

Chronic Obstructive Pulmonary Disease in Ontario

1996/97 to 2014/15

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About the Institute for Clinical Evaluative Sciences

Established in 1992, the **Institute for Clinical Evaluative Sciences** (ICES) is an independent not-for-profit corporation with an international reputation as a trusted source of high-quality health and health services research and evidence.

ICES researchers have access to a vast and secure array of Ontario's health-related data, including population-based health surveys, anonymous patient records, and clinical and administrative databases. ICES' unbiased evidence provides measures of health system performance, a clearer understanding of the shifting health care needs of Ontarians, and a stimulus for discussion of practical solutions to optimize scarce resources. ICES research and reports influence the development, implementation and evaluation of health policy and the delivery of health care.

Key to ICES' work is its ability to link population-based health information, at the patient level, in a way that ensures the privacy and confidentiality of personal health information. Linked databases reflecting 1.3 million of 36 million Canadians allow researchers to follow patient populations through diagnosis and treatment, and to evaluate outcomes. ICES goes to great lengths to protect privacy and is recognized as an international leader in maintaining the security of health information.

ICES receives core funding from the Ontario Ministry of Health and Long-Term Care. In addition, ICES scientists and staff have highly successful track records competing for peer-reviewed grants from federal agencies, such as the Canadian Institutes of Health Research, and from provincial and international funding bodies.

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Executive Summary

Issue

Chronic obstructive pulmonary disease (COPD) is a serious respiratory condition that is estimated to be the third leading cause of death worldwide; it affects approximately 10% of adult Ontarians.¹⁻³ Persons with COPD are frequent users of the health care system and understanding how their patterns of use change over time can help inform health services planning. More information is required on temporal changes in rates of COPD incidence, prevalence and mortality, both across Ontario and in the province's 14 Local Health Integration Networks (LHINs).

Objectives

This study describes the characteristics of persons with COPD by age, sex and income level for each LHIN in Ontario from April 1, 2014 to March 31, 2015. Additionally, it examines changes in rates of COPD prevalence, incidence and mortality from April 1, 1996, to March 31, 2015, and investigates health services use by persons with COPD from April 1, 2002, to March 31, 2015.

Data sources

The following administrative databases held at the Institute for Clinical Evaluative Sciences were used to identify the health services use and demographic characteristics of persons with COPD in Ontario:

- Hospitalizations – Canadian Institute for Health Information Discharge Abstract Database
- Emergency department visits – National Ambulatory Care Reporting System
- Long-term care – Ontario Drug Benefit Program and Ontario Health Insurance Plan Claims Database

- Home care visits – Ontario Association of Community Care Access Centres Home Care Database
- Ambulatory care visits – Ontario Health Insurance Plan Claims Database
- Population estimates – Ontario Ministry of Health and Long-Term Care IntelliHealth Ontario Population Estimates and Projections
- Demographic characteristics – Ontario Registered Persons Database
- Neighbourhood income quintile – Statistics Canada Census Area Profiles

Methods

Incidence, prevalence and mortality rates were calculated by fiscal year (April 1 to March 31 of the following year) for the entire sample, and subsequently stratified by sex and by LHIN. For 2014/15 only, individuals with COPD were compared by LHIN, age, sex and neighbourhood income quintile. Finally, this report examined COPD-specific and all-cause rates of health services use of COPD patients by LHIN over time. The examination of rates of health services use involved three subanalyses. First, COPD-specific hospital admissions, emergency department visit and ambulatory care visits were calculated. Because individuals with COPD often have other comorbid conditions, rates of all-cause hospital admissions,

emergency department visits and ambulatory care visits, were also calculated. Finally, long-term care residence and home care use were calculated. Due to a lack of data prior to 2005, home care use was calculated from April 1, 2005, to March 31, 2015.

Key findings

- In 2014/15, the prevalence rate for COPD was 11.8%, while the incidence rate was 8.8 per 1,000 individuals. The all-cause mortality rate was 4.0% among individuals with COPD.
- The overall standardized prevalence rate for COPD increased from 1996/97 to 2014/15, while both the age- and sex-standardized incidence and all-cause mortality rates decreased.
- There was considerable heterogeneity in COPD prevalence rates, incidence rates and mortality among people with COPD, with up to a three-fold difference in rates across LHINs.
- Compared to the general Ontario population, individuals with COPD tended to live in lower-income neighbourhoods.
- Among people with COPD, rates of hospitalization and long-term care decreased slightly between 2002/03 and 2014/15, while rates of emergency department visits, ambulatory care visits and home care visits increased. Given the increasing

prevalence of COPD, it can be concluded that the absolute number of health services being used by individuals with COPD is increasing.

- There were sizable variations in health services use by LHIN of residence, with up to a five-fold difference in rates across LHINs.

Implications and future directions

- Overall, COPD prevalence is increasing; however, COPD incidence and mortality are decreasing.
- The considerable heterogeneity among the LHINs for COPD incidence, prevalence and mortality is striking.
- Variation in health services use by LHIN requires further study to determine whether it is the result of differences in access to care, differences in the availability of programs and services, or for other reasons.
- As the prevalence of COPD increases, there continues to be an increased use of health services among this complex patient population.
- As an ambulatory care-sensitive condition, management of COPD in the outpatient setting can help reduce the risk of hospitalization.

Background

Chronic obstructive pulmonary disease (COPD) is a common and preventable respiratory disease responsible for significant mortality, morbidity and health care costs. COPD is the third leading cause of death worldwide, affecting over 10% of the adult population.¹⁻³ Effective community-based programs and primary care services, informed by population-based evidence, are needed to manage the increasing number of people living with this disease.

Methods

Data sources

Administrative databases from the Institute for Clinical Evaluative Sciences were used to identify individuals in the general population with COPD.

- To determine area-level measures, data from the 2006 Census of Canada (Census) is used to assign area-level characteristics, such as neighbourhood-level income, to an individual.
- The Client Profile (CPRO) Database contains individual-level long-term care home application information.
- The Discharge Abstract Database (CIHI-DAD) is compiled by the Canadian Institute for Health Information; it captures administrative, clinical and demographic information on hospital discharges, including deaths.
- The Home Care Database (HCD) is provided to ICES by the Ontario Association of Community Care Access Centres; it contains information on clients receiving home care.
- The National Ambulatory Care Reporting System (NACRS) is maintained by the Canadian Institute for Health Information; it contains data for all hospital- and community-based ambulatory care, such as day surgery, outpatient clinics and emergency department visits.

- Ontario Health Insurance Plan (OHIP) claims data received by ICES contain most claims paid for by the plan. These data cover all health care providers who can claim under OHIP (including physicians, physician groups, laboratories and out-of-province providers). Therefore, OHIP billing reflects the use of physician services in Ontario.
- IntelliHealth Ontario's Population Estimates and Projections database (POP), which is generated by Statistics Canada, provides Ontario population estimates and projections and is made available by the Ontario Ministry of Health and Long-Term Care through IntelliHealth Ontario.
- The Registered Persons Database (RPDB) provides demographic information about all individuals who have received an Ontario health card number, including their date of birth and their sex, as well as the address on their health card.

Data availability

The data set from this study is held securely in coded form at ICES. While data sharing agreements prohibit ICES from making the data set publicly available, access may be granted to those who meet pre-specified criteria for confidential access, available at www.ices.on.ca/DAS. The full data set creation plan is available from the authors upon request.

Study cohort

Individuals were identified as having COPD through health administrative data from CIHI-DAD, OHIP and the RPDB. To be classified as having COPD, individuals must have met all of the following criteria⁴:

- Age from 35 to 99 years and living in Ontario;
- Have a valid Ontario health card number; and
- Have at least one health care interaction (emergency department visit, hospitalization or physician visit) that is specific to COPD.

Study period

This study covered fiscal years 1996/97 to 2014/15. A fiscal year is defined as the beginning of April to the end of March of the following calendar year (e.g., 2014/15 = April 1, 2014, to March 31, 2015).

Analysis

In **Section 1 (Characteristics of of the COPD population)**, individuals with COPD were characterized by age, sex, socioeconomic status and LHIN of residence. To contextualize the results, the COPD population was compared to the non-COPD population (i.e., those who were not identified as having COPD per the criteria above). Income was attributed by using an individual's postal code to determine the average household income of his or her neighborhood, as derived from the Census of Canada and categorized into quintiles.⁵ We used the 1996 census for 1996/97 to 1998/99, the 2001 census for 1999/00 to 2003/04, and the 2006 census for 2004/05 and onward.

In **Section 2 (Trends in the prevalence, incidence and mortality of COPD)**, age- and sex-standardized prevalence, incidence and mortality rates of COPD were compared by sex and LHIN over time. When a patient entered the COPD cohort (after their first hospitalization or ambulatory care visit for COPD), they were considered an incident case in the fiscal year in which they had their first health care interaction. They were considered a prevalent case from the year of their initial COPD health care interaction until the year they died or left the province. For calculations of the prevalence rate, the numerator was the number of prevalent cases of COPD in the province in a fiscal year, and the denominator was the number of people in the province in the same fiscal year. For the

incidence rate calculations, the numerator was the number of new cases of COPD in the province in a fiscal year, and the denominator was the number of people in the province in the same fiscal year still at risk for developing COPD. For the mortality rate calculations, the numerator was the number of COPD patients in the province who died in a fiscal year, and the denominator was the number of alive people with COPD in the province in the same fiscal year. Prevalence and incidence rates were standardized by age and sex to the 2001 Ontario population, and mortality rates were standardized by age and sex to the 2001 Ontario COPD population. Population estimates were obtained from IntelliHealth Ontario's Population Estimates and Projections database (POP), which contains intercensal and postcensal estimates of the Ontario population by age, sex and geographic area. Mortality attributed to COPD is not well captured in available cause-specific mortality data, as COPD has been found to be underestimated as a cause of death on vital statistics death records by around 50%, and COPD deaths are often attributed to other causes, such as pneumonia or cardiovascular disease.⁶⁻⁷ As such, mortality rates were calculated using all-cause mortality (i.e., including all deaths in those with COPD irrespective of the cause of death).

In **Section 3 (Health services use among persons with COPD)**, rates of health services use by patients with COPD in Ontario, including hospitalizations, emergency department visits and ambulatory care visits, were compared over time. For emergency department visits, only those visits that did not result in a hospitalization were counted. Age- and sex-standardized rates were compared from 2002/03 to 2014/15. All-cause rates captured all health services visits made by persons with COPD, regardless of the reason for the visit, in order to determine the effect of the numerous comorbidities associated with COPD and to which COPD contributed. COPD-specific rates capture only COPD-related health service visits. Rates are presented in terms of person-years, which is a measure of the actual time that each patient was at risk of a health service use event. If an individual died, left the province or was otherwise ineligible for care, then only the time prior to any of these events was counted toward the calculation of his or her person-years. If an individual was alive, residing in Ontario and eligible for care for an entire fiscal year, then his or her number of person-years equalled 1 for that year. The numerators for the calculation of rates were the total number of hospitalizations, emergency department visits or ambulatory care visits made by COPD patients

in the province in a fiscal year; the denominators were the total number of person-years for COPD patients divided by 1,000 (to express the rate per 1,000 person-years). Long-term care residents and home care users were any persons with COPD who had at least one long-term care or home care health claim in a given year, respectively. Both long-term care and home care rates are expressed per 1,000 persons with COPD.

In **Section 4 (Health services use among persons with COPD, by Local Health Integration Network)**, rates of health services use by persons with COPD, including hospitalizations, emergency department visits and ambulatory care visits, are compared over time by LHIN. Age- and sex-standardized COPD-specific rates are compared from 2002/03 to 2014/15 by LHIN. Rates are presented per 1,000 person-years, as described above.

Exhibits and Findings

1. Characteristics of the COPD population

This section presents information describing the COPD population by age, sex and income quintile overall in Ontario and by Local Health Integration Network (LHIN). The demographic characteristics of persons with COPD were calculated for Ontario and subsequently stratified by LHIN. The demographic characteristics of Ontarians without COPD were also tabulated to provide context.

EXHIBIT 1.1 Map of the Local Health Integration Networks in Ontario

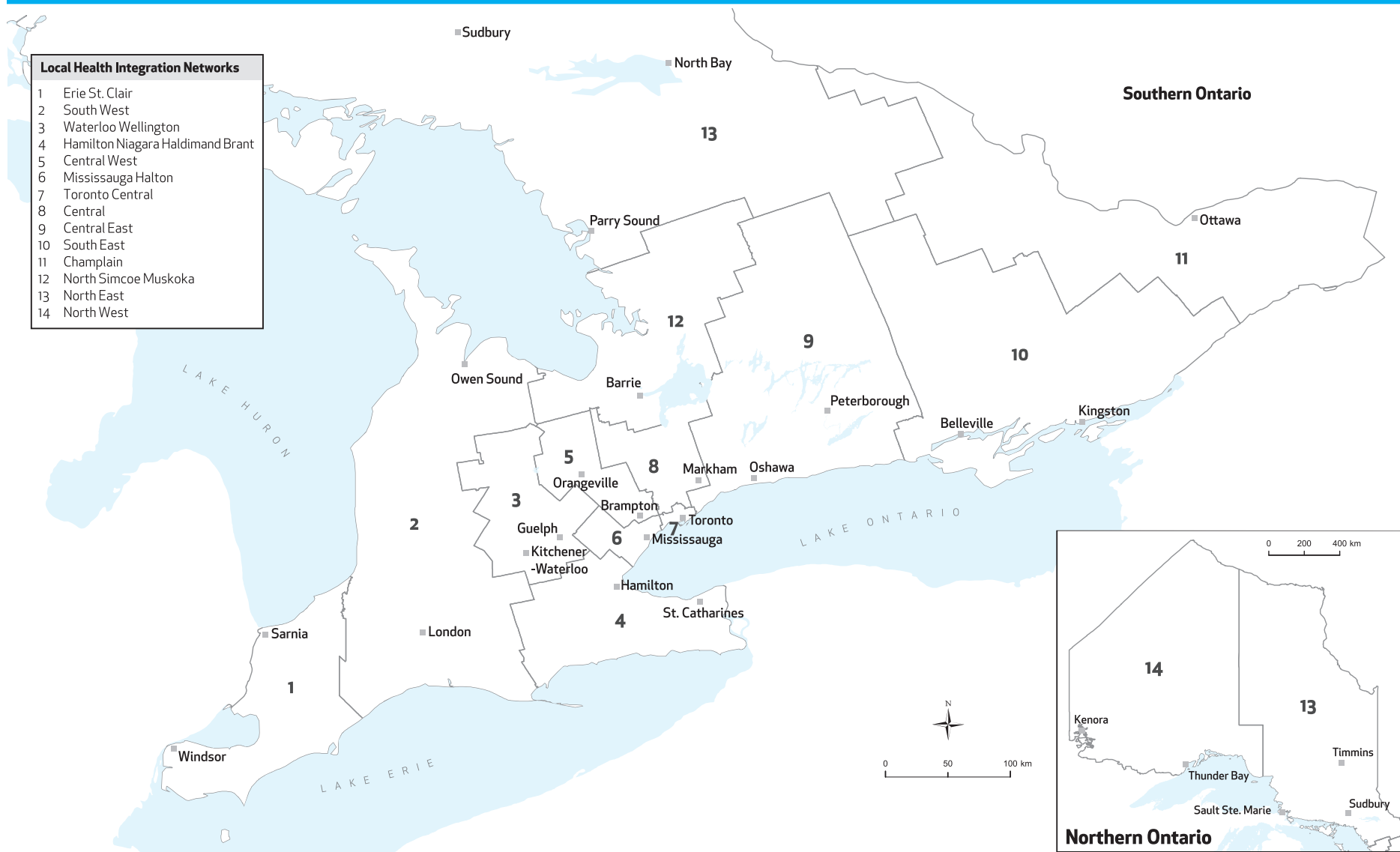


EXHIBIT 1.2 Distribution of age, sex and income level among COPD and non-COPD populations, in Ontario and by Local Health Integration Network, 2014/15

Key Findings

- In comparing persons with COPD to those without, the former were more likely to be aged 65 and older (51.5% vs. 23.9%) and male (49.4% vs. 47.7%).
- COPD was more prevalent among women than men (50.6% vs. 49.4%), likely because women live longer and thus live longer with COPD.
- Persons with COPD were more likely to be in the lowest income quintile (Q1) compared to the non-COPD population (23.0% vs. 17.4% respectively).
- The North East, Toronto Central and South East LHINs had the highest proportions of low-income persons with COPD (respectively, 30.3%, 30.1% and 28.5%). The Central, Central West and Mississauga Halton LHINs had the lowest proportions of low-income persons with COPD (respectively, 17.2%, 15.9% and 12.4%).

Characteristic	COPD Population														Non-COPD Population	
	Ontario	1. Erie St. Clair	2. South West	3. Waterloo Wellington	4. Hamilton Niagara Haldimand Brant	5. Central West	6. Mississauga Halton	7. Toronto Central	8. Central	9. Central East	10. South East	11. Champlain	12. North Simcoe Muskoka	13. North East		14. North West
Age Group (years), %																
35-49	11.9	13.0	11.2	12.3	12.2	14.7	13.8	13.0	12.3	11.4	9.9	11.5	10.4	10.9	9.8	39.8
50-64	36.6	38.0	36.2	36.5	36.5	35.9	35.5	35.9	33.8	36.9	37.4	37.7	37.1	38.0	37.6	36.3
65-99	51.5	49.0	52.6	51.2	51.3	49.4	50.8	51.1	53.9	51.8	52.7	50.9	52.5	51.2	52.6	23.9
Sex, %																
Female	50.6	51.8	50.8	50.5	51.9	48.1	49.0	47.6	47.7	50.1	53.0	52.9	52.6	50.8	51.1	52.3
Male	49.4	48.2	49.2	49.5	48.1	51.9	51.0	52.5	52.3	49.9	47.0	47.1	47.4	49.2	48.9	47.7
Income Quintile, %																
Q1 (lowest)	23.0	23.6	23.2	22.2	24.9	15.9	12.4	30.1	17.2	25.1	28.5	19.7	21.4	30.3	23.1	17.4
Q2	21.6	21.4	21.8	23.1	22.1	25.2	15.3	20.8	19.8	25.1	22.8	22.1	17.2	22.2	18.0	19.0
Q3	19.5	19.1	20.9	18.2	19.7	29.1	20.2	12.1	19.7	20.3	18.2	19.4	20.5	19.0	20.1	20.1
Q4	19.0	18.9	17.9	17.8	17.8	18.4	28.2	13.3	24.9	16.5	17.7	20.9	21.0	15.9	19.2	21.9
Q5 (highest)	16.9	16.9	16.2	18.7	15.5	11.4	23.9	23.8	18.4	13.0	12.8	17.9	20.0	12.6	19.6	21.6

Data sources: CIHI-DAD, OHIP, RPDB.

2. Trends in COPD prevalence, incidence and mortality

This section presents age- and sex-standardized prevalence, incidence and mortality rates for COPD over time, by sex and by LHIN in Ontario.

For calculation of prevalence rates, the numerator is the number of prevalent cases of COPD in the province in a fiscal year, and the denominator is the number of people in the province in the same fiscal year. For calculation of incidence rates, the numerator is the number of new cases of COPD in the province in a fiscal year, and the denominator is the number of people in the province in the same fiscal year still at risk of developing COPD. Rates for prevalence and incidence were standardized to the 2001 Ontario population.

For calculation of mortality rates, the numerator is the number of COPD patients in the province who died in a fiscal year, and the denominator is the number of people with COPD in the province in the same fiscal year. Mortality rates were standardized to the 2001 Ontario COPD population.

EXHIBIT 2.1 Prevalence, incidence and mortality rates for COPD, overall (age- and sex-standardized) and by sex (age-standardized), in Ontario, 1996/97 to 2014/15

Key Findings

- In 2014/15, the COPD prevalence rate was 11.8%, and the incidence rate was 8.8 per 1,000 individuals. The all-cause mortality rate among persons with COPD was 4.0%.
- The overall standardized prevalence rate for COPD increased 36.6% from 1996/97 to 2014/15, while the age- and sex-standardized incidence and all-cause mortality rates decreased 31.7% and 27.7%, respectively.
- From 1996/97 to 2014/15, men had higher age-standardized rates of COPD prevalence, incidence and mortality compared to women.
- In 2014/15, the age-standardized prevalence rate for COPD among men and women was 11.2% and 10.0%, respectively. The age-standardized incidence rate for COPD among men and women was 9.1 and 7.3 per 1,000, respectively.

Data sources: Census, CIHI-DAD, OHIP, POP, RPDB
 Note: Prevalence and incidence rates were standardized to the 2001 Ontario population; mortality rates were standardized to the 2001 Ontario population with COPD. See Exhibits A.1 and A.2 for crude and adjusted rates by age, sex and year.

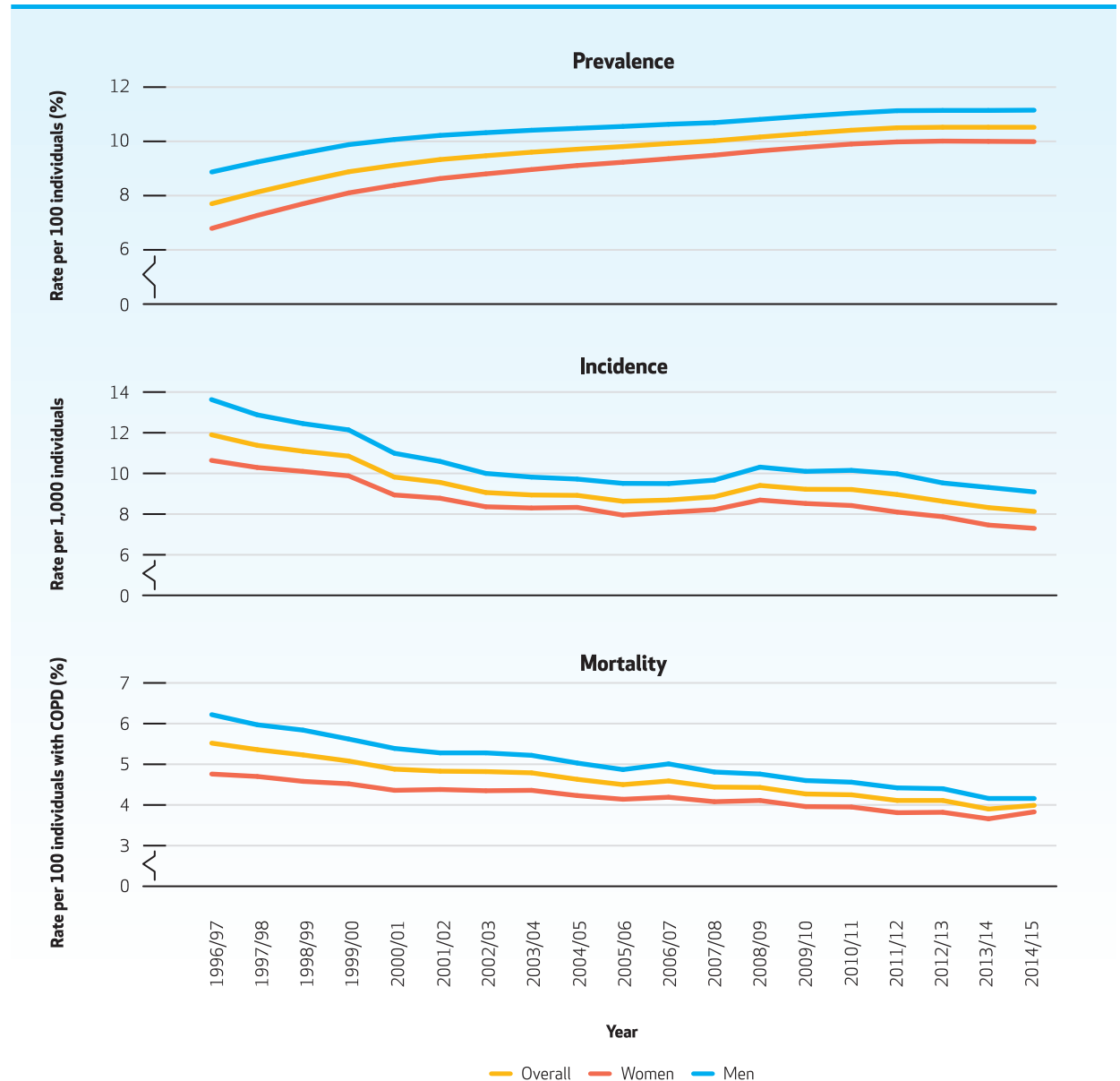
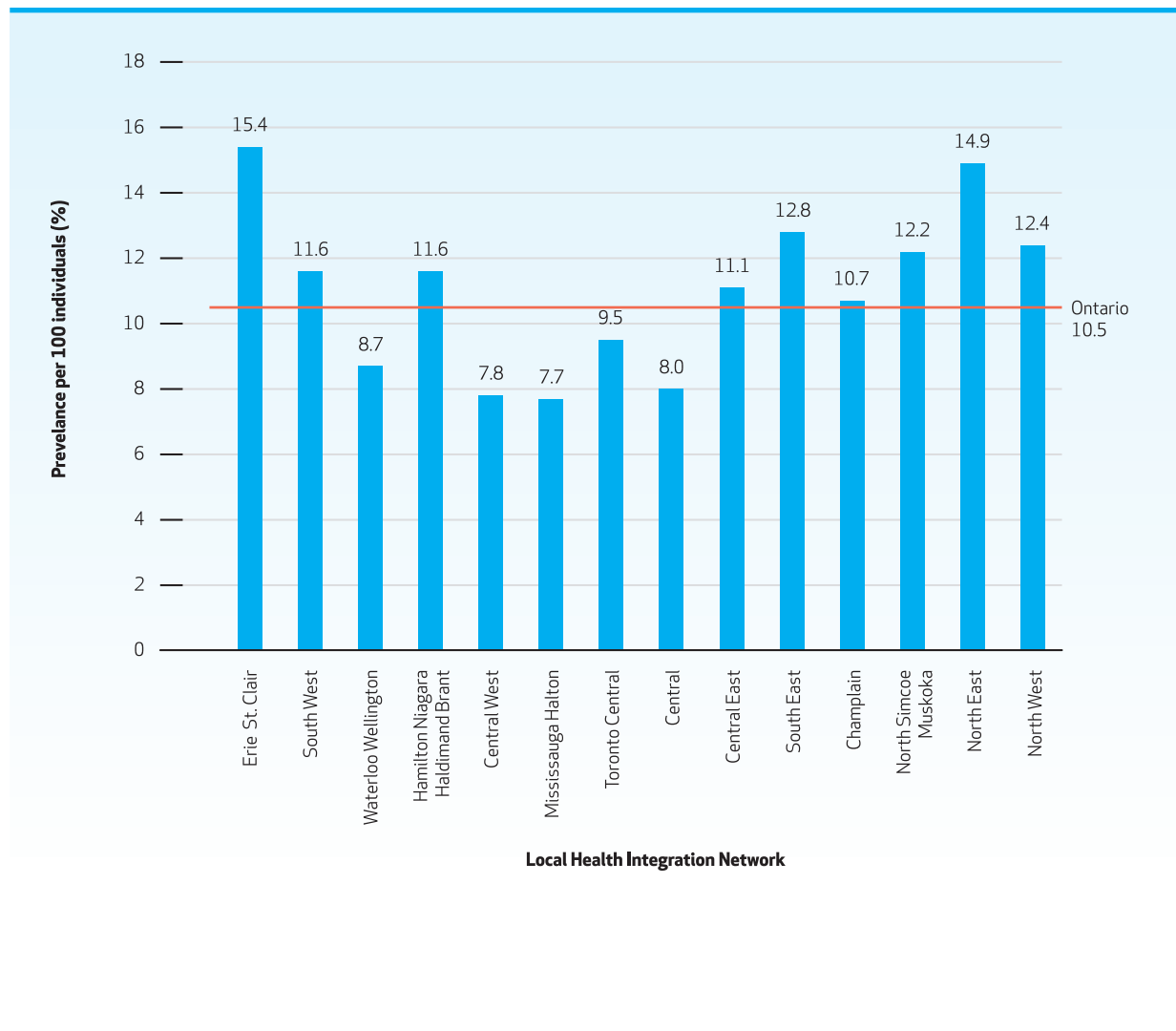


EXHIBIT 2.2 Age- and sex-standardized prevalence rate for COPD, in Ontario and by Local Health Integration Network, 2014/15

Key Findings

- The highest prevalence rates for COPD were observed in the Erie St. Clair (15.4%), North East (14.9%) and South East (12.8%) LHINs.
- The lowest prevalence rates for COPD were observed in the Central (8.0%), Central West (7.8%) and Mississauga Halton (7.7%) LHINs.

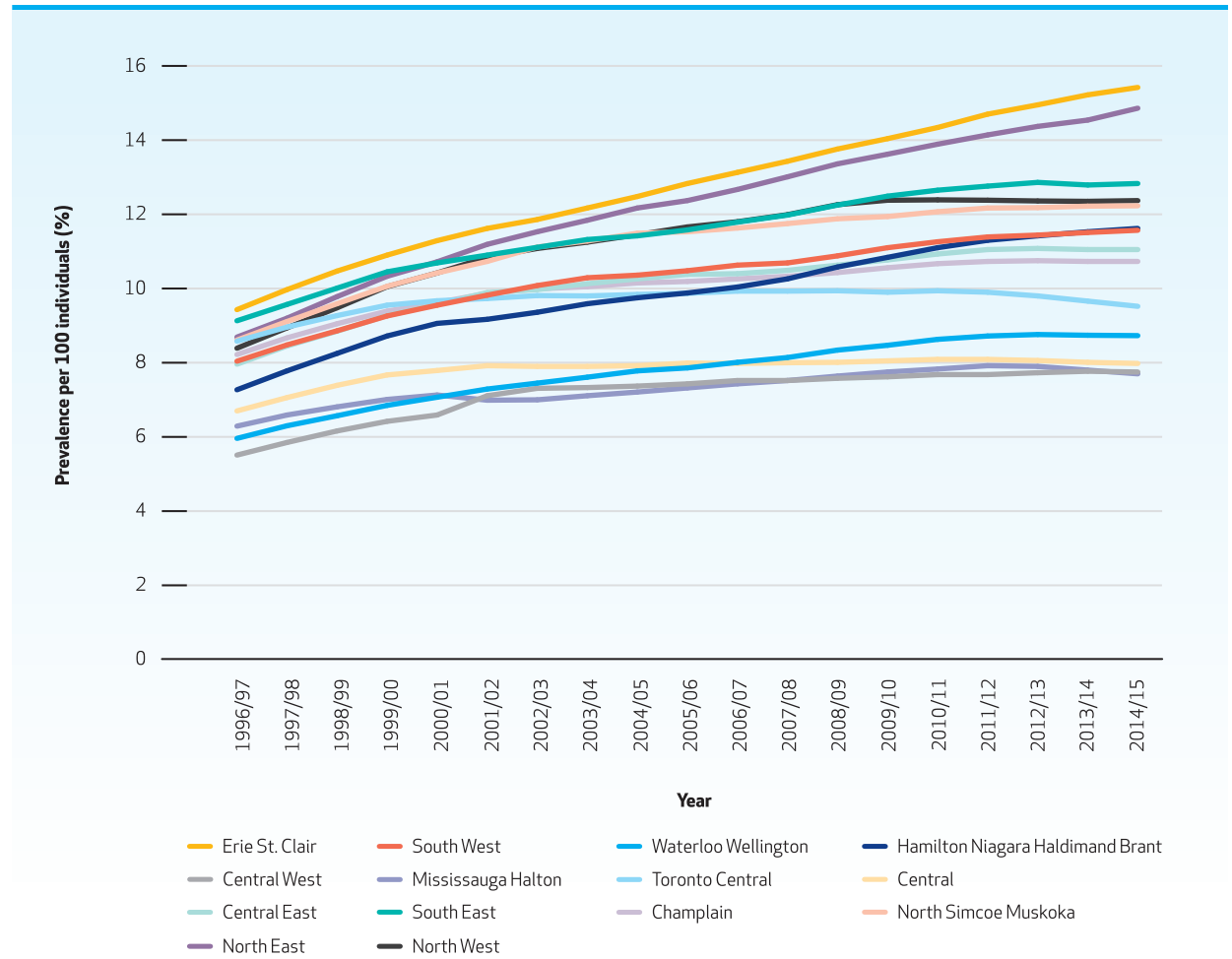


Data sources: Census, CIHI-DAD, OHIP, POP, RPDB.
 Note: Prevalence rates were standardized to the 2001 Ontario population.

EXHIBIT 2.3 Age- and sex-standardized prevalence rate for COPD, by Local Health Integration Network, in Ontario, 1996/97 to 2014/15

Key Findings

- The age- and sex-standardized prevalence rate of COPD increased in all LHINs between 1996/97 and 2014/15.
- In that period, the largest increases in the prevalence rate were observed in the following LHINs: North East (71.3%, from 8.7% to 14.9%), Erie St. Clair (63.4%, from 9.4% to 15.4%) and Hamilton Niagara Haldimand Brant (58.9%, from 7.3% to 11.6%).

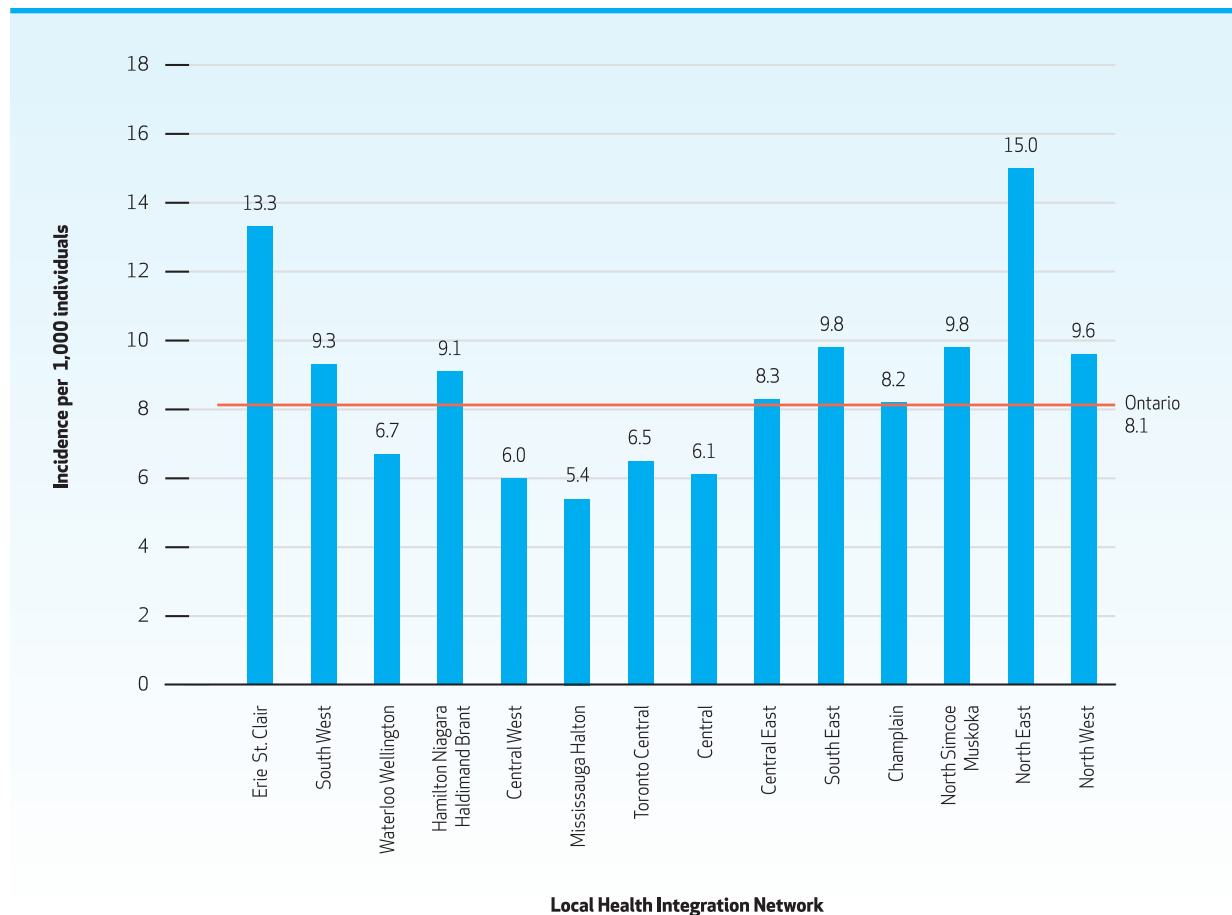


Data sources: Census, CIHI-DAD, OHIP, POP, RPDB.
 Note: Prevalence rates were standardized to the 2001 Ontario population.

EXHIBIT 2.4 Age- and sex-standardized incidence rate for COPD, in Ontario and by Local Health Integration Network, 2014/15

Key Findings

- In 2014, highest age- and sex-standardized incidence rates for COPD were observed in the North East (15.0), Erie St Clair (13.3), South East (9.8) and North Simcoe Muskoka (9.8) LHINs.
- In 2014, lowest age- and sex-standardized incidence rates for COPD were observed in the Central (6.1), Central West (6.0) and Mississauga Halton (5.4) LHINs.

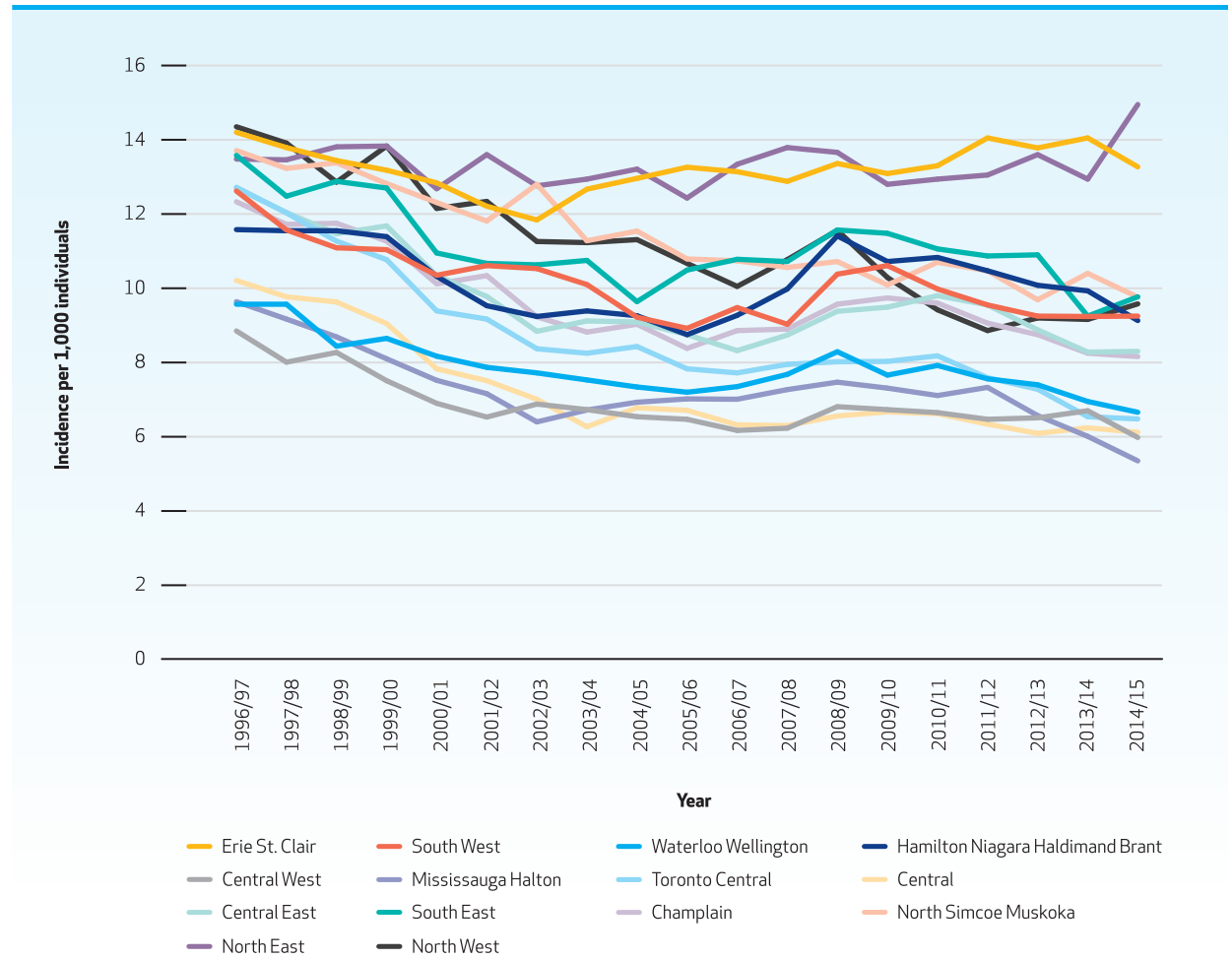


Data sources: Census, CIHI-DAD, OHIP, POP, RPDB.
 Note: Incidence rates were standardized to the 2001 Ontario population.

EXHIBIT 2.5 Age- and sex-standardized incidence rate for COPD, by Local Health Integration Network, in Ontario, 1996/97 to 2014/15

Key Findings

- The age- and sex-standardized incidence rate for COPD per 1,000 individuals fluctuated between 1996/97 and 2014/15, but had an overall decline in all LHINs, with the exception of the North East LHIN where it increased by 11.1%, from 13.5 to 15.0.
- From 1996/97 to 2014/15, the largest declines in the incidence rate for COPD were observed in the following LHINs: Toronto Central (45.8%, from 12.0 to 6.5), North West (30.9%, from 13.9 to 9.6) and Central East (30.8%, from 12.0 to 8.3). (All rates are per 1,000 individuals without COPD at the beginning of the year)
- While the incidence of COPD remained high across Ontario, there were relatively stable rates in recent years, other than an increasing rate in the Erie St. Clair LHIN since 2002/03, and modestly decreasing rates in the Toronto Central, Waterloo Wellington, and Mississauga Halton LHINs since 2010/11.

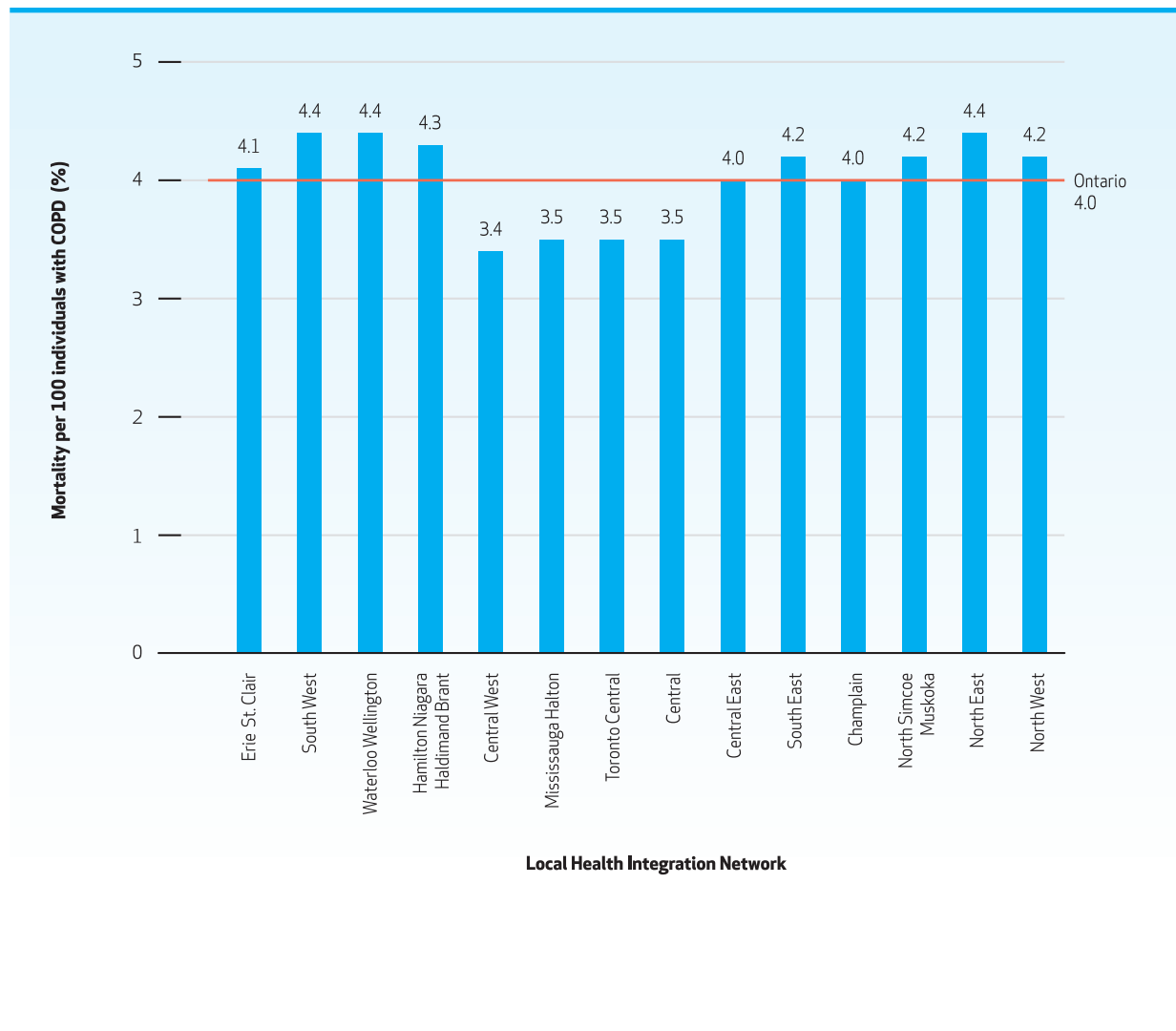


Data sources: Census, CIHI-DAD, OHIP, POP, RPDB.
 Note: Incidence rates were standardized to the 2001 Ontario population.

EXHIBIT 2.6 Age- and sex-standardized mortality rate for COPD, in Ontario and by Local Health Integration Network, 2014/15

Key Findings

- In 2014/15, the highest age- and sex-standardized mortality rates for COPD were observed in the following LHINs: North East (4.4%), South West (4.4%), Waterloo Wellington (4.4%) and Hamilton Niagara Haldimand Brant (4.3%).
- The lowest age- and sex-standardized mortality rates for COPD were observed in the following LHINs: Mississauga Halton (3.5%), Toronto Central (3.5%), Central (3.5%) and Central West (3.4%).

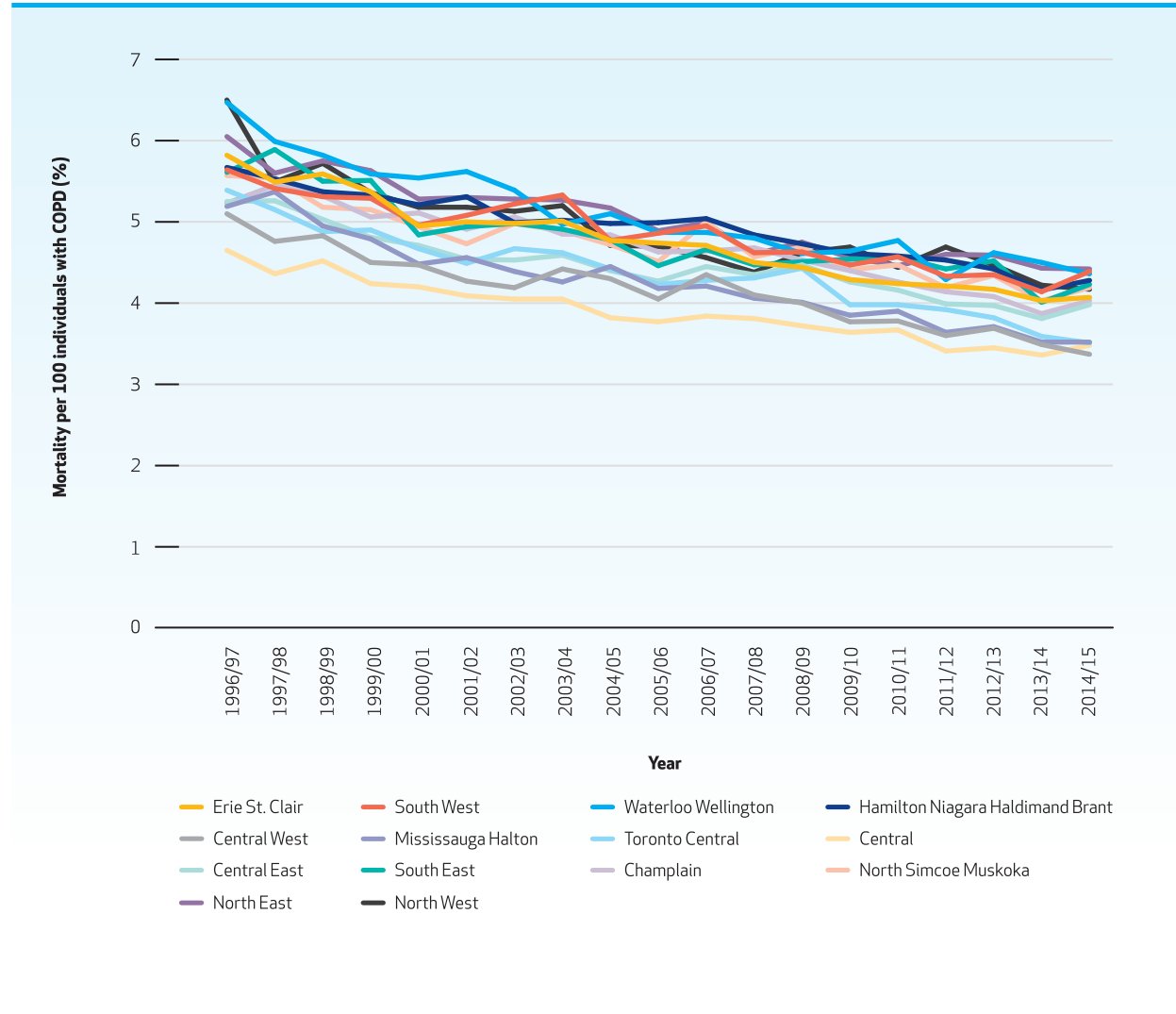


Data sources: Census, CIHI-DAD, OHIP, POP, RPDB.
 Note: Mortality rates were standardized to the 2001 Ontario COPD population.

EXHIBIT 2.7 Age- and sex-standardized mortality rate for COPD, by Local Health Integration Network, in Ontario, 1996/97 to 2014/15

Key Findings

- For all LHINs, the age- and sex-standardized mortality rate for COPD decreased from 1996/97 to 2014/15.
- In that period, the largest decreases in the COPD mortality rate occurred in the following LHINs: Toronto Central (35.2%, from 5.4% to 3.5%), North West (33.4%, from 6.5% to 4.2%), Waterloo Wellington (32.3%, from 6.5% to 4.4%), and Erie St. Clair (29.3%, from 5.8% vs 4.1%).



Data sources: Census, CIHI-DAD, OHIP, POP, RPDB.
 Note: Mortality rates were standardized to the 2001 Ontario COPD population.

3. Health services use among persons with COPD

This section presents age- and sex-standardized rates of health services use for COPD patients in Ontario from 2002/03 to 2014/15.

COPD-specific rates capture only COPD-related health service visits. All-cause rates capture all health service visits made by COPD patients, regardless of the reason for the visit, in order to capture the effect of the numerous comorbidities associated with COPD.

Rates of hospitalization, emergency department visits and ambulatory care visits are presented in terms of person-years, which is a measure of the actual time that each patient was at risk of a health service use event. If an individual died, left the

province or was otherwise ineligible for care, then only the time prior to any of these events counted toward the calculation of their person-years. If an individual was alive, residing in Ontario and eligible for health care for an entire fiscal year, then his or her number of person-years equalled 1 for that year.

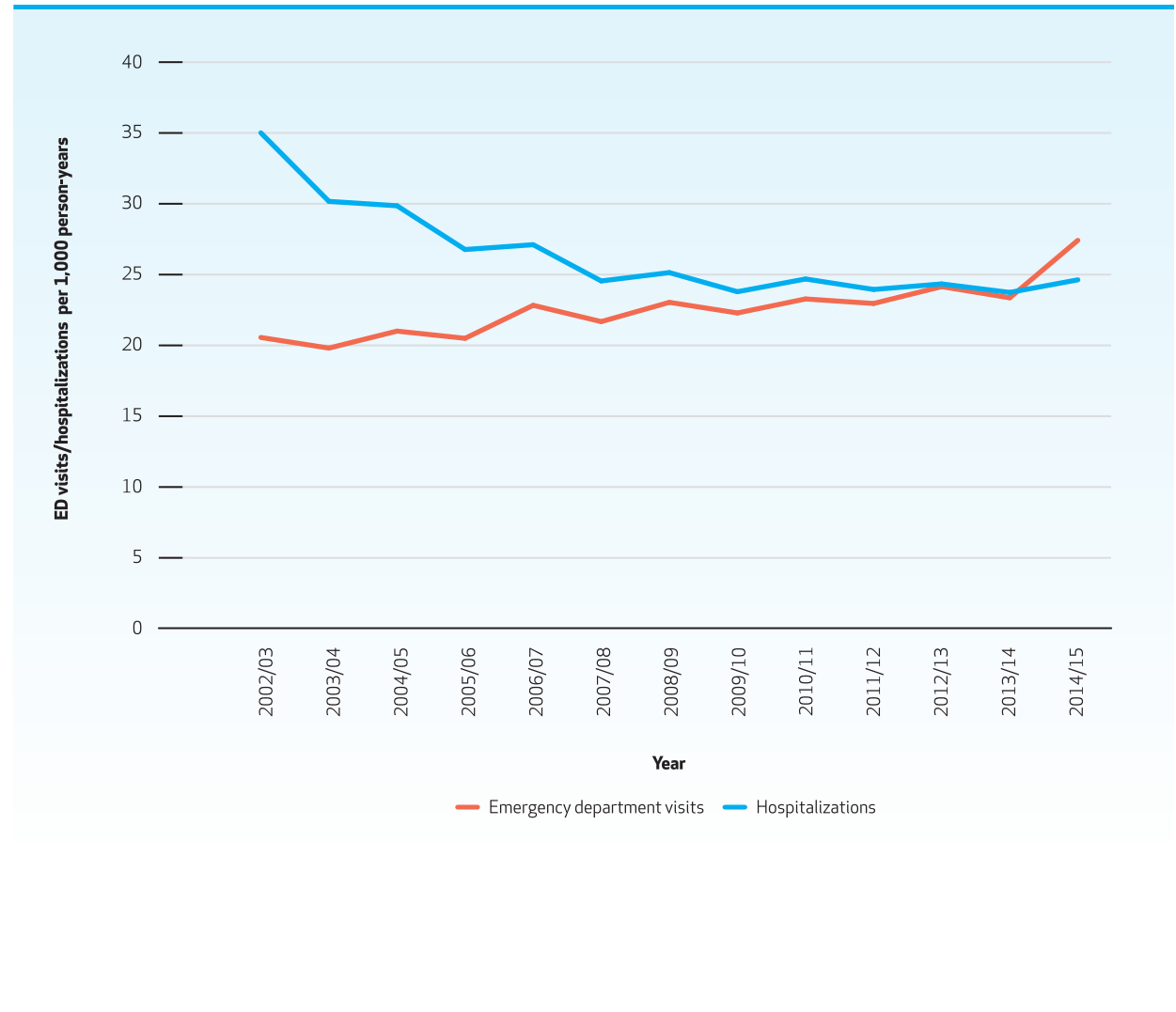
The numerators for the calculation of rates were the total number of hospitalizations, emergency department visits and ambulatory care visits made by persons with COPD in the province in each fiscal year, respectively. The denominators were the total number of person-years of COPD patients in each fiscal year divided by 1,000 (to express the rate per 1,000 person-years).

Long-term care residents and home care users were any persons with COPD who had at least one long-term care or home care health claim in a given year, respectively. Rates are expressed per 1,000 people with COPD.

EXHIBIT 3.1 Age- and sex-standardized rates of COPD-specific emergency department visits and hospitalizations among persons with COPD, in Ontario, 2002/03 to 2014/15

Key Findings

- In 2014/15, persons with COPD had 24.6 hospitalizations (95% CI: 24.3, 25.0), and 27.4 emergency department visits (95% CI: 27.0, 27.9) directly related to their COPD per 1,000 person-years (age- and sex-standardized).
- In 2014/15, the unadjusted rates of COPD-specific emergency department visits and hospitalizations per 1,000 person-years were 38.0 and 43.5, respectively (data not shown).
- From 2002/03 to 2008/09, the standardized rate of COPD-specific emergency department visits rose by 11.9%, while the standardized rate of COPD-specific hospitalizations declined by 28.0%. From 2008/09 onward, the standardized rate of emergency department visits increased by 18.9% and the standardized rate of hospitalizations remained fairly stable.
- As the number of people with COPD has increased (see Exhibit 2.1) and rates of ED visits and hospitalizations for COPD have remained stable, it can be concluded that the absolute numbers of ED visits and hospitalizations for COPD are increasing.



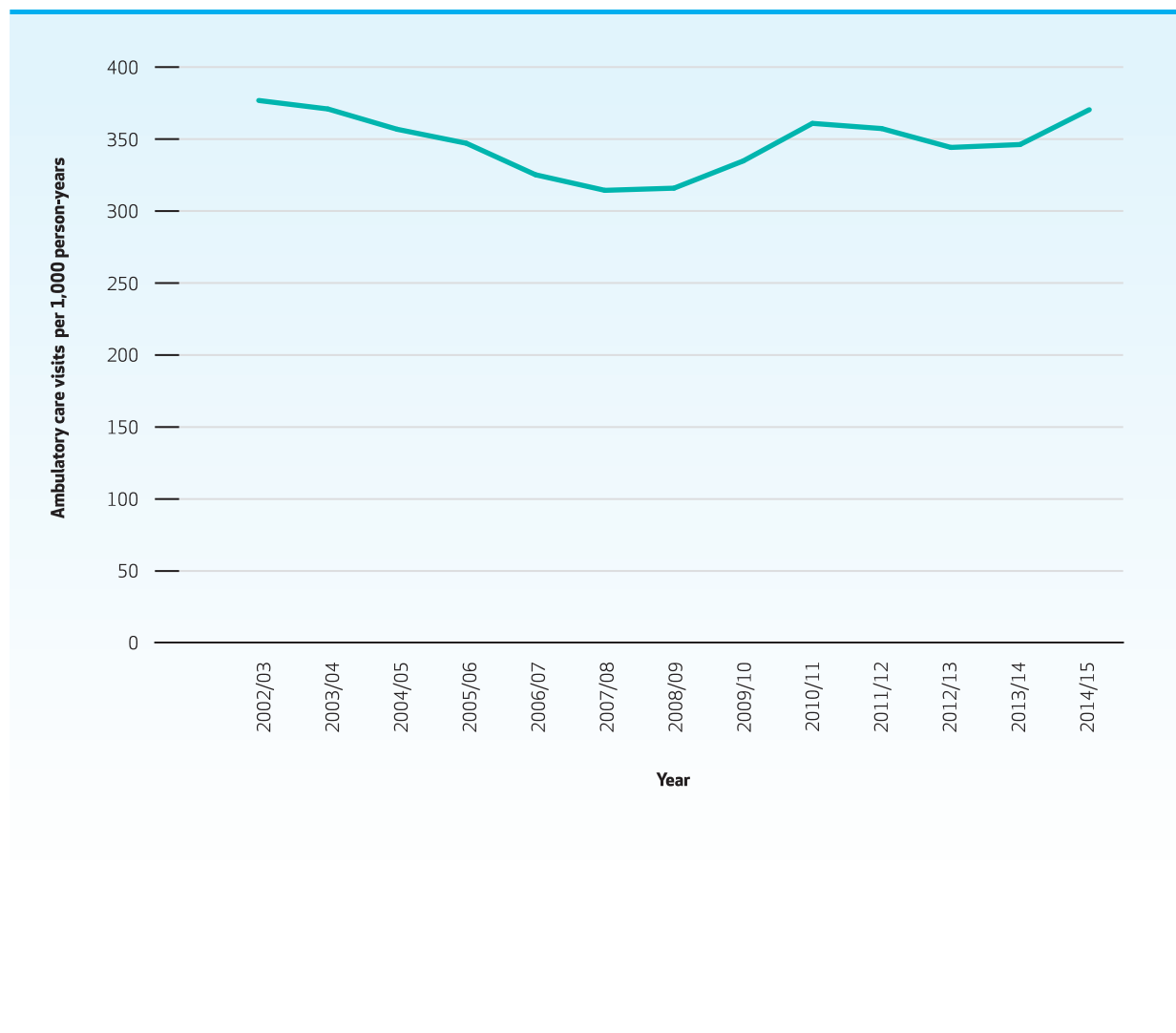
Data sources: CIHI-DAD, NACRS, OHIP, RPDB.

Note: Rates of health services use were standardized to the 2001 Ontario population.

EXHIBIT 3.2 Age- and sex-standardized rate of COPD-specific ambulatory care visits among persons with COPD, in Ontario, 2002/03 to 2014/15

Key Findings

- In 2014/15, persons with COPD had 370.4 COPD-specific ambulatory care visits per 1,000 person-years (age- and sex-standardized; 95% CI: 368.7, 372.0).
- In 2014/15, the unadjusted rate of COPD-specific ambulatory care visits (534.5) per 1,000 person-years was much higher than the corresponding standardized rate above (data not shown).
- The rate of standardized COPD-specific ambulatory care visits increased by 14.2% between 2008/09 and 2010/11 and was fairly stable thereafter.
- As the number of people with COPD has increased (see Exhibit 2.1) and the rate of ambulatory care visits for COPD has remained stable, it can be concluded that the absolute number of ambulatory care visits for COPD is increasing.



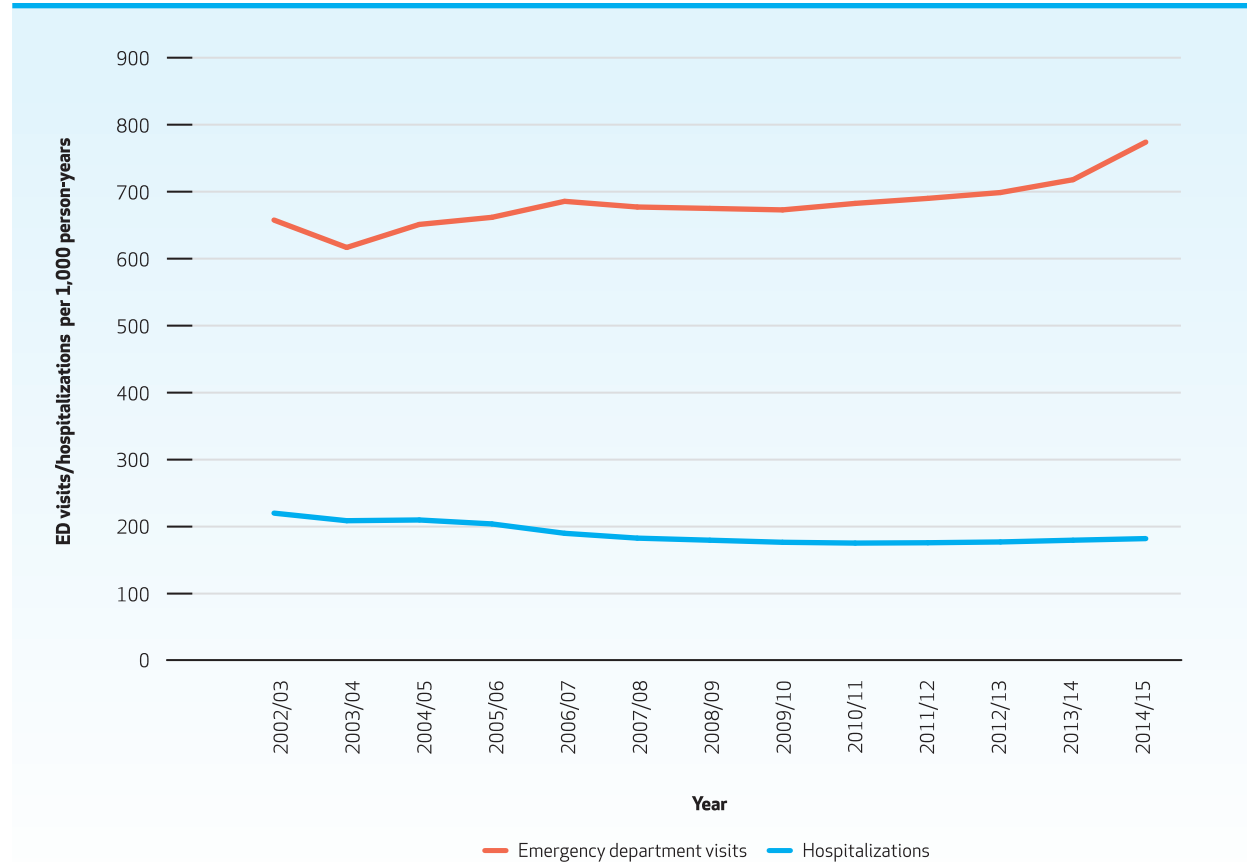
Data sources: CIHI-DAD, NACRS, RPDB, OHIP.

Note: Ambulatory care visit rates were standardized to the 2001 Ontario population.

EXHIBIT 3.3 Age- and sex-standardized rates of all-cause emergency department visits and hospitalizations among persons with COPD, in Ontario, 2002/03 to 2014/15

Key Findings

- In 2014/15, individuals with COPD had 774.0 all-cause emergency department visits (95% CI: 770.9, 777.1) and 182.1 all-cause hospitalizations (95% CI: 180.9, 183.2) per 1,000 person-years (age- and sex-standardized).
- In 2014/15, the unadjusted rates of all-cause emergency department visits (753.8) and hospitalizations (266.3) per 1,000 person-years were lower and higher, respectively, than the corresponding standardized rates above (data not shown).
- Between 2003/04 and 2014/15, the standardized rate of all-cause emergency department visits for individuals with COPD increased by 17.7%, from 657.6 to 774.0 per 1,000 person-years. In the same period, the standardized rate of all-cause hospitalizations decreased by 18.4% and then remained steady from 2007/08 onward.
- As the number of people with COPD has increased (see Exhibit 2.1) and rates of all-cause emergency department visits and hospitalizations have remained stable or increased, it can be concluded that the absolute numbers of emergency department visits and hospitalizations among people with COPD are increasing.



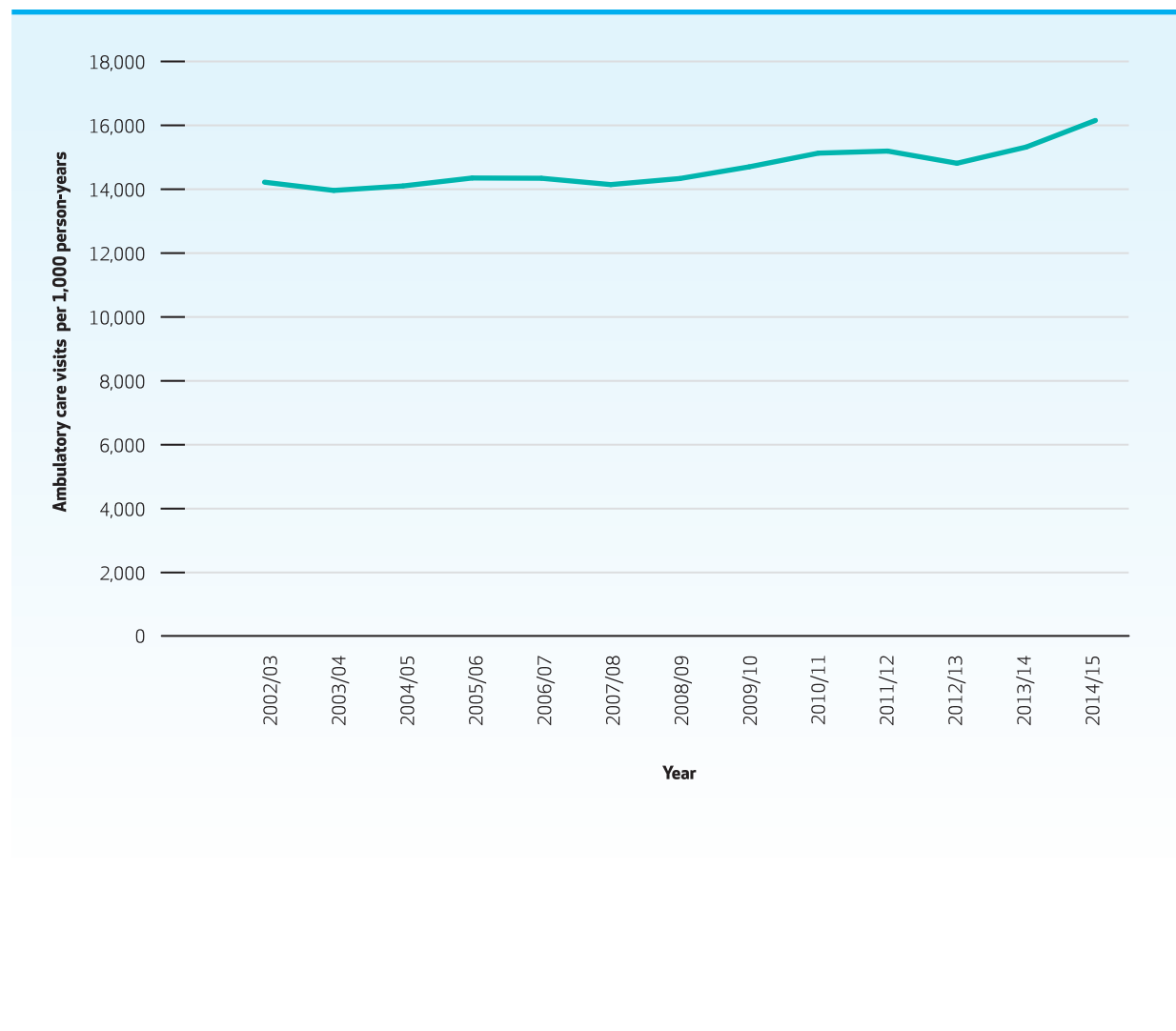
- It has been shown that rates of all-cause emergency department visits and hospitalizations are more than twice as high among individuals with COPD compared to individuals without COPD.⁷
- Unlike the COPD-specific rates shown in Exhibit 3.1, all-cause hospitalization rates were lower than all-cause emergency department visit rates.

Data sources: CIHI-DAD, NACRS, OHIP, RPDB.
 Note: Rates of health services use were standardized to the 2001 Ontario population.

EXHIBIT 3.4 Age- and sex-standardized rate of all-cause ambulatory care visits among persons with COPD, in Ontario, 2002/03 to 2014/15

Key Findings

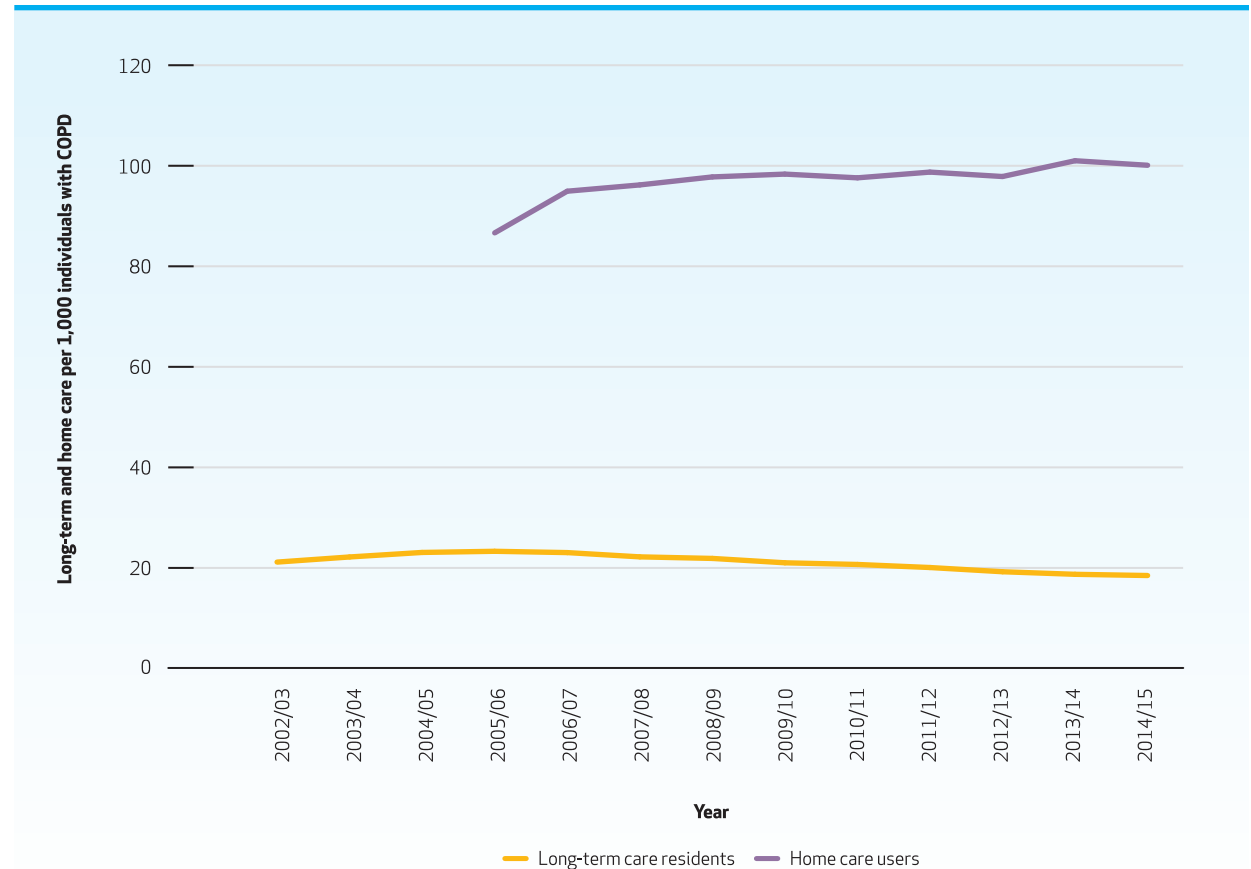
- In 2014/15, persons with COPD had 16,154 all-cause ambulatory care visits per 1,000 person-years (95% CI: 16,141, 16,167; age- and sex-standardized).
- In 2014/15, the unadjusted rate of all-cause ambulatory care visits (n=19,341) per 1,000 person-years was much higher than the corresponding standardized rate above (data not shown).
- The standardized rate of all-cause ambulatory care visits for persons with COPD increased by 13.6%, from 14,220 in 2002/03 to 16,154 in 2014/15.
- It has been shown previously that ambulatory care visit rates are more than twice as high among persons with COPD compared to persons without.⁸
- As the number of people with COPD has increased (see Exhibit 2.1) and the rate of all-cause ambulatory visits among persons with COPD has increased, it can be concluded that the absolute number of all-cause ambulatory visits among people with COPD is increasing.



Data sources: CIHI-DAD, CIHI-NACRS, OHIP, RPDB.
 Note: Ambulatory care visit rates were standardized to the 2001 Ontario population.

EXHIBIT 3.5 Age- and sex-standardized rates of long-term care and home care use among persons with COPD, in Ontario, 2002/03 to 2014/15**Key Findings**

- Between 2005/06 and 2014/15, the rate of home care use per 1,000 individuals with COPD increased slightly (15.5%, from 86.7 to 100.1), and the rate of long-term care use declined slightly (20.6%, from 23.3 to 18.5).
- It has been shown that rates of long-term care use and home care use are significantly higher among persons with COPD compared to persons without.⁸
- As the number of people with COPD has increased (see Exhibit 2.1) and rates of long-term care and home care use among persons with COPD have remained relatively stable, it can be concluded that the absolute numbers of people who use long-term care and home care are increasing.



Data sources: CIHI-DAD, CPRO, HCD, OHIP, RPDB.

Note: Rates of health services use were standardized to the 2001 Ontario population. Data for home care use were not available prior to 2005.

4. Health services use by persons with COPD, by Local Health Integration Network

This section presents age- and sex-standardized rates of health services use by persons with COPD in Ontario's 14 Local Health Integration Networks (LHINs) from 2002/03 to 2014/15.

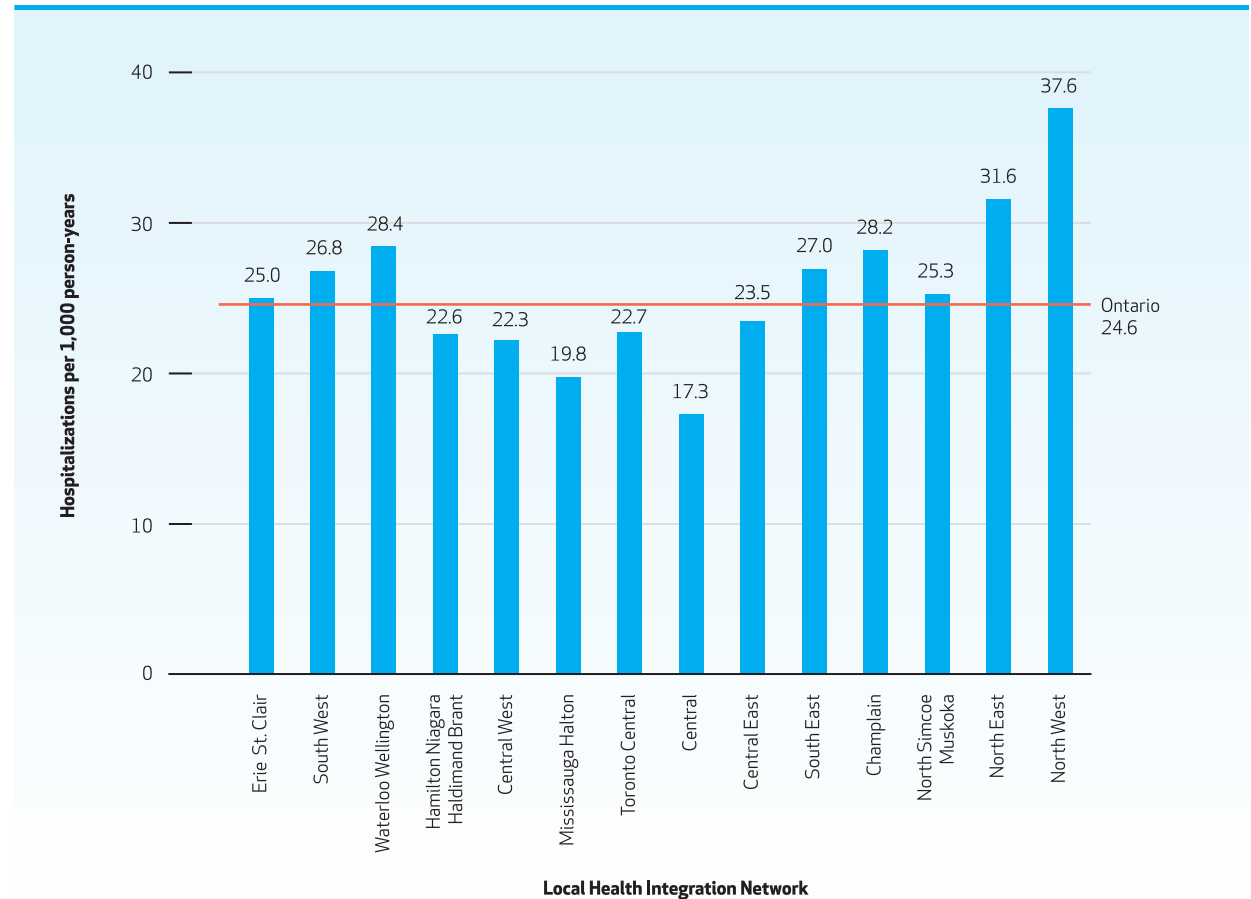
COPD-specific rates capture only COPD-related health service visits. Rates of hospitalization, emergency department visits and ambulatory care visits are presented in terms of person-years, which is

a measure of the actual time that each person is at risk of a health service use event. If an individual died, left the province or was otherwise ineligible for care, only the time prior to any of these events was counted toward the calculation of his or her person-years. If an individual was alive, residing in Ontario and eligible for health care for an entire fiscal year, then his or her number of person-years equalled 1 for that year.

For the calculation of rates, the numerators were the total number of hospitalizations, emergency department visits or ambulatory care visits made by persons with COPD in each LHIN in a fiscal year, respectively, and the denominators were the total number of person-years for persons with COPD in each LHIN divided by 1,000 (to express the rate per 1,000 person-years).

EXHIBIT 4.1 Age- and sex-standardized rate of COPD-specific hospitalizations among persons with COPD, in Ontario and by Local Health Integration Network, 2014/15**Key Findings**

- The highest COPD-specific hospitalization rates were observed in the following LHINs: North West (37.6; 95% CI: 35.1, 40.2), North East (31.6; 95% CI: 30.5, 32.8), Waterloo Wellington (28.4; 95% CI: 27.1, 29.9) and Champlain (28.2; 95% CI: 27.4, 29.0).
- The lowest COPD-specific hospitalization rates were observed in the following LHINs: Hamilton Niagara Haldimand Brant (22.6; 95% CI: 22.0, 23.3), Central West (22.3; 95% CI: 21.2, 23.4), Mississauga Halton (19.8; 95% CI: 18.9, 20.7) and Central (17.3; 95% CI: 16.7, 18.0).
- The LHIN with the highest COPD-specific hospitalization rate (North West) had a rate that was 2.2 times higher than that of the LHIN with the lowest COPD-specific hospitalization rate (Central).



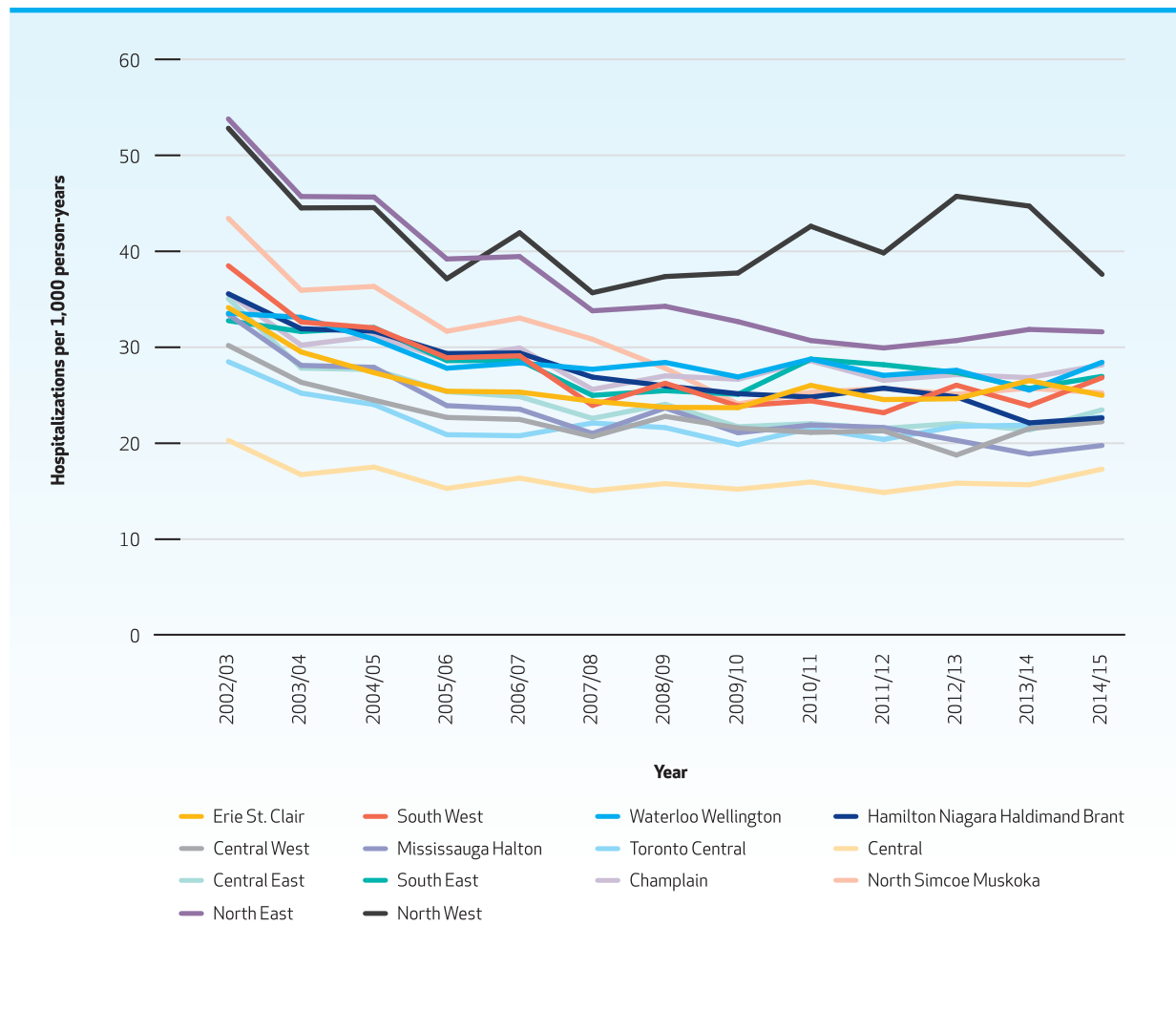
Data sources: CIHI-DAD, OHIP, RPDB.

Note: Hospitalization rates were standardized to the 2001 Ontario population.

EXHIBIT 4.2 Age- and sex-standardized rate of COPD-specific hospitalizations among persons with COPD, by Local Health Integration Network, in Ontario, 2002/03 to 2014/15

Key Findings

- Between 2002/03 and 2014/15, the rate of COPD-specific hospitalizations for individuals with COPD declined in all 14 LHINs. However, from 2007/08 onward, 10 of the 14 LHINs had minimal increases in COPD-specific hospitalizations.
- As the number of people with COPD has increased (see Exhibit 2.1) and the rate of hospitalizations has remained stable, it can be concluded that the absolute number of hospitalizations for COPD is increasing.
- Between 2002/03 and 2014/15, the largest decreases in age- and sex-standardized COPD-specific hospitalization rates occurred in the following LHINs: South East (41.7%, from 43.4 to 25.3), North East (41.3%, from 53.8 to 31.6), and North West (28.8%, from 52.8 to 37.6).
- Generally, there was a levelling off of COPD-specific hospitalizations across LHINs in recent years. However, the North West LHIN experienced much more variability compared to other LHINs.



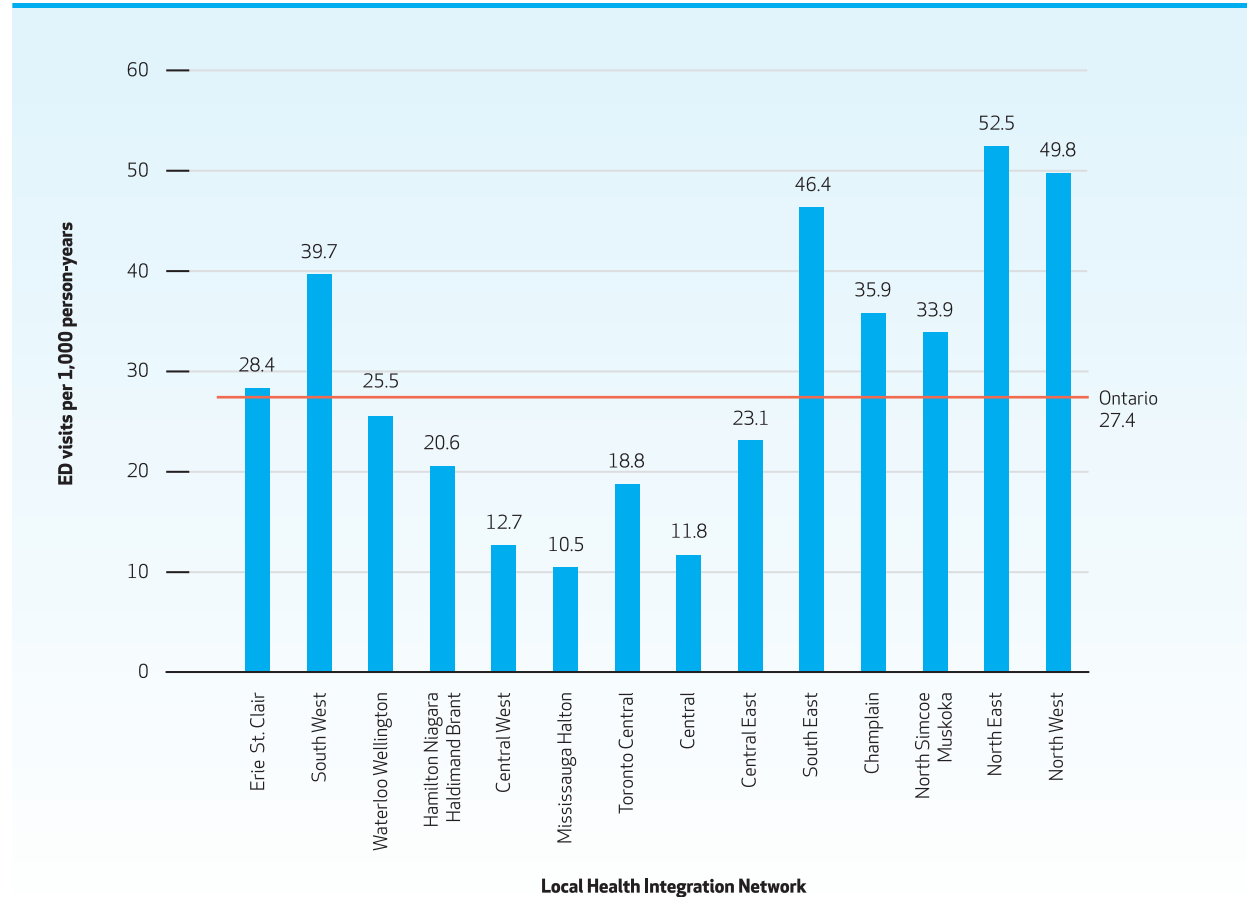
Data sources: CIHI-DAD, OHIP, RPDB.

Note: Hospitalization rates were standardized to the 2001 Ontario population.

EXHIBIT 4.3 Age- and sex-standardized rate of COPD-specific emergency department visits among persons with COPD, in Ontario and by Local Health Integration Network, 2014/15

Key Findings

- The highest COPD-specific emergency department visit rates were observed in the following LHINs: North East (52.5; 95% CI: 50.7, 54.4), North West (49.8; 95% CI: 46.2, 53.5), South East (46.4; 95% CI: 44.2, 48.6) and South West (39.7; 95% CI: 38.4, 41.2).
- The lowest COPD-specific emergency department visit rates were observed in the following LHINs: Toronto Central (18.8; 95% CI: 17.9, 19.8), Central West (12.7; 95% CI: 11.8, 13.8), Central (11.8; 95% CI: 11.1, 12.4) and Mississauga Halton (10.5; 95% CI: 9.8, 11.2).
- The LHIN with the highest COPD-specific emergency department visit rate (North East) had a rate that was 5 times higher than that of the LHIN with the lowest COPD-specific rate (Mississauga Halton).

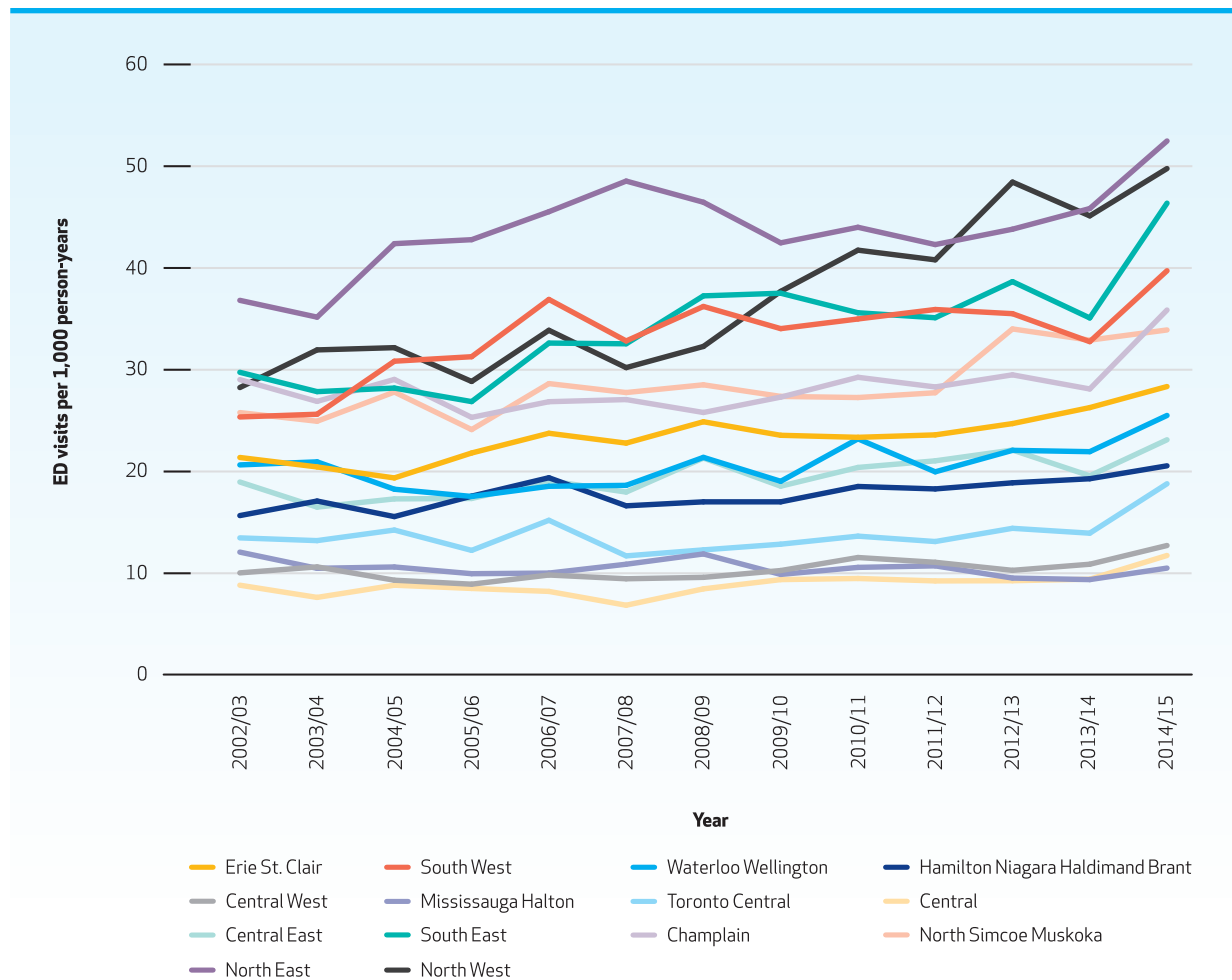


Data sources: CIHI-DAD, CIHI-NACRS, OHIP, RPDB
 Note: Emergency department visit rates were standardized to the 2001 Ontario population.

EXHIBIT 4.4 Age- and sex-standardized rate of COPD-specific emergency department visits among persons with COPD, by Local Health Integration Network, in Ontario, 2002/03 to 2014/15

Key Findings

- Between 2002/03 and 2014/15, increases in age- and sex-standardized COPD-specific emergency department visits made by people with COPD were seen in 13 of the 14 LHINs, with the exception of the Mississauga Halton LHIN.
- The largest increases in age-sex standardized COPD-specific emergency department visit rates between 2002/03 and 2014/15 occurred in the North West (76.0%, from 28.3 per 1,000 person-years to 49.8 per 1,000 person-years), South East (55.7%, from 29.8 to 46.4), and the North East (42.7%, from 36.8 to 52.5) LHINs.

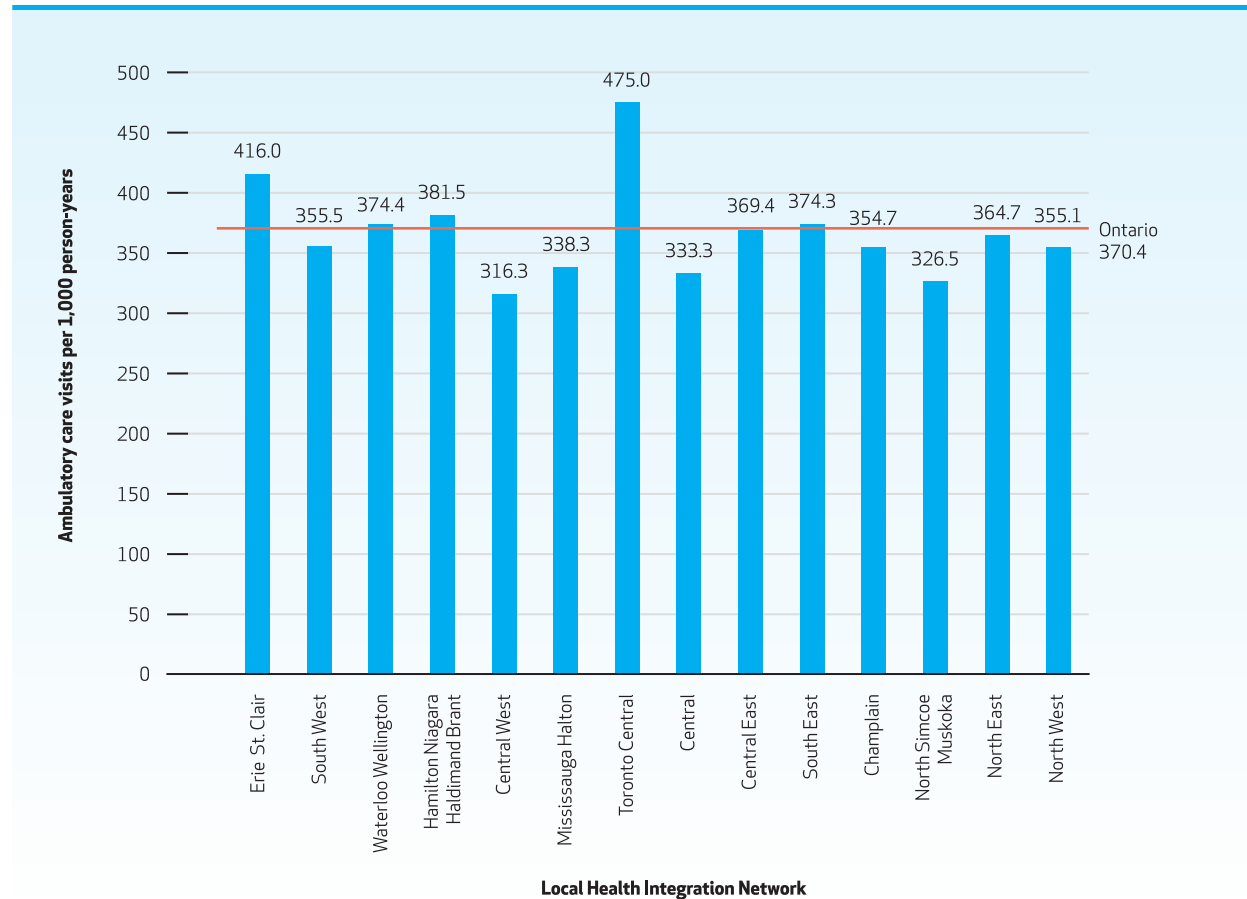


Data sources: CIHI-DAD, CIHI-NACRS, OHIP, RPDB
 Note: Emergency department visit rates were standardized to the 2001 Ontario population.

EXHIBIT 4.5 Age- and sex-standardized rate of COPD-specific ambulatory care visits among persons with COPD, in Ontario and by Local Health Integration Network, 2014/15

Key Findings

- The highest rates of COPD-specific ambulatory care visits were observed in the Toronto Central LHIN (475.0 [95% CI: 469.9, 480.0]), and the Erie St. Clair LHIN (416.0 [95% CI: 411.4, 420.5]).
- The lowest rates of COPD-specific ambulatory care visits were observed in the following LHINs: Central West (316.3 [95% CI: 311.5, 321.2]), North Simcoe Muskoka (326.5 [95% CI: 320.9, 332.1]) and Central (333.3 [95% CI: 329.6, 337.0]).
- The Toronto Central LHIN had a COPD-specific ambulatory care visit rate that was 1.5 times higher than that of the Central West LHIN (475.0 vs. 316.3).



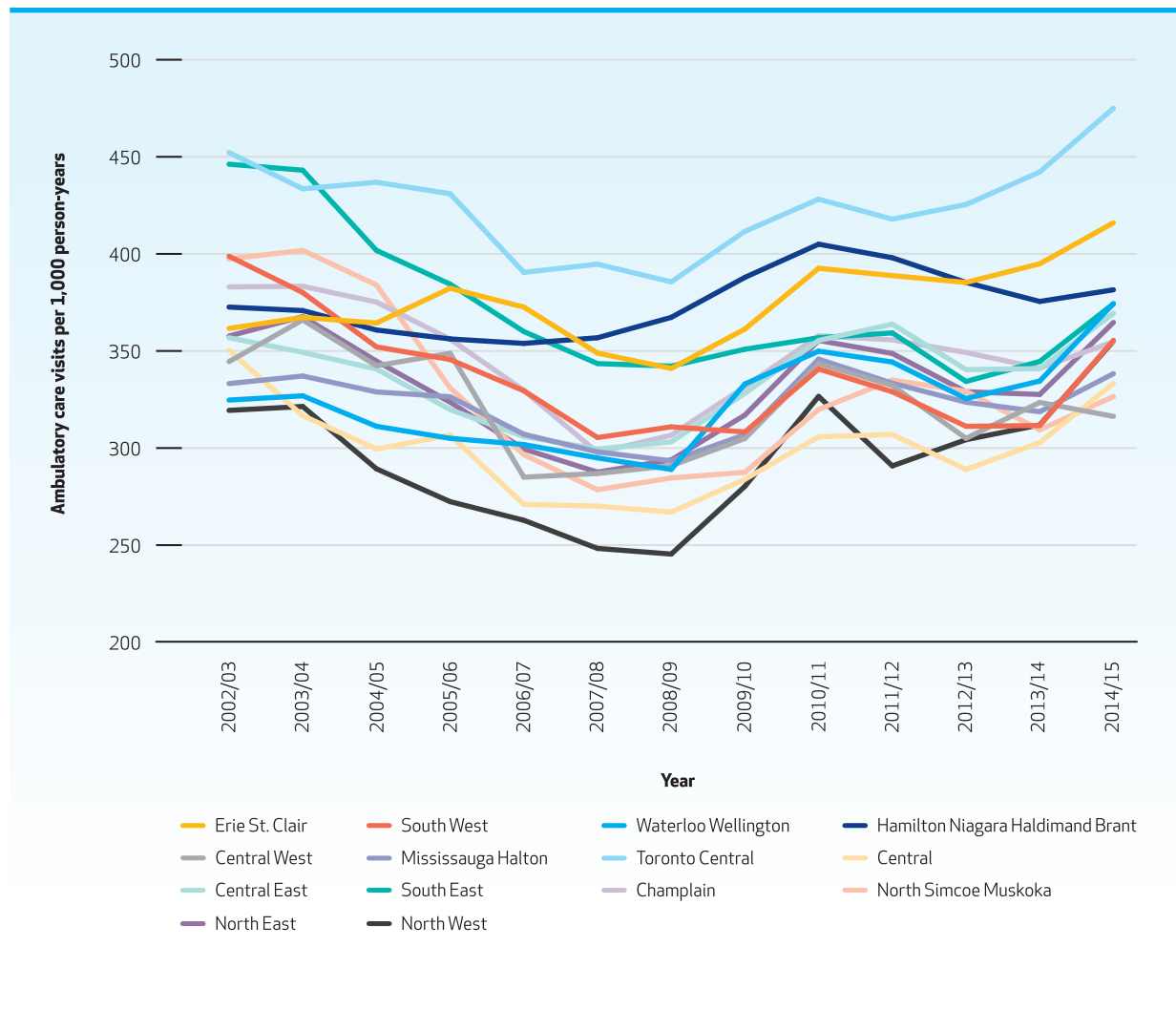
Data sources: CIHI-DAD, OHIP, RPDB.

Note: Ambulatory care visit rates were standardized to the 2001 Ontario population.

EXHIBIT 4.6 Age- and sex-standardized rate of COPD-specific ambulatory care visits among persons with COPD, by Local Health Integration Network, in Ontario, 2002/03 to 2014/15

Key Findings

- Between 2002/03 and 2007/08, all 14 LHINs in Ontario experienced a decrease in the age- and sex-standardized rate of COPD-specific ambulatory care visits made by persons with COPD; between 2007/08 and 2014/15, all 14 LHINs experienced an increase in this rate.
- Between 2007/08 and 2014/15, the largest increases in the age- and sex-standardized rate of COPD-specific ambulatory care visits per 1,000 person-years occurred in the following LHINs: North West (43.0%, from 248.3 to 355.1), Waterloo Wellington (27.0%, from 294.9 to 374.4), and Toronto Central (20.3%, from 394.7 to 475.0).



Data sources: CIHI-DAD, OHIP, RPDB
 Note: Ambulatory care visit rates were standardized to the 2001 Ontario population.

Discussion

COPD is a disease that most commonly occurs among older individuals, in females and in areas of low socioeconomic status. While the rate of new cases of COPD has been decreasing over time, the prevalence of COPD continues to rise.

We found that persons with COPD are frequent users of the health care system, both for reasons specific to COPD and as a result of their having multiple comorbid conditions (as measured by the number of all-cause visits). As the number of people with COPD has increased and rates of health services use have remained stable, can be concluded that, the absolute number of health services being

used is increasing. COPD is an ambulatory care-sensitive condition, which means that better management in the outpatient setting can help reduce the risk of subsequent hospitalizations.

At the level of the Local Health Integration Network, there are substantial differences in rates of COPD prevalence, incidence, mortality and health services use. While there may be many unique and integrated reasons for these differences, our findings suggest that initiatives for treating COPD in Ontario might be more effective by considering characteristics unique to each LHIN.

Limitations

There were three main limitations to this report, each involving how individuals were identified for inclusion in the study cohort.

First, using administrative data to identify individuals with COPD has inherent limitations. The identification of disease in this report depends on health services use, and people who use more health services are more likely to be diagnosed with COPD. These higher-volume health system users are also more likely to have moderate to severe disease; therefore, some individuals with milder disease may have been missed.

Second, the COPD case definition used in this study relied on physician diagnosis; it did not include spirometry-confirmed COPD. This was done to capture information about an entire population of people with physician-diagnosed COPD, as only 30% to 50% of people with COPD are diagnosed with spirometry.⁹ Thus, while these results are reflective of real-world practice, they likely underestimate the actual number of people who have COPD.

Finally, there is the potential for misclassification of COPD following physician diagnosis. To enter the cohort, individuals were

required to have one health care interaction for COPD (either a hospitalization or an ambulatory care visit). This validated case definition of COPD has a sensitivity of 85% and a specificity of 78%.⁴ It is possible that some of the individuals classified as having COPD based on this case definition may not have actually had the disease, and vice versa.

Conclusions and Next Steps

COPD is a common disease that demands a significant amount of health resources. Over the past 20 years, the prevalence of COPD has increased while COPD incidence and mortality rates have decreased, an indication that the disease's burden on the health care system is likely to worsen before it improves. The considerable variation in COPD incidence, prevalence, mortality and health services use among the Local Health Integration Networks is notable and should receive additional investigation. Future studies should focus on measuring and improving the quality of COPD care with a view to optimizing services to improve the health of people with COPD.

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Appendix

EXHIBIT A.1 Age- and sex-standardized rates of prevalence, incidence and mortality among persons with COPD, overall and by sex, in Ontario, 1996/97 to 2014/15

Year	Prevalence per 100 Individuals (%)			Incidence per 1,000 Individuals			Mortality per 100 Individuals with COPD		
	Overall	Men	Women	Overall	Men	Women	Overall	Men	Women
1996/97	7.7	8.9	6.8	11.9	13.6	10.6	5.5	6.2	4.8
1997/98	8.1	9.3	7.3	11.4	12.9	10.3	5.4	6.0	4.7
1998/99	8.5	9.6	7.7	11.1	12.5	10.1	5.2	5.8	4.6
1999/00	8.9	9.9	8.1	10.9	12.1	9.9	5.1	5.6	4.5
2000/01	9.1	10.1	8.4	9.8	11.0	8.9	4.9	5.4	4.4
2001/02	9.3	10.2	8.6	9.6	10.6	8.8	4.8	5.2	4.4
2002/03	9.5	10.3	8.9	9.1	10.0	8.4	4.8	5.3	4.3
2003/04	9.6	10.4	9.0	8.9	9.8	8.3	4.8	5.2	4.4
2004/05	9.7	10.5	9.1	8.9	9.7	8.3	4.6	5.0	4.2
2005/06	9.8	10.6	9.3	8.6	9.5	8.0	4.5	4.9	4.1
2006/07	9.9	10.6	9.4	8.7	9.5	8.1	4.6	5.0	4.2
2007/08	10.0	10.7	9.5	8.8	9.6	8.2	4.4	4.8	4.1
2008/09	10.2	10.8	9.6	9.4	10.3	8.7	4.4	4.7	4.1
2009/10	10.3	10.9	9.8	9.2	10.0	8.5	4.3	4.6	4.0
2010/11	10.4	11.0	9.9	9.2	10.1	8.4	4.3	4.6	4.0
2011/12	10.5	11.1	10.0	8.9	9.9	8.1	4.1	4.4	3.8
2012/13	10.5	11.1	10.0	8.6	9.5	7.8	4.1	4.4	3.8
2013/14	10.5	11.1	10.0	8.3	9.3	7.5	3.9	4.2	3.7
2014/15	10.5	11.2	10.0	8.1	9.1	7.3	4.0	4.2	3.8

Data sources: Census, CIHI-DAD, OHIP, POP and RPDB.

Note: Prevalence and incidence rates are standardized to the 2001 Ontario population; mortality rates are standardized to the 2001 COPD population. Prevalence and incidence rates are per 100 and 1,000 individuals, respectively, in the Ontario population; mortality rates are per 100 individuals with COPD.

EXHIBIT A.2 Unadjusted rates of prevalence, incidence and mortality among persons with COPD, overall and by age group, in Ontario, 1996/97 to 2014/15

Year	Prevalence per 100 Individuals (%)				Incidence per 1,000 Individuals				Mortality per 100 Individuals with COPD (%)			
	Overall	Age group, years			Overall	Age group, years			Overall	Age group, years		
		35-49	50-64	≥65		35-49	50-64	≥65		35-49	50-64	≥65
1996/97	7.7	3.0	8.0	17.0	12.1	5.2	11.8	27.9	5.6	0.6	2.3	9.0
1997/98	8.2	3.2	8.0	18.1	11.5	5.1	11.1	26.7	5.4	0.6	2.1	8.8
1998/99	8.6	3.3	8.4	18.9	11.2	5.3	10.8	25.3	5.3	0.5	2.0	8.6
1999/00	8.9	3.5	8.8	19.7	10.9	5.0	10.6	24.9	5.1	0.5	1.9	8.4
2000/01	9.1	3.5	9.0	20.3	9.8	4.6	9.4	22.8	4.9	0.5	1.8	8.0
2001/02	9.3	3.5	9.2	20.9	9.6	4.4	9.1	22.5	4.8	0.6	1.7	7.9
2002/03	9.5	3.5	9.4	21.3	9.1	4.2	8.7	21.0	4.8	0.6	1.8	7.9
2003/04	9.6	3.5	9.6	21.6	9.0	4.2	8.4	21.0	4.8	0.6	1.8	7.9
2004/05	9.8	3.5	9.8	21.9	9.0	4.2	8.5	20.7	4.6	0.5	1.6	7.7
2005/06	9.9	3.5	9.9	22.1	8.7	4.1	8.4	19.7	4.5	0.5	1.5	7.5
2006/07	10.1	3.5	10.1	22.3	8.8	4.3	8.4	19.5	4.6	0.6	1.6	7.6
2007/08	10.3	3.5	10.4	22.4	9.0	4.9	8.8	18.2	4.4	0.5	1.5	7.4
2008/09	10.5	3.6	10.6	22.5	10.0	5.8	9.6	17.6	4.4	0.6	1.5	7.4
2009/10	10.8	3.7	10.9	22.6	9.4	5.6	9.4	17.3	4.2	0.5	1.5	7.1
2010/11	11.0	3.8	11.0	22.6	9.5	5.7	9.5	16.9	4.2	0.5	1.4	7.1
2011/12	11.2	3.9	11.2	22.6	9.3	5.5	9.2	16.6	4.0	0.5	1.4	6.8
2012/13	11.4	3.9	11.4	22.4	9.1	5.4	8.9	16.1	4.1	0.4	1.4	6.9
2013/14	11.6	3.9	11.5	22.3	8.9	5.0	8.8	15.6	3.9	0.4	1.3	6.5
2014/15	11.8	3.8	11.6	22.3	8.8	4.6	8.7	15.9	4.0	0.4	1.3	6.7

Data sources: CIHI-DAD, OHIP and RPDB.

Note: All rates presented are crude rates unadjusted for age or sex. Prevalence and incidence rates are per 100 and 1,000 individuals, respectively, in the Ontario population. Mortality rates are per 100 individuals with COPD.



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