these conditions are among the highest 25% of the rate ratios for all communities.

Regression analysis indicated that Port Colborne hospital discharge rates were lower than the Niagara communities overall for diseases of the nervous system, diseases of the genitourinary system, other respiratory diseases and diseases of the skin and subcutaneous tissue. Box plots show that Port Colborne rate ratios for other diseases of the respiratory tract and diseases of the skin and subcutaneous tissue fall below the median and close to the bottom of the box, corresponding to the line below which 25% of the data is included. Therefore, Port Colborne's rate ratios for these conditions are among the lowest 25% of the rate ratios for all communities.

For the majority of the comparisons, there was no evidence to determine whether the overall rates reported for Port Colborne were different from those reported for the Niagara communities. However, for only three of the 18 disease categories (heart failure, COPD and allied conditions, and asthma) does the rate ratio for Port Colborne fall below or

around the median rate ratio for all communities, as illustrated in the box plots. For all causes combined, diseases of the circulatory system, acute myocardial infarction, cerebrovascular disease and injury and poisoning, the Port Colborne rate ratio falls on or very near the line representing the 75th percentile. Therefore, the Port Colborne rate ratio for these diseases is among the highest 25% of the rate ratios for all communities.

However, two-sample t-tests comparing Port Colborne's rate ratios and the Niagara communities (as illustrated in the box plot distributions) do not indicate that Port Colborne's rate ratios for any of the disease categories overall, by age group, sex or study period are statistically significantly different than those of the Niagara communities. The results for ischemic heart disease indicate that hospital discharges in Port Colborne may be higher than the Niagara communities, as p-values are close to statistical significance (i.e. 0.08 overall, 0.06 for females and 0.08 during the study period 1990 to 2000) (see Exhibit 64 and Exhibit 65).

3.2.4 Rate ratios including day surgeries

Exhibit 58 provides overall estimated rate ratios comparing Port Colborne to the comparison communities and the Niagara communities, with hospital discharge data that both exclude and include data for day surgeries. For many of the disease categories under study, the rate ratios incorporating day surgery data are similar to what is presented in Sections 3.2.1 and 3.2.3. This is because the number of discharges attributable to day surgeries does not significantly affect the total number of discharges for many of the disease categories under study. The disease categories that stayed consistent were generally the sub-categories of the broad disease groupings (e.g., heart disease and cerebrovascular disease). In the cases where the exclusion of the day surgery data affects the total number of discharges, differences are noted in the rate ratios generated from the analyses. These disease categories were the broad groupings, including all causes combined and diseases of the nervous, circulatory, digestive and genitourinary systems.

3.2.5 Rate ratios calculated with and without scaled deviance

To examine the extent to which including a dispersion factor in the Poisson regression analysis comparing discharge rates adjusts for variability in the data, limited analyses were conducted with and without this dispersion factor included in the model. Exhibit 59 presents results for the comparison of the overall rates between Port Colborne and the comparison communities for the conditions under study with and without scaled deviance. With scaled deviance and prior to adjusting for confounders, in several instances the confidence intervals are wider allowing for a more conservative estimate of statistical significance. After adjustment for both overdispersion and additional confounding factors, columns four and five demonstrate that most rates that were initially higher were reduced and no longer statistically significant. For two exceptions, ischemic heart disease and acute respiratory infections, the rates were consistently higher in each of the types of analysis.

4. DISCUSSION

The CHAP series of studies has been designed to address whether non-occupational exposure to the CoCs has affected the health of residents in Port Colborne. Like CHAP Study A, CHAP Study C forms only one component of the planned research, and was conducted for the purposes of generating hypotheses for further research. This section discusses the methodological considerations of Study C and their implications for the interpretation of the findings.

4.1 Methodological Considerations

4.1.1 The use of hospitalization data as a health measure

Hospital discharge data only partially describe a community's health status, and cannot be used to reflect the underlying prevalence or incidence of all diseases in a community. Since hospitalization data represents health service events, only those diseases severe enough to require hospitalization are captured. For example, contact dermatitis, a condition that has frequently been associated with exposure to nickel, does not require hospitalization; it can be treated using topical creams.[70] Similarly, a large portion of individuals with heart disease who experience a heart attack will die before being admitted to hospital. Nonetheless, hospital discharge data can serve as a reasonable proxy for disease occurrence for those conditions associated with poor survival that are typically diagnosed near the time of hospital admission (e.g., cancer of the lung or pancreas).

The use of hospitalization data as a measure of health status is also limited in that hospitalization trends are influenced not only by disease prevalence, but by changes in the administration of health services. For example, the restructuring of health care costs in the 1990s resulted in a reduced number of available hospital beds and, consequently, fewer discharges. More recently, the increased number of surgeries that are done on an outpatient basis has reduced the number of inpatients and resulted in dramatic effects on inpatient discharge rates.[71] The extent to which these circumstances are different between communities may contribute to observed differences in the calculated rate ratios.

Despite these limitations, hospital discharge data have been used to complement incidence and prevalence data because of the utility for measuring disease severity.[72-74] For some health conditions, it has been suggested that environmental exposures exacerbate existing health conditions rather than cause them. In such instances, the net effect would be an associated increase in hospitalizations, with no appreciable change in disease prevalence. For example, air pollution and pollen exposure have been identified as factors that increase the severity of asthma rather than lead to its development.[75-78] If this were the case, then the use of hospital discharge data for asthma would enhance the findings of prevalence data collected from health surveys.

These methodological considerations emphasize the importance of measuring different types of health outcomes when attempting to characterize the health of a community through the analysis of hospitalization statistics.

4.1.2 Ecological bias and control for confounding variables

Risk factors for disease vary across both individuals and populations. Risk factors may include socioeconomic status, genetics, diet, lifestyle or the environment. In ecological studies, one cannot make adjustments for individual-level differences in these risk factors. The attempt to infer individual characteristics or relationships from group-level measures is called "ecologic fallacy." "Ecological bias" associated with such inference is such that expected ecologic effects poorly reflect the biologic effect at the individual level.[79-82] The influence of risk factors varies by health condition and, therefore, the magnitude of the associated bias will fluctuate across different health conditions. This study used aggregate counts of discharges and population estimates for each community by age group and sex. Therefore, some adjustment was possible for community differences in discharge rates with respect to age and sex. For other disease risk factors such as smoking and income, only a summary value for each was available for a given community.

Ecological bias is an important limitation of these studies and, as mentioned above, is the result of improper interpretation and inference about individual-level associations based on associations at the aggregate level.[68,83] Creating area-based values for variables stems from an assumption that the characteristics are stable and homogeneous within a geographic area. However, within regions, the population can be heterogeneous in terms of the risk factors for disease. This heterogeneity may exist even in small areas (e.g., one city block) and can change over time.[84]

In this study, there is no way to determine the magnitude of any possible ecological bias. More rigorous studies are necessary to investigate whether there is a causal relationship between exposure and disease. Despite this important limitation, ecologic studies have demonstrated utility for generating hypotheses or for the initial evaluation of suspected associations.

Income

Income is a recognized determinant of health that is inversely related to health status. Individuals with lower incomes have been found to have a higher risk of hospitalization for several different health conditions.[27,28,66,85-87] Income level has been found to be positively associated with the use of specialists.[87]

The adjusted rate ratios in this report included the average annual family income in each community as measured in the census. However, only a crude adjustment can be made for the effect of income as we have used an ecological variable. This crude adjustment is subject to misclassification error. Misclassification is expected to be the same in all groups being compared and unrelated to disease status (i.e. non-differential). In this case, the effect of such measures would be an attenuation of the rate ratios. Consequently, such rate ratios will fail to reach statistical significance. If misclassification is differential, then

results could be biased toward either higher or lower estimates of rate ratios depending on how the misclassification is related to the comparison groups and disease status.[88] Because of the discrepancy between area-based and individual-level socioeconomic indicators, caution should be applied when interpreting the results.[88,89]

Access to care

Observed differences in hospital discharge rates may also be explained by regional differences in factors related to access to care. These factors include medication compliance and the availability of diagnostic and other technologies during initial visits. Hospital readmission may be affected by the quality of care during hospitalization, and follow-up care after discharge. The use of hospital resources is also influenced by the availability of health care services. The distance to the closest hospital is known to affect rates of discharge.[90]

Although the patient typically initiates primary care, subsequent use of hospital resources is largely determined by the physicians (e.g., return visits, specialist referrals and hospital admission).[91] It has recently been observed that referral rates to specialists in Ontario are influenced by the gender and age of the primary care physician. Specifically, female and older physicians were more likely to make referrals.[91] Physician referral practices have been found to affect management preferences for cardiac patients.[92]

In these analyses, adjustment could not be made for variations in all of the factors related to access to care. Although there is an attempt to adjust for distance to closest hospital by adjusting for the population-to-physician ratio, the use of this variable as a proxy measure for access to care is limited. Primarily, there is the potential for ecological bias, because the variable is not specific to each community but is based on regional estimates. Many of the comparison communities share the same region (see Exhibit A10) but may have varying access to hospitals. This variation would not be accounted for in the population-to-physician ratio because it is not a community-specific estimate. Further, not all physicians work in a hospital setting. Ultimately, residents of communities that have a hospital may be more likely to seek medical attention at a hospital for certain health conditions than residents of communities that do not have a local hospital. Since it is not possible to assess either the extent of this variation across the comparison communities or the impact it may have on the results, it is possible that the study findings have been influenced by variations in factors related to access to care.

Additionally, estimates of the proportion of the public health unit population with unmet health care needs (see Exhibit A11) indicate that there may be differences of this measure among Port Colborne and the comparison communities. No calculations of the statistical significance of these differences were performed.

Cigarette smoking

Cigarette smoking is an important determinant of health and a leading cause of premature mortality among Canadians.[93,94] It has been estimated that 9.3% and 3.5% of Canadian hospitalization among males and females, respectively, can be due to the effects of active

cigarette smoking.[95] The actual percentage is likely to be higher if one were to take into account the additional effects of exposure to environmental tobacco smoke, which has been suggested to increase hospitalization rates among children.[85,96] These points underscore the importance of taking into account differences in smoking behaviours when comparing hospitalization rates between regions.

Within this study, it was difficult to adjust for the effects of smoking on observed differences in disease rates. The survey data used to derive smoking prevalence estimates in this study are not available at a community level. Instead, the OHS, from which the smoking prevalence data have been drawn, only permits estimates to be made at a regional level. The use of the smoking data in this manner assumes that community-specific prevalence estimates are equivalent to those obtained from the much larger health regions that included these communities. The aggregate nature of the smoking data again allows for the possibility for ecological bias.

Some information on smoking prevalence in Port Colborne was obtained from the recently completed Self-Reported Health Questionnaire.[97] In 2003, the proportion of non-smokers in Port Colborne was higher than that reported among the other Ontario health regions in the 1996/97 OHS (see Exhibit A12). However, some of this difference may be due in part to the fact that smoking in the general population has declined over time. Moreover, the prevalence estimates from the Self-Reported Health Questionnaire may be subject to participation bias, as only 45% of the targeted population completed surveys.

Because adjustment for smoking prevalence could not be made at the individual or even at the community level, the possibility that differences in smoking behaviours may explain the observed differences in discharge rates cannot be disregarded.

Other potential confounding factors

There are other important risk factors for disease that include diet, level of physical activity and obesity for which these analyses were not controlled. It is possible that community differences in these characteristics may explain observed differences.

4.1.3 Community mortality rates

In a hospitalization study such as this, there was no opportunity to account for underlying differences in mortality rates between Port Colborne and the comparison regions. If individual records were available for deceased persons and the date of death was known, it would have been possible to calculate the duration of an individual's time at risk. Since aggregate data with estimated annual population estimates serving as the rate denominators (as opposed to actual time at risk) was used, it was assumed that mortality patterns in Port Colborne and the comparison communities are the same. In the event that mortality rates are higher in Port Colborne, the actual time at risk in this community will be overstated and the resulting hospitalization rates underestimated, leading to an underestimation of the risk ratios. However, the magnitude of this bias is expected to be quite small given that, overall, mortality rates are low and any differences in these rates between regions would be even smaller. The implications of different mortality patterns

are more relevant for chronic diseases than for acute events, such as asthma attacks in children.

4.1.4 Repeated hospitalizations

Some diseases require repeated hospitalizations for diagnostic procedures or treatment. The total number of discharges may be affected by individual differences in the response to treatment or differences in treatment itself. Transfers between institutions will result in more than one discharge record being issued. The aggregate hospitalization data do not allow for the determination of whether observed differences in rates are due to higher numbers of individuals being hospitalized or higher rates of readmission. Only individual-based data would have allowed for further investigation of repeated visits.

4.1.5 The use of the Most Responsible Diagnosis

The Most Responsible Diagnosis (MRDx) has been widely used in Canadian studies to compare hospital rates over time, place, age and sex.[52,73,98] The editorial boards of numerous journals have accepted the utility of classifying hospital admissions based on discharge diagnosis. Despite its widespread use, there are important limitations in the use of the MRDx that require comment.

By definition, the MRDx identifies the health condition that is most responsible for the admission. It does not record the contribution of other co-morbid conditions that may contribute to the need for hospitalization. Often, the determination of which diagnosis is most responsible for resource use is subjective, and is done subsequent to the patient's discharge.

Errors in the coding of the MRDx are unavoidable even with the numerous quality control steps that CIHI has incorporated into the reporting of hospital discharges. A re-abstraction study revealed that misclassification of the MRDx occurred at a rate of approximately 12.8%.[99] However, it was found that a small proportion of facilities with unusually high discrepancy rates were contributing substantially to this figure.[99] The more common reasons for disagreement were that the re-abstractor disagreed that the diagnosis significantly impacted treatment or length of stay, there were different interpretations of the documentation, the original code was missing chart information or the original coder did not properly follow the code book.[48] The quality of the coding may differ by type of institution, and may not be consistent between acute care and non-acute care facilities.[100] Larger hospitals sometimes have greater resources to assign to the collection and coding of data. The extent that misclassification of the MRDx is different between Port Colborne and the other comparison communities contributes a bias to the presented rate ratios. A re-abstraction study of discharges among Port Colborne residents and those of the communities included in the referent group would be required to assess the magnitude and direction of this bias.

Given that the primary purpose of this study was to determine whether there were differences in the rates of hospital discharge in Port Colborne compared to other communities, the use of the MRDx permits comparisons to recently published findings for

Niagara[52,73] and other communities.[74] However, these comparisons are not made in this report.

4.1.6 Air pollution

Air pollution has been widely associated with an increased frequency of hospitalization for several respiratory and cardiovascular conditions.[101-105] It also has been identified as an exposure that exacerbates pre-existing asthma in both adults and children. The Niagara region is recognized as having higher levels of air pollution for several constituents including ozone, sulphur dioxide and particulate matter. Port Colborne is in close proximity (~80km) to the Nanticoke coal-fired thermal generating station, which is the leading Canadian source of air pollution.[106]

4.1.7 Residential mobility

This study is unable to take into account residential mobility. As a result, we are unable to distinguish between discharges that occurred among long- and short-term residents of Port Colborne. The migration of individuals can affect the ability of ecological studies to detect geographical differences in disease occurrence. With respect to environmental health studies, the diffusion of diseased persons originally exposed in a localized area will reduce the spatial variability in disease prevalence.[107] These diffusion effects will be larger for those diseases with longer latency periods.

Migration is highly correlated with income. Deprived families have fewer options for selecting places to live, and those who are more affluent may move into improved or cleaner areas. Such phenomena may give rise to the impression that the health of a region has changed, whereas, in reality, the underlying population has changed.[108] Studies that incorporate longitudinal follow-up are better equipped to evaluate the effect of residential mobility. CHAP Study D, a longitudinal study by design, has been suggested to examine mortality and cancer incidence patterns among past Port Colborne residents.[109]

4.1.8 Limitations of data analysis techniques

Aside from the important methodological considerations that must be kept in mind when interpreting the results, limitations with the data analysis techniques also affect the interpretation of the results. The use of Poisson regression with scaled deviance for adjustment of overdispersion in the data is limited if the overdispersion is not modest. Extra-variability or overdispersion may arise when the data are highly correlated or the observations are not independent. With aggregate hospitalization data, no accounting can be made of the number of records that represent an individual and whether overdispersion in this study is modest. Therefore, the estimation of the standard error used to calculate the confidence intervals around the estimated rate ratios may not fully account for the overdispersion or correlation in the data. Caution must be taken in concluding that the statistical significance of a rate ratio is completely accurate based on the calculated confidence intervals. Accurately correcting for overdispersion usually widens the confidence intervals, resulting in significance tests that are more conservative. Limited

analyses, with and without scaled deviance, demonstrated that confidence intervals were widened.

No determination was made as to how well the data fit the model compared to other possible methods for adjusting for correlation, including modeling a negative binomial distribution of the data and utilizing general estimating equations.

Similarly, there is limitation with the results of the two-sample t-tests of the rate ratios for individual communities as presented in the box plots. The t-tests do not use an adequate sample size for the power to detect differences in rate ratios between Port Colborne and the group of Niagara or comparison communities. Therefore, caution must be taken in concluding that the statistical significance of a result is completely accurate.

Although the limitations discussed here are inherent in the data analysis techniques, more confidence may be had in those results where there is consistency, or a trend toward consistency, between analyses.

4.2 Interpretation of Study Findings

The key methodological considerations influencing the interpretation of the study results are as follows:

- only those conditions that are severe enough to warrant hospitalization are captured in this study; findings from this work should therefore be used to complement other health outcome measures (i.e. incidence and prevalence)
- data were analysed at an aggregate level rather than at an individual level and, therefore, the study is subject to several forms of ecological bias
- the rate ratios could not be fully adjusted for community differences in:
  - access to care, cigarette smoking, diet, physical activity, obesity
  - underlying mortality rates
  - hospital admission policies and disease management
- the aggregate data provided do not allow for determining whether observed differences in rates are due to higher numbers of individuals being hospitalized or higher rates of readmission
- the coding of the discharge based on the MRDx is subject to misclassification; if differential coding errors exist between regions, this could bias the presented rate ratios in either direction
- no analysis was done on the role of air pollution or the effects of residential mobility
- the interpretation of standard errors and confidence intervals should be done cautiously due to limitations inherent in the data analysis techniques.

Although these methodological considerations exist, ecologic studies are an important first step in the investigation of health and environment associations. Analyses of such studies provide information on, for example, recognition of the scope of any possible problem as well as the description of trends.[110]

As noted earlier, when interpreting findings it is important to examine the results for consistencies, as the limitations outlined in Section 4.1 highlight the potential for bias or for finding spurious significant results. In this way, if consistencies exist across different methods of analysis, then greater reliability can be attributed to those results. Exhibit 2 and Exhibit 3 provide a summary of the study findings for each condition, overall and by age group, sex and study period, for the comparisons to the 35 communities and the Niagara communities, respectively.

A general assessment of the results of these comparisons indicates that hospitalizations in Port Colborne are not different from those observed among the Niagara and the comparison communities. In many of the comparisons, hospital discharge rates among Port Colborne residents were observed to be lower. In addition, these results are consistent in the box plot analyses and, in many instances, are similar to the results for the Ontario comparison (exceptions include all causes, diseases of the digestive system and diseases of the genitourinary system).

A lower rate of hospitalization was consistently observed for Port Colborne residents when compared to the Niagara and comparison communities and to Ontario for the following conditions:

- diseases of the nervous system (<20 years and 1980 to 1989)
- other diseases of the respiratory tract (overall and 1980 to 1989)
- diseases of the skin and subcutaneous tissue (1980 to1989).

In keeping with these results, discharge rates observed for injury and poisoning in Port Colborne were generally either decreased or not different than the rates reported for the Niagara and the comparison communities. This was expected given that injury and poisoning was examined in this study as a control condition.

A higher rate of hospitalization was consistently observed for Port Colborne residents when compared to the Niagara communities, the comparison communities and to Ontario for the following conditions:

- ischemic heart disease (overall, all subgroups excluding 45-64 years)
- acute respiratory infections (overall, >45 years, females and 1980 to 1989)
- COPD and allied conditions (<20 years)
- asthma (<20 years).

The box plots were generally consistent with the results for the overall analysis of ischemic heart disease and acute respiratory infections. The increase observed in the <20 year age group for COPD and allied conditions is reflective of the higher rates observed for asthma, which is a sub-category of COPD and allied conditions. The parallel trend in hospitalization over the study period for these two conditions is demonstrated in Exhibit 18 and Exhibit 19.

With such findings, and in consideration of the study limitations that preclude the drawing of definitive conclusions, it is important to reiterate that the differences observed with this study may be due to issues including ecologic bias, confounding (in particular, access to care issues) and limitations with the data analysis techniques. Further, although the issue of multiple comparisons was not adjusted for in this study (see Section 2.4.4), it has been reported that observational studies that often consider several exposures, outcomes, and subgroups may be prone to finding spurious results. In many studies, 20% or more of the findings may be erroneous, rather than the expected 5% false positive associations ($p < 0.05$).[111]

Finally, this study was designed to investigate whether hospital discharge rates for Port Colborne are different from what may be expected based on comparisons to suitable referent populations. In so keeping, differences observed highlight the need for considering these results in conjunction with those results from CHAP Study A and with the purpose of this study in the context of the entire suite of proposed CHAP studies.

Exhibit 2: Summary of findings from regression analysis* comparing Port Colborne discharge rates to those of the group of comparison communities

	Overall	Age group (years)				Sex		Study period	
Condition		**< 20**	**20 – 44**	**45 – 64**	**≥ 65**	**Males**	**Females**	**1980 – 1989**	**1990 - 2000**
All causes	▼	NS	▼	▼	▼	▼	▼	▼	▼
Malignant diseases of the respiratory system	▼	—	NS	▼	▼	▼	NS	NS	▼
Diseases of the nervous system	▼	▼	▼	▼	▼	▼	▼	▼	▼
Diseases of the circulatory system	▼	NS	NS	▼	▼	NS	NS	NS	▼
Ischemic heart disease	▲	—	▲	NS	▲	▲	▲	▲	▲
Acute myocardial infarction	NS	—	NS	NS	NS	NS	NS	NS	NS
Heart failure	NS	—	NS	▼	▼	NS	NS	NS	NS
Cerebrovascular disease	▼	—	NS	▼	▼	NS	▼	NS	▼
Diseases of the digestive system	▼	NS	▼	▼	▼	▼	▼	▼	▼
Diseases of the genitourinary system	▼	NS	▼	▼	NS	NS	▼	▼	▼
Non-malignant diseases of the respiratory system	▼	NS	▼	▼	▼	▼	▼	▼	▼
Acute respiratory infections	▲	NS	▲	▲	▲	▲	▲	▲	▲
Other diseases of the respiratory tract	▼	▼	▼	▼	▼	▼	▼	▼	▼
Pneumonia and influenza	NS	NS	NS	NS	▼	NS	NS	NS	NS
COPD and allied conditions	▼	▲	NS	▼	▼	▼	NS	▼	▼
Asthma	NS	▲	NS	NS	▲	NS	NS	NS	▲
Diseases of the skin and subcutaneous tissue	▼	▼	▼	▼	▼	▼	▼	▼	▼
Injury and poisoning	▼	NS	NS	▼	▼	▼	▼	▼	▼

NS = Not significant; ▼ = decrease; ▲ = increase; — = not applicable

* Regression adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.

Exhibit 3: Summary of findings from regression analysis* comparing Port Colborne discharge rates to those of the group of Niagara communities

	Overall	Age group (years)				Sex		Study period	
Condition		**< 20**	**20 – 44**	**45 – 64**	**≥ 65**	**Males**	**Females**	**1980 – 1989**	**1990 - 2000**
All causes	NS	NS	NS	NS	NS	NS	NS	NS	▲
Malignant diseases of the respiratory system	NS	—	▲	NS	NS	NS	NS	▲	NS
Diseases of the nervous system	▼	▼	NS	NS	▼	NS	▼	▼	NS
Diseases of the circulatory system	NS	NS	▲	▲	▲	NS	NS	NS	NS
Ischemic heart disease	▲	—	▲	▲	▲	▲	▲	▲	▲
Acute myocardial infarction	NS	—	NS	▲	NS	▲	NS	NS	NS
Heart failure	NS	—	NS	NS	▼	NS	NS	NS	NS
Cerebrovascular disease	NS	—	NS	NS	NS	▲	NS	NS	NS
Diseases of the digestive system	NS	NS	NS	NS	NS	NS	NS	▼	NS
Diseases of the genitourinary system	▼	NS	NS	▼	▼	NS	▼	▼	NS
Nonmalignant diseases of the respiratory system	NS	NS	NS	NS	NS	NS	NS	NS	NS
Acute respiratory infections	▲	▼	NS	▲	▲	NS	▲	▲	NS
Other diseases of the respiratory tract	▼	NS	NS	NS	NS	NS	NS	▼	NS
Pneumonia and influenza	▲	NS	▲	NS	NS	NS	▲	NS	▲
COPD and allied conditions	NS	▲	NS	▼	NS	NS	NS	NS	NS
Asthma	NS	▲	NS	NS	NS	NS	NS	NS	NS
Diseases of the skin and subcutaneous tissue	▼	NS	▼	NS	NS	NS	▼	▼	NS
Injury and poisoning	NS	NS	▲	NS	▼	NS	NS	NS	NS

NS = Not significant; ▼ = decrease; ▲ = increase; — = not applicable

* Regression adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.

5. SUMMARY AND RECOMMENDATIONS

Several study design limitations are considered in the interpretation of the results. These limitations include the lack of data at an individual level and the inability to control for the effects of disease-specific risk factors. Regional differences in access to care and the treatment or management of disease likely contribute to important differences in hospital discharge rates. The data do not allow us to take into account underlying mortality rates and residential mobility patterns and, therefore, cannot identify those discharges that occurred among long-term residents in a given community. The coding of the discharges based on the MRDx may have biased the presented rate ratios in either direction. While the prevalence of smoking at a health region level was considered in the analysis, such adjustments were crude and it is possible that individual differences in smoking behaviours and exposure to environmental tobacco smoke may have contributed to some of the observed differences. This may have particular implication for the observed differences in heart disease and respiratory conditions. Finally, limitations inherent in the data analysis techniques require cautious interpretation of the confidence intervals.

In general, hospital discharge rates for Port Colborne were found to be lower or not different for Port Colborne compared to the comparison and the Niagara communities, respectively. Post-hoc analyses correlate in most instances with the results. However, certain disease excesses were found to be consistent across comparisons and analytic methods. These include ischemic heart disease and acute respiratory infections, and asthma among those less than 20 years of age.

Higher hospital discharge rates observed for Port Colborne for ischemic heart disease and acute respiratory infections, and for asthma in young people, should be evaluated as potential candidates for further research.

6. GLOSSARY OF TERMS

Census Subdivision (CSD) is the general term for municipalities as determined by provincial legislation.

Confidence Interval (CI) is the computed interval with a given probability, e.g., 95%, that the true value of a variable such as a mean, proportion, or rate is contained within the interval.

Confounder (From the Latin *confundere*, to mix together)
A variable that can cause or prevent the outcome of interest, is not an intermediate variable, and is associated with the factor under investigation. Unless it is possible to adjust for confounding variables, their effects cannot be distinguished from those of factor(s) being studied. Bias can occur when adjustment is made for any factor that is caused in part by the exposure and is also correlated with the outcome.

Direct Standardization is the method whereby the specific rates in a study population are averaged, using as weights the distribution of a specified standard population. The directly standardized rate represents what the crude rate would have been in the study population of that population had the same distribution as the standard population with respect to the variable(s) for which the adjustment or standardization was carried out. See Standardization.

Ecologic study is a study that uses data on populations rather than on individuals.

Ecologic fallacy is the attempt to infer individual characteristics or relationships from group-level measures.

Epidemiology is the study of the distribution and determinants of health-related states or events in specified populations, and the application of this study to control of health problems.

Forward Sortation Area is the first three digits of a postal code.

ICD-9 - International Classification of Diseases, 9th Edition/Revision (ICD-9) code. ICD codes were developed to allow assignment of codes to diagnoses and procedures associated with hospital utilization.

Incidence is the number of instances of illness commencing, or of persons falling ill, during a given period in a specified population. More generally, the number of new events, e.g., new cases of a disease in a defined population, within a specified period of time. The term incidence is sometimes wrongly used to denote Incidence Rate.

Indirect Standardization is the method used to compare study populations for which the specific rates are either statistically unstable or unknown. The specific rates in the standard population are averaged, using as weights the distribution of the study population. The ratio of the crude rate for the study population to the weighted average so obtained is the standardized mortality (or morbidity) ratio, or SMR. The indirectly standardized rate itself is the product of the SMR and the crude rate for the standard population, but this is rarely used.

Measurement Error occurs when responses collected from the survey differ from the actual values. This may occur due to the use of misleading or unclear questions, or when participants are unable to accurately recall the required information.

Misclassification Bias is the erroneous classification of an individual, a value or an attribute into a category other than that to which it should be assigned. The probability of misclassification may be

the same in all study groups (non-differential misclassification) or may vary between groups (differential misclassification).

Most Responsible Diagnosis is the diagnosis for the most significant condition which causes the patient to stay in hospital. Each discharge record has a code for this diagnosis.

Null hypothesis states that the results observed in a study are no different from what might have occurred as a result of chance alone.

Prevalence is the number of events, e.g., instances of a given disease or other condition, in a given population at a designated time; sometimes used to mean PREVALENCE RATE. When used without qualification, the term usually refers to the situation at a specified point in time (**Point Prevalence**). Note that this is a number, not a rate.

Response Bias is systematic error due to differences in characteristics between those who chose to partake in a study and those who do not.

Rate Ratio is the ratio of a rate in the exposed population relative to the unexposed population.

Risk Factor is an aspect of personal behaviour or life-style, an environmental exposure, or an inborn or inherited characteristic, that, on the basis of epidemiologic evidence, is known to be associated with health-related condition(s) considered important to prevent.

Standardization is a set of techniques used to remove as much as possible the effects of differences in age or other confounding variables when comparing two or more populations. The common method uses weighted averaging of rates specific for age, sex or some other potential confounding variable(s) according to some specified distribution of these variables. There are two main methods, Direct Standardization and Indirect Standardization.

Type II Error is the error that occurs when investigators fail to reject the null hypothesis, declaring a difference does not exist when it does.

Many of the above epidemiological terms have been taken directly from *A Dictionary of Epidemiology Fourth Edition,* John M. Last. Oxford University Press, 2001.

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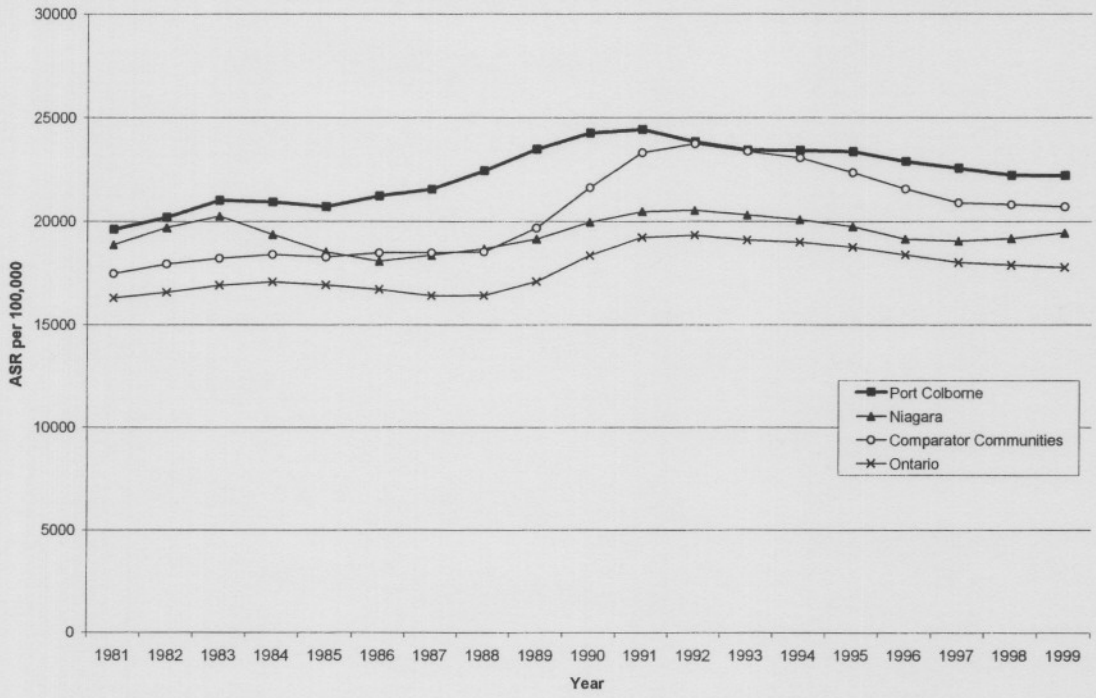
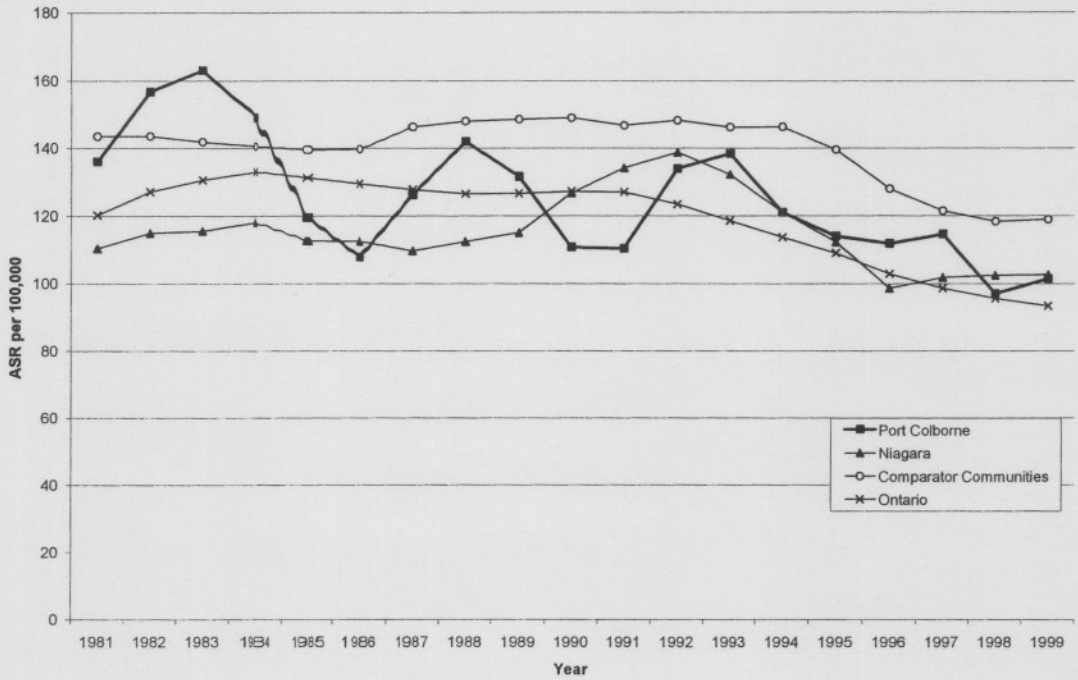
8. EXHIBITS

Exhibit 4: Annual age-standardized hospital discharge rates (ASR) based on 3-year moving averages for all causes in Port Colborne, 11 Niagara communities, 35 comparison communities and Ontario, 1980 to 2000, based on inpatient discharges



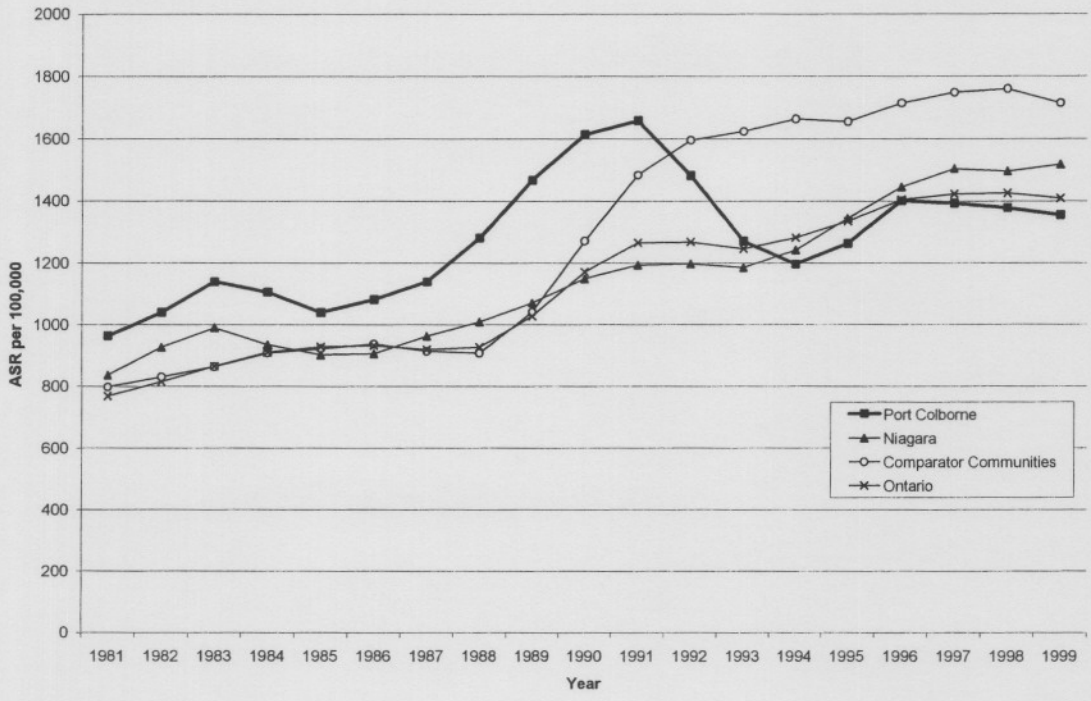
Rates were age standardized to the 1991 Canadian census population based on 5-year age intervals.

Exhibit 5: Annual age-standardized hospital discharge rates (ASR) based on 3-year moving averages for malignant neoplasms of the respiratory and intrathoracic organs in Port Colborne, 11 Niagara communities, 35 comparison communities and Ontario, 1980 to 2000, based on inpatient discharges



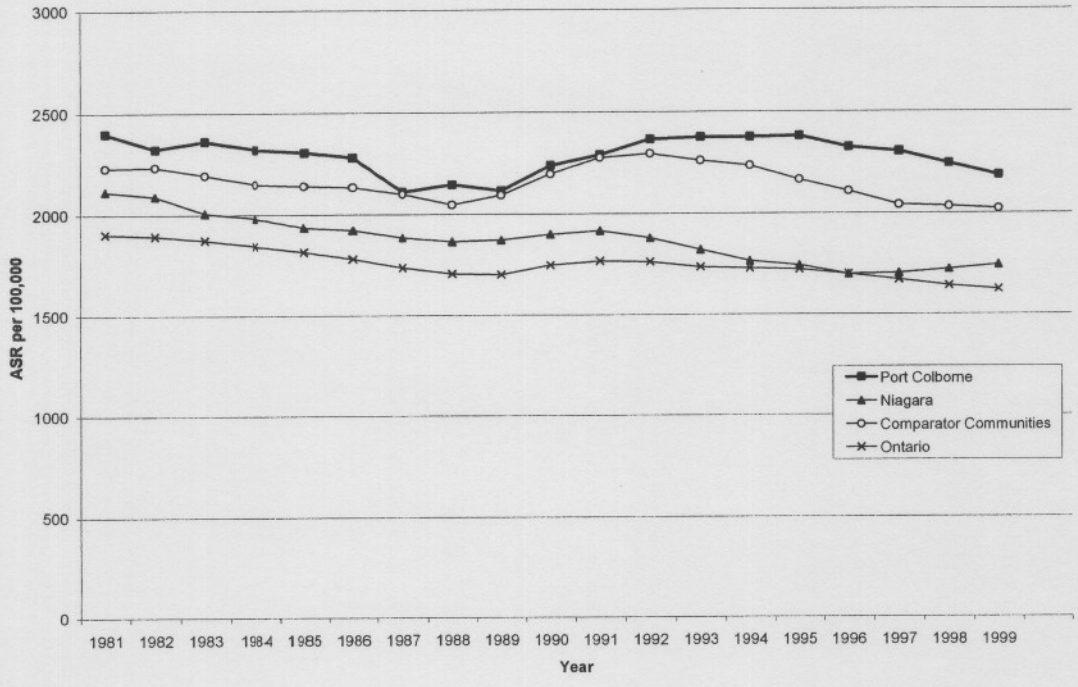
Rates were age standardized to the 1991 Canadian census population based on 5-year age intervals.

Exhibit 6: Annual age-standardized hospital discharge rates (ASR) based on 3-year moving averages for diseases of the nervous system in Port Colborne, 11 Niagara communities, 35 comparison communities and Ontario, 1980 to 2000, based on inpatient discharges



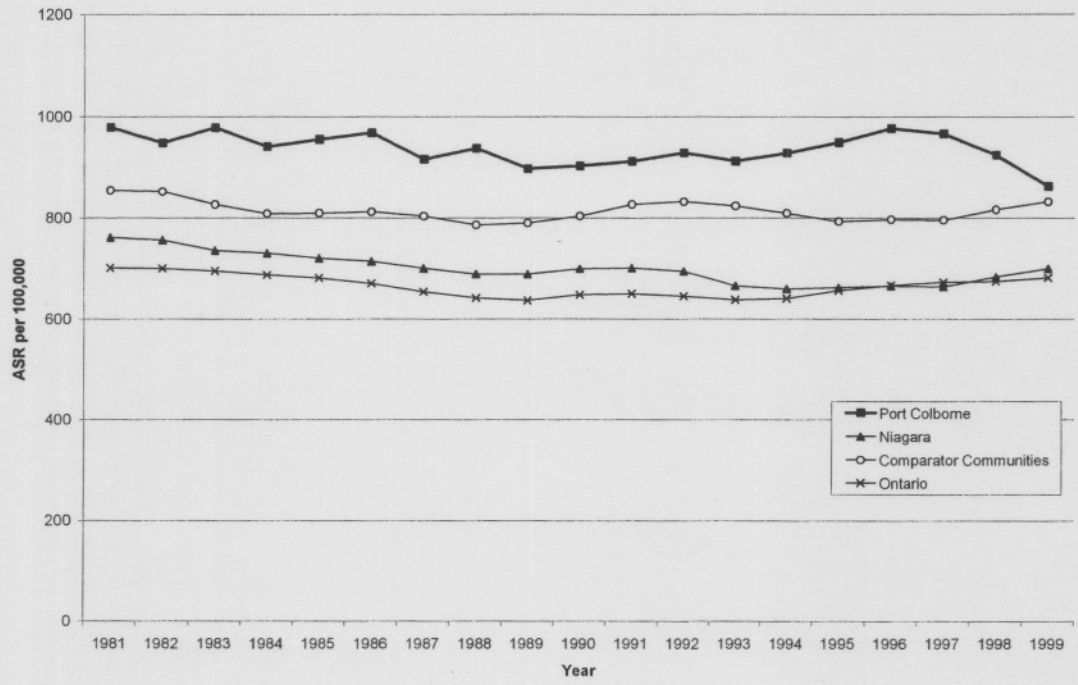
Rates were age standardized to the 1991 Canadian census population based on 5-year age intervals.

Exhibit 7: Annual age-standardized hospital discharge rates (ASR) based on 3-year moving averages for diseases of the circulatory system in Port Colborne, 11 Niagara communities, 35 comparison communities and Ontario, 1980 to 2000, based on inpatient discharges



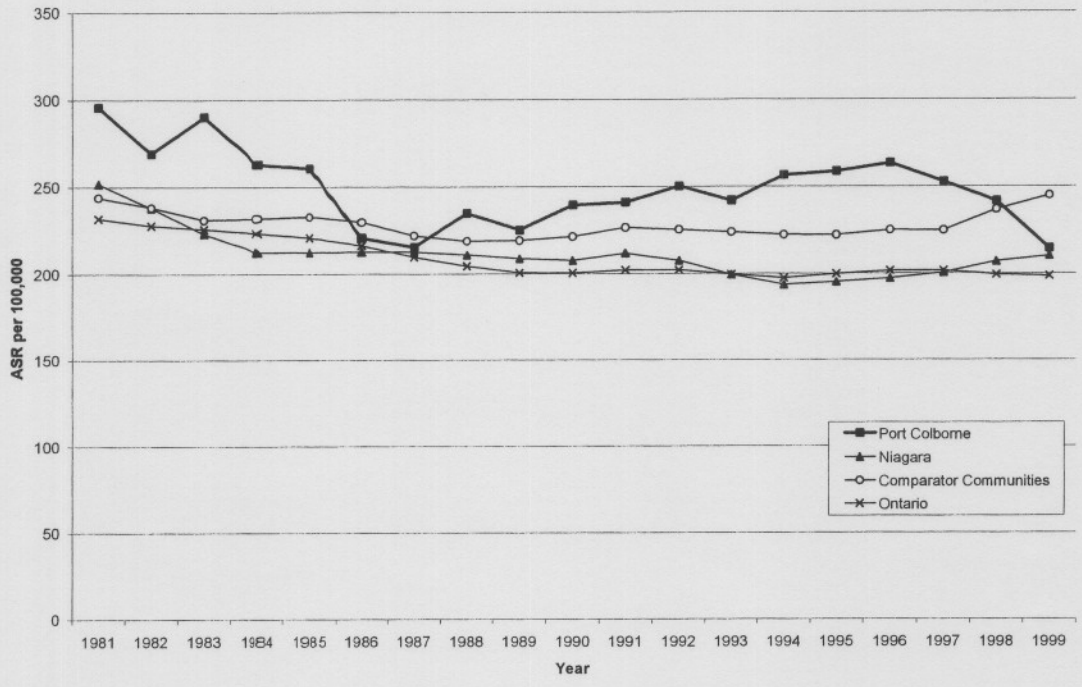
Rates were age standardized to the 1991 Canadian census population based on 5-year age intervals.

Exhibit 8: Annual age-standardized hospital discharge rates (ASR) based on 3-year moving averages for ischemic heart disease in Port Colborne, 11 Niagara communities, 35 comparison communities and Ontario, 1980 to 2000, based on inpatient discharges



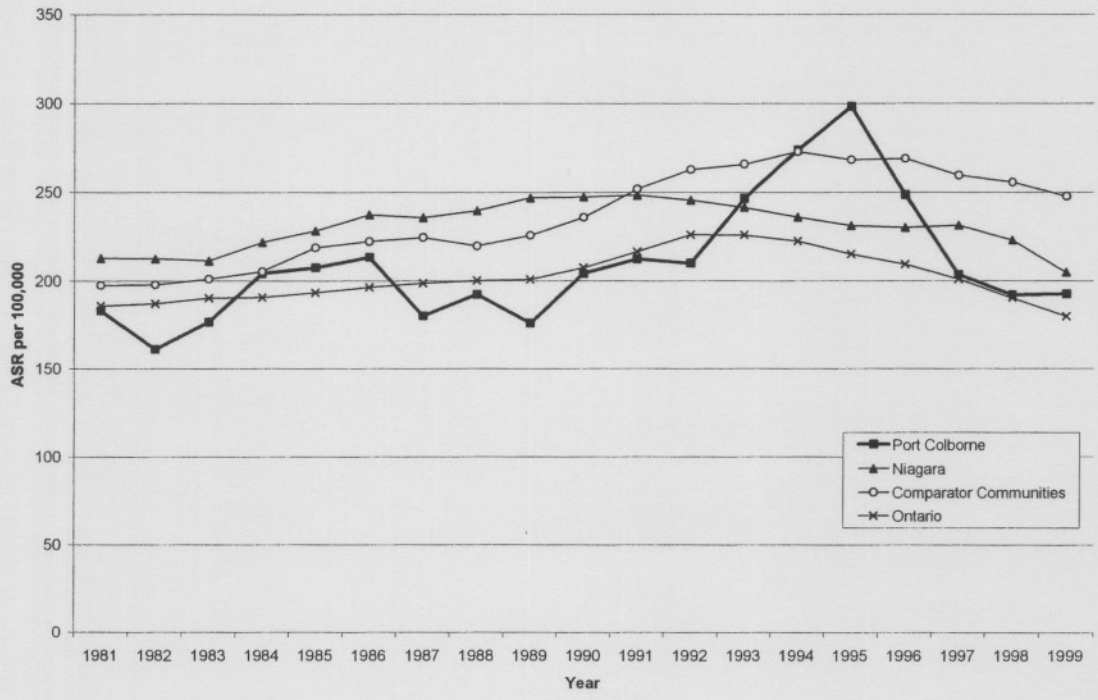
Rates were age standardized to the 1991 Canadian census population based on 5-year age intervals.

Exhibit 9: Annual age-standardized hospital discharge rates (ASR) based on 3-year moving averages for acute myocardial infarction in Port Colborne, 11 Niagara communities, 35 comparison communities and Ontario, 1980 to 2000, based on inpatient discharges



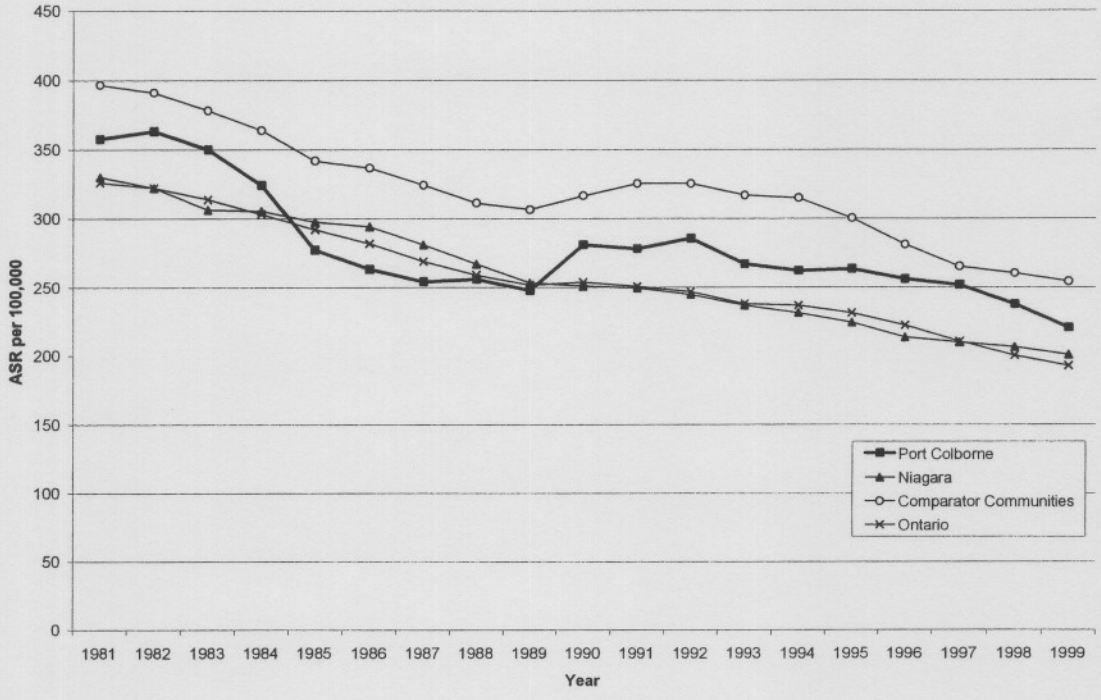
Rates were age standardized to the 1991 Canadian census population based on 5-year age intervals.

Exhibit 10: Annual age-standardized hospital discharge rates (ASR) based on 3-year moving averages for heart failure in Port Colborne, 11 Niagara communities, 35 comparison communities and Ontario, 1980 to 2000, based on inpatient discharges



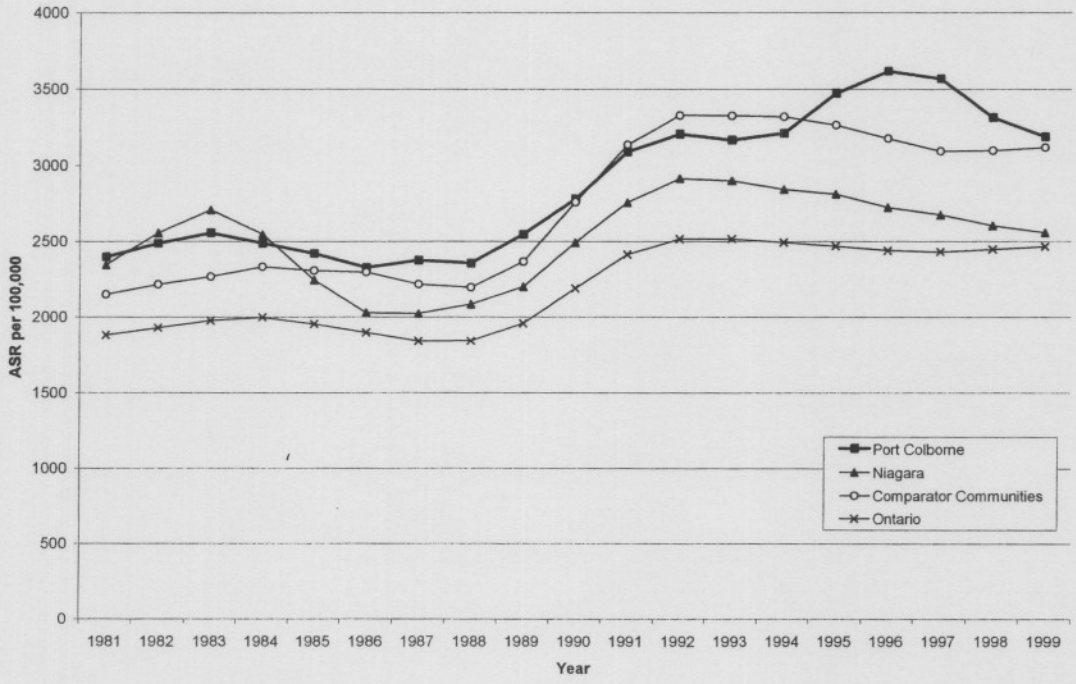
Rates were age standardized to the 1991 Canadian census population based on 5-year age intervals.

Exhibit 11: Annual age-standardized hospital discharge rates (ASR) based on 3-year moving averages for cerebrovascular disease in Port Colborne, 11 Niagara communities, 35 comparison communities and Ontario, 1980 to 2000, based on inpatient discharges



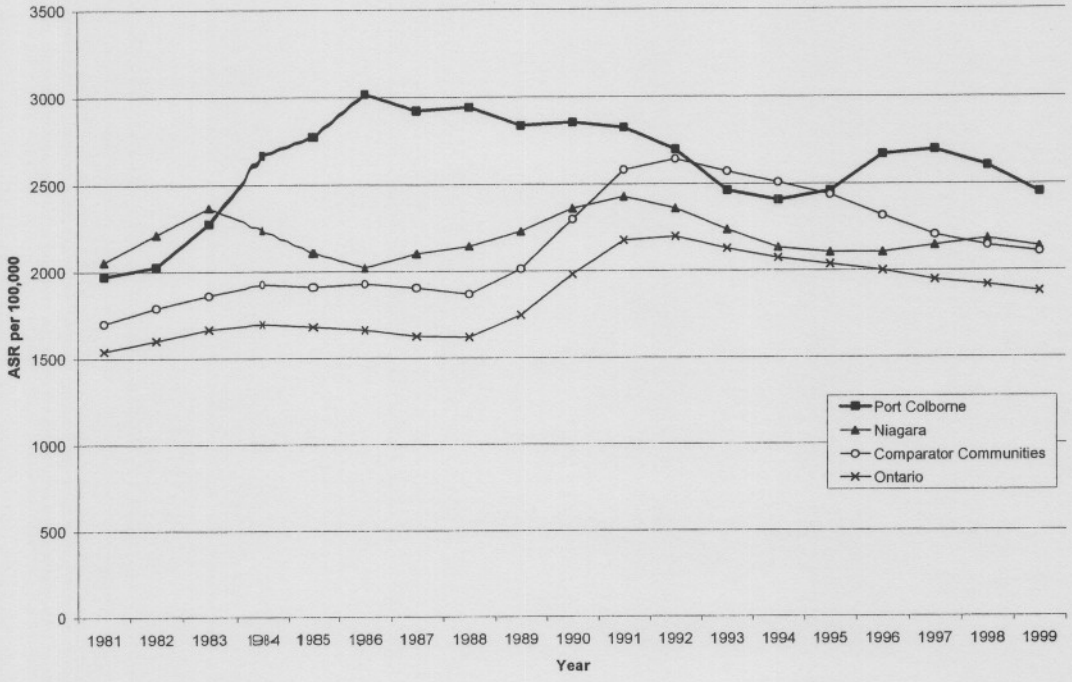
Rates were age standardized to the 1991 Canadian census population based on 5-year age intervals.

Exhibit 12: Annual age-standardized hospital discharge rates (ASR) based on 3-year moving averages for diseases of the digestive system in Port Colborne, 11 Niagara communities, 35 comparison communities and Ontario, 1980 to 2000, based on inpatient discharges



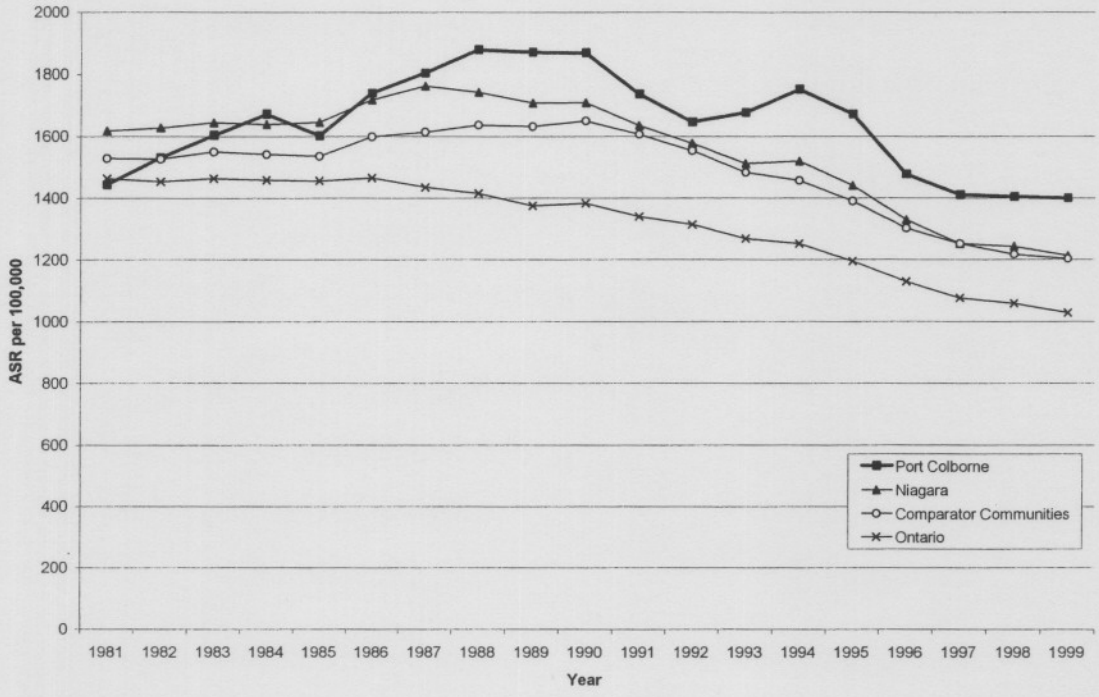
Rates were age standardized to the 1991 Canadian census population based on 5-year age intervals.

Exhibit 13: Annual age-standardized hospital discharge rates (ASR) based on 3-year moving averages for diseases of the genitourinary system in Port Colborne, 11 Niagara communities, 35 comparison communities and Ontario, 1980 to 2000, based on inpatient discharges



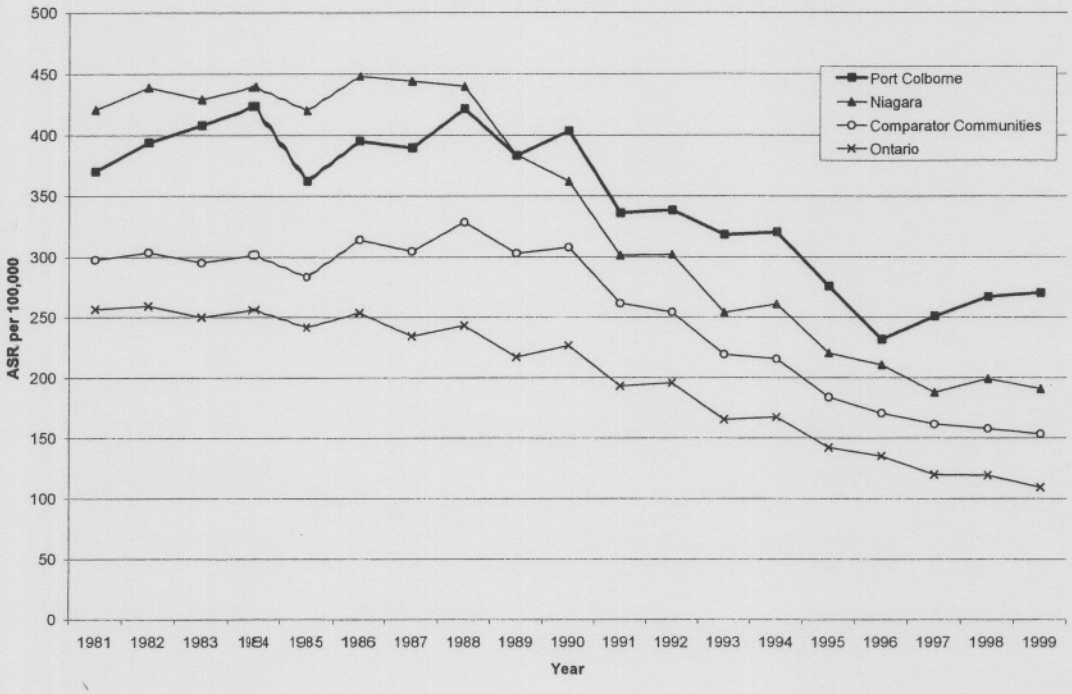
Rates were age standardized to the 1991 Canadian census population based on 5-year age intervals.

Exhibit 14: Annual age-standardized hospital discharge rates (ASR) based on 3-year moving averages for non-malignant diseases of the respiratory system in Port Colborne, 11 Niagara communities, 35 comparison communities and Ontario, 1980 to 2000, based on inpatient discharges



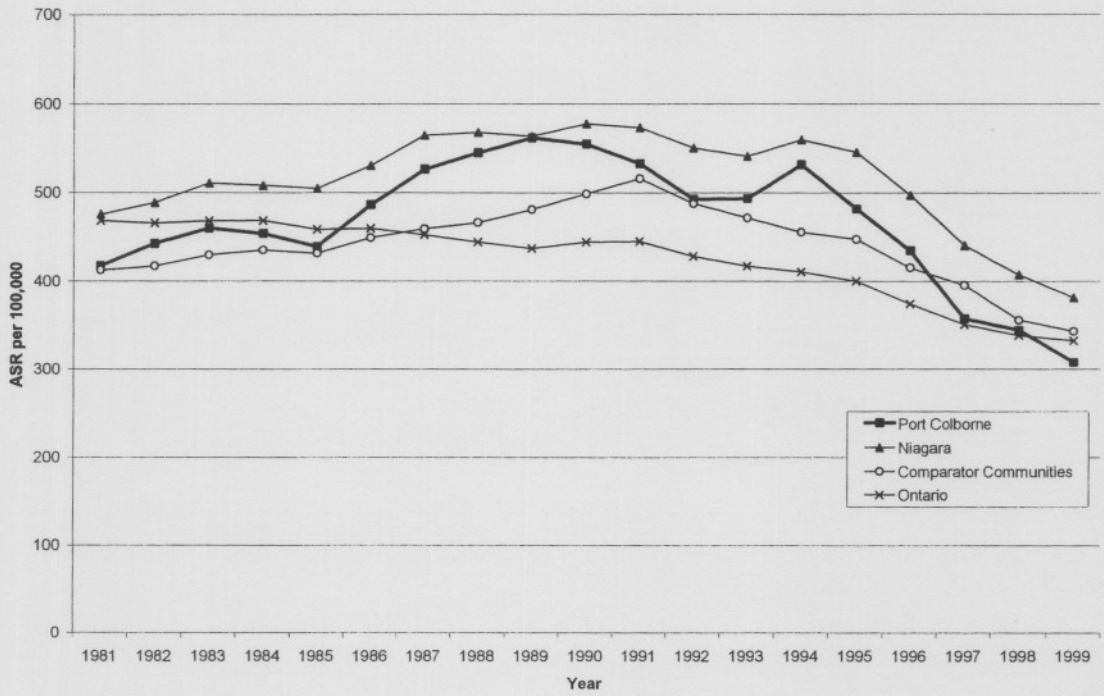
Rates were age standardized to the 1991 Canadian census population based on 5-year age intervals.

Exhibit 15: Annual age-standardized hospital discharge rates (ASR) based on 3-year moving averages for acute respiratory infections in Port Colborne, 11 Niagara communities, 35 comparison communities and Ontario, 1980 to 2000, based on inpatient discharges



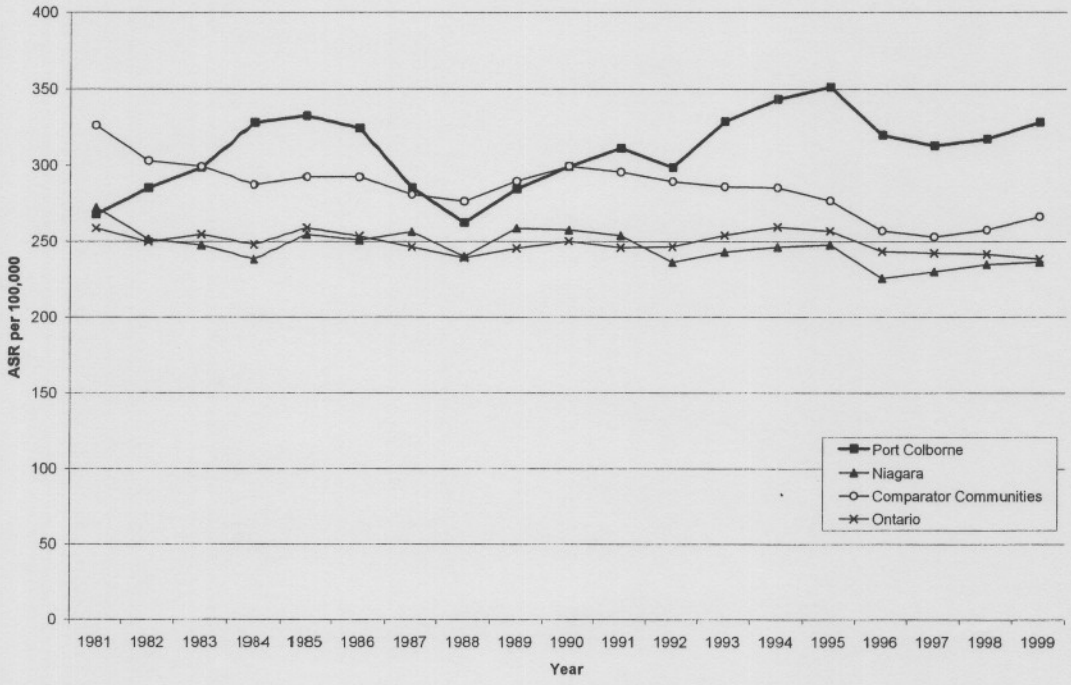
Rates were age standardized to the 1991 Canadian census population based on 5-year age intervals.

Exhibit 16: Annual age-standardized hospital discharge rates (ASR) based on 3-year moving averages for other diseases of the respiratory tract in Port Colborne, 11 Niagara communities, 35 comparison communities and Ontario, 1980 to 2000, based on inpatient discharges



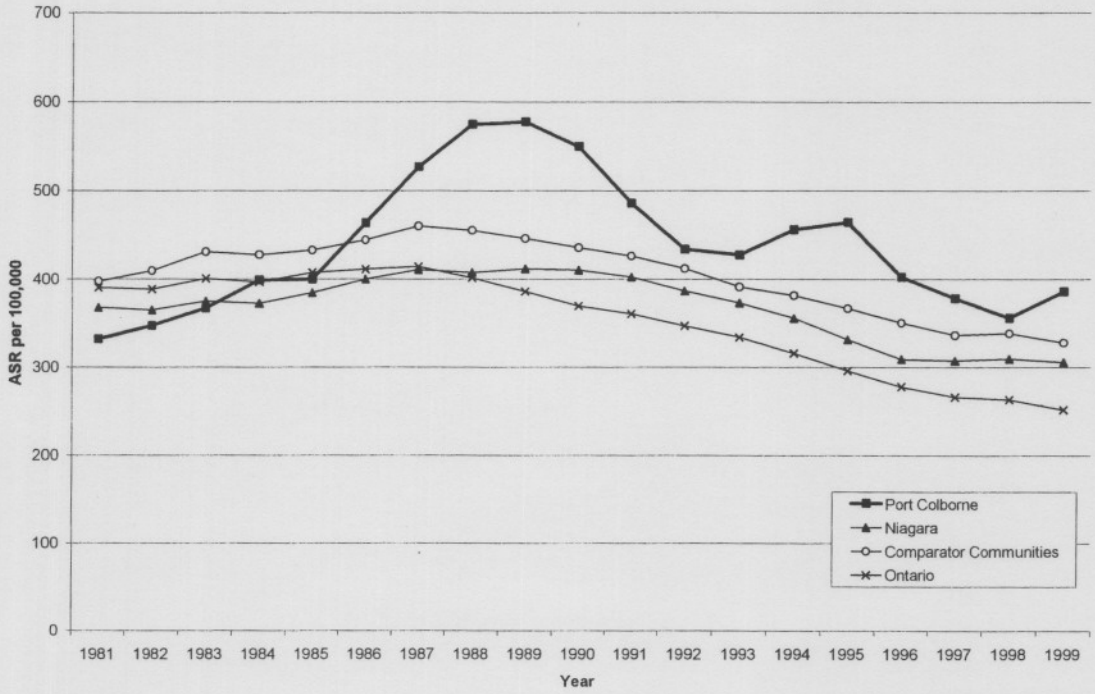
Rates were age standardized to the 1991 Canadian census population based on 5-year age intervals.

Exhibit 17: Annual age-standardized hospital discharge rates (ASR) based on 3-year moving averages for pneumonia and influenza in Port Colborne, 11 Niagara communities, 35 comparison communities and Ontario, 1980 to 2000, based on inpatient discharges



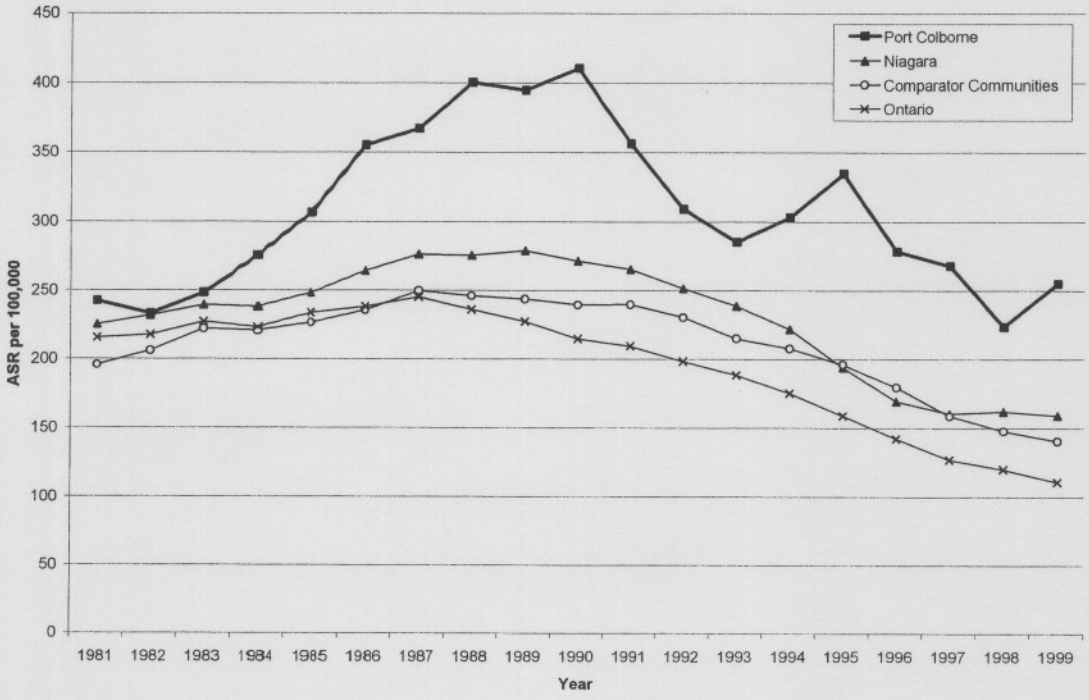
Rates were age standardized to the 1991 Canadian census population based on 5-year age intervals.

Exhibit 18: Annual age-standardized hospital discharge rates (ASR) for based on 3-year moving averages Chronic Obstructive Pulmonary Disease and allied conditions in Port Colborne, 11 Niagara communities, 35 comparison communities and Ontario, 1980 to 2000, based on inpatient discharges



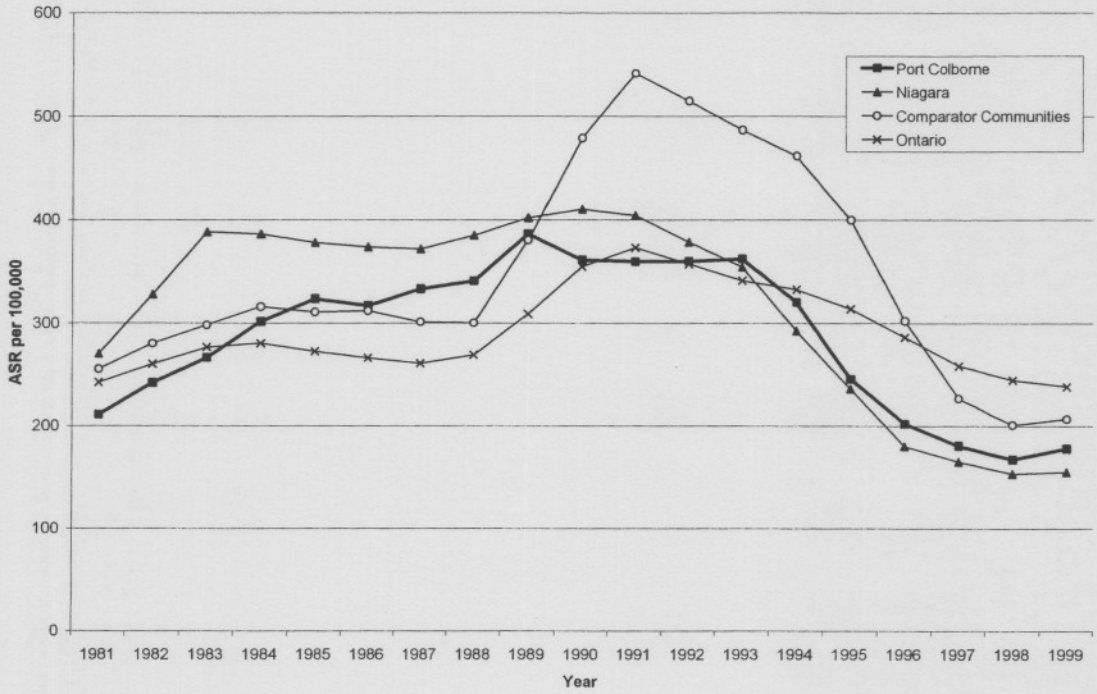
Rates were age standardized to the 1991 Canadian census population based on 5-year age intervals.

Exhibit 19: Annual age-standardized hospital discharge rates (ASR) based on 3-year moving averages for asthma in Port Colborne, 11 Niagara communities, 35 comparison communities and Ontario, 1980 to 2000, based on inpatient discharges



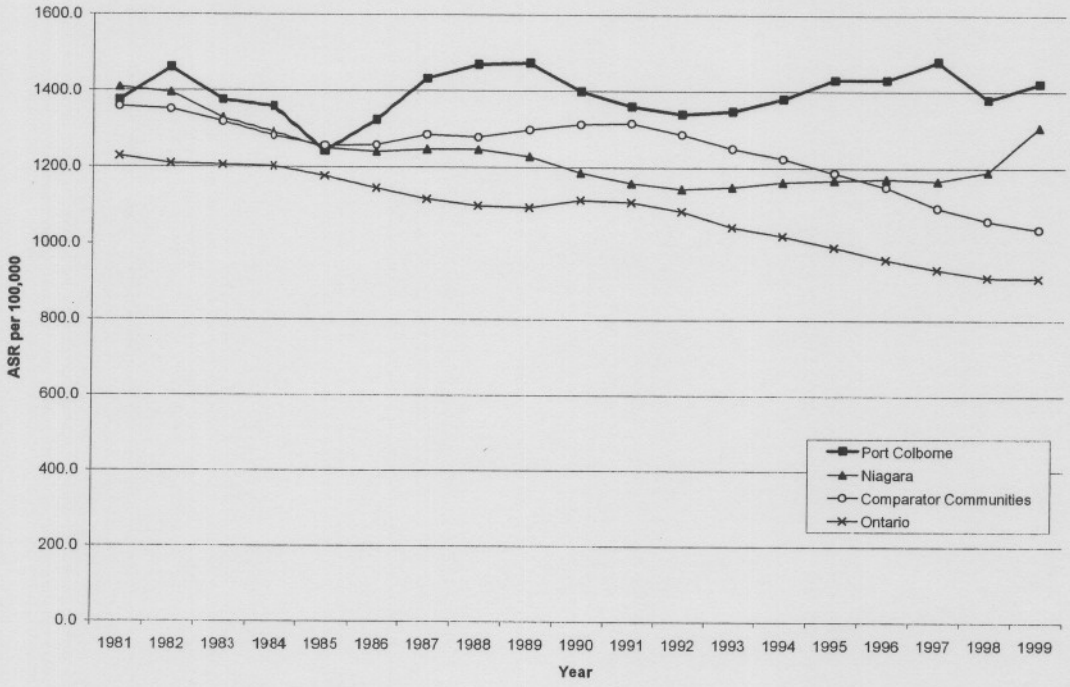
Rates were age standardized to the 1991 Canadian census population based on 5-year age intervals.

Exhibit 20: Annual age-standardized hospital discharge rates (ASR) based on 3-year moving averages for diseases of the skin and subcutaneous tissue in Port Colborne, 11 Niagara communities, 35 comparison communities and Ontario, 1980 to 2000, based on inpatient discharges



Rates were age standardized to the 1991 Canadian census population based on 5-year age intervals.

Exhibit 21: Annual age-standardized hospital discharge rates (ASR) based on 3-year moving averages for injury and poisoning in Port Colborne, 11 Niagara communities, 35 comparison communities and Ontario, 1980 to 2000, based on inpatient discharges



Rates were age standardized to the 1991 Canadian census population based on 5-year age intervals.

Exhibit 22: A comparison of hospital discharge rates for all causes between Port Colborne and (i) the comparison communities and (ii) the Niagara communities

	PC vs.	Inpatient Discharges		Rate Ratio (95% CI)[a]	
		PC	Other	Minimally Adjusted[b]	Adjusted[c]
Overall	CC	61,933	1,917,644	1.00 (0.97, 1.03)	0.91 (0.88, 0.93)
	NG[d]	61,933	1,069,536	1.10 (1.07, 1.13)	1.02 (0.99, 1.05)
<20 years	CC	8,691	283,180	1.09 (1.02, 1.17)	0.99 (0.92, 1.06)
	NG	8,691	165,841	1.12 (1.05, 1.21)	1.04 (0.96, 1.11)
20-44 years	CC	16,565	608,681	1.01 (0.95, 1.06)	0.91 (0.86, 0.96)
	NG	16,565	318,439	1.12 (1.06, 1.19)	1.03 (0.98, 1.09)
45-64 years	CC	13,848	426,373	0.93 (0.88, 0.99)	0.85 (0.80, 0.90)
	NG	13,848	230,520	1.09 (1.03, 1.16)	1.01 (0.95, 1.06)
65+ years	CC	22,829	599,410	0.97 (0.93, 1.01)	0.88 (0.85, 0.92)
	NG	22,829	354,736	1.07 (1.03, 1.12)	0.99 (0.95, 1.04)
Males	CC	27,800	822,059	1.02 (0.98, 1.06)	0.93 (0.89, 0.96)
	NG	27,800	463,849	1.12 (1.08, 1.17)	1.03 (0.99, 1.08)
Females	CC	34,133	1,095,585	0.98 (0.94, 1.02)	0.89 (0.85, 0.92)
	NG	34,133	605,687	1.08 (1.04, 1.13)	1.00 (0.96, 1.04)
1980-1989	CC	31,186	1,005,202	0.97 (0.94, 1.01)	0.91 (0.87, 0.94)
	NG	31,186	561,233	1.01 (0.97, 1.05)	0.96 (0.92, 1.00)
1990-2000	CC	30,747	912,442	1.03 (0.98, 1.07)	0.90 (0.87, 0.94)
	NG	30,747	508,303	1.20 (1.15, 1.25)	1.08 (1.03, 1.13)

a. Rate ratios were estimated using Poisson regression. A scaled deviance was used to adjust for overdispersion.
b. Rate ratio was adjusted for age, sex and calendar period.
c. Rate ratio was adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.
d. The Niagara population includes residents of all communities in the Niagara census division except Port Colborne.

Exhibit 23: A comparison of hospital discharge rates for malignant neoplasms of the respiratory and intrathoracic organs between Port Colborne and (i) the comparison communities and (ii) the Niagara communities

	PC vs.	Inpatient Discharges		Rate Ratio (95% CI)[a]	
		PC	Other	Minimally Adjusted[b]	Adjusted[c]
Overall	CC	530	17,670	0.91 (0.78, 1.07)	0.81 (0.69, 0.95)
	NG[d]	530	8,304	1.22 (1.04, 1.44)	1.12 (0.95, 1.32)
<20 years	CC	<5*	19	—	—
	NG	<5*	24	—	—
20-44 years	CC	24	517	1.40 (0.91, 2.18)	1.23 (0.80, 1.91)
	NG	24	244	1.82 (1.16, 2.84)	1.66 (1.06, 2.59)
45-64 years	CC	214	7,221	0.74 (0.64, 0.85)	0.65 (0.56, 0.75)
	NG	214	3,205	1.04 (0.89, 1.20)	0.95 (0.82, 1.10)
65+ years	CC	291	9,913	0.74 (0.66, 0.83)	0.65 (0.58, 0.74)
	NG	291	4,831	0.97 (0.86, 1.10)	0.89 (0.79, 1.01)
Males	CC	381	12,085	0.85 (0.67, 1.09)	0.75 (0.59, 0.96)
	NG	381	5,522	1.21 (0.95, 1.55)	1.11 (0.87, 1.42)
Females	CC	149	5,585	0.98 (0.80, 1.20)	0.86 (0.70, 1.06)
	NG	149	2,782	1.24 (1.00, 1.52)	1.13 (0.92, 1.40)
1980-1989	CC	308	9,217	1.15 (0.96, 1.37)	1.05 (0.88, 1.26)
	NG	308	4,368	1.48 (1.23, 1.78)	1.40 (1.17, 1.69)
1990-2000	CC	222	8,453	0.73 (0.56, 0.95)	0.62 (0.47, 0.80)
	NG	222	3,936	1.01 (0.78, 1.32)	0.89 (0.68, 1.17)

a. Rate ratios were estimated using Poisson regression. A scaled deviance was used to adjust for overdispersion.
b. Rate ratio was adjusted for age, sex and calendar period.
c. Rate ratio was adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.
d. The Niagara population includes residents of all communities in the Niagara census division except Port Colborne.
* indicates rate ratios were suppressed due to a small number of discharge counts.

Exhibit 24: A comparison of hospital discharge rates for diseases of the nervous system between Port Colborne and (i) the comparison communities and (ii) the Niagara communities

	PC vs.	Inpatient Discharges		Rate Ratio (95% CI)[a]	
		PC	Other	Minimally Adjusted[b]	Adjusted[c]
Overall	CC	1,951	69,409	0.82 (0.77, 0.87)	0.74 (0.69, 0.79)
	NG[d]	1,951	37,475	0.98 (0.92, 1.05)	0.90 (0.84, 0.96)
<20 years	CC	259	12,787	0.69 (0.59, 0.82)	0.63 (0.53, 0.74)
	NG	259	6,250	0.85 (0.72, 1.01)	0.78 (0.66, 0.93)
20-44 years	CC	324	13,424	0.87 (0.76, 1.00)	0.78 (0.68, 0.90)
	NG	324	5,841	1.16 (1.01, 1.33)	1.07 (0.93, 1.23)
45-64 years	CC	464	15,554	0.85 (0.75, 0.96)	0.77 (0.68, 0.87)
	NG	464	8,190	1.02 (0.90, 1.15)	0.93 (0.83, 1.05)
65+ years	CC	904	27,644	0.87 (0.80, 0.94)	0.79 (0.73, 0.86)
	NG	904	17,194	0.92 (0.85, 1.00)	0.85 (0.78, 0.92)
Males	CC	909	32,421	0.83 (0.76, 0.91)	0.75 (0.69, 0.83)
	NG	909	17,186	1.01 (0.92, 1.10)	0.93 (0.84, 1.02)
Females	CC	1,042	36,988	0.80 (0.73, 0.88)	0.72 (0.66, 0.79)
	NG	1,042	20,289	0.95 (0.87, 1.05)	0.88 (0.80, 0.97)
1980-1989	CC	1,219	44,600	0.82 (0.77, 0.89)	0.77 (0.71, 0.83)
	NG	1,219	24,743	0.92 (0.85, 0.99)	0.87 (0.80, 0.93)
1990-2000	CC	732	24,809	0.81 (0.73, 0.90)	0.71 (0.64, 0.79)
	NG	732	12,732	1.05 (0.94, 1.17)	0.94 (0.84, 1.05)

a. Rate ratios were estimated using Poisson regression. A scaled deviance was used to adjust for overdispersion.
b. Rate ratio was adjusted for age, sex and calendar period.
c. Rate ratio was adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.
d. The Niagara population includes residents of all communities in the Niagara census division except Port Colborne.

Exhibit 25: A comparison of hospital discharge rates for diseases of the circulatory system between Port Colborne and (i) the comparison communities and (ii) the Niagara communities

	PC vs.	Inpatient Discharges		Rate Ratio (95% CI)[a]	
		PC	Other	Minimally Adjusted[b]	Adjusted[c]
Overall	CC	10,308	274,049	0.94 (0.84, 1.06)	0.88 (0.79, 0.99)
	NG[d]	10,308	158,181	1.05 (0.93, 1.17)	0.99 (0.88, 1.11)
<20 years	CC	43	1,776	0.76 (0.49, 1.17)	0.71 (0.46, 1.09)
	NG	43	1,041	0.78 (0.50, 1.21)	0.74 (0.48, 1.14)
20-44 years	CC	634	20,173	1.04 (0.93, 1.16)	0.97 (0.87, 1.09)
	NG	634	10,451	1.21 (1.08, 1.36)	1.15 (1.02, 1.28)
45-64 years	CC	2,899	82,984	0.99 (0.94, 1.04)	0.92 (0.88, 0.97)
	NG	2,899	46,398	1.12 (1.07, 1.18)	1.06 (1.01, 1.12)
65+ years	CC	6,732	169,116	1.01 (0.98, 1.05)	0.95 (0.92, 0.98)
	NG	6,732	100,291	1.12 (1.09, 1.16)	1.07 (1.03, 1.10)
Males	CC	5,586	147,716	0.94 (0.80, 1.10)	0.88 (0.75, 1.03)
	NG	5,586	86,910	1.02 (0.87, 1.19)	0.96 (0.82, 1.13)
Females	CC	4,722	126,333	0.95 (0.81, 1.11)	0.89 (0.76, 1.04)
	NG	4,722	71,271	1.07 (0.91, 1.26)	1.02 (0.87, 1.20)
1980-1989	CC	4,796	132,306	1.03 (0.91, 1.18)	0.99 (0.87, 1.13)
	NG	4,796	74,106	1.10 (0.97, 1.25)	1.07 (0.94, 1.21)
1990-2000	CC	5,512	141,743	0.86 (0.71, 1.04)	0.78 (0.65, 0.94)
	NG	5,512	84,075	0.99 (0.82, 1.20)	0.92 (0.77, 1.11)

a. Rate ratios were estimated using Poisson regression. A scaled deviance was used to adjust for overdispersion.
b. Rate ratio was adjusted for age, sex and calendar period.
c. Rate ratio was adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.
d. The Niagara population includes residents of all communities in the Niagara census division except Port Colborne.

Exhibit 26: A comparison of hospital discharge rates for ischemic heart disease between Port Colborne and (i) the comparison communities and (ii) the Niagara communities

	PC vs.	Inpatient Discharges		Rate Ratio (95% CI)[a]	
		PC	Other	Minimally Adjusted[b]	Adjusted[c]
Overall	CC	4,631	106,495	1.24 (1.15, 1.33)	1.18 (1.09, 1.27)
	NG[d]	4,631	61,784	1.38 (1.28, 1.49)	1.34 (1.24, 1.44)
<20 years	CC	<5*	44	—	—
	NG	<5*	39	—	—
20-44 years	CC	246	5,731	1.44 (1.17, 1.77)	1.37 (1.11, 1.69)
	NG	246	2,928	1.60 (1.29, 1.98)	1.54 (1.25, 1.91)
45-64 years	CC	1,516	40,208	1.09 (1.02, 1.17)	1.04 (0.97, 1.11)
	NG	1,516	23,122	1.22 (1.14, 1.31)	1.18 (1.10, 1.26)
65+ years	CC	2,866	60,512	1.20 (1.15, 1.26)	1.15 (1.09, 1.20)
	NG	2,866	35,695	1.36 (1.29, 1.42)	1.31 (1.25, 1.38)
Males	CC	2,614	63,051	1.21 (1.13, 1.30)	1.15 (1.08, 1.23)
	NG	2,614	37,682	1.37 (1.28, 1.47)	1.32 (1.24, 1.42)
Females	CC	2,017	43,444	1.26 (1.10, 1.44)	1.20 (1.05, 1.37)
	NG	2,017	24,102	1.40 (1.22, 1.60)	1.35 (1.18, 1.55)
1980-1989	CC	2,154	51,668	1.26 (1.15, 1.39)	1.22 (1.11, 1.35)
	NG	2,154	27,989	1.41 (1.27, 1.56)	1.38 (1.25, 1.53)
1990-2000	CC	2,477	54,827	1.21 (1.08, 1.35)	1.13 (1.01, 1.27)
	NG	2,477	33,795	1.36 (1.21, 1.52)	1.29 (1.15, 1.45)

a. Rate ratios were estimated using Poisson regression. A scaled deviance was used to adjust for overdispersion.
b. Rate ratio was adjusted for age, sex and calendar period.
c. Rate ratio was adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.
d. The Niagara population includes residents of all communities in the Niagara census division except Port Colborne.
* Indicates rate ratios were suppressed due to a small number of discharge counts.

Exhibit 27: A comparison of hospital discharge rates for acute myocardial infarction between Port Colborne and (i) the comparison communities and (ii) the Niagara communities

	PC vs.	Inpatient Discharges		Rate Ratio (95% CI)[a]	
		PC	Other	Minimally Adjusted[b]	Adjusted[c]
Overall	CC	1,307	32,661	1.07 (0.95, 1.20)	0.98 (0.87, 1.10)
	NG[d]	1,307	19,735	1.19 (1.06, 1.34)	1.11 (0.98, 1.26)
<20 years	CC	<5*	13	—	—
	NG	<5*	19	—	—
20-44 years	CC	65	1,913	1.07 (0.76, 1.50)	0.98 (0.70, 1.37)
	NG	65	998	1.24 (0.88, 1.74)	1.15 (0.82, 1.63)
45-64 years	CC	447	11,409	1.09 (0.99, 1.21)	1.00 (0.91, 1.11)
	NG	447	6,661	1.23 (1.11, 1.36)	1.15 (1.04, 1.27)
65+ years	CC	795	19,326	1.04 (0.97, 1.11)	0.95 (0.89, 1.02)
	NG	795	12,057	1.11 (1.04, 1.19)	1.04 (0.97, 1.11)
Males	CC	820	20,359	1.13 (1.03, 1.24)	1.03 (0.94, 1.13)
	NG	820	12,702	1.21 (1.11, 1.33)	1.13 (1.03, 1.24)
Females	CC	487	12,302	1.01 (0.81, 1.26)	0.92 (0.74, 1.15)
	NG	487	7,033	1.17 (0.94, 1.46)	1.09 (0.87, 1.37)
1980-1989	CC	596	14,642	1.13 (0.95, 1.34)	1.03 (0.87, 1.23)
	NG	596	8,660	1.19 (1.01, 1.42)	1.13 (0.95, 1.34)
1990-2000	CC	711	18,019	1.01 (0.85, 1.19)	0.92 (0.78, 1.09)
	NG	711	11,075	1.19 (1.00, 1.41)	1.10 (0.93, 1.30)

a. Rate ratios were estimated using Poisson regression. A scaled deviance was used to adjust for overdispersion.
b. Rate ratio was adjusted for age, sex and calendar period.
c. Rate ratio was adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.
d. The Niagara population includes residents of all communities in the Niagara census division except Port Colborne.
* Indicates rate ratios were suppressed due to a small number of discharge counts.

Exhibit 28: A comparison of hospital discharge rates for heart failure between Port Colborne and (i) the comparison communities and (ii) the Niagara communities

	PC vs.	Inpatient Discharges		Rate Ratio (95% CI)[a]	
		PC	Other	Minimally Adjusted[b]	Adjusted[c]
Overall	CC	1,179	34,649	1.01 (0.83, 1.22)	0.88 (0.73, 1.07)
	NG[d]	1,179	21,704	1.11 (0.92, 1.35)	1.01 (0.83, 1.23)
<20 years	CC	<5*	156	—	—
	NG	<5*	86	—	—
20-44 years	CC	14	404	1.21 (0.69, 2.10)	1.05 (0.61, 1.82)
	NG	14	221	1.38 (0.79, 2.42)	1.25 (0.72, 2.19)
45-64 years	CC	174	5,038	0.98 (0.84, 1.13)	0.85 (0.73, 0.99)
	NG	174	2,757	1.14 (0.98, 1.33)	1.03 (0.89, 1.20)
65+ years	CC	990	29,051	0.87 (0.82, 0.93)	0.76 (0.72, 0.81)
	NG	990	18,640	0.88 (0.82, 0.93)	0.80 (0.75, 0.85)
Males	CC	580	16,979	0.99 (0.78, 1.25)	0.86 (0.68, 1.09)
	NG	580	10,847	1.05 (0.83, 1.33)	0.95 (0.75, 1.21)
Females	CC	599	17,670	1.03 (0.76, 1.39)	0.90 (0.66, 1.21)
	NG	599	10,857	1.18 (0.87, 1.61)	1.07 (0.79, 1.46)
1980-1989	CC	451	13,243	1.04 (0.77, 1.41)	0.94 (0.70, 1.27)
	NG	451	8,735	1.07 (0.79, 1.46)	1.01 (0.74, 1.36)
1990-2000	CC	728	21,406	0.98 (0.77, 1.24)	0.82 (0.65, 1.04)
	NG	728	12,969	1.15 (0.91, 1.47)	1.02 (0.80, 1.29)

a. Rate ratios were estimated using Poisson regression. A scaled deviance was used to adjust for overdispersion.
b. Rate ratio was adjusted for age, sex and calendar period.
c. Rate ratio was adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.
d. The Niagara population includes residents of all communities in the Niagara census division except Port Colborne.
* Indicates rate ratios were suppressed due to a small number of discharge counts.

Exhibit 29: A comparison of hospital discharge rates for cerebrovascular disease between Port Colborne and (i) the comparison communities and (ii) the Niagara communities

	PC vs.	Inpatient Discharges		Rate Ratio (95% CI)[a]	
		PC	Other	Minimally Adjusted[b]	Adjusted[c]
Overall	CC	1,503	45,261	0.87 (0.78, 0.97)	0.84 (0.75, 0.95)
	NG[d]	1,503	23,797	1.12 (0.99, 1.25)	1.09 (0.97, 1.22)
<20 years	CC	<5*	203	—	—
	NG	<5*	75	—	—
20-44 years	CC	45	1,465	0.99 (0.72, 1.35)	0.96 (0.70, 1.31)
	NG	45	674	1.30 (0.95, 1.79)	1.27 (0.92, 1.74)
45-64 years	CC	265	9,639	0.74 (0.65, 0.84)	0.72 (0.63, 0.82)
	NG	265	4,507	0.99 (0.87, 1.13)	0.97 (0.85, 1.10)
65+ years	CC	1,193	33,954	0.90 (0.85, 0.95)	0.88 (0.83, 0.93)
	NG	1,193	18,541	1.08 (1.02, 1.14)	1.05 (0.99, 1.12)
Males	CC	786	22,896	1.02 (0.89, 1.16)	0.99 (0.86, 1.13)
	NG	786	11,884	1.31 (1.14, 1.50)	1.28 (1.11, 1.46)
Females	CC	717	22,365	0.74 (0.62, 0.89)	0.72 (0.60, 0.87)
	NG	717	11,913	0.95 (0.79, 1.15)	0.93 (0.77, 1.12)
1980-1989	CC	711	22,193	0.96 (0.83, 1.12)	0.98 (0.85, 1.14)
	NG	711	11,482	1.14 (0.98, 1.32)	1.15 (0.99, 1.33)
1990-2000	CC	792	23,068	0.78 (0.66, 0.93)	0.72 (0.61, 0.86)
	NG	792	12,315	1.09 (0.91, 1.30)	1.03 (0.86, 1.23)

a. Rate ratios were estimated using Poisson regression. A scaled deviance was used to adjust for overdispersion.
b. Rate ratio was adjusted for age, sex and calendar period.
c. Rate ratio was adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.
d. The Niagara population includes residents of all communities in the Niagara census division except Port Colborne.
* Indicates rate ratios were suppressed due to a small number of discharge counts.

Exhibit 30: A comparison of hospital discharge rates for diseases of the digestive system between Port Colborne and (i) the comparison communities and (ii) the Niagara communities

	PC vs.	Inpatient Discharges		Rate Ratio (95% CI)[a]	
		PC	Other	Minimally Adjusted[b]	Adjusted[c]
Overall	CC	7,243	226,141	0.97 (0.93, 1.01)	0.90 (0.87, 0.94)
	NG[d]	7,243	126,217	1.06 (1.02, 1.10)	0.98 (0.94, 1.02)
<20 years	CC	886	30,738	1.04 (0.93, 1.15)	0.96 (0.87, 1.07)
	NG	886	19,380	0.98 (0.88, 1.09)	0.91 (0.82, 1.01)
20-44 years	CC	1,672	62,078	0.97 (0.89, 1.04)	0.90 (0.83, 0.97)
	NG	1,672	32,635	1.07 (0.99, 1.16)	1.00 (0.92, 1.08)
45-64 years	CC	2,032	65,133	0.90 (0.84, 0.96)	0.83 (0.78, 0.89)
	NG	2,032	34,745	1.06 (0.99, 1.14)	0.98 (0.92, 1.05)
65+ years	CC	2,653	68,192	0.99 (0.93, 1.05)	0.92 (0.87, 0.98)
	NG	2,653	39,457	1.12 (1.05, 1.19)	1.04 (0.98, 1.11)
Males	CC	3,516	111,739	0.94 (0.89, 1.00)	0.88 (0.83, 0.93)
	NG	3,516	61,937	1.04 (0.98, 1.10)	0.97 (0.91, 1.02)
Females	CC	3,727	114,402	1.00 (0.94, 1.05)	0.93 (0.88, 0.98)
	NG	3,727	64,280	1.07 (1.01, 1.13)	1.00 (0.94, 1.05)
1980-1989	CC	3,624	118,172	0.93 (0.88, 0.99)	0.91 (0.87, 0.97)
	NG	3,624	67,334	0.95 (0.90, 1.00)	0.91 (0.86, 0.96)
1990-2000	CC	3,619	107,969	1.01 (0.95, 1.07)	0.89 (0.84, 0.95)
	NG	3,619	58,883	1.18 (1.11, 1.25)	1.06 (1.00, 1.12)

a. Rate ratios were estimated using Poisson regression. A scaled deviance was used to adjust for overdispersion.
b. Rate ratio was adjusted for age, sex and calendar period.
c. Rate ratio was adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.
d. The Niagara population includes residents of all communities in the Niagara census division except Port Colborne.

Exhibit 31: A comparison of hospital discharge rates for diseases of the genitourinary system between Port Colborne and (i) the comparison communities and (ii) the Niagara communities

	PC vs.	Inpatient Discharges		Rate Ratio (95% CI)[a]	
		PC	Other	Minimally Adjusted[b]	Adjusted[c]
Overall	CC	4,694	149,396	0.96 (0.91, 1.01)	0.90 (0.85, 0.95)
	NG[d]	4,694	90,220	0.96 (0.91, 1.01)	0.89 (0.84, 0.94)
<20 years	CC	322	12,067	0.98 (0.84, 1.14)	0.91 (0.78, 1.06)
	NG	322	7,428	0.96 (0.82, 1.12)	0.89 (0.76, 1.03)
20-44 years	CC	1,593	58,520	0.96 (0.87, 1.05)	0.89 (0.81, 0.98)
	NG	1,593	31,337	1.00 (0.91, 1.10)	0.93 (0.85, 1.02)
45-64 years	CC	1,272	39,779	0.92 (0.86, 1.00)	0.86 (0.80, 0.93)
	NG	1,272	25,233	0.92 (0.85, 0.99)	0.85 (0.79, 0.92)
65+ years	CC	1,507	39,030	0.99 (0.92, 1.06)	0.93 (0.86, 1.00)
	NG	1,507	26,222	0.96 (0.89, 1.03)	0.89 (0.83, 0.96)
Males	CC	1,965	55,788	1.00 (0.93, 1.09)	0.94 (0.86, 1.01)
	NG	1,965	35,783	1.00 (0.92, 1.08)	0.93 (0.86, 1.00)
Females	CC	2,729	93,608	0.92 (0.86, 0.99)	0.86 (0.80, 0.92)
	NG	2,729	54,437	0.92 (0.86, 0.99)	0.85 (0.80, 0.92)
1980-1989	CC	2,604	85,558	0.91 (0.85, 0.98)	0.88 (0.82, 0.94)
	NG	2,604	51,322	0.87 (0.81, 0.93)	0.82 (0.77, 0.88)
1990-2000	CC	2,090	63,838	1.01 (0.93, 1.09)	0.92 (0.85, 0.99)
	NG	2,090	38,898	1.06 (0.98, 1.14)	0.96 (0.89, 1.04)

a. Rate ratios were estimated using Poisson regression. A scaled deviance was used to adjust for overdispersion.
b. Rate ratio was adjusted for age, sex and calendar period.
c. Rate ratio was adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.
d. The Niagara population includes residents of all communities in the Niagara census division except Port Colborne.

Exhibit 32: A comparison of hospital discharge rates for non-malignant diseases of the respiratory system between Port Colborne and (i) the comparison communities and (ii) the Niagara communities

	PC vs.	Inpatient Discharges		Rate Ratio (95% CI)[a]	
		PC	Other	Minimally Adjusted[b]	Adjusted[c]
Overall	CC	5,724	177,605	0.97 (0.92, 1.02)	0.83 (0.79, 0.88)
	NG[d]	5,724	101,646	1.10 (1.05, 1.16)	0.98 (0.93, 1.03)
<20 years	CC	2,596	79,408	1.19 (1.12, 1.27)	1.03 (0.96, 1.09)
	NG	2,596	50,533	1.14 (1.06, 1.21)	1.01 (0.94, 1.07)
20-44 years	CC	600	23,061	0.96 (0.84, 1.09)	0.82 (0.72, 0.94)
	NG	600	11,373	1.11 (0.97, 1.27)	0.99 (0.86, 1.13)
45-64 years	CC	687	22,247	0.88 (0.77, 1.00)	0.76 (0.67, 0.86)
	NG	687	11,422	1.07 (0.95, 1.22)	0.95 (0.84, 1.08)
65+ years	CC	1,841	52,889	0.88 (0.82, 0.95)	0.76 (0.71, 0.82)
	NG	1,841	28,318	1.08 (1.00, 1.17)	0.96 (0.89, 1.04)
Males	CC	3,022	95,656	0.93 (0.86, 1.00)	0.80 (0.74, 0.86)
	NG	3,022	54,988	1.08 (1.00, 1.16)	0.95 (0.88, 1.03)
Females	CC	2,702	81,949	1.01 (0.94, 1.09)	0.87 (0.81, 0.93)
	NG	2,702	46,658	1.13 (1.05, 1.21)	1.00 (0.93, 1.08)
1980-1989	CC	2,926	95,508	0.95 (0.89, 1.02)	0.85 (0.79, 0.91)
	NG	2,926	55,344	1.04 (0.96, 1.11)	0.94 (0.88, 1.01)
1990-2000	CC	2,798	82,097	0.99 (0.91, 1.06)	0.82 (0.76, 0.89)
	NG	2,798	46,302	1.17 (1.08, 1.27)	1.01 (0.93, 1.09)

a. Rate ratios were estimated using Poisson regression. A scaled deviance was used to adjust for overdispersion.
b. Rate ratio was adjusted for age, sex and calendar period.
c. Rate ratio was adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.
d. The Niagara population includes residents of all communities in the Niagara census division except Port Colborne.

Exhibit 33: A comparison of hospital discharge rates for acute respiratory infections between Port Colborne and (i) the comparison communities and (ii) the Niagara communities

	PC vs.	Inpatient Discharges		Rate Ratio (95% CI)[a]	
		PC	Other	Minimally Adjusted[b]	Adjusted[c]
Overall	CC	1,218	30,651	1.64 (1.48, 1.82)	1.38 (1.24, 1.52)
	NG[d]	1,218	24,121	1.40 (1.27, 1.56)	1.19 (1.07, 1.32)
<20 years	CC	861	24,938	1.30 (1.20, 1.40)	1.08 (1.00, 1.17)
	NG	861	20,201	0.95 (0.88, 1.03)	0.81 (0.75, 0.87)
20-44 years	CC	76	1,521	1.75 (1.33, 2.30)	1.46 (1.11, 1.91)
	NG	76	1,018	1.46 (1.10, 1.92)	1.24 (0.94, 1.63)
45-64 years	CC	82	1,312	1.82 (1.42, 2.33)	1.51 (1.18, 1.94)
	NG	82	855	1.74 (1.35, 2.24)	1.47 (1.14, 1.89)
65+ years	CC	199	2,880	1.78 (1.52, 2.08)	1.50 (1.29, 1.75)
	NG	199	2,047	1.61 (1.37, 1.89)	1.37 (1.17, 1.60)
Males	CC	676	17,974	1.60 (1.37, 1.87)	1.33 (1.14, 1.56)
	NG	676	14,161	1.38 (1.17, 1.61)	1.17 (1.00, 1.36)
Females	CC	542	12,677	1.70 (1.49, 1.93)	1.42 (1.24, 1.62)
	NG	542	9,960	1.43 (1.25, 1.64)	1.22 (1.07, 1.39)
1980-1989	CC	682	18,294	1.69 (1.49, 1.92)	1.51 (1.34, 1.71)
	NG	682	14,614	1.41 (1.24, 1.59)	1.25 (1.10, 1.42)
1990-2000	CC	536	12,357	1.60 (1.36, 1.88)	1.25 (1.06, 1.47)
	NG	536	9,507	1.40 (1.19, 1.65)	1.14 (0.96, 1.34)

a. Rate ratios were estimated using Poisson regression. A scaled deviance was used to adjust for overdispersion.
b. Rate ratio was adjusted for age, sex and calendar period.
c. Rate ratio was adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.
d. The Niagara population includes residents of all communities in the Niagara census division except Port Colborne.

Exhibit 34: A comparison of hospital discharge rates for other diseases of the respiratory tract between Port Colborne and (i) the comparison communities and (ii) the Niagara communities

	PC vs.	Inpatient Discharges		Rate Ratio (95% CI)[a]	
		PC	Other	Minimally Adjusted[b]	Adjusted[c]
Overall	CC	939	41,301	0.55 (0.46, 0.66)	0.50 (0.42, 0.60)
	NG[d]	939	19,260	0.88 (0.74, 1.05)	0.82 (0.68, 0.98)
<20 years	CC	685	26,612	0.89 (0.81, 0.97)	0.81 (0.74, 0.89)
	NG	685	13,631	1.13 (1.03, 1.24)	1.05 (0.95, 1.15)
20-44 years	CC	176	10,298	0.60 (0.51, 0.71)	0.55 (0.46, 0.65)
	NG	176	4,041	0.97 (0.81, 1.16)	0.90 (0.75, 1.08)
45-64 years	CC	62	3,288	0.48 (0.34, 0.67)	0.43 (0.31, 0.62)
	NG	62	1,186	0.85 (0.60, 1.21)	0.79 (0.55, 1.12)
65+ years	CC	16	1,103	0.36 (0.20, 0.64)	0.33 (0.18, 0.59)
	NG	16	402	0.64 (0.36, 1.15)	0.60 (0.33, 1.07)
Males	CC	465	20,716	0.51 (0.39, 0.66)	0.46 (0.36, 0.60)
	NG	465	9,813	0.83 (0.64, 1.07)	0.77 (0.59, 1.00)
Females	CC	474	20,585	0.60 (0.47, 0.76)	0.54 (0.43, 0.69)
	NG	474	9,447	0.94 (0.74, 1.19)	0.87 (0.68, 1.11)
1980-1989	CC	656	26,195	0.62 (0.48, 0.79)	0.56 (0.44, 0.72)
	NG	656	14,412	0.75 (0.59, 0.96)	0.69 (0.54, 0.89)
1990-2000	CC	283	15,106	0.49 (0.38, 0.63)	0.45 (0.35, 0.58)
	NG	283	4,848	1.03 (0.80, 1.33)	0.96 (0.74, 1.24)

a. Rate ratios were estimated using Poisson regression. A scaled deviance was used to adjust for overdispersion.
b. Rate ratio was adjusted for age, sex and calendar period.
c. Rate ratio was adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.
d. The Niagara population includes residents of all communities in the Niagara census division except Port Colborne.

Exhibit 35: A comparison of hospital discharge rates for pneumonia and influenza between Port Colborne and (i) the comparison communities and (ii) the Niagara communities

	PC vs.	Inpatient Discharges		Rate Ratio (95% CI)[a]	
		PC	Other	Minimally Adjusted[b]	Adjusted[c]
Overall	CC	1,405	38,927	1.14 (1.07, 1.22)	0.97 (0.90, 1.04)
	NG[d]	1,405	20,877	1.29 (1.20, 1.38)	1.13 (1.05, 1.21)
<20 years	CC	299	9,286	1.15 (1.02, 1.30)	0.98 (0.86, 1.11)
	NG	299	5,220	1.22 (1.08, 1.38)	1.07 (0.94, 1.21)
20-44 years	CC	146	3,839	1.41 (1.18, 1.67)	1.19 (1.00, 1.41)
	NG	146	2,107	1.47 (1.23, 1.75)	1.29 (1.08, 1.54)
45-64 years	CC	212	5,262	1.13 (0.97, 1.31)	0.96 (0.83, 1.11)
	NG	212	2,904	1.30 (1.12, 1.51)	1.14 (0.98, 1.32)
65+ years	CC	748	20,540	0.92 (0.85, 1.00)	0.79 (0.73, 0.85)
	NG	748	10,646	1.17 (1.08, 1.27)	1.03 (0.95, 1.12)
Males	CC	741	20,870	1.10 (1.00, 1.21)	0.93 (0.85, 1.03)
	NG	741	11,097	1.26 (1.15, 1.39)	1.11 (1.00, 1.22)
Females	CC	664	18,057	1.19 (1.08, 1.30)	1.01 (0.91, 1.11)
	NG	664	9,780	1.31 (1.19, 1.44)	1.15 (1.04, 1.27)
1980-1989	CC	607	18,264	1.06 (0.97, 1.17)	0.90 (0.82, 1.00)
	NG	607	9,264	1.21 (1.09, 1.33)	1.08 (0.97, 1.19)
1990-2000	CC	798	20,663	1.22 (1.11, 1.34)	1.04 (0.94, 1.14)
	NG	798	11,613	1.37 (1.25, 1.51)	1.18 (1.08, 1.30)

a. Rate ratios were estimated using Poisson regression. A scaled deviance was used to adjust for overdispersion.
b. Rate ratio was adjusted for age, sex and calendar period.
c. Rate ratio was adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.
d. The Niagara population includes residents of all communities in the Niagara census division except Port Colborne.

Exhibit 36: A comparison of hospital discharge rates for Chronic Obstructive Pulmonary Disease and allied conditions between Port Colborne and (i) the comparison communities and (ii) the Niagara communities

	PC vs.	Inpatient Discharges		Rate Ratio (95% CI)[a]	
		PC	Other	Minimally Adjusted[b]	Adjusted[c]
Overall	CC	1,832	53,384	0.98 (0.90, 1.06)	0.84 (0.77, 0.91)
	NG[d]	1,832	30,382	1.07 (0.98, 1.16)	0.95 (0.88, 1.03)
<20 years	CC	714	16,840	1.54 (1.40, 1.70)	1.32 (1.20, 1.46)
	NG	714	10,566	1.48 (1.34, 1.63)	1.32 (1.20, 1.45)
20-44 years	CC	152	5,312	0.97 (0.76, 1.23)	0.83 (0.65, 1.06)
	NG	152	3,033	0.98 (0.77, 1.25)	0.87 (0.68, 1.12)
45-64 years	CC	253	9,371	0.76 (0.64, 0.90)	0.65 (0.55, 0.77)
	NG	253	5,016	0.89 (0.75, 1.05)	0.79 (0.67, 0.94)
65+ years	CC	713	21,861	0.81 (0.74, 0.90)	0.70 (0.63, 0.77)
	NG	713	11,767	1.01 (0.91, 1.12)	0.90 (0.82, 1.00)
Males	CC	949	28,566	0.91 (0.80, 1.04)	0.78 (0.68, 0.89)
	NG	949	16,002	1.01 (0.88, 1.15)	0.90 (0.79, 1.03)
Females	CC	883	24,818	1.06 (0.96, 1.16)	0.91 (0.82, 1.00)
	NG	883	14,380	1.13 (1.03, 1.25)	1.01 (0.92, 1.11)
1980-1989	CC	844	26,705	0.90 (0.80, 1.01)	0.82 (0.73, 0.93)
	NG	844	14,042	1.03 (0.91, 1.16)	0.96 (0.85, 1.08)
1990-2000	CC	988	26,679	1.06 (0.95, 1.19)	0.86 (0.77, 0.96)
	NG	988	16,340	1.11 (0.99, 1.24)	0.95 (0.84, 1.06)

a. Rate ratios were estimated using Poisson regression. A scaled deviance was used to adjust for overdispersion.
b. Rate ratio was adjusted for age, sex and calendar period.
c. Rate ratio was adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.
d. The Niagara population includes residents of all communities in the Niagara census division except Port Colborne.

Exhibit 37: A comparison of hospital discharge rates for asthma between Port Colborne and (i) the comparison communities and (ii) the Niagara communities

	PC vs.	Inpatient Discharges		Rate Ratio (95% CI)[a]	
		PC	Other	Minimally Adjusted[b]	Adjusted[c]
Overall	CC	1,130	26,466	1.23 (1.13, 1.35)	1.07 (0.98, 1.17)
	NG[d]	1,130	17,601	1.13 (1.03, 1.23)	1.02 (0.93, 1.12)
<20 years	CC	677	14,419	1.72 (1.58, 1.87)	1.49 (1.37, 1.62)
	NG	677	9,738	1.52 (1.40, 1.66)	1.38 (1.27, 1.50)
20-44 years	CC	132	4,491	0.97 (0.77, 1.22)	0.84 (0.67, 1.06)
	NG	132	2,690	0.93 (0.73, 1.17)	0.84 (0.67, 1.06)
45-64 years	CC	123	3,846	0.98 (0.80, 1.20)	0.85 (0.70, 1.04)
	NG	123	2,455	0.93 (0.76, 1.14)	0.84 (0.69, 1.03)
65+ years	CC	198	3,710	1.41 (1.20, 1.66)	1.23 (1.05, 1.44)
	NG	198	2,718	1.23 (1.04, 1.44)	1.12 (0.95, 1.31)
Males	CC	551	12,776	1.24 (1.07, 1.44)	1.08 (0.93, 1.25)
	NG	551	8,695	1.11 (0.96, 1.28)	1.00 (0.87, 1.16)
Females	CC	579	13,690	1.22 (1.10, 1.35)	1.06 (0.96, 1.18)
	NG	579	8,906	1.14 (1.03, 1.27)	1.04 (0.94, 1.16)
1980-1989	CC	556	13,784	1.07 (0.94, 1.22)	1.00 (0.88, 1.14)
	NG	556	8,867	1.04 (0.91, 1.18)	1.00 (0.87, 1.14)
1990-2000	CC	574	12,682	1.42 (1.26, 1.61)	1.14 (1.01, 1.29)
	NG	574	8,734	1.22 (1.08, 1.38)	1.05 (0.93, 1.19)

a. Rate ratios were estimated using Poisson regression. A scaled deviance was used to adjust for overdispersion.
b. Rate ratio was adjusted for age, sex and calendar period.
c. Rate ratio was adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.
d. The Niagara population includes residents of all communities in the Niagara census division except Port Colborne.

Exhibit 38: A comparison of hospital discharge rates for diseases of the skin and subcutaneous tissue between Port Colborne and (i) the comparison communities and (ii) the Niagara communities

	PC vs.	Inpatient Discharges		Rate Ratio (95% CI)[a]	
		PC	Other	Minimally Adjusted[b]	Adjusted[c]
Overall	CC	596	23,084	0.82 (0.76, 0.88)	0.72 (0.66, 0.78)
	NG[d]	596	11,509	0.99 (0.92, 1.07)	0.88 (0.82, 0.96)
<20 years	CC	110	4,531	0.89 (0.75, 1.06)	0.79 (0.66, 0.94)
	NG	110	2,303	1.04 (0.87, 1.24)	0.93 (0.78, 1.11)
20-44 years	CC	152	7,804	0.71 (0.61, 0.82)	0.62 (0.53, 0.72)
	NG	152	3,569	0.88 (0.76, 1.03)	0.79 (0.67, 0.92)
45-64 years	CC	147	5,250	0.81 (0.70, 0.94)	0.71 (0.61, 0.83)
	NG	147	2,578	1.03 (0.88, 1.20)	0.92 (0.79, 1.07)
65+ years	CC	187	5,499	0.87 (0.76, 1.00)	0.77 (0.67, 0.88)
	NG	187	3,059	1.03 (0.89, 1.18)	0.92 (0.80, 1.05)
Males	CC	303	11,738	0.83 (0.75, 0.93)	0.73 (0.66, 0.82)
	NG	303	5,841	1.01 (0.90, 1.12)	0.90 (0.80, 1.00)
Females	CC	293	11,346	0.80 (0.72, 0.90)	0.70 (0.63, 0.79)
	NG	293	5,668	0.98 (0.88, 1.10)	0.87 (0.78, 0.98)
1980-1989	CC	296	13,267	0.70 (0.63, 0.78)	0.64 (0.57, 0.72)
	NG	296	6,199	0.87 (0.78, 0.97)	0.80 (0.72, 0.89)
1990-2000	CC	300	9,817	0.95 (0.85, 1.06)	0.81 (0.72, 0.90)
	NG	300	5,310	1.13 (1.01, 1.27)	0.98 (0.88, 1.10)

a. Rate ratios were estimated using Poisson regression. A scaled deviance was used to adjust for overdispersion.
b. Rate ratio was adjusted for age, sex and calendar period.
c. Rate ratio was adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.
d. The Niagara population includes residents of all communities in the Niagara census division except Port Colborne.

Exhibit 39: A comparison of hospital discharge rates for injury and poisoning between Port Colborne and (i) the comparison communities and (ii) the Niagara communities

	PC vs.	Inpatient Discharges		Rate Ratio (95% CI)[a]	
		PC	Other	Minimally Adjusted[b]	Adjusted[c]
Overall	CC	4,770	147,393	1.00 (0.96, 1.04)	0.88 (0.84, 0.91)
	NG[d]	4,770	82,054	1.12 (1.07, 1.16)	1.02 (0.98, 1.06)
<20 years	CC	972	32,969	1.05 (0.96, 1.14)	0.92 (0.84, 1.00)
	NG	972	19,667	1.06 (0.97, 1.15)	0.96 (0.89, 1.05)
20-44 years	CC	1,451	47,720	1.11 (1.03, 1.18)	0.97 (0.90, 1.03)
	NG	1,451	23,985	1.29 (1.20, 1.38)	1.17 (1.09, 1.26)
45-64 years	CC	878	27,210	0.92 (0.85, 1.01)	0.81 (0.75, 0.88)
	NG	878	13,985	1.14 (1.04, 1.24)	1.03 (0.95, 1.12)
65+ years	CC	1,469	39,494	0.94 (0.87, 1.00)	0.82 (0.77, 0.88)
	NG	1,469	24,417	1.00 (0.93, 1.07)	0.91 (0.85, 0.98)
Males	CC	2,525	80,299	1.00 (0.95, 1.05)	0.87 (0.83, 0.92)
	NG	2,525	43,974	1.12 (1.06, 1.18)	1.02 (0.97, 1.07)
Females	CC	2,245	67,094	1.00 (0.95, 1.06)	0.88 (0.83, 0.93)
	NG	2,245	38,080	1.11 (1.05, 1.18)	1.01 (0.96, 1.07)
1980-1989	CC	2,424	78,870	0.97 (0.92, 1.02)	0.85 (0.80, 0.89)
	NG	2,424	43,349	1.04 (0.99, 1.10)	0.96 (0.91, 1.01)
1990-2000	CC	2,346	68,523	1.04 (0.98, 1.10)	0.91 (0.86, 0.96)
	NG	2,346	38,705	1.20 (1.13, 1.27)	1.07 (1.02, 1.14)

a. Rate ratios were estimated using Poisson regression. A scaled deviance was used to adjust for overdispersion.
b. Rate ratio was adjusted for age, sex and calendar period.
c. Rate ratio was adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.
d. The Niagara population includes residents of all communities in the Niagara census division except Port Colborne.

Exhibit 40: A comparison of standardized hospital discharge ratios for all causes

	Number of discharges in Port Colborne		Standardized Discharge Ratio (95% CI)
	Observed	Expected*	
Inpatient discharges only			
Overall	61,933	54,267	1.14 (1.13, 1.15)
<20 years	8,691	6,797	1.28 (1.25, 1.31)
20-44 years	16,565	14,135	1.17 (1.15, 1.19)
45-64 years	13,848	12,283	1.13 (1.11, 1.15)
65+ years	22,829	21,052	1.08 (1.07, 1.10)
Males	27,800	23,496	1.18 (1.17, 1.20)
Females	34,133	30,772	1.11 (1.10, 1.12)
1980-1989	31,186	28,897	1.08 (1.07, 1.09)
1990-2000	30,747	25,370	1.21 (1.20, 1.23)
All discharges			
Overall	96,032	77,910	1.23 (1.22, 1.24)
<20 years	12,679	9,041	1.40 (1.38, 1.43)
20-44 years	27,323	20,668	1.32 (1.31, 1.34)
45-64 years	22,674	18,773	1.21 (1.19, 1.22)
65+ years	33,356	29,428	1.13 (1.12, 1.15)
Males	43,382	34,111	1.27 (1.26, 1.28)
Females	52,650	43,799	1.20 (1.19, 1.21)
1980-1989	41,141	33,086	1.24 (1.23, 1.26)
1990-2000	54,891	44,824	1.22 (1.21, 1.23)

* Based on Ontario rates.

Exhibit 41: A comparison of standardized hospital discharge ratios for malignant respiratory disease

	Number of discharges in Port Colborne		Standardized Discharge Ratio (95% CI)
	Observed	Expected*	
Inpatient discharges only			
Overall	530	550	0.96 (0.88, 1.05)
<20 years	<5**	<5**	—
20-44 years	24	13	1.84 (1.18, 2.74)
45-64 years	214	206	1.04 (0.90, 1.19)
65+ years	291	330	0.88 (0.78, 0.99)
Males	381	371	1.03 (0.93, 1.13)
Females	149	178	0.84 (0.71, 0.98)
1980-1989	308	291	1.06 (0.94, 1.18)
1990-2000	222	258	0.86 (0.75, 0.98)
All discharges			
Overall	662	637	1.04 (0.96, 1.12)
<20 years	<5**	<5**	—
20-44 years	29	15	1.92 (1.28, 2.76)
45-64 years	266	237	1.12 (0.99, 1.27)
65+ years	366	384	0.95 (0.86, 1.06)
Males	469	429	1.09 (1.00, 1.20)
Females	193	208	0.93 (0.80, 1.07)
1980-1989	317	304	1.04 (0.93, 1.16)
1990-2000	345	333	1.04 (0.93, 1.15)

* Based on Ontario rates.
** Indicates rate ratios were suppressed due to a small number of discharge counts.

Exhibit 42: A comparison of standardized hospital discharge ratios for diseases of the nervous system

	Number of discharges in Port Colborne		Standardized Discharge Ratio (95% CI)
	Observed	Expected*	
Inpatient discharges only			
Overall	1,951	2,094	0.93 (0.89, 0.97)
<20 years	259	322	0.80 (0.71, 0.91)
20-44 years	324	286	1.13 (1.01, 1.26)
45-64 years	464	475	0.98 (0.89, 1.07)
65+ years	904	1,012	0.89 (0.84, 0.95)
Males	909	949	0.96 (0.90, 1.02)
Females	1,042	1,146	0.91 (0.85, 0.97)
1980-1989	1,219	1,412	0.86 (0.82, 0.91)
1990-2000	732	682	1.07 (1.00, 1.15)
All discharges			
Overall	6,187	5,516	1.12 (1.09, 1.15)
<20 years	740	807	0.92 (0.85, 0.99)
20-44 years	751	551	1.36 (1.27, 1.46)
45-64 years	1,332	1,074	1.24 (1.17, 1.31)
65+ years	3,364	3,084	1.09 (1.05, 1.13)
Males	2,717	2,372	1.15 (1.10, 1.19)
Females	3,470	3,144	1.10 (1.07, 1.14)
1980-1989	2,285	1,823	1.25 (1.20, 1.31)
1990-2000	3,902	3,692	1.06 (1.02, 1.09)

* Based on Ontario rates.

Exhibit 43: A comparison of standardized hospital discharge ratios for diseases of the circulatory system

	Number of discharges in Port Colborne		Standardized Discharge Ratio (95% CI)
	Observed	Expected*	
Inpatient discharges only			
Overall	10,308	8,425	1.22 (1.20, 1.25)
<20 years	43	45	0.95 (0.69, 1.28)
20-44 years	634	445	1.43 (1.32, 1.54)
45-64 years	2,899	2,423	1.20 (1.15, 1.24)
65+ years	6,732	5,512	1.22 (1.19, 1.25)
Males	5,586	4,610	1.21 (1.18, 1.24)
Females	4,722	3,815	1.24 (1.20, 1.27)
1980-1989	4,796	4,070	1.18 (1.15, 1.21)
1990-2000	5,512	4,354	1.27 (1.23, 1.30)
All discharges			
Overall	11,827	9,225	1.28 (1.26, 1.31)
<20 years	53	50	1.05 (0.79, 1.38)
20-44 years	1,027	582	1.76 (1.66, 1.88)
45-64 years	3,499	2,750	1.27 (1.23, 1.32)
65+ years	7,248	5,843	1.24 (1.21, 1.27)
Males	6,445	5,068	1.27 (1.24, 1.30)
Females	5,382	4,157	1.29 (1.26, 1.33)
1980-1989	5,115	4,164	1.23 (1.19, 1.26)
1990-2000	6,712	5,061	1.33 (1.29, 1.36)

* Based on Ontario rates.

Exhibit 44: A comparison of standardized hospital discharge ratios for ischemic heart disease

	Number of discharges in Port Colborne		Standardized Discharge Ratio (95% CI)
	Observed	Expected*	
Inpatient discharges only			
Overall	4,631	3,315	1.40 (1.36, 1.44)
<20 years	<5**	<5**	—
20-44 years	246	128	1.92 (1.68, 2.17)
45-64 years	1,516	1,203	1.26 (1.20, 1.32)
65+ years	2,866	1,983	1.45 (1.39, 1.50)
Males	2,614	2,025	1.29 (1.24, 1.34)
Females	2,017	1,290	1.56 (1.50, 1.63)
1980-1989	2,154	1,562	1.38 (1.32, 1.44)
1990-2000	2,477	1,753	1.41 (1.36, 1.47)
All discharges			
Overall	4,900	3,551	1.38 (1.34, 1.42)
<20 years	<5**	<5**	—
20-44 years	267	141	1.89 (1.67, 2.13)
45-64 years	1,630	1,316	1.24 (1.18, 1.30)
65+ years	3,000	2,093	1.43 (1.38, 1.49)
Males	2,790	2,194	1.27 (1.23, 1.32)
Females	2,110	1,357	1.56 (1.49, 1.62)
1980-1989	2,181	1,578	1.38 (1.32, 1.44)
1990-2000	2,719	1,973	1.38 (1.33, 1.43)

* Based on Ontario rates.

** Indicates rate ratios were suppressed due to a small number of discharge counts.

Exhibit 45: A comparison of standardized hospital discharge ratios for acute myocardial infarction

	Number of discharges in Port Colborne		Standardized Discharge Ratio (95% CI)
	Observed	Expected*	
Inpatient discharges only			
Overall	1,307	1,116	1.17 (1.11, 1.24)
<20 years	<5**	<5**	—
20-44 years	65	45	1.45 (1.12, 1.85)
45-64 years	447	361	1.24 (1.13, 1.36)
65+ years	795	710	1.12 (1.04, 1.20)
Males	820	697	1.18 (1.10, 1.26)
Females	487	419	1.16 (1.06, 1.27)
1980-1989	596	510	1.17 (1.08, 1.27)
1990-2000	711	606	1.17 (1.09, 1.26)
All discharges			
Overall	1,309	1,118	1.17 (1.11, 1.24)
<20 years	<5**	<5**	—
20-44 years	65	45	1.44 (1.11, 1.84)
45-64 years	449	361	1.24 (1.13, 1.36)
65+ years	795	711	1.12 (1.04, 1.20)
Males	822	698	1.18 (1.10, 1.26)
Females	487	420	1.16 (1.06, 1.27)
1980-1989	596	510	1.17 (1.08, 1.27)
1990-2000	713	607	1.17 (1.09, 1.26)

* Based on Ontario rates.

** Indicates rate ratios were suppressed due to a small number of discharge counts.

Exhibit 46: A comparison of standardized hospital discharge ratios for heart failure

	Number of discharges in Port Colborne		Standardized Discharge Ratio (95% CI)
	Observed	Expected*	
Inpatient discharges only			
Overall	1,179	1,130	1.04 (0.98, 1.10)
<20 years	<5**	<5**	—
20-44 years	14	8	1.65 (0.90, 2.78)
45-64 years	174	150	1.16 (0.99, 1.34)
65+ years	990	969	1.02 (0.96, 1.09)
Males	580	551	1.05 (0.97, 1.14)
Females	599	579	1.03 (0.95, 1.12)
1980-1989	451	458	0.98 (0.90, 1.08)
1990-2000	728	672	1.08 (1.01, 1.17)
All discharges			
Overall	1,182	1,132	1.04 (0.99, 1.11)
<20 years	<5**	<5**	—
20-44 years	15	9	1.76 (0.98, 2.90)
45-64 years	176	151	1.17 (1.00, 1.35)
65+ years	990	970	1.02 (0.96, 1.09)
Males	583	552	1.06 (0.97, 1.15)
Females	599	580	1.03 (0.95, 1.12)
1980-1989	451	458	0.98 (0.90, 1.08)
1990-2000	731	674	1.09 (1.01, 1.17)

* Based on Ontario rates.
** Indicates rate ratios were suppressed due to a small number of discharge counts.

Exhibit 47: A comparison of standardized hospital discharge ratios for cerebrovascular disease

	Number of discharges in Port Colborne		Standardized Discharge Ratio (95% CI)
	Observed	Expected*	
Inpatient discharges only			
Overall	1,503	1,380	1.09 (1.03, 1.15)
<20 years	<5**	<5**	—
20-44 years	45	31	1.44 (1.05, 1.93)
45-64 years	265	268	0.99 (0.87, 1.12)
65+ years	1,193	1,077	1.11 (1.05, 1.17)
Males	786	688	1.14 (1.06, 1.22)
Females	717	692	1.04 (0.96, 1.12)
1980-1989	711	687	1.03 (0.96, 1.11)
1990-2000	792	693	1.14 (1.06, 1.23)
All discharges			
Overall	1,518	1,401	1.08 (1.03, 1.14)
<20 years	<5**	<5**	—
20-44 years	45	32	1.40 (1.02, 1.87)
45-64 years	269	274	0.98 (0.87, 1.11)
65+ years	1,204	1,090	1.10 (1.04, 1.17)
Males	796	701	1.14 (1.06, 1.22)
Females	722	700	1.03 (0.96, 1.11)
1980-1989	711	690	1.03 (0.96, 1.11)
1990-2000	807	711	1.14 (1.06, 1.22)

* Based on Ontario rates.
** Indicates rate ratios were suppressed due to a small number of discharge counts.

Exhibit 48: A comparison of standardized hospital discharge ratios for diseases of the digestive system

	Number of discharges in Port Colborne		Standardized Discharge Ratio (95% CI)
	Observed	Expected*	
Inpatient discharges only			
Overall	7,243	5,997	1.21 (1.18, 1.24)
<20 years	886	670	1.32 (1.24, 1.41)
20-44 years	1,672	1,316	1.27 (1.21, 1.33)
45-64 years	2,032	1,771	1.15 (1.10, 1.20)
65+ years	2,653	2,239	1.18 (1.14, 1.23)
Males	3,516	3,011	1.17 (1.13, 1.21)
Females	3,727	2,986	1.25 (1.21, 1.29)
1980-1989	3,624	3,209	1.13 (1.09, 1.17)
1990-2000	3,619	2,788	1.30 (1.26, 1.34)
All discharges			
Overall	12,521	9,816	1.28 (1.25, 1.30)
<20 years	1,973	1,135	1.74 (1.66, 1.82)
20-44 years	3,283	2,321	1.41 (1.37, 1.46)
45-64 years	3,357	2,939	1.14 (1.10, 1.18)
65+ years	3,908	3,420	1.14 (1.11, 1.18)
Males	6,029	4,821	1.25 (1.22, 1.28)
Females	6,492	4,995	1.30 (1.27, 1.33)
1980-1989	4,838	3,870	1.25 (1.22, 1.29)
1990-2000	7,683	5,945	1.29 (1.26, 1.32)

* Based on Ontario rates.

Exhibit 49: A comparison of standardized hospital discharge ratios for diseases of the genitourinary system

	Number of discharges in Port Colborne		Standardized Discharge Ratio (95% CI)
	Observed	Expected*	
Inpatient discharges only			
Overall	4,694	3,943	1.19 (1.16, 1.22)
<20 years	322	280	1.15 (1.03, 1.28)
20-44 years	1,593	1,210	1.32 (1.25, 1.38)
45-64 years	1,272	1,129	1.13 (1.07, 1.19)
65+ years	1,507	1,325	1.14 (1.08, 1.20)
Males	1,965	1,624	1.21 (1.16, 1.26)
Females	2,729	2,319	1.18 (1.13, 1.22)
1980-1989	2,604	2,295	1.13 (1.09, 1.18)
1990-2000	2,090	1,648	1.27 (1.21, 1.32)
All discharges			
Overall	10,874	7,988	1.36 (1.34, 1.39)
<20 years	648	460	1.41 (1.30, 1.52)
20-44 years	4,027	2,542	1.58 (1.54, 1.63)
45-64 years	3,131	2,418	1.29 (1.25, 1.34)
65+ years	3,068	2,567	1.20 (1.15, 1.24)
Males	3,953	3,201	1.23 (1.20, 1.27)
Females	6,921	4,786	1.45 (1.41, 1.48)
1980-1989	4,846	3,142	1.54 (1.50, 1.59)
1990-2000	6,028	4,845	1.24 (1.21, 1.28)

* Based on Ontario rates.

Exhibit 50: A comparison of standardized hospital discharge ratios for diseases of the respiratory system

	Number of discharges in Port Colborne		Standardized Discharge Ratio (95% CI)
	Observed	Expected*	
Inpatient discharges only			
Overall	5,724	4,919	1.16 (1.13, 1.19)
<20 years	2,596	1,879	1.38 (1.33, 1.44)
20-44 years	600	557	1.08 (0.99, 1.17)
45-64 years	687	675	1.02 (0.94, 1.10)
65+ years	1,841	1,808	1.02 (0.97, 1.07)
Males	3,022	2,625	1.15 (1.11, 1.19)
Females	2,702	2,294	1.18 (1.13, 1.22)
1980-1989	2,926	2,708	1.08 (1.04, 1.12)
1990-2000	2,798	2,211	1.27 (1.22, 1.31)
All discharges			
Overall	6,565	5,526	1.19 (1.16, 1.22)
<20 years	3,034	2,124	1.43 (1.38, 1.48)
20-44 years	771	711	1.08 (1.01, 1.16)
45-64 years	819	796	1.03 (0.96, 1.10)
65+ years	1,941	1,896	1.02 (0.98, 1.07)
Males	3,536	2,956	1.20 (1.16, 1.24)
Females	3,029	2,571	1.18 (1.14, 1.22)
1980-1989	3,125	2,790	1.12 (1.08, 1.16)
1990-2000	3,440	2,736	1.26 (1.22, 1.30)

* Based on Ontario rates.

Exhibit 51: A comparison of standardized hospital discharge ratios for acute respiratory infections

	Number of discharges in Port Colborne		Standardized Discharge Ratio (95% CI)
	Observed	Expected*	
Inpatient discharges only			
Overall	1,218	684	1.78 (1.68, 1.88)
<20 years	861	523	1.65 (1.54, 1.76)
20-44 years	76	37	2.04 (1.60, 2.55)
45-64 years	82	36	2.29 (1.82, 2.84)
65+ years	199	88	2.27 (1.96, 2.60)
Males	676	391	1.73 (1.60, 1.86)
Females	542	293	1.85 (1.69, 2.01)
1980-1989	682	422	1.62 (1.50, 1.74)
1990-2000	536	262	2.04 (1.87, 2.22)
All discharges			
Overall	1,224	700	1.75 (1.65, 1.85)
<20 years	862	528	1.63 (1.53, 1.74)
20-44 years	80	41	1.94 (1.54, 2.41)
45-64 years	82	40	2.05 (1.63, 2.54)
65+ years	200	91	2.20 (1.90, 2.52)
Males	680	399	1.71 (1.58, 1.84)
Females	544	302	1.80 (1.65, 1.96)
1980-1989	684	424	1.61 (1.49, 1.74)
1990-2000	540	276	1.96 (1.79, 2.13)

* Based on Ontario rates.

Exhibit 52: A comparison of standardized hospital discharge ratios for other diseases of the respiratory system

	Number of discharges in Port Colborne		Standardized Discharge Ratio (95% CI)
	Observed	Expected*	
Inpatient discharges only			
Overall	939	1,084	0.87 (0.81, 0.92)
<20 years	685	676	1.01 (0.94, 1.09)
20-44 years	176	264	0.67 (0.57, 0.77)
45-64 years	62	104	0.60 (0.46, 0.76)
65+ years	16	40	0.40 (0.23, 0.66)
Males	465	560	0.83 (0.76, 0.91)
Females	474	524	0.90 (0.82, 0.99)
1980-1989	656	768	0.85 (0.79, 0.92)
1990-2000	283	316	0.90 (0.79, 1.01)
All discharges			
Overall	1,683	1,583	1.06 (1.01, 1.12)
<20 years	1,120	913	1.23 (1.16, 1.30)
20-44 years	333	403	0.83 (0.74, 0.92)
45-64 years	165	189	0.87 (0.75, 1.02)
65+ years	65	78	0.84 (0.64, 1.07)
Males	916	831	1.10 (1.03, 1.18)
Females	767	752	1.02 (0.95, 1.09)
1980-1989	849	834	1.02 (0.95, 1.09)
1990-2000	834	749	1.11 (1.04, 1.19)

* Based on Ontario rates.

Exhibit 53: A comparison of standardized hospital discharge ratios for pneumonia / influenza

	Number of discharges in Port Colborne		Standardized Discharge Ratio (95% CI)
	Observed	Expected*	
Inpatient discharges only			
Overall	1,405	1,190	1.18 (1.12, 1.24)
<20 years	299	207	1.45 (1.29, 1.62)
20-44 years	146	86	1.71 (1.44, 2.01)
45-64 years	212	165	1.28 (1.12, 1.47)
65+ years	748	733	1.02 (0.95, 1.10)
Males	741	623	1.19 (1.11, 1.28)
Females	664	567	1.17 (1.08, 1.26)
1980-1989	607	525	1.16 (1.07, 1.25)
1990-2000	798	665	1.20 (1.12, 1.29)
All discharges			
Overall	1,430	1,204	1.19 (1.13, 1.25)
<20 years	299	207	1.44 (1.28, 1.62)
20-44 years	149	88	1.70 (1.44, 2.00)
45-64 years	222	170	1.31 (1.14, 1.49)
65+ years	760	739	1.03 (0.96, 1.10)
Males	754	630	1.20 (1.11, 1.29)
Females	676	573	1.18 (1.09, 1.27)
1980-1989	607	527	1.15 (1.06, 1.25)
1990-2000	823	677	1.22 (1.13, 1.30)

* Based on Ontario rates.

Exhibit 54: A comparison of standardized hospital discharge ratios for COPD and allied conditions

	Number of discharges in Port Colborne		Standardized Discharge Ratio (95% CI)
	Observed	Expected*	
Inpatient discharges only			
Overall	1,832	1,556	1.18 (1.12, 1.23)
<20 years	714	436	1.64 (1.52, 1.76)
20-44 years	152	118	1.28 (1.09, 1.51)
45-64 years	253	282	0.90 (0.79, 1.01)
65+ years	713	719	0.99 (0.92, 1.07)
Males	949	825	1.15 (1.08, 1.23)
Females	883	731	1.21 (1.13, 1.29)
1980-1989	844	808	1.04 (0.97, 1.12)
1990-2000	988	747	1.32 (1.24, 1.41)
All discharges			
Overall	1,843	1,582	1.17 (1.11, 1.22)
<20 years	714	437	1.63 (1.52, 1.76)
20-44 years	153	122	1.25 (1.06, 1.47)
45-64 years	256	292	0.88 (0.77, 0.99)
65+ years	720	730	0.99 (0.91, 1.06)
Males	955	839	1.14 (1.07, 1.21)
Females	888	743	1.20 (1.12, 1.28)
1980-1989	846	814	1.04 (0.97, 1.11)
1990-2000	997	768	1.30 (1.22, 1.38)

* Based on Ontario rates.

Exhibit 55: A comparison of standardized hospital discharge ratios for asthma

	Number of discharges in Port Colborne		Standardized Discharge Ratio (95% CI)
	Observed	Expected*	
Inpatient discharges only			
Overall	1,130	745	1.52 (1.43, 1.61)
<20 years	677	393	1.72 (1.60, 1.86)
20-44 years	132	102	1.29 (1.08, 1.54)
45-64 years	123	120	1.03 (0.85, 1.23)
65+ years	198	130	1.52 (1.32, 1.75)
Males	551	357	1.54 (1.42, 1.68)
Females	579	387	1.49 (1.38, 1.62)
1980-1989	556	425	1.31 (1.20, 1.42)
1990-2000	574	319	1.80 (1.65, 1.95)
All discharges			
Overall	1,131	747	1.51 (1.43, 1.60)
<20 years	677	394	1.72 (1.59, 1.86)
20-44 years	132	103	1.29 (1.08, 1.52)
45-64 years	123	120	1.02 (0.85, 1.22)
65+ years	199	131	1.52 (1.32, 1.75)
Males	551	359	1.54 (1.41, 1.67)
Females	580	389	1.49 (1.37, 1.62)
1980-1989	556	426	1.31 (1.20, 1.42)
1990-2000	575	321	1.79 (1.65, 1.94)

* Based on Ontario rates.

Exhibit 56: A comparison of standardized hospital discharge ratios for diseases of the skin and subcutaneous tissue

	Number of discharges in Port Colborne		Standardized Discharge Ratio (95% CI)
	Observed	Expected*	
Inpatient discharges only			
Overall	596	638	0.93 (0.86, 1.01)
<20 years	110	113	0.97 (0.80, 1.17)
20-44 years	152	172	0.89 (0.75, 1.04)
45-64 years	147	153	0.96 (0.81, 1.13)
65+ years	187	200	0.93 (0.80, 1.08)
Males	303	324	0.94 (0.83, 1.05)
Females	293	315	0.93 (0.83, 1.04)
1980-1989	296	371	0.80 (0.71, 0.89)
1990-2000	300	267	1.12 (1.00, 1.26)
All discharges			
Overall	1,172	1,231	0.95 (0.90, 1.01)
<20 years	172	184	0.94 (0.80, 1.09)
20-44 years	362	373	0.97 (0.87, 1.08)
45-64 years	324	322	1.01 (0.90, 1.12)
65+ years	314	352	0.89 (0.80, 1.00)
Males	574	612	0.94 (0.86, 1.02)
Females	598	619	0.97 (0.89, 1.05)
1980-1989	570	524	1.09 (1.00, 1.18)
1990-2000	602	707	0.85 (0.78, 0.92)

* Based on Ontario rates.

Exhibit 57: A comparison of standardized hospital discharge ratios for injury/poisoning

	Number of discharges in Port Colborne		Standardized Discharge Ratio (95% CI)
	Observed	Expected*	
Inpatient discharges only			
Overall	4,770	4,172	1.14 (1.11, 1.18)
<20 years	972	840	1.16 (1.09, 1.23)
20-44 years	1,451	1,022	1.42 (1.35, 1.49)
45-64 years	878	787	1.12 (1.04, 1.19)
65+ years	1,469	1,523	0.96 (0.92, 1.02)
Males	2,525	2,134	1.18 (1.14, 1.23)
Females	2,245	2,038	1.10 (1.06, 1.15)
1980-1989	2,424	2,234	1.09 (1.04, 1.13)
1990-2000	2,346	1,938	1.21 (1.16, 1.26)
All discharges			
Overall	5,815	4,700	1.24 (1.21, 1.27)
<20 years	1,321	963	1.37 (1.30, 1.45)
20-44 years	1,806	1,229	1.47 (1.40, 1.54)
45-64 years	1,067	896	1.19 (1.12, 1.26)
65+ years	1,621	1,612	1.01 (0.96, 1.06)
Males	3,205	2,455	1.31 (1.26, 1.35)
Females	2,610	2,245	1.16 (1.12, 1.21)
1980-1989	2,659	2,337	1.14 (1.10, 1.18)
1990-2000	3,156	2,363	1.34 (1.29, 1.38)

* Based on Ontario rates.

Exhibit 58: A comparison of hospital discharge rates for all health conditions between Port Colborne and the comparison communities, and Port Colborne and Niagara, 1980 to 2000

	Port Colborne vs.	Rate Ratios (Overall)*	
		Excluding Day Surgeries	Including Day Surgeries
All Causes	Comparison	0.91 (0.88, 0.93)	1.04 (1.01, 1.07)
	Niagara	1.02 (0.99, 1.05)	1.07 (1.04, 1.10)
Malignant Respiratory	Comparison	0.81 (0.69, 0.95)	0.93 (0.80, 1.07)
	Niagara	1.12 (0.95, 1.32)	1.12 (0.96, 1.29)
Nervous System	Comparison	0.74 (0.69, 0.79)	0.98 (0.93, 1.03)
	Niagara	0.90 (0.84, 0.96)	1.07 (1.02, 1.13)
Circulatory System	Comparison	0.88 (0.79, 0.99)	0.99 (0.89, 1.10)
	Niagara	0.99 (0.88, 1.11)	1.12 (1.01, 1.24)
Ischemic Heart Disease	Comparison	1.18 (1.09, 1.27)	1.16 (1.08, 1.25)
	Niagara	1.34 (1.24, 1.44)	1.37 (1.27, 1.48)
Acute Myocardial Infarction	Comparison	0.98 (0.87, 1.10)	0.97 (0.86, 1.10)
	Niagara	1.11 (0.98, 1.26)	1.11 (0.98, 1.26)
Heart Failure	Comparison	0.88 (0.73, 1.07)	0.89 (0.74, 1.08)
	Niagara	1.01 (0.83, 1.23)	1.02 (0.84, 1.24)
Cerebrovascular Disease	Comparison	0.84 (0.75, 0.95)	0.84 (0.74, 0.94)
	Niagara	1.09 (0.97, 1.22)	1.09 (0.97, 1.22)
Digestive System	Comparison	0.90 (0.87, 0.94)	1.05 (1.01, 1.08)
	Niagara	0.98 (0.94, 1.02)	1.08 (1.04, 1.12)
Genitourinary System	Comparison	0.90 (0.85, 0.95)	1.13 (1.08, 1.18)
	Niagara	0.89 (0.84, 0.94)	1.03 (0.98, 1.07)
Respiratory System	Comparison	0.83 (0.79, 0.88)	0.90 (0.86, 0.95)
	Niagara	0.98 (0.93, 1.03)	0.95 (0.91, 1.00)
Acute Respiratory Infections	Comparison	1.38 (1.24, 1.52)	1.34 (1.21, 1.48)
	Niagara	1.19 (1.07, 1.32)	1.19 (1.07, 1.31)
Other Respiratory	Comparison	0.50 (0.42, 0.60)	0.91 (0.82, 1.01)
	Niagara	0.82 (0.68, 0.98)	0.85 (0.77, 0.95)
Pneumonia / Influenza	Comparison	0.97 (0.90, 1.04)	0.98 (0.92, 1.05)
	Niagara	1.13 (1.05, 1.21)	1.13 (1.05, 1.21)
COPD and allied conditions	Comparison	0.84 (0.77, 0.91)	0.84 (0.77, 0.91)
	Niagara	0.95 (0.88, 1.03)	0.95 (0.87, 1.03)
Asthma	Comparison	1.07 (0.98, 1.17)	1.07 (0.97, 1.17)
	Niagara	1.02 (0.93, 1.12)	1.02 (0.93, 1.12)
Skin and Subcutaneous Tissue	Comparison	0.72 (0.66, 0.78)	0.90 (0.83, 0.97)
	Niagara	0.88 (0.82, 0.96)	0.87 (0.80, 0.94)
Injury / Poisoning	Comparison	0.88 (0.84, 0.91)	0.96 (0.92, 0.99)
	Niagara	1.02 (0.98, 1.06)	1.00 (0.96, 1.03)

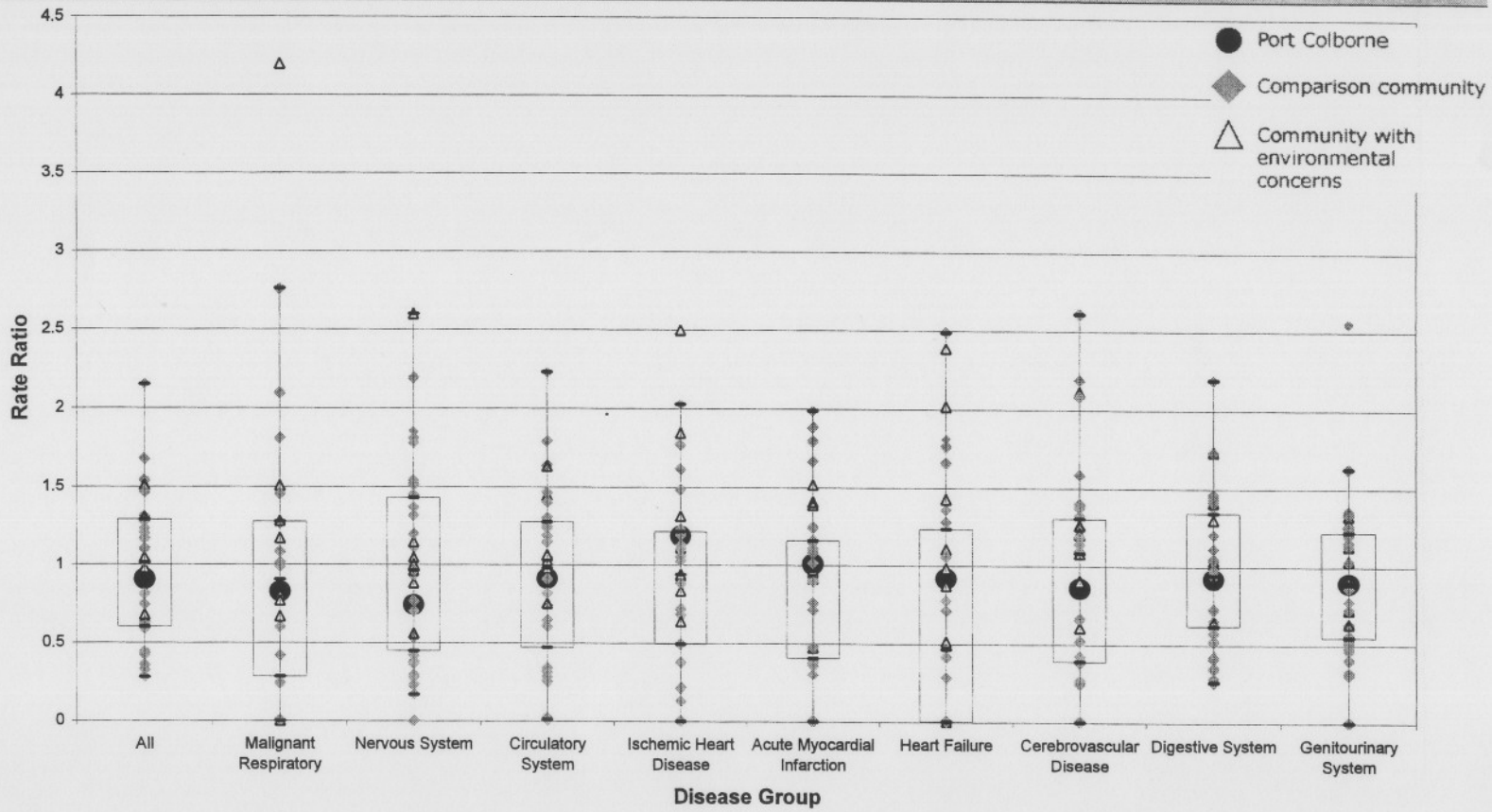
* Rate ratios were adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.

Exhibit 59: A comparison of hospital discharge rates (inpatients only) for all health conditions between Port Colborne, Ontario and the comparison communities (1980 to 2000): the influence of analysis techniques

	Ontario		Comparison Communities		
Disease Group	Standardized Discharge Ratio[a] (95% CI)	Rate Ratio (95% CI)[b] (no scaled deviance)	Rate Ratio (95% CI)[b] (no scaled deviance)	Rate Ratio (95% CI)[c] (scaled deviance)	Rate Ratio (95% CI)[d] (scaled deviance and adjustment for confounders)
All Causes	1.14 (1.13, 1.15)	1.19 (1.18, 1.20)	1.00 (0.99, 1.01)	1.00 (0.97, 1.03)	0.91 (0.88, 0.93)
Malignant Respiratory	0.96 (0.88, 1.05)	1.09 (0.92, 1.30)	0.91 (0.76, 1.08)	0.91 (0.78, 1.06)	0.81 (0.69, 0.95)
Nervous System	0.93 (0.89, 0.97)	0.97 (0.92, 1.03)	0.81 (0.77, 0.86)	0.81 (0.76, 0.87)	0.74 (0.69, 0.79)
Circulatory	1.22 (1.20, 1.25)	1.14 (1.05, 1.25)	0.94 (0.86, 1.03)	0.94 (0.84, 1.05)	0.88 (0.79, 0.99)
Ischemic Heart Disease	1.40 (1.36, 1.44)	1.54 (1.45, 1.64)	1.24 (1.16, 1.31)	1.24 (1.15, 1.33)	1.18 (1.09, 1.27)
Acute Myocardial Infarction	1.17 (1.11, 1.24)	1.24 (1.09, 1.41)	1.07 (0.94, 1.22)	1.07 (0.95, 1.20)	0.98 (0.87, 1.10)
Heart Failure	1.04 (0.98, 1.10)	1.24 (1.02, 1.51)	1.01 (0.82, 1.23)	1.01 (0.84, 1.20)	0.88 (0.73, 1.07)
Cerebrovascular	1.09 (1.03, 1.15)	1.13 (1.00, 1.27)	0.87 (0.77, 0.97)	0.87 (0.78, 0.97)	0.84 (0.75, 0.95)
Diseases of the Digestive System	1.21 (1.18, 1.24)	1.24 (1.21, 1.27)	0.97 (0.94, 0.99)	0.97 (0.93, 1.01)	0.90 (0.87, 0.94)
Diseases of the Genitourinary System	1.19 (1.16, 1.22)	1.21 (1.16, 1.25)	0.96 (0.92, 1.00)	0.96 (0.91, 1.01)	0.90 (0.85, 0.95)
Diseases of the Respiratory System	1.16 (1.13, 1.19)	1.13 (1.10, 1.17)	0.97 (0.93, 1.00)	0.97 (0.92, 1.01)	0.83 (0.79, 0.88)
Acute Respiratory Infections	1.78 (1.68, 1.88)	2.04 (1.86, 2.25)	1.64 (1.49, 1.80)	1.64 (1.49, 1.80)	1.38 (1.24, 1.52)
Other Respiratory	0.87 (0.81, 0.92)	0.63 (0.53, 0.74)	0.54 (0.46, 0.64)	0.54 (0.46, 0.64)	0.50 (0.42, 0.60)
Pneumonia / Influenza	1.18 (1.12, 1.24)	1.34 (1.26, 1.43)	1.14 (1.07, 1.22)	1.14 (1.07, 1.22)	0.97 (0.90, 1.04)
COPD and allied conditions	1.18 (1.12, 1.23)	1.15 (1.08, 1.23)	0.98 (0.92, 1.04)	0.98 (0.90, 1.05)	0.84 (0.77, 0.91)
Asthma	1.52 (1.43, 1.61)	1.37 (1.26, 1.49)	1.22 (1.13, 1.33)	1.22 (1.13, 1.33)	1.07 (0.98, 1.17)
Diseases of the Skin and Subcutaneous Tissue	0.93 (0.86, 1.01)	0.96 (0.89, 1.05)	0.81 (0.75, 0.89)	0.81 (0.76, 0.88)	0.72 (0.66, 0.78)
Injury / Poisoning	1.14 (1.11, 1.18)	1.17 (1.14, 1.21)	1.00 (0.97, 1.03)	1.00 (0.96, 1.04)	0.88 (0.84, 0.91)

a Overall rate based on inpatient discharges only.
b Overall rate based on inpatient discharges. Adjusted for age and sex. No scaled deviance was applied to adjust overdispersion in the data.
c Overall rate based on inpatient discharges. Adjusted for age and sex. A scaled deviance was applied to adjust for overdispersion in the data.
d Overall rate based on inpatient discharges. Adjusted for age and sex and all confounding variables. A scaled deviance was applied to adjust for overdispersion in the data.

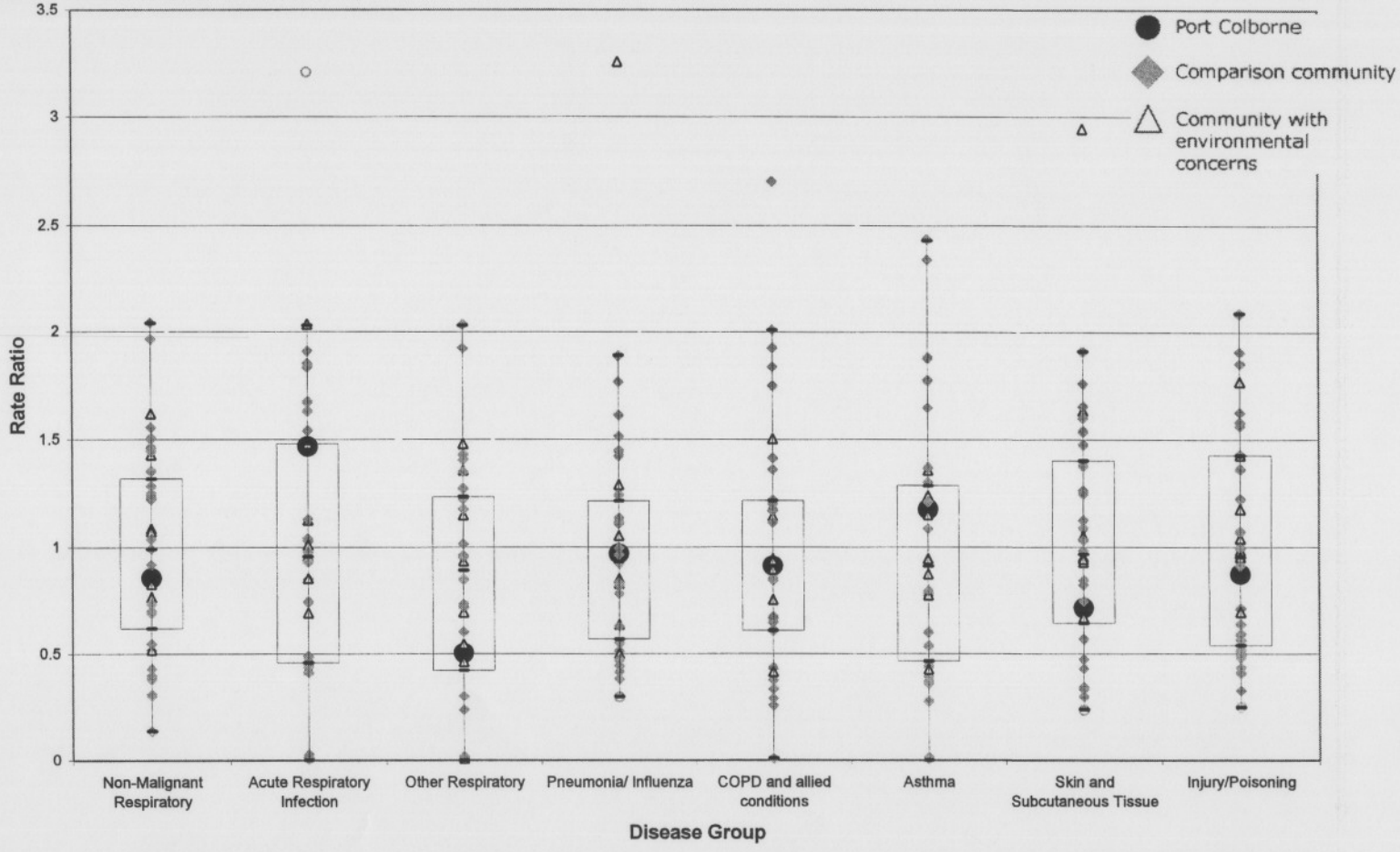
Exhibit 60: Distribution of rate ratios for Port Colborne and each of the comparison communities, excluding day surgeries, for the period from 1980 to 2000 (Part 1)



p-values	0.64	0.84	0.46	0.80	0.64	0.92	0.98	0.78	0.66	0.82

Each data point represents a comparison of discharge rates in one community to each of the remaining comparison communities.
Rate ratios were adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population-to-physician ratio.
The p-values have been calculated from a two-sample t-test comparing the rate ratio for Port Colborne to the mean of the rate ratios for the comparison communities.

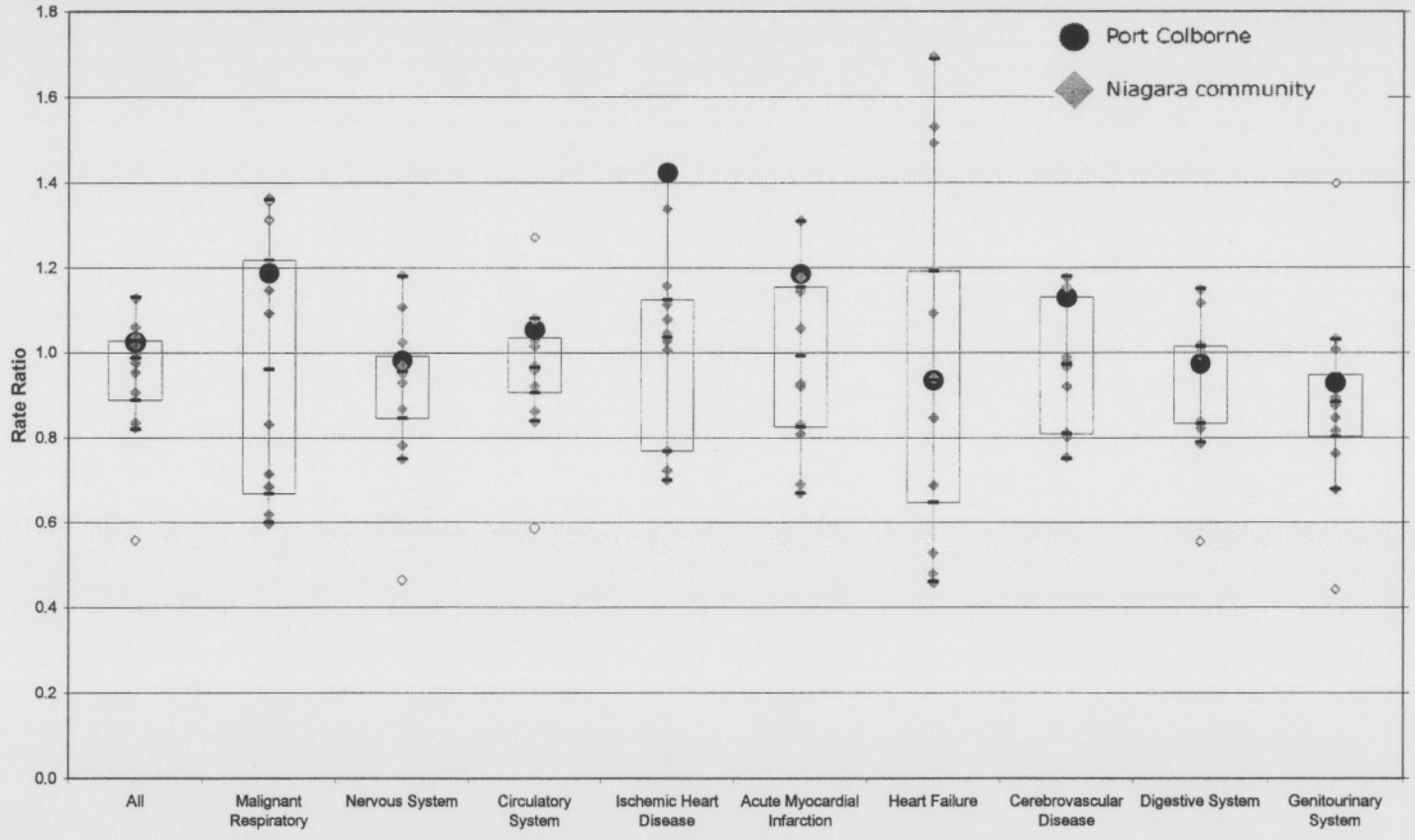
Exhibit 61: Distribution of rate ratios for Port Colborne and each of the comparison communities, excluding day surgeries, for the period from 1980 to 2000 (Part 2)



p-values	0.62	0.42	0.26	0.94	0.80	0.70	0.28	0.66

Each data point represents a comparison of discharge rates in one community to each of the remaining comparison communities.
Rate ratios were adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population-to-physician ratio.
The p-values have been calculated from a two-sample t-test comparing the rate ratio for Port Colborne to the mean of the rate ratios for the comparison communities.

Exhibit 62: Distribution of rate ratios for Port Colborne and each of the Niagara communities, excluding day surgeries, for the period from 1980 to 2000 (Part 1)



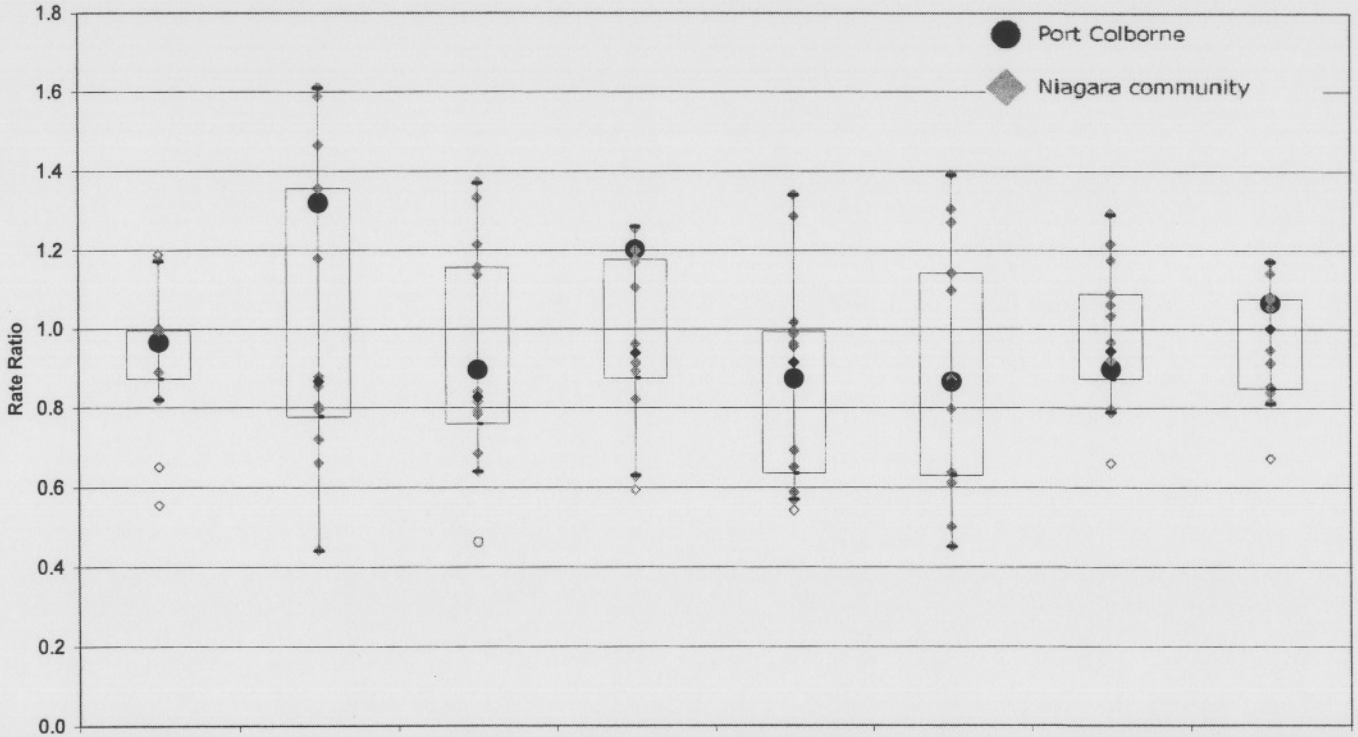
	All	Malignant Respiratory	Nervous System	Circulatory System	Ischemic Heart Disease	Acute Myocardial Infarction	Heart Failure	Cerebrovascular Disease	Digestive System	Genitourinary System
p-values	0.88	0.58	0.98	0.74	0.08	0.46	0.98	0.54	0.92	0.86

Each data point represents a comparison of discharge rates in one community to each of the remaining Niagara region communities.

Rate ratios were adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population-to-physician ratio.

The p-values have been calculated from a two-sample t-test comparing the rate ratio for Port Colborne to the mean of the rate ratios for the Niagara communities.

Exhibit 63: Distribution of rate ratios for Port Colborne and each of the Niagara communities, excluding day surgeries, for the period from 1980 to 2000 (Part 2)



	Non-Malignant Respiratory	Acute Respiratory Infections	Other Respiratory	Pneumonia / Influenza	COPD and allied conditions	Asthma	Skin and Subcutaneous Tissue	Injury/ Poisoning
p-values	0.92	0.42	0.86	0.42	0.78	0.80	0.64	0.68

Each data point represents a comparison of discharge rates in one community to each of the remaining Niagara region communities.

Rate ratios were adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population-to-physician ratio.

The p-values have been calculated from a two-sample t-test comparing the rate ratio for Port Colborne to the mean of the rate ratios for the Niagara communities.

Exhibit 64: The p-values for two-sample t-tests comparing Port Colborne rate ratios to the (i) comparison communities and (ii) Niagara communities (part 1)

		All	Malignant neoplasms of the respiratory and intrathoracic organs	Diseases of the Nervous System	Diseases of the Circulatory System	Ischemic Heart Disease	Acute Myocardial Infarction	Heart Failure	Cerebrovascular Disease	Diseases of the Digestive System	Diseases of the Genitourinary System
Overall	Comparison Communities	0.64	0.84	0.46	0.8	0.64	0.92	0.98	0.78	0.66	0.82
	Niagara	0.88	0.58	0.98	0.74	0.08	0.46	0.98	0.54	0.92	0.86
<20 years	Comparison Communities	0.92	Not Available	0.54	0.82	Not Available	Not Available	Not Available	Not Available	0.84	0.94
	Niagara	0.92	Not Available	0.74	0.64	Not Available	Not Available	Not Available	Not Available	0.78	0.8
20-44 years	Comparison Communities	0.6	0.86	0.54	1	0.68	0.9	0.86	0.96	0.66	0.86
	Niagara	0.82	0.34	0.5	0.28	0.06	0.44	0.74	0.42	0.96	0.92
45-64 years	Comparison Communities	0.5	0.46	0.62	0.68	0.9	0.96	0.72	0.32	0.46	0.58
	Niagara	0.92	0.94	0.92	0.6	0.38	0.46	0.98	1	0.92	0.76
65+ years	Comparison Communities	0.56	0.32	0.32	0.76	0.5	0.9	0.32	0.52	0.68	0.82
	Niagara	0.9	0.82	0.72	0.42	0.1	0.7	0.56	0.68	0.76	0.86
Males	Comparison Communities	0.82	0.9	0.46	0.82	0.72	0.92	0.96	0.84	0.64	0.98
	Niagara	0.74	0.42	0.96	0.76	0.12	0.5	0.98	0.38	0.94	0.94
Females	Comparison Communities	0.46	0.76	0.44	0.78	0.56	0.94	0.98	0.72	0.68	0.62
	Niagara	0.94	0.78	0.92	0.66	0.06	0.48	0.98	0.78	0.92	0.74
1980-1989	Comparison Communities	0.56	0.98	0.38	0.78	0.66	0.88	0.94	0.82	0.62	0.82
	Niagara	0.86	0.48	0.76	0.82	0.1	0.44	0.92	0.64	0.7	0.8
1990-2000	Comparison Communities	0.72	0.68	0.56	0.82	0.62	0.96	1	0.76	0.7	0.82
	Niagara	0.6	0.72	0.8	0.62	0.08	0.54	0.92	0.5	0.84	0.94

Exhibit 65: The p-values for two-sample t-tests comparing Port Colborne rate ratios to the (i) comparison communities and (ii) Niagara communities (part 2)

		Non-Malignant Diseases of the Respiratory System	Acute Respiratory Infections	Other Respiratory Disease	Pneumonia and Influenza	Chronic Obstructive Pulmonary Disease and allied conditions	Asthma	Diseases of the skin and subcutaneous tissue	Injuries / Poisoning
Overall	Comparison Communities	0.62	0.42	0.26	0.94	0.8	0.7	0.28	0.66
	Niagara	0.92	0.42	0.86	0.42	0.78	0.8	0.64	0.68
<20 years	Comparison Communities	0.96	0.76	0.48	0.96	0.56	0.38	0.36	0.82
	Niagara	0.92	0.84	0.88	0.74	0.76	0.8	0.72	1
20-44 years	Comparison Communities	0.6	0.6	0.38	0.54	0.94	0.94	0.16	0.98
	Niagara	0.98	0.4	0.9	0.34	0.72	0.62	0.32	0.42
45-64 years	Comparison Communities	0.54	0.56	0.32	1	0.48	0.9	0.34	0.46
	Niagara	0.96	0.26	0.98	0.38	0.5	0.52	0.88	0.66
65+ years	Comparison Communities	0.36	0.24	0.46	0.4	0.28	0.7	0.44	0.48
	Niagara	0.86	0.36	0.34	0.54	0.48	0.86	0.96	0.9
Males	Comparison Communities	0.6	0.44	0.28	0.92	0.74	0.68	0.28	0.56
	Niagara	0.92	0.42	0.82	0.36	0.7	0.78	0.76	0.7
Females	Comparison Communities	0.64	0.4	0.26	0.98	0.88	0.72	0.32	0.76
	Niagara	0.94	0.38	0.9	0.5	0.82	0.78	0.62	0.66
1980-1989	Comparison Communities	0.58	0.46	0.34	0.78	0.8	0.68	0.14	0.44
	Niagara	0.7	0.54	0.4	0.54	0.8	0.76	0.34	0.94
1990-2000	Comparison Communities	0.7	0.42	0.28	0.88	0.84	0.76	0.52	0.86
	Niagara	0.8	0.26	0.78	0.42	0.74	0.84	0.94	0.4

9. APPENDIX

Exhibit A1: Health outcomes commonly associated with exposure to the chemicals of concern,* and non-CoC related risk factors for these outcomes

CoC	Health Outcome	Sources of harmful exposures	Recognized risk factors
Nickel	Irritant and allergic contact dermatitis	Chronic dermal exposure in environmental as well as occupational settings; leaching of nickel from inexpensive earrings, other jewellery, or wrist watches. Work-related nickel dermatitis; common diagnosis in reports of permanent disability involving skin diseases.	Occupation (hairdressing, food handling and health care; metal workers; History of allergies; Rubber; Cosmetics; Fabrics and clothing; Detergents; Solvents; Adhesives; Fragrances; perfumes; Other chemicals and substances
	Asthma	Occupational exposures; rare nickel-related asthma. Incidents with environmental exposures have not been reported.	Adults Chronic levels of silica dust; Age; Smoking; BMI >/= 28 among women; Parental history of Rhinitis; House dust mites, pets, cockroaches; Rhinitis, allergic and non allergic; Atopy; history of childhood asthma; Female; family history of allergies or eczema; Children Atopy; Parental history of asthma; Severe lower respiratory tract infections; Atopic Dermatitis; Allergic Rhinitis; Food allergies; Wheezing apart from colds; Elevated serum IgE in infancy; Peripheral blood eosinophilia (>4%); Obesity; Males
	Respiratory cancer	Workers with high exposure to nickel compounds from refinery dust.	Smoking, age, ETS, asbestos exposure, air pollution, radon exposure, asbestos and benzene
Cobalt	Irritant and allergic contact dermatitis	Chronic skin exposure in environmental as well as occupational settings	As above; eczema; concurrent dermal exposure to nickel.
	Hard metal asthma	Occurs primarily in cobalt workers	Age, atopy, smoking
	Hard metal disease: Alveolitis; pulmonary fibrosis	Workers exposed to cobalt; rarely occurs from exposure to cobalt alone but is present with exposure to cobalt combined with other metals	Smoking, genetic predisposition, other other sarcoid-like diseases, anti-depressants.
	Hemopoiesis	Workers exposed to cobalt; elevated haemoglobin Incidents with environmental exposures have not been reported.	Numerous (lifestyle, dietary factors, aging)
	Cardiomyopathy	Chronic exposure in occupational settings; Russian cobalt refinery and hard metal workers Was observed in general population after cobalt chloride was added to beer as a foam stabilizing agent	Hypertension, Hyperlipidemia, Obesity, Diabetes mellitus, Smoking, Stress, Sedentary lifestyle, viral infections, alcoholism, heart attacks
	Thyroid dysfunction	Hypothyroidism and goiter may occur after prolonged exposure to cobalt; observed among cobalt beer-drinker patients.	Age over 50 years, female gender, obesity, thyroid surgery, and exposure of the neck to x-ray or radiation treatments

*the above table is an abridged summary of previous research findings; a more detailed summary would take into account the fact that each CoC consists of several different subtypes with associations with health outcomes occurring only certain subtypes.

Exhibit A2: Health outcomes commonly associated with exposure to the chemicals of concern,* and non-CoC related risk factors for these outcomes

CoC	Health Outcome	Sources of harmful exposure	Other risk factors
Copper	Upper airways irritation	Copper exposure in the workplace appears not to be associated with serious adverse health effects. Upper airways irritation has been observed.	Numerous (smoking, physical and chemical environmental pollution, exposure to dust.)
	Metal fume fever	Reported in workers exposed to copper oxide, metallic dust or fumes.	N/A
	Gastrointestinal disorders (nausea, vomiting and diarrhea)	Ingestion of large amounts of copper (0.5g or more, usually as sulfate salt).	Improperly prepared foods or contaminated water and travel or residence in areas of poor sanitation.
Arsenic	Cardiovascular disease	Copper smelter workers exposed to arsenic trioxide; estimates of workplace exposure levels were 0.05-0.5 mg As/m3. Drinking-water contamination incidents; severe peripheral vascular disease; ingestion rates of 14 to 65 µg As/kg/day are suspected	Genetic predisposition, male gender, age, cigarette smoking, high blood pressure, diabetes, obesity (especially excess abdominal fat), lack of physical activity, and abnormal blood cholesterol and homocysteine levels
	Cancer (several body sites)	Contaminated drinking-water occurrences; elevated risks of bladder, kidney, lung, liver and skin cancers Workers exposed to arsenic trioxide (As2O3) in copper smelters; respiratory cancer (and other sites); average duration of exposure approximately 20 years.	Numerous (smoking, lifestyle, diet, genetics)
	Neurological outcomes	Chronic exposure to arsenic by ingestion or inhalation; peripheral neuropathy, axonal degeneration and encephalopathy Neurological outcomes are not seen for arsenic intakes <10 µg/kg/day	Numerous (Age, Sex, Lifestyle)
	Skin lesions	Contaminated drinking-water occurrences; hyperkeratosis and hyperpigmentation Drinking water concentrations above 50 µg/L (WHO maximum allowable level, 10 µg/L); concentrations > 500 µg/L were not uncommon.	Numerous (Lifestyle, etc.)
	Gastrointestinal and hepatic disorders	Chronic intake of high levels of inorganic arsenic; nausea, vomiting, diarrhea, anorexia, weight loss, hepatomegaly, jaundice, pancreatitis and liver cirrhosis; exposure levels above 10 µg As/kg/day.	Numerous (Lifestyle, etc.)

*the above table is an abridged summary of previous research findings; a more detailed summary would take into account the fact that each CoC consists of several different subtypes with associations with health outcomes occurring only certain subtypes.

Exhibit A3: ICD-9 codes for disease groupings

Malignant neoplasm of respiratory and intrathoracic organs (160-165)

160 Malignant neoplasm of nasal cavities, middle ear, and accessory sinuses	163 Malignant neoplasm of pleura
161 Malignant neoplasm of larynx	164 Malignant neoplasm of thymus, heart, and mediastinum
162 Malignant neoplasm of trachea, bronchus, and lung	165 Malignant neoplasm of other and ill-defined sites within the respiratory system and intrathoracic organs

Diseases of the nervous system and sense organs (320-389)

Inflammatory diseases of the central nervous system (320-326)

320 Bacterial meningitis	324 Intracranial and intraspinal abscess
321 Meningitis due to other organisms	325 Phlebitis and thrombophlebitis of intracranial venous sinuses
322 Meningitis of unspecified cause	
323 Encephalitis, myelitis, and encephalomyelitis	326 Late effects of intracranial abscess or pyogenic infection

Hereditary and degenerative diseases of the central nervous system (330-337)

330 Cerebral degenerations usually manifest in childhood	334 Spinocerebellar disease
331 Other cerebral degenerations	335 Anterior horn cell disease
332 Parkinson's disease	336 Other diseases of spinal cord
333 Other extrapyramidal disease and abnormal movement disorders	337 Disorders of the autonomic nervous system

Other disorders of the central nervous system (340-349)

340 Multiple sclerosis	345 Epilepsy
341 Other demyelinating diseases of central nervous system	346 Migraine
342 Hemiplegia and hemiparesis	347 Cataplexy and narcolepsy
343 Infantile cerebral palsy	348 Other conditions of brain
344 Other paralytic syndromes	349 Other and unspecified disorders of the nervous system

Disorders of the peripheral nervous system (350-359)

350 Trigeminal nerve disorders	355 Mononeuritis of lower limb
351 Facial nerve disorders	356 Hereditary and idiopathic peripheral neuropathy
352 Disorders of other cranial nerves	357 Inflammatory and toxic neuropathy
353 Nerve root and plexus disorders	358 Myoneural disorders
354 Mononeuritis of upper limb and mononeuritis multiplex	359 Muscular dystrophies and other myopathies

Disorders of the eye and adnexa (360-379)

360 Disorders of the globe	370 Keratitis
361 Retinal detachments and defects	371 Corneal opacity and other disorders of cornea
362 Other retinal disorders	372 Disorders of conjunctiva
363 Chorioretinal inflammations, scars, and other disorders	373 Inflammation of eyelids
364 Disorders of iris and ciliary body	374 Other disorders of eyelids
365 Glaucoma	375 Disorders of lacrimal system
366 Cataract	376 Disorders of the orbit
367 Disorders of refraction and accommodation	377 Disorders of optic nerve and visual pathways
368 Visual disturbances	378 Esotropia
369 Blindness and low vision	379 Other disorders of eye

Diseases of the ear and mastoid process (380-389)

380 Disorders of external ear	385 Tympanosclerosis
381 Nonsuppurative otitis media and Eustachian tube disorders	386 Vertiginous syndromes and other disorders of vestibular
382 Suppurative and unspecified otitis media	387 Otosclerosis
383 Mastoiditis and related conditions	388 Other disorders of ear
384 Other disorders of tympanic membrane	389 Hearing loss

Diseases of the circulatory system (390-459)

Acute rheumatic fever (390-392)

390 Rheumatic fever without mention of heart involvement
391 Rheumatic fever with heart involvement
392 Rheumatic chorea

Chronic rheumatic heart disease (393-398)

393 Chronic rheumatic pericarditis
394 Diseases of mitral valve
395 Diseases of aortic valve
396 Diseases of mitral and aortic valves
397 Diseases of other endocardial structures
398 Other rheumatic heart disease

Hypertensive disease (401-405)

401 Essential hypertension
402 Hypertensive heart disease
403 Hypertensive renal disease
404 Hypertensive heart and renal disease
405 Secondary hypertension

Ischemic heart disease (410-414)

410 Acute myocardial infarction
411 Other acute and subacute form of ischemic heart disease
412 Old myocardial infarction
413 Angina pectoris
414 Other forms of chronic ischemic heart disease

Diseases of pulmonary circulation (415-417)

415 Acute pulmonary heart disease
416 Chronic pulmonary heart disease
417 Other diseases of pulmonary circulation

Other forms of heart disease (420-429)

420 Acute pericarditis
421 Acute and subacute endocarditis
422 Acute myocarditis
423 Other diseases of pericardium
424 Other diseases of endocardium
425 Cardiomyopathy
426 Conduction disorders
427 Cardiac dysrhythmias
428 Heart failure
429 Ill-defined descriptions and complications of heart disease

Cerebrovascular disease (430-438)

430 Subarachnoid hemorrhage
431 Intracerebral hemorrhage
432 Other and unspecified intracranial hemorrhage
433 Occlusion and stenosis of precerebral arteries
434 Occlusion of cerebral arteries
435 Transcient cerebral ischemia
436 Acute but ill-defined cerebrovascular disease
437 Other and ill-defined cerebrovascular disease
438 Late effects of cerebrovascular disease

Diseases of arteries, arterioles, and capillaries (440-448)

440 Atherosclerosis
441 Aortic aneurysm
442 Other aneurysm
443 Other peripheral vascular disease
444 Arterial embolism and thrombosis
446 Polyarteritis nodosa and allied conditions
447 Other disorders of arteries and arterioles
448 Diseases of capillaries

Diseases of veins and lymphatics, and other diseases of circulatory system (451-459)

451 Phlebitis and thrombophlebitis
452 Portal vein thrombosis
453 Other venous embolism and thrombosis
454 Varicose veins of lower extremities
455 Hemorrhoids
456 Varicose veins of other sites
457 Noninfective disorders of lymphatic channels
458 Hypotension
459 Other disorders of circulatory system

Non-malignant respiratory disease (460-519)

Acute respiratory infections (460-466)

460 Acute nasopharyngitis [common cold]
461 Acute sinusitis
462 Acute pharyngitis
463 Acute tonsillitis
464 Acute laryngitis and tracheitis
465 Acute upper respiratory infections of multiple or unspecified site
466 Acute bronchitis and bronchiolitis

Other diseases of the respiratory tract (470-478)

470 Deflected nasal septum
471 Nasal polyp
472 Chronic pharyngitis and nasopharyngitis
473 Chronic sinusitis
474 Chronic disease of tonsils and adenoids
475 Peritonsillar abscess
476 Chronic laryngitis and laryngotracheitis
477 Allergic rhinitis
478 Other disease of the respiratory tract

Pneumonia and influenza (480-487)	
480 Viral pneumonia	484 Pneumonia in infectious diseases classified elsewhere
481 Pneumococcal pneumonia	485 Bronchopneumonia, organism unspecified
482 Other bacterial pneumonia	486 Pneumonia, organism unspecified
483 Pneumonia due to other specified organism	487 Influenza
Chronic Obstructive pulmonary disease and allied conditions (490-494, 496)	
490 Bronchitis, not specified as acute or chronic	493 Asthma
491 Chronic bronchitis	494 Bronchiectasis
492 Emphysema	496 Chronic airways obstruction, not elsewhere classified
Diseases of the digestive system (520-579)	
Diseases of oral cavity, salivary glands, and jaws (520-529)	
520 Disorders of tooth development and eruption	525 Other diseases and conditions of the teeth and supporting structures
521 Diseases of hard tissues of teeth	526 Diseases of the jaws
522 Diseases of pulp and periapical tissues	527 Diseases of the salivary glands
523 Gingival and periodontal diseases	528 Diseases of the oral soft tissues, excluding lesions specific for gingiva and tongue
524 Dentofacial anomalies, including malocclusion	529 Diseases and other conditions of the tongue
Diseases of esophagus, stomach, and duodenum (530-537)	
530 Diseases of esophagus	534 Gastrojejunal ulcer
531 Gastric ulcer	535 Gastritis and duodenitis
532 Duodenal ulcer	536 Disorders of function of stomach
533 Peptic ulcer, site unspecified	537 Other disorders of stomach and duodenum
Appendicitis (540-543)	
540 Acute appendicitis	542 Other appendicitis
541 Appendicitis, unqualified	543 Other diseases of appendix
Hernia of abdominal cavity (550-553)	
550 Inguinal hernia	552 Other hernia of abdominal cavity, with obstruction, but without mention of gangrene
551 Other hernia of abdominal cavity, with gangrene	553 Other hernia of abdominal cavity without mention of obstruction or gangrene
Noninfective enteritis and colitis (555-558)	
555 Regional enteritis	557 Vascular insufficiency of intestine
556 Idiopathic proctocolitis	558 Other noninfective gastroenteritis and colitis
Other diseases of intestines and peritoneum (560-569)	
560 Intestinal obstruction without mention of hernia	566 Abscess of anal and rectal regions
562 Diverticula of intestine	567 Peritonitis
564 Functional digestive disorders, not elsewhere classified	568 Other disorders of peritoneum
565 Anal fissure and fistula	569 Other disorders of intestine
Other diseases of digestive system (570-579)	
570 Acute and subacute necrosis of liver	575 Other disorders of gallbladder
571 Chronic liver disease and cirrhosis	576 Other disorders of biliary tract
572 Liver abscess and sequelae of chronic liver disease	577 Diseases of pancreas
573 Other disorders of liver	578 Gastrointestinal hemorrhage
574 Cholelithiasis	579 Intestinal malabsorption
Diseases of the genitourinary system (580-629)	
Nephritis, nephrotic syndrome, and nephrosis (580-589)	
580 Acute glomerulonephritis	585 Chronic renal failure
581 Nephrotic syndrome	586 Renal failure, unspecified
582 Chronic glomerulonephritis	587 Renal sclerosis, unspecified
583 Nephritis and nephropathy, not specified as acute or chronic	588 Disorders resulting from impaired renal function
584 Acute renal failure	589 Small kidney of unknown cause
Other diseases of urinary system (590-599)	
590 Infections of kidney	595 Cystitis
591 Hydronephrosis	596 Other disorders of bladder

592 Calculus of kidney and ureter
593 Other disorders of kidney and ureter
594 Calculus of lower urinary tract
597 Urethritis, not sexually transmitted, and urethral syndrome
598 Urethral stricture
599 Other disorders of urethra and urinary tract

Diseases of male genital organs (600-608)

600 Hyperplasia of prostate
601 Inflammatory diseases of prostate
602 Other disorders of prostate
603 Hydrocele
604 Orchitis and epididymitis
605 Redundant prepuce and phimosis
606 Infertility, male
607 Disorders of penis
608 Other disorders of male genital organs

Disorders of breast (610-611)

610 Benign mammary dysplasias
611 Other disorders of breast

Inflammatory disease of female pelvic organs (614-616)

614 Inflammatory disease of ovary, fallopian tube, pelvic cellular tissue, and peritoneum
615 Inflammatory diseases of uterus, except cervix
616 Inflammatory disease of cervix, vagina, and vulva

Other disorders of female genital tract (617-629)

617 Endometriosis
618 Genital prolapse
619 Fistula involving female genital tract
620 Noninflammatory disorders of ovary, fallopian tube, and broad ligament
621 Disorders of uterus, not elsewhere classified
622 Noninflammatory disorders of cervix
623 Noninflammatory disorders of vagina
624 Noninflammatory disorders of vulva and perineum
625 Pain and other symptoms associated with female genital organs
626 Disorders of menstruation and other abnormal bleeding from female genital tract
627 Menopausal and postmenopausal disorders
628 Infertility, female
629 Other disorders of female genital organs

Diseases of the skin and subcutaneous tissue (680-709)

680 Carbuncle and furuncle
681 Cellulitis and abscess of finger and toe
682 Other cellulitis and abscess
683 Acute lymphadenitis
684 Impetigo
685 Pilonidal cyst
686 Other local infections of skin and subcutaneous tissue

Injury and Poisoning (800-999)

(800-804) Fracture of skull
(805-809) Fracture of neck and trunk
(810-819) Fracture of upper limb
(820-829) Fracture of lower limb
(830-839) Dislocation
(840-848) Sprains and strains of joints and adjacent muscles
(850-854) Intracranial injury, excluding those with skull fracture
(860-869) Internal injury of thorax, abdomen, and pelvis
(870-897) Open wound
(870-879) Open wound of head, neck, and trunk
(880-887) Open wound of upper limb
(890-897) Open wound of lower limb
(900-904) Injury to blood vessels
(905-909) Late effects of injuries, poisonings, toxic effects, and other external causes
(910-919) Superficial injury
(920-924) Contusion with intact skin surface
(925-929) Crushing injury
(930-939) Effects of foreign body entering through orifice
(940-949) Burns
(950-957) Injury to nerves and spinal cord
(958-959) Certain traumatic complications and unspecified injuries
(960-979) Poisoning by drugs, medicinal and biological substances
(980-989) Toxic effects of substances chiefly nonmedicinal as to source
(990-995) Other and unspecified effects of external causes
(996-999) Complications of surgical and medical care, not elsewhere classified

Exhibit A4: Census variables used to identify comparison communities using discriminant analysis

No.	Type	Census Variable	t-value	p-value[A]
1	Mean	Population	0.12	0.902
2	Slope	Population	-0.25	0.806
3	Mean	Proportion of population 65 years of age and older	0.50	0.617
4	Slope	Proportion of population 65 years of age and older	1.15	0.250
5	Mean	Proportion of population younger than 15 years of age	-0.96	0.338
6	Slope	Proportion of population younger than 15 years of age	-0.11	0.911
7	Mean	Population density	-0.20	0.841
8	Slope	Population density	-0.24	0.808
9	Mean	Population change	-1.00	0.317
10	Mean	Male to female ratio	-0.85	0.395
11	Slope	Male to female ratio	-0.01	0.994
12	Mean	Proportion of males with postsecondary education	-0.39	0.699
13	Slope	Proportion of males with postsecondary education	-0.03	0.977
14	Mean	Proportion of females with postsecondary education	-0.11	0.916
15	Slope	Proportion of females with postsecondary education	-0.00	0.998
16	Mean	Proportion of persons with postsecondary education	-0.24	0.808
17	Slope	Proportion of persons with postsecondary education	-0.04	0.971
18	Mean	Proportion of persons who have not completed high school	0.25	0.806
19	Slope	Proportion of persons who have not completed high school	-0.10	0.917
20	Mean	Proportion of persons ≥ 15 years with a postsecondary degree or certificate	-0.47	0.637
21	Slope	Proportion of persons ≥ 15 years with a postsecondary degree or certificate	-0.01	0.991
22	Mean	Unemployment rate for males 15 years of age and older	0.28	0.776
23	Slope	Unemployment rate for males 15 years of age and older	-0.18	0.857
24	Mean	Unemployment rate for females 15 years of age and older	0.97	0.335
25	Slope	Unemployment rate for females 15 years of age and older	-0.28	0.783
26	Mean	Unemployment rate for persons 15 years of age and older	0.63	0.526
27	Slope	Unemployment rate for persons 15 years of age and older	-0.70	0.486
28	Mean	Proportion of immigrants	0.89	0.373
29	Slope	Proportion of immigrants	-1.08	0.279
30	Mean	Proportion of residents who speak English	-0.29	0.773
31	Slope	Proportion of residents who speak English	0.95	0.340
32	Mean	Proportion for whom English /French is not mother tongue	1.12	0.261
33	Slope	Proportion for whom English /French is not mother tongue	-1.07	0.283
34	Mean	Persons per household	-0.83	0.406
35	Slope	Persons per household	-0.46	0.648
36	Mean	Persons per room	-0.33	0.738
37	Slope	Persons per room	0.84	0.400
38	Mean	Income	-0.07	0.946
39	Slope	Income	-0.36	0.716
40	Mean	Income (males)	0.14	0.889
41	Slope	Income (males)	-0.28	0.781
42	Mean	Income (females)	-0.17	0.866

Exhibit A4: Census variables used to identify comparison communities using discriminant analysis

No.	Type	Census Variable	t-value	p-value[A]
43	Slope	Income (females)	-0.15	0.880
44	Mean	Number of lone parent household	0.83	0.405
45	Slope	Number of lone parent household	0.25	0.801
46	Mean	Government transfers	0.41	0.683
47	Slope	Government transfers	0.66	0.510

A Those variables with the smallest p-values are the most important predictors of group membership (i.e., Port Colborne or not). The 14 shaded variables formed the basis for a separate discriminant analysis that was conducted for sensitivity analysis ($t \geq 0.7$).

Exhibit A5: Listing of 35 comparison communities, sorted by the smallest Mahalanobis Distances to Port Colborne, based on discriminant analysis of 47 predictor census variables

Number	CSD Number	CSD Name	MD to Port Colborne	Population[A]	Study Interval
—	3526011	Port Colborne	0.00000	18,600	1980 to 2000
1	3559046	McCrosson and Tovell	2.22782	228	1980 to 1997
2	3547039	Eganville	2.67320	1,243	1980 to 2000
3	3554056	Matachewan[B]	2.98439	457	1980 to 2000
4	3537022	Harrow	3.01319	2,441	1980 to 1998
5	3557061	Sault Ste. Marie[B]	3.38805	80,975	1980 to 2000
6	3537006	Leamington	3.51237	13,680	1980 to 1997
7	3553007	Sudbury[B]	4.00671	90,814	1980 to 1997
8	3559041	Atwood	4.16355	288	1980 to 1997
9	3547036	South Algona	4.48652	331	1980 to 2000
10	3554068	Kirkland Lake[B]	4.60732	10,906	1980 to 2000
11	3512048	Tudor and Cashel	4.80399	555	1980 to 2000
12	3534036	West Lorne	4.81849	1,423	1980 to 1997
13	3547028	Barry's Bay	5.12654	1,122	1980 to 2000
14	3547096	Deep River	5.22742	4,665	1980 to 2000
15	3558004	Thunder Bay[B]	5.39013	112,278	1980 to 2000
16	3537039	Windsor	5.48839	192,388	1980 to 2000
17	3539004	Wardsville	6.03647	394	1980 to 2000
18	3549036	Carling	6.08293	922	1980 to 2000
19	3547026	Sherwood Jones and Burns	6.25068	1,997	1985 to 2000
20	3547012	Griffith and Matawatchan	6.25877	369	1980 to 2000
21	3539016	Strathroy	6.43790	10,012	1980 to 2000
22	3551001	Tehkummah	6.45543	350	1980 to 2000
23	3560041	Red Lake[B]	6.52501	2,180	1980 to 1998
24	3554058	McGarry	6.64969	1,202	1980 to 2000
25	3549056	South River	7.08151	1,117	1980 to 2000
26	3537004	Mersea	7.09821	8,871	1980 to 1997
27	3537009	Gosfield South	7.15478	7,441	1980 to 1998
28	3549005	The Archipelago	7.34054	599	1982 to 2000
29	3552031	Nairn[B]	7.36860	462	1980 to 2000
30	3515011	North Monaghan	7.40302	1,148	1980 to 1996
31	3525003	Stoney Creek[B]	7.55926	46,055	1980 to 2000
32	3547031	Hagarty and Richards	7.96175	1,578	1980 to 2000
33	3529009	Oakland	8.12783	1,285	1980 to 1998
34	3548001	Airy	8.13318	826	1980 to 1998
35	3528049	Delhi	8.19646	15,558	1980 to 2000

[A] Based on the average value across the 1981, 1986, 1991 and 1996 Canadian censuses.
[B] Communities with environmental contamination concerns.
MD: Mahalanobis Distance

Exhibit A6: Estimated proportion of non-smokers for each of the 35 comparison communities

Health Region	CSD Number	CSD Name	Non-Smokers (%)	
			OHS 1990	OHS 1996/97
2	3558004	Thunder Bay	43.5	40.8
2	3559041	Atwood	41.0	41.4
2	3559046	McCrosson and Tovell	46.6	40.2
2	3560041	Red Lake	43.5	40.7
3	3547012	Griffith and Matawatchan	50.2	40.6
3	3547026	Sherwood Jones and Burns	50.1	41.7
3	3547028	Barrys Bay	48.8	42.8
3	3547031	Hagarty and Richards	50.5	40.1
3	3547036	South Algona	49.7	40.4
3	3547039	Eganville	50.3	42.1
3	3547096	Deep River	48.9	41.3
4	3548001	Airy	43.6	38.5
4	3549005	The Archipelago	39.4	37.6
4	3549036	Carling	39.6	38.4
4	3549056	South River	45.1	40.4
4	3554056	Matachewan	47.5	39.3
4	3554058	McGarry	45.2	38.3
4	3554068	Kirkland Lake	44.9	40.5
5	3537004	Mersea	54.3	47.9
5	3537006	Leamington	55.2	49.1
5	3537009	Gosfield South	53.6	47.4
5	3537022	Harrow	55.9	49.9
5	3537039	Windsor	53.6	47.7
6	3557061	Sault Ste. Marie	44.5	42.0
7	3551001	Tehkummah	37.9	41.7
7	3552031	Nairn	44.0	41.0
7	3553007	Sudbury	41.6	42.4
8	3512048	Tudor and Cashel	51.0	42.3
9	3534036	West Lorne	49.3	47.4
9	3539004	Wardsville	48.2	46.5
9	3539016	Strathroy	49.7	47.3
10	3515011	North Monaghan	47.8	44.0
11	3525003	Stoney Creek	48.4	49.0
12	3528049	Delhi	49.6	43.8
12	3529009	Oakland	48.6	43.7

Exhibit A7: List of estimated proportion of non-smokers, 11 Niagara communities, Port Colborne and Ontario

Health Region	CSD Number	CSD Name	Non-Smokers (%)	
			(1990 OHS)	(1996 OHS)
1	3526011	Port Colborne	45.3	44.6
1	3526003	Fort Erie	45.4	44.7
1	3526014	Wainfleet	45.8	44.7
1	3526021	West Lincoln	47.2	45.4
1	3526028	Pelham	45.9	44.7
1	3526032	Welland	45.6	44.6
1	3526037	Thorold	44.5	44.6
1	3526043	Niagara Falls	45.2	44.5
1	3526047	Niagara On The Lake	45.0	44.5
1	3526053	St. Catharine's	45.3	44.7
1	3526057	Lincoln	46.2	45.0
1	3526065	Grimsby	45.6	44.7
99	—	Ontario	52.5	48.7

The proportion of non-smokers is derived from the 'never smoked' variable of the Ontario Health Survey, estimated at the regional level. The community level estimate for each of the two survey years is the corresponding regional estimate, weighted by the age distribution of the community (see Exhibit A8 for the relationship between health regions and communities).

Exhibit A8: Relationship between health region and survey data

Health Region	OHS 1990 Regions based on Public Health Units	OHS 1996/97 Derived Health Region, based on County
1	Niagara (21)	Niagara (3531)
2	Northwestern (23)△, Thunder Bay (33)	Thunder Bay/Kenora/Rainy River (3561)
3	Renfrew (30), Eastern (5)°	Renfrew, Prescott & Russell, Stormont, Dundas & Glengarry (3512)
4	Timiskaming (34), Muskoka-Parry Sound (20), North Bay (22)*	Muskoka, Parry Sound, Nipissing, Timiskaming (3553)
5	Windsor-Essex (7)	Essex (3541)
6	Algoma (1), Porcupine (29) **	Algoma, Cochrane (3551)
7	Sudbury (32)^	Manitoulin, Sudbury (3552)
8	Lanark (18), Hastings and Prince Edward (13), Kingston, Frontenac, Lennox and Addington (16)	Lanark / Leeds/Grenville, Hastings, Prince Edward, Frontenac, Lennox & Addington (3513)
9	Elgin (6), Middlesex (19), Oxford (25)	Elgin, Oxford, Middlesex (3543)
10	Haliburton, Kawartha, Pine Ridge District Health Unit (10)♈ Peterborough (28)	Northumberland, Victoria, Haliburton, Peterborough (3521)
11	Hamilton-Wentworth (12)	Hamilton-Wentworth (3533)
12	Brant (2), Haldimand-Norfolk (9)	Brant, Haldimand Norfolk (3533)
99	Ontario (99)	Ontario (9999)

△ Northwestern Public Health Unit represented Kenora, Rainy River counties.
° Eastern Public Health Unit represented Prescott and Russell, Stormont and Dundas and Glengarry counties.
* North Bay Public Health Unit represented Nipissing county.
**Porcupine Public Health Unit represented Cochrane county.
^ Sudbury Public Health unit represented Sudbury and Manitoulin counties.
♈ Haliburton, Kawartha, Pine Ridge District Health Unit represented the counties of Haliburton, Northumberland and Victoria (now Kawartha).

Exhibit A9: Estimates of access to hospitals for Port Colborne and each of the 35 comparison communities

CSD Number	Community	Number of Hospitals (1991)	Number of Hospital Beds (1991)	Average Population[A]
3526011	Port Colborne	1	102	18,600
3512048	Tudor and Cashel	—	—	555
3515011	North Monaghan	—	—	1,148
3525003	Stoney Creek	—	—	46,055
3528049	Delhi	—	—	15,558
3529009	Oakland	—	—	1,285
3534036	West Lorne	—	—	1,423
3537004	Mersea	—	—	8,871
3537006	Leamington	1	157	13,680
3537009	Gosfield South	—	—	7,441
3537022	Harrow	—	—	2,441
3537039	Windsor	4	1,529	192,388
3539004	Wardsville	—	—	394
3539016	Strathroy	1	121	10,012
3547012	Griffith and Matawatchan	—	—	369
3547026	Sherwood Jones and Burns	—	—	1,997
3547028	Barry's Bay	1	38	1,122
3547031	Hagarty and Richards	—	—	1,578
3547036	South Algona	—	—	331
3547039	Eganville	—	—	1,243
3547096	Deep River	1	35	4,665
3548001	Airy	—	—	826
3549005	The Archipelago	—	—	599
3549036	Carling	—	—	922
3549056	South River	—	—	1,117
3551001	Tehkummah	—	—	350
3552031	Nairn	—	—	462
3553007	Sudbury	3	857	90,814
3554056	Matachewan	—	—	457
3554058	McGarry	—	—	1,202
3554068	Kirkland Lake	1	132	10,906
3557061	Sault Ste. Marie	2	518	80,975
3558004	Thunder Bay	4	971	112,278
3559041	Atwood	—	—	288
3559046	McCrosson and Tovell	—	—	228
3560041	Red Lake	1	38	2,180

[A] Based on the average value across the 1981, 1986, 1991 and 1996 Canadian censuses.
Data obtained from the Canadian Healthcare Association, Canadian Hospital Directory (1980-1992).

Exhibit A10: Estimates of access to physicians and specialists at a regional level for Port Colborne and each of the 35 comparison communities

Health Region (1980-1984)	County (1985-2000)	CSD Number	Community	Average Population to Physician Ratio (1980-2000)	Average Population to Specialist Ratio (1980-2000)
		35	Ontario	1,169	1,107
Central West	Niagara	3526011	Port Colborne*	1,414	1,656
Eastern	Hastings	3512048	Tudor and Cashel	1,191	1,536
Central East	Peterborough	3515011	North Monaghan	1,173	1,069
Central West	Ham-Wentwth	3525003	Stoney Creek	1,192	815
	Haldimd-Norfk	3528049	Delhi	1,680	6,368
	Brant	3529009	Oakland	1,342	1,652
South West	Elgin	3534036	West Lorne	1,522	1,779
	Essex	3537004	Mersea	1,551	1,454
		3537006	Leamington	1,551	1,454
		3537009	Gosfield South	1,558	1,460
		3537022	Harrow	1,558	1,460
		3537039	Windsor	1,571	1,471
	Middlesex	3539004	Wardsville	1,067	1,001
		3539016	Strathroy	1,067	1,001
Eastern	Renfrew	3547012	Griffith and Matawatchan	1,242	3,156
		3547026	Sherwood Jones and Burns	1,236	3,707
		3547028	Barry's Bay	1,242	3,156
		3547031	Hagarty and Richards	1,242	3,156
		3547036	South Algona	1,242	3,156
		3547039	Eganville	1,242	3,156
		3547096	Deep River	1,242	3,156
North East	Nipissing	3548001	Airy	1,252	1,725
	Parry Sound	3549005	The Archipelago	1,214	5,277
		3549036	Carling	1,253	4,995
		3549056	South River	1,253	4,995
	Manitoulin	3551001	Tehkummah	981	77,222
	Sudbury Dist.	3552031	Nairn	1,933	10,922
	Sudbury RM	3553007	Sudbury	1,466	1,515
	Timiskaming	3554056	Matachewan	1,120	5,202
		3554058	McGarry	1,120	5,202
		3554068	Kirkland Lake	1,120	5,202
	Algoma	3557061	Sault Ste. Marie	1,381	1,906
North West	Thunder Bay	3558004	Thunder Bay	1,403	1,675
	Rainy River	3559041	Atwood	1,187	12,318
		3559046	McCrosson and Tovell	1,187	12,318
	Kenora	3560041	Red Lake	1,185	5,020

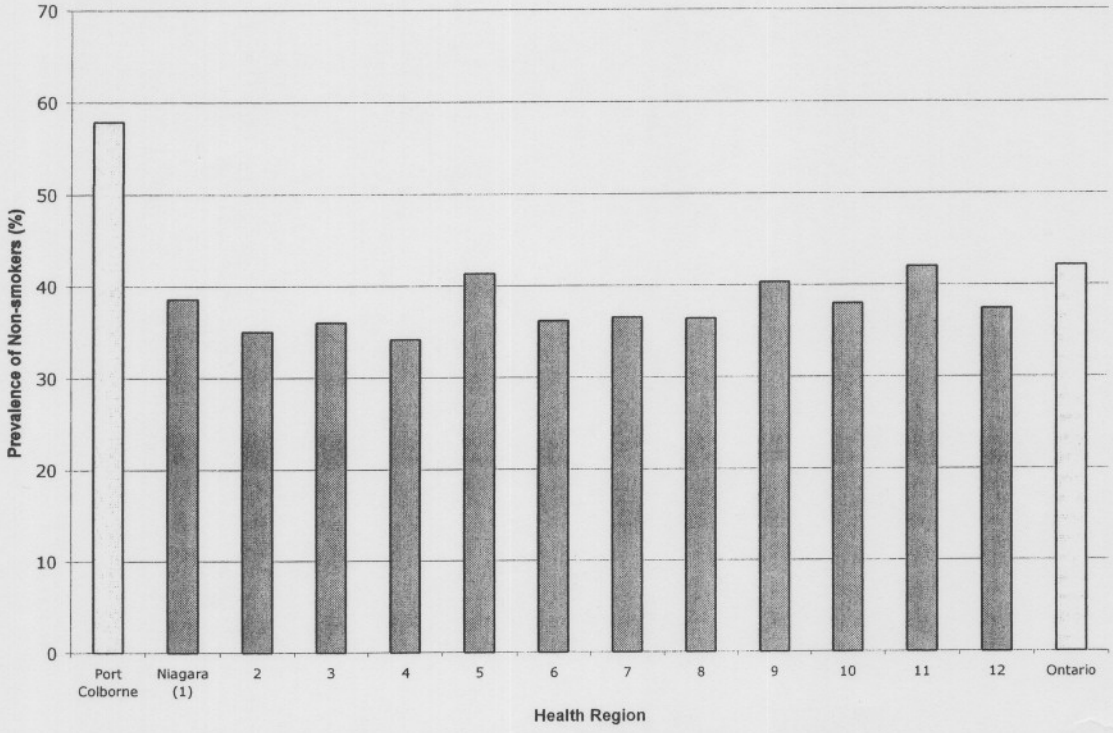
*Since estimates are based at a regional level, Port Colborne estimates are the same as the Niagara municipalities.
NB: The ratios within some counties fluctuate due to the censoring of some communities from the dataset at the time of amalgamation.
Data obtained from The Ontario Physician Manpower Data Centre, 1982-1990 and the Ontario Physician Human Resources Data Centre , 1992-1998

Exhibit A11: Proportion of the public health unit population with unmet health care needs, as identified in the Canadian Community Health Survey (2000/2001)

Public Health Unit	CSD Number	CSD Name	Unmet health care needs (%)
Ontario	35	Ontario	12.8
Niagara	3526011	Port Colborne*	14.2
Hastings and Prince Edward	3512048	Tudor and Cashel	12.8
Peterborough	3515011	North Monaghan	11.8
Hamilton-Wentworth	3525003	Stoney Creek	14.3
Haldimand-Norfolk	3528049	Delhi	12.9
Brant	3529009	Oakland	12.2
Elgin-St Thomas	3534036	West Lorne	8.9
Windsor-Essex	3537004	Mersea	17.5
	3537006	Leamington	
	3537009	Gosfield South	
	3537022	Harrow	
	3537039	Windsor	
Middlesex-London	3539004	Wardsville	13.1
	3539016	Strathroy	
Renfrew	3547012	Griffith and Matawatchan	10.3
	3547026	Sherwood Jones and Burns	
	3547028	Barry's Bay	
	3547031	Hagarty and Richards	
	3547036	South Algona	
	3547039	Eganville	
	3547096	Deep River	
North Bay and Timiskaming	3548001	Airy	14.9
Muskoka-Parry Sound	3549005	The Archipelago	12.3
	3549036	Carling	
	3549056	South River	
Sudbury	3551001	Tehkummah	15.1
	3552031	Nairn	
	3553007	Sudbury	
North Bay and Timiskaming	3554056	Matachewan	14.9
	3554058	McGarry	
	3554068	Kirkland Lake	
Algoma	3557061	Sault Ste. Marie	14.4
Thunder Bay	3558004	Thunder Bay	16.5
Northwestern	3559041	Atwood	19.4
	3559046	McCrosson and Tovell	
	3560041	Red Lake	

*Since estimates are based at a regional level, Port Colborne estimates are the same as the Niagara municipalities. NB: Sudbury Public Health unit represented Sudbury and Manitoulin counties; Northwestern Public Health Unit represented Kenora, Rainy River counties; North Bay Public Health Unit represented Nipissing county.

Exhibit A12: Age Standardized Rate of Non-Smokers across Health Regions representing Port Colborne and the Comparison Communities (Ontario Health Surveys 1990 and 1996/97)



See Exhibit A8 for definition of Health Regions. For Port Colborne, data were obtained from preliminary analyses of the Self-reported Health Questionnaire.

Exhibit A13: Education and Income characteristics for Port Colborne, the 35 comparison communities, and Ontario

CSD Number	CSD Name	Residents ≥15 years of age who have not completed high school (%)	Average Annual Family Income ($)
3526011	Port Colborne	50.2	37,736
3512048	Tudor and Cashel	56.6	24,827
3515011	North Monaghan	42.7	50,411
3525003	Stoney Creek	41.6	47,371
3528049	Delhi	53.0	39,473
3529009	Oakland	48.7	43,444
3534036	West Lorne	59.7	35,077
3537004	Mersea	54.8	45,340
3537006	Leamington	58.0	38,339
3537009	Gosfield South	46.1	47,049
3537022	Harrow	53.0	40,789
3537039	Windsor	42.2	42,606
3539004	Wardsville	55.8	30,931
3539016	Strathroy	50.3	39,229
3547012	Griffith and Matawatchan	52.6	29,426
3547026	Sherwood Jones and Burns	54.3	35,158
3547028	Barrys Bay	59.2	30,937
3547031	Hagarty and Richards	58.9	29,151
3547036	South Algona	57.9	27,249
3547039	Eganville	56.3	30,074
3547096	Deep River	24.6	51,833
3548001	Airy	63.0	33,293
3549005	The Archipelago	45.4	31,860
3549036	Carling	42.5	32,309
3549056	South River	52.8	30,051
3551001	Tehkummah	53.6	28,805
3552031	Nairn	54.2	37,936
3553007	Sudbury	42.7	43,904
3554056	Matachewan	68.7	27,433
3554058	McGarry	64.9	31,907
3554068	Kirkland Lake	51.1	37,790
3557061	Sault Ste. Marie	42.9	41,569
3558004	Thunder Bay	42.4	45,738
3559041	Atwood	64.2	33,274
3559046	McCrosson and Tovell	66.4	Not available
3560041	Red Lake	48.8	43,182
	Median (Comparison Communities)	53.0	36,474
-	Ontario	40.0	46,688

Based on an average of the values recorded in the 1981, 1986, 1991 and 1996 Canadian censuses

Exhibit A14: Hospital discharges in Ontario, by disease category and type of discharge

Health Condition	Total discharges 1980-2000		Total Day Surgeries	Proportion of discharges due to Day Surgery
	Day Surgeries included	Day Surgeries excluded		
All Causes	37,825,134	28,698,088	9,127,046	0.24
Malignant neoplasm of respiratory and intrathoracic organs	251,802	215,566	36,236	0.14
Diseases of the nervous system and sense organs	2,475,767	919,219	1,556,548	0.63
Diseases of the circulatory system	3,757,689	3,377,367	380,322	0.1
Ischemic heart disease	1,444,775	1,338,328	106,447	0.07
Acute myocardial infarction	449,670	449,163	507	0.001
Heart failure	430,069	429,428	641	0.001
Cerebrovascular disease	539,275	531,031	8,244	0.015
Diseases of the digestive system	4,763,765	2,793,100	1,970,665	0.41
Diseases of the genitourinary system	3,951,138	1,870,753	2,080,385	0.53
Non-malignant respiratory disease	2,752,191	2,398,280	353,911	0.13
Acute respiratory infections	401,555	392,823	8,732	0.02
Other diseases of the respiratory tract	890,468	586,240	304,228	0.34
Pneumonia and influenza	529,813	524,186	5,627	0.01
COPD and allied conditions	729,439	717,880	11,559	0.02
Asthma	397,669	396,332	1,337	0.003
Diseases of the skin and subcutaneous tissue	615,820	308,614	307,206	0.5
Injury and poisoning	2,292,772	1995863	296909	0.13

Exhibit A15: Hospital discharges in Ontario, by year and type of discharge

Year	Day Surgeries Only	All Discharges, excluding day surgeries	Total discharges	Proportion of discharges due to Day Surgery
1980	70,780	1,268,123	1,338,903	0.05
1981	83,467	1,269,219	1,352,686	0.06
1982	133,202	1,280,801	1,414,003	0.09
1983	184,096	1,289,185	1,473,281	0.12
1984	212,092	1,298,468	1,510,560	0.14
1985	224,487	1,300,338	1,524,825	0.15
1986	235,520	1,315,054	1,550,574	0.15
1987	252,361	1,334,718	1,587,079	0.16
1988	269,518	1,317,086	1,586,604	0.17
1989	355,431	1,321,419	1,676,850	0.21
1990	600,567	1,315,379	1,915,946	0.31
1991	775,462	1,314,226	2,089,688	0.37
1992	789,108	1,256,932	2,046,040	0.39
1993	816,074	1,228,181	2,044,255	0.40
1994	893,092	1,211,544	2,104,636	0.42
1995	921,813	1,182,793	2,104,606	0.44
1996	953,895	1,103,942	2,057,837	0.46
1997	1,021,316	1,060,864	2,082,180	0.49
1998	1,035,240	1,047,722	2,082,962	0.50
1999	1,084,156	1,040,651	2,124,807	0.51
2000	1,126,912	1,029,900	2,156,812	0.52

Exhibit A16: Number of hospital discharges, by community between 1980 and 2000 for selected health conditions (Part 1)

Census Subdivision	All Causes	Malignant neoplasm of respiratory and intrathoracic organs	Diseases of the nervous system	Diseases of the circulatory system	Ischemic Heart Disease	Acute Myocardial Infarction
McCrosson and Tovell	72	<5*	<5*	15	<5*	<5*
Eganville	8,613	121	421	1,380	449	114
Matachewan	2,548	54	154	350	180	34
Harrow	16,259	132	496	2,183	790	246
Sault Ste. Marie	258,968	2,112	9,257	33,514	13,756	4,311
Leamington	54,841	413	2,177	7,964	2,884	877
Sudbury	244,446	2,906	8,953	34,167	14,172	4,058
Atwood	264	<5*	10	24	8	<5*
South Algona	674	<5*	22	85	25	10
Kirkland Lake	50,332	662	2,093	7,637	2,843	994
Tudor and Cashel	1,538	28	80	200	102	38
West Lorne	4,883	27	201	728	250	95
Barry's Bay	8,086	113	351	1,320	443	170
Deep River	16,393	209	679	2,570	1,179	268
Thunder Bay	345,797	2,686	12,604	50,495	19,341	6,185
Windsor	656,398	6,132	23,541	95,563	35,519	10,377
Wardsville	3,422	23	130	586	156	69
Carling	2,182	8	27	355	157	48
Sherwood Jones and Burns	2,268	17	53	395	92	39
Griffith and Matawatchan	808	9	24	130	66	13
Strathroy	37,282	265	1,708	4,659	1,517	611
Tehkummah	2,105	28	75	372	160	40
Red Lake	8,853	46	200	793	214	52
McGarry	4,932	58	155	755	311	97
South River	6,563	74	285	933	390	122
Mersea	9,844	64	371	1,268	500	159
Gosfield South	9,103	51	295	1,146	413	125
The Archipelago	1,397	28	36	183	76	18
Nairn	1,309	8	55	217	96	22
North Monaghan	1,630	22	55	210	75	36
Stoney Creek	98,568	735	2,961	14,203	6,372	2,146
Hagarty and Richards	4,084	44	104	649	262	86
Oakland	5,986	28	208	801	339	111
Airy	2,148	25	95	302	127	53
Delhi	45,048	533	1,531	7,897	3,228	1,035
Port Colborne	61,933	530	1,951	10,308	4,631	1,307
Total for Comparison Communities	1,917,644	17,670	69,409	274,049	106,495	32,661
Total for Niagara	1,069,536	8,304	37,475	158,181	61,784	19,735
Total for Ontario	25,786,545	215,480	918,023	3,374,492	1,337,674	448,916

* Indicates value was suppressed due to a small number of discharge counts.

Exhibit A17: Number of hospital discharges, by community between 1980 and 2000 for selected health conditions (Part 2)

Census Subdivision	Heart Failure	Cerebrovascular disease	Diseases of the digestive system	Diseases of the genitourinary system	Diseases of the respiratory system	Acute respiratory infections
McCrosson and Tovell	<5*	<5*	10	11	9	<5*
Eganville	219	296	913	563	755	111
Matachewan	18	43	318	191	216	43
Harrow	262	381	2,087	1,594	1,368	264
Sault Ste. Marie	4,157	5,109	27,374	20,570	26,938	4,761
Leamington	1,067	1,419	6,525	4,592	5,177	1,313
Sudbury	3,925	5,007	28,607	20,001	19,941	2,949
Atwood	<5*	7	42	11	11	<5*
South Algona	14	16	73	52	62	11
Kirkland Lake	912	1,151	5,823	3,703	5,405	863
Tudor and Cashel	21	23	147	137	159	15
West Lorne	88	136	523	324	473	92
Barry's Bay	192	267	998	515	596	77
Deep River	312	396	1,717	1,052	1,448	258
Thunder Bay	6,815	8,779	38,707	24,642	32,277	5,463
Windsor	12,214	17,212	84,628	52,277	59,917	10,752
Wardsville	122	133	345	211	497	58
Carling	38	39	280	161	186	37
Sherwood Jones and Burns	106	103	213	128	260	19
Griffith and Matawatchan	15	14	106	78	66	9
Strathroy	543	769	3,815	2,928	4,058	786
Tehkummah	62	41	215	107	167	31
Red Lake	136	108	836	436	807	172
McGarry	131	86	614	397	617	87
South River	156	140	728	516	683	155
Mersea	144	198	1,183	756	947	263
Gosfield South	121	168	1,183	811	876	246
The Archipelago	12	26	164	86	139	21
Nairn	30	27	150	97	99	26
North Monaghan	24	36	186	115	195	23
Stoney Creek	1,529	1,775	11,209	8,134	7,104	946
Hagarty and Richards	101	126	512	307	357	50
Oakland	98	146	656	368	675	120
Airy	24	52	231	167	189	18
Delhi	1,036	1,027	5,023	3,358	4,931	609
Port Colborne	1,179	1,503	7,243	4,694	5,724	1,218
Total for Comparison Communities	34,649	45,261	226,141	149,396	177,605	30,651
Total for Niagara	21,704	23,797	126,217	90,220	101,646	24,121
Total for Ontario	429,200	530,544	2,789,240	1,868,850	2,396,787	392,569

* Indicates value was suppressed due to a small number of discharge counts.

Exhibit A18: Number of hospital discharges, by community between 1980 and 2000 for selected health conditions (Part 3)

Census Subdivision	Other diseases of the respiratory tract	Pneumonia and influenza	Chronic obstructive pulmonary disease and allied conditions	Asthma	Diseases of the Skin and Subcutaneous Tissue	Injury / Poisoning
McCrosson and Tovell	<5*	<5*	<5*	<5*	<5*	<5*
Eganville	120	168	278	145	89	757
Matachewan	63	38	49	23	23	223
Harrow	345	263	386	180	191	1,115
Sault Ste. Marie	6,782	5,018	8,264	4,639	2,959	20,296
Leamington	1,213	982	1,299	561	614	4,306
Sudbury	4,544	4,237	6,712	3,609	2,903	19,698
Atwood	<5*	<5*	<5*	<5*	<5*	32
South Algona	<5*	17	27	13	12	55
Kirkland Lake	1,060	1,397	1,661	584	751	3,443
Tudor and Cashel	41	46	45	23	21	115
West Lorne	100	101	152	52	72	403
Barry's Bay	135	149	161	56	105	696
Deep River	257	337	489	220	144	1,387
Thunder Bay	8,365	7,359	8,827	4,299	3,947	30,897
Windsor	12,918	12,540	19,083	9,453	8,173	43,843
Wardsville	32	255	115	26	61	362
Carling	20	55	57	34	37	172
Sherwood Jones and Burns	9	134	75	38	38	120
Griffith and Matawatchan	11	20	22	12	9	58
Strathroy	841	1,145	1,048	377	449	3,110
Tehkummah	23	49	46	22	34	196
Red Lake	76	353	125	73	212	1,025
McGarry	158	125	216	98	87	291
South River	115	113	253	109	72	567
Mersea	305	168	163	72	129	762
Gosfield South	234	146	203	117	94	823
The Archipelago	23	29	53	23	31	111
Nairn	12	20	35	17	20	112
North Monaghan	76	53	32	20	14	122
Stoney Creek	2,134	1,719	1,706	818	1,149	7,485
Hagarty and Richards	69	106	106	41	42	272
Oakland	158	138	230	109	84	556
Airy	51	39	64	18	20	135
Delhi	1,002	1,603	1,396	583	495	3,846
Port Colborne	939	1,405	1,832	1,130	596	4,770
Total for Comparison Communities	41,301	38,927	53,384	26,466	23,084	147,393
Total for Niagara	19,260	20,877	30,382	17,601	11,509	82,054
Total for Ontario	586,002	523,684	717,542	396,185	307,095	1,994,023

* Indicates value was suppressed due to a small number of discharge counts.

Exhibit A19: A comparison of hospital discharge rates including day surgery data for all causes between Port Colborne and (a) the comparison communities and (b) the Niagara communities (1980 to 2000)

	PC vs.	All Discharges		Rate Ratio (95% CI)[a]	
		PC	Other	Minimally Adjusted[b]	Adjusted[c]
Overall	CC	96,032	2,709,442	1.11 (1.08, 1.14)	1.04 (1.01, 1.07)
	NG[d]	96,032	1,605,707	1.14 (1.11, 1.17)	1.07 (1.04, 1.10)
<20 years	CC	12,679	367,519	1.21 (1.13, 1.30)	1.14 (1.06, 1.21)
	NG	12,679	233,263	1.15 (1.07, 1.23)	1.07 (1.01, 1.15)
20-44 years	CC	27,323	877,362	1.16 (1.10, 1.22)	1.09 (1.04, 1.14)
	NG	27,323	494,567	1.19 (1.13, 1.25)	1.11 (1.06, 1.17)
45-64 years	CC	22,674	643,361	1.03 (0.98, 1.09)	0.97 (0.92, 1.02)
	NG	22,674	368,414	1.14 (1.08, 1.20)	1.06 (1.01, 1.12)
65+ years	CC	33,356	821,200	1.03 (0.99, 1.08)	0.97 (0.93, 1.02)
	NG	33,356	509,463	1.10 (1.05, 1.15)	1.03 (0.98, 1.07)
Males	CC	43,382	1,160,320	1.14 (1.10, 1.19)	1.07 (1.03, 1.11)
	NG	43,382	700,459	1.17 (1.12, 1.21)	1.09 (1.05, 1.14)
Females	CC	52,650	1,549,122	1.07 (1.03, 1.11)	1.01 (0.97, 1.04)
	NG	52,650	905,248	1.12 (1.08, 1.16)	1.05 (1.01, 1.09)
1980-1989	CC	41,141	1,124,846	1.15 (1.11, 1.20)	1.12 (1.08, 1.17)
	NG	41,141	682,511	1.10 (1.06, 1.15)	1.06 (1.01, 1.10)
1990-2000	CC	54,891	1,584,596	1.06 (1.02, 1.10)	0.96 (0.93, 1.00)
	NG	54,891	923,196	1.18 (1.14, 1.23)	1.08 (1.05, 1.12)

a. Rate ratios were estimated using Poisson regression. A scaled deviance was used to adjust for overdispersion.
b. Rate ratio was adjusted for age, sex and calendar period.
c. Rate ratio was adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.
d. The Niagara population includes residents of all communities in the Niagara census division except Port Colborne.

Exhibit A20: A comparison of hospital discharge rates including day surgery data for malignant neoplasms of the respiratory and intrathoracic organs between Port Colborne and (a) the comparison communities and (b) the Niagara communities (1980 to 2000)

	PC vs.	All Discharges		Rate Ratio (95% CI)[a]	
		PC	Other	Minimally Adjusted[b]	Adjusted[c]
Overall	CC	662	20,065	1.02 (0.89, 1.18)	0.93 (0.80, 1.07)
	NG[d]	662	10,685	1.20 (1.04, 1.39)	1.12 (0.96, 1.29)
<20 years	CC	<5*	20	—	—
	NG	<5*	25	—	—
20-44 years	CC	29	590	1.56 (1.05, 2.31)	1.40 (0.94, 2.09)
	NG	29	343	1.70 (1.13, 2.53)	1.57 (1.05, 2.35)
45-64 years	CC	266	8,164	0.86 (0.76, 0.98)	0.78 (0.68, 0.89)
	NG	266	4,120	1.07 (0.94, 1.22)	0.99 (0.87, 1.13)
65+ years	CC	366	11,291	0.80 (0.71, 0.90)	0.73 (0.64, 0.82)
	NG	366	6,197	0.96 (0.85, 1.07)	0.89 (0.79, 1.00)
Males	CC	469	13,694	0.94 (0.76, 1.17)	0.85 (0.69, 1.06)
	NG	469	7,067	1.18 (0.95, 1.47)	1.10 (0.88, 1.37)
Females	CC	193	6,371	1.11 (0.92, 1.35)	1.00 (0.83, 1.22)
	NG	193	3,618	1.22 (1.00, 1.48)	1.13 (0.93, 1.38)
1980-1989	CC	317	9,447	1.15 (0.95, 1.38)	1.08 (0.89, 1.30)
	NG	317	4,525	1.44 (1.19, 1.75)	1.39 (1.14, 1.68)
1990-2000	CC	345	10,618	0.92 (0.74, 1.14)	0.79 (0.64, 0.99)
	NG	345	6,160	1.00 (0.80, 1.25)	0.90 (0.72, 1.12)

a. Rate ratios were estimated using Poisson regression. A scaled deviance was used to adjust for overdispersion.
b. Rate ratio was adjusted for age, sex and calendar period.
c. Rate ratio was adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.
d. The Niagara population includes residents of all communities in the Niagara census division except Port Colborne.
* indicates rate ratios were suppressed due to a small number of discharge counts.

Exhibit A21: A comparison of hospital discharge rates including day surgery data for diseases of the nervous system between Port Colborne and (a) the comparison communities and (b) the Niagara communities (1980 to 2000)

	PC vs.	All Discharges		Rate Ratio (95% CI)[a]	
		PC	Other	Minimally Adjusted[b]	Adjusted[c]
Overall	CC	6,187	179,211	1.05 (0.99, 1.10)	0.98 (0.93, 1.03)
	NG[d]	6,187	105,141	1.14 (1.08, 1.20)	1.07 (1.02, 1.13)
<20 years	CC	740	27,337	0.96 (0.85, 1.09)	0.90 (0.79, 1.01)
	NG	740	15,161	1.04 (0.92, 1.18)	0.98 (0.86, 1.11)
20-44 years	CC	751	24,939	1.13 (1.00, 1.27)	1.05 (0.93, 1.18)
	NG	751	12,551	1.29 (1.14, 1.45)	1.21 (1.07, 1.37)
45-64 years	CC	1,332	37,155	1.08 (0.99, 1.19)	1.01 (0.92, 1.11)
	NG	1,332	20,427	1.23 (1.12, 1.35)	1.15 (1.05, 1.26)
65+ years	CC	3,364	89,780	1.02 (0.96, 1.09)	0.95 (0.89, 1.02)
	NG	3,364	57,002	1.04 (0.97, 1.11)	0.97 (0.91, 1.04)
Males	CC	2,717	77,972	1.05 (0.98, 1.13)	0.98 (0.91, 1.05)
	NG	2,717	46,423	1.13 (1.05, 1.22)	1.07 (0.99, 1.15)
Females	CC	3,470	101,239	1.04 (0.97, 1.12)	0.97 (0.90, 1.05)
	NG	3,470	58,718	1.15 (1.07, 1.24)	1.08 (1.00, 1.16)
1980-1989	CC	2,285	54,527	1.28 (1.19, 1.38)	1.24 (1.15, 1.33)
	NG	2,285	34,370	1.21 (1.13, 1.31)	1.16 (1.08, 1.26)
1990-2000	CC	3,902	124,684	0.86 (0.80, 0.92)	0.77 (0.72, 0.83)
	NG	3,902	70,771	1.07 (1.00, 1.15)	0.99 (0.92, 1.06)

a. Rate ratios were estimated using Poisson regression. A scaled deviance was used to adjust for overdispersion.
b. Rate ratio was adjusted for age, sex and calendar period.
c. Rate ratio was adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.
d. The Niagara population includes residents of all communities in the Niagara census division except Port Colborne.

Exhibit A22: A comparison of hospital discharge rates including day surgery data for diseases of the circulatory system between Port Colborne and (a) the comparison communities and (b) the Niagara communities (1980 to 2000)

	PC vs.	All Discharges		Rate Ratio (95% CI)[a]	
		PC	Other	Minimally Adjusted[b]	Adjusted[c]
Overall	CC	11,827	304,779	1.04 (0.94, 1.15)	0.99 (0.89, 1.10)
	NG[d]	11,827	171,849	1.16 (1.05, 1.29)	1.12 (1.01, 1.24)
<20 years	CC	53	1,991	0.84 (0.56, 1.25)	0.80 (0.54, 1.19)
	NG	53	1,192	0.85 (0.57, 1.27)	0.81 (0.55, 1.21)
20-44 years	CC	1,027	26,956	1.31 (1.20, 1.43)	1.25 (1.15, 1.36)
	NG	1,027	13,736	1.54 (1.41, 1.68)	1.48 (1.35, 1.61)
45-64 years	CC	3,499	96,614	1.03 (0.98, 1.08)	0.98 (0.94, 1.03)
	NG	3,499	52,140	1.22 (1.16, 1.28)	1.17 (1.11, 1.22)
65+ years	CC	7,248	179,218	1.03 (0.99, 1.06)	0.98 (0.95, 1.01)
	NG	7,248	104,781	1.16 (1.12, 1.19)	1.11 (1.08, 1.15)
Males	CC	6,445	164,610	1.03 (0.89, 1.19)	0.98 (0.85, 1.13)
	NG	6,445	94,624	1.13 (0.98, 1.30)	1.08 (0.94, 1.25)
Females	CC	5,382	140,169	1.05 (0.90, 1.22)	1.00 (0.86, 1.16)
	NG	5,382	77,225	1.20 (1.03, 1.40)	1.15 (0.99, 1.34)
1980-1989	CC	5,115	135,279	1.14 (1.00, 1.29)	1.12 (0.99, 1.27)
	NG	5,115	75,987	1.18 (1.04, 1.34)	1.16 (1.02, 1.32)
1990-2000	CC	6,712	169,500	0.95 (0.80, 1.12)	0.87 (0.74, 1.03)
	NG	6,712	95,862	1.15 (0.97, 1.35)	1.07 (0.91, 1.27)

a. Rate ratios were estimated using Poisson regression. A scaled deviance was used to adjust for overdispersion.
b. Rate ratio was adjusted for age, sex and calendar period.
c. Rate ratio was adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.
d. The Niagara population includes residents of all communities in the Niagara census division except Port Colborne.

Exhibit A23: A comparison of hospital discharge rates including day surgery data for ischemic heart disease between Port Colborne and (a) the comparison communities and (b) the Niagara communities (1980 to 2000)

	PC vs.	All Discharges		Rate Ratio (95% CI)[a]	
		PC	Other	Minimally Adjusted[b]	Adjusted[c]
Overall	CC	4,900	116,052	1.21 (1.12, 1.30)	1.16 (1.08, 1.25)
	NG[d]	4,900	65,181	1.40 (1.30, 1.51)	1.37 (1.27, 1.48)
<20 years	CC	<5*	47	—	—
	NG	<5*	40	—	—
20-44 years	CC	267	6,367	1.40 (1.14, 1.73)	1.35 (1.10, 1.66)
	NG	267	3,130	1.63 (1.32, 2.00)	1.59 (1.29, 1.96)
45-64 years	CC	1,630	45,112	1.06 (0.99, 1.13)	1.02 (0.95, 1.09)
	NG	1,630	24,826	1.24 (1.15, 1.32)	1.21 (1.13, 1.30)
65+ years	CC	3,000	64,526	1.18 (1.13, 1.24)	1.14 (1.08, 1.19)
	NG	3,000	37,185	1.37 (1.30, 1.43)	1.34 (1.28, 1.41)
Males	CC	2,790	69,819	1.17 (1.10, 1.26)	1.13 (1.06, 1.21)
	NG	2,790	40,112	1.38 (1.29, 1.48)	1.35 (1.26, 1.45)
Females	CC	2,110	46,233	1.24 (1.08, 1.41)	1.19 (1.04, 1.36)
	NG	2,110	25,069	1.42 (1.24, 1.62)	1.39 (1.22, 1.59)
1980-1989	CC	2,181	51,987	1.27 (1.15, 1.41)	1.25 (1.13, 1.39)
	NG	2,181	28,316	1.41 (1.27, 1.56)	1.41 (1.27, 1.56)
1990-2000	CC	2,719	64,065	1.14 (1.03, 1.27)	1.08 (0.97, 1.20)
	NG	2,719	36,865	1.39 (1.25, 1.55)	1.34 (1.20, 1.49)

a. Rate ratios were estimated using Poisson regression. A scaled deviance was used to adjust for overdispersion.
b. Rate ratio was adjusted for age, sex and calendar period.
c. Rate ratio was adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.
d. The Niagara population includes residents of all communities in the Niagara census division except Port Colborne.
* indicates rate ratios were suppressed due to a small number of discharge counts.

Exhibit A24: A comparison of hospital discharge rates including day surgery data for acute myocardial infarction between Port Colborne and (a) the comparison communities and (b) the Niagara communities (1980 to 2000)

	PC vs.	All Discharges		Rate Ratio (95% CI)[a]	
		PC	Other	Minimally Adjusted[b]	Adjusted[c]
Overall	CC	1,309	32,777	1.06 (0.94, 1.20)	0.97 (0.86, 1.10)
	NG[d]	1,309	19,768	1.19 (1.05, 1.34)	1.11 (0.98, 1.26)
<20 years	CC	<5*	13	—	—
	NG	<5*	20	—	—
20-44 years	CC	65	1,935	1.06 (0.76, 1.48)	0.97 (0.69, 1.36)
	NG	65	1,004	1.23 (0.87, 1.73)	1.15 (0.81, 1.62)
45-64 years	CC	449	11,465	1.09 (0.99, 1.20)	1.00 (0.90, 1.10)
	NG	449	6,674	1.23 (1.11, 1.36)	1.15 (1.04, 1.27)
65+ years	CC	795	19,364	1.04 (0.97, 1.11)	0.95 (0.89, 1.02)
	NG	795	12,070	1.11 (1.04, 1.18)	1.04 (0.97, 1.11)
Males	CC	822	20,448	1.12 (1.03, 1.23)	1.03 (0.94, 1.13)
	NG	822	12,724	1.21 (1.11, 1.33)	1.13 (1.03, 1.24)
Females	CC	487	12,329	1.00 (0.80, 1.25)	0.92 (0.73, 1.15)
	NG	487	7,044	1.17 (0.93, 1.46)	1.09 (0.87, 1.36)
1980-1989	CC	596	14,647	1.13 (0.95, 1.34)	1.03 (0.87, 1.22)
	NG	596	8,663	1.19 (1.01, 1.42)	1.13 (0.95, 1.34)
1990-2000	CC	713	18,130	1.00 (0.84, 1.18)	0.92 (0.77, 1.08)
	NG	713	11,105	1.18 (1.00, 1.40)	1.10 (0.92, 1.30)

a. Rate ratios were estimated using Poisson regression. A scaled deviance was used to adjust for overdispersion.
b. Rate ratio was adjusted for age, sex and calendar period.
c. Rate ratio was adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.
d. The Niagara population includes residents of all communities in the Niagara census division except Port Colborne.
* indicates rate ratios were suppressed due to a small number of discharge counts.

Exhibit A25: A comparison of hospital discharge rates including day surgery data for heart failure between Port Colborne and (a) the comparison communities and (b) the Niagara communities (1980 to 2000)

	PC vs.	All Discharges		Rate Ratio (95% CI)[a]	
		PC	Other	Minimally Adjusted[b]	Adjusted[c]
Overall	CC	1,182	34,713	1.02 (0.85, 1.24)	0.89 (0.74, 1.08)
	NG[d]	1,182	21,788	1.13 (0.93, 1.37)	1.02 (0.84, 1.24)
<20 years	CC	<5*	156	—	—
	NG	<5*	86	—	—
20-44 years	CC	15	404	1.25 (0.73, 2.17)	1.09 (0.63, 1.88)
	NG	15	222	1.43 (0.82, 2.50)	1.30 (0.75, 2.26)
45-64 years	CC	176	5,067	0.98 (0.84, 1.14)	0.86 (0.74, 0.99)
	NG	176	2,762	1.15 (0.99, 1.34)	1.04 (0.89, 1.21)
65+ years	CC	990	29,086	0.87 (0.82, 0.93)	0.76 (0.71, 0.81)
	NG	990	18,718	0.87 (0.82, 0.93)	0.80 (0.75, 0.85)
Males	CC	583	17,014	1.02 (0.81, 1.28)	0.89 (0.71, 1.12)
	NG	583	10,868	1.08 (0.86, 1.36)	0.98 (0.78, 1.24)
Females	CC	599	17,699	1.03 (0.76, 1.39)	0.89 (0.66, 1.21)
	NG	599	10,920	1.18 (0.87, 1.61)	1.07 (0.79, 1.46)
1980-1989	CC	451	13,246	1.04 (0.77, 1.41)	0.94 (0.70, 1.27)
	NG	451	8,735	1.07 (0.79, 1.46)	1.01 (0.74, 1.37)
1990-2000	CC	731	21,467	1.01 (0.80, 1.27)	0.85 (0.67, 1.07)
	NG	731	13,053	1.19 (0.94, 1.50)	1.04 (0.82, 1.32)

a. Rate ratios were estimated using Poisson regression. A scaled deviance was used to adjust for overdispersion.
b. Rate ratio was adjusted for age, sex and calendar period.
c. Rate ratio was adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.
d. The Niagara population includes residents of all communities in the Niagara census division except Port Colborne.
* indicates rate ratios were suppressed due to a small number of discharge counts.

Exhibit A26: A comparison of hospital discharge rates including day surgery data for cerebrovascular disease between Port Colborne and (a) the comparison communities and (b) the Niagara communities (1980 to 2000)

	PC vs.	All Discharges		Rate Ratio (95% CI)[a]	
		PC	Other	Minimally Adjusted[b]	Adjusted[c]
Overall	CC	1,518	46,077	0.86 (0.76, 0.96)	0.84 (0.74, 0.94)
	NG[d]	1,518	24,003	1.11 (0.99, 1.25)	1.09 (0.97, 1.22)
<20 years	CC	<5*	206	—	—
	NG	<5*	76	—	—
20-44 years	CC	45	1,499	0.97 (0.71, 1.32)	0.94 (0.68, 1.29)
	NG	45	684	1.28 (0.93, 1.76)	1.25 (0.91, 1.72)
45-64 years	CC	269	9,908	0.73 (0.64, 0.83)	0.71 (0.63, 0.81)
	NG	269	4,579	0.99 (0.87, 1.13)	0.97 (0.85, 1.10)
65+ years	CC	1,204	34,464	0.89 (0.84, 0.95)	0.87 (0.82, 0.92)
	NG	1,204	18,664	1.08 (1.02, 1.14)	1.06 (1.00, 1.12)
Males	CC	796	23,381	1.00 (0.88, 1.15)	0.98 (0.85, 1.12)
	NG	796	12,003	1.30 (1.14, 1.50)	1.27 (1.11, 1.46)
Females	CC	722	22,696	0.73 (0.61, 0.88)	0.71 (0.59, 0.86)
	NG	722	12,000	0.95 (0.78, 1.14)	0.93 (0.77, 1.12)
1980-1989	CC	711	22,283	0.96 (0.83, 1.11)	0.98 (0.85, 1.14)
	NG	711	11,494	1.14 (0.98, 1.32)	1.15 (0.99, 1.33)
1990-2000	CC	807	23,794	0.77 (0.64, 0.92)	0.71 (0.60, 0.85)
	NG	807	12,509	1.08 (0.91, 1.30)	1.03 (0.86, 1.23)

a. Rate ratios were estimated using Poisson regression. A scaled deviance was used to adjust for overdispersion.
b. Rate ratio was adjusted for age, sex and calendar period.
c. Rate ratio was adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.
d. The Niagara population includes residents of all communities in the Niagara census division except Port Colborne.
* indicates rate ratios were suppressed due to a small number of discharge counts.

Exhibit A27: A comparison of hospital discharge rates including day surgery data for diseases of the digestive system between Port Colborne and (a) the comparison communities and (b) the Niagara communities (1980 to 2000)

	PC vs.	All Discharges		Rate Ratio (95% CI)[a]	
		PC	Other	Minimally Adjusted[b]	Adjusted[c]
Overall	CC	12,521	365,135	1.08 (1.04, 1.12)	1.05 (1.01, 1.08)
	NG[d]	12,521	210,600	1.13 (1.09, 1.17)	1.08 (1.04, 1.12)
<20 years	CC	1,973	50,990	1.35 (1.24, 1.47)	1.31 (1.20, 1.42)
	NG	1,973	33,798	1.21 (1.12, 1.32)	1.16 (1.06, 1.26)
20-44 years	CC	3,283	105,290	1.15 (1.08, 1.23)	1.11 (1.04, 1.19)
	NG	3,283	60,041	1.16 (1.09, 1.24)	1.11 (1.04, 1.18)
45-64 years	CC	3,357	107,485	0.91 (0.85, 0.97)	0.88 (0.82, 0.94)
	NG	3,357	57,837	1.07 (1.00, 1.14)	1.02 (0.95, 1.08)
65+ years	CC	3,908	101,370	0.97 (0.91, 1.03)	0.94 (0.88, 1.00)
	NG	3,908	58,924	1.10 (1.03, 1.17)	1.05 (0.99, 1.12)
Males	CC	6,029	175,630	1.07 (1.02, 1.12)	1.03 (0.98, 1.09)
	NG	6,029	101,372	1.13 (1.08, 1.19)	1.08 (1.03, 1.14)
Females	CC	6,492	189,505	1.10 (1.04, 1.15)	1.06 (1.01, 1.11)
	NG	6,492	109,228	1.13 (1.08, 1.19)	1.08 (1.03, 1.14)
1980-1989	CC	4,838	137,941	1.10 (1.05, 1.17)	1.13 (1.07, 1.19)
	NG	4,838	83,666	1.05 (1.00, 1.11)	1.03 (0.98, 1.09)
1990-2000	CC	7,683	227,194	1.06 (1.01, 1.11)	0.97 (0.93, 1.02)
	NG	7,683	126,934	1.22 (1.17, 1.28)	1.13 (1.08, 1.19)

a. Rate ratios were estimated using Poisson regression. A scaled deviance was used to adjust for overdispersion.
b. Rate ratio was adjusted for age, sex and calendar period.
c. Rate ratio was adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.
d. The Niagara population includes residents of all communities in the Niagara census division except Port Colborne.

Exhibit A28: A comparison of hospital discharge rates including day surgery data for diseases of the genitourinary system between Port Colborne and (a) the comparison communities and (b) the Niagara communities (1980 to 2000)

	PC vs.	All Discharges		Rate Ratio (95% CI)[a]	
		PC	Other	Minimally Adjusted[b]	Adjusted[c]
Overall	CC	10,874	278,825	1.20 (1.15, 1.26)	1.13 (1.08, 1.18)
	NG[d]	10,874	179,238	1.13 (1.07, 1.18)	1.03 (0.98, 1.07)
<20 years	CC	648	18,811	1.20 (1.04, 1.38)	1.12 (0.98, 1.29)
	NG	648	12,148	1.12 (0.97, 1.28)	1.02 (0.89, 1.17)
20-44 years	CC	4,027	115,730	1.23 (1.13, 1.33)	1.15 (1.06, 1.25)
	NG	4,027	65,031	1.23 (1.13, 1.34)	1.12 (1.03, 1.22)
45-64 years	CC	3,131	78,604	1.19 (1.12, 1.27)	1.12 (1.05, 1.19)
	NG	3,131	52,663	1.11 (1.04, 1.19)	1.01 (0.95, 1.08)
65+ years	CC	3,068	65,680	1.19 (1.11, 1.28)	1.13 (1.05, 1.21)
	NG	3,068	49,396	1.05 (0.98, 1.13)	0.96 (0.90, 1.03)
Males	CC	3,953	94,485	1.22 (1.13, 1.31)	1.14 (1.06, 1.22)
	NG	3,953	65,188	1.12 (1.04, 1.20)	1.02 (0.95, 1.10)
Females	CC	6,921	184,340	1.19 (1.12, 1.26)	1.12 (1.05, 1.19)
	NG	6,921	114,050	1.13 (1.06, 1.20)	1.03 (0.97, 1.09)
1980-1989	CC	4,846	110,842	1.28 (1.20, 1.38)	1.26 (1.18, 1.35)
	NG	4,846	75,726	1.09 (1.01, 1.17)	1.02 (0.95, 1.09)
1990-2000	CC	6,028	167,983	1.13 (1.06, 1.20)	1.01 (0.95, 1.07)
	NG	6,028	103,512	1.16 (1.09, 1.24)	1.04 (0.97, 1.10)

a. Rate ratios were estimated using Poisson regression. A scaled deviance was used to adjust for overdispersion.
b. Rate ratio was adjusted for age, sex and calendar period.
c. Rate ratio was adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.
d. The Niagara population includes residents of all communities in the Niagara census division except Port Colborne.

Exhibit A29: A comparison of hospital discharge rates including day surgery data for non-malignant diseases of the respiratory system between Port Colborne and (a) the comparison communities and (b) the Niagara communities (1980 to 2000)

	PC vs.	All Discharges		Rate Ratio (95% CI)[a]	
		PC	Other	Minimally Adjusted[b]	Adjusted[c]
Overall	CC	6,565	195,024	1.03 (0.98, 1.07)	0.90 (0.86, 0.95)
	NG[d]	6,565	123,248	1.06 (1.01, 1.11)	0.95 (0.91, 1.00)
<20 years	CC	3,034	88,136	1.24 (1.17, 1.32)	1.09 (1.03, 1.16)
	NG	3,034	63,431	1.03 (0.98, 1.10)	0.93 (0.88, 0.99)
20-44 years	CC	771	27,069	1.06 (0.95, 1.19)	0.93 (0.83, 1.04)
	NG	771	15,511	1.06 (0.94, 1.19)	0.96 (0.86, 1.07)
45-64 years	CC	819	25,173	0.94 (0.84, 1.05)	0.82 (0.74, 0.92)
	NG	819	14,220	1.05 (0.94, 1.18)	0.95 (0.85, 1.06)
65+ years	CC	1,941	54,646	0.90 (0.83, 0.97)	0.79 (0.74, 0.85)
	NG	1,941	30,086	1.08 (1.00, 1.16)	0.97 (0.90, 1.05)
Males	CC	3,536	104,908	1.03 (0.96, 1.10)	0.91 (0.85, 0.97)
	NG	3,536	66,775	1.06 (0.99, 1.13)	0.96 (0.90, 1.02)
Females	CC	3,029	90,116	1.02 (0.96, 1.09)	0.90 (0.84, 0.96)
	NG	3,029	56,473	1.05 (0.98, 1.12)	0.95 (0.89, 1.01)
1980-1989	CC	3,125	97,191	1.02 (0.95, 1.08)	0.93 (0.87, 1.00)
	NG	3,125	59,640	1.05 (0.98, 1.12)	0.98 (0.91, 1.04)
1990-2000	CC	3,440	97,833	1.04 (0.97, 1.11)	0.88 (0.82, 0.93)
	NG	3,440	63,608	1.07 (1.00, 1.14)	0.93 (0.87, 0.99)

a. Rate ratios were estimated using Poisson regression. A scaled deviance was used to adjust for overdispersion.
b. Rate ratio was adjusted for age, sex and calendar period.
c. Rate ratio was adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.
d. The Niagara population includes residents of all communities in the Niagara census division except Port Colborne.

Exhibit A30: A comparison of hospital discharge rates including day surgery data for acute respiratory infections between Port Colborne and (a) the comparison communities and (b) the Niagara communities (1980 to 2000)

	PC vs.	All Discharges		Rate Ratio (95% CI)[a]	
		PC	Other	Minimally Adjusted[b]	Adjusted[c]
Overall	CC	1,224	31,232	1.60 (1.44, 1.76)	1.34 (1.21, 1.48)
	NG[d]	1,224	24,275	1.40 (1.26, 1.55)	1.19 (1.07, 1.31)
<20 years	CC	862	25,223	1.28 (1.19, 1.38)	1.07 (0.99, 1.15)
	NG	862	20,241	0.95 (0.88, 1.03)	0.81 (0.75, 0.87)
20-44 years	CC	80	1,628	1.77 (1.36, 2.29)	1.47 (1.14, 1.91)
	NG	80	1,048	1.53 (1.18, 2.00)	1.31 (1.01, 1.70)
45-64 years	CC	82	1,418	1.66 (1.29, 2.13)	1.38 (1.08, 1.77)
	NG	82	904	1.64 (1.27, 2.11)	1.39 (1.08, 1.78)
65+ years	CC	200	2,963	1.73 (1.48, 2.03)	1.46 (1.25, 1.71)
	NG	200	2,082	1.59 (1.36, 1.87)	1.35 (1.16, 1.58)
Males	CC	680	18,278	1.56 (1.34, 1.82)	1.31 (1.12, 1.52)
	NG	680	14,249	1.38 (1.18, 1.60)	1.17 (1.00, 1.36)
Females	CC	544	12,954	1.63 (1.43, 1.86)	1.37 (1.20, 1.56)
	NG	544	10,026	1.42 (1.24, 1.62)	1.20 (1.05, 1.38)
1980-1989	CC	684	18,392	1.69 (1.49, 1.91)	1.51 (1.33, 1.71)
	NG	684	14,690	1.39 (1.22, 1.57)	1.23 (1.09, 1.40)
1990-2000	CC	540	12,840	1.51 (1.29, 1.77)	1.18 (1.01, 1.38)
	NG	540	9,585	1.41 (1.20, 1.65)	1.14 (0.97, 1.34)

a. Rate ratios were estimated using Poisson regression. A scaled deviance was used to adjust for overdispersion.
b. Rate ratio was adjusted for age, sex and calendar period.
c. Rate ratio was adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.
d. The Niagara population includes residents of all communities in the Niagara census division except Port Colborne.

Exhibit A31: A comparison of hospital discharge rates including day surgery data for other diseases of the respiratory tract between Port Colborne and (a) the comparison communities and (b) the Niagara communities (1980 to 2000)

	PC vs.	All Discharges		Rate Ratio (95% CI)[a]	
		PC	Other	Minimally Adjusted[b]	Adjusted[c]
Overall	CC	1,683	55,847	0.96 (0.87, 1.06)	0.91 (0.82, 1.01)
	NG[d]	1,683	38,940	0.90 (0.81, 0.99)	0.85 (0.77, 0.95)
<20 years	CC	1,120	34,973	1.14 (1.06, 1.22)	1.08 (1.00, 1.16)
	NG	1,120	26,432	0.90 (0.84, 0.96)	0.86 (0.80, 0.92)
20-44 years	CC	333	13,855	0.87 (0.77, 1.00)	0.83 (0.72, 0.95)
	NG	333	7,958	0.87 (0.76, 1.00)	0.83 (0.73, 0.95)
45-64 years	CC	165	5,222	0.93 (0.77, 1.13)	0.88 (0.73, 1.07)
	NG	165	3,330	0.93 (0.77, 1.13)	0.89 (0.73, 1.08)
65+ years	CC	65	1,797	0.91 (0.66, 1.25)	0.87 (0.63, 1.20)
	NG	65	1,220	0.88 (0.64, 1.22)	0.85 (0.61, 1.17)
Males	CC	916	28,350	1.08 (0.96, 1.21)	1.02 (0.91, 1.15)
	NG	916	20,536	0.98 (0.87, 1.10)	0.93 (0.83, 1.05)
Females	CC	767	27,497	0.85 (0.72, 1.00)	0.81 (0.69, 0.95)
	NG	767	18,404	0.82 (0.70, 0.97)	0.78 (0.66, 0.93)
1980-1989	CC	849	27,392	1.09 (0.94, 1.26)	1.07 (0.93, 1.25)
	NG	849	18,431	0.99 (0.85, 1.15)	0.98 (0.84, 1.13)
1990-2000	CC	834	28,455	0.85 (0.74, 0.97)	0.77 (0.67, 0.88)
	NG	834	20,509	0.81 (0.71, 0.93)	0.75 (0.65, 0.86)

a. Rate ratios were estimated using Poisson regression. A scaled deviance was used to adjust for overdispersion.
b. Rate ratio was adjusted for age, sex and calendar period.
c. Rate ratio was adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.
d. The Niagara population includes residents of all communities in the Niagara census division except Port Colborne.

Exhibit A32: A comparison of hospital discharge rates including day surgery data for pneumonia and influenza between Port Colborne and (a) the comparison communities and (b) the Niagara communities (1980 to 2000)

	PC vs.	All Discharges		Rate Ratio (95% CI)[a]	
		PC	Other	Minimally Adjusted[b]	Adjusted[c]
Overall	CC	1,430	39,211	1.15 (1.08, 1.23)	0.98 (0.92, 1.05)
	NG[d]	1,430	21,339	1.28 (1.20, 1.37)	1.13 (1.05, 1.21)
<20 years	CC	299	9,293	1.15 (1.02, 1.30)	0.98 (0.87, 1.11)
	NG	299	5,225	1.22 (1.08, 1.38)	1.07 (0.95, 1.21)
20-44 years	CC	149	3,897	1.41 (1.19, 1.68)	1.20 (1.01, 1.42)
	NG	149	2,151	1.47 (1.24, 1.75)	1.30 (1.09, 1.55)
45-64 years	CC	222	5,380	1.16 (1.00, 1.34)	0.99 (0.85, 1.14)
	NG	222	3,056	1.30 (1.12, 1.51)	1.14 (0.99, 1.32)
65+ years	CC	760	20,641	0.93 (0.86, 1.01)	0.80 (0.74, 0.86)
	NG	760	10,907	1.17 (1.08, 1.26)	1.03 (0.95, 1.11)
Males	CC	754	21,029	1.11 (1.01, 1.22)	0.95 (0.86, 1.04)
	NG	754	11,347	1.26 (1.15, 1.39)	1.11 (1.01, 1.22)
Females	CC	676	18,182	1.20 (1.09, 1.31)	1.02 (0.92, 1.12)
	NG	676	9,992	1.30 (1.18, 1.44)	1.15 (1.04, 1.27)
1980-1989	CC	607	18,296	1.06 (0.96, 1.17)	0.90 (0.82, 1.00)
	NG	607	9,297	1.20 (1.09, 1.32)	1.07 (0.97, 1.19)
1990-2000	CC	823	20,915	1.25 (1.14, 1.37)	1.06 (0.97, 1.17)
	NG	823	12,042	1.37 (1.25, 1.51)	1.19 (1.08, 1.31)

a. Rate ratios were estimated using Poisson regression. A scaled deviance was used to adjust for overdispersion.
b. Rate ratio was adjusted for age, sex and calendar period.
c. Rate ratio was adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.
d. The Niagara population includes residents of all communities in the Niagara census division except Port Colborne.

Exhibit A33: A comparison of hospital discharge rates including day surgery data for Chronic Obstructive Pulmonary Disease and allied conditions between Port Colborne and (a) the comparison communities and (b) the Niagara communities (1980 to 2000)

	PC vs.	All Discharges		Rate Ratio (95% CI)[a]	
		PC	Other	Minimally Adjusted[b]	Adjusted[c]
Overall	CC	1,843	54,031	0.97 (0.89, 1.05)	0.84 (0.77, 0.91)
	NG[d]	1,843	30,676	1.06 (0.98, 1.15)	0.95 (0.87, 1.03)
<20 years	CC	714	16,875	1.54 (1.40, 1.70)	1.33 (1.20, 1.46)
	NG	714	10,571	1.48 (1.34, 1.63)	1.32 (1.20, 1.46)
20-44 years	CC	153	5,414	0.95 (0.74, 1.21)	0.82 (0.64, 1.04)
	NG	153	3,073	0.97 (0.76, 1.24)	0.87 (0.68, 1.11)
45-64 years	CC	256	9,657	0.74 (0.63, 0.88)	0.64 (0.54, 0.76)
	NG	256	5,129	0.88 (0.74, 1.04)	0.78 (0.66, 0.93)
65+ years	CC	720	22,085	0.81 (0.74, 0.90)	0.70 (0.64, 0.78)
	NG	720	11,903	1.01 (0.91, 1.12)	0.90 (0.82, 1.00)
Males	CC	955	28,899	0.89 (0.78, 1.02)	0.77 (0.68, 0.88)
	NG	955	16,154	1.00 (0.87, 1.14)	0.89 (0.78, 1.02)
Females	CC	888	25,132	1.05 (0.95, 1.16)	0.91 (0.82, 1.00)
	NG	888	14,522	1.13 (1.02, 1.24)	1.01 (0.92, 1.11)
1980-1989	CC	846	26,854	0.90 (0.80, 1.01)	0.82 (0.73, 0.93)
	NG	846	14,106	1.02 (0.91, 1.15)	0.96 (0.85, 1.08)
1990-2000	CC	997	27,177	1.05 (0.94, 1.17)	0.85 (0.76, 0.95)
	NG	997	16,570	1.10 (0.98, 1.23)	0.94 (0.84, 1.06)

a. Rate ratios were estimated using Poisson regression. A scaled deviance was used to adjust for overdispersion.
b. Rate ratio was adjusted for age, sex and calendar period.
c. Rate ratio was adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.
d. The Niagara population includes residents of all communities in the Niagara census division except Port Colborne.

Exhibit A34: A comparison of hospital discharge rates including day surgery data for asthma between Port Colborne and (a) the comparison communities and (b) the Niagara communities (1980 to 2000)

	PC vs.	All Discharges		Rate Ratio (95% CI)[a]	
		PC	Other	Minimally Adjusted[b]	Adjusted[c]
Overall	CC	1,131	26,549	1.23 (1.12, 1.34)	1.07 (0.97, 1.17)
	NG[d]	1,131	17,620	1.12 (1.03, 1.23)	1.02 (0.93, 1.12)
<20 years	CC	677	14,448	1.71 (1.58, 1.86)	1.49 (1.37, 1.62)
	NG	677	9,741	1.52 (1.40, 1.66)	1.38 (1.27, 1.50)
20-44 years	CC	132	4,510	0.97 (0.77, 1.22)	0.84 (0.66, 1.06)
	NG	132	2,696	0.92 (0.73, 1.17)	0.84 (0.67, 1.06)
45-64 years	CC	123	3,871	0.97 (0.79, 1.19)	0.85 (0.69, 1.03)
	NG	123	2,459	0.93 (0.76, 1.14)	0.84 (0.69, 1.03)
65+ years	CC	199	3,720	1.41 (1.20, 1.66)	1.23 (1.05, 1.44)
	NG	199	2,724	1.23 (1.05, 1.44)	1.12 (0.95, 1.31)
Males	CC	551	12,814	1.24 (1.07, 1.43)	1.07 (0.93, 1.24)
	NG	551	8,704	1.10 (0.95, 1.28)	1.00 (0.87, 1.16)
Females	CC	580	13,735	1.22 (1.10, 1.35)	1.06 (0.96, 1.17)
	NG	580	8,916	1.15 (1.03, 1.27)	1.04 (0.94, 1.16)
1980-1989	CC	556	13,793	1.07 (0.94, 1.22)	1.00 (0.88, 1.14)
	NG	556	8,868	1.04 (0.91, 1.18)	1.00 (0.87, 1.14)
1990-2000	CC	575	12,756	1.41 (1.25, 1.60)	1.13 (1.00, 1.28)
	NG	575	8,752	1.22 (1.08, 1.38)	1.05 (0.93, 1.19)

a. Rate ratios were estimated using Poisson regression. A scaled deviance was used to adjust for overdispersion.
b. Rate ratio was adjusted for age, sex and calendar period.
c. Rate ratio was adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.
d. The Niagara population includes residents of all communities in the Niagara census division except Port Colborne.

Exhibit A35: A comparison of hospital discharge rates including day surgery data for diseases of the skin and subcutaneous tissue between Port Colborne and (a) the comparison communities and (b) the Niagara communities (1980 to 2000)

	PC vs.	All Discharges		Rate Ratio (95% CI)[a]	
		PC	Other	Minimally Adjusted[b]	Adjusted[c]
Overall	CC	1,172	45,120	0.84 (0.77, 0.91)	0.90 (0.83, 0.97)
	NG[d]	1,172	24,683	0.91 (0.84, 0.98)	0.87 (0.80, 0.94)
<20 years	CC	172	7,161	0.84 (0.69, 1.02)	0.90 (0.74, 1.09)
	NG	172	3,988	0.91 (0.75, 1.10)	0.87 (0.72, 1.06)
20-44 years	CC	362	16,857	0.79 (0.69, 0.90)	0.85 (0.74, 0.97)
	NG	362	8,370	0.91 (0.80, 1.04)	0.87 (0.76, 1.00)
45-64 years	CC	324	11,346	0.85 (0.74, 0.98)	0.91 (0.79, 1.05)
	NG	324	6,360	0.92 (0.80, 1.06)	0.88 (0.77, 1.02)
65+ years	CC	314	9,756	0.87 (0.75, 1.00)	0.94 (0.81, 1.09)
	NG	314	5,965	0.88 (0.76, 1.02)	0.84 (0.73, 0.98)
Males	CC	574	22,394	0.85 (0.76, 0.95)	0.91 (0.81, 1.01)
	NG	574	12,449	0.89 (0.80, 1.00)	0.85 (0.76, 0.95)
Females	CC	598	22,726	0.83 (0.74, 0.92)	0.89 (0.80, 0.99)
	NG	598	12,234	0.92 (0.82, 1.03)	0.88 (0.79, 0.99)
1980-1989	CC	570	18,323	0.98 (0.87, 1.09)	1.10 (0.99, 1.23)
	NG	570	12,754	0.81 (0.73, 0.91)	0.79 (0.71, 0.88)
1990-2000	CC	602	26,797	0.72 (0.64, 0.80)	0.73 (0.66, 0.82)
	NG	602	11,929	1.01 (0.90, 1.13)	0.95 (0.85, 1.07)

a. Rate ratios were estimated using Poisson regression. A scaled deviance was used to adjust for overdispersion.
b. Rate ratio was adjusted for age, sex and calendar period.
c. Rate ratio was adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.
d. The Niagara population includes residents of all communities in the Niagara census division except Port Colborne.

Exhibit A36: A comparison of hospital discharge rates including day surgery data for injury and poisoning between Port Colborne and (a) the comparison communities and (b) the Niagara communities (1980 to 2000)

	PC vs.	All Discharges		Rate Ratio (95% CI)[a]	
		PC	Other	Minimally Adjusted[b]	Adjusted[c]
Overall	CC	5,815	165,229	1.09 (1.05, 1.13)	0.96 (0.92, 0.99)
	NG[d]	5,815	102,159	1.10 (1.06, 1.14)	1.00 (0.96, 1.03)
<20 years	CC	1,321	37,295	1.23 (1.14, 1.33)	1.09 (1.01, 1.17)
	NG	1,321	25,436	1.09 (1.01, 1.17)	0.99 (0.92, 1.06)
20-44 years	CC	1,806	55,870	1.16 (1.09, 1.24)	1.02 (0.96, 1.09)
	NG	1,806	32,009	1.20 (1.13, 1.28)	1.10 (1.03, 1.17)
45-64 years	CC	1,067	30,612	1.00 (0.92, 1.08)	0.88 (0.82, 0.95)
	NG	1,067	17,659	1.11 (1.02, 1.20)	1.01 (0.93, 1.09)
65+ years	CC	1,621	41,452	0.97 (0.91, 1.04)	0.86 (0.80, 0.92)
	NG	1,621	27,055	1.00 (0.93, 1.07)	0.91 (0.85, 0.97)
Males	CC	3,205	91,426	1.10 (1.05, 1.16)	0.97 (0.93, 1.02)
	NG	3,205	56,894	1.10 (1.05, 1.16)	1.00 (0.96, 1.05)
Females	CC	2,610	73,803	1.07 (1.01, 1.13)	0.94 (0.89, 1.00)
	NG	2,610	45,265	1.09 (1.03, 1.15)	0.99 (0.94, 1.05)
1980-1989	CC	2,659	81,374	1.03 (0.97, 1.08)	0.92 (0.87, 0.96)
	NG	2,659	47,519	1.04 (0.99, 1.10)	0.96 (0.91, 1.02)
1990-2000	CC	3,156	83,855	1.15 (1.09, 1.21)	1.00 (0.96, 1.05)
	NG	3,156	54,640	1.15 (1.10, 1.21)	1.03 (0.98, 1.08)

a. Rate ratios were estimated using Poisson regression. A scaled deviance was used to adjust for overdispersion.
b. Rate ratio was adjusted for age, sex and calendar period.
c. Rate ratio was adjusted for age, sex, calendar period, mean community income, mean proportion of residents without high school education, regional prevalence of non-smoking and population to physician ratio.
d. The Niagara population includes residents of all communities in the Niagara census division except Port Colborne.

Exhibit A37: Information flow diagram for the CIHI Discharge Abstract Database

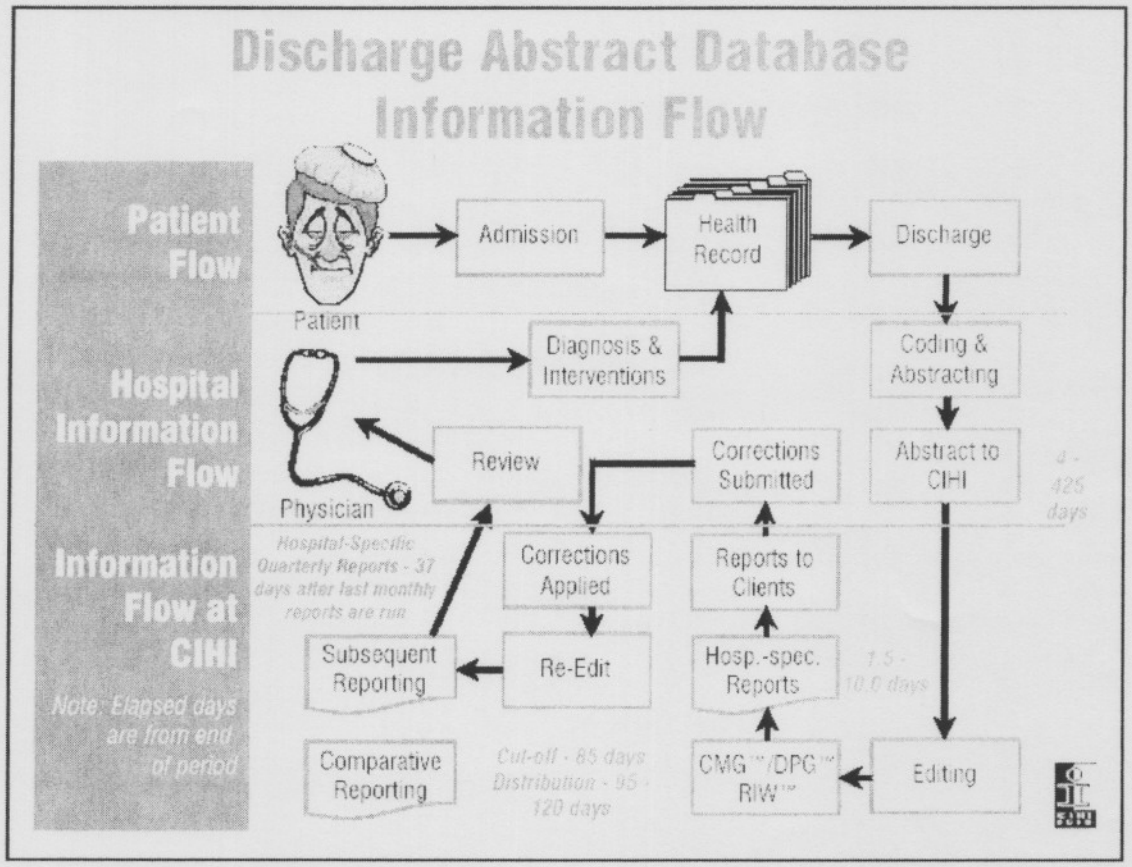


Exhibit A38: A comparison of hospital discharge rates for all causes between Port Colborne and Ontario

	Inpatient Discharges		
	Port Colborne	Ontario	Rate Ratio (95% CI)[a]
Overall	61,933	25,786,545	1.19 (1.18, 1.20)
<20 years	8,691	3,862,660	1.31 (1.28, 1.34)
20-44 years	16,565	8,756,276	1.22 (1.20, 1.24)
45-64 years	13,848	5,396,797	1.16 (1.14, 1.18)
65+ years	22,829	7,770,812	1.08 (1.06, 1.09)
Males	27,800	10,749,788	1.23 (1.21, 1.24)
Females	34,133	15,036,757	1.15 (1.14, 1.16)
1980-1989	31,186	12,994,411	1.10 (1.09, 1.11)
1990-2000	30,747	12,792,134	1.28 (1.27, 1.30)

a. Rate ratios were estimated using Poisson regression. Rate ratio was adjusted for age and sex.

Exhibit A39: A comparison of hospital discharge rates for malignant neoplasms of the respiratory and intrathoracic organs between Port Colborne and Ontario

	Inpatient Discharges		
	Port Colborne	Ontario	Rate Ratio (95% CI)[a]
Overall	530	215,480	1.09 (0.92, 1.30)
<20 years	<5*	445	—
20-44 years	24	7,661	1.62 (1.01, 2.60)
45-64 years	214	85,483	0.94 (0.80, 1.10)
65+ years	291	121,891	0.85 (0.75, 0.97)
Males	381	144,439	1.08 (0.83, 1.41)
Females	149	71,041	1.10 (0.88, 1.38)
1980-1989	308	109,473	1.24 (1.03, 1.51)
1990-2000	222	106,007	0.96 (0.72, 1.27)

a. Rate ratios were estimated using Poisson regression. Rate ratio was adjusted for age and sex.
* Indicates rate ratios were suppressed due to a small number of discharge counts.

Exhibit A40: A comparison of hospital discharge rates for diseases of the nervous system between Port Colborne and Ontario

	Inpatient Discharges		
	Port Colborne	Ontario	Rate Ratio (95% CI)[a]
Overall	1,951	918,023	0.97 (0.92, 1.03)
<20 years	259	178,661	0.81 (0.70, 0.93)
20-44 years	324	171,032	1.14 (1.02, 1.28)
45-64 years	464	199,322	1.04 (0.94, 1.14)
65+ years	904	369,008	0.94 (0.88, 1.00)
Males	909	425,110	1.00 (0.93, 1.08)
Females	1,042	492,913	0.95 (0.88, 1.02)
1980-1989	1,219	593,566	0.91 (0.85, 0.96)
1990-2000	732	324,457	1.04 (0.96, 1.14)

a. Rate ratios were estimated using Poisson regression. Rate ratio was adjusted for age and sex.

Exhibit A41: A comparison of hospital discharge rates for diseases of the circulatory system between Port Colborne and Ontario

	Inpatient Discharges		
	Port Colborne	Ontario	Rate Ratio (95% CI)[a]
Overall	10,308	3,374,492	1.14 (1.05, 1.25)
<20 years	43	25,732	0.83 (0.60, 1.16)
20-44 years	634	265,118	1.37 (1.26, 1.49)
45-64 years	2,899	1,048,655	1.23 (1.18, 1.28)
65+ years	6,732	2,034,987	1.22 (1.19, 1.25)
Males	5,586	1,878,514	1.11 (0.98, 1.26)
Females	4,722	1,495,978	1.18 (1.04, 1.33)
1980-1989	4,796	1,551,940	1.21 (1.10, 1.34)
1990-2000	5,512	1,822,552	1.08 (0.94, 1.24)

a. Rate ratios were estimated using Poisson regression. Rate ratio was adjusted for age and sex.

Exhibit A42: A comparison of hospital discharge rates for ischemic heart disease between Port Colborne and Ontario

	Inpatient Discharges		
	Port Colborne	Ontario	Rate Ratio (95% CI)[a]
Overall	4,631	1,337,674	1.54 (1.45, 1.64)
<20 years	<5*	548	—
20-44 years	246	75,660	1.91 (1.62, 2.26)
45-64 years	1,516	528,543	1.33 (1.26, 1.40)
65+ years	2,866	732,923	1.45 (1.40, 1.50)
Males	2,614	837,698	1.44 (1.37, 1.52)
Females	2,017	499,976	1.65 (1.49, 1.84)
1980-1989	2,154	593,249	1.57 (1.45, 1.70)
1990-2000	2,477	744,425	1.52 (1.39, 1.66)

a. Rate ratios were estimated using Poisson regression. Rate ratio was adjusted for age and sex.
* Indicates rate ratios were suppressed due to a small number of discharge counts.

Exhibit A43: A comparison of hospital discharge rates for acute myocardial infarction between Port Colborne and Ontario

	Inpatient Discharges		
	Port Colborne	Ontario	Rate Ratio (95% CI)[a]
Overall	1,307	448,916	1.24 (1.09, 1.41)
<20 years	<5*	186	—
20-44 years	65	26,640	1.37 (0.95, 1.98)
45-64 years	447	158,784	1.25 (1.12, 1.39)
65+ years	795	263,306	1.11 (1.03, 1.19)
Males	820	287,742	1.26 (1.14, 1.40)
Females	487	161,174	1.21 (0.95, 1.55)
1980-1989	596	193,184	1.24 (1.03, 1.49)
1990-2000	711	255,732	1.24 (1.03, 1.49)

a. Rate ratios were estimated using Poisson regression. Rate ratio was adjusted for age and sex.
* Indicates rate ratios were suppressed due to a small number of discharge counts.

Exhibit A44: A comparison of hospital discharge rates for heart failure between Port Colborne and Ontario

	Inpatient Discharges		
	Port Colborne	Ontario	Rate Ratio (95% CI)[a]
Overall	1,179	429,200	1.24 (1.02, 1.51)
<20 years	<5*	1,544	—
20-44 years	14	5,174	1.62 (0.92, 2.86)
45-64 years	174	64,074	1.17 (1.00, 1.37)
65+ years	990	358,408	1.01 (0.95, 1.08)
Males	580	212,249	1.22 (0.96, 1.56)
Females	599	216,951	1.26 (0.93, 1.73)
1980-1989	451	165,437	1.19 (0.87, 1.62)
1990-2000	728	263,763	1.30 (1.02, 1.66)

a. Rate ratios were estimated using Poisson regression. Rate ratio was adjusted for age and sex.
* Indicates rate ratios were suppressed due to a small number of discharge counts.

Exhibit A45: A comparison of hospital discharge rates for cerebrovascular disease between Port Colborne and Ontario

	Inpatient Discharges		
	Port Colborne	Ontario	Rate Ratio (95% CI)[a]
Overall	1,503	530,544	1.13 (1.00, 1.27)
<20 years	<5*	2,554	—
20-44 years	45	18,860	1.33 (0.97, 1.83)
45-64 years	265	113,074	0.97 (0.85, 1.11)
65+ years	1,193	396,056	1.11 (1.05, 1.17)
Males	786	267,266	1.32 (1.16, 1.51)
Females	717	263,278	0.96 (0.80, 1.16)
1980-1989	711	252,362	1.18 (1.02, 1.37)
1990-2000	792	278,182	1.08 (0.90, 1.29)

a. Rate ratios were estimated using Poisson regression. Rate ratio was adjusted for age and sex.
* Indicates rate ratios were suppressed due to a small number of discharge counts.

Exhibit A46: A comparison of hospital discharge rates for diseases of the digestive system between Port Colborne and Ontario

	Inpatient Discharges		
	Port Colborne	Ontario	Rate Ratio (95% CI)[a]
Overall	7,243	2,789,240	1.24 (1.21, 1.27)
<20 years	886	380,749	1.35 (1.27, 1.44)
20-44 years	1,672	799,625	1.27 (1.21, 1.33)
45-64 years	2,032	782,705	1.17 (1.12, 1.23)
65+ years	2,653	826,161	1.17 (1.13, 1.22)
Males	3,516	1,403,312	1.19 (1.14, 1.23)
Females	3,727	1,385,928	1.30 (1.25, 1.34)
1980-1989	3,624	1,410,376	1.14 (1.10, 1.18)
1990-2000	3,619	1,378,864	1.35 (1.30, 1.40)

a. Rate ratios were estimated using Poisson regression. Rate ratio was adjusted for age and sex.

Exhibit A47: A comparison of hospital discharge rates for diseases of the genitourinary system between Port Colborne and Ontario

	Inpatient Discharges		
	Port Colborne	Ontario	Rate Ratio (95% CI)[a]
Overall	4,694	1,868,850	1.21 (1.16, 1.25)
<20 years	322	152,969	1.22 (1.09, 1.36)
20-44 years	1,593	730,997	1.31 (1.23, 1.41)
45-64 years	1,272	496,316	1.17 (1.10, 1.23)
65+ years	1,507	488,568	1.14 (1.08, 1.20)
Males	1,965	693,975	1.27 (1.20, 1.35)
Females	2,729	1,174,875	1.14 (1.09, 1.20)
1980-1989	2,604	1,036,688	1.11 (1.06, 1.17)
1990-2000	2,090	832,162	1.31 (1.24, 1.39)

a. Rate ratios were estimated using Poisson regression. Rate ratio was adjusted for age and sex.

Exhibit A48: A comparison of hospital discharge rates for non-malignant diseases of the respiratory system between Port Colborne and Ontario

	Inpatient Discharges		
	Port Colborne	Ontario	Rate Ratio (95% CI)[a]
Overall	5,724	2,396,787	1.13 (1.10, 1.17)
<20 years	2,596	1,096,773	1.44 (1.38, 1.50)
20-44 years	600	337,441	1.09 (1.01, 1.19)
45-64 years	687	292,341	1.05 (0.97, 1.13)
65+ years	1,841	670,232	1.00 (0.96, 1.05)
Males	3,022	1,295,189	1.09 (1.04, 1.14)
Females	2,702	1,101,598	1.19 (1.14, 1.24)
1980-1989	2,926	1,272,608	1.04 (0.99, 1.08)
1990-2000	2,798	1,124,179	1.24 (1.18, 1.30)

a. Rate ratios were estimated using Poisson regression. Rate ratio was adjusted for age and sex.

Exhibit A49: A comparison of hospital discharge rates for acute respiratory infections between Port Colborne and Ontario

	Inpatient Discharges		
	Port Colborne	Ontario	Rate Ratio (95% CI)[a]
Overall	1,218	392,569	2.04 (1.86, 2.25)
<20 years	861	322,186	1.69 (1.58, 1.81)
20-44 years	76	22,864	1.87 (1.46, 2.41)
45-64 years	82	15,327	2.44 (1.95, 3.07)
65+ years	199	32,192	2.25 (1.96, 2.60)
Males	676	231,827	1.98 (1.71, 2.28)
Females	542	160,742	2.11 (1.87, 2.39)
1980-1989	682	225,371	2.02 (1.81, 2.26)
1990-2000	536	167,198	2.07 (1.78, 2.40)

a. Rate ratios were estimated using Poisson regression. Rate ratio was adjusted for age and sex.

Exhibit A50: A comparison of hospital discharge rates for other diseases of the respiratory tract between Port Colborne and Ontario

	Inpatient Discharges		
	Port Colborne	Ontario	Rate Ratio (95% CI)[a]
Overall	939	586,002	0.63 (0.53, 0.74)
<20 years	685	367,816	1.07 (0.98, 1.16)
20-44 years	176	157,704	0.68 (0.58, 0.79)
45-64 years	62	45,910	0.55 (0.40, 0.75)
65+ years	16	14,572	0.39 (0.23, 0.66)
Males	465	303,592	0.58 (0.46, 0.73)
Females	474	282,410	0.68 (0.55, 0.85)
1980-1989	656	394,170	0.58 (0.47, 0.73)
1990-2000	283	191,832	0.68 (0.54, 0.85)

a. Rate ratios were estimated using Poisson regression. Rate ratio was adjusted for age and sex.

Exhibit A51: A comparison of hospital discharge rates for pneumonia and influenza between Port Colborne and Ontario

	Inpatient Discharges		
	Port Colborne	Ontario	Rate Ratio (95% CI)[a]
Overall	1,405	523,684	1.34 (1.26, 1.43)
<20 years	299	126,258	1.41 (1.26, 1.59)
20-44 years	146	52,697	1.72 (1.46, 2.03)
45-64 years	212	72,557	1.30 (1.13, 1.49)
65+ years	748	272,172	1.02 (0.95, 1.10)
Males	741	276,932	1.30 (1.19, 1.43)
Females	664	246,752	1.38 (1.26, 1.51)
1980-1989	607	220,124	1.26 (1.15, 1.38)
1990-2000	798	303,560	1.42 (1.30, 1.55)

a. Rate ratios were estimated using Poisson regression. Rate ratio was adjusted for age and sex.

Exhibit A52: A comparison of hospital discharge rates for Chronic Obstructive Pulmonary Disease and allied conditions between Port Colborne and Ontario

	Inpatient Discharges		
	Port Colborne	Ontario	Rate Ratio (95% CI)[a]
Overall	1,832	717,542	1.15 (1.08, 1.23)
<20 years	714	258,340	1.68 (1.56, 1.81)
20-44 years	152	72,572	1.18 (0.98, 1.43)
45-64 years	253	120,182	0.93 (0.82, 1.06)
65+ years	713	266,448	0.96 (0.89, 1.03)
Males	949	382,405	1.08 (0.97, 1.20)
Females	883	335,137	1.23 (1.15, 1.33)
1980-1989	844	356,599	0.99 (0.90, 1.08)
1990-2000	988	360,943	1.35 (1.23, 1.47)

a. Rate ratios were estimated using Poisson regression. Rate ratio was adjusted for age and sex.

Exhibit A53: A comparison of hospital discharge rates for asthma between Port Colborne and Ontario

	Inpatient Discharges		
	Port Colborne	Ontario	Rate Ratio (95% CI)[a]
Overall	1,130	396,185	1.37 (1.26, 1.49)
<20 years	677	233,623	1.76 (1.63, 1.90)
20-44 years	132	62,723	1.15 (0.93, 1.42)
45-64 years	123	51,938	1.12 (0.93, 1.35)
65+ years	198	47,901	1.55 (1.34, 1.79)
Males	551	197,919	1.37 (1.20, 1.57)
Females	579	198,266	1.37 (1.25, 1.51)
1980-1989	556	208,224	1.12 (1.00, 1.27)
1990-2000	574	187,961	1.67 (1.49, 1.87)

a. Rate ratios were estimated using Poisson regression. Rate ratio was adjusted for age and sex.

Exhibit A54: A comparison of hospital discharge rates for diseases of the skin and subcutaneous tissue between Port Colborne and Ontario

	Inpatient Discharges		
	Port Colborne	Ontario	Rate Ratio (95% CI)[a]
Overall	596	307,095	0.96 (0.89, 1.05)
<20 years	110	62,813	1.03 (0.86, 1.25)
20-44 years	152	102,822	0.91 (0.77, 1.07)
45-64 years	147	67,687	0.99 (0.84, 1.16)
65+ years	187	73,773	0.93 (0.80, 1.08)
Males	303	159,999	0.96 (0.85, 1.08)
Females	293	147,096	0.97 (0.86, 1.09)
1980-1989	296	170,228	0.80 (0.71, 0.89)
1990-2000	300	136,867	1.16 (1.03, 1.31)

a. Rate ratios were estimated using Poisson regression. Rate ratio was adjusted for age and sex.

Exhibit A55: A comparison of hospital discharge rates for injury and poisoning between Port Colborne and Ontario

	Inpatient Discharges		
	Port Colborne	Ontario	Rate Ratio (95% CI)[a]
Overall	4,770	1,994,023	1.17 (1.14, 1.21)
<20 years	972	460,263	1.21 (1.13, 1.29)
20-44 years	1,451	619,050	1.45 (1.37, 1.53)
45-64 years	878	353,349	1.12 (1.05, 1.19)
65+ years	1,469	561,361	0.96 (0.91, 1.01)
Males	2,525	1,072,469	1.18 (1.13, 1.23)
Females	2,245	921,554	1.16 (1.11, 1.22)
1980-1989	2,424	1,017,632	1.09 (1.05, 1.14)
1990-2000	2,346	976,391	1.25 (1.20, 1.31)

a. Rate ratios were estimated using Poisson regression. Rate ratio was adjusted for age and sex.

Exhibit A56: Comparison communities excluded from box plot analyses due to small counts, by disease group

Disease Group	Comparison Communities Excluded
All Causes	McCrosson and Tovell
Malignant Respiratory	McCrosson and Tovell, Atwood , South Algona, Wardsville, Tehkummah, South River, Mersea, The Archipelago, North Monaghan, Oakland
Nervous System	McCrosson and Tovell, Atwood
Diseases of the Circulatory System	McCrosson and Tovell
Ischemic Heart Disease	McCrosson and Tovell
Acute Myocardial Infarction	McCrosson and Tovell, Atwood
Heart Failure	McCrosson and Tovell, Atwood
Cerebrovascular	McCrosson and Tovell, Atwood
Diseases of the Digestive System	McCrosson and Tovell
Diseases of the Genitourinary System	McCrosson and Tovell
Non-malignant diseases of the Respiratory System	McCrosson and Tovell
Acute Respiratory Infections	McCrosson and Tovell, Atwood, North Monaghan
Other Respiratory	McCrosson and Tovell, Atwood, South Algona, Sherwood Jones and Burns
Pneumonia / Influenza	McCrosson and Tovell, Atwood
Chronic Obstructive Pulmonary Disease and allied conditions	McCrosson and Tovell, Atwood, Griffith and Matawatchan
Asthma	McCrosson and Tovell, Atwood, South Algona, Griffith and Matawatchan, Tehkummah, North Monaghan
Diseases of the Skin and Subcutaneous Tissue	McCrosson and Tovell, Atwood, South Algona, Nairn
Injury / Poisoning	McCrosson and Tovell