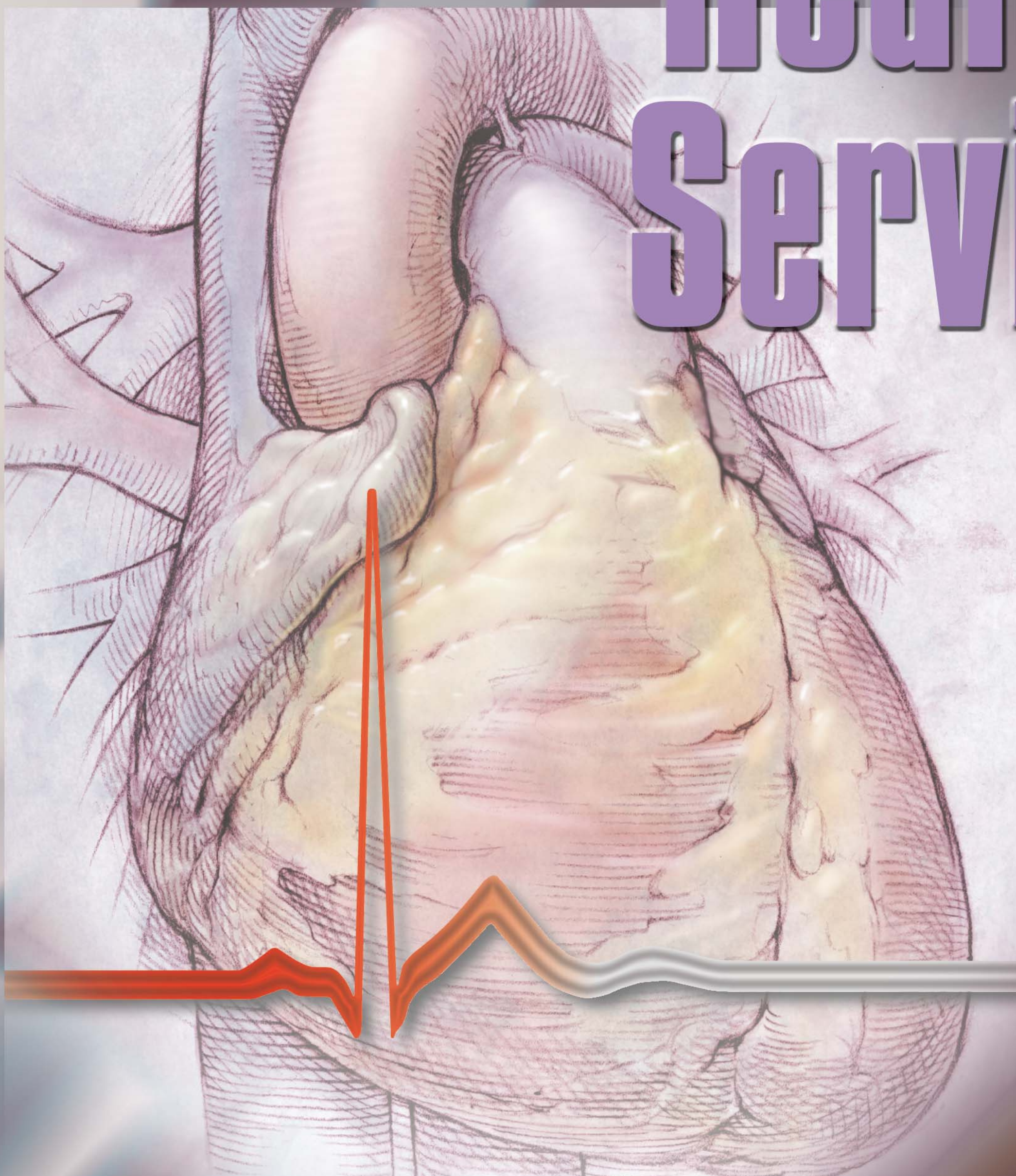
Cardiovascular Health & Services

IN ONTARIO

AN ICES ATLAS



ICES

Produced by the
Institute for Clinical Evaluative Sciences
with the support of the Heart and Stroke Foundation of Ontario

HEART AND STROKE FOUNDATION OF ONTARIO

Cardiovascular Health & Services

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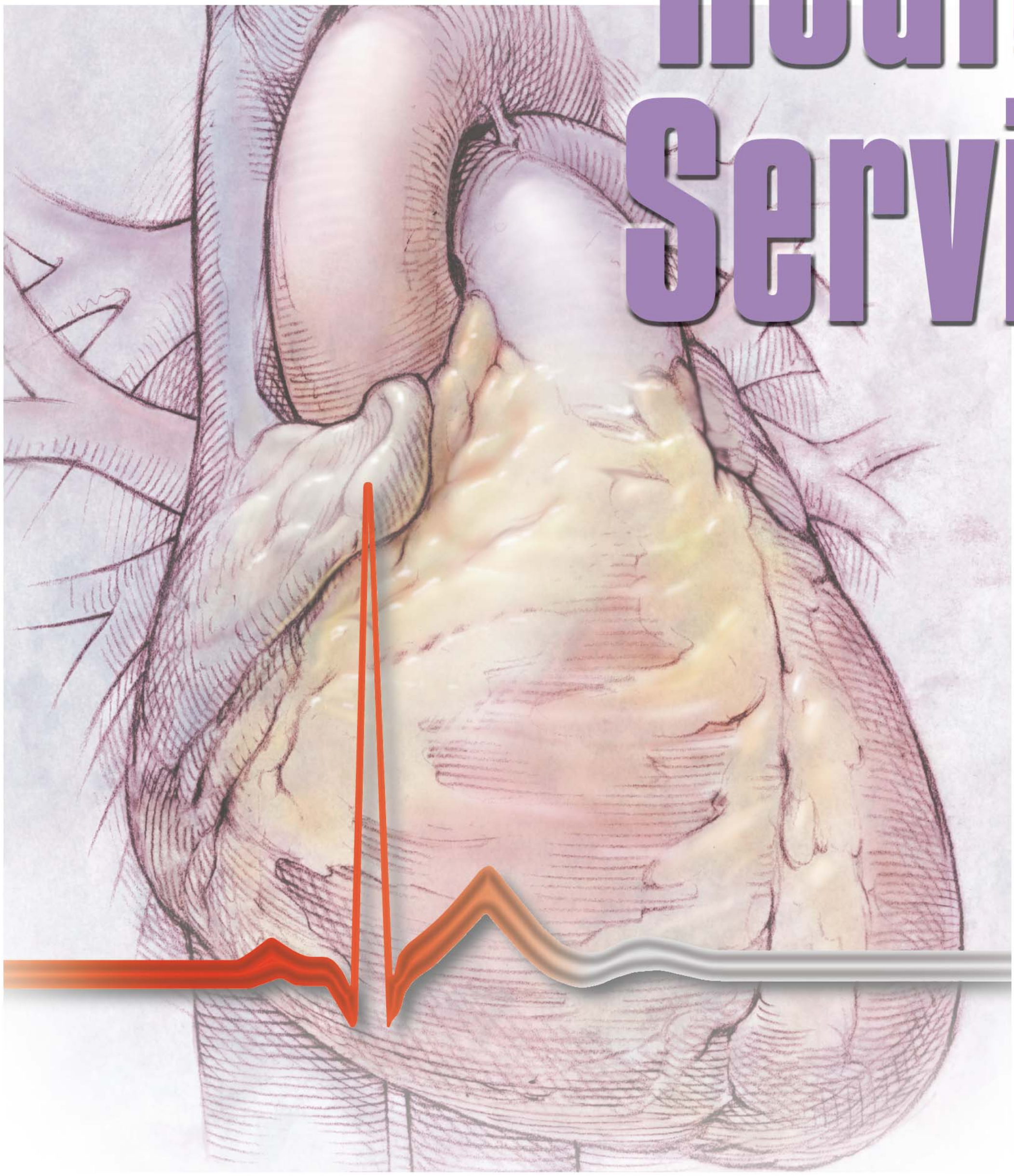

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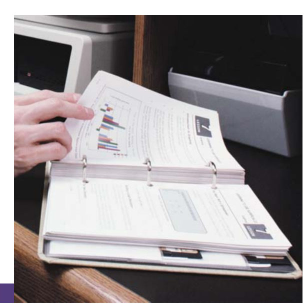

List of Exhibits and Appendices

ACKNOWLEDGEMENTS

The research, development and production of this Atlas is the result of the cooperative efforts of many individuals involved in all phases of this project.

A separate list of contributors provides information on the co-authors of the various chapters in this volume. However, the authors wish to take this opportunity to acknowledge a number of individuals who contributed in other important ways to the project. We apologize in advance for any unintentional oversights and omissions.

Thanks are due in the first instance to Karey Iron, Research Coordinator at ICES, who played a pivotal role in managing a large project with numerous contributors. As well, Cathy Cameron, Evaluation Coordinator with the ICES Research Transfer Unit, efficiently and effectively oversaw the crucial final phase of editing, proofing, and production. Without these individuals, the Atlas would have been completed sometime in the next millennium!

Kathy Knowles Chapeskie, Manager of the ICES Research Transfer Unit, worked with her entire team to translate the prose and figures generated by a diverse group of authors into a volume that would be accessible, consistent, and visually inviting. We are very grateful to Lawrence Stevenson, Communications Officer at ICES, for his yeoman contributions to the final phase of production. The graphic design team worked against an extremely tight deadline, and was led capably and creatively by Laura Benben. Members of the team included Rick Eskins, Karen Marcus and Louise Musial. Thanks also to Patty Bell, Communications Officer, for proofing exhibits, and to Donna Hoppenheim, Administrative Secretary, for supporting the dissemination of the Atlas.

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Patti Pinfold, Manager, Research Coordinators, lent a knowledgeable pair of eyes to the final proofing process.

The other Atlas co-authors would like to thank David Alter and Peter Austin for their work on the Glossary.

The Atlas also drew on the talents of our systems group: J-R Kidston, Manager Information Systems; Donna Polyak, Information Systems Analyst; and Jackson Wong, Systems Administrator.

Several members of the ICES Programming and Biostatistics group are co-authors, but all members of the team contributed directly or indirectly to this project. We would like to acknowledge Adina Bica, Siew Tan and Marc-Erick Thériault, all Programmer/Analysts and Keyi Wu, Biostatistician, for their help with aspects of the project.

The Administrative Support group at ICES bears an enormous burden in the production of any Atlas. We wish to acknowledge all group members for their professionalism and commitment. Our thanks particularly to: Francine Duquette who coordinated workflow, Wendy Cooke, Rebecca MacBride, Eileen Patchett, Mona Shaw and Linda Toews. These individuals consistently went the proverbial extra mile supporting all the authors and ensuring that a massive document was in the best possible shape before layout.

Inevitably with a project of this magnitude, the Atlas took precedence over many other activities, and placed indirect burdens on all those working at and with the Institute. We are grateful to all our colleagues at ICES for their patience and support.

Last, all those involved with the project wish to acknowledge and thank the Heart and Stroke Foundation of Ontario for their shared vision and their generous sponsorship of this project. We are grateful to all the volunteers and donors who make the Foundation such a success, along with several individuals who have been supportive, including: Diane Black, VP External Relations; Carolyn Brooks, Past-Chair; Monica Caverson, VP Research; Rick Gallop, President; Anthony Graham, Chair, External Relations; Corinne Hodgson, Scientific Advisor; Mary Lewis, Government Relations Manager; and Michael J. Sole, Chair, Research Policy Committee.

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FOREWORD

Cardiovascular Health and Services in Ontario was developed by the Institute for Clinical Evaluative Sciences (ICES) with the support and sponsorship of the Heart and Stroke Foundation of Ontario (HSFO).

The relevance of this new ICES Atlas is obvious. Heart disease remains the single largest cause of death for both men and women across Canada. It impairs the quality of life for countless individuals and generates massive direct and indirect costs for society. Moreover, the burden of heart disease is going to increase in the near future as the population continues to age. This monograph was developed to assist the general public, health care providers, planners, researchers and policy-makers in responding to the growing epidemic of cardiovascular disease in Ontario.

More specifically, *Cardiovascular Health and Services in Ontario* was designed to offer population-based information that will catalyze cardiac health promotion at the regional level, accelerate primary and secondary preventive activities by physicians and patients, provide regional and institutional stimuli for better patient care, encourage better data-gathering and galvanize research to deepen our understanding of how factors such as ethnicity, gender, and socioeconomic status relate to the incidence and management of heart disease.

The Heart and Stroke Foundation of Ontario has long been known for its commitment to basic research into cardiovascular and cerebrovascular diseases, contributing in excess of $20 million each year to support close to 300 university- and hospital-based investigative teams. In fact, the Foundation remains the country's largest provider of funds for non-commercial heart and stroke research.

For the Foundation, this Atlas is part of a broader thrust that began with a project in 1996 that mapped out the "hot spots" where Ontario residents were at high risk for cardiac death. The Foundation found that many regions of Ontario had death rates due to ischemic heart disease that were 20% to 60% higher than the provincial average. Along with supporting the Atlas, the Foundation has commissioned ongoing studies focused on regional disparities in cardiovascular health and disease.

This Atlas represents a crucial step in the Foundation's strategy for helping Ontario achieve better cardiovascular health. It systematically dissects the regional variations in mortality and morbidity from heart disease and relates those variations to differences in the prevalence of risk factors. Moreover, by examining the care of patients with heart disease from a regional and institutional perspective, *Cardiovascular Health and Services in Ontario* sheds new light on the role of variations in health services as a potential contributor to regional variations in cardiac mortality.

On behalf of patients with heart disease and their families, the Foundation wishes to thank the entire ICES team for this pioneering work. We believe that the information in *Cardiovascular Health and Services in Ontario* will help patients, providers, planners and policy-makers. It will also assist the Foundation in its role as a community health advocate.

The mandate of ICES is to do research that will help improve the quality, effectiveness, efficiency and accessibility of health services. The Institute's researchers use methods designed to fastidiously safeguard citizen privacy while linking information across and within a wide variety of data sources.

For ICES, this Atlas follows logically from two general "report cards" on health care in Ontario (1994 and 1996), as well as two specialized monographs—one on cancer surgery and another that analyzed the burden and management of arthritis and related conditions in Ontario. *Cardiovascular Health and Services in Ontario* reflects the Institute's increasing commitment and capacity to examine health status and disease management from a multi-sectoral perspective, focusing on both short- and longer-term outcomes.

All those at ICES who have worked on the project are grateful to the Heart and Stroke Foundation for its generous support and join the Foundation's leadership in thanking the thousands of volunteers and donors who make the Foundation's work possible.

Both the Heart and Stroke Foundation and ICES are committed to the widest possible dissemination of these findings. We believe that *Cardiovascular Health and Services in Ontario* poses important challenges to the entire health sector. We look forward to constructive debate, further research, and above all, positive changes that will help reduce the staggering burden on our society caused by heart disease and related conditions.

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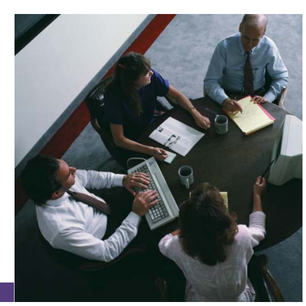

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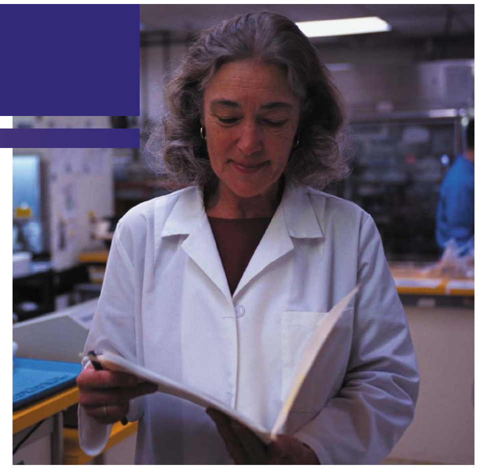

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A General Introduction for Readers

INTRODUCTION

Key messages

- *Overview of the general format and specific elements of the Atlas.*
- *A table showing the relationship between new Ministry of Health Planning Regions, District Health Councils and counties in Ontario.*
- *A map showing District Health Council boundaries.*
- *List of useful websites for cardiovascular information.*
- *A glossary of clinical, statistical and epidemiological terms.*

A General Introduction for Readers

Cardiovascular Health and Services in Ontario is meant to inform a diverse group of readers. Like other Atlases produced by the Institute for Clinical Evaluative Sciences (ICES), the book takes its name from the fact that it maps or charts health status and health care on a population-wide basis, drawing comparisons across age groups, genders, regions and to some extent, individual hospitals.

Historically, ICES Atlases have provided information on health care to clinicians, policy-makers, hospital administrators, researchers, health planners and other health system stakeholders. With this Atlas, we have tried to make the presentation accessible to a wider audience, including the informed lay person. Thus, the introductory material includes items such as:

- a map showing District Health Council (DHC) boundaries (see Intro I.1)
- a table depicting the new Ministry of Health Planning Regions and how the existing DHCs and counties will fold into them (see Intro I.2)
- a list of resources, particularly websites (www.hsf.on.ca is a useful starting point) that offer general information about heart disease and related conditions
- a glossary of terms—clinical, statistical and epidemiological

Although the Atlas does include some hospital-specific performance profiles that have not previously been published in Canada, we caution general readers against using this volume as a "consumer guide" to choose hospitals. Many cardiac conditions require urgent treatment, and "shopping around" is impractical. Our hope, therefore, is that the findings here will be a positive catalyst to ensure that the quality of cardiac care is as consistently high as possible across Ontario. To that end, informed citizens can usefully press members of the provincial parliament, district health executives, hospital CEOs and a range of health professionals for responses to the findings and recommendations presented in *Cardiovascular Health and Services in Ontario*.

The structure of this Atlas is somewhat different and reflects our concern to enhance "reader-friendliness". Traditionally, scientific publications are presented in the so-called IMRD format (Introduction, Methods, Results, and Discussion, with or without a separate conclusion). We have deliberately dropped that format for this book. Each chapter includes an introductory section, a brief summary noting the data sources for the chapter, and a description of how the analyses were performed. Detailed methods have been moved to a Methods Appendix in a separate accompanying volume. General readers with particular interest or expertise may wish to browse these sections, or the Technical Appendix, which is also located in the second volume.

We recommend, however, that all readers pay particular attention to the section in each chapter called "Interpretive Cautions." This section highlights the limitations of the data used, and the limits to the inferences that can be drawn from the results that follow. Many of the data used in the Atlas were originally collected and maintained by other agencies for administrative purposes (financial or record-keeping). This is a potential source of problems, such as non-standardized definitions for some data elements and missing detail about relevant clinical characteristics of patients and services.

We also thought that general readers would prefer to have results explained with appropriate qualifiers and contextual elements. To that end, the results and discussion are combined. A short section with conclusions closes out each chapter.

Researchers are inordinately fond of references or footnotes. However, we have urged our colleagues to sharply limit the number of references for each chapter, and gathered them by chapter at the back of this volume. Technical references are listed with the detailed methods that they support, and the various data sources are described in a single Technical Appendix. We have also tried to ensure that the index is detailed and adequately cross-referenced to help readers find subjects of interest.

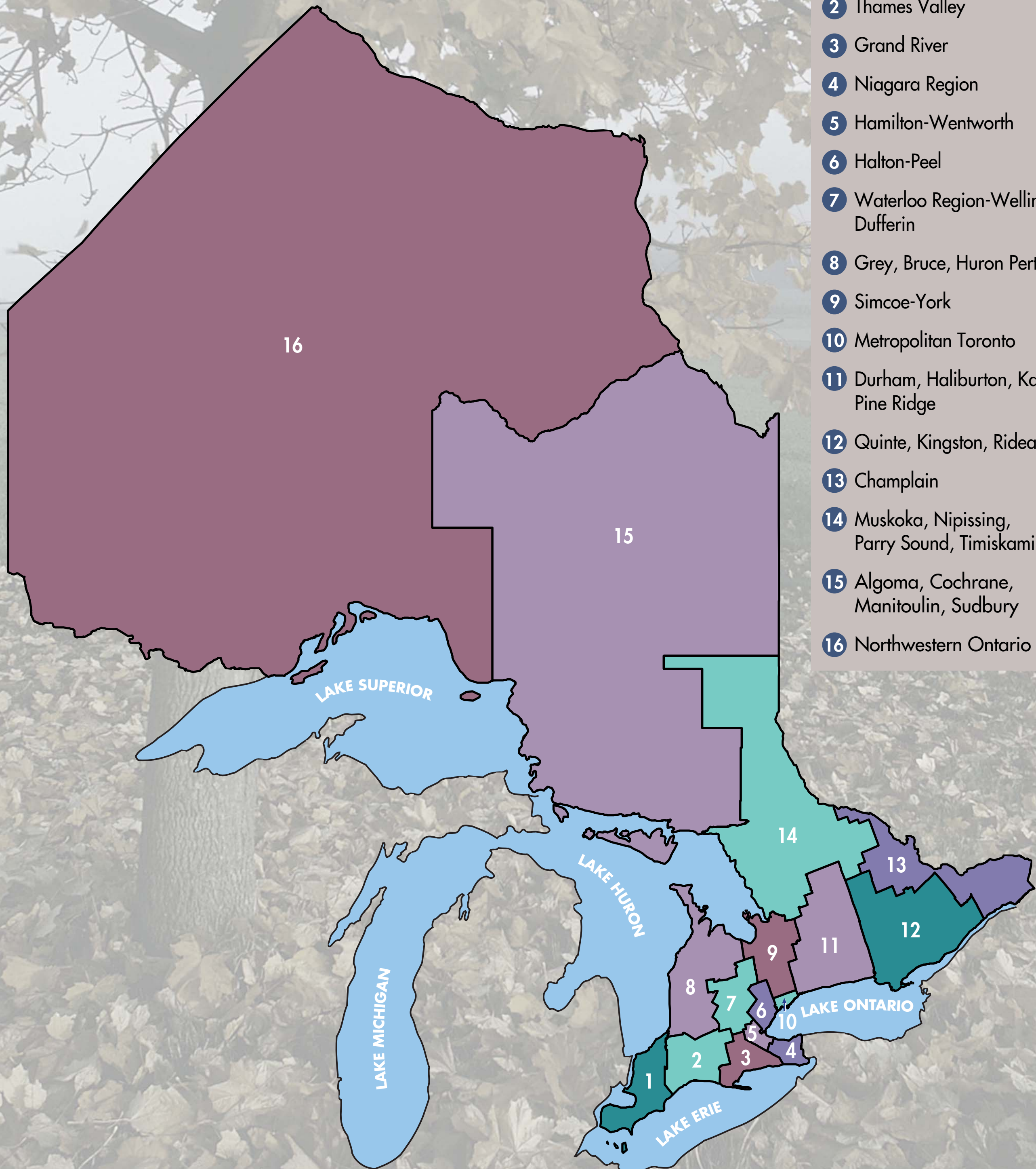
As to the actual contents, the primary focus of the Atlas is ischemic heart disease, also known as coronary heart disease. However, some chapters do have a slightly wider scope and cover other cardiovascular conditions. We have not dealt with cerebrovascular disease, or stroke and related conditions, as these merit a separate volume.

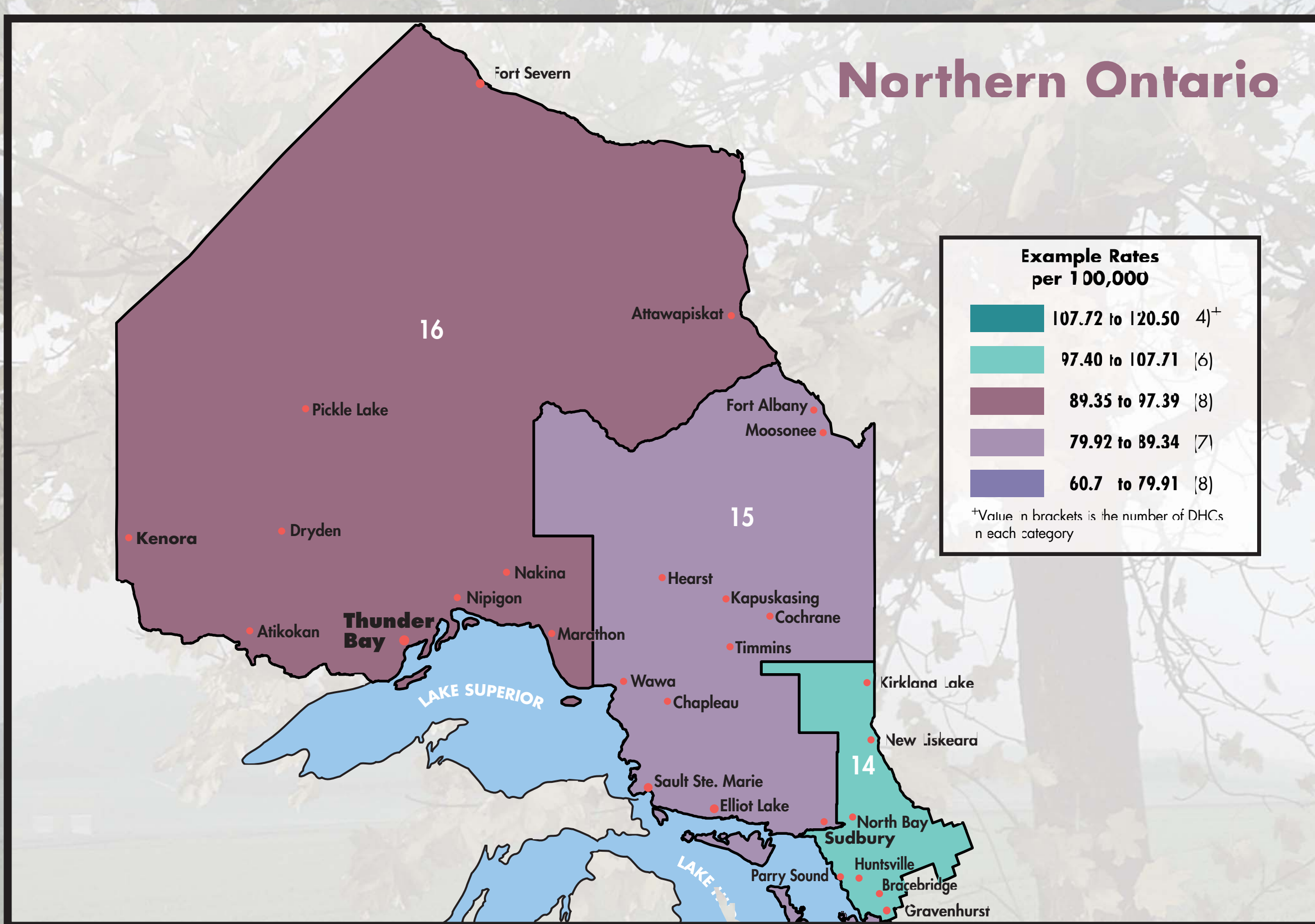
Information is often broken out by region, generally at the level of the current District Health Councils (DHCs) and new Ministry of Health Planning Regions, or by hospital. We have also separated out information for larger municipalities (with populations over 100,000) within each District Health Council to distinguish larger urban from smaller urban and rural areas. For areas within DHCs, Census 1996 population data were used for rate denominators. This accounts for any apparent inconsistencies in rates as compared with previous DHC-specific tables. For hospital-level data, it is pertinent to note that data have been drawn from years ranging from 1990 to 1998, with particular concentration on the mid-1990s. Hospital mergers and name changes were a recurrent source of potential confusion in dealing with data from 1996 to 1998. However, we have taken some pains to check dates of role and name changes with hospitals themselves. A listing of the hospital names pre- and post-merger is located in the Technical Appendix.

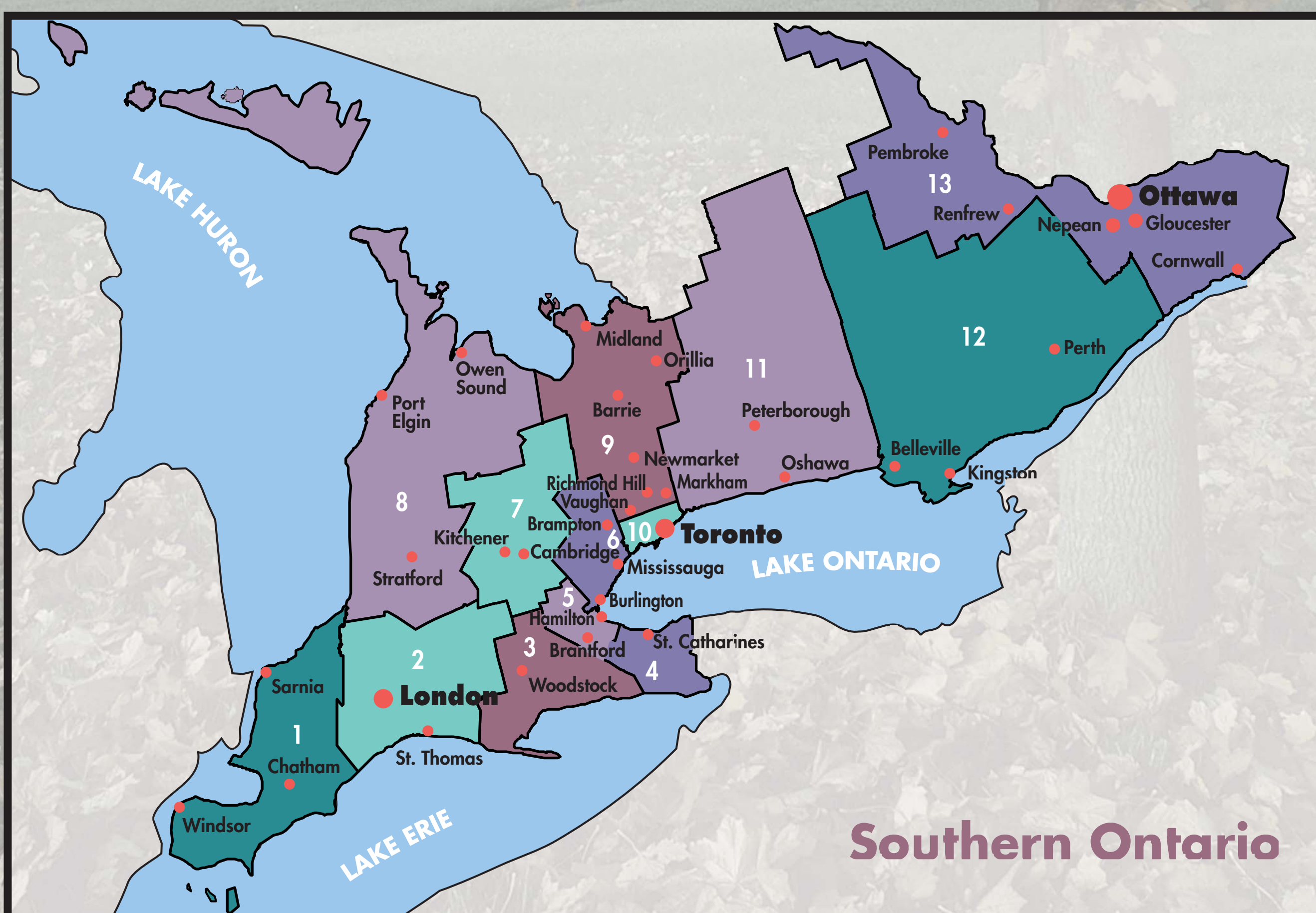
In closing, we welcome all readers to *Cardiovascular Health and Services in Ontario*, and invite your feedback (info@ices.on.ca) as to how future ICES Atlases can be made more accessible and informative.

ONTARIO District Health Councils

1. Essex, Kent, Lambton
2. Thames Valley
3. Grand River
4. Niagara Region
5. Hamilton-Wentworth
6. Halton-Peel
7. Waterloo Region-Wellington-Dufferin
8. Grey, Bruce, Huron Perth
9. Simcoe-York
10. Metropolitan Toronto
11. Durham, Haliburton, Kawartha, Pine Ridge
12. Quinte, Kingston, Rideau
13. Champlain
14. Muskoka, Nipissing, Parry Sound, Timiskaming
15. Algoma, Cochrane, Manitoulin, Sudbury
16. Northwestern Ontario




Northern Ontario
Example Rates
per 100,000
107.72 to 120.50 (4)+
97.40 to 107.71 (6)
89.35 to 97.39 (8)
79.92 to 89.34 (7)
60.7 to 79.91 (8)
+Value in brackets is the number of DHCs in each category
16
15
14
Fort Severn
Attawapiskat
Pickle Lake
Kenora
Dryden
Nakina
Nipigon
Atikokan
Thunder Bay
Marathon
Fort Albany
Moosonee
Hearst
Kapuskasing
Cochrane
Timmins
Wawa
Chapleau
Kirkland Lake
New Liskeard
Sault Ste. Marie
Elliot Lake
North Bay
Sudbury
Huntsville
Parry Sound
Bracebridge
Gravenhurst
LAKE SUPERIOR


Southern Ontario
LAKE HURON
LAKE ONTARIO
LAKE ERIE
Pembroke
13
Renfrew
Ottawa
Nepean
Gloucester
Cornwall
12
Perth
Midland
Orillia
11
Owen Sound
Port Elgin
Barrie
Peterborough
9
Belleville
Kingston
Newmarket
Oshawa
Richmond Hill
Markham
Vaughan
8
7
Brampton
10
Toronto
Kitchener
Cambridge
6
Mississauga
Stratford
5
Burlington
Hamilton
3
Brantford
St. Catharines
2
4
Woodstock
Sarnia
London
1
Chatham
St. Thomas
Windsor

INTRO I.2 Ministry of Health Planning Regions and Corresponding District Health Councils and Counties

New Ministry of Health Planning Region	District Health Council	County
Toronto	Toronto	Toronto
Central East	Durham, Haliburton, Kawartha and Pine Ridge	Durham Regional Municipality
		Haliburton County
		Northumberland County
		Victoria
		Peterborough County
	Simcoe - York	York Regional Municipality
		Simcoe County
Central West	Waterloo Region - Wellington - Dufferin	Dufferin County
		Wellington County
		Waterloo Regional Municipality
	Halton - Peel	Halton Regional Municipality
		Peel Regional Municipality
Central South	Grand River	Brant
		Haldimand - Norfolk Regional Municipality
	Hamilton - Wentworth	Hamilton - Wentworth Regional Municipality
	Niagara Region	Niagra Regional Municipality
Eastern	Champlain	Ottawa - Carleton Regional Municipality
		Prescott - Russel United Counties
		Stormont, Dundas and Glengarry United Counties
		Renfrew County
	Quinte, Kingston, Rideau Valley	Frontenac County
		Lennox and Addington
		Hastings County
		Prince Edward County
		Leeds and Grenville United Counties
		Lanark County
North	Algoma, Cochrane, Manitoulin and Sudbury	Algoma District
		Cochrane District
		Sudbury Regional Municipality
		Sudbury District
		Manitoulin District
	Muskoka, Nipissing, Parry Sound and Timiskaming	Muskoka District Municipality
		Parry Sound District
		Nipissing District
		Timiskaming District
	Northwestern Ontario	Thunder Bay District
		Rainy River District
		Kenora District
South West	Grey, Bruce, Huron, Perth	Grey County
		Bruce County
		Huron County
		Perth County
	Thames Valley	Elgin County
		Middlesex County
		Oxford County
	Essex, Kent and Lambton	Essex County
		Kent County
		Lambton County

Websites for Cardiovascular Information

These suggestions cover only a few of the useful websites. Many sites are linked to other websites with good quality information on cardiovascular disease.

http://www.hsf.on.ca
Heart and Stroke Foundation of Ontario (HSFO)
The Heart and Stroke Foundation of Ontario is a community-based volunteer organization whose mission is to reduce the risk of premature death and disability from heart disease and stroke by raising funds for research and health promotion. This is a comprehensive website with useful information for patients, practitioners and researchers, including topic areas such as facts and statistics on: Women, Heart Disease and Stroke, Heart Disease and Stroke Prevalence; prevention and recovery programs; health promotion strategies (Children's Heart Health Quiz, The HeartSmart™ Family Fun Pack); and the Heart and Stroke Healthline to order a free catalogue listing over 450 information pieces available on heart disease, stroke and lifestyle.

http://www.hsfpe.org
Heart and Stroke Foundation Professional Education
The HSFO Continuing Medical Education website provides an innovative and interactive mode of communication for Ontario physicians to learn about the most up-to-date information regarding heart disease and stroke. The site was developed in response to physicians' increasing need to integrate continuing medical education into their daily environment. Whether at home or in the office, it's possible for the user to access such information and communicate with peers whenever it's most convenient. This website is updated regularly

http://www.ices.on.ca
The Institute for Clinical Evaluative Sciences (ICES)
ICES was established in 1992 and is a non-profit research agency funded in part by the Ontario Ministry of Health. Its mandate is to conduct research that contributes to the effectiveness, quality and efficiency of health care in the province of Ontario. The ICES website contains up-to-date, discipline-specific information. The Institute's quarterly practice newsletter for family physicians (informed) is also available, and often features cardiovascular topics. This website features an extensive links list which includes the Cardiac Care Network of Ontario, National Library of Medicine, AHCPR Clinical Practice and Consumer Guidelines, Guide to Clinical Preventive Services and CMA Online among many others.

http://www.ccn.on.ca
Cardiac Care Network of Ontario (CCN)
The Cardiac Care Network of Ontario (CCN) is an advisory body dedicated to ensuring equitable, timely and appropriate access to cardiac services in the province of Ontario. Referring physicians to Ontario cardiac centres will find information of specific use for them. The site includes general information about Ontario's twelve hospitals for angiography, as well as waiting times at Ontario's eight hospitals for cardiac surgery, which are updated on a monthly basis. Patients can obtain general information on how the cardiac care system works by reading CCN's patient brochure, available in both English and French. A thorough overview of CCN and its history is posted on the website for health-care planners, managers, practitioners and the public to familiarize themselves with the revascularization care system of Ontario.

http://www.gov.on.ca/health/index.html
Ontario Ministry of Health
This website is extensive and provides access to multiple layers of health-related sources of information. It is indexed into topic areas such as: Children & Youth, Dental, Disabilities, Diseases & Conditions, Drug Information, Health Promotion, Laboratories, Medical Reference, Medical Research, Mental Health and Nutrition.

http://www.hc-sc.gc.ca
Health Canada
A comprehensive website providing access to multiple health topics, including the following: news, health care, public health, health factors, regulated products, health research, regulations and policy, A-Z index for searching, links, consumer information and products, disease information, drugs, healthy living, heart health, home care, nutrition (including Canada's Food Guide), and pharmacare.

http://www.cihi.ca
Canadian Institute for Health Information (CIHI)
CIHI brings programs, functions and activities from The Hospital Medical Records Institute (HMRI), The MIS Group, Health Canada (Health Information Division) and Statistics Canada (Health Statistics Division) together under one roof. Its primary functions are: collecting, processing and maintaining a comprehensive and growing number of health databases and registries, covering health human resources, health services and health expenditures; setting national standards for financial, statistical and clinical data as well as standards for health informatics technology; and producing value-added analyses from its information holdings.

http://www.ccs.ca
Canadian Cardiovascular Society (CCS)
This website has links to cardiovascular journals and general information about the Society, and includes information from scientific publications and consensus panels on multiple topics.

http://www.cma.ca/cpgs
Canadian Medical Association (CMA)
This comprehensive website provides access to CMA Online and CMA practice guidelines.

http://library.auhs.edu/resource/reviews
University of Allegheny
This website provides health reviews for primary care providers. It posts a listing of documents about primary care medicine and medical practice which are available through the Internet. Some links are to research articles' abstracts, some of the documents themselves, others article reviews, plus links to disease prevention, health promotion, screening and patient education materials. Of particular interest in the area of cardiovascular disease: hypertension, atherosclerosis and coronary disease, myocardial disease, congestive heart failure, valvular heart disease, arrhythmias, vascular disease and cardiac surgery.

http://www.ahcpr.gov
Agency for Health Care Policy & Research (AHCPR)
This website provides Clinical Practice Guidelines, Quick Reference Guides for Clinicians and Consumers (English and Spanish) in the following topic areas: unstable angina, heart failure, cardiac rehabilitation, and smoking cessation.

http://www.acc.org
American College of Cardiology (ACC)
This website has a great deal of information for both practitioner and patient on multiple cardiovascular topics. A password is required for access, but it is easy to sign on.

http://www.amhrt.org
American Heart Association (AHA)
The AHA website has good patient information, including topics such as: Managing Your Lifestyle for Better Health, Risk Factors for Heart Disease and Stroke That Can Be Changed, Heart and Stroke Patient Information, Cookbooks and Publications, Diet and Nutrition and Talking with Your Doctor. The website also includes an interactive risk assessment; an easy-to-use reference guide; nutrition information; exercise programs; diseases, conditions, and treatments; and, prevention, treatment, and recovery. Health professionals will also find their publications, research, statistics, listings of CME and scientific meetings useful.

http://www.med.yale.edu/library/heartbk
Yale University School of Medicine Heart Book
This website features a medical textbook written by Yale professors, divided into eight sections totalling 29 chapters.

http://clinical-cardiology.org/
Clinical Cardiology
A peer reviewed journal, Clinical Cardiology provides a forum for the coordination of clinical research in cardiology and cardiovascular surgery. The journal includes editorials, articles in brief, reviews, clinical investigations, short communications, letters to the editor, calendars of continuing medical education, and book reviews. Editorial sections include Electrophysiology, Pacing and Arrhythmias, Clinical Pathological Correlations, Profiles in Cardiology, Computers in Cardiology, Editor's Note and Images in Cardiology. The site has some full text articles.

http://www.pulsus.com/CARDIOL/home.htm
Canadian Journal of Cardiology
The Canadian Journal of Cardiology is on this publisher's website. Table of Contents listings (1995-present) and abstracts only.

http://www.cardiologycompass.com
Cardiology Compass
A navigation site for cardiac information with links to good standard websites, including Canadian sites.

http://www.gen.emory.edu/medweb
Emory University's Medweb
This website was developed by Emory University, and also has an extensive links list.

http://www.hsforum.com/heartsurgery/internetlinks.hsf
Heart Surgery Forum
This is a multimedia-dedicated site for those with technical interest in cardiac surgery.

http://www.who.int
World Health Organization
This website provides the global perspective on heart disease epidemiology, ongoing health inititatives and policies.

http://www.pharminfo.com/disease/cardio_db.html#patient
Pharmaceutical Information Network Cardiovascular Information Center
This site has cardiovascular information arranged with an A-Z glossary. There is information from reputable sources, such as the National Heart, Lung, and Blood Institute (NHLBI), AHCPR and others. Users can access information on cardiovascular medications with links to entries in DrugDB, PharmInfoNet's database of information about specific drugs. There is an archive of articles, research news from medical meetings, and highlights from medical meetings of various professional societies, such as the American Society of Hypertension. The site also includes information on diverse topics such as the American National Cholesterol Education Program, and the DASH Diet, an eating plan from the "Dietary Approaches to Stop Hypertension" clinical study.

http://cythera.ic.gc.ca/spansweb/web/cvd
Cardiovascular Disease Surveillance On-line-Health Canada
This website provides up-to-date cardiovascular disease statistcs in Canada.

Glossary

abdominal aorta
the main artery leading from the heart through the abdomen.

abdominal aortic aneurysm
a sac that forms in the wall of the abdominal aorta due to disease, injury or a birth defect; if not surgically repaired the vessel may break, causing death.

access
in the context of this publication, the ability to receive health care services without barriers.

acute care hospital
an institution that provides in-hospital medical or surgical treatment.

acute myocardial infarction
a heart attack, occurring when a blood clot completely blocks one of the coronary arteries that provide oxygen-rich blood to the heart.

adjusted rate
a rate that is independent of, or controls for the distribution of a particular set of characteristics within a study population that are thought to affect the outcome of interest; allows for comparisons across areas or institutions with different population characteristics.

administrative data
information that is primarily collected for record keeping, finances or purposes other than research.

aggregated data
a dataset wherein individual records are combined, usually by age and/or sex.

ambulatory care
medical care, provided in a clinic or office, where the patient is not admitted to hospital.

ambulatory electrocardiography (ECG) monitoring (or Holter monitoring)
records electrocardiographic rhythms on magnetic tape over an extended period to detect transient arrhythmias or ST segment changes.

anastomosis
a surgical procedure that creates a connection between two formerly separate structures, such as a connection of a vein to a constricted artery.

angina pectoris (or angina)
tightness, pressure or pain in the chest due to a lack of oxygenated blood to the heart muscle, generally occurring when there is a significant but incomplete blockage of an coronary artery.

angiography (see coronary angiography)

angioplasty (or percutaneous transluminal coronary angioplasty, PTCA)
an invasive technique performed under X-ray guidance that helps to improve blood circulation for patients with hardening of the arteries and chest pain; a catheter is inserted through the blood vessels to the affected areas and a balloon at the end of the catheter is inflated/deflated several times to flatten the plaque build-up so blood can flow more freely.

angiotensin converting enzyme (ACE) inhibitors
a class of drugs used to treat high blood pressure and congestive heart failure by interfering with the body's production of angiotensin, a chemical that adds stress to the heart by causing the small arteries to constrict.

aorto-iliac-femoral bypass
a surgical procedure that uses a graft to connect the aorta to the femoral artery in order to bypass narrowed blood vessels, such as the iliac artery.

apnea
absence of respiration.

area-based ethnicity analysis
a method to examine the ethnoracial composition of the area of residence in which a person lives based on Census information; does not assume that the ethnic make-up of the area reflects the individual person directly.

area variations (see also small area rate variations)
a comparison of processes or outcomes by site of patient residence.

asystole
a condition when normal electrical activity of the heart stops.

atherogenesis
the process of plaque formation that causes "hardening" of the arteries.

atheromatous plaque (atherosclerosis)
yellowish plaque containing cholesterol and other fat substances that build up inside the arteries, causing the arteries to narrow and possibly reducing blood flow if severe.

atherosclerosis
the condition of "hardening" of the arteries, which is accelerated by risk factors such as smoking, high blood pressure, high blood cholesterol levels and diabetes.

average length of stay (ALOS)
the average number of days that patients spent in the hospital (see also bed days and length of stay).

bed days
the number of days that patients spent in the hospital.

beta-blockers (or beta-adrenergic receptor blocking agents)
a class of drugs that are used for the treatment of hypertension, heart attacks and angina; reduce stress on the heart by slowing down the heart rate, thus reducing the oxygen requirements.

bias
in the context of this publication, the error related to the ways that populations differ that could prejudice thinking about a research problem or outcomes in a study.

Body Mass Index (BMI)
a method of assessing body weight while taking height into account calculated by dividing weight by height squared (wt[kg]/ht [meters]^2); a BMI score between 20 and 27 is considered acceptable.

burden of illness
the short- and long-term physical, emotional, social, financial, familial and societal effects associated with a particular illness or condition; provides an estimation of the overall scope and impact of a particular disease.

bypass surgery (see coronary artery bypass surgery, CABG)

calcium channel blockers
a group of drugs that can be used to treat hypertension and angina.

Canadian Cardiovascular Society (CCS) Anginal Scale
a scale used to determine the extent of angina or chest pain; originally published in Campeau L. Circulation 1976;54(13):52-3 (letter).

Grade I: "Ordinary activity does not cause angina," such as walking or climbing stairs. Angina with strenuous or rapid or prolonged exertion at work or recreation.

Grade II: "Slight limitation of ordinary activity." Walking or climbing stairs rapidly, walking uphill, walking or stair climbing after meals, or in cold, wind or under emotional stress, or early during the few hours after awakening.

Grade III: "Marked limitation of ordinary physical activity." Walking one or two blocks on the level and climbing more than one flight of ordinary stairs in normal conditions and at a normal pace.

Grade IV: "Inability to carry on any physical activity without discomfort—angina syndrome may be present at rest."

Source: Can J Cardiol 1996;12(2):1281.

Modified (CCS) Classification of Angina

CCS Classes I-II: "Stable angina on reasonable medical therapy: mild to moderate."

CCS Class III: "Stable angina on reasonable medical therapy: severe."

Panel* Class IV-A: "Unstable angina, pain resolving with intensified medical therapy, now stable on oral medication."

Panel* Class IV-B: "Unstable angina on oral therapy, symptoms improved by anginal with minimal provocation."

Panel* Class IV-C: "Symptoms persisting, not manageable on oral therapy, may be hemodynamically unstable, requires coronary care monitoring and parenteral medication."

*Panel = expert panel of cardiologists and cardiac surgeons. Scale from Naylor CD et al. Assessment of priority for coronary revascularization procedures.
Source: Lancet 1990;335:1070-73.

Canadian Classification of Procedures (CCP):
a coding system used in many administrative databases for classifying surgical and medical procedures; developed by Statistics Canada in 1987.

Canadian Institute for Health Information (CIHI)
a federally chartered but independent, non-profit organization that collects and processes health data from a number of sources, particularly from hospitals (see Technical Appendix for more detail).

cardiac arrest
a disruption of the normal rhythmic pumping capabilities of the heart which compromises normal circulation and results in loss of consciousness and certain death if not treated.

cardiac arrhythmia
any change from the normal beating rhythm of the heart due to aberrations in the generation or movement of electrical activity.

Cardiac Care Network (CCN)
established in 1991 as a partnership among government, doctors and hospitals who provide acute cardiac care, for planning, coordinating and monitoring the provision of cardiac care services (see Technical Appendix for more detail).

cardiac catheterization (see coronary angiography)

cardiopulmonary bypass
the "heart-lung" machine used in open heart surgery that mechanically performs the function of the heart and provides oxygen to blood.

cardiopulmonary resuscitation (CPR)
external cardiac compression of the sternum that artificially pumps the heart, coupled with mouth-to-mouth resuscitation.

case mix groups
a system devised by Canadian Institute for Health Information that categorizes hospital patients into groups, based on similarities of diagnosis, procedure, length of hospital stay and resource requirements.

chain of survival
incorporates early recognition, early cardiopulmonary resuscitation (CPR), early defibrillation and early advanced life support (ALS) in delivery of care for sudden cardiac arrest; usually performed by ambulance attendants, firefighters, emergency personnel. See Circulation 1991;83:1832-1847.

Charlson Comorbidity Index
a measure that provides a way to combine the relative effects of a combination of diseases or risk factors on outcomes for a given individual.

chest pain
a descriptive symptom that may represent either angina, other cardiac diseases or non-cardiac diseases such as gastrointestinal conditions, musculoskeletal or respiratory illnesses.

chi-square test
a statistical test used to test the hypothesis that a set of proportions are equal or that characteristics are independent or not associated.

cholesterol
a fat-like substance found in humans and animals; present in various foods such as milk products, oils and red meat.

clinical trial (see randomized controlled trial)

coefficient of variation
a statistical calculation used to obtain a measure of relative variation of a distribution that divides the standard deviation by the mean multiplied by 100.

cohort
a group of subjects who remain together in the same study over a period of time.

comorbid conditions
a set of medical conditions present in an individual, other than the condition of primary interest.

Community Care Access Centre (CCAC)
CCACs provide single point access to more than 1,200 community agencies in Ontario that provide home care to eligible individuals; accountable to the Ministry of Health and governed by independent non-profit boards.

confidence interval
an indication of the precision of an estimate of a population value; wider intervals indicate lesser precision while narrower intervals indicate greater precision.

congestive heart failure (CHF)
a condition where the heart pumps inefficiently due to conditions that affects the heart or lungs; may cause fluid back-up in the lungs and/or legs adversely affecting the heart muscle.

coronary angiography
the X-ray visualization of the internal anatomy of the heart and blood vessels after a dye is injected into the coronary arteries.

coronary artery bypass graft surgery (CABG or CABS)
an open-heart surgical procedure that helps to improve blood circulation for patients with hardening of arteries or blockages. A heart to lung bypass pump is used to re-route the blood from the heart while surgery is taking place. Grafts are taken from arteries or veins elsewhere in the body and attached above and below the blocked area of the coronary artery so that the blood can be re-routed to the heart. It is usually reserved for patients with left mainstem disease, or with 2 or more vessels blocked and/or if angioplasty or medication are not treatment options.

coronary artery disease (CAD—see also coronary heart disease or ischemic heart disease)
any form of pathology in the coronary arteries; condition may not necessarily be symptomatic.

coronary heart disease (CHD—see also coronary artery disease or ischemic heart disease)
a general term often used to describe heart disease that is likely to produce angina or heart attack, but with more of an inference that the heart muscle or electrical system is in some way affected.

coronary revascularization
a procedure that aims to restore the blood flow through the coronary arteries to the heart by dilating or bypassing the affected area.

correlation coefficient
a statistic ranging from -1 to 1 that measures the strength of the linear relationship between two variables made on the same set of individuals; a value of 1 indicates perfect positive association, a value of -1 indicates perfect negative association and a value of 0 indicates no linear association.

cross-sectional study
a study that observes a set of characteristics in a set of subjects at one point in time, such as a survey.

crude mortality rate (see mortality rate)

defibrillation
a method for attempting to electrically shock the heart back into a normal rhythm.

derived variable
a variable which is a composite of other variables.

diabetes mellitus
a disease whereby the body does not produce or use insulin properly; insulin is necessary to convert sugar and starch into energy.

direct costs
for the purpose of this publication, the value of tangible resources used to manage and prevent disease, including hospital costs, physician expenditures, drugs, research, prevention programs, home care and ambulance services.

direct standardization (see also adjusted rate)
a statistical method whereby the specific rates in a study population are averaged, using as weights the distribution of a specified standard population; the rate represents what the crude rate would have been in the study population if the population had the same distribution as the standard population (with respect to the variables for which the standardization was carried out).

disaggregated data
a dataset where each individual record is presented; in all cases where ICES uses disaggregated data, a scrambled identifier is used to keep track of different individuals.

District Health Council (DHC)
16 councils in Ontario that plan and coordinate health services in the most appropriate way for the populations they serve, based on studies that identify service gaps and community needs; Goals are: to identify the health care needs in their communities and recommend ways of meeting them; to establish short-term and long-term health care priorities; to coordinate all the health planning activities within their communities into an effective and efficient system; to work towards cooperation in the social development activities of their communities; and, to provide advice to the Health Minister regarding the allocation of human and financial resources for health care and social services.

dyslipidemia
irregularity in a person's lipid profile which generally includes total blood cholesterol, low-density lipoproteins (LDL), high-density lipoproteins (HDL) and triglycerides; low HDL is considered a dyslipidemia because the reverse is desirable; elevated HDL protects against atherogenesis.

echocardiogram (also known as echo, echocardiography, 2-D echocardiography or Doppler echo)
diagnostic ultrasound test to examine the function of the heart muscle and valves, commonly used to assess the extent of damage to the heart; the 2-D echo is often accompanied by Doppler examinations which allow the clinician to measure blood flow through the heart and valves.

echocardiography (see echocardiogram)

ecological study
an epidemiological study whereby the group, rather than individual is the unit of analysis; data can be analyzed when the joint distributions of many of the study factors are unknown at the individual level.

electrocardiogram (ECG; also called EKG)
a procedure where leads are attached to the patients limbs and chest wall to record the electrical rhythm of the heart.

emergency medical services
ambulance services equipped for emergency medical care in the community; staffed by paramedics or ambulance attendants.

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

ethnoracial status
belonging to a group of people with a similar culture or language, or having a common origin with some shared physical traits.

exercise stress test
a diagnostic test that records an electrocardiogram while the patient is exercising to see if the stress on the heart will precipitate visible ischemia.

femoral artery
the artery located near the skin surface of both groins that carries oxygenated blood from the heart to the lower extremities; is used to access the heart for certain procedures such as angiography and angioplasty.

fiscal year
a financial construct, usually from April 1 to March 31 of the following year for Ontario's public agencies.

furosemide
a diuretic commonly used as a drug treatment for heart failure patients to reduce fluid accumulation.

glycoprotein IIb/IIIa inhibitors
a class of highly potent anti-platelet drugs used in coronary angioplasty patients.

gross domestic product (GDP)
a measure of the total production and consumption of services in Canada.

health promotion
defined by the World Health Organization as "a process of enabling people to increase control over, and improve their health."

heart failure (see congestive heart failure)

home care
the provision of professional health and/or homemaking services within the home, such as nursing care, physiotherapy, social work, cleaning, shopping and cooking.

homocysteinuria (hyperhomocysteinuria)
elevated level of the amino acid homocysteine due to a variety of genetic and/or nutritional factors. Recent epidemiologic evidence suggests that mild hyperhomocysteinura is associated with increased risk of coronary artery disease and stroke.

hyperlipidemia
a general term for elevated concentrations of lipids or fat substances in the plasma of the body.

hypertension
elevated blood pressure; elevated systolic and/or diastolic readings.

incidence
a rate that describes the proportion of new cases of a given condition over a specific time period.

indirect costs
for purposes of this publication, the human capital method that represents the income foregone due to death or disability.

indirect standardization
a statistical method used to compare study populations for which the specific rates are either statistically unstable or unknown; specific rates in the standard population are averaged, using as weights the distribution of the study population and the ratio of the crude rate for the study population to the weighted average so obtained is the standardized mortality (or morbidity) ratio (SMR); the indirect standardized rate itself is the product of the SMR and the crude rate for the standard population.

International Classification of Diseases, 9th revision (ICD-9)
a set of internationally accepted codes for classification of medical diagnoses, conditions and procedures; medical records staff use these codes when transcribing from physician written medical charts to the hospital database that is submitted to the Canadian Institute for Health Information.

invasive cardiac facility
a hospital that provides invasive cardiac services such as angiography, angioplasty and bypass surgery.

ischemic heart disease (IHD) (see coronary artery disease or coronary heart disease)
a term applied specifically to symptomatic narrowing of the coronary arteries by atherosclerotic changes; characterized by a decreased blood supply to the heart causing anginal pain.

length of stay (LOS) (see also average length of stay or bed days)
the number of days spent in the hospital.

logistic regression
a statistical modelling technique to predict the effect of a set of factors on an event that is binary in nature, such as the presence of risk factors associated with AMI mortality.

major clinical category (MCC)
categorical system developed by the Canadian Institute for Health Information based on the International Classification of Diseases diagnostic categories and the diagnosis most responsible for the greatest portion of the patient's in-hospital length of stay; it is divided into medical and surgical partitions.

major municipality
for the purpose of this publication, a city with population greater than 100,000 people within a specified District Health Council.

mean
the sum of the values in a sample divided by the number of values; also known as the average.

median
the middle observation or the one that divides a distribution into two equal halves; also the 50th percentile.

morbidity
an overall term to describe non-fatal illness at any level; often refers to the extent of hospitalization or disease within a population.

mortality rate
the number of deaths in a given population divided by the number of people alive within that population; may be adjusted for age, sex or other sets of risk factors.

most responsible diagnosis
the overriding condition that accounts for the majority of the days spent in hospital; used for administrative purposes.

multivariate model
statistical modelling technique that predicts the effect of a set of multiple independent variables on a dependent or outcome variable; includes multiple linear or logistic regression modelling techniques.

myocardial perfusion scan (see thallium scan)

myocardium
the muscle of the heart.

National Population Health Survey (NPHS)
a household survey conducted by Statistics Canada in 1994 to obtain information about the health of the Canadian population.

neoplasms
cancerous or non-cancerous lesions.

non-invasive diagnostic testing (also called non-invasive ischemic testing)
tests done to determine structural abnormalities and functional impairment of the heart including the presence of coronary artery disease and arrhythmias; includes graded exercise stress tests, thallium scans, technetium sestimibi scans, 2-D echocardiography and Holter monitoring.

null hypothesis
the hypothesis that there is no difference between groups for the outcome of interest, or that a given factor does not affect the outcome in a statistical model.

odds ratio
the ratio of the odds of acquiring a particular disease, given exposure to one or a set of risk factors, divided by the odds of acquiring the disease if not exposed.

Ontario Health Insurance Plan (OHIP)
the universal health insurance plan for all Ontario residents; Ontario physicians submit claims for payment under this plan that are documented in a database (see Technical Appendix for more detail).

Ontario Health Survey (OHS)
a household survey initiated by the Ontario Ministry of Health in 1990 to understand the health of the Ontario population (see Technical Appendix for more detail).

Ontario Heart Health Survey (OHHS)
a household survey in Ontario, fielded as part of the Canadian Heart Health Initiative in 1992, to obtain information on the prevalence of cardiovascular disease and relevant risk factors; self-report data and physiologic measures were collected.

Ontario Ministry of Health Planning Regions
regions defined by the Ministry of Health to aid in the coordination and distribution of health services.

outcome
the factor that is being studied such as death or hospitalization.

p-value (see null hypothesis)
the probability of obtaining a result as extreme or more extreme than the one that is observed, based on chance alone, if the null hypothesis is true.

percutaneous transluminal coronary angioplasty (PTCA) (see angioplasty)

peripheral vascular bypass surgery (PVB)
surgery performed on the aorta/peripheral arteries where there is extensive symptomatic atherosclerotic disease.

person years of life lost (PYLL)
a statistic that describes premature mortality; often calculated as the life expectancy at the age of death minus the age of death.

pharmacotherapy
treatment of disease using drugs.

Poisson model
a statistical modelling technique used for rare events.

post acute patient
a patient who has been discharged from an acute care hospital.

prevalence
the proportion of people in a population who have a particular condition at a given point in time.

primary prevention
modification of risk factors and/or behaviours that are thought to contribute to a particular disease, so that the disease may be prevented.

primary procedure
the procedure that is the most responsible for the patient's length of stay in hospital.

proxy responses
used in survey design to increase the sample size, where one person speaks or answers questions on behalf of others.

Public Health Unit
plan for and deliver a variety of health programs and services pertinent to local circumstances and needs, according to the Health Protection and Promotion Act; mandatory programs include chronic and infectious disease prevention and detection, injury prevention and family and sexual health education.

pulseless electrical activity
a condition whereby the electrical beat of the heart continues without any cardiac output.

queue
for the purpose of this publication, a waiting list of patients for cardiac services.

quintiles
a division of a distribution into five equal, ordered subgroups, each containing 20% or one-fifth of the data.

radionuclide angiocardiography (RNA)
a non-invasive nuclear technique to assess the ventricular function of the heart, rather than the function of blood circulation.

randomized controlled trial
a research activity that involves administration of a test regimen to humans to evaluate efficacy and safety of a particular drug or treatment; subjects are randomly assigned into treatment or non-treatment groups.

readmission
a second admission to hospital following a specific admission of interest, usually for the same clinical problem or complication thereof.

Receiver Operating Characteristic (ROC) curve
a performance parameter for statistical models which is used to reflect the accuracy of the model, or its ability to discriminate who will or will not have the outcome of interest; an ROC curve of 0.50 or 50% indicates model performance no better than chance alone; in diagnostic testing, it is a plot of the true-positives on the y-axis versus the false-positives on the x-axis.

Recommended Maximum Waiting Time (see also urgency score)
the maximum amount of time that a patient with a given clinical cardiac condition should wait for cardiac surgery, based on the Cardiac Care Network recommendations and guidelines; may fall anywhere within the applicable time range.

regional mortality mapping
the use of visual means to study spatial patterns of death by specific causes.

Registered Persons Database (RPDP)
the card number, date of birth, sex, postal code and death date (where applicable) associated with the carrier of each valid Ontario health card; developed and maintained by the Ministry of Health (see Technical Appendix for more detail).

Resource Intensity Weight (RIW)
a resource allocation algorithm, devised by the Canadian Institute for Health Information for estimating the relative hospital resources used for a typical in-patient or day surgery case; used with Case Mix Groups (CMGs) to marry the medical and financial aspects of hospital care, however, it is limited in its use because the algorithm uses United States cost data owing to the lack of similar Canadian information.

revascularization (see coronary revascularization)

risk adjusted rate
a rate that is independent of, or controls for the distribution of a particular set of characteristics or risk factors within the study population that are thought to affect the outcome of interest; for example, risk adjusted acute myocardial infarction mortality rate may control for age, sex, other co-existing medical conditions.

risk factor
a characteristic that is more prevalent among the people who have a particular disease or outcome than those who do not.

sampling variability
since the inclusion of individuals in a sample is determined by chance, the results of an analysis in two or more samples will differ, purely by chance, even if there is no difference between the populations from which the samples are drawn.

secondary prevention
the modification or prevention of risk factors or behaviours for people who already exhibit a given disease.

sensitivity
the probability that a diognostic test is positive in patients who have the disease/condition; a test with a low false-negative rate is sensitive.

small area rate variation (SARV) analysis
statistical tests that compare outcome rates across small geographic areas and compares each one to the average.

socioeconomic status (SES)
a label that describes a combination of social and economic factors, such as education and income.

Spearman's rank correlation
a measure of association that indicates the degree to which the ordered ranking of two variables have a linear relationship.

specific rate
the number of people with a disease within a population group divided by the overall number of people in the same group over a given period of time; for example, an age- and sex-specific heart attack rate is the number of people who had a heart attack in a given age/sex group divided by the total number of people in that same age/sex group.

specificity
the probability that a diagnostic test is negative in patients who do not have the disease/condition; a test with a low false-positive rate is specific.

statins
synthetically-derived cholesterol-lowering agents; the principal metabolites of these drugs are specific inhibitors of 3-hydroxy-3-methylglutaryl-coenzyme A (HMG-CoA reductase).

statistical significance
generally expressed as a probability value (or p-value), reflecting the likelihood that the observed findings could have occurred on the basis of the play of chance alone; by convention, a p-value <0.05 is regarded as statistically significant, but with large sample sizes (which occur commonly with administrative datasets), more conservative p-values may be prudent.

stenosis
narrowing of an artery caused by atheromatous plaque and/or blood clots.

stent
small titanium mesh device that is positioned (like scaffolding) and then expanded against the wall of the coronary artery during angioplasty that opens the vessel and mechanically supports it as it heals.

stress test (see exercise stress test)

sudden cardiac death
a death as a result of cardiac arrest.

surname analysis
a method of inferring ethnoracial origins based on the surname of the individual.

thallium scan (also known as stress thallium or myocardial perfusion scan)
a non-invasive diagnostic procedure to identify vessels that are narrowed, whereby the patient undergoes usual graded exercise testing and at peak performance, a radioactive substance called thallium is injected into a peripheral vein to be taken up by the general circulation; X-ray images are taken of the heart immediately and hours after exercise when the heart has returned to a pre-exercise state for comparison.

thrombolysis
emergency therapy given during a heart attack which involves the injection of a drug to dissolve the clot in a coronary artery and restore blood flow to the heart muscle; the sooner the therapy is administered, the better the prognosis.

urgency score (see also Recommended Maximum Waiting Time)
a scale used by the Cardiac Care Network that helps to decide how urgently bypass surgery is needed; derived by a panel of experts who rated hypothetical scenarios based on combinations of diagnostic test results, coronary anatomy, heart muscle function, and Canadian Cardiovascular Society class. Validity has been confirmed by several studies. Each urgency rating level represents the period within which revascularization is expected to be performed: the outer time limit for each level represents the maximum acceptable waiting period for patients assigned that urgency rating.

ventricle
the pumping chamber of the heart.

ventricular fibrillation
a disorganized electrical disturbance of the ventricle; the heart "quivers" rather than pumps effectively.

ventricular tachycardia
an organized electrical disturbance of the ventricle causing the heart to pump ineffectively, which can result in cardiac arrest; may degenerate into ventricular fibrillation if not immediately treated.

Vital Statistics
a registry of Canadian births and deaths that is compiled by the Registrar General of Canada (see Technical Appendix for more detail).

volume-outcome relationship
the theory that an outcome of a surgical procedure or treatment regimen is related to the amount of experience, or case volume, for either an individual physician, or a group of physicians within a practice or hospital.

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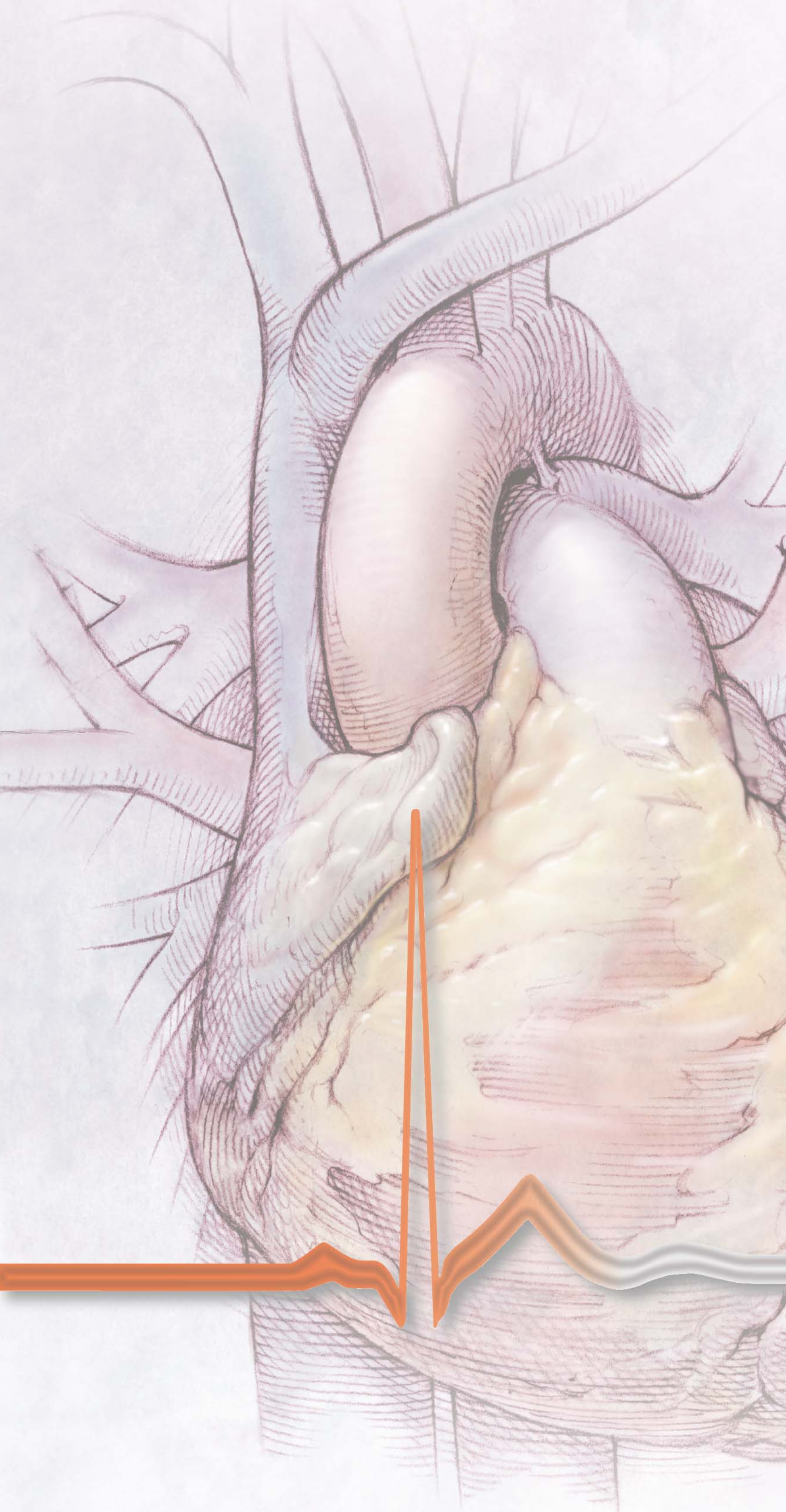
Burden of Cardiac Disease

Ben Chan, Wendy Young



CHAPTER 1

Key messages

- *Cardiovascular disease places a heavy burden on society.*
- *It is the leading single cause of mortality in Ontario.*
- *The prevalence of cardiovascular disease in Northern Ontario is 50% higher than the prevalence in the Central West and Central East regions of Ontario.*
- *The number of deaths due to cardiovascular disease could double by the year 2018.*
- *We must develop more effective and efficient ways to prevent and treat cardiovascular disease.*

Key Terms & Concepts:

- burden of illness
- person years of life lost
- prevalence
- self-reported data
- mortality rates
- morbidity
- direct costs
- indirect costs
- discount rate

Background

Cardiovascular disease is a broad category of conditions affecting the heart and circulatory system. Its largest component is ischemic heart disease (IHD), where the blood supply to the heart muscle is compromised, usually because of atherosclerosis or "hardening" of the coronary arteries that supply blood to the heart. IHD includes angina (chest pain from transient ischemia) and acute myocardial infarction, where prolonged ischemia leads to muscle damage (a heart attack). Other notable forms of cardiovascular disease include diseases of the arteries and veins (peripheral vascular disease); blockages, leakages or infections in the valves of the heart (valvular disease); high blood pressure (hypertension); disturbances of the heart rhythm (arrhythmia); and various inflammatory and infectious diseases of the heart muscle itself.

What is the impact of cardiovascular disease on individuals, on the health care system and on society? For an individual afflicted with illness, the immediate effects may be premature death, disability or impaired quality of life. The individual's ability to sustain employment may also be compromised. Family may be affected if the individual was the household breadwinner, or can otherwise no longer fulfill normal social roles, or if family members must devote time and energy to caring for the patient. From the health system perspective, large amounts of resources are consumed in order to cure, manage or prevent cardiovascular illnesses. From the societal perspective, all taxpayers have to share the cost of financing the health care system through tax contributions. Furthermore, when an individual loses income, various mechanisms such as disability insurance serve to redistribute the burden of that economic loss from the individual to society at large.

Burden-of-illness studies give policy-makers an idea of the scope and impact of a particular disease. Specifically, burden-of-illness measures allow for comparisons in scope between different diseases and serve as a rough guideline on where to prioritize future investments in health care. Policy-makers can also use burden-of-illness measures to identify changes over time, with a view to determining whether progress is being made in managing the disease. Last, such studies may also identify groups of individuals who have a higher burden of illness; these individuals may require special programs to ensure that their needs are met.

This chapter accordingly presents an overview of the epidemiology of cardiovascular disease and its burden on society. The measures of key interest are premature mortality, disability, person-years of life lost, prevalence of activity limitation and the economic cost of cardiovascular disease. We define cardiovascular disease as all conditions related to the heart and circulatory system, excluding cerebrovascular disease, congenital abnormalities and neoplasms. These latter conditions are often included in separate disease categories altogether. We also define two subcategories of cardiovascular disease: acute myocardial infarction (AMI) and other coronary heart disease (see the Methods Appendix for Chapter 1 for a complete description of the classification scheme).

Data Sources

This chapter draws on mortality and disability data from various sources. The original source for mortality data is the death certificate as completed by a physician or coroner and collected by the provincial Registrar General of the Ministry of Consumer and Commercial Relations (MCCR). Death certificates contain information on an individual's birth date, sex, cause of mortality and antecedent factors related to death. Mortality statistics are routinely compiled by the MCCR, as well as Statistics Canada. In this chapter, we reference a number of analyses prepared by these organizations.

In other assessments of disease burden, we use the National Population Health Survey (NPHS) 1994/95 for measurement of the prevalence of cardiovascular disease and cardiovascular-related disability. For the estimation of the cost of cardiovascular disease, we rely on provincial budget statements for total cost of disease to the public health insurance system and industry estimates of total costs for research and pharmaceutical expenditures. Databases on health care services provide information on the percentage of total expenditures related to cardiovascular disease. These databases include the Canadian Institute for Health Information (CIHI) Discharge Abstract Database, data from the Ontario Health Insurance Plan (OHIP) on physician billings and survey data from Intercontinental Medical Statistics (IMS) on drug prescriptions (see Methods Appendix for a complete description).

How We Did the Analysis

We compiled descriptive age-sex breakdowns of cardiovascular mortality. An alternative way of looking at mortality is not just the number of deaths but the person-years of life lost (PYLL). The underlying premise behind this measure is that a death at age 70 is not the same as one at age 15, as the former individual has had a much greater opportunity to live a full, productive life than the latter. PYLL for an individual is calculated as the life expectancy at age of death minus the age at death.

Prevalence is the proportion of the population afflicted with disease at a given moment in time and is a much broader measure of disease burden than mortality. We relied on NPHS survey data and measured the proportion of the population who replied that they have heart disease that has been diagnosed by a health professional.

The cost of cardiovascular disease was calculated using a prevalence approach, which estimates the total disease-related costs expended within a given year. A detailed description of the methods used is found in the Methods Appendix. Direct costs are the value of resources used to manage and prevent disease, and include such items as hospital costs, physician expenditures, drugs, research, prevention programs, home care and ambulances. Indirect costs (as measured by the human capital method) represent the income foregone due to death or disability. The societal approach, which considers costs incurred by all parties, was used.

For direct costs, we calculated the total for each different cost category (i.e. hospitals, physicians etc.). Much of the estimate of total costs came from provincial budget statements, particularly for those items that are funded by universal health insurance. Estimates of costs not funded by the provincial government came from various sources. For example, total drug costs were estimated from surveys by IMS and estimates of total research costs came from the Medical Research Council of Canada. We then used various data sources to assign a portion of total costs to cardiovascular disease. The proportion of weighted hospital cases where the primary diagnosis was cardiovascular disease was used to calculate cardiovascular hospital costs. Physician costs were calculated as the total of all physician visits with a cardiovascular diagnosis plus all surgical, diagnostic and therapeutic procedures of an obvious cardiac nature (e.g. electrocardiogram or coronary bypass surgery). A detailed description of methods used for other cost calculations is found in the Methods Appendix.

Indirect costs were calculated using the human capital approach, which estimates the foregone income due to illness. For individuals who die prematurely, we estimated their future income streams based on Statistics Canada data on average income earned at different stages in life. Implicit in these calculations was an assumption that incomes for all age groups will rise in the future by 2% a year and that future earnings should be discounted by 6% per year. We also made adjustments for individuals (particularly women) who work outside the traditional workplace such as in the home. Some studies suggest that the value of housework is approximately 0.4 to 0.6 times the value of work in the traditional workplace.[1,2] We question the fairness and validity of such a low valuation of the contribution to society made by homemakers, but have accepted this arbitrary weighting in the absence of a consensus on an alternative approach.

Individuals partially or completely disabled due to cardiovascular disease also incur indirect costs. We used two methods to calculate such costs. The first method estimates the total amount paid out in disability insurance for cardiovascular disease, multiplied by a factor of 1.5 to account for the fact that most disability plans cap benefits to two-thirds of earnings. It should be emphasized that disability payments in themselves are not costs from the societal perspective but are instead a mechanism for transferring the burden of lost income due to disability from the individual to society. As such, they are a proxy measure for the cost of that lost income to the individual.

The second method measures the approximate earned household income, as reported in the NPHS, of individuals free of disability and of individuals who have an activity limitation where the main cause was cardiovascular disease. The difference in earned household income was calculated and the total indirect cost of disease was calculated as average lost income multiplied by the number of individuals with a cardiovascular-related activity limitation.

Interpretive Cautions

As always with administrative data, data quality is a concern. However, at the levels of aggregation used here, imprecision in coding is unlikely to have a major impact on our results.

We do note that the estimate of cardiovascular mortality may err on the side of overestimation. Ultimately, all individuals die of stoppage of the heart. If the health practitioner who is responsible for declaring the death is not vigilant in identifying the underlying cause of death, there is the potential for deaths to be coded simply as sudden cardiac death or other inappropriate cardiac diagnoses. On the other hand, survey questions on disability may underestimate the prevalence of cardiovascular disease because those individuals not capable of responding may be more likely to be afflicted with an illness; hence there is a selection bias in the sample.

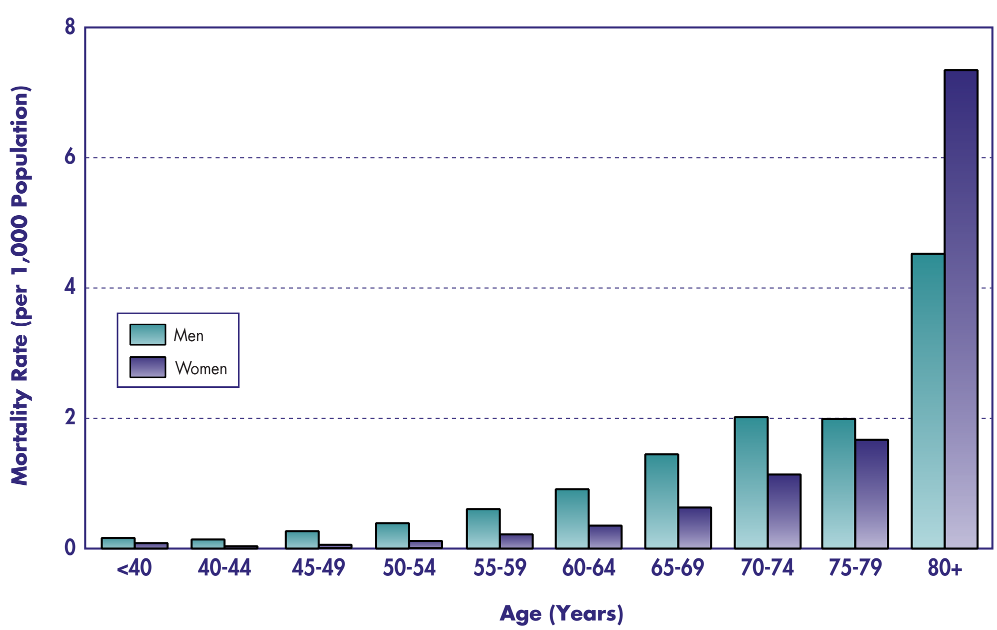
Measuring the indirect cost of illness is notoriously difficult and imprecise. Previous studies have estimated the proportion of the population disabled due to a particular illness, and then multiplied the income by some arbitrary weight from 0.2 to 0.9 to estimate the loss in economic output.[2-7] Such estimates, however, are based on entirely arbitrary weights which have not been validated. In this study, we use two radically different approaches. The disability payments method is clearly an underestimate of disability costs because many individuals do not have adequate disability insurance. On the other hand, the income loss method is an overestimate because the imprecision of the survey questions in the NPHS does not allow for a clearer distinction between earned and unearned income. While the range for disability costs is larger than in previous studies, we are more confident that they represent reasonable and defensible upper and lower bounds.

Burden-of-illness measures provide an indication of the scope of a disease but policy-makers should not necessarily conclude that health resources should be devoted to those illnesses with a high burden. It is also important to examine the cost-effectiveness of various interventions to offset the burden in each disease group. If a disease with a high burden can only be managed with very costly new interventions that have small marginal returns compared to no treatment or conventional care, then the investment of scarce health resources might better be made elsewhere.

Findings and Discussion

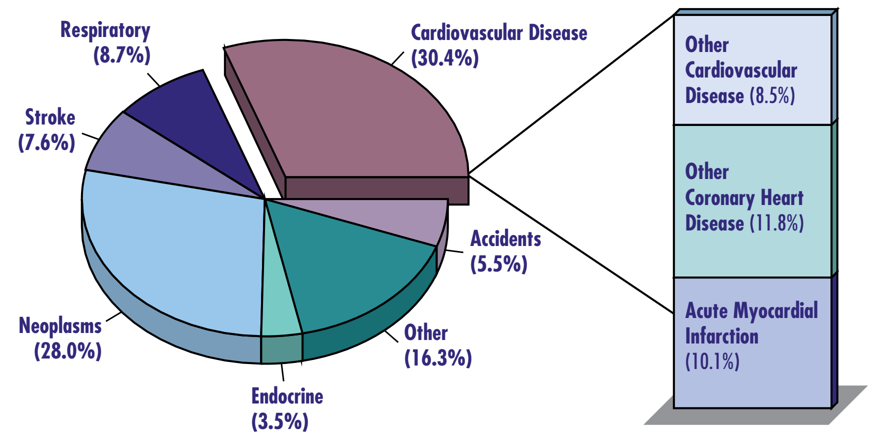
The crudest measure of burden of illness is the description of mortality patterns. Exhibit 1.1 shows the number of deaths by age and sex group from cardiovascular disease (excluding stroke) in Ontario. Ninety-nine per cent of cardiovascular deaths occur in individuals 40 years of age and over. Men have many more deaths from cardiovascular disease than women in all age groups, except in the over-80-year-old category where deaths in women are greater than deaths in men by a ratio of over three to two. Overall, cardiovascular disease accounts for approximately the same number of deaths among men and women (12,400 and 11,600 respectively) but affects men at an earlier age.

EXHIBIT 1.1: Age/Sex-specific Cardiovascular Disease Mortality Rates per 1,000 Population in Ontario, 1996



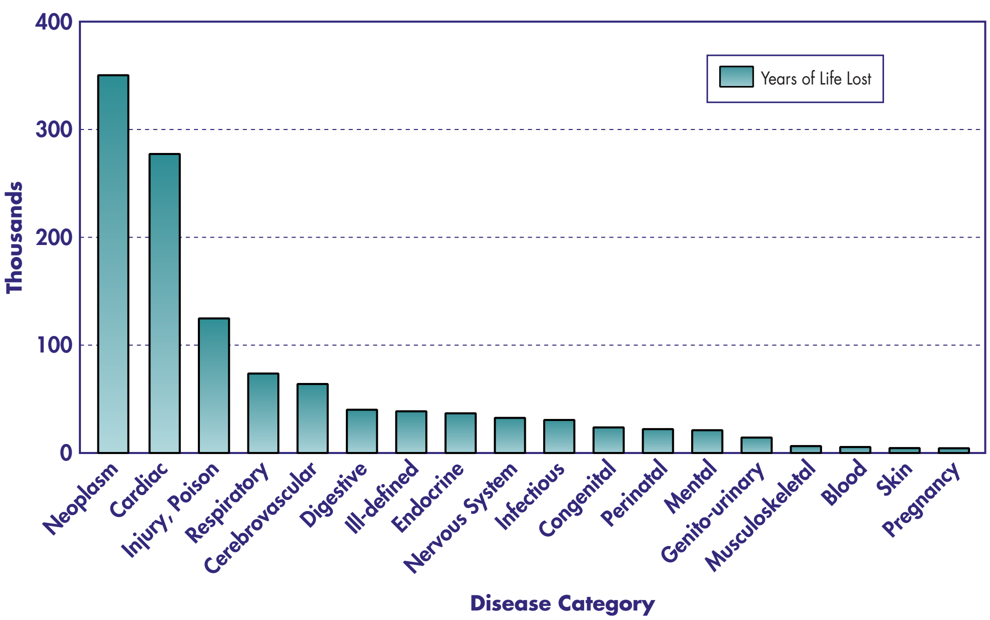
Data Source: Ministry of Consumer and Commercial Relations, 1997

EXHIBIT 1.2: Leading Causes of Mortality in Ontario, 1996



Data Source: Office of the Registrar General, Ministry of Consumer and Commercial Relations, Annual Report, 1997

EXHIBIT 1.3: Person-years of Life Lost in Ontario by Major Disease Category, 1996



Data Source: Ministry of Consumer and Commercial Relations, 1997 - for data on deaths in 1996; Statistics Canada Life Tables, 1995 - for data on average life expectancy (1995 data extrapolated to 1996).

Exhibit 1.2 examines mortality by different disease groups. Cardiovascular disease is responsible for more deaths than any other disease group and is followed closely by cancer. Note that cerebrovascular disease is excluded; stroke is a major killer in its own right. Most cardiovascular disease mortality is attributable to acute myocardial infarction and other coronary heart disease. Cardiovascular disease is also responsible for an estimated 277,000 person-years of life lost or 24% of total PYLL in Ontario (see Exhibit 1.3). On this measure, cardiovascular disease is second to cancer, which has a greater impact on PYLL because, unlike cardiovascular disease, it afflicts larger numbers of individuals at younger ages.

Exhibit 1.4 examines the number and per cent of deaths due to cardiac diseases in Ontario for men and women in 1996. This exhibit confirms the finding that among young age categories, cardiovascular disease is a relatively minor cause of death relative to other conditions such as cancer or accidents and injuries. The proportion of deaths due to cardiac disease rises steadily with age, to the point where at age 75 and over, more than one-third of deaths are cardiac-related.

EXHIBIT 1.4 Age/Sex-specific Mortality due to Cardiac Disease in Ontario, 1996

MEN

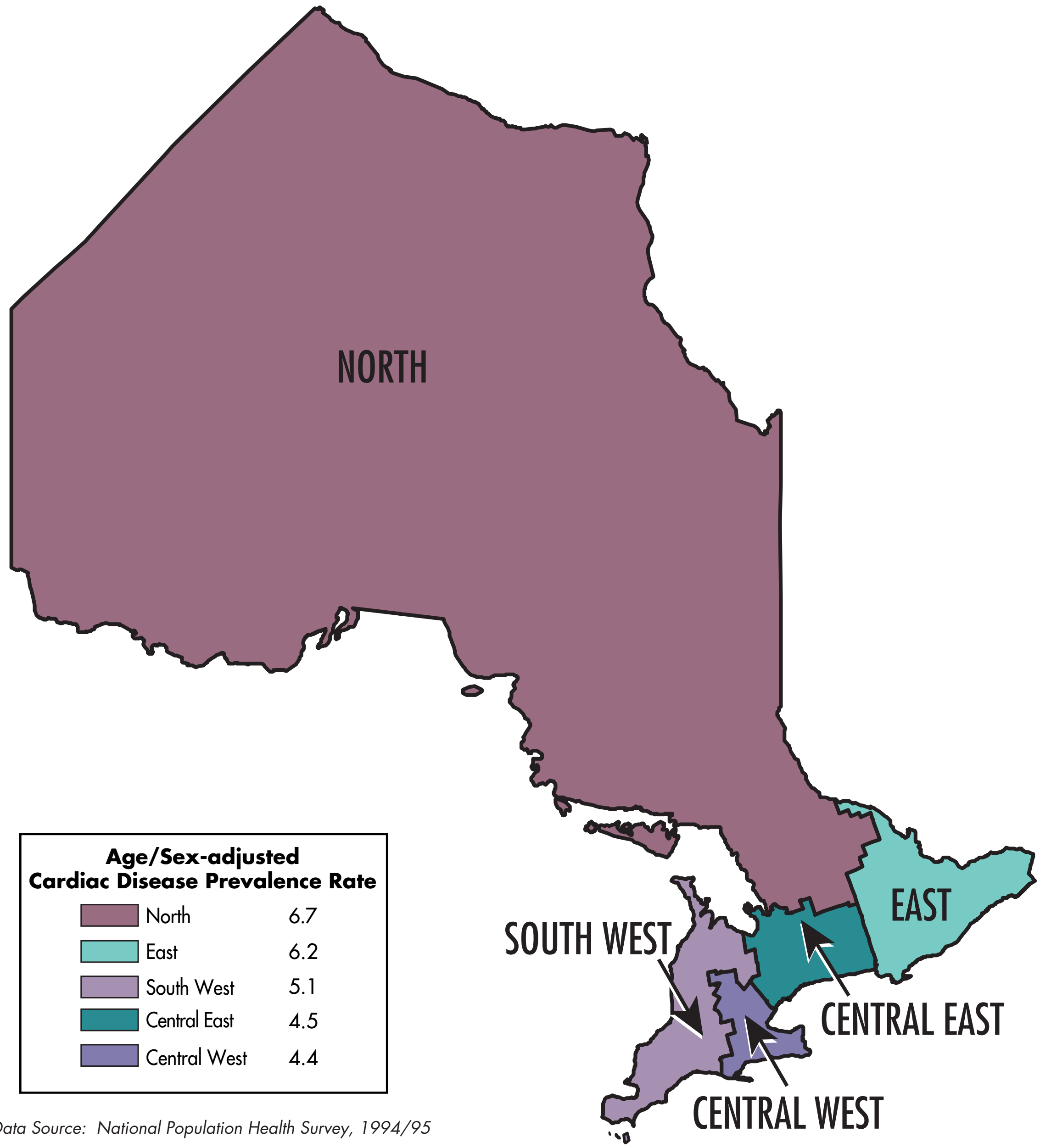
Age	All Deaths	All Cardiac		Acute Myocardial Infarction		Other Coronary Heart Disease	
		n	%	n	%	n	%
≤ 34	1,989	87	4.4	16	0.8	16	0.8
35 - 44	1,597	218	13.7	99	6.2	70	4.4
45 - 54	2,560	656	25.6	321	12.5	221	8.6
55 - 64	4,965	1,517	30.6	695	14.0	552	11.1
65 - 74	10,711	3,465	32.3	1,386	12.9	1,318	12.3
≥ 75	18,857	6,519	34.6	2,041	10.8	2,674	14.2
Not Stated	87						
All Ages	**40,766**	**12,462**		**4,558**		**4,851**	

WOMEN

Age	All Deaths	All Cardiac		Acute Myocardial Infarction		Other Coronary Heart Disease	
		n	%	n	%	n	%
≤ 34	1,020	55	5.4	9	0.9	5	0.5
35 - 44	870	65	7.5	20	2.3	12	1.4
45 - 54	1,633	159	9.7	53	3.2	47	2.9
55 - 64	3,124	571	18.3	237	7.6	176	5.6
65 - 74	7,022	1,767	25.2	660	9.4	569	8.1
≥ 75	24,749	9,016	36.4	2,494	10.1	3,693	14.9
Not Stated	77						
All Ages	**38,495**	**11,633**		**3,473**		**4,502**	

Data Source: Ministry of Consumer and Commercial Relations, 1997

EXHIBIT 1.5: Age/Sex-adjusted Cardiac Disease Prevalence Rate per 100 Population Aged 20 Years and Over by Ministry of Health Planning Region in Ontario, 1994/95

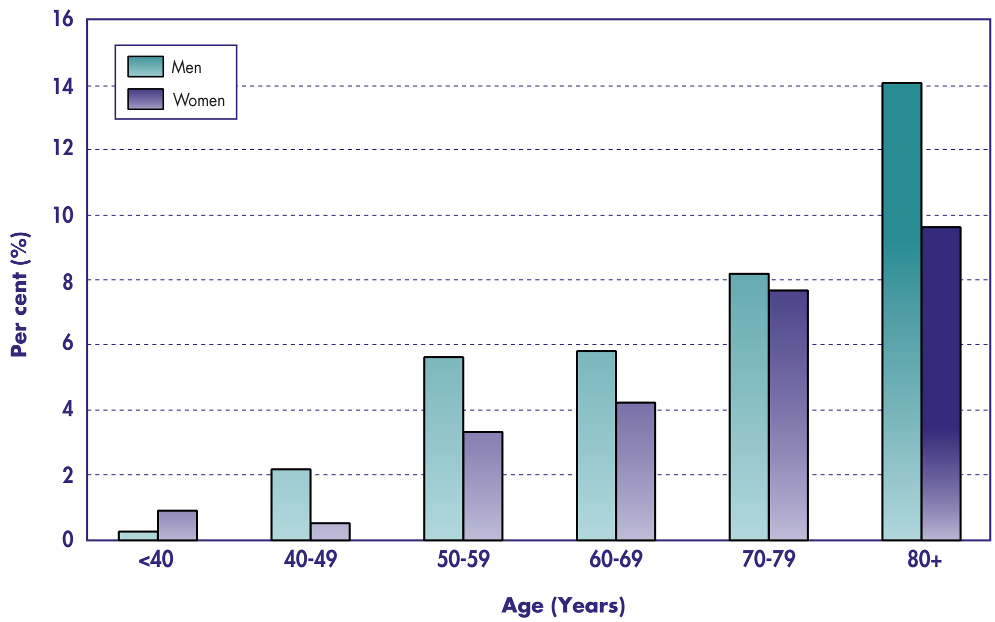


Data Source: National Population Health Survey, 1994/95

Exhibit 1.5 shows the regional variations in prevalence of cardiovascular disease based on NPHS self-reported data for the planning regions used in 1994/95 when the survey was fielded. The lowest prevalence was found in the highly industrialized Central West and Central East regions, centred around the major Metropolitan areas of Toronto and Hamilton. Northern Ontario had a prevalence 50% higher than in these regions.

Exhibit 1.6 shows the prevalence of activity limitation by age-sex group. As expected, the prevalence of disability increases with age. One in 13 individuals over age 65 and one in eight individuals over age 80 have some type of disability related to cardiovascular disease.

EXHIBIT 1.6: Age/Sex-specific Percentage of the Population with a Self-reported Restriction of Activity due to Cardiac Disease in Ontario, 1994/95



Data Source: National Population Health Survey, 1994/95

Detailed estimates of the direct and indirect cost of cardiovascular disease are listed in Exhibit 1.7. We estimate that cardiovascular disease costs Ontario $5.5 billion per year, with a lowest estimate of $3.8 billion and a highest estimate of $7.0 billion. This expenditure is split into nearly equal proportions between direct and indirect costs. Cardiovascular disease accounts for 20% of acute care hospital costs, 15% of home care, 10% of medical services and 17% of drug expenditures.

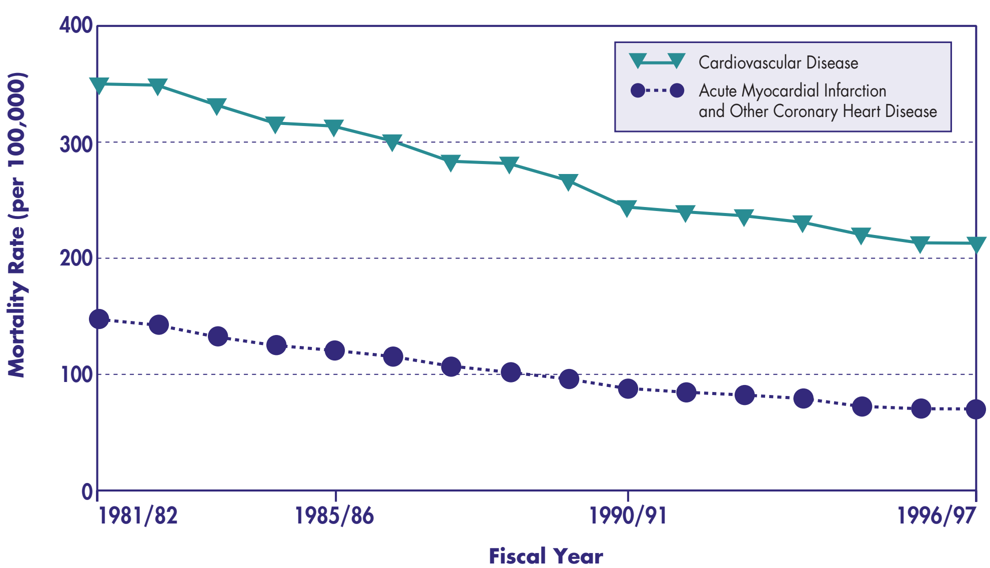
EXHIBIT 1.7 Direct and Indirect Costs of Cardiovascular Disease in Ontario, 1996

Cost Component	Low Estimate ($mil)	Baseline Estimate ($mil)	High Estimate ($mil)
Direct Costs			
Acute Hospitals	1,072.3	1,261.5	1,450.8
Rehabilitation Hospitals	85.2	100.2	115.2
Residential Care Facilities	96.2	113.2	130.0
Medical Services	518.2	609.6	701.0
Drugs and Professional Fees	353.9	416.3	478.8
Research	67.8	79.7	91.7
Home Care	106.9	125.8	144.7
Emergency Health Services	20.7	34.6	69.1
Other Community Support	23.2	30.3	37.5
Total Direct Costs	**2,344.3**	**2,771.2**	**3,218.9**
Indirect Costs			
Premature Mortality	1,077.9	1,566.8	1,811.3
Disability	419.5	1,184.8	1,944.3
Total Indirect Costs	**1,503.1**	**2,751.6**	**3,755.7**
Total, Direct and Indirect Costs	**3,847.4**	**5,522.8**	**6,974.5**

Data Source: See Methods Appendix

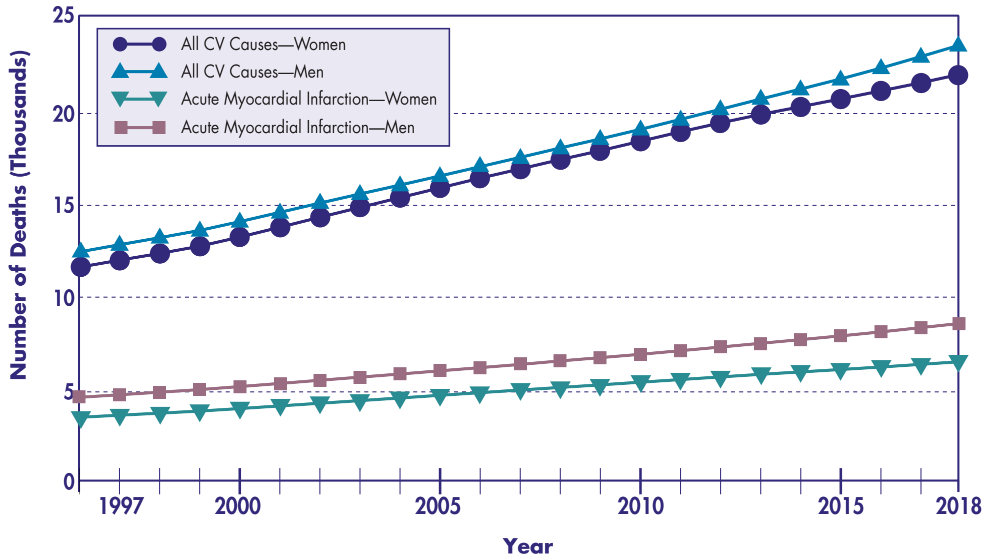
Exhibit 1.8 shows age- and sex-adjusted cardiovascular mortality in Ontario per 100,000 population over time. Cardiovascular mortality continues to decline steadily. This finding is consistent with previous data which show that cardiovascular disease death rates have been declining steadily in Ontario since the mid-1960s.[8] The 1992 death rates are almost half those of 1969 and this decline applies to all major categories of cardiac diseases for both men and women.

EXHIBIT 1.8: Age/Sex-adjusted Cardiovascular Mortality Rates per 100,000 Population in Ontario, 1981/82 - 1996/97



Data Source: Statistics Canada

EXHIBIT 1.9: Projected Number of Deaths from All Cause Cardiovascular Disease and Acute Myocardial Infarction Only in Ontario, 1997 to 2018*



***Note: Projected deaths based on assumption that age-sex mortality remains constant from 1996 onwards.**

Data Source: Office of the Registrar General, Ministry of Consumer and Commerical Relations, Annual Report, 1997, Ontario Ministry of Finance, and County Population Projections, April 1995

Exhibit 1.9 shows the projected number of all-cause cardiovascular diesease mortality and AMI-only deaths over time if the age- and sex-adjusted mortality did not change after 1996/97. Based on population projections prepared by the provincial government, the number of deaths in the cardiovascular category would almost double (an increase of 90%) by the year 2018, due to population growth and aging. However, it is possible that the continuing slow decline in mortality rates will blunt the impact of population aging.

Conclusions

By almost any measure, cardiovascular disease (CVD) places a heavy burden on society. It is the leading single cause of mortality in Ontario and has a particularly strong impact on the middle-aged and elderly populations. It is also an expensive disease; its estimated direct and indirect cost of $5.5 billion represents 2% of the provincial gross domestic product.

The data here underscore a commonly known phenomenon, that men experience almost twice the cardiovascular death rates of women in all age categories except among the very old. Research suggests that normal estrogen levels in pre-menopausal women confer a protective benefit against the development of ischemic heart disease. In the decades following menopause, CVD death rates in women approach those in men. Gender issues in cardiovascular disease will be explored in greater detail in Chapter 18 of this Atlas.

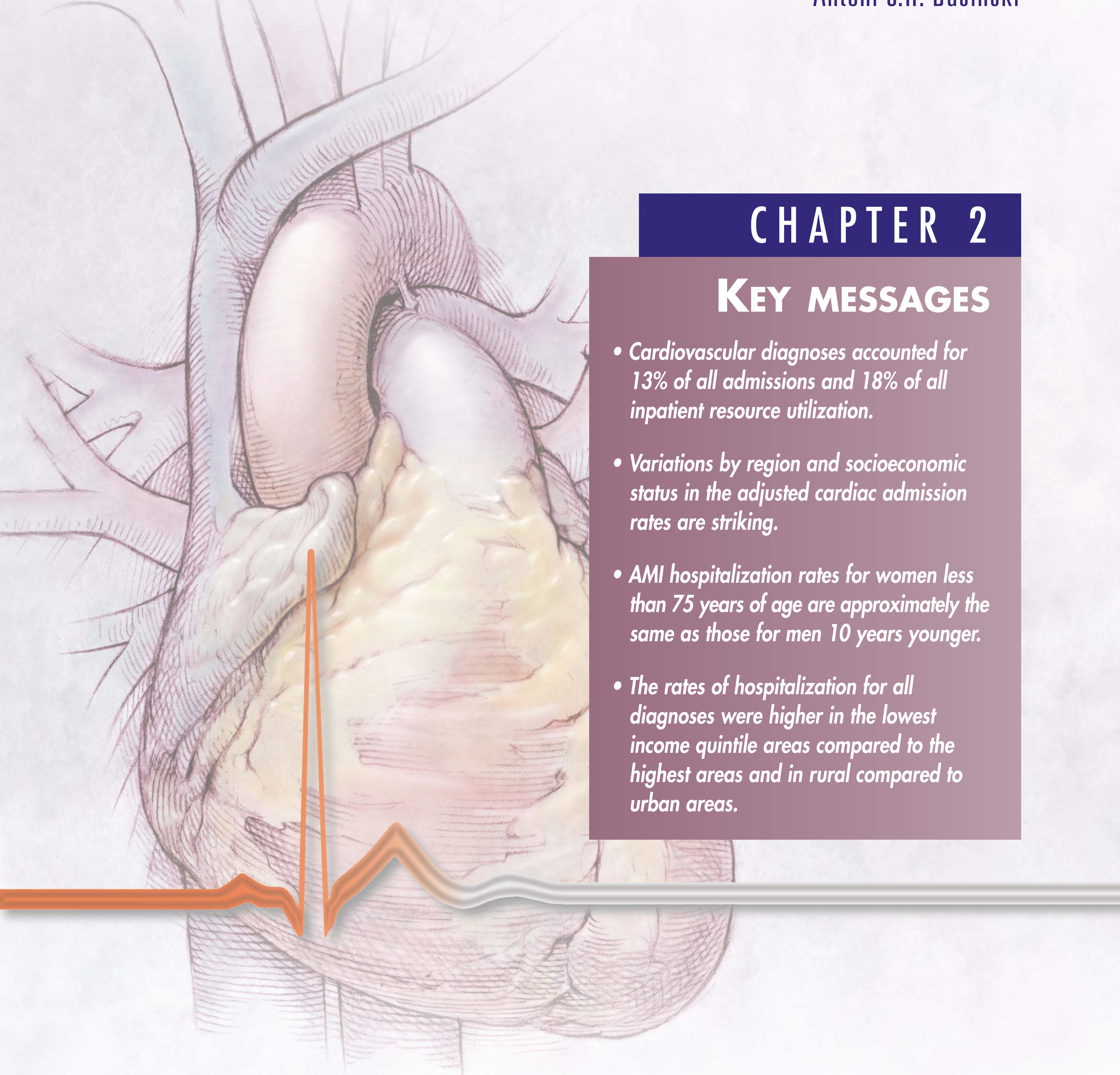
Another source of concern is the extent of regional variation in the prevalence of cardiovascular disease in the province. The high prevalence of cardiovascular disease in Northern Ontario suggests a greater need for health promotion and preventive measures in this region. Chapters 2, 3 and 4 will shed additional light on these regional variations in disease burden and risk factor profiles.

Our analyses confirm that some progress has been made in battling cardiovascular disease. Mortality declines have been steady and are continuing. The decline in deaths partly reflects a declining incidence of CVD, which in turn may be explained by a reduction in prevalence of smoking, consumption of fat, and improved identification and control of high blood pressure.[9] Part of the decline may also be related to improved medical and surgical care of individuals who have developed cardiac disease. For example, AMI is a common cause of death among individuals with CVD. Naylor and Chen[10] looked at population-wide mortality trends among patients hospitalized for AMI in Ontario from 1981 to 1991. During this time period, the age- and sex-adjusted case fatality rate during the hospital admission decreased from 22% to 16%. These improvements were most likely due to better clinical management. Analyses in Chapter 5 include more recent AMI outcomes data for Ontario.

Despite these positive trends, progress in reducing the mortality from cardiovascular disease remains slow. In Ontario, the population is aging and this will have important consequences unless we develop more effective and efficient ways to prevent and treat cardiovascular disease. This agenda is one that requires urgent attention from a global perspective, as more developing countries make the epidemiologic transition away from communicable diseases toward chronic non-communicable conditions such as CVD.[11] Indeed, it is estimated that by the year 2020, ischemic heart disease will be the number one cause of disease burden in the world.

Hospitalization for Cardiovascular Medical Diagnoses

Antoni S.H. Basinski



CHAPTER 2

Key messages

- *Cardiovascular diagnoses accounted for 13% of all admissions and 18% of all inpatient resource utilization.*
- *Variations by region and socioeconomic status in the adjusted cardiac admission rates are striking.*
- *AMI hospitalization rates for women less than 75 years of age are approximately the same as those for men 10 years younger.*
- *The rates of hospitalization for all diagnoses were higher in the lowest income quintile areas compared to the highest areas and in rural compared to urban areas.*

Key Terms & Concepts:

- acute myocardial infarction
- congestive heart failure
- angina pectoris
- chest pain
- ischemic heart disease
- adjusted rates
- income quintiles
- length of stay

Background

Cardiovascular diagnoses are the second most common reasons for admission to Ontario hospitals. They accounted for approximately 13% of all admissions and 18% of all inpatient resource utilization in Ontario during fiscal 1996/97. Among the cardiovascular diagnoses, the most common cardiac admissions are for acute myocardial infarction (AMI), congestive heart failure (CHF), and the presentation of chest pain leading to discharge diagnoses of angina pectoris and ischemic heart disease (angina) or chest pain without a proven cardiac cause. We include non-cardiac chest pain admissions since these typically result from admissions to "rule out" acute cardiac events.

This chapter examines a number of characteristics of hospitalizations for these three common cardiac conditions. First, we consider the Ontario incidence rates for acute hospitalization for each of these conditions over the fiscal years 1992/93 to 1996/97. Incidence rates for each year during the five-year time period under study are calculated, as well as regional variations in these rates. Due to aging and population growth, projections of the rise in the total number of hospitalizations for each of these conditions within each Ontario county between the last year under study (1996) and the year 2003 are provided.

The trends in average lengths of stay (LOS) over the study period and the variations in LOS by hospital type and hospital geographic location are also described. As well, the outcome of urgent/emergent readmissions for each diagnosis is examined.

Incidence rates, average lengths of hospital stay (ALOS), and readmission rates may all be influenced by a number of factors.[1-4] In this respect, we considered the influence of the patient's age, sex and comorbidity (a measure of additional disease burden experienced by the patient).[5] As a marker of socioeconomic status, the mean household income in the location of the patient's residence is also examined. Hospital factors studied include hospital size, teaching status and the designation of "urban," "rural" or "isolated" hospital.

Data Sources

The primary source of hospitalization data is the hospital separation abstract database maintained by the Canadian Institute for Health Information (CIHI). Population data that provide denominators for the calculation of regional rates are from the 1991 and 1996 Statistics Canada censuses, with intercensal interpolation of populations. Patient place of residence was identified from the patient's postal code.

In order to consider mortality in combination with readmission analyses, death outcomes were obtained from the Ontario Registered Persons Database (RPDB).

Population projection estimates of the growth and changing age structure of census subdivision populations were obtained from Statistics Canada population growth estimates.

How We Did the Analysis

All hospital separations for adults (aged 20 years and over) with a most responsible diagnosis of AMI, CHF or angina/chest pain were identified for the period under study. Data items such as the patient's postal code, age, sex, comorbid diagnoses, and the treating hospital, length of stay, discharge date and disposition (i.e. transfer, in-hospital death) were obtained from the CIHI hospital record abstract. We tracked each anonymous patient forward in time to examine whether they were readmitted to hospital (or died) after discharge. More specifically, we combined out-of-hospital death within 30 days with acute, non-elective readmissions within 30 days into a single event (hereafter called "readmission"). Since the great majority of early post-hospitalization deaths and urgent readmissions are related to the cardiac disease process responsible for the original hospitalization, the combined event is an indicator of post-hospitalization outcome.[6]

Readmission rates for the same diagnosis are relatively high for some of these conditions. Since we considered readmissions in the incidence rate calculations, the rate of hospitalization per population per time is accurate at the population level, but does not imply that the admissions are each incurred independently by separate individuals.

Non-teaching hospitals were grouped into three size classes (small, medium and large) on the basis of their cardiovascular caseload during the study period. Teaching hospitals were considered in a separate group (see Technical Appendix for more detail).

To study the effect of variations in hospital ALOS on readmission rates, we calculated the quintiles of adjusted ALOS within each hospital group and each year. Hospitals with the shortest ALOS relative to their peers in a given year would be assigned to the first LOS quintile, while those with the longest ALOS relative to their peers were assigned to the fifth LOS quintile.

We also grouped hospitals according to the urban or rural nature of the population served and their degree of isolation from other acute care institutions. The definition of "rural" (hospitals in smaller communities serving rural areas) and "isolated" (hospitals serving the most remote areas of the province) hospital groups was based on the Ontario Ministry of Health/Ontario Hospital Association designation of rural and isolated hospitals (MOH/OHA Rural and Northern Policy).

For analyses where the influence of ordered variables (e.g. year, income quintile, or ALOS quintile) on rates or outcomes is of interest, the statistical significance of the influence of the factors was determined by performing tests of trend. Age-adjusted rates were directly standardized using the average Ontario population during the study period, categorized by age and sex.

Interpretive Cautions

Patients' places of residence are used throughout the chapter to match incident events to geographically-defined populations, which may occasionally be a source of confusion. For example, if suburban residents working in a city core prefer to seek care near their workplace rather than at home, geographic analyses may be difficult to interpret.

The analyses of hospitalizations by income were ecological. That is, rather than examining the patterns of hospitalization incidence by individuals' actual or family incomes, we examined the relation between the average household incomes in geographic areas and the per capita rates of hospitalization. Individual level inferences from these analyses are potentially false—a phenomenon dubbed the "ecological fallacy."[7] Hence, we suggest the income analyses be interpreted as applicable to persons living in a region with a given average annual household income. Individual household incomes may, of course, vary from the average.

Finally, diagnostic accuracy and consistency are required to make meaningful comparisons over time, across regions or between institutions.[8] As we see in the findings below, coding practices vary between institutions and over time. Also please note for areas within District Health Councils (DHCs), Census 1996 population data were used for rate denominators. This accounts for any apparent inconsistencies in rates as compared with previous DHC-specific tables.

Findings and Discussion

Hospitalization Rates

Hospitalization rates for AMI averaged 311 admissions per 100,000 adult men and 172 admissions per 100,000 adult women (Exhibit 2.1). These rates increased with age for both men and women. The rates for women to age 75 years are approximately the same as those for men 10 years younger. There was a 1.2% annual decrease in the age-adjusted admission rates for men during the study period and a 0.6% annual increase in age-adjusted admission rates for women. The 1.8% annual difference between these admission rates was statistically significant.

Hospitalization rates for CHF averaged 296 admissions per 100,000 adult men and 279 admissions per 100,000 adult women. These rates increased dramatically with age for both men and women. There was a 2.4% annual decrease in the age-adjusted admission rates for men during the study period and a 0.7% annual decrease in age-adjusted admission rates for women. The 1.7% annual difference between these admission rates was statistically significant. The changes in annual rates of admission for CHF may have resulted from more effective ambulatory care.

Hospitalization rates for angina including the general category of ischemic heart disease and angina pectoris specifically, averaged 307 admissions per 100,000 men and 231 admissions per 100,000 women in Ontario. As with the other cardiac diagnoses, these rates were markedly higher for the elderly, averaging 1,318 and 1,066 per 100,000 population, for men and women respectively, over the age of 75 years.

Hospitalization rates for chest pain (i.e. admissions to hospital with a most responsible diagnosis at discharge of chest pain of non-cardiac origin) averaged 183 admissions per 100,000 men and 159 admissions per 100,000 women in Ontario. These rates were relatively constant above the age of 50 for men and 65 for women.

While hospitalization rates for angina rose 1.4% annually during the five-year period 1992/93 to 1996/97, these were offset by falling hospitalization rates (annual 1.9% decrease) for chest pain (Exhibit 2.2). In fact, the overall angina and chest pain admission rates were stable during the study period. These changes are probably due to fluctuations in the coding practices of Ontario hospitals over the study period for the three diagnoses of ischemic heart disease, angina pectoris and chest pain. Some institutions systematically altered their coding practices (as seen in their relative rates of coding among the three diagnoses) during the study period (generally from a diagnosis of chest pain to one of angina). These coding changes may have resulted from the use of computerized coding schemes (choosing between angina pectoris and ischemic heart disease), or improved detection or recording of the cardiac origin of chest pain admissions.

EXHIBIT 2.1 Age/Sex-specific Hospitalization Rates for Selected Cardiac Diagnoses per 100,000 Population Aged 20 Years and Over in Ontario, 1992/93 - 1996/97

Fiscal Year	Overall Men & Women	Men (Age)					Women (Age)				
		20-49	50-64	65-74	75+	Overall	20-49	50-64	65-74	75+	Overall
Acute Myocardial Infarction											
1992/93	243	68	558	995	1,543	320	13	175	493	980	171
1993/94	243	71	532	1,005	1,540	318	13	174	492	991	171
1994/95	236	64	524	957	1,531	307	13	178	494	963	170
1995/96	234	66	512	939	1,498	302	14	163	497	987	170
1996/97	241	62	517	986	1,585	309	13	162	523	1,046	176
Overall	**240**	**66**	**528**	**976**	**1,540**	**311**	**13**	**170**	**500**	**994**	**172**
Congestive Heart Failure											
1992/93	288	12	263	1,074	2,963	304	8	142	621	2,199	272
1993/94	302	15	274	1,102	2,972	310	7	156	688	2,361	294
1994/95	291	13	264	1,104	2,845	301	6	149	646	2,286	282
1995/96	280	12	247	1,008	2,693	281	7	143	617	2,290	278
1996/97	277	13	235	1,033	2,726	283	8	134	608	2,220	271
Overall	**287**	**13**	**257**	**1,064**	**2,834**	**296**	**7**	**145**	**636**	**2,271**	**279**
Angina											
1992/93	259	61	544	1,007	1,289	301	21	285	694	1,001	218
1993/94	266	61	553	1,073	1,257	307	22	310	700	1,028	226
1994/95	274	62	564	1,066	1,375	315	25	300	741	1,086	235
1995/96	264	57	552	996	1,297	299	23	302	700	1,091	230
1996/97	277	59	577	1,065	1,363	315	25	316	742	1,113	241
Overall	**268**	**60**	**558**	**1,042**	**1,318**	**307**	**23**	**303**	**716**	**1,066**	**231**
Chest Pain											
1992/93	178	109	362	391	374	196	60	304	365	356	161
1993/94	174	105	349	373	383	190	58	296	381	347	159
1994/95	171	99	332	384	359	183	60	297	361	365	160
1995/96	171	96	333	377	340	179	60	302	377	368	162
1996/97	163	88	329	354	338	171	57	289	363	354	155
Overall	**171**	**99**	**341**	**376**	**358**	**183**	**59**	**297**	**370**	**358**	**159**
Angina and Chest Pain											
1992/93	437	170	906	1,398	1,663	497	81	589	1,060	1,357	379
1993/94	440	166	902	1,446	1,640	497	80	606	1,082	1,374	385
1994/95	445	161	897	1,450	1,734	497	84	598	1,102	1,452	395
1995/96	435	154	884	1,373	1,637	479	82	604	1,078	1,459	393
1996/97	440	147	905	1,418	1,701	486	82	605	1,105	1,467	396
Overall	**439**	**159**	**899**	**1,417**	**1,676**	**491**	**82**	**600**	**1,086**	**1,424**	**390**

Data Source: Canadian Institute for Health Information

The relative changes in the rates of hospitalization for women versus men during the study period are consistent across the three diagnostic categories: AMI, CHF, and angina/chest pain. That is, while the overall rates of admissions may have either remained constant (AMI and angina/chest pain) or decreased (CHF) during the study period, the gap between the admission rates for women and men decreased by 1.7% to 1.9% annually for these common cardiac diagnoses. This pattern is consistent with the increases in the rates of cardiac disease in women compared to men reported in other epidemiological studies of cardiac disease.[9-11]

EXHIBIT 2.2 Age-adjusted Annual Changes in Hospitalization Rates for Selected Cardiac Diagnoses per 100,000 Population Aged 20 Years and Over in Ontario, 1992/93 - 1996/97

Diagnosis	Annual Change (%)	p Trend	Annual Change for Men (%)	p Trend	Annual Change for Women (%)	p Trend	Annual Change for Women - Men (%)	p Trend
Acute Myocardial Infarction	–0.3	0.22	–1.2	0.00	0.6	0.12	1.8	0.00
Congestive Heart Failure	–1.6	0.00	–2.4	0.00	–0.7	0.01	1.7	0.00
Angina	1.4	0.00	0.7	0.02	2.1	0.00	1.5	0.00
Chest Pain	–1.9	0.00	–3.3	0.00	–0.5	0.23	2.9	0.00
Angina and Chest Pain	0.1	0.58	–0.9	0.00	1.1	0.00	1.9	0.00

Data Source: Canadian Institute for Health Information

Influence of Income

Hospitalization rates were assessed against area-level income as a marker for the socioeconomic status of the patient's geographic region of residence (Exhibit 2.3). The incidence rates of hospitalization are substantially higher in areas in the lowest quintile of household income than for the highest household income quintile for all of the cardiac conditions considered in this chapter.

The rates of hospitalization for AMI in the lowest income quintile areas compared to the highest areas (areas with a 1991 mean household income below $36,855 versus areas with a mean household income above $64,836) were 65% and 53% higher for men and women, respectively. The discrepancy in incidence is much more evident among younger patients (those under the age of 65 to 74). That is, the relative rates of hospitalization across income regions converge as the cohort ages.

The differences in rates of hospitalization for CHF in the lowest income quintile areas compared to the highest areas are even more striking, 81% and 50% higher for men and women, respectively. The discrepancy in incidence is again much more evident among younger patients.

The variations in angina and chest pain admission rates by quintile of income are the most remarkable. Overall, angina admissions were 97% higher in low-income areas compared to high-income areas while chest pain admissions were 121% higher.

The average income of geographic regions and the population density of the region (a marker of the urban or rural nature of the region) are correlated. However, Exhibit 2.4 using a population-density-based classification of urban/rural regions demonstrates that income levels in rural areas tend to be lower than those in urban areas.

Admission rates for all the cardiac diagnoses in rural areas are significantly in excess of those in urban areas (Exhibit 2.5). The rural admission rates, adjusted for age and sex, are 17%, 24% and 48% higher than for urban areas for AMI, CHF and angina/chest pain respectively.

EXHIBIT 2.3 Age/Sex-specific Hospitalization Rates for Selected Cardiac Diagnoses per 100,000 Population Aged 20 Years and Over by Residence Area Income Quintile in Ontario, 1992/93 - 1996/97

Income Quintile	Overall For Men & Women	Men (Age) 20-49	50-64	65-74	75+	Overall	Women (Age) 20-49	50-64	65-74	75+	Overall
Acute Myocardial Infarction											
1 - Low	305	106	753	1,210	1,684	409	25	268	581	1,007	206
2	271	84	609	1,067	1,629	351	20	202	569	1,085	196
3	232	70	522	910	1,488	304	14	163	466	953	164
4	220	54	467	906	1,470	281	10	144	469	1,000	162
5 - High	190	44	405	798	1,360	248	6	107	387	885	135
Overall	**240**	**66**	**528**	**976**	**1,540**	**311**	**13**	**170**	**500**	**994**	**172**
Congestive Heart Failure											
1 - Low	359	24	464	1,476	3,122	394	16	267	815	2,261	325
2	342	19	345	1,215	3,311	354	11	180	751	2,643	330
3	288	16	261	1,078	2,800	298	8	148	628	2,253	278
4	258	10	204	917	2,572	257	6	121	568	2,169	259
5 - High	218	7	153	766	2,314	218	3	74	424	1,962	217
Overall	**287**	**13**	**257**	**1,064**	**2,834**	**296**	**7**	**145**	**636**	**2,271**	**279**
Angina											
1 - Low	366	107	861	1,309	1,455	428	47	496	900	1,154	308
2	314	80	674	1,183	1,520	366	34	362	791	1,174	265
3	261	65	567	974	1,240	303	24	299	687	1,001	222
4	238	48	462	936	1,260	269	16	250	648	1,067	210
5 - High	186	33	379	813	1,003	219	11	169	490	821	155
Overall	**268**	**60**	**558**	**1,042**	**1,318**	**307**	**23**	**303**	**716**	**1,066**	**231**
Chest Pain											
1 - Low	248	163	512	472	423	271	103	445	441	405	226
2	209	133	422	433	408	230	79	352	405	408	190
3	165	99	336	354	320	179	60	278	365	321	153
4	136	75	274	306	299	145	41	235	307	315	127
5 - High	112	53	220	284	276	117	32	197	279	260	106
Overall	**171**	**99**	**341**	**376**	**358**	**183**	**59**	**297**	**370**	**358**	**159**

Data Source: Canadian Institute for Health Information

EXHIBIT 2.4 Per cent of Ontario Population in Rural and Urban Areas by Geographic Income Quintile in Ontario, 1992/93 - 1996/97

Urban/Rural Area	Income Quintile Low 1	2	Median 3	4	High 5	Total
Rural (%)	20	31	29	17	4	100
Urban (%)	16	16	18	23	27	100

Data Source: Canadian Institute for Health Information

EXHIBIT 2.5 Age/Sex-specific Hospitalization Rates for Selected Cardiac Diagnoses per 100,000 Population Aged 20 Years and Over by Urban/Rural Residence Area in Ontario, 1992/93 - 1996/97

Residence	Overall For Men & Women	Men (Age) 20-49	Men 50-64	Men 65-74	Men 75+	Men Overall	Women (Age) 20-49	Women 50-64	Women 65-74	Women 75+	Women Overall
Acute Myocardial Infarction											
Rural	272	78	603	1,066	1,660	347	19	216	572	1,116	201
Urban	232	64	512	954	1,511	303	12	160	484	970	165
Overall	**240**	**66**	**528**	**976**	**1,540**	**311**	**13**	**170**	**500**	**994**	**172**
Congestive Heart Failure											
Rural	341	16	295	1,161	3,262	335	12	194	828	2,716	347
Urban	275	12	248	1,039	2,724	286	6	134	591	2,178	265
Overall	**287**	**13**	**257**	**1,064**	**2,834**	**279**	**7**	**145**	**636**	**2,271**	**279**
Angina											
Rural	354	85	740	1,303	1,564	395	39	445	933	1,382	315
Urban	248	55	515	973	1,254	286	20	271	666	996	212
Overall	**268**	**60**	**558**	**1,042**	**1,318**	**307**	**23**	**303**	**716**	**1,066**	**231**
Chest Pain											
Rural	243	156	461	497	486	262	96	410	469	484	224
Urban	155	87	313	343	323	166	51	273	347	330	146
Overall	**171**	**99**	**341**	**376**	**358**	**183**	**59**	**297**	**370**	**358**	**159**

Data Source: Canadian Institute for Health Information

EXHIBIT 2.6 Age/Sex-adjusted Acute Myocardial Infarction Hospitalization Rates, Expected Number of Cases and Expected Annual Growth per 100,000 Population Aged 20 Years and Over by District Health Council in Ontario, 1992/93 - 1996/97

District Health Council	Adjusted Rate	Expected Cases 1996/97	Expected Cases 2003/04	Annual Growth (%)	Rank
Algoma, Cochrane, Manitoulin and Sudbury	281	783	911	2	2
Champlain	220	1,812	2,265	3	15
Durham, Haliburton, Kawartha and Pine Ridge	250	1,375	1,803	4	9
Essex, Kent and Lambton	280	1,159	1,377	3	3
Grand River	299	443	521	2	1
Grey, Bruce, Huron, Perth	260	641	724	2	7
Halton-Peel	225	1,739	2,645	6	14
Hamilton-Wentworth	232	953	1,119	2	12
Muskoka, Nipissing, Parry Sound and Timiskaming	273	474	543	2	5
Niagara Region	249	906	1,035	2	10
Northwestern Ontario	254	444	504	2	8
Quinte, Kingston, Rideau	275	1,018	1,223	3	4
Simcoe-York	231	1,514	2,241	6	13
Thames Valley	261	1,071	1,270	3	6
Toronto	211	4,654	5,538	3	16
Waterloo Region-Wellington-Dufferin	236	1,054	1,358	4	11
Ontario	**240**	**20,040**	**25,080**		

Data Source: Canadian Institute for Health Information

Numerous studies have demonstrated increased incidence and prevalence of cardiovascular disease with decreasing socioeconomic status.[12-14] This factor, as evidenced by the gradient in hospitalizations with income, is obviously also influential in Ontario.

In addition, cardiac admissions to hospital are more common in rural areas. This may reflect the lack of follow-up and outpatient facilities for investigation and treatment of episodes of CHF and angina/chest pain. The further development of Emergency Department Chest Pain Assessment Units[15] to improve rapid diagnosis and triage of episodes of chest pain presentation, will likely increase the discrepancy between assessment modalities in urban and rural areas.

Area Variations

As in other Atlas chapters, adjusted hospitalization rates in Ontario according to District Health Council (DHC) boundaries, and by large cities (population over 100,000) versus other areas within those DHCs are presented. However, in this chapter the data are also broken down by county, and by cities or other relevant subdivisions within larger census metropolitan areas (including some that have been administratively superceded, e.g. in Toronto). This was done because the following two chapters show cardiovascular death rates, self-reported cardiac morbidity rates and risk factor data disaggregated beyond the DHC level. The admission rates shown below by county and by subdivided urban areas should complement these later chapters (Exhibits 2.8, 2.11, 2.14, 2.17 and 2.18).

During the years under study (1992/93 to 1996/97) the overall adjusted hospitalization rates in Ontario were 240 per 100,000 for AMI, 287 per 100,000 for CHF, 268 per 100,000 for angina and 171 per 100,000 for chest pain. The variation of the adjusted cardiac admission rates across DHCs, counties and other areas in Ontario is marked. The lowest per capita rates of AMI hospitalization are in the metropolitan areas of Toronto and Ottawa (Champlain); the highest rates are in the North, and the Essex-Kent-Lambton, Quinte-Kingston-Rideau, and Grand River DHC areas (Exhibits 2.6 to 2.8 and 2.17). For CHF, the lowest admission rates are in the "golden horseshoe" of Toronto-Hamilton; the highest rates are in the North, Essex-Kent-Lambton and Grey-Bruce-Huron-Perth (Exhibits 2.7 to 2.11 and 2.17). Combined admission rates for angina and chest pain were far higher in Grand River, Quinte-Kingston-Rideau and the North (at over 600 admissions per 100,000 adult population per year) than in Metropolitan Toronto, with 298 admissions per 100,000 per year (Exhibits 2.12 to 2.14 and 2.18 for angina, and Exhibits 2.15 to 2.17 and 2.18 for chest pain). The county population-weighted 25th and 75th percentile age/sex-standardized rates for AMI are 219 and 260 per 100,000 respectively. The corresponding variations are 246 and 320 for CHF, 208 and 324 angina, and 107 and 216 for chest pain.

In the coming years, different areas of the province can anticipate changes to their population numbers and structure. Some areas will experience little growth in population, but can expect their populations to become increasingly elderly. In contrast, some areas in the vicinity of major metropolitan centres are currently experiencing rapid growth in both younger and older segments of the population. The impact of changing demographics is shown. The expected annual growth rate between now and the year 2003 varies between 0.7% and 7.3% in AMI cases, and between 1.1% and 9.4% in CHF cases. Expected growth rates for angina and chest pain are similar to those for AMI. The fastest growing areas (in terms of the expected numbers of cases of AMI and CHF) can expect incidence rates in 2003 to be approximately 63% and 88% higher, respectively, than they were in 1996.

Length of Hospital Stay

There has been a steady decrease in overall length of stay for the cardiac diagnoses examined during the study period (Exhibit 2.19). The average length of stay for AMI, after adjustment for other influential system factors (such as hospital size) and patient factors, was 16% lower in 1996/97 than it was in 1992/93. The corresponding LOS decreases during the study period were 15%, 9% and 15% for CHF, angina and chest pain, respectively.

Length of stay for the cardiac conditions varies by hospital group (Exhibit 2.20). Teaching hospitals have the longest average adjusted length of stay (ALOS). For AMI and CHF, the ALOS in non-teaching large, medium and small hospitals is quite similar, with slight increases in ALOS among the small hospitals. For angina, and to a lesser extent for chest pain, there is a gradient of increasing ALOS from small to large hospitals. The ALOS for all conditions is substantially greater among teaching hospitals compared to non-teaching hospitals. A number of factors may be at play here. The larger, and especially teaching, hospitals may treat more complex cases than the smaller hospitals. As noted in the section above, the incidence of hospitalization in rural areas, where small hospitals are the norm, is appreciably greater than in more urban areas. Hence, the lower ALOS in the hospitals serving these areas may be, at least partly, attributed to higher hospitalization rates with lower complexity and/or severity of the average case admitted to the hospital. When considering the hospitals designated by the Ministry of Health/Ontario Hospital Association as “isolated” (serving the most remote areas of the province) and “rural” (hospitals in smaller communities serving rural areas), no effect of isolation on ALOS for cardiac cases is evident (Exhibit 2.21). In fact, the ALOS among the isolated hospitals is lower than that of the rural hospitals for AMI and CHF.

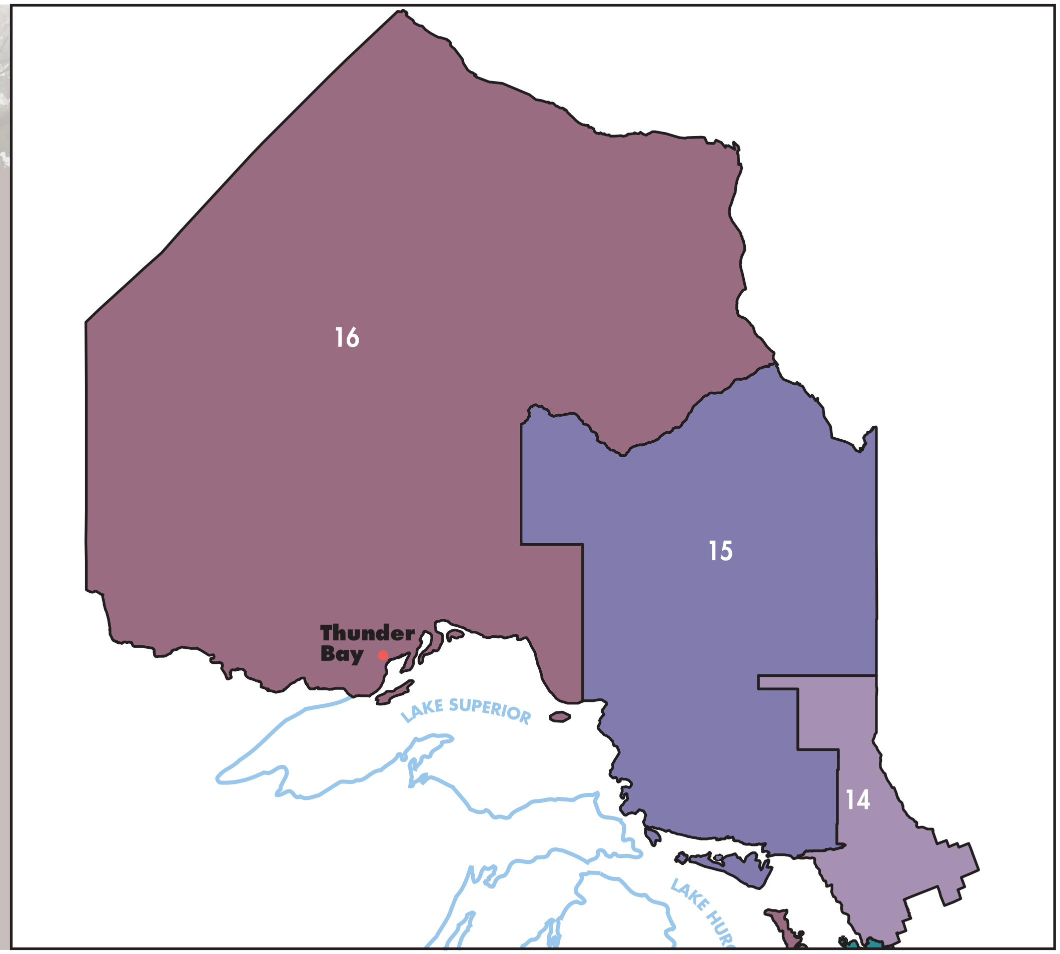
Apart from hospital factors, ALOS is also influenced by patient factors. It increases with the age of the patient and increases with comorbidity. ALOS for women was 0.74, 0.79, 0.34 and 0.42 days shorter for AMI, CHF, angina and chest pain, respectively, than for men after adjustment for age and comorbidity. The oldest patients had hospitalizations 0.72, 0.84, 0.23, and 0.35 days longer than those aged 65 to 75 years for these cardiac conditions. Patients with the highest levels of comorbidity had ALOS 3.00, 2.50, 1.59, and 1.36 days longer than those with no recorded comorbidity, as measured by the Charlson-Deyo index.

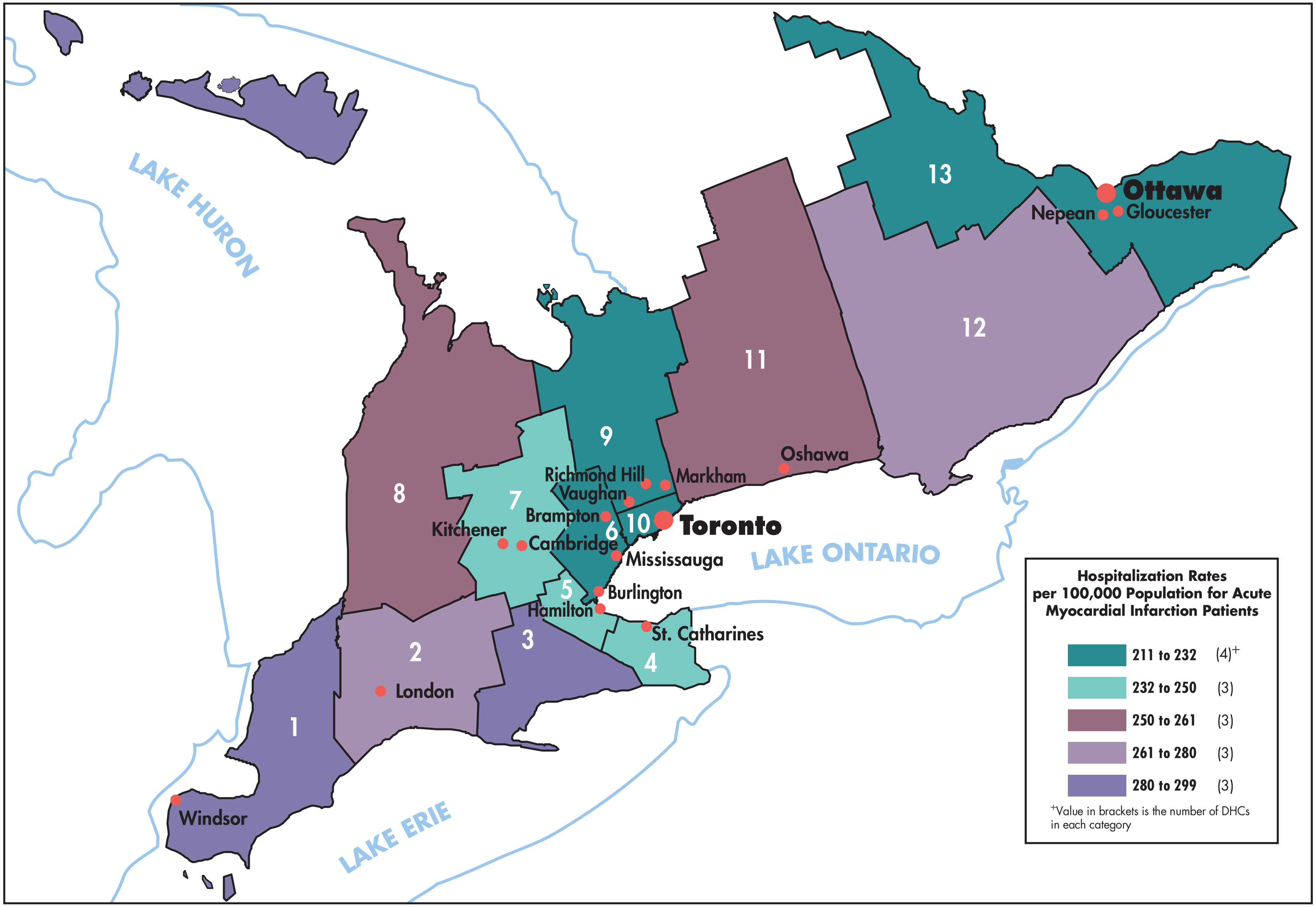
2.7 EXHIBIT

Age/Sex-adjusted Acute Myocardial Infarction Hospitalization Rates per 100,000 Population Aged 20 Years and Over by District Health Council in Ontario, 1992/93 - 1996/97

ONTARIO *District Health Councils*

1. Essex, Kent and Lambton
2. Thames Valley
3. Grand River
4. Niagara Region
5. Hamilton-Wentworth
6. Halton-Peel
7. Waterloo Region-Wellington-Dufferin
8. Grey, Bruce, Huron, Perth
9. Simcoe-York
10. Toronto
11. Durham, Haliburton, Kawartha and Pine Ridge
12. Quinte, Kingston, Rideau
13. Champlain
14. Muskoka, Nipissing, Parry Sound and Timiskaming
15. Algoma, Cochrane, Manitoulin and Sudbury
16. Northwestern Ontario





Data Source: Canadian Institute for Health Information, Registered Persons Database

EXHIBIT 2.8 Age/Sex-adjusted Acute Myocardial Infarction Hospitalization Rates, Expected Number of Cases and Expected Annual Growth per 100,000 Population Aged 20 Years and Over by County and City in Ontario, 1992/93 - 1996/97

County/City	Adjusted Rate	Expected Cases 1996/97	Expected Cases 2003/04	Annual Growth (%)	Rank
Algoma District	285	257	286	2	10
Brant County	263	232	269	2	25
Bruce County	285	147	165	2	11
Cochrane District	263	155	181	2	24
Dufferin County	273	72	105	6	18
Durham Regional Municipality	256	683	993	6	28
Elgin County	281	158	188	3	13
Essex County	253	665	833	3	31
Frontenac County	269	270	335	3	21
Grey County	250	207	242	2	33
Haldimand-Norfolk Regional Municipality	340	211	252	3	4
Haliburton County	231	45	54	3	43
Halton Regional Municipality	214	604	806	4	49
Hamilton-Wentworth Regional Municipality	232	953	1,119	2	42
Hastings County	302	258	293	2	7
Huron County	272	140	153	1	19
Kenora District	193	97	113	2	55
Kent County	390	225	246	1	1
Lambton County	254	269	299	2	30
Lanark County	260	127	160	3	27
Leeds and Grenville United Counties	239	216	261	3	38
Lennox and Addington County	300	81	97	3	8
Manitoulin District	384	26	30	2	2
Middlesex County	251	715	850	3	32
Muskoka District Municipality	232	125	150	3	41
Niagara Regional Municipality	249	906	1,035	2	34
Nipissing District	275	166	188	2	15
Northumberland County	219	186	222	3	48
Ottawa-Carleton Regional Municipality					
City of Ottawa	188	727	817	2	56
East Region	227	212	308	6	47
West Region	197	311	457	6	54
Oxford County	282	198	231	2	12
Parry Sound District	254	101	118	2	29
Peel Regional Municipality					
Brampton	234	388	620	7	40
Mississauga	229	747	1,220	7	45
Perth County	239	148	164	2	37
Peterborough County	248	295	332	2	35
Prescott and Russell United Counties	271	122	168	5	20
Prince Edward County	314	65	77	3	5
Rainy River District	264	48	51	1	23
Renfrew County	260	201	238	3	26
Simcoe County	268	633	856	4	22
Stormont, Dundas and Glengarry United Counties	310	239	276	2	6
Sudbury District	298	47	54	2	9
Sudbury Regional Municipality	273	297	359	3	17
Thunder Bay District	274	299	339	2	16
Timiskaming District	349	82	86	1	3
Toronto Metropolitan Municipality					
East York	205	232	285	3	51
Etobicoke	201	707	855	3	53
North York	227	1,255	1,465	2	46
City of Scarborough	241	1,008	1,271	3	36
City of Toronto	182	1,175	1,325	2	57
City of York	202	277	337	3	52
Victoria County	281	167	202	3	14
Waterloo Regional Municipality	236	676	865	4	39
Wellington County	229	307	388	3	44
York Regional Municipality	206	881	1,386	7	50
Ontario	**240**	**20,040**	**25,080**		

Data Source: Canadian Institute for Health Information

EXHIBIT 2.9 Age/Sex-adjusted Congestive Heart Failure Hospitalization Rates, Expected Number of Cases and Expected Annual Growth per 100,000 Population Aged 20 Years and Over by District Health Council in Ontario, 1992/93 - 1996/97

District Health Council	Adjusted Rate	Expected Cases 1996/97	Expected Cases 2003/04	Annual Growth (%)	Rank
Algoma, Cochrane, Manitoulin and Sudbury	360	890	1,083	3	3
Champlain	267	2,176	2,820	4	11
Durham, Haliburton, Kawartha and Pine Ridge	296	1,635	2,288	5	9
Essex, Kent and Lambton	360	1,430	1,769	3	4
Grand River	346	558	678	3	6
Grey, Bruce, Huron, Perth	351	830	973	2	5
Halton-Peel	254	1,823	3,101	8	15
Hamilton-Wentworth	237	1,178	1,450	3	16
Muskoka, Nipissing, Parry Sound and Timiskaming	366	579	702	3	2
Niagara Region	320	1,138	1,373	3	7
Northwestern Ontario	373	532	616	2	1
Quinte, Kingston, Rideau	303	1,276	1,614	3	8
Simcoe-York	281	1,689	2,755	7	10
Thames Valley	262	1,339	1,630	3	13
Toronto	259	5,765	7,084	3	14
Waterloo Region-Wellington-Dufferin	262	1,263	1,688	4	12
Ontario	**287**	**24,100**	**31,620**		

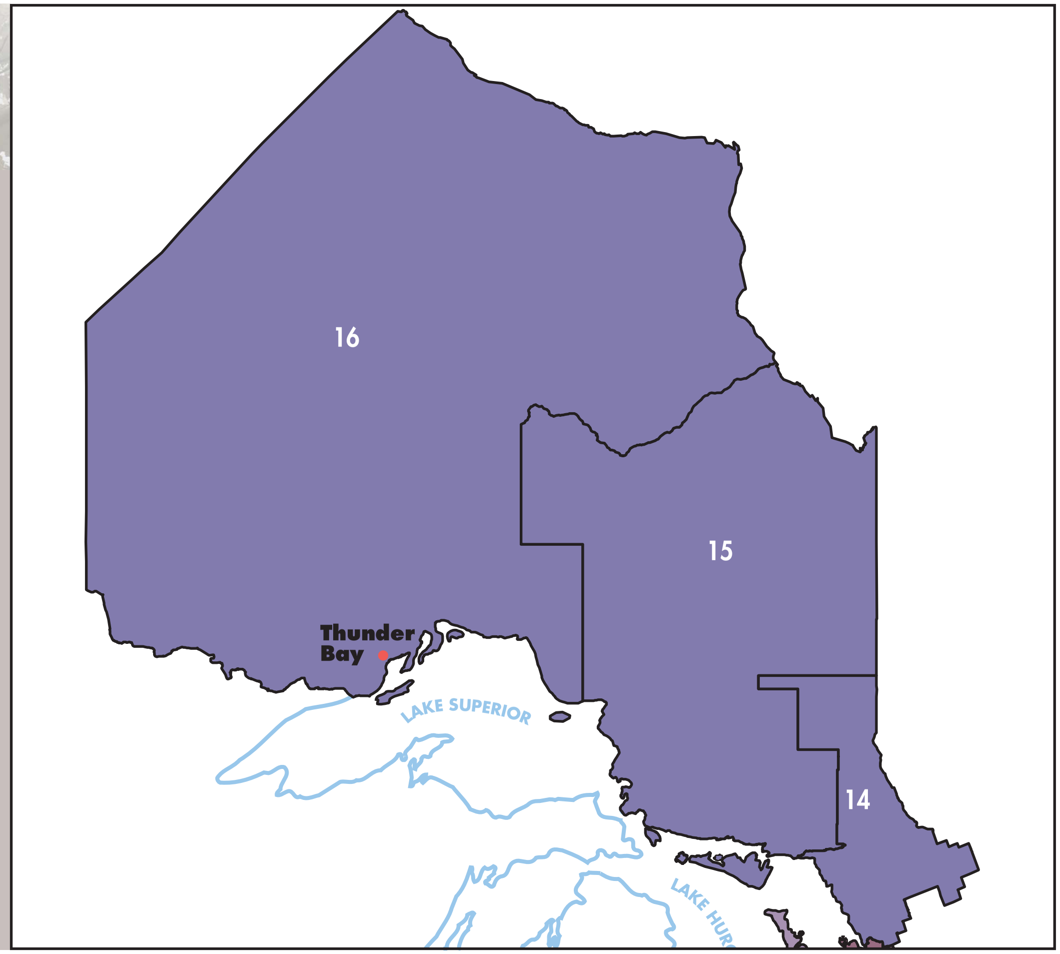
Data Source: Canadian Institute for Health Information

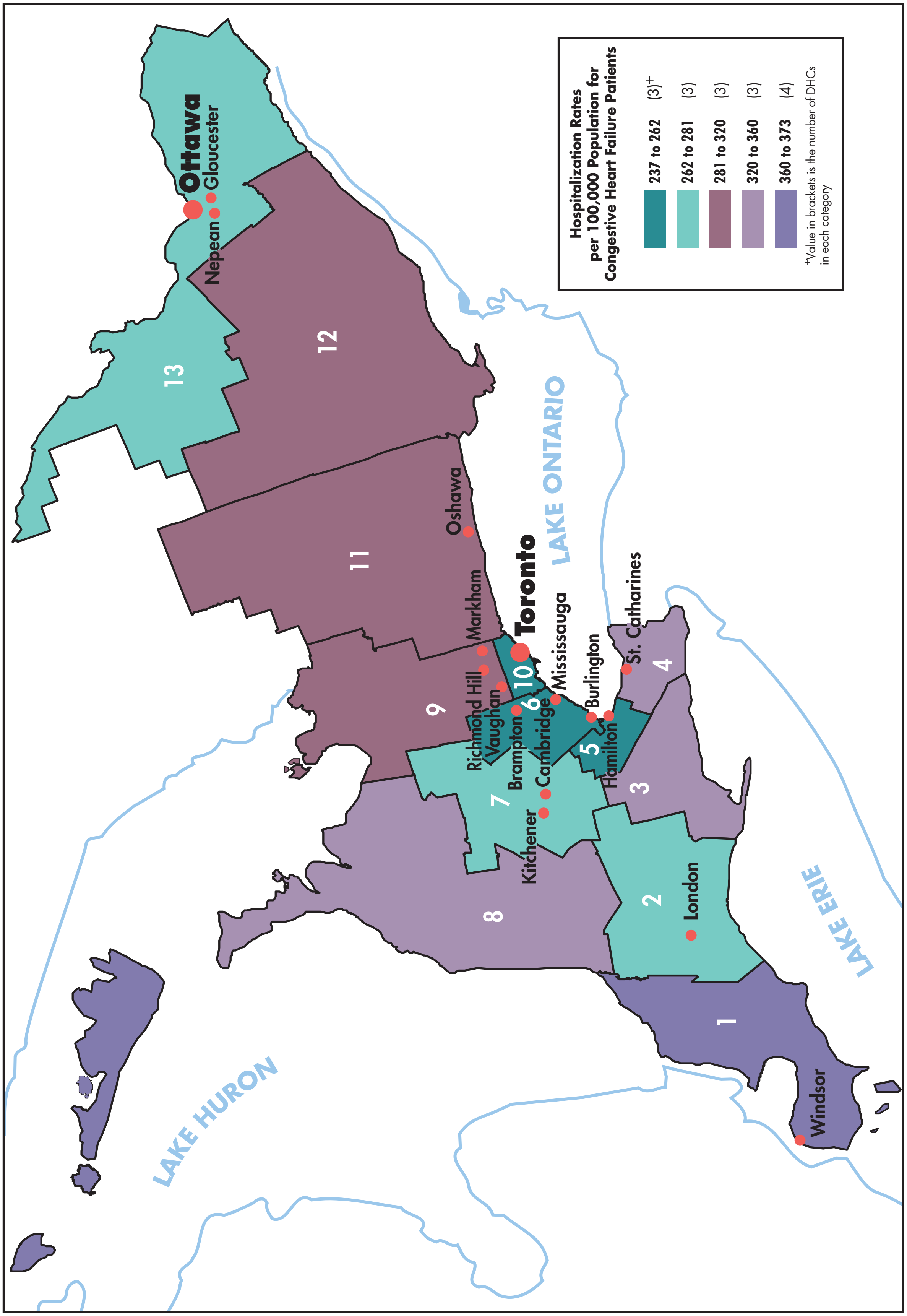
2.10 EXHIBIT

Age/Sex-adjusted Congestive Heart Failure Hospitalization Rates per 100,000 Population Aged 20 Years and Over by District Health Council in Ontario, 1992/93 - 1996/97

ONTARIO *District Health Councils*

1. Essex, Kent and Lambton
2. Thames Valley
3. Grand River
4. Niagara Region
5. Hamilton-Wentworth
6. Halton-Peel
7. Waterloo Region-Wellington-Dufferin
8. Grey, Bruce, Huron, Perth
9. Simcoe-York
10. Toronto
11. Durham, Haliburton, Kawartha and Pine Ridge
12. Quinte, Kingston, Rideau
13. Champlain
14. Muskoka, Nipissing, Parry Sound and Timiskaming
15. Algoma, Cochrane, Manitoulin and Sudbury
16. Northwestern Ontario





Data Source: Canadian Institute for Health Information

EXHIBIT 2.11 Age/Sex-adjusted Congestive Heart Failure Hospitalization Rates, Expected Number of Cases and Expected Annual Growth per 100,000 Population Aged 20 Years and Over by County and City in Ontario, 1992/93 - 1996/97

County/City	Adjusted Rate	Expected Cases 1996/97	Expected Cases 2003/04	Annual Growth (%)	Rank
Algoma District	389	297	347	2	7
Brant County	320	296	353	3	25
Bruce County	374	184	215	2	12
Cochrane District	361	174	206	2	14
Dufferin County	310	85	131	6	31
Durham Regional Municipality	308	753	1,183	7	32
Elgin County	322	200	247	3	24
Essex County	361	816	1,073	4	15
Frontenac County	229	332	435	4	54
Grey County	412	267	329	3	5
Haldimand-Norfolk Regional Municipality	377	262	325	3	9
Haliburton County	196	57	76	4	57
Halton Regional Municipality	257	677	976	5	43
Hamilton-Wentworth Regional Municipality	237	1,178	1,450	3	52
Hastings County	316	326	387	3	29
Huron County	319	184	210	2	27
Kenora District	347	112	132	2	20
Kent County	364	287	319	2	13
Lambton County	358	327	377	2	17
Lanark County	341	162	213	4	22
Leeds and Grenville United Counties	353	273	348	4	18
Lennox and Addington County	229	100	124	3	53
Manitoulin District	628	33	40	3	1
Middlesex County	222	886	1,078	3	55
Muskoka District Municipality	318	156	203	4	28
Niagara Regional Municipality	320	1,138	1,373	3	26
Nipissing District	375	198	231	2	11
Northumberland County	308	231	295	4	33
Ottawa-Carleton Regional Municipality					
City of Ottawa	220	954	1,103	2	56
East Region	259	202	313	7	41
West Region	249	319	519	7	47
Oxford County	352	253	305	3	19
Parry Sound District	358	123	158	4	16
Peel Regional Municipality					
Brampton	258	381	691	9	42
Mississauga	246	765	1,435	9	49
Perth County	279	196	219	2	37
Peterborough County	274	382	455	3	38
Prescott and Russell United Counties	345	143	206	5	21
Prince Edward County	396	83	106	4	6
Rainy River District	414	61	68	1	4
Renfrew County	424	255	316	3	3
Simcoe County	332	769	1,122	6	23
Stormont, Dundas and Glengarry United Counties	308	303	362	3	34
Sudbury District	387	49	60	3	8
Sudbury Regional Municipality	306	336	430	4	35
Thunder Bay District	375	359	417	2	10
Timiskaming District	434	102	110	1	2
Toronto Metropolitan Municipality					
East York	248	312	392	3	48
Etobicoke	242	876	1,135	4	50
North York	272	1,591	1,954	3	39
City of Scarborough	255	1,168	1,567	4	46
City of Toronto	257	1,466	1,595	1	44
City of York	285	351	441	3	36
Victoria County	315	212	279	4	30
Waterloo Regional Municipality	261	802	1,065	4	40
Wellington County	256	376	492	4	45
York Regional Municipality	242	920	1,633	9	51
Ontario	**287**	**24,100**	**31,620**		

Data Source: Canadian Institute for Health Information

EXHIBIT 2.12 Age/Sex-adjusted Angina Hospitalization Rates, Expected Number of Cases and Expected Annual Growth per 100,000 Population Aged 20 Years and Over by District Health Council in Ontario, 1992/93 - 1996/97

District Health Council	Adjusted Rate	Expected Cases 1996/97	Expected Cases 2003/04	Annual Growth (%)	Rank
Algoma, Cochrane, Manitoulin and Sudbury	376	882	1,019	2	4
Champlain	263	2,026	2,511	3	11
Durham, Haliburton, Kawartha and Pine Ridge	293	1,536	1,986	4	9
Essex, Kent and Lambton	303	1,295	1,522	2	7
Grand River	404	492	573	2	1
Grey, Bruce, Huron, Perth	298	708	792	2	8
Halton-Peel	237	1,966	2,950	6	13
Hamilton-Wentworth	285	1,065	1,235	2	10
Muskoka, Nipissing, Parry Sound and Timiskaming	377	530	601	2	3
Niagara Region	304	1,012	1,140	2	6
Northwestern Ontario	335	494	557	2	5
Quinte, Kingston, Rideau	400	1,132	1,342	3	2
Simcoe-York	255	1,697	2,478	6	12
Thames Valley	211	1,193	1,402	2	15
Toronto	200	5,213	6,142	2	16
Waterloo Region-Wellington-Dufferin	237	1,177	1,501	4	14
Ontario	**268**	**22,415**	**27,750**		

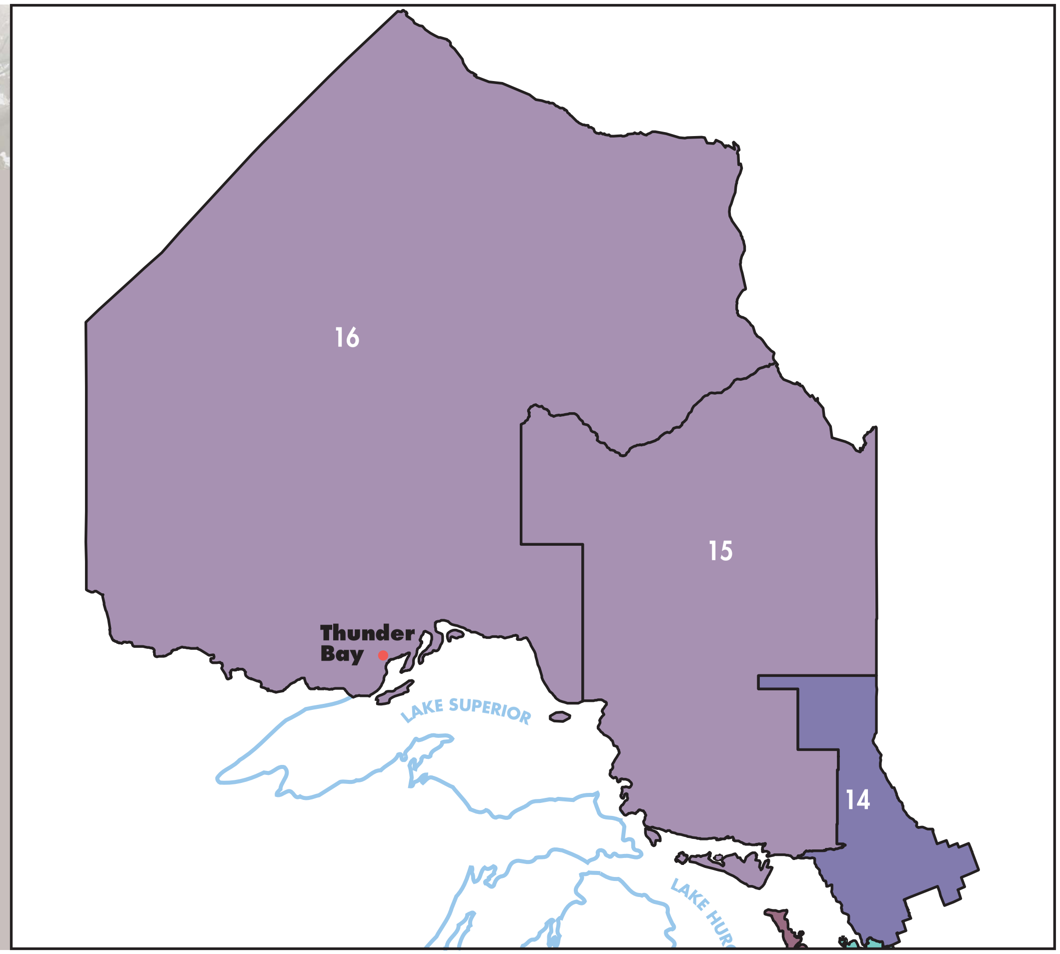
Data Source: Canadian Institute for Health Information

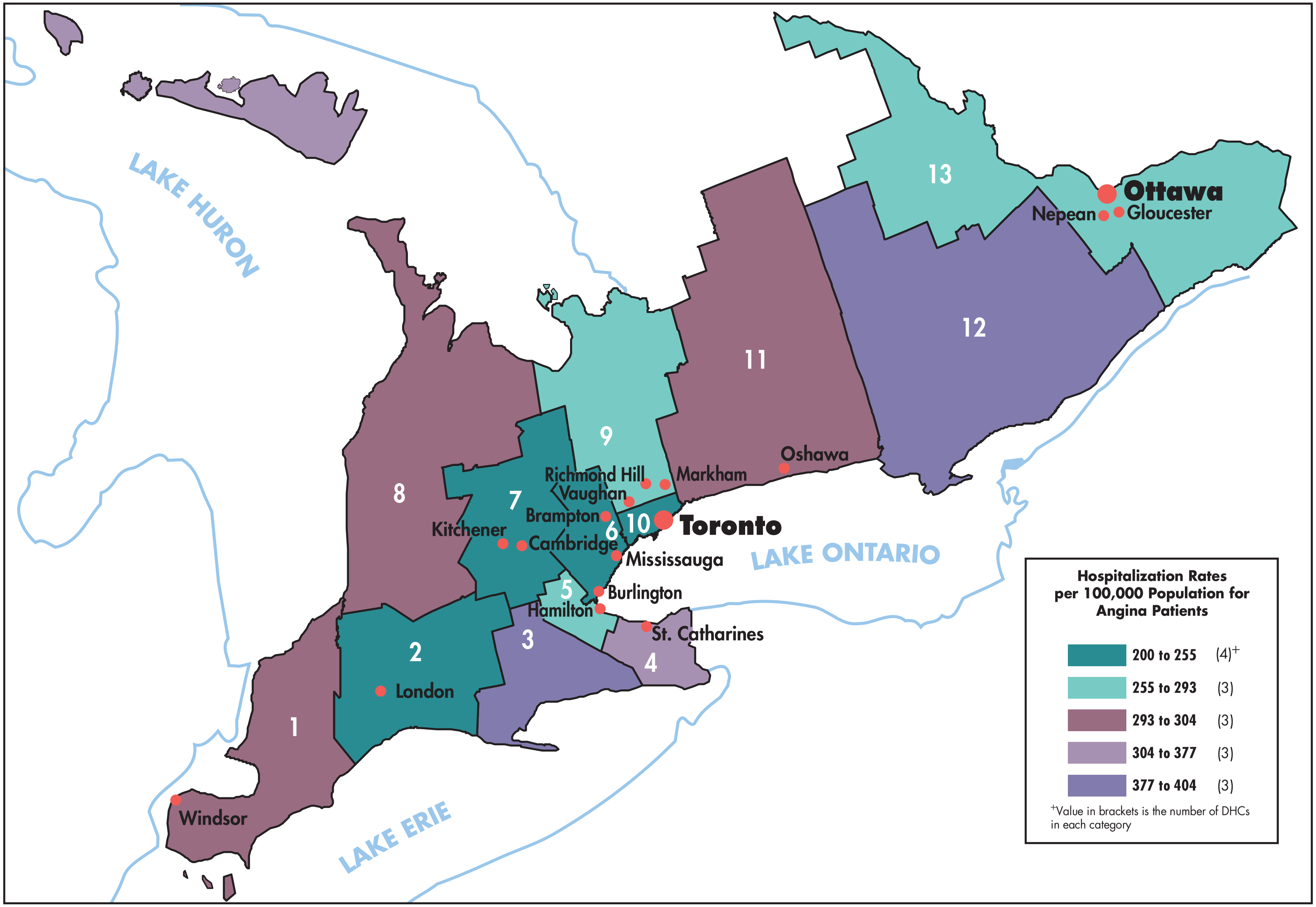
EXHIBIT 2.13

Age/Sex-adjusted Angina Hospitalization Rates per 100,000 Population Aged 20 Years and Over by District Health Council in Ontario, 1992/93 - 1996/97

ONTARIO District Health Councils

1. Essex, Kent and Lambton
2. Thames Valley
3. Grand River
4. Niagara Region
5. Hamilton-Wentworth
6. Halton-Peel
7. Waterloo Region-Wellington-Dufferin
8. Grey, Bruce, Huron, Perth
9. Simcoe-York
10. Toronto
11. Durham, Haliburton, Kawartha and Pine Ridge
12. Quinte, Kingston, Rideau
13. Champlain
14. Muskoka, Nipissing, Parry Sound and Timiskaming
15. Algoma, Cochrane, Manitoulin and Sudbury
16. Northwestern Ontario





Data Source: Canadian Institute for Health Information

EXHIBIT 2.14 Age/Sex-adjusted Angina Hospitalization Rates, Expected Number of Cases and Expected Annual Growth per 100,000 Population Aged 20 Years and Over by County and City in Ontario, 1992/93 - 1996/97

County/City	Adjusted Rate	Expected Cases 1996/97	Expected Cases 2003/04	Annual Growth (%)	Rank
Algoma District	355	289	321	2	18
Brant County	368	257	296	2	17
Bruce County	344	162	181	2	21
Cochrane District	480	174	203	2	5
Dufferin County	235	79	115	5	42
Durham Regional Municipality	329	767	1,101	5	24
Elgin County	290	175	207	2	36
Essex County	220	744	919	3	46
Frontenac County	292	302	369	3	35
Grey County	327	229	264	2	26
Haldimand-Norfolk Regional Municipality	447	235	277	2	7
Haliburton County	393	51	59	2	13
Halton Regional Municipality	297	680	898	4	33
Hamilton-Wentworth Regional Municipality	285	1,065	1,235	2	37
Hastings County	487	288	322	2	4
Huron County	270	154	167	1	39
Kenora District	311	108	126	2	29
Kent County	500	250	272	1	2
Lambton County	345	300	332	1	20
Lanark County	439	141	174	3	8
Leeds and Grenville United Counties	380	240	286	3	15
Lennox and Addington County	409	89	107	3	11
Manitoulin District	535	29	33	2	1
Middlesex County	154	798	941	2	57
Muskoka District Municipality	374	139	165	2	16
Niagara Regional Municipality	304	1,012	1,140	2	31
Nipissing District	343	187	210	2	22
Northumberland County	280	206	243	2	38
Ottawa-Carleton Regional Municipality					
City of Ottawa	216	809	898	2	47
East Region	235	240	351	6	43
West Region	202	352	513	6	51
Oxford County	354	220	254	2	19
Parry Sound District	404	112	130	2	12
Peel Regional Municipality					
Brampton	184	440	694	7	53
Mississauga	211	846	1,357	7	49
Perth County	239	163	179	1	41
Peterborough County	213	327	363	2	48
Prescott and Russell United Counties	306	135	185	5	30
Prince Edward County	494	72	84	2	3
Rainy River District	436	53	56	1	9
Renfrew County	465	224	261	2	6
Simcoe County	324	705	936	4	28
Stormont, Dundas and Glengarry United Counties	336	265	303	2	23
Sudbury District	389	53	61	2	14
Sudbury Regional Municipality	324	336	401	3	27
Thunder Bay District	328	333	375	2	25
Timiskaming District	412	91	96	1	10
Toronto Metropolitan Municipality					
East York	299	257	312	3	32
Etobicoke	173	795	943	3	55
North York	200	1,404	1,618	2	52
City of Scarborough	226	1,144	1,424	3	44
City of Toronto	182	1,303	1,473	2	54
City of York	167	310	372	3	56
Victoria County	295	185	220	3	34
Waterloo Regional Municipality	244	757	959	3	40
Wellington County	222	341	427	3	45
York Regional Municipality	208	992	1,543	7	50
Ontario	**268**	**22,415**	**27,750**		

Data Source: Canadian Institute for Health Information

EXHIBIT 2.15 Age/Sex-adjusted Chest Pain Hospitalization Rates, Expected Number of Cases and Expected Annual Growth per 100,000 Population Aged 20 Years and Over by District Health Council in Ontario, 1992/93 - 1996/97

District Health Council	Adjusted Rate	Expected Cases 1996/97	Expected Cases 2003/04	Annual Growth (%)	Rank
Algoma, Cochrane, Manitoulin and Sudbury	282	567	636	2	2
Champlain	151	1,317	1,593	3	14
Durham, Haliburton, Kawartha and Pine Ridge	161	981	1,222	3	13
Essex, Kent and Lambton	272	802	923	2	4
Grand River	205	300	345	2	8
Grey, Bruce, Huron, Perth	239	413	458	2	5
Halton-Peel	169	1,415	1,942	5	12
Hamilton-Wentworth	172	652	745	2	11
Muskoka, Nipissing, Parry Sound and Timiskaming	279	318	350	1	3
Niagara Region	178	601	663	1	9
Northwestern Ontario	294	313	352	2	1
Quinte, Kingston, Rideau	221	683	792	2	6
Simcoe-York	137	1,157	1,568	4	15
Thames Valley	176	745	869	2	10
Toronto	98	3,268	3,810	2	16
Waterloo Region-Wellington-Dufferin	208	770	956	3	7
Ontario	**171**	**14,300**	**17,225**		

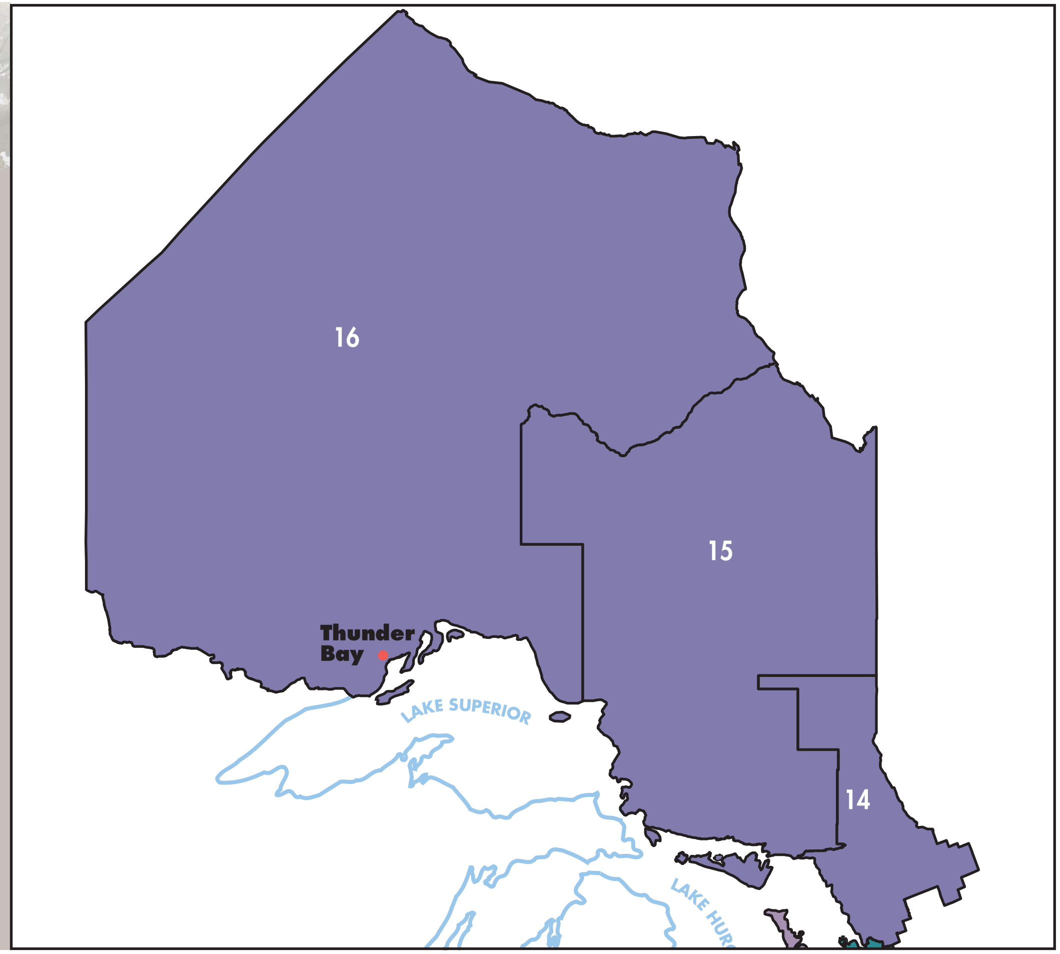
Data Source: Canadian Institute for Health Information

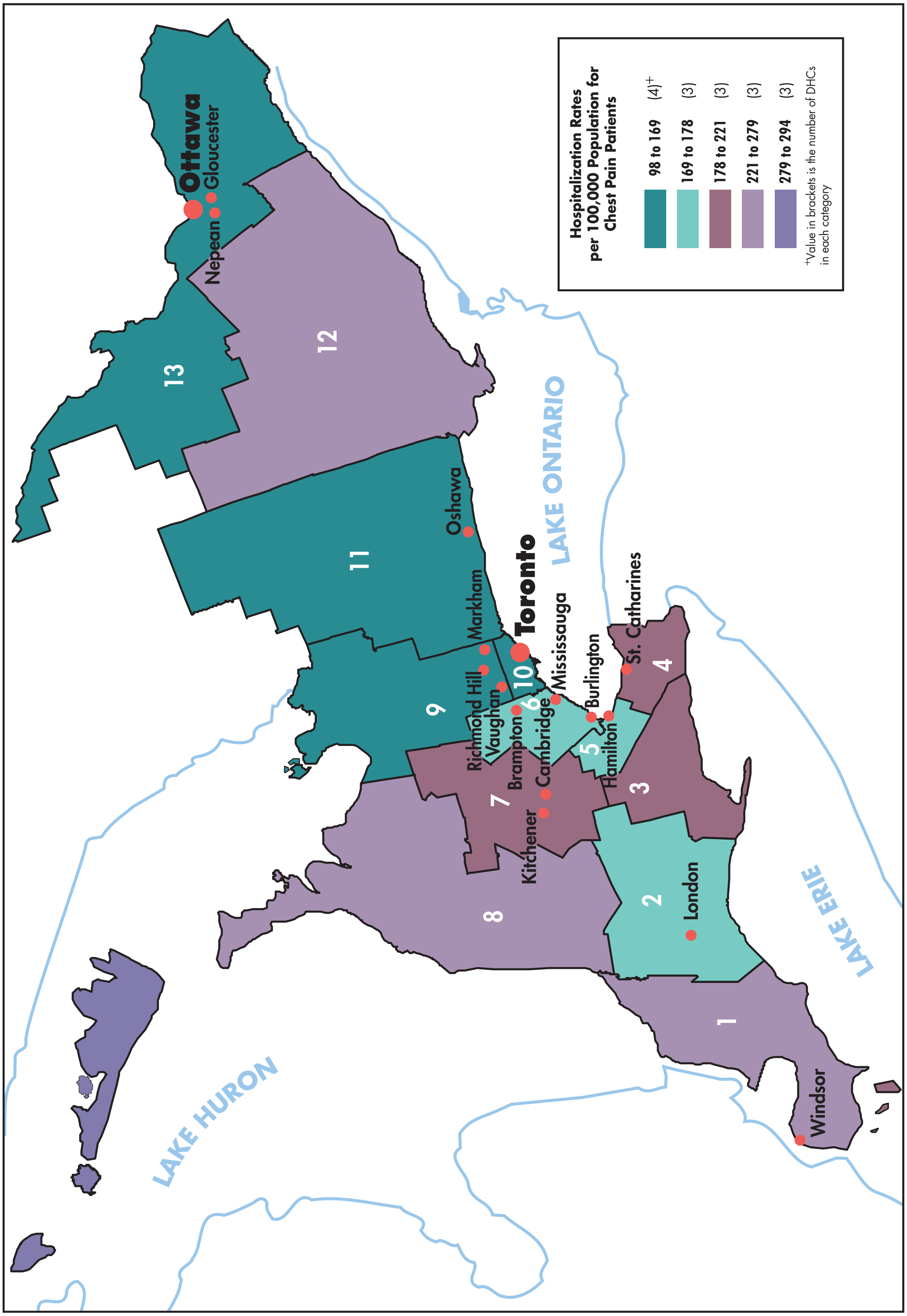
2.16 EXHIBIT

Age/Sex-adjusted Chest Pain Hospitalization Rates per 100,000 Population Aged 20 Years and Over by District Health Council in Ontario, 1992/93 - 1996/97

ONTARIO *District Health Councils*

1. Essex, Kent and Lambton
2. Thames Valley
3. Grand River
4. Niagara Region
5. Hamilton-Wentworth
6. Halton-Peel
7. Waterloo Region-Wellington-Dufferin
8. Grey, Bruce, Huron, Perth
9. Simcoe-York
10. Toronto
11. Durham, Haliburton, Kawartha and Pine Ridge
12. Quinte, Kingston, Rideau
13. Champlain
14. Muskoka, Nipissing, Parry Sound and Timiskaming
15. Algoma, Cochrane, Manitoulin and Sudbury
16. Northwestern Ontario





Data Source: Canadian Institute for Health Information

EXHIBIT 2.17 Age/Sex-adjusted Chest Pain Hospitalization Rates, Expected Number of Cases and Expected Annual Growth per 100,000 Population Aged 20 Years and Over by County and City in Ontario, 1992/93 - 1996/97

County/City	Adjusted Rate	Expected Cases 1996/97	Expected Cases 2003/04	Annual Growth (%)	Rank
Algoma District	223	181	194	1	27
Brant County	149	157	179	2	42
Bruce County	252	96	105	1	22
Cochrane District	317	116	132	2	7
Dufferin County	209	54	74	5	31
Durham Regional Municipality	127	537	724	4	47
Elgin County	228	107	124	2	26
Essex County	266	467	560	3	17
Frontenac County	147	187	223	3	43
Grey County	257	133	150	2	20
Haldimand-Norfolk Regional Municipality	266	143	166	2	18
Haliburton County	351	28	31	1	4
Halton Regional Municipality	198	455	566	3	34
Hamilton-Wentworth Regional Municipality	172	652	745	2	39
Hastings County	254	171	189	1	21
Huron County	277	88	95	1	16
Kenora District	288	71	82	2	14
Kent County	336	151	164	1	6
Lambton County	239	184	199	1	23
Lanark County	311	86	103	3	9
Leeds and Grenville United Counties	203	143	166	2	32
Lennox and Addington County	230	55	65	2	25
Manitoulin District	378	17	19	1	2
Middlesex County	135	506	593	2	46
Muskoka District Municipality	289	81	92	2	13
Niagara Regional Municipality	178	601	663	1	37
Nipissing District	313	117	129	1	8
Northumberland County	190	122	140	2	36
Ottawa-Carleton Regional Municipality					
City of Ottawa	108	487	546	2	49
East Region	103	190	252	4	51
West Region	141	256	342	4	45
Oxford County	292	133	152	2	11
Parry Sound District	212	65	72	1	30
Peel Regional Municipality					
Brampton	142	336	476	5	44
Mississauga	161	624	900	5	40
Perth County	173	97	108	2	38
Peterborough County	216	189	206	1	28
Prescott and Russell United Counties	91	91	119	4	56
Prince Edward County	294	41	46	2	10
Rainy River District	398	31	34	1	1
Renfrew County	346	134	154	2	5
Simcoe County	199	440	562	4	33
Stormont, Dundas and Glengarry United Counties	235	159	179	2	24
Sudbury District	358	35	38	1	3
Sudbury Regional Municipality	289	219	253	2	12
Thunder Bay District	280	210	235	2	15
Timiskaming District	265	55	57	1	19
Toronto Metropolitan Municipality					
East York	109	155	189	3	48
Etobicoke	90	478	554	2	57
North York	101	842	958	2	52
City of Scarborough	107	744	890	3	50
City of Toronto	93	855	989	2	55
City of York	96	193	230	3	54
Victoria County	150	105	122	2	41
Waterloo Regional Municipality	213	498	615	3	29
Wellington County	197	217	267	3	35
York Regional Municipality	101	717	1,006	5	53
Ontario	**171**	**14,300**	**17,225**		

Data Source: Canadian Institute for Health Information

EXHIBIT 2.18 Age/Sex-adjusted Acute Myocardial Infarction, Angina and Congestive Heart Failure Hospitalization Rates per 100,000 Population Aged 20 Years and Over by Municipalities with Populations Greater than 100,000 Versus Other Areas in Ontario District Health Councils, 1992/93 - 1996/97

Large Municipality/Other Areas	Acute Myocardial Infarction Age/Sex-adjusted Rate	Angina Age/Sex-adjusted Rate	Congestive Heart Failure Age/Sex-adjusted Rate	Chest Pain Age/Sex-adjusted Rate
Champlain				
Gloucester	192	191	233	89
Nepean	176	184	226	126
Ottawa	198	229	233	112
Other	254	323	317	198
Durham, Haliburton, Kawartha and Pine Ridge				
Oshawa	274	374	340	156
Other	248	281	290	166
Essex, Kent and Lambton				
Windsor	273	245	398	280
Other	283	334	340	268
Halton-Peel				
Brampton	244	188	266	145
Burlington	240	368	238	213
Mississauga	228	211	247	160
Oakville	202	271	267	197
Other	201	212	286	168
Hamilton-Wentworth				
Hamilton	248	305	259	188
Other	181	222	171	130
Niagara Region				
St. Catharines	240	318	297	170
Other	255	300	334	184
Northwestern Ontario				
Thunder Bay	286	311	381	289
Other	217	366	363	303
Simcoe-York				
Markham	183	172	177	77
Richmond Hill	195	210	210	83
Vaughan	198	180	287	89
Other	254	298	316	173
Thames Valley				
London	247	144	208	131
Other	290	304	342	242
Waterloo Region-Wellington-Dufferin				
Cambridge	288	341	309	239
Kitchener	235	233	275	231
Other	223	210	243	189

Note: For areas within District Health Councils (DHCs), Census 1996 population data were used for rate denominators. This accounts for any apparent inconsistencies in rates as compared with previous DHC-specific tables.

Data Source: Canadian Institute for Health Information, Canadian Census 1996

EXHIBIT 2.19 Average Length of Stay for Selected Cardiac Diagnoses in Ontario by Year, 1992/93 - 1996/97

Diagnosis/ Fiscal Year	Number of Eligible Cases	Actual Length of Stay	Adjusted Length of Stay**	Alternate Level of Care Days (%)***	Alternate Level of Care or Above Trim Days (%)†
Acute Myocardial Infarction					
1992/93	13,939	9.82	9.87	3.6	6.6
1993/94	14,501	9.31	9.36	3.6	6.3
1994/95	14,364	9.02	9.03	2.7	4.9
1995/96	14,613	8.66	8.65	4.1	6.5
1996/97	15,251	8.38	8.29	3.6	5.9
Congestive Heart Failure					
1992/93	18,697	8.57	8.59	8.3	12.1
1993/94	20,310	8.32	8.36	10.8	13.8
1994/95	20,110	7.93	7.94	10.1	13.5
1995/96	20,039	7.62	7.60	9.6	12.1
1996/97	20,449	7.33	7.29	10.8	12.9
Angina					
1992/93	17,260	4.63	4.64	1.1	6.6
1993/94	18,227	4.58	4.60	1.9	6.7
1994/95	19,079	4.47	4.49	1.5	5.8
1995/96	18,811	4.31	4.30	1.5	5.4
1996/97	20,063	4.26	4.23	1.4	5.7
Chest Pain					
1992/93	13,217	2.82	2.83	0.7	2.5
1993/94	13,294	2.67	2.69	1.1	2.7
1994/95	13,400	2.57	2.58	1.0	3.1
1995/96	13,731	2.51	2.49	0.8	2.3
1996/97	13,420	2.42	2.40	0.8	2.2

* Eligible Cases: Hospital admissions not including in-hospital deaths and cases transferred in or out of hospital.

** Length of Stay: Average length of hospitalization not including days coded as "alternate level of care" or days above 97.5 percentile for the diagnostic group.

*** Alternate Level of Care Days: Percentage of total hospitalized days coded as "alternate level of care" by hospitals.

† Alternate Level of Care or Above Trim Days: Percentage of total hospitalized days either coded as alternate level of care or above the 97.5 percentile length of stay.

Data Source: Canadian Institute for Health Information

EXHIBIT 2.20 Average Length of Stay for Cardiac Diagnoses by Hospital Group in Ontario, 1992/93 - 1996/97

Diagnosis/ Hospital Size	Number of Eligible Cases	Actual Length of Stay (Days)	Adjusted Length of Stay (Days)
Acute Myocardial Infarction			
Small	4,670	9.01	9.03
Medium	16,287	8.94	8.90
Large	37,580	8.77	8.87
Teaching	14,131	9.81	9.67
Congestive Heart Failure			
Small	9,552	7.97	7.98
Medium	24,591	7.72	7.74
Large	48,068	7.79	8.01
Teaching	17,394	8.68	8.93
Angina			
Small	8,600	3.69	3.72
Medium	21,733	3.96	3.97
Large	43,632	4.49	4.43
Teaching	19,475	5.20	4.93
Chest Pain			
Small	6,917	2.44	2.42
Medium	18,350	2.47	2.42
Large	30,115	2.60	2.56
Teaching	11,680	2.87	2.85

Data Source: Canadian Institute for Health Information

EXHIBIT 2.21 Average Length of Stay for Cardiac Diagnoses by Urban/Rural/Isolated Hospital in Ontario, 1992/93 - 1996/97

Diagnosis/ Hospital Location	Number of Eligible Cases	Actual Length of Stay (Days)	Adjusted Length of (Days)
Acute Myocardial Infarction			
Isolated	1,815	8.77	8.84
Rural	7,021	8.88	8.93
Urban	63,832	9.05	9.06
Congestive Heart Failure			
Isolated	3,355	7.43	7.61
Rural	12,489	7.75	7.92
Urban	83,761	8.00	8.13
Angina			
Isolated	3,494	3.54	3.61
Rural	11,516	3.71	3.75
Urban	78,430	4.59	4.41
Chest Pain			
Isolated	2,879	2.29	2.29
Rural	7,814	2.40	2.41
Urban	56,369	2.64	2.59

Data Source: Canadian Institute for Health Information

EXHIBIT 2.22 Age/Sex-adjusted Urgent/Emergent Acute Hospital Readmission or Death Rates within 30 Days of Discharge by Hospital Length of Stay Quintile in Ontario, 1992/93 - 1996/97

Diagnosis/Length of Stay Quintile	Number of Eligible Cases*	Age/Sex-adjusted Readmission Rate (%)**	Relative Rate***	p Trend
Acute Myocardial Infarction				
1 - Low	15,036	18.04	1.08	0.02
2	14,066	17.13	1.03	
3	14,126	17.61	1.06	
4	14,270	17.42	1.04	
5 - High	12,744	16.69	1.00	
Congestive Heart Failure				
1 - Low	20,403	25.66	1.03	0.05
2	19,277	26.08	1.04	
3	19,534	25.98	1.04	
4	19,565	25.22	1.01	
5 - High	17,345	25.03	1.00	
Angina				
1 - Low	19,893	18.11	1.10	0.00
2	17,340	17.43	1.06	
3	18,430	17.00	1.04	
4	17,958	17.22	1.05	
5 - High	16,422	16.39	1.00	
Chest Pain				
1 - Low	13,611	7.80	0.92	0.06
2	13,298	8.31	0.98	
3	12,948	8.08	0.95	
4	13,384	8.50	1.00	
5 - High	11,549	8.49	1.00	

* Eligible Cases: Cases excluding transferred cases, in-hospital deaths and cases in last two months of fiscal year 1996/97.

** Adjusted Readmission Rate: Directly standardized rate of non-elective readmission or out-of-hospital death within 30 days of discharge per 100 admissions.

*** Relative Rate: Ratio of standardized readmission rate for each ALOS quintile versus the highest ALOS quintile.

Data Source: Canadian Institute for Health Information

Readmissions

Very few markers of the outcomes of hospitalization are available through regularly collected data. Two common, potentially preventable events that are studied as sequelae to hospitalization are urgent readmissions and death after hospitalization.[1,16-22] With the decrease in ALOS over time noted above, concerns have been raised that patient outcomes may be compromised due to premature discharge of medically unstable patients. We studied the rates of readmission, the urgent hospitalization or out of hospital death within 30 days of discharge from a hospital for a cardiac diagnosis.

Despite the decrease in LOS over time noted above, the rate of readmission did not vary significantly over time for any of the diagnoses considered. However, when hospitals were grouped relative to their peers by their ALOS (that is, separated into five groups according to their ALOS within each hospital size group and

EXHIBIT 2.23 Age/Sex-adjusted Urgent/Emergent Acute Hospital Readmission or Death Rates within 30 Days of Discharge by Year in Ontario, 1992/93 - 1996/97

Diagnosis/ Fiscal Year	Number of Cases	Number of Eligible Cases*	Age/Sex-adjusted Readmission Rate (%)**	p Trend
Acute Myocardial Infarction				
1992/93	18,492	13,939	17.80	0.16
1993/94	18,956	14,501	16.61	
1994/95	18,977	14,364	17.09	
1995/96	19,330	14,613	17.46	
1996/97	17,169	12,825	18.12	
Congestive Heart Failure				
1992/93	21,705	18,697	25.65	0.29
1993/94	23,522	20,310	25.63	
1994/95	23,399	20,110	26.00	
1995/96	23,141	20,039	25.57	
1996/97	19,598	16,968	25.11	
Angina				
1992/93	19,700	17,261	17.07	0.19
1993/94	20,784	18,227	16.81	
1994/95	22,002	19,079	17.54	
1995/96	21,752	18,811	17.64	
1996/97	19,384	16,666	17.22	
Chest Pain				
1992/93	13,582	13,218	7.88	0.14
1993/94	13,633	13,294	8.15	
1994/95	13,706	13,400	8.44	
1995/96	14,054	13,731	8.30	
1996/97	11,413	11,148	8.36	

* Eligible Cases: Cases excluding transferred cases, in-hospital deaths and cases in last two months of fiscal year 1996/97.

** Adjusted Readmission Rate: Directly standardized rate of non-elective readmission or out-of-hospital death within 30 days of discharge per 100 admissions.

Data Source: Canadian Institute for Health Information

within each year of study) a pattern of increasing readmission with decreasing ALOS is evident for AMI.[23] Readmission rates in the lowest quintile of ALOS are 8% higher than for the highest quintile of ALOS for AMI. That is, on average, in any given year, within any hospital peer group size, those hospitals with the longest lengths of stay had a slightly smaller readmission rate (18.0% versus 16.7%) than those hospitals with the shortest lengths of stay. For CHF, the difference, although statistically significant, was only about 3% of readmissions. Patterns for angina and chest pain are not readily interpreted due to the coding changes noted previously (Exhibits 2.22 to 2.25).

The great majority of the readmission or death events within 30 days of discharge were readmissions of patients who were alive 30 days after the index case discharge. Of the 17.4% of AMI readmissions or deaths, 16.2% were readmitted.

EXHIBIT 2.24 Age/Sex adjusted Urgent/Emergent Acute Hospital Readmission or Death Rates within 30 Days of Discharge by Hospital Size in Ontario, 1992/93 - 1996/97

Diagnosis/ Hospital Size	Number of Cases	Number of Eligible Cases*	Age/Sex-adjusted Readmission Rate (%)**
Acute Myocardial Infarction			
Small	47,058	36,273	17.17
Medium	21,387	15,757	18.19
Large	6,641	4,550	18.00
Teaching	17,838	13,662	16.90
Congestive Heart Failure			
Small	53,139	46,270	25.54
Medium	27,606	23,797	26.28
Large	11,255	9,291	25.88
Teaching	19,365	16,766	24.69
Angina			
Small	48,455	41,948	17.62
Medium	24,124	20,982	18.06
Large	9,727	8,365	18.92
Teaching	21,316	18,749	14.90
Chest Pain			
Small	29,420	28,954	8.03
Medium	18,288	17,791	8.84
Large	7,057	6,733	10.46
Teaching	11,623	11,313	6.46

* Eligible Cases: Cases excluding transferred cases, in-hospital deaths and cases in last two months of fiscal year 1996/97.

** Adjusted Readmission Rate: Directly standardized rate of non-elective readmission or out-of-hospital death within 30 days of discharge per 100 admissions.

Data Source: Canadian Institute for Health Information

Of those readmitted, 15.0% were alive at 30 days and 1.2% had died within 30 days of discharge for the index AMI admission. An additional 1.2% of patients died within 30 days of AMI discharge without urgent readmission. For CHF, 23.2% were readmitted, of whom 2.7% died within 30 days and 2.5% died within 30 days without readmission. For angina/chest pain, 16.8% were readmitted, of whom 0.8% died within 30 days and 0.5% died within 30 days without readmission.

Readmissions for all cardiac diagnoses are slightly lower among the teaching hospitals compared to the non-teaching acute care hospitals for AMI and CHF (approximately 6% and 4% lower). The greater differences in readmission rates between teaching and non-teaching hospitals for angina and chest pain may be the result of a lower propensity to admit these cases (e.g. by managing them in the emergency department and/or outpatient facilities).

EXHIBIT 2.25 Age/Sex-adjusted Urgent/Emergent Acute Hospital Readmission or Death Rates within 30 Days of Discharge by Urban/Rural/Isolated Hospital in Ontario, 1992/93 - 1996/97

Diagnosis/ Hospital Location	Number of Cases	Number of Eligible Cases*	Age/Sex-adjusted Readmission Rate (%)**
Acute Myocardial Infarction			
Isolated	2,615	1,815	19.14
Rural	9,913	7,021	18.21
Urban	83,652	63,832	17.08
Congestive Heart Failure			
Isolated	3,985	3,355	26.08
Rural	14,681	12,489	26.29
Urban	96,701	83,761	25.14
Angina			
Isolated	4,060	3,494	19.24
Rural	13,234	11,516	18.65
Urban	90,335	78,431	16.77
Chest Pain			
Isolated	3,040	2,879	11.29
Rural	8,020	7,815	9.45
Urban	57,647	56,369	7.81

* Eligible Cases: Cases excluding transferred cases, in-hospital deaths and cases in last two months of fiscal year 1996/97.

** Adjusted Readmission Rate: Directly standardized rate of non-elective readmission or out-of-hospital death within 30 days of discharge per 100 admissions.

Data Source: Canadian Institute for Health Information

Readmissions for all cardiac diagnoses are higher among those living in lower income regions compared to high income regions (Exhibit 2.26). This is evident for both AMI and CHF (6% and 8% higher readmission rates) and most striking for angina and chest pain (15% and 38% higher rates). Part of the marked increase in the readmission rates in lower income regions may be a function of higher overall admission rates in these regions as has been demonstrated above. That is, if the propensity to admit patients to hospital is higher in lower income areas, whether due to disease severity or social factors, the likelihood of readmission will also likely be higher in these regions. On the other hand, high admission and readmission rates may both reflect limitations in ambulatory care.

EXHIBIT 2.26 Age/Sex-adjusted Urgent/Emergent Acute Hospital Readmission and Death Rates within 30 Days of Discharge by Residence Income Quintile in Ontario, 1992/93 - 1996/97

Diagnosis/ Income Quintile	Number of Cases	Number of Eligible Cases*	Age/Sex-adjusted Readmission Rate (%)**	Relative Rate***	p Trend
Acute Myocardial Infarction					
1 - Low	22,650	17,009	17.56	1.06	0.03
2	20,959	15,454	17.69	1.06	
3	17,984	13,526	17.79	1.07	
4	16,913	13,048	17.08	1.03	
5 - High	14,418	11,205	16.62	1.00	
Congestive Heart Failure					
1 - Low	26,308	22,784	25.80	1.08	0.00
2	26,321	22,602	26.03	1.09	
3	22,290	19,281	26.39	1.11	
4	20,000	17,262	25.36	1.06	
5 - High	16,446	14,195	23.87	1.00	
Angina					
1 - Low	27,112	24,028	17.98	1.15	0.00
2	24,132	21,027	17.67	1.13	
3	20,176	17,500	17.24	1.10	
4	18,217	15,731	16.83	1.07	
5 - High	13,985	11,758	15.66	1.00	
Chest Pain					
1 - Low	18,532	18,060	9.43	1.38	0.00
2	16,083	15,612	8.40	1.23	
3	12,872	12,560	7.91	1.16	
4	10,478	10,283	7.24	1.06	
5 - High	8,423	8,276	6.81	1.00	

* Eligible Cases: Cases excluding transferred cases, in-hospital deaths and cases in last two months of fiscal year 1996/97.

** Adjusted Readmission Rate: Directly standardized rate of non-elective readmission or out-of-hospital death within 30 days of discharge per 100 admissions.

*** Relative Rate: Ratio of standardized readmission rate for each income quintile versus the highest income quintile.

Data Source: Canadian Institute for Health Information

Conclusions

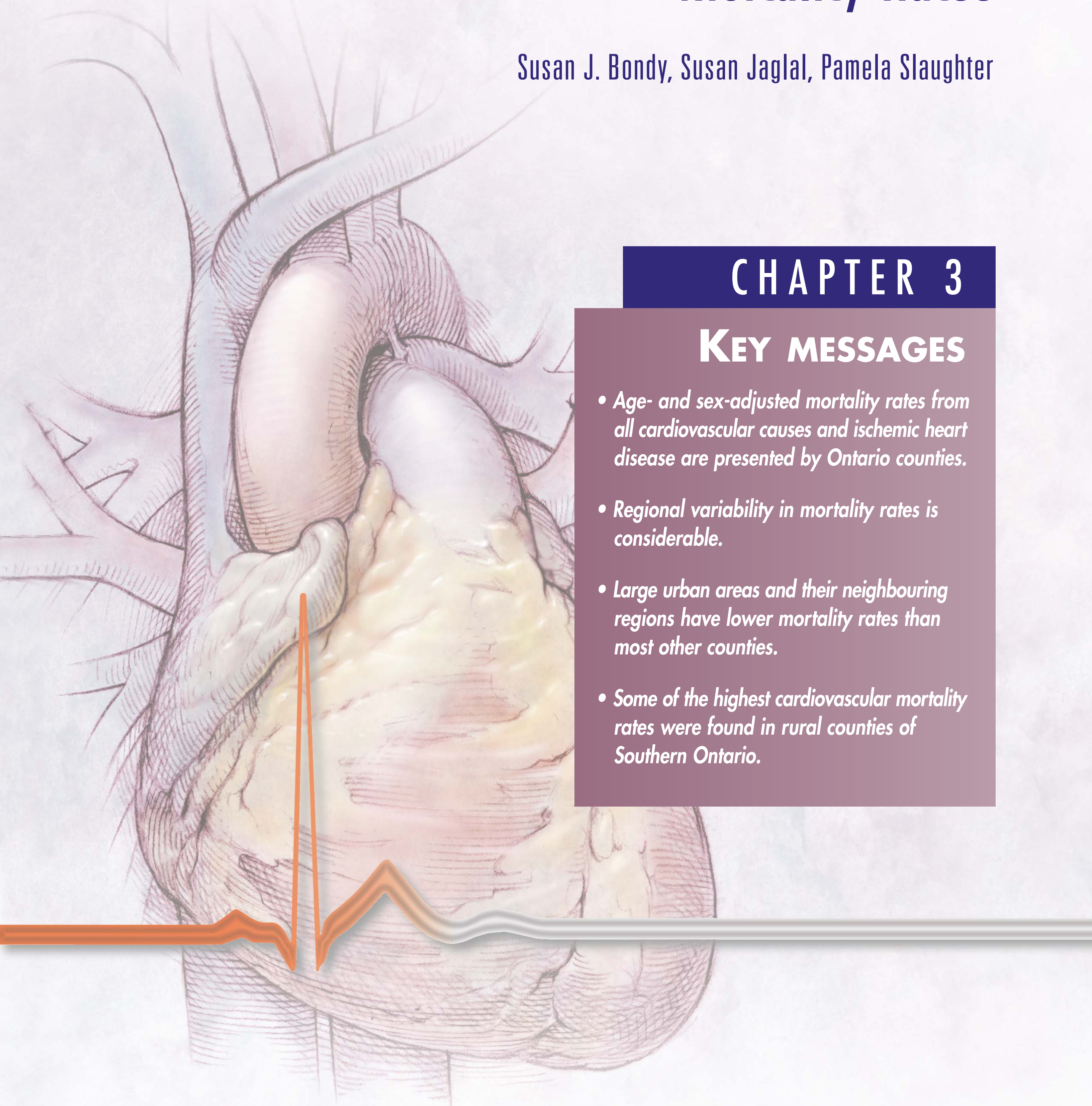
Cardiac disease is a very common reason for admission to hospital. The incidence of common cardiac hospitalizations has decreased slightly over the period 1992/93 to 1996/97 in concert with overall trends to decreased hospitalizations. Although hospitalizations remain more common among men than women, there is a clear cut trend toward increased hospitalization among women compared to men during this time period. As with many chronic diseases, the incidence rises strikingly with age in both sexes.

Cardiac admissions are far more common in areas of low income and somewhat more common in rural areas. There is substantial geographic variation in admission rates for all the common cardiac diagnoses. The lowest rates of AMI are in the metropolitan areas around Ottawa and Toronto, while the highest rates are found in northern and rural counties.

Despite the marked decrease in average lengths of hospitalization during the study period, rates of readmission did not change over time. While some relation was found between hospitals with short average LOS (when compared to their peers) and higher readmission rates, the magnitude of the difference is very modest. Readmissions vary with hospital size, location and the income level of the residence region of patients. However, observed differences are relatively small and/or are confounded with other factors, such as the propensity to admit cases and the availability of alternative health care resources that may preclude hospitalization.

Area Variation in Heart Disease Mortality Rates

Susan J. Bondy, Susan Jaglal, Pamela Slaughter



CHAPTER 3

Key messages

- *Age- and sex-adjusted mortality rates from all cardiovascular causes and ischemic heart disease are presented by Ontario counties.*
- *Regional variability in mortality rates is considerable.*
- *Large urban areas and their neighbouring regions have lower mortality rates than most other counties.*
- *Some of the highest cardiovascular mortality rates were found in rural counties of Southern Ontario.*

Key Terms & Concepts:

- regional mortality mapping
- mortality rates
- area variation
- direct standardization
- health promotion

Background

In 1997, the Heart and Stroke Foundation of Ontario (HSFO) released a report demonstrating variation in mortality rates from cardiovascular disease (CVD), ischemic heart disease (IHD) and stroke among counties in Ontario for the years 1991 to 1993.[1] A main goal of the research was to identify those regions with higher CVD mortality rates so that planners, clinicians and educators could help Ontarians in those regions modify risk factors for IHD.

Known as mortality mapping, this method has traditionally been a way to review the health history of a geographical area, facilitating appropriate intervention in areas of concern through the analysis of data. In this chapter, we present mortality rates for CVD, as well as for IHD by region from 1991/92 to 1996/97. However, this is not strictly an "update" of the previous HSFO analysis because too many factors have changed in the interim. First, Health Planning Regions, District Health Councils and Public Health Units have been reorganized significantly enough to preclude comparison. Second, this analysis was performed using a different statistical methodology than that used by the HSFO.

Data Sources

Age- and sex-adjusted mortality rates were calculated using death counts and population size estimates by county that were obtained from Statistics Canada. Reference is also made to supplementary data on regional variations in cardiovascular risk as described in the following chapter.

Number of deaths due to CVD were obtained from Statistics Canada. Cause of death categories were defined as: general CVD diagnoses (ICD-9: 390-459); and IHD (ICD-9: 410-414). Yearly data were obtained for the six-year period 1991/92 to 1996/97. The counts were tabulated by county of residence, sex and 10-year age groupings beginning with individuals 20 years of age and over.

How We Did the Analysis

For purposes of this analysis, the rates were calculated for adults 20 years and over. Any deaths that could not be attributed to a particular county, age or sex were excluded. Age- and sex-adjusted death rates by county were calculated for two three-year periods, 1991/92 to 1993/94 and 1994/95 to 1996/97. Age- and sex-adjustment was accomplished with the direct method.[2] Overall provincial age- and sex-adjusted death rates were also calculated for each of the six years (see the Methods Appendix for Chapter 3 for more detail).

Interpretive Cautions

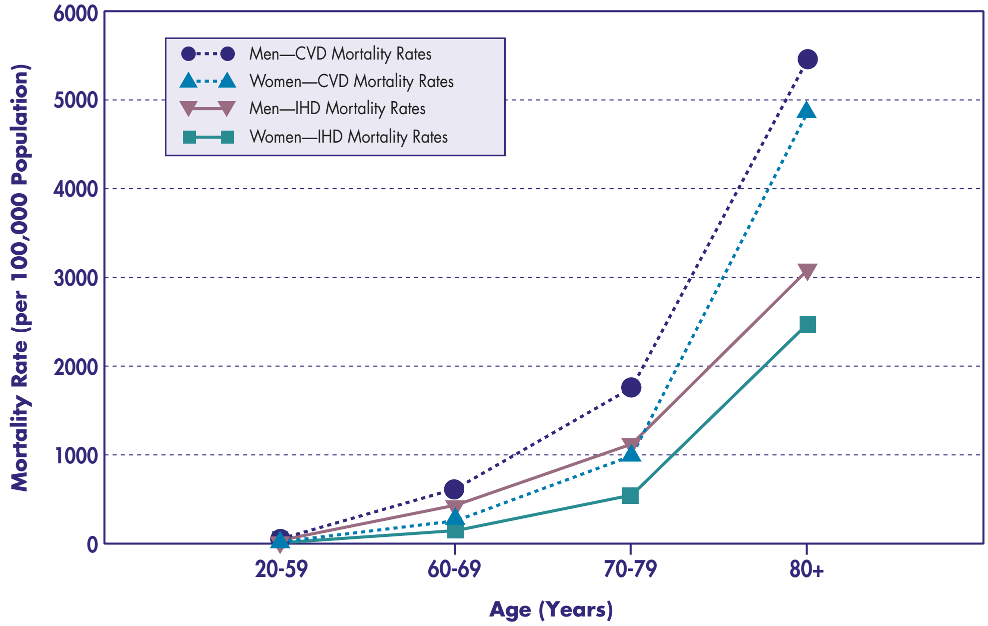
Some caution should be used in interpreting geographical differences in mortality. When a large number of comparisons are made, differences may occasionally be found that are due to chance alone. Researchers have also expressed concern about the quality of cause-of-death information recorded on death certificates. Although it is known that cause-of-death as recorded is not always accurate, it is not known to what extent differences in data quality may contribute to observed regional differences. It should be noted that mortality for all CVD causes in this chapter includes stroke, while stroke is excluded from data presented in other chapters. However, the definition for IHD is consistent throughout.

Findings and Discussion

Mortality from CVD and IHD is strongly associated with age (Exhibit 3.1) and is also higher in men, mostly at the younger ages as noted in Chapter 1. The incidence and mortality of cardiovascular disease have been declining in many countries. In Ontario, the mortality rates for CVD in general, as well as IHD specifically, steadily declined between 1991/92 and 1996/97 (see Exhibit 3.2). The decline is found across each age- and sex-specific group (Exhibit 3.3).

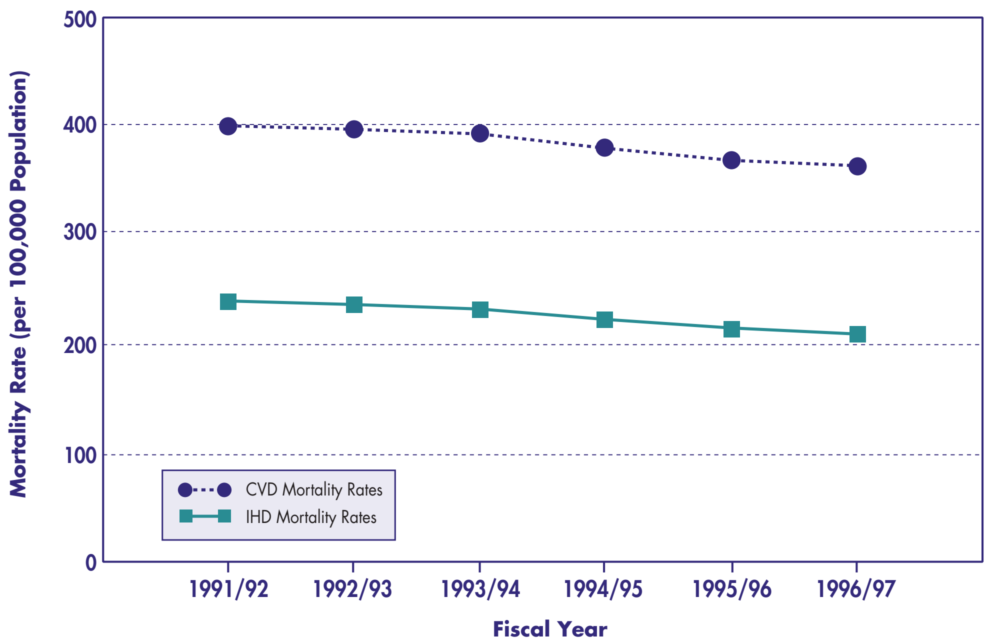
Variations in mortality rates by county are evident in Exhibits 3.4 through 3.7. In the later time period (1994/95 to 1996/97), the county with the highest adjusted mortality rate for CVD was 75% higher than the lowest rate; the highest adjusted mortality rate for IHD was 2.4 times that of the lowest county. The highest age- and sex-adjusted mortality rates for all CVD were found for the following counties: Kent; Prescott and Russell; Bruce; Haldimand-Norfolk;

EXHIBIT 3.1: Age/Sex-specific Cardiovascular and Ischemic Heart Disease Mortality Rates per 100,000 Population Aged 20 Years and Over in Ontario, 1996/97



Data Source: Statistics Canada

EXHIBIT 3.2: Age/Sex-adjusted Cardiovascular and Ischemic Heart Disease Mortality Rates per 100,000 Population Aged 20 Years and Over in Ontario, 1991/92 - 1996/97



Data Source: Statistics Canada

Prince Edward; Thunder Bay District; Sudbury Regional Municipality; Essex, Leeds and Grenville United Counties; and Dufferin (Exhibits 3.4 and 3.6). Most of these counties had been among the 10 counties with the highest adjusted mortality rates for the earlier time period as well (the exceptions being Prince Edward, Leeds and Grenville United Counties, and Dufferin). Those with the lowest rates tended to represent major urban centres or regions near major urban centres. The lowest rates were found in York Regional Municipality, Peel Regional Municipality, Toronto Metropolitan Municipality, Halton Regional Municipality and Ottawa. Following these were Victoria, Peterborough, Middlesex and Durham.

EXHIBIT 3.3 Age/Sex-specific Cardiovascular and Ischemic Heart Disease Mortality Rates per 100,000 Population Aged 20 Years and Over in Ontario, 1991/92 - 1996/97

CARDIOVASCULAR DISEASE

	Fiscal Year					
Age/Sex	**1991/92**	**1992/93**	**1993/94**	**1994/95**	**1995/96**	**1996/97**
Women						
20-59	21.3	21.6	19.3	19.6	19.9	20.1
60-69	306.2	300.2	293.6	287.3	283.3	257.6
70-79	1,131.3	1,098.5	1,090.0	1,033.6	971.4	989.9
80+	5,208.7	5,112.0	5,058.2	5,019.4	4,891.7	4,863.8
Men						
20-59	56.7	58.0	60.4	54.2	52.5	53.4
60-69	736.9	707.9	712.2	679.5	642.4	620.1
70-79	1,961.4	1,970.2	1,964.6	1,845.7	1,813.0	1,757.1
80+	5,825.7	5,941.3	5,762.2	5,659.0	5,541.4	5,456.4
Total	**399.8**	**396.6**	**392.4**	**379.3**	**368.2**	**363.3**

ISCHEMIC HEART DISEASE

	Fiscal Year					
Age/Sex	**1991/92**	**1992/93**	**1993/94**	**1994/95**	**1995/96**	**1996/97**
Women						
20-59	10.3	11.0	8.7	10.1	10.0	9.5
60-69	190.0	182.0	172.2	171.6	168.9	147.9
70-79	679.8	656.1	628.0	573.4	557.1	547.6
80+	2,762.0	2,648.4	2,636.8	2,599.4	2,513.3	2,478.2
Men						
20-59	41.6	42.2	43.0	38.9	36.5	37.9
60-69	531.8	500.5	502.8	480.5	447.3	434.3
70-79	1,275.5	1,275.7	1,284.1	1,201.7	1,175.7	1,122.7
80+	3,347.5	3,512.5	3,361.4	3,267.0	3,168.1	3,084.1
Total	**239.6**	**236.3**	**232.2**	**222.7**	**214.9**	**209.4**

Data Source: Statistics Canada

EXHIBIT 3.4 Age/Sex-adjusted Cardiovascular Disease Mortality Rates per 100,000 Population Aged 20 Years and Over by County of Patient Residence in Ontario, 1991/92 - 1996/97

County	1991/92 - 1993/94				1994/95 - 1996/97			
	Number of Deaths /Year	Age/Sex-adjusted Rate per 100,000	Rank	p-value	Number of Deaths /Year	Age/Sex-adjusted Rate per 100,000	Rank	p-value
Algoma District	386	441.5	19	*	418	427.3	22	**
Brant County	430	452.5	14	**	425	418.4	25	*
Bruce County	302	503.0	2	***	295	494.6	3	***
Cochrane District	259	461.1	11	**	245	421.8	23	*
Dufferin County	109	431.7	24		116	454.5	10	*
Durham Regional Municipality	843	405.7	35		901	369.5	40	
Elgin County	289	448.3	16	*	292	437.4	18	**
Essex County	1,220	473.8	9	***	1,249	455.4	8	***
Frontenac County	382	381.4	40		427	386.5	36	
Grey County	358	435.2	23		341	394.0	32	
Haldimand-Norfolk Regional Municipality	399	494.6	4	***	417	494.3	4	***
Haliburton County	56	351.4	46		57	320.1	46	
Halton Regional Municipality	620	336.3	48	***	732	334.7	45	**
Hamilton-Wentworth Regional Municipality	1,544	425.0	28	**	1,469	375.7	39	
Hastings County	489	479.8	8	***	488	447.0	15	***
Huron County	237	398.3	36		262	411.7	26	
Kenora District	133	372.9	42		158	403.4	28	
Kent County	491	526.0	1	***	505	526.5	1	***
Lambton County	447	453.0	13	**	435	395.8	31	
Lanark County	213	425.3	27		240	446.2	16	**
Leeds and Grenville United Counties	365	436.9	22		398	455.2	9	***
Lennox and Addington County	133	431.4	25		140	452.6	12	*
Manitoulin District	45	390.9	38		50	451.0	13	
Middlesex County	1,046	381.0	41		1,087	368.7	41	
Muskoka District Municipality	164	353.4	44		191	398.4	30	
Niagara Regional Municipality	1,535	449.7	15	***	1,598	432.0	19	***
Nipissing District	270	442.9	17		277	419.1	24	*
Northumberland County	292	415.3	31		316	411.4	27	
Ottawa-Carleton Regional Municipality	1,725	394.0	37		1,724	348.8	44	*
Oxford County	313	384.2	39		339	392.9	33	
Parry Sound District	159	426.9	26		176	427.9	21	
Peel Regional Municipality	1,041	337.9	47	***	1,119	302.0	48	***
Perth County	262	410.0	32		256	387.5	35	
Peterborough County	420	372.2	43		447	364.1	42	
Prescott and Russell United Counties	225	494.2	5	***	236	499.1	2	***
Prince Edward County	112	437.8	21		125	486.7	5	**
Rainy River District	86	440.1	20		77	380.8	37	
Renfrew County	372	465.2	10	**	382	440.3	17	***
Simcoe County	949	424.9	29	*	1,008	400.0	29	*
Stormont, Dundas and Glengarry United Counties	418	441.6	18	*	446	448.5	14	***
Sudbury District	79	492.3	6	**	76	452.7	11	*
Sudbury Regional Municipality	495	496.5	3	***	509	455.9	7	***
Thunder Bay District	551	488.4	7	***	554	456.3	6	***
Timiskaming District	150	460.1	12		141	430.6	20	
Toronto Metropolitan Municipality	5,995	333.1	49	***	6,016	303.1	47	***
Victoria County	257	405.8	34		258	363.5	43	
Waterloo Regional Municipality	993	408.0	33		1,017	378.2	38	
Wellington County	485	416.9	30		492	388.8	34	
York Regional Municipality	823	353.2	45	***	864	300.3	49	***
Total Ontario	**28,966**	**396.5**			**29,792**	**369.9**		
Coefficient of Variation	13.7				16.2			
Extremal Quotient	1.6				1.8			
Systematic Component of Variation	16.9				28.2			
Adjusted Chi-square (Likelihood Ratio)	574.19 (p<0.0001, 48 d.f.)				815.73 (p<0.0001, 48 d.f.)			

* Significant at 5% level ** Significant at 1% level *** Significant at 0.1% level

Data Source: Statistics Canada

EXHIBIT 3.5 Age/Sex-adjusted Ischemic Heart Disease Mortality Rates per 100,000 Population Aged 20 Years and Over by County of Patient Residence in Ontario, 1991/92 - 1996/97

County	1991/92 - 1993/94				1994/95 - 1996/97			
	Number of Deaths /Year	Age/Sex-adjusted Rate per 100,000	Rank	p-value	Number of Deaths /Year	Age/Sex-adjusted Rate per 100,000	Rank	p-value
Algoma District	245	276.9	19	**	264	266.9	17	***
Brant County	257	272.3	21	*	246	244.2	25	
Bruce County	194	324.1	2	***	174	290.4	5	***
Cochrane District	146	255.3	27		134	226.0	34	
Dufferin County	61	240.2	31		67	260.2	21	
Durham Regional Municipality	506	239.6	32		530	214.6	40	
Elgin County	185	289.5	12	**	184	277.8	13	***
Essex County	745	289.7	11	***	752	274.9	14	***
Frontenac County	224	223.0	38		239	217.0	39	
Grey County	215	262.5	24		211	244.9	24	
Haldimand-Norfolk Regional Municipality	262	323.8	3	***	275	325.7	2	***
Haliburton County	37	224.6	37		31	175.6	46	
Halton Regional Municipality	381	204.5	46	**	437	198.5	43	
Hamilton-Wentworth Regional Municipality	976	268.5	23	***	889	227.7	32	
Hastings County	321	315.1	6	***	297	273.0	15	***
Huron County	150	251.4	28		158	252.5	23	
Kenora District	75	205.0	45		90	228.3	31	
Kent County	369	395.9	1	***	367	383.8	1	***
Lambton County	269	271.4	22	*	267	243.0	26	
Lanark County	138	277.5	18		145	270.5	16	**
Leeds and Grenville United Counties	233	279.3	17	*	244	280.0	11	***
Lennox and Addington County	86	281.1	16		87	281.3	9	*
Manitoulin District	24	207.8	44		32	289.2	6	
Middlesex County	618	225.6	36		623	212.3	41	
Muskoka District Municipality	100	213.1	42		114	236.8	29	
Niagara Regional Municipality	1,006	294.1	10	***	1,055	285.2	7	***
Nipissing District	180	294.8	9	**	173	261.4	20	*
Northumberland County	158	223.0	39		173	225.8	35	
Ottawa-Carleton Regional Municipality	967	219.3	40	*	964	195.9	44	**
Oxford County	175	216.7	41		193	225.4	36	
Parry Sound District	88	235.1	35		99	240.0	27	
Peel Regional Municipality	591	187.9	48	***	606	160.2	48	***
Perth County	150	237.6	33		147	226.7	33	
Peterborough County	238	210.5	43		254	209.5	42	
Prescott and Russell United Counties	140	308.2	8	**	152	319.7	3	***
Prince Edward County	73	283.8	15		77	297.5	4	**
Rainy River District	48	245.5	30		45	223.9	37	
Renfrew County	204	255.5	26		224	258.5	22	**
Simcoe County	573	255.6	25		587	231.9	30	
Stormont, Dundas and Glengarry United Counties	257	273.0	20	*	281	284.2	8	***
Sudbury District	51	308.5	7	*	45	261.7	18	
Sudbury Regional Municipality	327	322.2	4	***	314	278.7	12	***
Thunder Bay District	359	316.4	5	***	341	280.1	10	***
Timiskaming District	94	289.4	13		86	261.4	19	
Toronto Metropolitan Municipality	3,291	182.9	49	***	3,218	162.8	47	***
Victoria County	182	286.8	14	*	169	237.9	28	
Waterloo Regional Municipality	579	237.5	34		588	219.2	38	
Wellington County	292	251.1	29		246	195.1	45	
York Regional Municipality	464	195.1	47	***	463	158.7	49	***
Total Ontario	**17,304**	**236.1**			**17,359**	**215.4**		
Coefficient of Variation	20.1				22.9			
Extremal Quotient	2.2				2.4			
Systematic Component of Variation	37.9				53.5			
Adjusted Chi-square (Likelihood Ratio)	711.7 (p<0.0001, 48 d.f.)				908.8 (p<0.0001, 48 d.f.)			

* Significant at 5% level ** Significant at 1% level *** Significant at 0.1% level

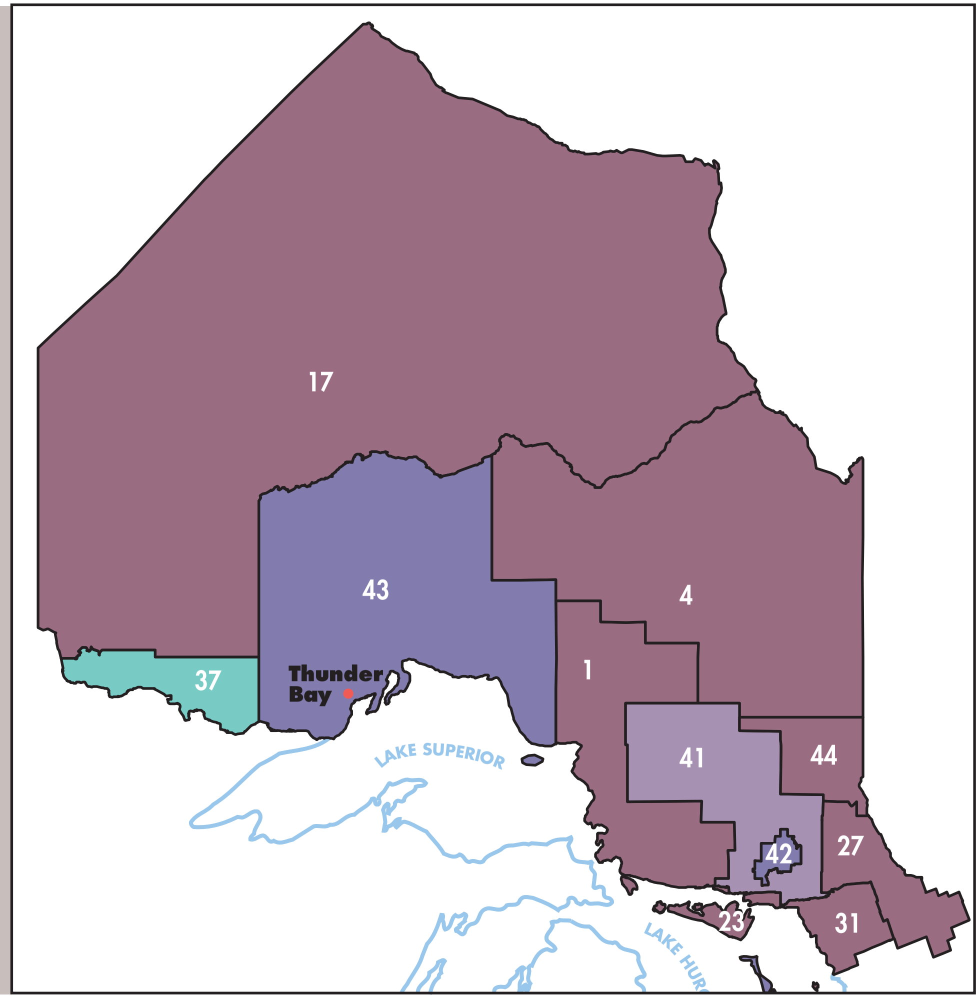
Data Source: Statistics Canada

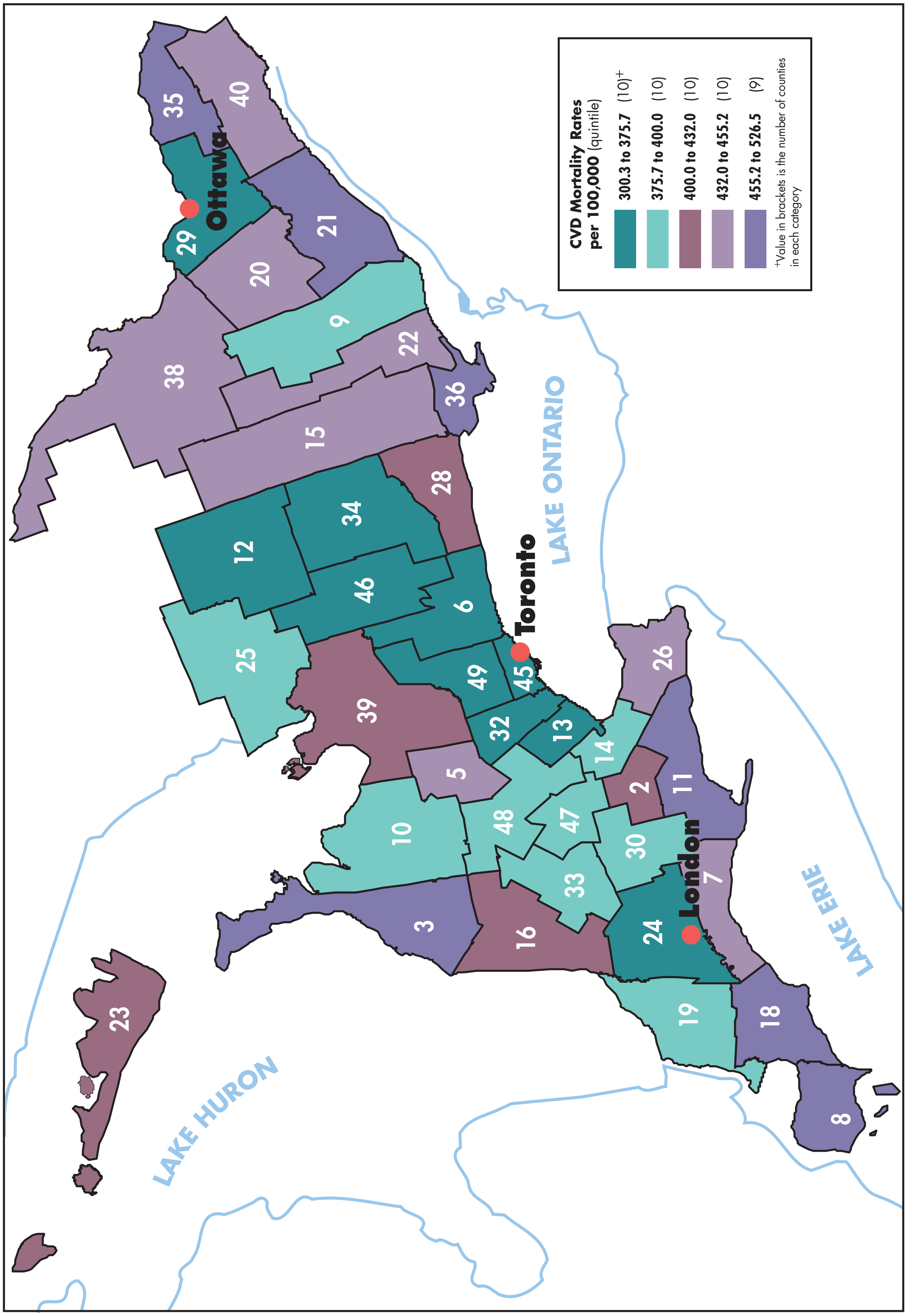
3.6 EXHIBIT

ONTARIO Counties

Age/Sex-adjusted Cardiovascular Disease Mortality Rates per 100,000 Population Aged 20 Years and Over by County of Patient Residence in Ontario, 1994/95 - 1996/97

1. Algoma District
2. Brant County
3. Bruce County
4. Cochrane District
5. Dufferin County
6. Durham Regional Municipality
7. Elgin County
8. Essex County
9. Frontenac County
10. Grey County
11. Haldimand-Norfolk Regional Municipality
12. Haliburton County
13. Halton Regional Municipality
14. Hamilton-Wentworth Regional Municipality
15. Hastings County
16. Huron County
17. Kenora District
18. Kent County
19. Lambton County
20. Lanark County
21. Leeds and Grenville United Counties
22. Lennox and Addington Counties
23. Manitoulin District
24. Middlesex County
25. Muskoka District Municipality
26. Niagara Regional Municipality
27. Nipissing District
28. Northumberland County
29. Ottawa-Carleton Regional Municipality
30. Oxford County
31. Parry Sound District
32. Peel Regional Municipality
33. Perth County
34. Peterborough County
35. Prescott and Russell United Counties
36. Prince Edward County
37. Rainy River District
38. Renfrew County
39. Simcoe County
40. Stormont, Dundas and Glengarry United Counties
41. Sudbury District
42. Sudbury Regional Municipality
43. Thunder Bay District
44. Timiskaming District
45. Toronto Metropolitan Municipality
46. Victoria County
47. Waterloo Regional Municipality
48. Wellington County
49. York Regional Municipality





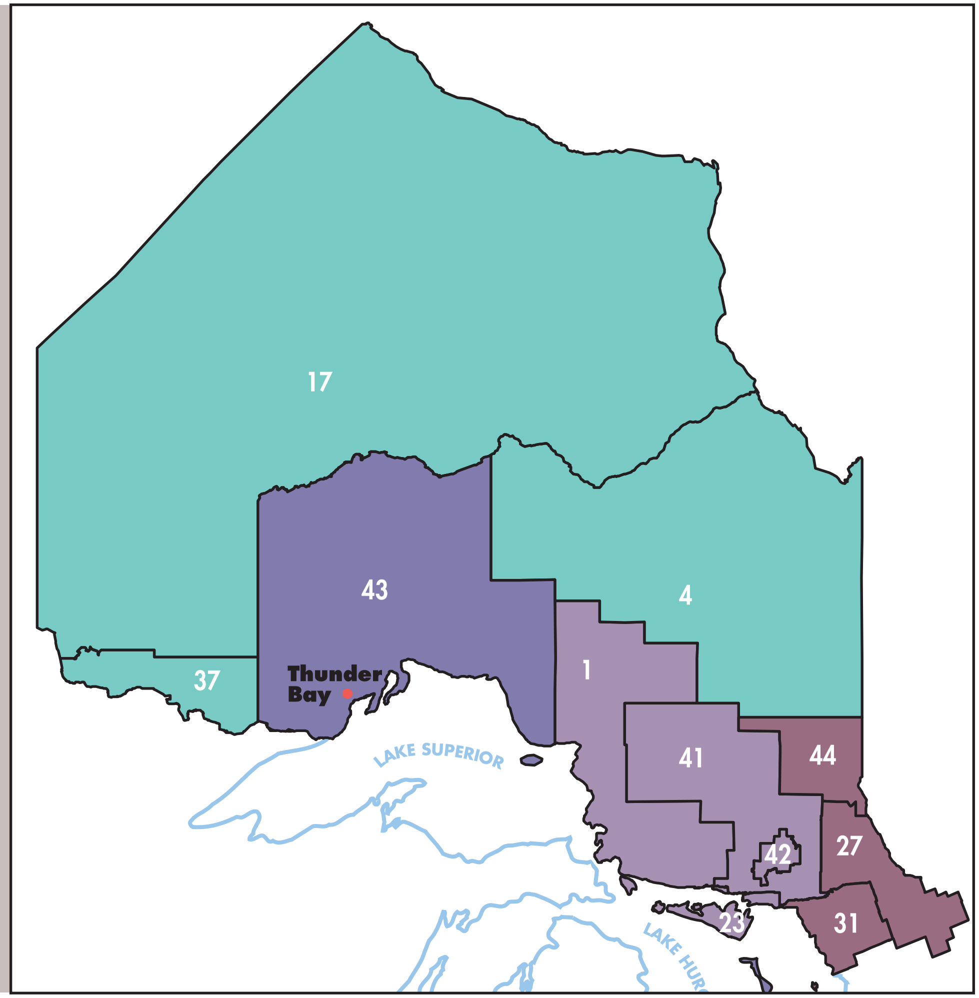
Data Source: Statistics Canada

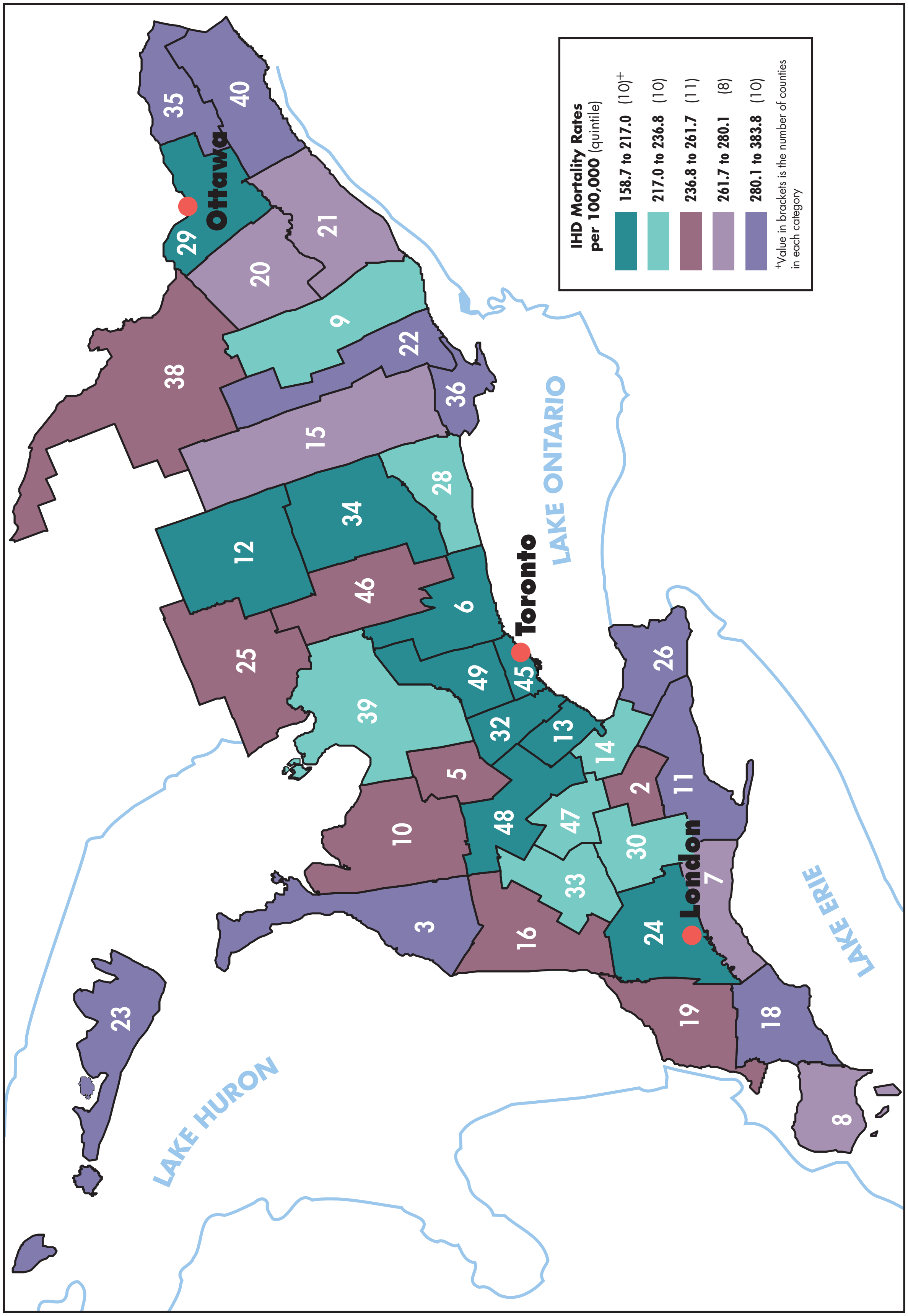
3.7 EXHIBIT

ONTARIO Counties

Age/Sex-adjusted Ischemic Heart Disease Mortality Rates per 100,000 Population Aged 20 Years and Over by County of Patient Residence in Ontario, 1994/95 - 1996/97

1. Algoma District
2. Brant County
3. Bruce County
4. Cochrane District
5. Dufferin County
6. Durham Regional Municipality
7. Elgin County
8. Essex County
9. Frontenac County
10. Grey County
11. Haldimand-Norfolk Regional Municipality
12. Haliburton County
13. Halton Regional Municipality
14. Hamilton-Wentworth Regional Municipality
15. Hastings County
16. Huron County
17. Kenora District
18. Kent County
19. Lambton County
20. Lanark County
21. Leeds and Grenville United Counties
22. Lennox and Addington Counties
23. Manitoulin District
24. Middlesex County
25. Muskoka District Municipality
26. Niagara Regional Municipality
27. Nipissing District
28. Northumberland County
29. Ottawa-Carleton Regional Municipality
30. Oxford County
31. Parry Sound District
32. Peel Regional Municipality
33. Perth County
34. Peterborough County
35. Prescott and Russell United Counties
36. Prince Edward County
37. Rainy River District
38. Renfrew County
39. Simcoe County
40. Stormont, Dundas and Glengarry United Counties
41. Sudbury District
42. Sudbury Regional Municipality
43. Thunder Bay District
44. Timiskaming District
45. Toronto Metropolitan Municipality
46. Victoria County
47. Waterloo Regional Municipality
48. Wellington County
49. York Regional Municipality





Data Source: Statistics Canada

The counties with the highest rates of IHD for the same period (Exhibits 3.5 and 3.7) were: Kent; Haldimand-Norfolk; Prescott and Russell United Counties and adjacent Prince Edward; Bruce and adjacent Manitoulin; Niagara Region; Stormont, Dundas and Glengarry United Counties; Lennox and Addington; and Thunder Bay District. Although reasons for these counties being in the highest rank are uncertain, many of these areas are rural and agricultural. Lowest IHD mortality rates were observed again in the York, Peel and Toronto areas, in Haliburton and Wellington, in Ottawa-Carlton, in Halton Regional Municipality, Peterborough, Middlesex and Durham Region.

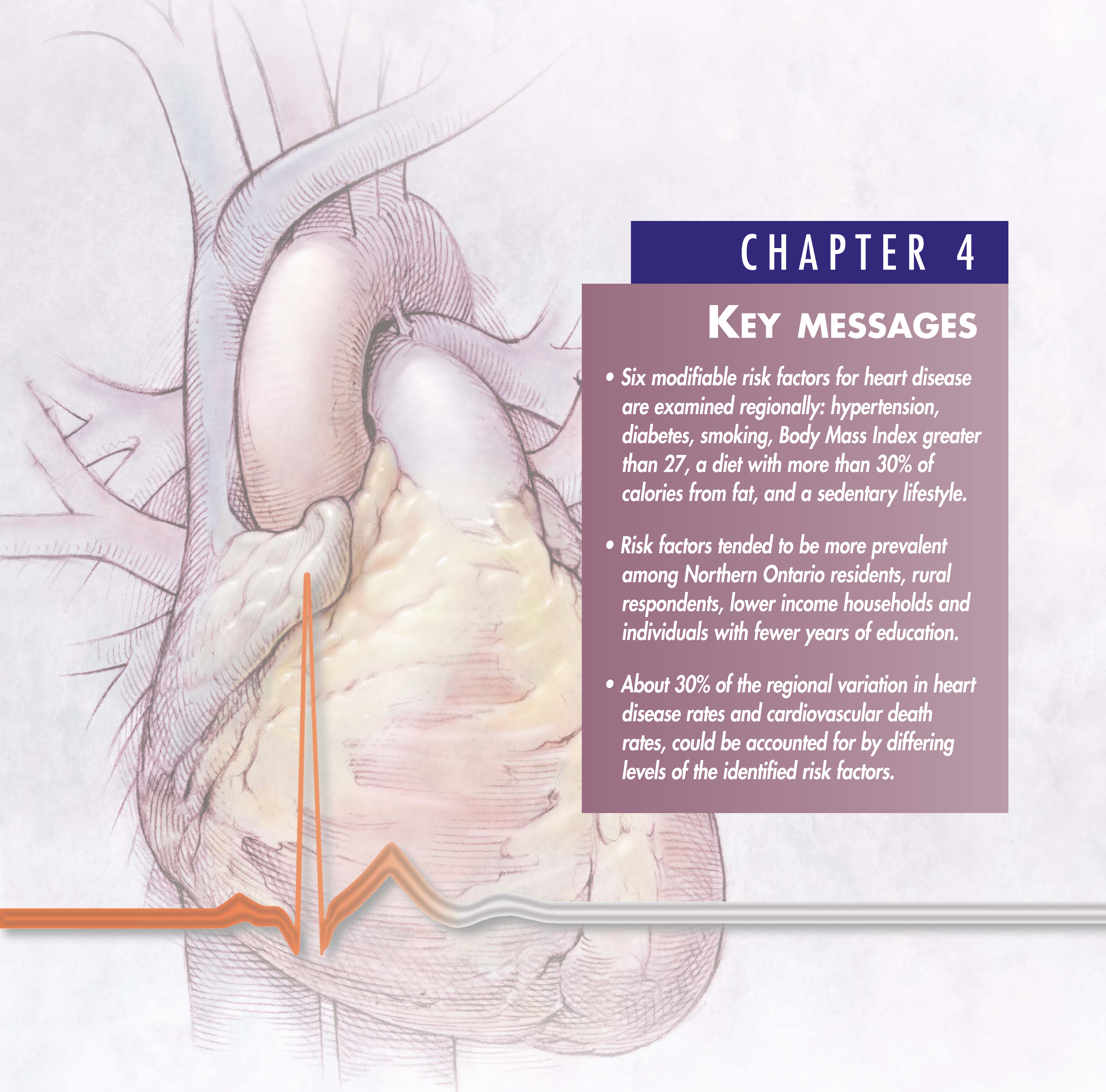
Conclusions

The HSFO study suggested that county-specific mortality rate differences for 1991 to 1993 were related to geographical area—big cities fared better than smaller communities.[1,3-5] The findings here are consistent with that conclusion. However, variation in mortality by small area could be due to a number of variables such as patient risk factors, access to and availability of diagnostic and interventional services, physician practice patterns and disease prevention and health promotion activities.

Data on cardiovascular diagnoses and related use of health services by region will be influenced by both differences in disease rates and the availability and use of health services. The following chapter explores further possible explanatory factors for the county level variation. Variations in the prevalence of risk factors, the degree of association between urban-rural residence and CVD risk factors will be examined.

Risk Factors for Cardiovascular Disease

Susan Jaglal, Susan J. Bondy, Pamela Slaughter



CHAPTER 4

KEY MESSAGES

- *Six modifiable risk factors for heart disease are examined regionally: hypertension, diabetes, smoking, Body Mass Index greater than 27, a diet with more than 30% of calories from fat, and a sedentary lifestyle.*
- *Risk factors tended to be more prevalent among Northern Ontario residents, rural respondents, lower income households and individuals with fewer years of education.*
- *About 30% of the regional variation in heart disease rates and cardiovascular death rates, could be accounted for by differing levels of the identified risk factors.*

Key Terms & Concepts:

- risk factors
- socioeconomic status
- Ontario Health Survey
- health promotion
- burden of illness
- area variations
- correlation coefficients

Background

Over the past three decades, researchers have determined many of the risk factors that contribute to the modern epidemic of ischemic heart disease (IHD). Major risk factors include smoking, high blood pressure, a rich diet and high levels of cholesterol in the bloodstream. Diabetes also contributes to the development of IHD but is not as common as the major risk factors. The presence of multiple risk factors greatly increases the patient's level of risk. For example, a woman with markedly elevated cholesterol may have double the risk of other women of the same age. However, her risk doubles again if she smokes and doubles yet again to eight times the risk of other women if she also has high blood pressure.[1] To provide some background on the percentage of Ontarians with various cardiovascular risk factors for heart disease, the Methods Appendix for Chapter 4 summarizes the results of the 1992 Ontario Heart Health Survey.

Health-related behaviours, such as diet, smoking and physical activity, may reflect factors which are both characteristics of the individual (e.g. age, sex and socioeconomic status) and of the community. Controllable risk factors must be addressed by effective health promotion and clinical prevention programs if we are to reduce the burden of illness from cardiovascular disease.

In this chapter we provide information on the prevalence and distribution of important ischemic heart disease risk factors across regions of Ontario using the most current data available. Specifically, we describe the distribution of rich diet, high blood pressure, smoking, physical activity, obesity and diabetes in Ontario residents by age, sex and socioeconomic status. We also examine these risk factors by various geographical areas.

Rich Diet and Blood Cholesterol

A rich diet is defined as one high in animal fats and processed animal products, high in total fat, hydrogenated fat and cholesterol, high in refined and processed sugars, high in salt, low in fibre and high in total calories for a low level of energy expenditure.[2] Along with sedentary living, this diet contributes to an increased prevalence of hypercholesterolemia, high blood pressure, obesity and diabetes in adulthood. For purposes of this chapter, we focus primarily on a high total fat content.

While the relationship between a rich diet and high blood cholesterol is strong across populations on average, individuals do vary considerably in how their bodies process dietary fats. Some individuals have genetic abnormalities that lead to high serum cholesterol levels regardless of the composition of their diets. In general, however, blood cholesterol increases with a rich diet and with increased body weight and decreases with physical activity. The deposits that clog the coronary arteries in people with IHD consist mostly of cholesterol. It should be noted that total cholesterol has two main components. Low-density lipoprotein (LDL) cholesterol contributes to hardening of the arteries (atherogenesis), while high levels of high-density lipoprotein (HDL) cholesterol protect against it.

Men with cholesterol levels near the top of the population distribution have IHD mortality rates that are five times higher than those of men with levels near the bottom.[3] Fortunately, a large body of evidence from clinical studies now shows that lowering cholesterol reduces IHD risk in persons without symptoms and slows the progression of IHD in persons who have already been diagnosed with this condition.

High Blood Pressure

As blood pressure increases so does the risk of IHD. Blood pressure is determined by a number of factors, including age, heredity, body weight, alcohol consumption, level of physical activity and, to a very minimal degree, salt intake. Over the past 20 years, the health care system has made substantial progress in identifying and treating those with high blood pressure; these patients have a three- to four-fold increase in risk of IHD compared to others with normal blood pressure of the same age and sex.

Cigarette Smoking

Cigarette smoking increases the risk of cardiovascular disease (CVD) two to four times and accounts for more than a 70% excess rate of death from CVD and an elevated risk of sudden death.[4] Cigarette smoke contains more than 4,000 active compounds, many of which contribute to IHD risk.[5] Smoking cessation produces a striking and immediate reduction in the risk of sudden death. Within two to three years of smoking cessation, much of the extra risk of heart disease is eliminated; within 10 to 14 years of cessation, risk is reduced to the level of a non-smoker.[5]

In the 1992 Ontario Heart Health Survey, 23% of Ontarians aged 18 to 74 reported being regular smokers. Historically, smoking was more common among men; however, prevalence rates for men and women have been similar throughout the 1990s and no meaningful sex differences are now found among youth and young adults. The overall prevalence of smoking in Ontario declined markedly from the 1960s to the late 1980s, but unfortunately this downward trend has not continued in the 1990s.[6-8]

Physical Inactivity and Obesity

Physical activity reduces three risk factors: blood pressure, cholesterol and body weight. It also has an independent protective effect against cardiovascular disease. The gains are greatest for those who engage in sustained physical exercise at least three times per week but even moderate physical activity is beneficial.

The body mass index (BMI) is a measurement based on weight and height (kg/m^2). The risk of heart disease rises gradually as BMI climbs above 22 but is particularly pronounced among obese persons with a BMI greater than 27. The Nurses Cohort Study, a prospective evaluation of 115,195 American women showed that BMI was more strongly associated with deaths due to IHD and other cardiovascular diseases than with other causes.[9] Increased weight contributes to CVD by increasing the prevalence of high blood cholesterol and related blood fat disorders, diabetes and hypertension. Sedentariness among obese persons compounds the risk.

Diabetes

People with diabetes mellitus are more likely to have high blood pressure and high blood cholesterol or related blood-fat disorders. Diabetes also leads directly to an increased risk of cardiovascular disease. Diabetes almost entirely eliminates the protective effect of estrogen in premenopausal women and in users of hormone replacement therapy (HRT). Consequently, women with diabetes have the same rates of ischemic heart disease as non-diabetic men.

Social Class and Socioeconomic Status (SES)

During the last three decades a changing pattern in the social class distribution of CVD has been observed.[10,11] In Scotland, people living in affluent areas showed a 40% decline in CVD mortality between 1980-82 and 1990-92, while people living in the most deprived areas experienced only a 20% decrease.[12] Several recent studies have confirmed that the prevalence of risk factors for IHD is higher among those with lower SES.[12,13] Because of their higher prevalence of smoking and elevated blood cholesterol, we found that persons in Ontario with lower income and education had twice the risk of developing IHD as those who were more affluent.[14] However, SES is itself an independent risk factor. For example, the first Whitehall study of London civil servants (all office workers in stable employment) found that after 10 years of follow-up the highest employment grade had about one-third the mortality of the lowest.[15] In this study, differences in smoking, obesity, physical activity, blood pressure or plasma cholesterol level could only partly explain the differences. Numerous other studies have similarly shown that those who are poor or less educated have an incidence of IHD higher than would be expected on the basis of the traditional risk factors alone.

Alcohol

Alcohol users, relative to abstainers, have a lower risk of essentially all thrombotic circulatory diseases, including IHD.[16-20] The benefit is probably due to ethanol itself which increases high density lipoprotein cholesterol and inhibits clotting. Other chemicals, such as antioxidants in wine, have been touted as having an additional protective effect against IHD but the evidence is inconclusive.[17,20,21]

Because IHD is a common cause of death in industrialized nations, moderate drinkers who are middle-aged or elderly actually have lower total mortality than abstainers. Most of the protective effect against heart disease is found with as little as 5g of ethanol per day (less than one-half of one Canadian standard drink).[20,22] Higher levels of intake do not increase the degree of protection from heart disease, but do increase the risk of other health problems, and heavy drinkers have higher overall mortality than moderate drinkers. The consequences of inappropriate alcohol use (injury, chronic disease and alcohol dependence) are so significant that no major agency has recommended that alcohol be used for primary prevention of heart disease. For these reasons, we have not presented regional data on alcohol use.

Data Sources

Regional data were taken from The Ontario Health Survey 1990 (OHS 1990).[23,24] The large sample of the OHS 1990 makes it a valuable resource for research and study of smaller geographical regions including Public Health Units (PHU). There were 43 PHUs at the time of the survey.

For most of the risk factors presented, the 1994/95 National Population Health Survey (NPHS 1994/95) provides more recent estimates but the Ontario sample is insufficient for small area analyses. The Ontario Health Survey 1996/97 was not available at the time of writing. The Ontario Heart Health Survey (OHHS 1992) provides more objective information than the OHS 1990 (such as blood pressure testing), but the OHHS 1992 sample is too small to allow a useful geographical breakdown.

In the OHS 1990, six risk factor variables were examined: hypertension, diabetes, daily smoking, BMI greater than 27 kg/m^2, greater than 30% of total caloric intake from dietary fat and sedentary lifestyle. Also included were responses to the question, "Do you have heart disease?" Information on diabetes, high blood pressure and existing heart disease was taken from the interview form. This information was provided by one member of the household speaking for everyone in the household.

Data on smoking status, physical activity and height and weight for BMI were taken from the self-completed, written questionnaire. The intensity of physical activity was expressed as daily energy expenditure and estimated by multiplying the duration of each of the activities with its energy costs.

The "inactive" category was defined as less than 1.5 kcal/kg of energy expended daily. Per cent calories from dietary fat was taken from the nutrition questionnaire and recorded as persons consuming less than 30% of total calories from fat versus higher percentages. One new derived variable was created indicating respondents who reported three or more of these risk factors (see Methods Appendix).

How We Did the Analysis

As the OHS 1990 involved only a sample of Ontarians, estimates of the prevalence of any risk factor were adjusted according to the number of persons surveyed and the proportion those individuals represented in each region. We calculated prevalences of risk factors for subgroups by age, sex and several sociodemographic variables (e.g. highest level of education attained). Some descriptive data have also been presented in the form of maps indicating the relative prevalence of heart disease risk factors and existing heart disease.

Tests of statistical significance were performed to accompany the data presented in the tables using procedures that take into account the complex sampling design of the OHS 1990. Only associations which were statistically significant are discussed in the text.

Finally, data presented for risk factor prevalence by geographical area were combined with area-specific mortality data presented in the preceding chapter. Combining the 43 former PHUs (which in some instances comprised several counties) and county-level data resulted in 38 comparable areas. For these areas, age- and sex-adjusted mortality figures were recalculated using methods identical to those for Chapter 3, and age- and sex-adjusted risk factor prevalence figures were recalculated as described above. The degree of association, at the regional level, between risk factor prevalence and CVD rates was assessed using correlational statistics (see Methods Appendix).

Interpretive Cautions

General health surveys routinely capture information on lifestyle and behavioural risk factors such as smoking, as well as knowledge of existing health conditions (e.g. hypertension). Self-reports cannot capture conditions that the respondent is unaware of or that require diagnostic techniques to verify. Therefore, surveys can be expected to provide prevalence rates which differ from administrative data or studies that rely on objective measures and physiologic assessments. Also, some of the information was provided by proxy (i.e. one knowledgeable member of the household attempts to answer on behalf of all residents) and therefore may not be accurate. (Refer to the Technical Appendix for limitations of the OHS 1990).

Regional differences should be interpreted cautiously. First, the large number of comparisons means that some differences observed may be due to chance alone. Also, cultural differences and other factors might affect the way people in different regions interpret and answer the same questions. It is difficult to gauge these possible effects.

Exhibits 4.1 and 4.2 describe the estimated prevalence of a factor for the given population without adjustments. However, Exhibits 4.3, 4.4 and 4.5 present age- and sex-adjusted estimates. The adjusted percentages reflect the proportion of the population with the risk factor that would be observed if that area had the same age- and sex-distribution as the entire province. These adjusted estimates may not exactly match other published estimates. A few of the estimates at the level of former PHU must also be interpreted with caution due to high sampling variability as indicated in relevant tables.

We have also produced some correlational analyses relating risk factor prevalence with heart disease rates at the same time (i.e. in the OHS 1990) and with mortality rates four to seven years later. Such correlational analysis does not prove cause and effect and can be influenced by biases (e.g. someone may be more likely to report risk factors after learning they have heart disease).

Last, the OHS 1990 provides baseline data on the distribution of cardiac risk factors in the province of Ontario at the regional and small area level. Since then, there has been ongoing promotion of the idea of healthy living (reducing fat intake, quitting smoking and increasing exercise). In order to evaluate the impact of these efforts on Ontarians we need to have more recent risk factor data. These should be available shortly from the OHS 1996.

Findings and Discussion

Distribution of Risk Factors by Sociodemographic Variables

A high intake of dietary fat (greater than 30% of total calories) was the most common of the risk factors identified in the OHS 1990 (Exhibit 4.1). The prevalence was higher for men than women and declined slightly with older age. A high-fat diet was somewhat more common among rural respondents (Exhibit 4.2).

Approximately 10% of adults aged 20 years and over said they had high blood pressure and this increased steadily with age. Over the age of 65, more women than men reported high blood pressure. People in lower-income households and with lower levels of education reported high blood pressure more often. The distribution of diabetes by socioeconomic status indicators was similar to that of high blood pressure.

Generally, there were no sex differences in smoking prevalence except that older women were more likely to have never smoked (reflecting historical patterns). However, an association was found between indicators of lower socioeconomic status (household income and education) and smoking.

EXHIBIT 4.1 Age/Sex-specific Prevalence of Ischemic Heart Disease Risk Factors and Self-reported Prevalence of Heart Disease for Population Aged 20 Years and Over in Ontario, 1990

MEN

	AGE					
Risk Factor	**20-34**	**35-49**	**50-64**	**65-74**	**75+**	**Total**
"Do You Have High Blood Pressure?"* (% yes)	2	6	18	25	22	10
"Do You Have Diabetes?"* (% yes)	<1	2	5	10	9	3
Daily Smoker (%)	33	30	26	17	12	29
Low Physical Activity (% inactive)	59	69	76	71	77	67
Body Mass Index (% >27)**	24	35	39	30	22	31
More Than 30% of Total Calories From Fat (%)	92	90	88	88	80	90
Any 3 or More of Above Risk Factors*** (%)	29	38	42	35	25	35
"Do You Have Heart Disease?"* (% yes)	<1	2	9	18	22	5

WOMEN

	AGE					
Risk Factor	**20-34**	**35-49**	**50-64**	**65-74**	**75+**	**Total**
"Do You Have High Blood Pressure?"* (% yes)	2	5	18	32	33	11
"Do You Have Diabetes?"* (% yes)	<1	1	4	7	7	3
Daily Smoker (%)	29	28	21	16	9	25
Low Physical Activity (% inactive)	73	81	81	84	89	79
Body Mass Index (% >27)**	15	24	32	28	21	23
More Than 30% of Total Calories From Fat (%)	86	86	81	79	78	84
Any 3 or More of Above Risk Factors*** (%)	25	32	33	32	27	30
"Do You Have Heart Disease?"* (% yes)	<1	2	5	13	15	4

* Response provided by one knowledgeable adult per household and so information may have been provided by proxy.

** It is often recommended that body mass index not be used for adults over 65 years of age.

*** Calculated as the percentage of people with information for each of the described risk factors with any three or more of the other risk factors; approximately 30% of survey respondents were missing information for at least one of these risk factors.

Data Source: Ontario Health Survey, 1990

EXHIBIT 4.2 Prevalence of Selected Ischemic Heart Disease Risk Factors and Self-reported Prevalence of Heart Disease for Population Aged 20 Years and Over in Ontario, 1990

	Urbanicity †		Household Income Status †		Highest Level of Education Attained		
	Urban	Rural	Low	Adequate	Less Than Secondary	Completed Secondary	Some or Completed Post-secondary
"Do You Have High Blood Pressure?"* (% yes)	11	11	17	9	16	9	7
"Do You Have Diabetes?"* (% yes)	3	3	6	2	5	2	2
Daily Smoker (%)	26	29	32	26	33	29	20
Low Physical Activity (% inactive)	73	75	79	72	81	72	68
Body Mass Index (% >27)**	26	31	30	26	34	26	22
More Than 30% of Total Calories From Fat (%)	86	94	84	87	87	88	86
Any 3 or More of Above Risk Factors*** (%)	32	37	36	32	39	34	26
"Do You Have Heart Disease?"* (% yes)	5	5	9	4	7	4	3

* Response provided by one knowledgeable adult per household and so information may have been provided by proxy.

** It is often recommended that body mass index not be used for adults over 65 years of age. They are included here for comparison purposes.

*** Calculated as the percentage of people with information for each of the described risk factors with any three or more of the other risk factors; approximately 30% of survey respondents were missing information for at least one of these risk factors.

† Statistics Canada derived variable (see Methods Appendix).

Data Source: Ontario Health Survey, 1990

Overall 67% of men over age 20 and 79% of women, were physically inactive in the OHS 1990; and the proportions increased with age. Individuals with a lower household income and lower levels of education were more likely to be physically inactive. Men were also somewhat more likely to be obese, but for both sexes the prevalence peaked around 50 to 64 years of age. Obesity was related to low household income status and lower education levels, and was more common among rural respondents.

Roughly 35% of men over 20 and 30% of women reported at least three risk factors. This percentage appeared to peak in the middle years (50 to 64) for both sexes, although this was slightly more marked for men. As expected, rural respondents, those in a low-income household and people with fewer years of completed education were more likely to report three or more risk factors.

Risk Factors by Health Planning Region

Exhibit 4.3 illustrates the variation observed in the prevalence of selected IHD risk factors by the seven Ontario Health Planning Regions. The figures reported

EXHIBIT 4.3 Age/Sex-adjusted Prevalence of Selected Risk Factors for Ischemic Heart Disease and Self-reported Prevalence of Heart Disease by Health Planning Region in Ontario, 1990

	New Health Planning Regions						
Risk Factor	**South West**	**Central West**	**Central South**	**Central East**	**Toronto ††**	**Eastern**	**Northern**
"Do You Have High Blood Pressure?"* (% yes)	11	10	11	10	11	10	11
"Do You Have Diabetes?"* (% yes)	3	2†	3	3	3	3	3
Daily Smoker (%)	28†	25	27†	27†	23	27†	32†
Low Physical Activity (% inactive)	75	74	76	74	76	68†	74
Body Mass Index (% >27)**	29†	25†	29	26	24	25	31†
More Than 30% of Total Calories From Fat (%)	90†	89†	90†	88†	79	88†	92†
Any 3 or More of Above Risk Factors*** (%)	31†	29	33†	30†	26	28	36†
"Do You Have Heart Disease?"* (% yes)	4	4	5	4	4	5	6†

* Response provided by one knowledgeable adult per household and so information may have been provided by proxy.

** It is often recommended that body mass index not be used for adults over 65 years of age. They are included here for comparison purposes.

*** Calculated as the percentage of people with information for each of the described risk factors with any three or more of the other risk factors; approximately 30% of survey respondents were missing information for at least one of these risk factors.

† Statistically significant difference when compared to Toronto ($p<0.05$).

†† Reference (comparison) category.

Data Source: Ontario Health Survey, 1990

have been adjusted to reflect the prevalence that would be observed if the region had the same age and sex makeup as the province.

The proportion of respondents reporting they had high blood pressure did not vary significantly by region but there was some variation in the prevalence of diabetes. For diabetes prevalence, only the Central West region was significantly lower than Toronto. Toronto and the Central West region had lower prevalence of smoking compared to the remaining regions. Only Eastern Ontario had a lower prevalence of a physically inactive lifestyle. For the risk factor BMI greater than 27, three regions had a significantly higher prevalence: the South West, Central West and the Northern regions. Toronto stands out as being significantly lower than all the other regions in terms of the prevalence of a high fat diet.

Central West and Eastern Ontario had a prevalence of multiple risk factors similar to Toronto. The remaining regions all had a higher prevalence of multiple risk factors after adjusting for age and sex.

EXHIBIT 4.4 Age/Sex-adjusted Prevalence of Selected Ischemic Heart Disease Risk Factors and Self-reported Prevalence of Heart Disease by Former Public Health Unit in Ontario, 1990

Public Health Units	"Do You Have High Blood Pressure?"* (% yes)	"Do You Have Diabetes?"* (% yes)	Daily Smoker (%)	Low Physical Activity (% inactive)	Body Mass Index (% >27)**	More Than 30% of Total Calories From Fat (%)	Any 3 or More of Above Risk Factors*** (%)	"Do You Have Heart Disease?"* (% yes)
Algoma	11	4	29	73	33	94	34	7
Brant County	11	3	31	78	26	89	35	5
Bruce County	10	2	24	70	32	94	34	3
Durham	11	3	32	74	27	90	33	5
Eastern Ontario	11	3	32	75	30	91	34	5
Elgin-St. Thomas	12	3	32	77	32	92	38	5
Windsor-Essex	9	2	28	76	28	85	23	3
Grey-Owen Sound	12	3	26	71	29	95	31	5
Haldimand-Norfolk	11	3	30	76	28	93	35	3
Haliburton/Kawartha/ Pine Ridge	7	2	30	73	30	95	35	4
Halton	10	1	23	73	23	89	27	4
Hamilton-Wentworth	11	3	27	75	29	89	31	5
Hastings and Prince Edward	12	3	30	73	26	92	32	6
Huron	10	4	23	78	31	95	33	4
Kent-Chatham	11	5	29	76	30	94	35	5
Kingston/Frontenac/ Lennox and Addington	11	2	26	73	30	89	33	5
Lambton	11	3	27	72	30	91	32	4
Leeds/Grenville/ Lanark	10	3	30	73	25	92	31	4
Middlesex-London	11	3	28	73	28	86	31	5
Muskoka-Parry Sound	10	3	29	73	28	93	34	7
Niagara Regional	10	4	26	77	30	91	34	4
North Bay and District	10	3	34	70	27	92	31	7
Northwestern	10	3	32	73	34	92	37	5
Ottawa-Carleton	10	2	25	61	22	86	24	5
Oxford County	11	4	28	79	31	92	37	5
Peel	12	3†	26	76	28	83	30	3
Perth	11	2	26	75	31	93	33	4
Peterborough County	9	3	30	70	23	93	31	5
Porcupine	12	4	38	76	35	94	40	8
Renfrew	12	4	30	77	34	93	36	5
Simcoe	9	1	29	70	26	91	31	4
Sudbury	13	4	34	78	32	91	40	6
Thunder Bay	9	2	30	71	29	88	33	7
Timiskaming	12	3	33	78	30	92	38	6
Toronto-East York	11	3	23	75	23	84	27	4
Toronto-Etobicoke	10	3	24	75	24	81	27	4
Toronto-North York	10	2†	19	79	26	73	23	3
Toronto-Scarborough	13	4	23	80	23	82	29	5
Toronto-City	10	3†	26	71	23	80	25	5
Toronto-York	11	4	23	81	31	80	27	5
Waterloo	10	3	26	74	26	89	29	4
Wellington/ Dufferin/Guelph	11	3	28	74	27	91	31	6
York Regional	10	3	19	74	25	85	26	2

* Response provided by one knowledgeable adult per household and so information may have been provided by proxy.

** It is often recommended that body mass index not be used for adults over 65 years of age. They are included here for comparison purposes.

*** Calculated as the percentage of people with information for each of the described risk factors with any three or more of the other risk factors; approximately 30% of survey respondents were missing information for at least one of these risk factors.

† Estimate should be interpreted with caution due to high sampling variability.

Data Source: Ontario Health Survey, 1990

Exhibit 4.3 also presents the prevalence of a positive response to the question, "Do you have heart disease?" by planning region. In this instance, only the Northern region had a significantly higher prevalence than Toronto. However, as we cautioned earlier, a survey of this nature may yield different findings than more direct measures of interregional variations in the burden of heart disease based on administrative data or vital statistics.

Risk Factors by Small Areas

For this section, the regional analysis was repeated for smaller geographical divisions, namely the 43 PHUs in place at the time of the OHS 1990 (see Exhibit 4.4), as well as by the boundaries of the 16 District Health Councils (DHCs) defined in 1998 (see Exhibit 4.5).

The PHUs with the lowest adjusted proportion of residents with multiple risk factors (see Exhibit 4.6) were Windsor-Essex, North York (Toronto), Ottawa-Carleton, Toronto (former City), York Region, East York, York and Etobicoke (all in Toronto) and Halton. Regions in which people were most likely to report three or more heart disease risk factors were Oxford County, Northwestern Ontario, Timiskaming, the Elgin-St. Thomas area, Sudbury and Porcupine PHU.

PHUs with the highest and lowest adjusted rates of reported heart disease, as reported by OHS 1990 survey respondents, are shown in Exhibit 4.7. The PHUs with the lowest proportions were York Region, Bruce County, Windsor-Essex, Peel, Haldimand-Norfolk, North York, Huron County, Halton Region and the Niagara Region. In contrast, the highest adjusted prevalence rates of heart disease were found for Timiskaming, Hastings and Prince Edward Counties, Sudbury, North Bay and District, Thunder Bay, Algoma, Muskoka-Parry Sound and Porcupine Region (Exhibit 4.7).

Correlation Between Risk Factor Prevalence and Mortality for Regions

Risk factor prevalence by geographical area was combined with area-specific mortality data presented in the preceding chapter. Exhibit 4.8 presents correlational results for 38 geographical areas defined by the intersection of county and former PHU.

The adjusted proportion of people with multiple risk factors was associated with the adjusted proportion who reported having "heart disease." Smoking alone was also significantly correlated with reported rates of heart disease. When all six of the risk factors were considered, roughly 43% of the variation in reported rates of heart disease by region was associated with the combined information on the regional prevalence of the six risk factors.

EXHIBIT 4.5 Age/Sex-adjusted Prevalence of Selected Ischemic Heart Disease Risk Factors and Self-reported Prevalence of Heart Disease by District Health Council in Ontario, 1990

District Health Councils	"Do You Have High Blood Pressure?"* (% yes)	"Do You Have Diabetes?"* (% yes)	Daily Smoker (%)	Low Physical Activity (% inactive)	Body Mass Index (% >27)**	More Than 30% of Total Calories From Fat (%)	Any 3 or More of Above Risk Factors*** (%)	"Do You Have Heart Disease?"* (% yes)
Algoma, Cochrane, Manitoulin and Sudbury	12	4	33	76	33	93	40	7
Champlain	10	3	26	64	23	87	28	5
Durham, Haliburton, Kawartha and Pine Ridge	9	3	31	72	27	92	36	5
Essex, Kent and Lambton	10	3	28	75	29	89	31	4
Grand River	11	3	30	77	27	91	38	5
Grey, Bruce, Huron, Perth	11	3	25	74	31	94	35	4
Halton-Peel	12	3	26	75	26	85	31	3
Hamilton-Wentworth	11	3	27	75	29	89	33	5
Muskoka, Nipissing, Parry Sound and Timiskaming	11	3	32	72	28	93	36	7
Niagara Region	10	4	26	77	30	91	36	4
Northwestern Ontario	10	2	31	72	31	90	37	6
Quinte, Kingston, Rideau	11	3	29	74	28	91	35	5
Simcoe-York	10	2	22	72	25	87	30	3
Thames Valley	11	3	29	75	29	88	35	5
Toronto	11	3	23	76	24	79	29	4
Waterloo Region-Wellington-Dufferin	10	3	26	74	26	89	32	5

* Response provided by one knowledgeable adult per household and so information may have been provided by proxy.

** It is often recommended that body mass index not be used for adults over 65 years of age. They are included here for comparison purposes.

*** Calculated as the percentage of people with information for each of the described risk factors with any three or more of the other risk factors; approximately 30% of survey respondents were missing information for at least one of these risk factors.

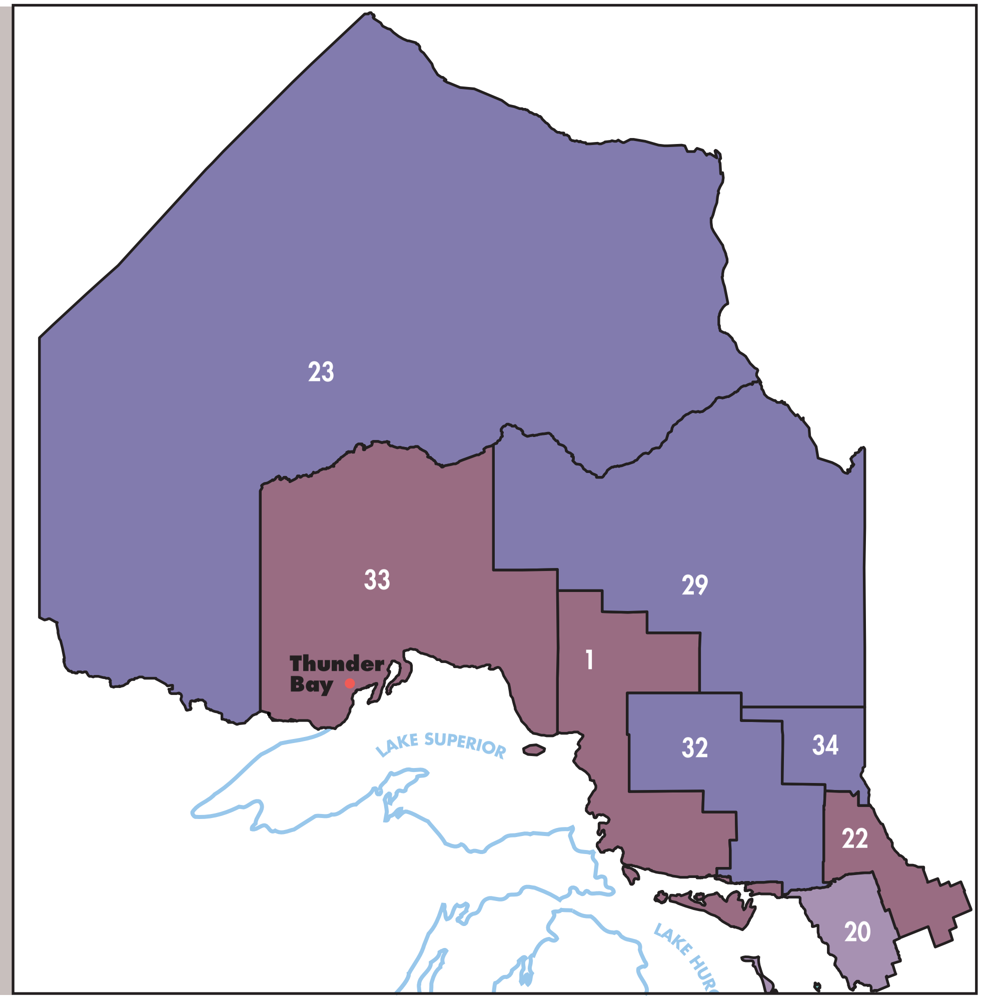
Data Source: Ontario Health Survey, 1990

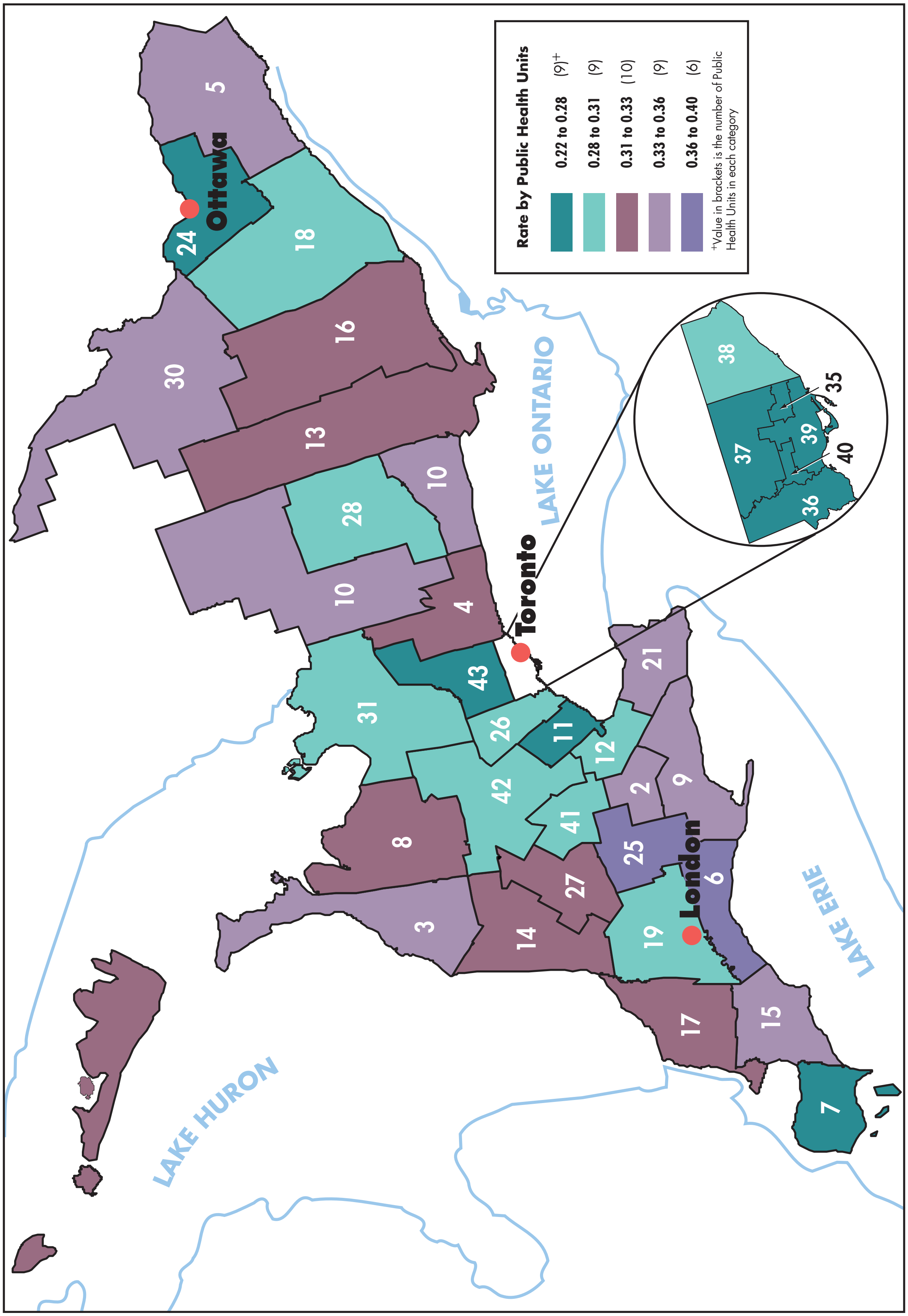
The adjusted rates of daily smoking, high BMI and a diet with more than 30% calories from fat, were all significantly correlated with adjusted mortality rates for all cardiovascular causes and for ischemic heart disease, between 1994/95 and 1996/97. When the six risk factors were taken together, approximately 32% of the regional variation in CVD mortality and 28% of regional differences in IHD mortality, could be "predicted" from knowledge of the regional adjusted risk factor rates. In other words, 30% of the observed variation in mortality rates can be explained by modifiable risk factors.

4.6 EXHIBIT

Age/Sex-adjusted Proportion of Population with Three or More Risk Factors for Ischemic Heart Disease by Former Public Health Unit in Ontario, 1990

1. Algoma
2. Brant County
3. Bruce
4. Durham
5. Eastern Ontario
6. Elgin-St. Thomas
7. Windsor-Essex
8. Grey-Owen Sound
9. Haldimand-Norfolk
10. Haliburton, Kawartha, Pine Ridge
11. Halton
12. Hamilton-Wentworth
13. Hastings and Prince Edward
14. Huron
15. Kent-Chatham
16. Kingston, Frontenac, Lennox
17. Lambton
18. Leeds, Grenville, Lanark
19. Middlesex-London
20. Muskoka-Parry Sound
21. Niagara Regional
22. North Bay and District
23. Northwestern
24. Ottawa-Carleton
25. Oxford
26. Peel
27. Perth
28. Peterborough
29. Porcupine
30. Renfrew
31. Simcoe
32. Sudbury
33. Thunder Bay
34. Timiskaming
35. East York
36. Etobicoke
37. North York
38. Scarborough
39. City of Toronto
40. City of York
41. Waterloo
42. Wellington, Dufferin, Guelph
43. York





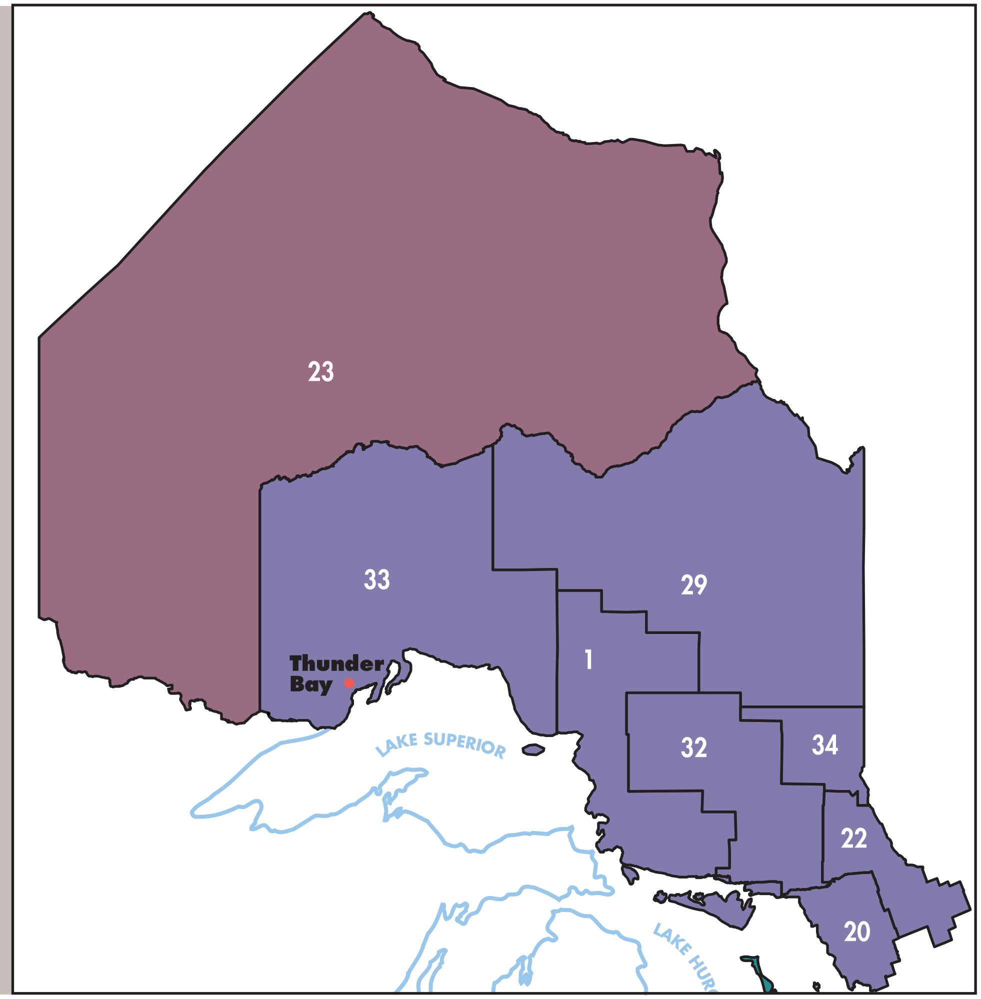
Data Source: Ontario Health Survey 1990

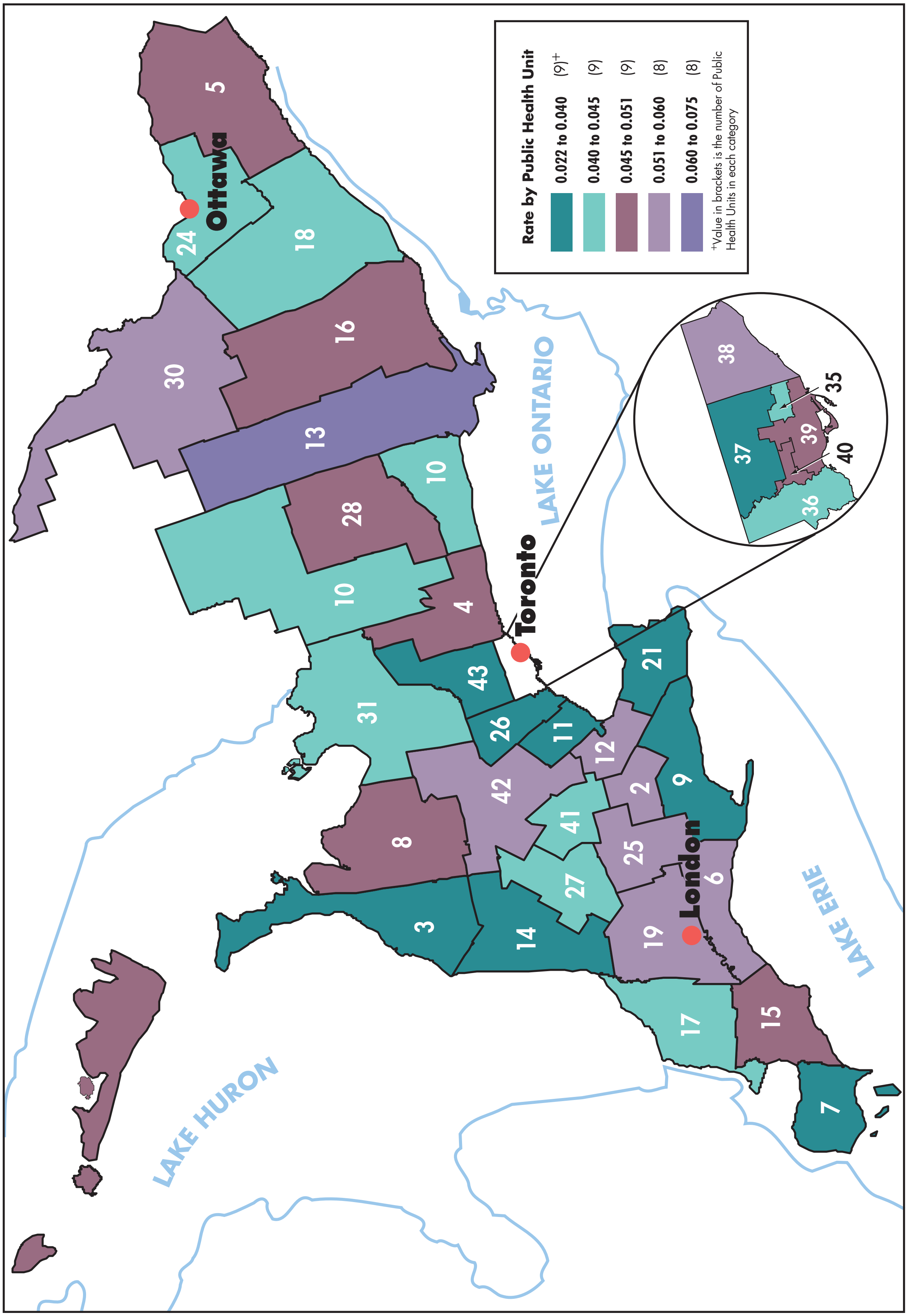
4·7 EXHIBIT

ONTARIO *Public Health Units*

Age/Sex-adjusted Proportion of Self-reported Prevalence of Ischemic Heart Disease by Former Public Health Unit in Ontario, 1990

1. Algoma
2. Brant County
3. Bruce
4. Durham
5. Eastern Ontario
6. Elgin-St. Thomas
7. Windsor-Essex
8. Grey-Owen Sound
9. Haldimand-Norfolk
10. Haliburton, Kawartha, Pine Ridge
11. Halton
12. Hamilton-Wentworth
13. Hastings and Prince Edward
14. Huron
15. Kent-Chatham
16. Kingston, Frontenac, Lennox
17. Lambton
18. Leeds, Grenville, Lanark
19. Middlesex-London
20. Muskoka-Parry Sound
21. Niagara Regional
22. North Bay and District
23. Northwestern
24. Ottawa-Carleton
25. Oxford
26. Peel
27. Perth
28. Peterborough
29. Porcupine
30. Renfrew
31. Simcoe
32. Sudbury
33. Thunder Bay
34. Timiskaming
35. East York
36. Etobicoke
37. North York
38. Scarborough
39. City of Toronto
40. City of York
41. Waterloo
42. Wellington, Dufferin, Guelph
43. York





Data Source: Ontario Health Survey 1990

EXHIBIT 4.8 Correlations Between Selected Risk Factors and Indicators of Heart Disease within 38 Regions of Ontario† and Age/Sex-adjusted Mortality Rates for 1994/95 - 1996/97

Risk Factor	Pearson's Correlation (p-value)		
	Heart Disease††	Mortality from Cardiovascular Disease‡	Mortality from Ischemic Heart Disease‡‡
"Do You Have High Blood Pressure?"* (% yes)	0.27 (0.101)	0.12 (0.491)	0.10 (0.561)
"Do You Have Diabetes?"* (% yes)	0.22 (0.193)	0.25 (0.130)	0.33 (0.042)
Daily Smoker (%)	0.69 (<0.001)	0.45 (0.005)	0.37 (0.024)
Low Physical Activity (% inactive)	0.03 (0.855)	0.21 (0.206)	0.22 (0.186)
Body Mass Index (% >27)**	0.31 (0.062)	0.44 (0.006)	0.37 (0.022)
More Than 30% of Total Calories From Fat (%)	0.31 (0.058)	0.61 (<0.001)	0.56 (<0.001)
Any 3 or More of Above Risk Factors*** (%)	0.50 (0.002)	0.49 (0.002)	0.43 (0.007)

* Response provided by one knowledgeable adult per household and so information may have been provided by proxy.

** It is often recommended that body mass index not be used for adults over 65 years of age. They are included here for comparison purposes.

*** Calculated as the percentage of people with information for each of the described risk factors with any three or more of the other risk factors; approximately 30% of survey respondents were missing information for at least one of these risk factors.

† The 38 regions corresponded to the 43 Public Health Units (PHU) in place at the time of the 1990 Ontario Health Survey. For comparison with mortality data acquired by county, the six PHUs in Toronto have been collapsed.

†† Age/sex-adjusted prevalence of heart disease assessed by self-report, Ontario Health Survey, 1990.

‡ Age/sex-adjusted mortality from all cardiovascular disease (ICD-9: 390-459) for three year period: 1994/95 to 1996/97, Statistics Canada.

‡‡ Age/sex-adjusted mortality from all ischemic heart disease (ICD-9: 410-414) for three year period: 1994/95 to 1996/97, Statistics Canada.

Data Source: Ontario Health Survey 1990, Statistics Canada

Conclusions

Our findings show that risk factors for ischemic heart disease and self-reported existing heart disease are both associated with indicators of lower socioeconomic status. These results are consistent with a large body of international research that suggests those with lower incomes and less education continue to bear an excess burden of IHD. Our data also show geographic variations in disease burden. Although urban versus rural location of residence was not consistently associated with differences in risk factor prevalence, Northern area residents have generally less favourable risk factor patterns. This finding is consistent with earlier studies by ICES. We also noted that Toronto-area residents have a more favourable pattern of risk factors and lower rates of disease. Planning for cardiovascular disease prevention and health promotion would be greatly enhanced by repeating the 1992 Ontario Heart Health Survey with larger samples that would allow more reliable regional profiling.

Notwithstanding the limitations of the OHS 1990 data, we found that smaller area variations in risk factors were clearly correlated with prevalence of "heart disease" by self-report, mortality from CVD in general and mortality from IHD specifically. Again, these findings are consistent with the international literature. For example, Byers et al recently reported on a study examining the correspondence between IHD mortality and risk factor prevalence among states in the United States using 1991 and 1992 data.[25] They found that about 60% of the variance in IHD mortality rates between states is attributable to the prevalence of established cardiac risk factors. In short, these findings emphasize the potentially large benefit from effective preventive strategies.

Two complementary approaches are available to address modifiable cardiac risk factors in the population. The clinical approach identifies individuals at high risk who need intensive intervention efforts. The population approach aims to shift rates of CVD in the entire population to a lower level, and relies on a combination of public policy tools (e.g. higher tobacco taxes or restricted cigarette advertising) and community health promotion programs.

With respect to clinical prevention, many clinical guidelines have been published that address single factors or multiple risk factors simultaneously.[26-28] Most of these guidelines urge a case-finding approach based in the family physician office and emphasize the need to address global risk of CVD by considering multiple risk factors simultaneously. Unfortunately, payment mechanisms in primary care provide few incentives for physicians to spend large amounts of time on multifactorial cardiovascular disease risk modification. The limited availability of dietitians in many parts of the province also remains a barrier to optimal preventive care. As well, some patients with limited incomes and no drug insurance will have difficulty affording life-long therapy with antihypertensive or cholesterol-lowering drugs.

It seems unlikely that clinical prevention in itself can address the persistence of substantial social inequalities in CVD risk and burden. Similarly, no evidence suggests that conventional health promotion programs can claim major successes in blunting income- and education-related inequalities in CVD prevalence.

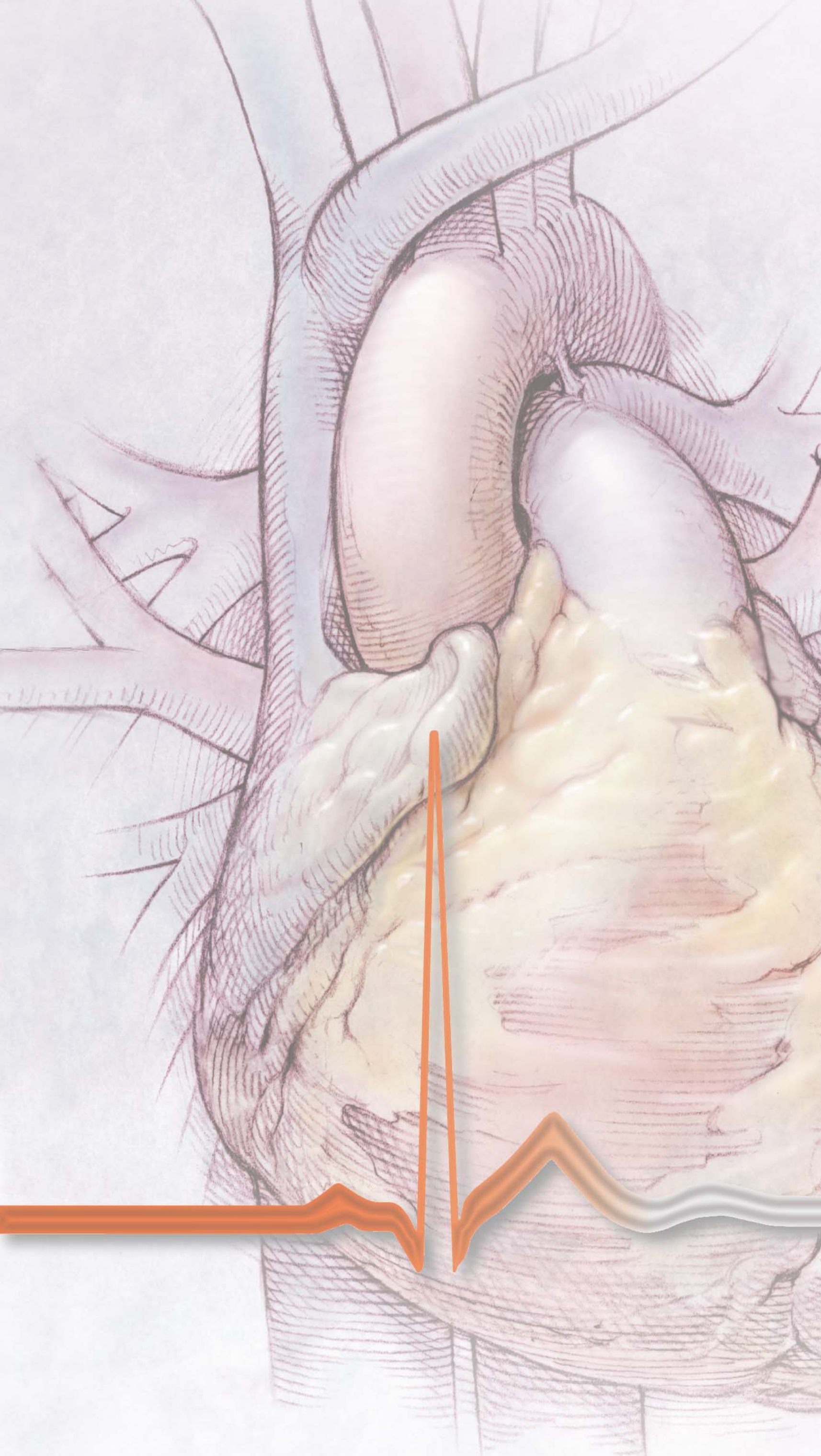
As Davey Smith[12] has argued, there has been a temptation to ascribe social inequalities in CVD to behavioural and lifestyle differences between social groups in a way that sometimes smacks of "victim-blaming." We need health promotion approaches which recognize that poor diet, smoking and lack of leisure time physical activity are not simply lifestyle choices. As long as major socioeconomic inequalities persist in Canadian society, it is plausible that the biggest pay-offs from community-based "heart-health" prevention will come from outreach programs targeted at disadvantaged neighbourhoods or communities.

The evidence concerning heart-health promotion programs is mixed. Ebrahim and Davey Smith have conducted a systematic review[3] of all randomized trials carried out in primary care settings or the workplace that tested the efficacy of multifactorial risk reduction programs. The programs studied used counselling and education in addition to, or instead of, pharmacological treatments to modify major risk factors. The authors concluded that the health promotion programs resulted in only small changes in risk factors and mortality in the general population albeit with definite beneficial effects in high-risk individuals. Public policies that aim at reducing smoking, limiting dietary fat, and increasing facilities and opportunities for exercise should arguably have a higher priority than health promotion interventions applied to general and workforce populations.

In short, to be effective, heart disease prevention strategies must be easy to understand and practical to implement. They must be designed to reach all sectors of the population and specifically overcome social barriers to health promotion such as poverty, lack of education and geographic remoteness. The prevention of heart disease is a matter of clinical, social and economic policy. Treatment, preventive care, community health promotion and health social policy are interlocking parts of a single strategy for better health.

Acute Myocardial Infarction Outcomes in Ontario

Jack V. Tu, Peter Austin, C. David Naylor, Karey Iron, Hua Zhang



CHAPTER 5

KEY MESSAGES

- *The average 30-day mortality rate after an acute myocardial infarction (AMI) in Ontario in fiscal 1994/95 to 1996/97 was 14.8% and the one-year mortality rate was 23.1%.*
- *Although mortality rates varied across hospitals, most institutions had 30-day risk-adjusted mortality rates that were not significantly different from the provincial average.*
- *Regional and hospital-specific analyses of AMI mortality and readmission rates should be interpreted with caution because they may be a reflection of multiple factors including the quality of in-hospital care, pre- and post-hospital care, unmeasured patient characteristics and random variation.*

Key Terms & Concepts:

- mortality rates
- risk-adjusted rate
- readmission
- angina
- heart failure
- outcomes
- acute myocardial infarction

Background

There is growing interest in measuring and improving the outcomes of cardiac care in Canada. Each year, thousands of Canadians die from cardiovascular causes, ranging from an acute myocardial infarction (AMI) to terminal heart failure.[1] While it is widely recognized that coronary heart disease is the leading cause of mortality in Canada, there has been very little systematic investigation into the amount of regional and interhospital variations in the outcomes of cardiac care in Canada. This contrasts with the situation in many other parts of the world where increasing information is being made publicly available on the outcomes of cardiac care.

Several regional health care organizations in the United States, such as the Pennsylvania Health Care Cost Containment Council and the California Hospital Outcomes Project, have published AMI "report cards."[2,3] These reports have contained hospital-specific analyses of mortality rates after an AMI using hospital discharge databases from each of these jurisdictions. AMI report cards have also been released overseas in Scotland.[4] Although there has been controversy surrounding the release of these reports,[5] there is some evidence to suggest a correlation between lower mortality rates after an AMI and better quality of AMI care. For example, a study of 974 patients in the California Hospital Outcomes Project showed that hospitals with the lowest mortality rates were the most likely to administer aspirin within six hours of admission and to treat patients with heparin.[6] A study of six hospitals in Connecticut showed that the two hospitals with the highest AMI mortality rates had the lowest rates of use of thrombolytic drugs, aspirin and beta-blockers.[7]

In this chapter of the Atlas, we present the first population-based analysis of acute myocardial infarction outcomes in Ontario. Until recently, most clinicians, managers and patients in Ontario have had almost no information with which to evaluate the relative outcomes of AMI care provided at their local institutions. These analyses of District Health Council (DHC), major municipality and hospital-specific mortality and readmission rates after an AMI should provide cardiovascular practitioners in Ontario with some important information that could potentially catalyze local quality improvement initiatives.

Data Sources

For the analysis of AMI outcomes, data were drawn from the Ontario Myocardial Infarction Database (OMID) project. The OMID project involves the linkage of all of Ontario's major health care administrative databases to create a comprehensive database that can be used for studying the quality of AMI care in Ontario. Its creation was funded by an operating grant from the Medical Research

Council of Canada. For this chapter, AMI patient demographic (age, sex) and comorbidity information from the Canadian Institute for Health Information (CIHI) database were used, as well as mortality information from a combination of the CIHI and the Ontario Registered Persons Database (RPDB). The cohort was restricted to patients having a new AMI; patients having an AMI in the year prior to the index admission were excluded. Data on a second AMI, angina and congestive heart failure readmissions in the year after a first AMI were obtained from the CIHI database. Patients who were transferred to a second hospital had their outcomes attributed to the original hospital to avoid biasing the results against hospitals receiving transferred patients. The inclusion and exclusion criteria for the patients in the AMI outcomes cohort are shown in Methods Appendix MA5.1, while the criteria for inclusion in the AMI readmissions cohort are shown in Methods Appendix MA5.2. Additional details about the construction of these cohorts are provided in the Methods Appendix for Chapter 5.

An important issue in any study relying on administrative data is the accuracy of the data. To address this issue, each hospital in Ontario was sent a list of the AMI patients that were going to be included in the analysis for independent verification of the accuracy of the AMI diagnosis in their patient charts. Hospitals with a large number of patients were asked to audit a random sample of patients (most hospitals chose between 50 and 100 cases). If major problems were discovered, hospitals were asked to verify the whole sample. Seventy per cent of the hospitals reported their audit results to us. All but one of the hospitals reported very high self-audited accuracy rates of 94% or higher for the AMI coding at their hospital. Any patients who the hospitals noted as being miscoded as having an AMI were excluded from the final outcomes cohort.

How We Did the Analysis

Analyses of 30-day and one-year mortality after an AMI at the DHC, major municipality, and hospital level were done. Thirty-day mortality rather than in-hospital mortality was used as one of the primary outcomes because differences in length of stay across institutions could potentially bias an in-hospital analysis. However, there was a very high correlation between an institution's in-hospital and 30-day mortality rate (r=0.90). In order to compare mortality across regions and institutions, two statistical models were created (one for 30-day and one for one-year mortality) to adjust for differences in age, sex, and eight other important comorbid conditions that influence AMI mortality, as described in the Methods Appendix. These models were used to calculate risk-adjusted mortality rates (RAMR) with 95% confidence intervals (CIs) for each DHC and major municipality in Ontario. The RAMR can be interpreted as the mortality rate a region would have if its patient case-mix were similar to the average case-mix in the province. Ninety-nine per cent rather than the traditional 95% confidence intervals were calculated for each hospital's RAMR in an effort to be conservative in classifying hospitals as mortality outliers. Institutions with RAMR significantly lower (i.e. low outliers) than the provincial average and significantly higher (i.e. high outliers) at the $p<0.01$ level were identified.

Age- and sex-adjusted readmission rates (with 95% confidence intervals) for cardiac reasons in the year after the first AMI admission were also determined for all patients surviving the in-hospital portion of their index admission. Specifically, we studied the frequency of readmissions for a second AMI, angina and congestive heart failure. Elective admissions during which an invasive cardiac procedure (e.g. coronary angiography, percutaneous transluminal coronary angioplasty [PTCA], or coronary artery bypass graft [CABG] surgery) was performed were excluded in determining readmission rates. We also excluded any admissions when the patient was admitted as a transfer from another institution.

Interpretive Cautions

While attempts have been made to develop the best possible statistical model to adjust for case-mix differences across institutions, it is important to remember that our adjustments were made based on comorbidities recorded in an administrative database rather than in a clinical database developed specifically for outcomes assessment. Although important factors such as age, sex and eight other comorbid conditions were adjusted for, data on other important prognostic factors such as site of AMI (i.e. anterior versus lateral or inferior wall), admitting blood pressure and heart rate were not available and may also have influenced outcomes.[8] It should also be recognized that some hospitals may have undercoded the prevalence of coexisting conditions in the CIHI database, leading to an underestimation of their expected outcomes. On the other hand, it is unlikely that undercoding of comorbidities would dramatically alter a hospital's risk-adjusted mortality rate, as demonstrated in the California AMI validation study.[6] Furthermore, sensitivity analyses were conducted to determine how much adjusting for comorbidities affected institutions' RAMRs after first adjusting for age and sex differences, and did not alter the 30-day RAMR by more than 3% in over 95% of the hospitals included in this study. Accordingly, variations in the accuracy with which comorbidities are coded across institutions are unlikely to be a major factor influencing the results.

Data on one-year mortality after an AMI are reported even though they predominantly reflect care that has occurred after a patient has been discharged from hospital. These data are included because it was felt that clinicians and hospitals would be very interested in the long-term outcomes of their patients, especially in light of their rates of cardiac procedure use (Chapter 8) and secondary prevention drug use (Chapter 11). One-year mortality is an important outcome that may be a reflection of multiple factors including patient characteristics, effective use of secondary preventive medications, timely access to invasive cardiac procedures, and comprehensive outpatient care.

We caution that mortality and readmission rates at institutions with small numbers of patients should be interpreted with caution as they may be statistically unstable. Hospital-specific mortality and readmission rates at institutions with fewer than 30 AMI patients over the three-year period are not reported for this reason. Smaller institutions may not have adequate resources for treating AMI patients (e.g. coronary care unit beds) and may have transferred many of their patients to other larger acute care institutions.

Because mortality after an AMI is a reflection of multiple factors, readers should not necessarily conclude that hospitals with the lowest mortality rates are offering the best quality of AMI care. While the quality of in-hospital care undoubtedly has an important influence on the 30-day RAMR, other factors such as unmeasured patient characteristics, pre- and post-hospital care (e.g. ambulance services, cardiac rehabilitation services etc.), and random variation may also contribute to differences in outcomes across institutions.

Findings and Discussion

The age- and sex-specific breakdown of the number of patients meeting the inclusion/exclusion criteria for the AMI outcomes analysis is shown in Exhibit 5.1. Overall, 52,616 patients were included in this analysis. Age- and sex-specific 30-day and one-year mortality rates after an AMI between fiscal 1994/95 and 1996/97 in Ontario are shown in Exhibit 5.2. They reveal an overall 30-day mortality rate of 14.8% and one-year mortality rate of 23.1% over the fiscal 1994/95 to 1996/97 study period. Rates for short-term and long-term mortality after an AMI were worse for women in Ontario as compared to men although this was largely a function of differences in the average age at presentation. Women had a 17% higher age-adjusted relative risk of dying within 30 days of their AMI as compared to men in fiscal 1996/97. Elderly AMI patients in Ontario had considerably worse outcomes than the non-elderly, highlighting the importance of age as the most important prognostic factor in AMI patients.

Analyses of 30-day and one-year mortality by DHC and major municipalities within a DHC are shown in Exhibits 5.3 and 5.4. The DHC analyses are also shown graphically in Exhibits 5.5 and 5.6. Overall, Halton-Peel DHC had the lowest 30-day and one-year RAMR of 13.3% and 20.8% respectively and Muskoka, Nipissing, Parry Sound and Timiskaming DHC had the highest 30-day and one-year RAMR of 18.5% and 27.4% respectively. Among the major municipalities, Vaughan had the lowest 30-day RAMR of 11.3% and other municipalities in Simcoe-York DHC had the highest 30-day RAMR of 17.2%. Further studies are required to elucidate the reasons for these differences. Overall, the outcomes were fairly similar with most DHCs and major municipalities having outcomes comparable to the provincial average.

EXHIBIT 5.1 Age/Sex-specific Volume of Acute Myocardial Infarction Patients Aged 20 Years and Over in the Ontario Myocardial Infarction Database Cohort, 1994/95 - 1996/97

		Women (Age)					Men (Age)				
Fiscal Year	**Total**	**20 - 49**	**50 - 64**	**65 - 74**	**75+**	**Total**	**20 - 49**	**50 - 64**	**65 - 74**	**75+**	**Total**
1994/95	17,115	315	1,216	1,889	2,868	6,288	1,581	3,598	3,065	2,583	10,827
1995/96	17,387	347	1,142	1,910	3,010	6,409	1,628	3,563	3,117	2,670	10,978
1996/97	18,114	321	1,133	2,024	3,253	6,731	1,605	3,666	3,221	2,891	11,383
Total	**52,616**	**983**	**3,491**	**5,823**	**9,131**	**19,428**	**4,814**	**10,827**	**9,403**	**8,144**	**33,188**
(%)	100	2	7	11	17	37	9	21	18	15	63

Data Source: Canadian Institute for Health Information, Ontario Myocardial Infarction Database

EXHIBIT 5.2 Age/Sex-specific 30-day and One-year Acute Myocardial Infarction Mortality Rates per 100 AMI Patients Aged 20 Years and Over in Ontario 1994/95 - 1996/97

		Women (Age)					Men (Age)				
Fiscal Year	**Total**	**20 - 49**	**50 - 64**	**65 - 74**	**75+**	**Total**	**20 - 49**	**50 - 64**	**65 - 74**	**75+**	**Total**
30-day Mortality Rate (%)											
1994/95	15.0	2.9	7.5	14.8	29.7	19.6	2.4	5.3	14.2	26.1	12.3
1995/96	14.7	2.6	7.7	14.5	28.1	19.0	1.5	5.5	12.9	26.4	12.1
1996/97	14.7	3.1	6.5	15.6	27.8	19.4	2.4	4.7	12.7	25.3	11.9
Total	**14.8**	**2.9**	**7.3**	**15.0**	**28.5**	**19.3**	**2.1**	**5.2**	**13.2**	**25.9**	**12.1**
One-year Mortality Rate (%)											
1994/95	23.4	5.4	12.2	23.9	43.6	29.7	3.5	8.7	22.5	41.9	19.8
1995/96	22.6	3.2	12.0	22.8	43.1	29.3	3.0	8.8	19.8	40.2	18.7
1996/97	23.3	4.7	11.9	23.9	42.6	30.0	3.3	7.8	21.6	40.4	19.4
Total	**23.1**	**4.4**	**12.0**	**23.5**	**43.1**	**29.7**	**3.3**	**8.5**	**21.3**	**40.8**	**19.3**

Data Source: Canadian Institute for Health Information, Registered Persons Database, Ontario Myocardial Infarction Database

Hospital-specific analyses of 30-day and one-year RAMR are shown in Exhibit 5.7. Although these numbers should be interpreted with caution, significant inter-hospital variations in 30-day RAMR after an AMI in Ontario were found. Overall, the median 30-day mortality rate at teaching hospitals (13.8%) and large hospitals (14.7%) was lower than that at medium (17.0%) and small (15.5%) hospitals in Ontario. Five hospitals in Ontario were found to have 30-day mortality rates significantly lower than the provincial average and seven hospitals had outcomes significantly worse than the provincial average at the $p<0.01$ level. It is important to note that the 99% confidence intervals for the RAMRs for the vast majority of institutions overlap, showing that our results cannot reliably be used to distinguish some hospitals as being better than others. Accordingly, these data should not be used to rank hospitals in Ontario.

EXHIBIT 5.3 Risk-adjusted 30-day and One-year Acute Myocardial Infarction Mortality Rates per 100 Acute Myocardial Infarction Patients Aged 20 Years and Over by District Health Council in Ontario, 1994/95 - 1996/97

District Health Council	Volume	30-day Mortality			One-year Mortality		
		Crude Rate (%)	Risk-adjusted Rate (%)	95% Confidence Interval	Crude Rate (%)	Risk-adjusted Rate (%)	95% Confidence Interval
Algoma, Cochrane, Manitoulin and Sudbury	2,485	14.2	**15.4**	14.1 - 16.7	22.5	**24.7**	23.1 - 26.2
Champlain	4,563	14.6	**15.1**	14.1 - 16.1	22.4	**22.9**	21.8 - 24.0
Durham, Haliburton, Kawartha and Pine Ridge	3,712	13.1	**14.0**	12.9 - 15.1	21.2	**22.3**	21.0 - 23.5
Essex, Kent and Lambton	3,479	15.6	**15.9**	14.8 - 17.0	23.3	**24.1**	22.8 - 25.4
Grand River	1,413	14.6	**15.1**	13.4 - 16.9	24.2	**24.6**	22.6 - 26.6
Grey, Bruce, Huron, Perth	1,692	17.1	**17.9****	16.2 - 19.5	24.3	**25.0**	23.1 - 26.9
Halton-Peel	4,205	11.9	**13.3***	12.3 - 14.4	18.5	**20.8***	19.6 - 22.0
Hamilton-Wentworth	2,317	15.1	**13.6**	12.4 - 14.9	24.6	**22.1**	20.7 - 23.5
Muskoka, Nipissing, Parry Sound and Timiskaming	1,448	15.9	**18.5****	16.6 - 20.4	24.0	**27.4****	25.2 - 29.5
Niagara Region	2,459	15.9	**15.6**	14.3 - 16.8	25.4	**24.7****	23.3 - 26.2
Northwestern Ontario	1,210	13.7	**13.6**	11.8 - 15.4	21.9	**21.4**	19.4 - 23.5
Quinte, Kingston, Rideau	2,845	13.9	**13.9**	12.7 - 15.1	22.7	**22.6**	21.2 - 24.0
Simcoe-York	3,733	14.2	**15.7**	14.6 - 16.8	21.6	**23.8**	22.5 - 25.1
Thames Valley	3,112	14.9	**14.8**	13.7 - 15.9	24.5	**24.2**	22.9 - 25.5
Toronto	11,223	16.2	**14.3**	13.8 - 14.9	25.3	**22.4**	21.8 - 23.1
Waterloo Region-Wellington-Dufferin	2,720	13.8	**14.8**	13.5 - 16.1	21.7	**22.8**	21.4 - 24.3

Total Volume	**52,616**
Overall Ontario 30-day Mortality Rate (%)	**14.8**
Overall Ontario One-year Mortality Rate (%)	**23.1**

Summary Statistics	30-day Risk-adjusted Rate	One-year Risk-adjusted Rate
Minimum	**13.3**	**20.8**
25th Percentile	**14.0**	**22.4**
Median	**15.0**	**23.4**
75th Percentile	**15.7**	**24.7**
Maximum	**18.5**	**27.4**

* Significantly lower than the provincial average (p<0.05)　　** Significantly higher than the provincial average (p<0.05)

Data Source: Canadian Institute for Health Information, Registered Persons Database, Ontario Myocardial Infarction Database

Although the one-year RAMRs shown in Exhibit 5.7 should not be solely attributed to the hospitals themselves, we did find significant interinstitutional variations in one-year RAMRs. Overall, four hospitals had one-year mortality rates significantly lower than the provincial average, and ten hospitals had one-year mortality rates significantly higher than the provincial average at the p<0.01 level. At the hospital level, there was a high correlation (r=0.83) between a hospital's 30-day and one-year RAMR.

EXHIBIT 5.4 Risk-adjusted 30-day and One-year Acute Myocardial Infarction Mortality Rates per 100 Acute Myocardial Infarction Patients Aged 20 Years and Over by Municipality with Population Greater than 100,000 versus Other Areas within Ontario District Health Councils, 1994/95 - 1997/98

Large Municipality/Other Areas	Volume	30-day Mortality Crude Rate (%)	30-day Mortality Risk-adjusted Rate (%)	30-day Mortality 95% Confidence Interval	One-year Mortality Crude Rate (%)	One-year Mortality Risk-adjusted Rate (%)	One-year Mortality 95% Confidence Interval
Champlain							
Gloucester	423	11.1	**13.5**	10.1 - 17.0	18.0	**21.4**	17.5 - 25.4
Nepean	363	14.3	**15.0**	11.6 - 18.4	22.3	**23.2**	19.4 - 27.1
Ottawa	1,607	15.9	**14.6**	13.1 - 16.1	23.6	**21.4**	19.7 - 23.2
Other	2,170	14.4	**15.8**	14.4 - 17.3	22.3	**24.5**	22.8 - 26.2
Durham, Haliburton, Kawartha and Pine Ridge							
Oshawa	695	12.9	**13.8**	11.3 - 16.2	20.9	**22.4**	19.5 - 25.3
Other	3,017	13.2	**14.0**	12.8 - 15.2	21.2	**22.2**	20.8 - 23.6
Essex, Kent and Lambton							
Windsor	1,208	14.5	**15.4**	13.5 - 17.3	22.2	**23.8**	21.6 - 26.1
Other	2,271	16.1	**16.2**	14.8 - 17.5	23.9	**24.2**	22.7 - 25.8
Halton-Peel							
Brampton	863	10.4	**12.5**	10.2 - 14.9	16.7	**20.0***	17.3 - 22.8
Burlington	658	13.1	**12.7**	10.3 - 15.1	20.7	**20.6**	17.8 - 23.4
Mississauga	1,824	11.9	**13.7**	12.1 - 15.3	18.3	**21.1***	19.3 - 23.0
Oakville	474	11.2	**12.4**	9.2 - 15.5	19.6	**21.0**	17.4 - 24.5
Other	386	14.0	**15.6**	12.2 - 19.0	19.2	**21.5**	17.5 - 25.5
Hamilton-Wentworth							
Hamilton	1,735	15.1	**13.5**	12.1 - 14.9	24.8	**22.2**	20.6 - 23.8
Other	582	15.3	**14.0**	11.5 - 16.5	23.9	**21.8**	19.0 - 24.7
Niagara Region							
St. Catharines	799	15.6	**14.7**	12.5 - 16.9	26.2	**24.7**	22.2 - 27.2
Other	1,660	16.0	**16.0**	14.4 - 17.6	25.1	**24.8**	23.0 - 26.6
Northwestern Ontario							
Thunder Bay	743	15.6	**13.4**	11.3 - 15.4	24.9	**21.3**	18.9 - 23.6
Other	467	10.7	**14.2**	10.6 - 17.8	17.1	**21.8**	17.7 - 25.9
Simcoe-York							
Markham	541	12.0	**13.9**	10.9 - 16.8	17.7	**20.6**	17.2 - 24.0
Richmond Hill	358	10.6	**12.2**	8.5 - 15.9	19.0	**21.9**	17.6 - 26.2
Vaughan	397	9.8	**11.3**	7.9 - 14.8	18.1	**20.7**	16.7 - 24.7
Other	2,437	15.9	**17.2****	15.9 - 18.6	23.4	**25.2****	23.7 - 26.8
Thames Valley							
London	1,687	15.2	**14.9**	13.4 - 16.4	24.7	**23.8**	22.0 - 25.5
Other	1,425	14.5	**14.7**	13.0 - 16.4	24.3	**24.6**	22.6 - 26.6
Waterloo Region-Wellington-Dufferin							
Cambridge	552	15.2	**16.0**	13.1 - 18.8	24.5	**24.4**	21.3 - 27.6
Kitchener	787	12.5	**14.5**	12.0 - 17.0	21.2	**24.1**	21.2 - 27.0
Other	1,381	14.0	**14.5**	12.7 - 16.3	20.8	**21.5**	19.5 - 23.5
Sumary Statistics							
Minimum			**11.3**			**20.0**	
25th Percentile			**13.5**			**21.4**	
Median			**14.4**			**22.1**	
75th Percentile			**15.1**			**24.1**	
Maximum			**17.2**			**25.2**	

* Significantly lower than the provincial average (p<0.05) ** Significantly higher than the provincial average (p<0.05)

Data Source: Canadian Institute for Health Information, Registered Persons Database, Ontario Myocardial Infarction Database

The number of AMI patients surviving their index hospitalization in different age and sex groups is shown in Exhibit 5.8. This cohort of 45,728 patients was used for an analysis of cardiac readmission rates shown in Exhibit 5.9. An average of 8.4% of AMI survivors were readmitted within one year of the index hospitalization with a second AMI, 12.5% for angina and 8.5% for congestive heart failure. The readmission rates were higher in the elderly for both AMI and congestive heart failure (CHF), whereas angina readmissions were actually more common in young female AMI survivors. Female patients were more likely to be readmitted for CHF and angina within all age strata, while readmission rates with a second AMI were similar between the genders.

Cardiac readmissions by DHC and major municipality are shown in Exhibits 5.10 and 5.11. Overall, the age- and sex-adjusted one-year AMI readmission rates varied from a low of 6.9% in Grey, Bruce, Huron, Perth DHC to a high of 9.3% in Toronto DHC. The angina readmission rates varied from a low of 9.7% in Hamilton-Wentworth DHC to a high of 16.3% in Quinte, Kingston, Rideau DHC. There was less variation in CHF readmission rates, ranging from a low of 6.7% in Halton-Peel DHC to a high of 10.2% in Grand River DHC. Among the major municipalities, one-year AMI readmission rates varied from a low of 5.3% in other areas of Halton-Peel DHC to a high of 10.3% in Vaughan, and one-year angina readmission rates varied from a low of 7.0% in London to a high of 16.2% in Oshawa. Other municipalities in Halton-Peel had the lowest one-year CHF readmission rate of 5.1% while no municipality had a significantly higher than expected CHF readmission rate.

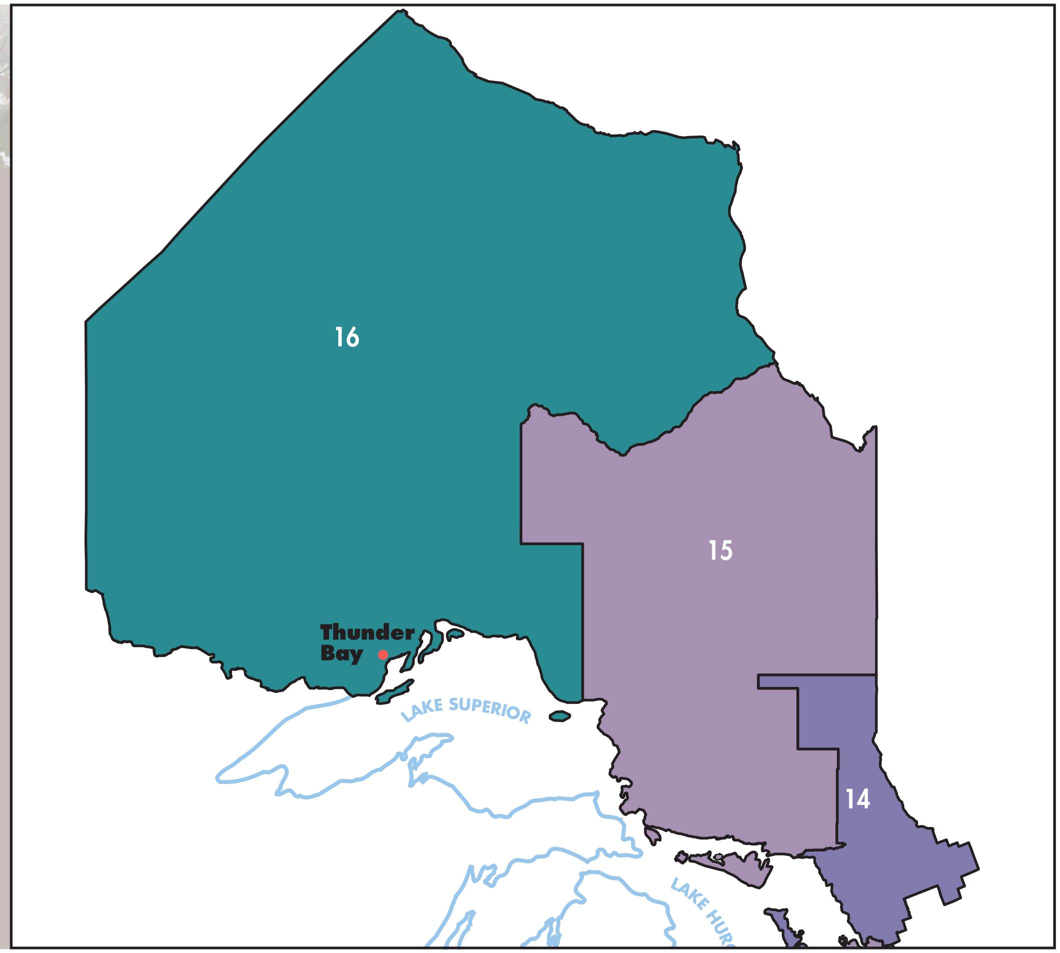
Cardiac readmission rates for individual hospitals are shown in Exhibit 5.12. Seven hospitals had one-year AMI readmission rates that were significantly lower than the provincial average and nine hospitals had one-year AMI readmission rates that were significantly higher than the provincial average. Eleven hospitals had one-year angina readmission rates that were significantly lower than the provincial average and 20 hospitals had one-year angina readmission rates that were higher than the provincial average. Less variation was seen for CHF, although five hospitals' readmission rates were significantly lower than the provincial average and eight hospitals' rates were significantly higher.

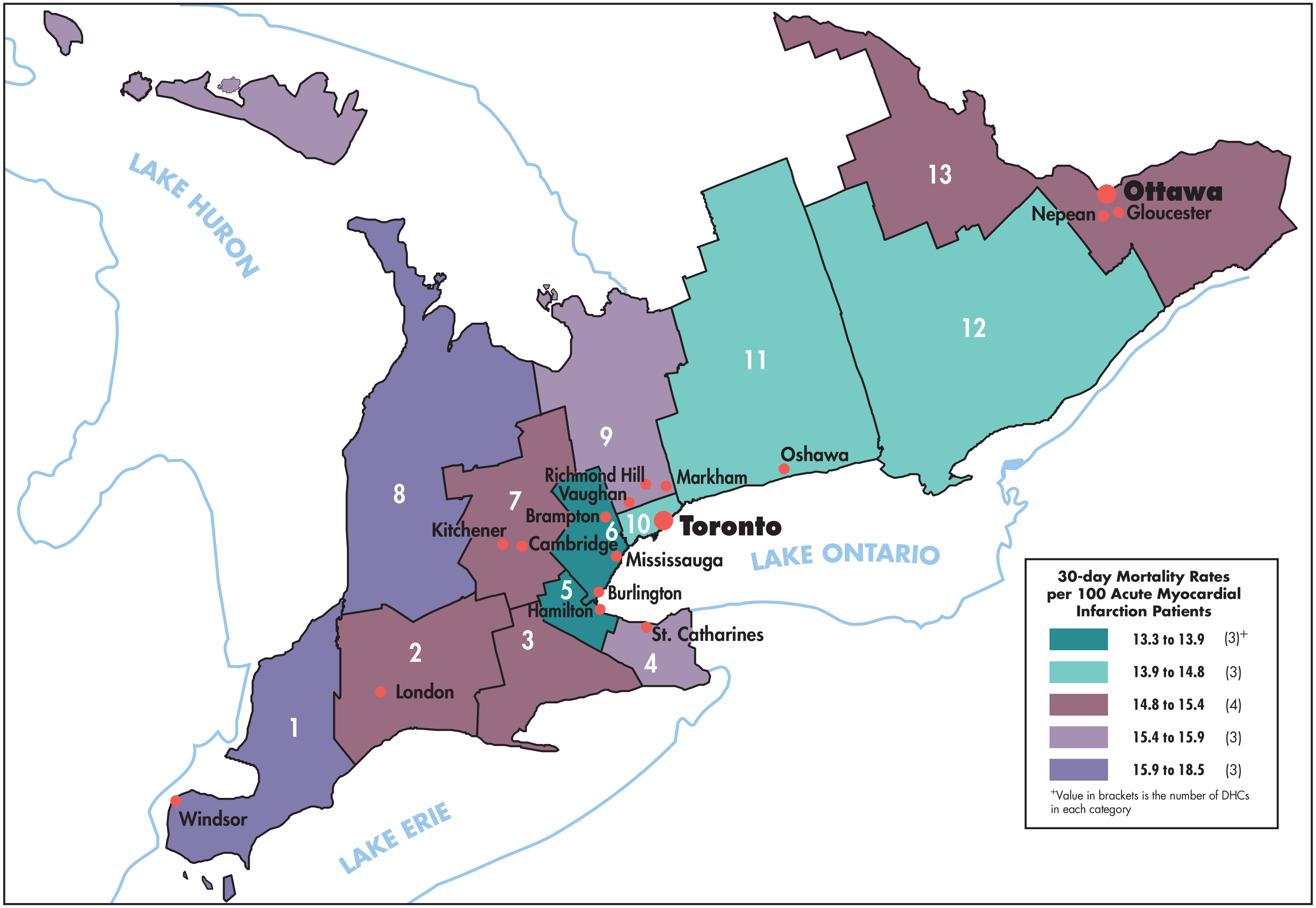
5.5 EXHIBIT

Risk-adjusted 30-day Acute Myocardial Infarction Mortality Rates per 100 Patients Aged 20 Years and Over by District Health Council in Ontario, 1994/95 - 1996/97

ONTARIO District Health Councils

1. Essex, Kent and Lambton
2. Thames Valley
3. Grand River
4. Niagara Region
5. Hamilton-Wentworth
6. Halton-Peel
7. Waterloo Region-Wellington-Dufferin
8. Grey, Bruce, Huron, Perth
9. Simcoe-York
10. Toronto
11. Durham, Haliburton, Kawartha and Pine Ridge
12. Quinte, Kingston, Rideau
13. Champlain
14. Muskoka, Nipissing, Parry Sound and Timiskaming
15. Algoma, Cochrane, Manitoulin and Sudbury
16. Northwestern Ontario





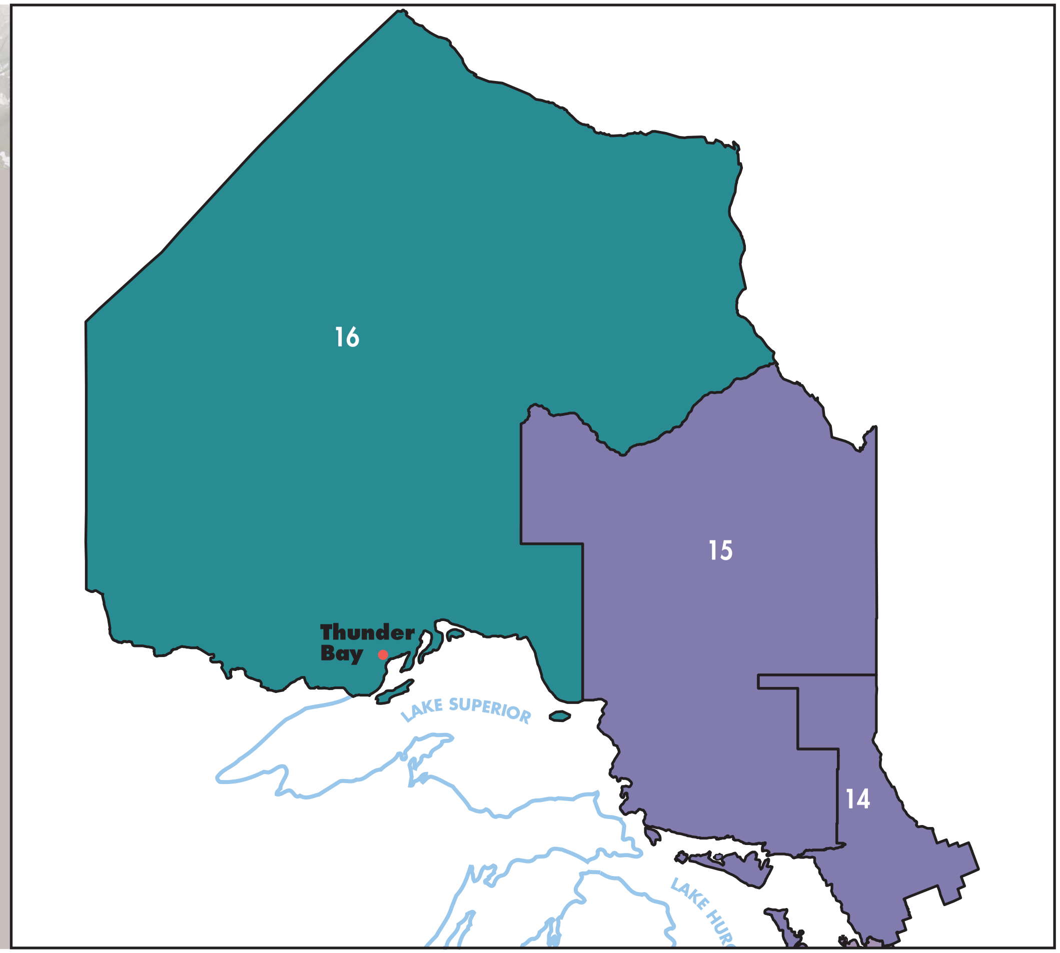
Data Source: Canadian Institute for Health Information, Registered Persons Database, Ontario Myocardial Infarction Database

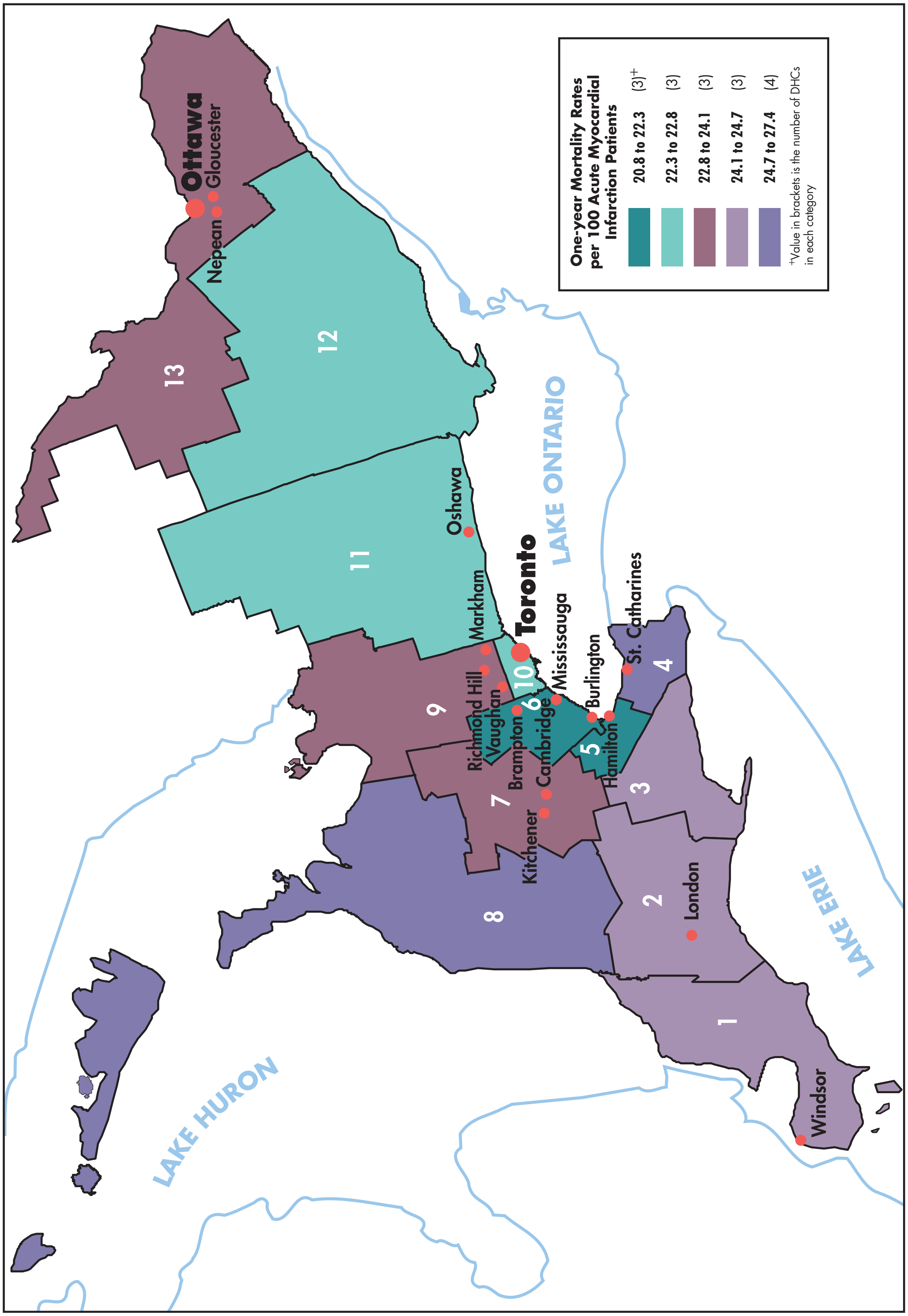
5.6 EXHIBIT

Risk-adjusted One-year Acute Myocardial Infarction Mortality Rates per 100 Patients Aged 20 Years and Over by District Health Council in Ontario, 1994/95 - 1996/97

ONTARIO District Health Councils

1. Essex, Kent and Lambton
2. Thames Valley
3. Grand River
4. Niagara Region
5. Hamilton-Wentworth
6. Halton-Peel
7. Waterloo Region-Wellington-Dufferin
8. Grey, Bruce, Huron, Perth
9. Simcoe-York
10. Toronto
11. Durham, Haliburton, Kawartha and Pine Ridge
12. Quinte, Kingston, Rideau
13. Champlain
14. Muskoka, Nipissing, Parry Sound and Timiskaming
15. Algoma, Cochrane, Manitoulin and Sudbury
16. Northwestern Ontario





Data Source: Canadian Institute for Health Information, Registered Persons Database, Ontario Myocardial Infarction Database

EXHIBIT 5.7 Risk-adjusted 30-day and One-year Acute Myocardial Infarction Mortality Rates per 100 AMI Patients Aged 20 Years and Over by Hospital in Ontario, 1994/95 - 1996/97

TEACHING

Hospital	Volume	30-day Mortality			One-year Mortality		
		Crude Rate (%)	Risk-adjusted Rate (%)	99% Confidence Interval	Crude Rate (%)	Risk-adjusted Rate (%)	99% Confidence Interval
Chedoke-McMaster Hospital, Hamilton	454	19.4	**15.6**	12.3 - 18.9	29.1	**24.0**	20.1 - 27.9
Hamilton Civic Hospitals (General Division)	686	11.8	**12.7**	9.4 - 16.0	21.4	**22.6**	18.9 - 26.4
Hamilton Civic Hospitals (Henderson Division)	767	16.8	**13.8**	11.2 - 16.5	26.6	**22.0**	19.0 - 25.0
Hôtel Dieu Hospital, Kingston	404	12.6	**13.5**	9.2 - 17.9	21.0	**22.4**	17.4 - 27.4
Kingston General Hospital	569	13.5	**11.6***	8.6 - 14.7	23.6	**19.8**	16.4 - 23.3
Mount Sinai Hospital, Toronto	369	14.9	**11.2***	7.6 - 14.7	25.5	**19.5**	15.4 - 23.5
Ottawa Civic Hospital	1,000	14.3	**13.8**	11.2 - 16.3	22.3	**21.0**	18.1 - 23.9
Ottawa General Hospital	678	12.7	**12.9**	9.7 - 16.1	21.4	**21.3**	17.7 - 25.0
St. Joseph's Health Centre of London	710	15.9	**14.6**	11.6 - 17.5	25.2	**22.9**	19.6 - 26.3
St. Joseph's Hospital, Hamilton	389	14.4	**11.8**	8.2 - 15.5	24.4	**19.7**	15.5 - 23.8
St. Michael's Hospital, Toronto	267	13.1	**12.7**	7.9 - 17.6	22.5	**22.6**	17.0 - 28.3
Sunnybrook Health Science Centre, Toronto	688	15.1	**12.5**	9.7 - 15.3	23.1	**19.4***	16.1 - 22.6
Toronto Hospital Corporation	868	18.3	**14.2**	11.8 - 16.7	29.6	**22.3**	19.6 - 24.9
University Hospital, London	331	12.4	**14.6**	9.5 - 19.7	19.6	**23.5**	17.5 - 29.6
Victoria Hospital, London	891	15.8	**16.1**	13.2 - 18.9	24.8	**24.4**	21.3 - 27.6
Wellesley-Central Hospital, Toronto	302	17.2	**14.5**	10.3 - 18.8	26.8	**22.9**	18.0 - 27.7
Women's College Hospital, Toronto	125	16.0	**15.0**	7.5 - 22.4	25.6	**22.9**	14.8 - 31.1
Summary Statistics							
Minimum			**11.2**			**19.4**	
25th Percentile			**12.7**			**21.0**	
Median			**13.8**			**22.4**	
75th Percentile			**14.6**			**22.9**	
Maximum			**16.1**			**24.4**	

LARGE

Hospital	Volume	30-day Mortality			One-year Mortality		
		Crude Rate (%)	Risk-adjusted Rate (%)	99% Confidence Interval	Crude Rate (%)	Risk-adjusted Rate (%)	99% Confidence Interval
Belleville General Hospital	546	11.2	**12.0**	8.3 - 15.8	19.8	**21.6**	17.2 - 26.0
Brantford General Hospital	668	14.8	**15.0**	11.7 - 18.2	23.5	**23.6**	19.9 - 27.3
Cambridge Memorial Hospital	567	15.3	**16.3**	12.6 - 20.0	25.2	**25.3**	21.2 - 29.3
Centenary Health Centre, Scarborough	752	14.5	**14.7**	11.7 - 17.6	22.1	**23.0**	19.5 - 26.5
Credit Valley Hospital, Mississauga	617	10.7	**11.5**	8.2 - 14.9	19.6	**21.2**	17.3 - 25.1
Etobicoke General Hospital	828	12.7	**13.6**	10.7 - 16.5	19.8	**22.0**	18.5 - 25.5
Grand River Hospital Corporation, Kitchener	651	10.9	**12.2**	8.6 - 15.8	19.2	**21.1**	17.0 - 25.3
Greater Niagara General Hospital	518	14.7	**16.4**	12.4 - 20.5	23.2	**25.3**	20.7 - 29.8
Grey Bruce Regional Health Centre, Owen Sound	380	14.5	**17.4**	12.4 - 22.4	21.1	**25.1**	19.3 - 30.9
Guelph General Hospital	442	15.2	**14.1**	10.4 - 17.8	20.4	**19.8**	15.3 - 24.2
Hôpital Montfort, Ottawa	540	15.2	**16.7**	12.8 - 20.6	23.3	**24.5**	20.1 - 28.8
Hôtel Dieu Hospital, St. Catharines	348	16.7	**15.1**	10.9 - 19.3	29.6	**26.5**	21.7 - 31.2
Hôtel Dieu Grace Hospital, Windsor	427	15.0	**15.0**	11.0 - 19.1	21.8	**22.2**	17.4 - 27.0

EXHIBIT 5.7

LARGE (CONT'D)

Hospital	Volume	30-day Mortality			One-year Mortality		
		Crude Rate (%)	Risk-adjusted Rate (%)	99% Confidence Interval	Crude Rate (%)	Risk-adjusted Rate (%)	99% Confidence Interval
Humber Memorial Hospital, Weston	435	23.0	**22.8****	18.7 - 26.9	32.6	**32.3****	27.5 - 37.0
Joseph Brant Memorial Hospital, Burlington	704	12.6	**12.4**	9.3 - 15.5	19.6	**19.9**	16.2 - 23.6
Mississauga Hospital (The)	932	13.4	**14.4**	11.6 - 17.2	19.5	**21.1**	17.9 - 24.4
Norfolk General Hospital, Simcoe	464	12.3	**13.4**	9.2 - 17.6	23.9	**25.3**	20.5 - 30.1
North York Branson Hospital	844	15.4	**14.6**	11.7 - 17.5	27.0	**24.4**	21.2 - 27.7
North York General Hospital	1,172	13.7	**12.8**	10.5 - 15.1	19.7	**18.6***	15.9 - 21.3
Northwestern General Hospital, Toronto	544	17.5	**15.5**	12.1 - 18.8	27.2	**23.4**	19.6 - 27.1
Oakville-Trafalgar Memorial Hospital	538	11.2	**12.8**	8.8 - 16.7	19.1	**21.1**	16.6 - 25.5
Orillia Soldiers' Memorial Hospital	441	19.5	**18.6**	14.7 - 22.4	29.7	**28.6****	24.1 - 33.1
Oshawa General Hospital	863	13.1	**14.1**	11.1 - 17.0	20.2	**21.9**	18.5 - 25.4
Peel Memorial Hospital, Brampton	840	10.2	**12.6**	9.4 - 15.8	16.1	**19.7**	15.9 - 23.4
Peterborough Civic Hospital	715	12.4	**12.7**	9.6 - 15.9	19.3	**19.6**	16.0 - 23.3
Public General Hospital, Chatham	494	14.0	**14.7**	10.9 - 18.6	20.6	**22.2**	17.6 - 26.7
Queensway General Hospital, Etobicoke	672	14.0	**14.3**	11.1 - 17.5	20.4	**21.3**	17.5 - 25.1
Queensway-Carleton Hospital, Nepean	506	14.0	**16.5**	12.4 - 20.6	20.8	**25.2**	20.3 - 30.1
Riverside Hospital, Ottawa	367	12.5	**11.7**	7.6 - 15.8	18.5	**17.6***	12.8 - 22.4
Ross Memorial Hospital, Lindsay	513	13.8	**12.9**	9.4 - 16.5	22.0	**20.2**	16.2 - 24.3
Royal Victoria Hospital, Barrie	595	16.3	**17.9**	14.2 - 21.5	22.9	**24.8**	20.6 - 29.1
Salvation Army Scarborough Grace Hospital	612	12.9	**13.3**	9.9 - 16.8	19.6	**19.6**	15.7 - 23.4
Sarnia General Hospital	490	13.1	**13.6**	9.8 - 17.4	20.2	**22.1**	17.4 - 26.7
Sault Ste. Marie General Hospital	320	17.5	**15.2**	11.1 - 19.4	25.0	**22.1**	17.3 - 26.9
Scarborough General Hospital	1,117	15.2	**15.1**	12.6 - 17.6	24.7	**24.2**	21.3 - 27.1
St. Catharines General Hospital	632	16.0	**15.5**	12.3 - 18.7	24.4	**24.2**	20.4 - 28.0
St. Thomas Elgin General Hospital	403	13.9	**12.1**	8.4 - 15.9	24.8	**22.1**	17.7 - 26.5
St. Joseph's Health Centre, Toronto	893	16.9	**11.6***	9.5 - 13.8	28.4	**20.2***	17.7 - 22.7
St. Mary's General Hospital, Kitchener	549	15.5	**18.4**	14.4 - 22.3	22.6	**26.4**	21.8 - 31.0
Sudbury General Hospital of the Immaculate Heart of Mary	464	15.5	**17.0**	12.9 - 21.0	22.6	**25.5**	20.7 - 30.3
Sudbury Memorial Hospital	520	15.0	**15.9**	12.2 - 19.6	22.1	**24.3**	19.9 - 28.7
Toronto East General and Orthopedic Hospital	1,032	19.3	**16.4**	14.1 - 18.7	28.2	**23.9**	21.3 - 26.6
Welland County General Hospital	405	14.6	**13.7**	9.8 - 17.6	23.5	**21.9**	17.5 - 26.4
York Central Hospital, Richmond Hill	615	12.5	**14.0**	10.3 - 17.6	21.1	**23.7**	19.5 - 27.9
York County Hospital, Newmarket	555	15.3	**19.0****	15.0 - 23.1	21.1	**26.5**	21.7 - 31.2
York-Finch General Hospital, North York	564	12.6	**14.8**	10.9 - 18.7	20.9	**23.7**	19.3 - 28.1
Summary Statistics							
Minimum			**11.5**			**17.6**	
25th Percentile			**12.9**			**21.1**	
Median			**14.7**			**22.6**	
75th Percentile			**16.3**			**24.8**	
Maximum			**22.8**			**32.3**	

EXHIBIT 5.7

MEDIUM

Hospital	Volume	30-day Mortality			One-year Mortality		
		Crude Rate (%)	Risk-adjusted Rate (%)	99% Confidence Interval	Crude Rate (%)	Risk-adjusted Rate (%)	99% Confidence Interval
Ajax and Pickering General Hospital	420	10.7	**13.0**	8.4 - 17.6	18.8	**22.0**	16.8 - 27.2
Alexandra Hospital, Ingersoll	110	4.5	**5.1***	0.0 - 14.0	20.9	**22.2**	12.5 - 31.9
Alexandra Marine and General Hospital, Goderich	113	17.7	**16.8**	9.1 - 24.4	26.5	**24.7**	16.0 - 33.5
Arnprior and District Memorial Hospital	98	16.3	**17.9**	8.5 - 27.2	27.6	**29.1**	18.6 - 39.6
Brockville General Hospital	240	15.0	**18.7**	12.5 - 24.9	20.8	**26.4**	19.0 - 33.7
Campbellford Memorial Hospital	169	19.5	**19.2**	12.6 - 25.8	29.6	**27.7**	20.5 - 34.9
Cobourg District General Hospital	131	13.7	**17.2**	8.5 - 25.8	23.7	**28.3**	18.7 - 37.8
Collingwood General and Marine Hospital	227	16.7	**19.7**	13.3 - 26.1	25.6	**29.9**	22.5 - 37.2
Cornwall General Hospital	270	18.9	**18.8**	13.8 - 23.8	25.2	**25.7**	19.8 - 31.5
Doctors Hospital, Toronto	87	16.1	**19.1**	8.9 - 29.2	21.8	**25.2**	13.7 - 36.6
Douglas Memorial Hospital, Fort Erie	130	20.8	**20.3**	12.7 - 27.8	31.5	**28.4**	20.3 - 36.6
Dufferin-Caledon Health Care Corporation, Orangeville	274	12.0	**12.1**	7.0 - 17.3	20.1	**19.7**	14.0 - 25.5
Georgetown and District Memorial Hospital	108	12.0	**11.5**	4.2 - 18.8	17.6	**17.5**	8.8 - 26.1
Groves Memorial and Community Hospital, Fergus	131	9.9	**11.2**	3.0 - 19.4	16.8	**18.7**	9.4 - 28.1
Hôpital General de Hawkesbury and District General Hospital Inc.	165	12.7	**14.9**	7.8 - 22.0	20.0	**23.1**	14.8 - 31.4
Hôtel Dieu Hospital, Cornwall	338	18.0	**17.2**	12.9 - 21.5	27.5	**27.1**	22.0 - 32.1
Hôtel Dieu of St. Joseph Hospital, Windsor	150	10.7	**11.7**	4.3 - 19.1	21.3	**22.7**	14.4 - 31.0
Huntsville District Memorial Hospital	194	16.0	**20.9**	13.6 - 28.2	22.2	**27.5**	19.3 - 35.6
Huronia District Hospital, Midland	264	11.7	**13.6**	7.9 - 19.2	19.7	**23.0**	16.3 - 29.7
Kirkland and District Hospital	144	21.5	**21.2**	14.3 - 28.1	32.6	**31.5****	23.6 - 39.3
Lake of the Woods District Hospital, Kenora	104	11.5	**14.9**	4.9 - 24.9	18.3	**22.1**	11.1 - 33.1
Leamington District Memorial Hospital	282	18.1	**16.6**	11.8 - 21.3	27.0	**24.8**	19.3 - 30.2
Lennox and Addington County General Hospital, Napanee	190	18.4	**13.9**	9.2 - 18.5	27.4	**22.7**	16.9 - 28.5
Markham Stouffville Hospital	340	13.8	**14.9**	10.3 - 19.6	19.4	**21.5**	16.0 - 27.0
Memorial Hospital, Bowmanville	183	16.4	**18.0**	11.3 - 24.7	26.2	**26.8**	19.5 - 34.1
Metropolitan General Hospital, Windsor	411	13.1	**14.5**	10.2 - 18.9	20.4	**23.3**	18.1 - 28.5
Milton District Hospital	134	15.7	**18.4**	10.3 - 26.6	17.9	**20.8**	11.5 - 30.1
North Bay General Hospital	300	14.3	**19.3**	13.4 - 25.2	20.7	**27.8**	20.8 - 34.8
Pembroke Civic Hospital	137	9.5	**10.5**	2.8 - 18.1	16.8	**18.8**	9.8 - 27.8
Pembroke General Hospital	118	16.1	**19.0**	10.3 - 27.7	20.3	**23.4**	13.6 - 33.1
Perth and Smiths Falls District Hospital	281	16.4	**17.4**	12.0 - 22.7	26.7	**28.0**	21.8 - 34.1
Plummer Memorial Public Hospital, Sault Ste. Marie	256	12.9	**12.7**	7.7 - 17.8	21.5	**21.7**	15.8 - 27.7
Port Colborne General Hospital	154	14.9	**14.5**	7.6 - 21.3	27.3	**25.3**	17.7 - 32.9
Prince Edward County Memorial Hospital, Picton	128	18.0	**18.2**	10.4 - 25.9	29.7	**28.7**	20.2 - 37.2
Renfrew Victoria Hospital	115	19.1	**20.0**	11.8 - 28.2	26.1	**26.8**	17.5 - 36.2
South Muskoka Memorial Hospital, Bracebridge	201	13.4	**14.7**	8.3 - 21.1	21.4	**22.9**	15.7 - 30.2
St. Joseph's General Hospital, Elliot Lake	128	15.6	**20.0**	11.5 - 28.5	25.8	**34.2****	23.9 - 44.6
St. Joseph's General Hospital, Thunder Bay	158	19.6	**16.2**	10.5 - 21.9	27.8	**24.0**	17.3 - 30.8
St. Joseph's Health Centre of Sarnia	89	23.6	**19.0**	11.7 - 26.3	28.1	**24.3**	15.3 - 33.2
St. Joseph's Hospital, Chatham	198	21.7	**22.0****	16.0 - 28.1	29.8	**30.6****	23.5 - 37.7
St. Joseph's Hospital and Health Centre of Peterborough	88	15.9	**13.2**	5.2 - 21.1	29.5	**24.4**	15.5 - 33.3
St. Vincent de Paul Hospital, Brockville	74	13.5	**12.1**	2.9 - 21.2	23.0	**19.9**	9.6 - 30.3
Stevenson Memorial Hospital, Alliston	230	13.9	**12.6**	7.4 - 17.8	23.9	**20.9**	15.3 - 26.6

EXHIBIT 5.7

MEDIUM (CONT'D)

Hospital	Volume	30-day Mortality: Crude Rate (%)	30-day Mortality: Risk-adjusted Rate (%)	30-day Mortality: 99% Confidence Interval	One-year Mortality: Crude Rate (%)	One-year Mortality: Risk-adjusted Rate (%)	One-year Mortality: 99% Confidence Interval
Stratford General Hospital	227	19.4	**17.7**	12.4 - 23.0	27.8	**24.7**	18.8 - 30.7
Strathroy Middlesex General Hospital	196	21.4	**20.6**	14.8 - 26.5	30.1	**29.3**	22.4 - 36.1
Sydenham District Hospital, Wallaceburg	176	14.8	**15.4**	8.7 - 22.2	21.0	**19.5**	12.4 - 26.6
Temiskaming Hospital, New Liskeard	137	17.5	**19.0**	11.3 - 26.6	22.6	**24.3**	15.5 - 33.0
Thunder Bay Regional Hospital	656	13.4	**12.2**	9.2 - 15.2	22.3	**19.9**	16.5 - 23.3
Tillsonburg District Memorial Hospital	220	13.6	**17.9**	10.9 - 24.8	22.3	**28.5**	20.5 - 36.5
Timmins and District Hospital	280	12.5	**14.0**	8.7 - 19.3	23.2	**25.9**	19.7 - 32.1
Trenton Memorial Hospital	262	14.9	**15.5**	10.3 - 20.7	21.4	**22.6**	16.5 - 28.7
West Lincoln Memorial Hospital, Grimsby	255	15.7	**15.0**	9.8 - 20.3	25.5	**24.6**	18.6 - 30.6
West Nipissing General Hospital, Sturgeon Falls	119	18.5	**19.6**	11.6 - 27.7	31.1	**32.4****	23.2 - 41.6
West Parry Sound Health Centre	173	15.6	**17.0**	10.2 - 23.8	23.1	**25.4**	17.4 - 33.4
Whitby General Hospital	132	20.5	**23.2****	15.1 - 31.3	26.5	**28.9**	19.9 - 38.0
Winchester District Memorial Hospital	168	11.9	**13.3**	6.1 - 20.4	21.4	**23.6**	15.4 - 31.7
Windsor Regional Hospital	285	15.4	**16.0**	11.0 - 21.0	21.8	**23.3**	17.3 - 29.2
Windsor Western Hospital Centre Incorporated	234	16.2	**17.7**	12.1 - 23.2	25.2	**28.1**	21.4 - 34.7
Woodstock General Hospital	279	19.7	**19.1**	14.3 - 23.9	30.1	**30.4****	24.7 - 36.2
Summary Statistics							
Minimum			**5.1**			**17.5**	
25th Percentile			**13.9**			**22.6**	
Median			**17.0**			**24.7**	
75th Percentile			**19.0**			**28.0**	
Maximum			**23.2**			**34.2**	

SMALL

Hospital	Volume	30-day Mortality: Crude Rate (%)	30-day Mortality: Risk-adjusted Rate (%)	30-day Mortality: 99% Confidence Interval	One-year Mortality: Crude Rate (%)	One-year Mortality: Risk-adjusted Rate (%)	One-year Mortality: 99% Confidence Interval
Almonte General Hospital	40	30.0	**23.2**	11.9 - 34.6	35.0	**26.7**	14.1 - 39.4
Atikokan General Hospital	37	10.8	**15.6**	0.0 - 33.7	18.9	**26.6**	5.5 - 47.6
Belleville General Hospital, Bancroft	59	8.5	**9.9**	0.0 - 22.6	16.9	**19.0**	4.8 - 33.3
Bruce Peninsula Health Services, Wiarton	87	9.2	**10.8**	0.6 - 21.1	13.8	**16.3**	4.2 - 28.4
Carleton Place and District Memorial Hospital	67	10.4	**12.3**	0.9 - 23.7	13.4	**15.8**	2.3 - 29.3
Centre Grey General Hospital, Markdale	74	10.8	**11.7**	1.1 - 22.4	16.2	**17.0**	5.2 - 28.9
Charlotte Eleanor Englehart Hospital, Petrolia	45	33.3	**25.2**	14.2 - 36.3	51.1	**38.8****	26.3 - 51.3
Chesley and District Memorial Hospital	31	16.1	**13.6**	0.4 - 26.8	25.8	**24.4**	7.5 - 41.2
Clinton Public Hospital	59	16.9	**20.4**	7.6 - 33.1	25.4	**29.3**	15.0 - 43.6
Community Memorial-Port Perry Hospital, Scugog	48	0.0	**0.0***	0.0 - 12.0	20.8	**19.0**	5.7 - 32.4
Cottage Hospital, Uxbridge	58	8.6	**9.6**	0.0 - 21.9	10.3	**11.2**	0.0 - 24.8
County of Bruce General Hospital, Walkerton	72	22.2	**22.4**	12.1 - 32.7	31.9	**31.9**	20.2 - 43.7
Deep River and District Hospital Corporation	37	18.9	**19.6**	5.1 - 34.2	21.6	**22.0**	5.5 - 38.5
Dryden District General Hospital	62	9.7	**13.4**	0.3 - 26.5	14.5	**18.6**	4.3 - 32.8
Durham Memorial Hospital	31	22.6	**19.5**	5.0 - 34.0	35.5	**28.8**	13.4 - 44.3

EXHIBIT 5.7

SMALL (CONT'D)

Hospital	Volume	30-day Mortality: Crude Rate (%)	30-day Mortality: Risk-adjusted Rate (%)	30-day Mortality: 99% Confidence Interval	One-year Mortality: Crude Rate (%)	One-year Mortality: Risk-adjusted Rate (%)	One-year Mortality: 99% Confidence Interval
Englehart and District Hospital	41	12.2	**15.1**	0.0 - 30.7	22.0	**27.2**	9.0 - 45.4
Espanola General Hospital	67	9.0	**13.4**	0.0 - 27.1	19.4	**27.6**	12.0 - 43.1
Four Countries General Hospital, Newbury	74	9.5	**7.7**	0.0 - 16.3	21.6	**17.2**	7.7 - 26.8
Geraldton District Hospital	40	12.5	**17.8**	1.5 - 34.0	20.0	**29.3**	9.7 - 49.0
Haldimand War Memorial Hospital, Dunnville	95	17.9	**22.1**	12.1 - 32.2	25.3	**31.2**	19.4 - 43.1
Hanover and District Hospital	64	17.2	**15.5**	6.3 - 24.7	18.8	**18.4**	6.9 - 29.8
Kemptville District Hospital	62	8.1	**12.0**	0.0 - 26.0	16.1	**24.2**	7.8 - 40.7
Kincardine and District General Hospital	89	10.1	**12.2**	1.7 - 22.7	16.9	**20.2**	8.0 - 32.5
Lady Minto Hosptial, Cochrane	44	15.9	**19.4**	5.5 - 33.3	22.7	**28.5**	11.7 - 45.4
Listowel Memorial Hospital	86	23.3	**22.2**	13.0 - 31.4	26.7	**23.9**	13.9 - 33.8
Louise Marshall Hospital, Mount Forest	85	14.1	**13.6**	4.6 - 22.7	24.7	**23.0**	13.0 - 33.0
Manitoulin Health Centre, Little Current	56	12.5	**12.9**	1.1 - 24.8	19.6	**19.0**	6.0 - 32.1
Manitoulin Health Centre, Mindemoya Unit	61	9.8	**11.0**	0.0 - 23.0	23.0	**24.1**	10.9 - 37.2
Mattawa General Hospital	47	8.5	**10.9**	0.0 - 25.7	12.8	**16.2**	0.0 - 33.4
Meaford General Hospital	88	23.9	**24.7****	15.2 - 34.2	36.4	**35.2****	24.8 - 45.6
North Bay Civic Hospital	47	25.5	**29.4****	15.6 - 43.1	36.2	**38.0****	23.3 - 52.8
Palmerston and District Hospital	56	26.8	**30.8****	18.0 - 43.7	32.1	**35.2**	20.8 - 49.6
Penetanguishene General Hospital	77	15.6	**16.4**	6.3 - 26.5	24.7	**26.7**	14.6 - 38.7
Port Hope and District Hospital	85	15.3	**16.6**	6.7 - 26.5	27.1	**28.9**	17.7 - 40.0
Riverside Health Care Facilities, Fort Frances	62	11.3	**14.7**	1.7 - 27.7	17.7	**22.0**	7.3 - 36.6
Salvation Army Grace Hospital, Windsor	70	18.6	**22.4**	10.7 - 34.1	30.0	**34.0**	21.0 - 47.0
Seaforth Community Hospital	56	19.6	**18.4**	7.0 - 29.8	32.1	**29.0**	16.4 - 41.7
Sensenbrenner Hospital, Kapuskasing	84	11.9	**15.5**	4.5 - 26.5	21.4	**28.4**	15.3 - 41.4
South Huron Hospital Association, Exeter	69	26.1	**24.3**	14.4 - 34.1	34.8	**32.1**	20.8 - 43.4
St. Joseph's Hospital and Health Centre of Peterborough, Haliburton	40	10.0	**13.9**	0.0 - 30.8	17.5	**23.7**	4.1 - 43.3
St. Joseph's General Hospital of North Bay	87	6.9	**9.6**	0.0 - 21.0	14.9	**20.5**	7.3 - 33.7
St. Joseph's Health Centre, Blind River	44	13.6	**18.4**	2.6 - 34.2	22.7	**29.0**	11.3 - 46.6
St. Mary's Memorial Hospital, St. Mary's	64	15.6	**17.2**	5.6 - 28.9	25.0	**26.0**	13.2 - 38.8
West Haldimand General Hospital, Hagersville	86	15.1	**14.1**	5.3 - 23.0	24.4	**21.6**	11.9 - 31.2
Wingham and District Hospital	90	23.3	**22.8**	13.9 - 31.6	33.3	**32.2**	22.1 - 42.3
30 Hospitals with 30 Cases or Less	**340**						
Total Ontario	**52,616**						
Summary Statistics (Small Hospitals)							
Minimum			**0.0**			**11.2**	
25th Percentile			**12.3**			**20.2**	
Median			**15.5**			**26.0**	
75th Percentile			**20.4**			**29.0**	
Maximum			**30.8**			**38.8**	

Note: Mortality rates at hospitals with small volumes of patients should be interpreted with caution because they may be statistically unstable.

* Significantly lower than the provincial average (p<0.01) ** Significantly higher than the provincial average (p<0.01)

Data Source: Canadian Institute for Health Information, Registered Persons Database, Ontario Myocardial Infarction Database

EXHIBIT 5.8 Age/Sex-specific Volume of Acute Myocardial Infarction Survivors Aged 20 Years and Over in the Ontario Myocardial Infarction Database Cohort, 1994/95 - 1996/97

		Women (Age)					Men (Age)				
Fiscal Year	Total	20 - 49	50 - 64	65 - 74	75+	Overall	20 - 49	50 - 64	65 - 74	75+	Overall
1994/95	14,836	307	1,139	1,649	2,079	5,174	1,551	3,442	2,695	1,974	9,662
1995/96	15,119	339	1,066	1,673	2,220	5,298	1,607	3,405	2,775	2,034	9,821
1996/97	15,773	313	1,069	1,760	2,421	5,563	1,579	3,552	2,875	2,234	10,210
Total	**45,728**	**959**	**3,274**	**5,082**	**6,720**	**16,035**	**4,737**	**10,369**	**8,345**	**6,242**	**29,693**
(%)	100.0	2.1	7.2	11.1	14.7	35.1	10.4	22.7	18.2	13.7	64.9

Data Source: Canadian Institute for Health Information, Ontario Myocardial Infarction Database

EXHIBIT 5.9 Age/Sex-specific Acute Myocardial Infarction, Angina and Congestive Heart Failure One-year Readmission Rates per 100 Acute Myocardial Infarction Survivors Aged 20 Years and Over in Ontario 1994/95 - 1996/97

		Women (Age)					Men (Age)				
Fiscal Year	Total	20 - 49	50 - 64	65 - 74	75+	Overall	20 - 49	50 - 64	65 - 74	75+	Overall
Acute Myocardial Infarction											
1994/95	8.2	5.5	5.9	8.3	12.3	9.2	4.6	6.1	8.2	12.4	7.7
1995/96	8.2	5.9	6.5	9.1	10.9	9.1	6.4	5.5	8.4	11.5	7.7
1996/97	8.7	5.8	8.7	10.0	12.2	10.5	5.3	5.9	8.8	10.7	7.7
Overall	**8.4**	**5.7**	**7.0**	**9.1**	**11.8**	**9.6**	**5.4**	**5.8**	**8.5**	**11.5**	**7.7**
Angina											
1994/95	12.4	16.9	16.1	13.5	12.5	13.8	12.5	12.1	10.9	11.4	11.7
1995/96	12.5	17.1	14.5	15.2	12.1	13.9	12.9	11.5	11.3	11.8	11.7
1996/97	12.6	18.5	17.6	15.1	12.4	14.6	11.8	12.3	11.4	10.4	11.6
Overall	**12.5**	**17.5**	**16.1**	**14.6**	**12.3**	**14.1**	**12.4**	**12.0**	**11.2**	**11.2**	**11.7**
Congestive Heart Failure											
1994/95	8.5	2.3	6.6	11.0	17.0	11.9	1.0	4.4	8.1	13.4	6.7
1995/96	8.3	2.4	4.8	10.4	16.8	11.4	1.4	3.7	7.5	14.6	6.7
1996/97	8.7	4.5	5.1	11.0	16.5	11.9	1.4	3.6	8.8	13.4	6.9
Overall	**8.5**	**3.0**	**5.5**	**10.8**	**16.7**	**11.7**	**1.3**	**3.9**	**8.2**	**13.8**	**6.8**

Data Source: Canadian Institute for Health Information, Ontario Myocardial Infarction Database

EXHIBIT 5.10 Age/Sex-adjusted Acute Myocardial Infarction, Angina and Congestive Heart Failure One-year Readmission Rates per 100 Acute Myocardial Infarction Survivors Aged 20 Years and Over by District Health Council in Ontario, 1994/95 - 1996/97

District Health Council	Volume	Acute Myocardial Infarction		Angina		Congestive Heart Failure	
		Readmission Rate (%)	95% Confidence Interval	Readmission Rate (%)	95% Confidence Interval	Readmission Rate (%)	95% Confidence Interval
Algoma, Cochrane, Manitoulin and Sudbury	2,153	7.6	6.5 - 8.9	12.7	11.3 - 14.4	8.2	7.0 - 9.5
Champlain	3,964	7.4*	6.6 - 8.3	12.8	11.8 - 14.0	7.6	6.7 - 8.5
Durham, Haliburton, Kawartha and Pine Ridge	3,299	9.3	8.3 - 10.4	14.3**	13.1 - 15.6	8.5	7.5 - 9.6
Essex, Kent and Lambton	2,988	7.9	7.0 - 9.0	12.2	11.1 - 13.6	8.9	7.9 - 10.1
Grand River	1,236	9.1	7.6 - 11.0	15.2**	13.2 - 17.6	10.2**	8.6 - 12.1
Grey, Bruce, Huron, Perth	1,466	6.9	5.7 - 8.4	13.4	11.6 - 15.4	7.6	6.3 - 9.1
Halton-Peel	3,753	8.6	7.7 - 9.7	12.5	11.4 - 13.7	6.7*	5.9 - 7.7
Hamilton-Wentworth	2,004	7.4	6.3 - 8.7	9.7*	8.4 - 11.2	8.1	7.0 - 9.5
Muskoka, Nipissing, Parry Sound and Timiskaming	1,253	7.7	6.3 - 9.4	13.5	11.6 - 15.7	7.6	6.2 - 9.3
Niagara Region	2,122	8.2	7.1 - 9.5	13.0	11.6 - 14.7	9.4	8.2 - 10.7
Northwestern Ontario	1,067	7.5	6.0 - 9.4	12.9	10.9 - 15.2	8.8	7.2 - 10.8
Quinte, Kingston, Rideau	2,510	8.4	7.3 - 9.6	16.3**	14.8 - 18.0	8.8	7.7 - 10.0
Simcoe-York	3,273	8.7	7.8 - 9.8	11.6	10.5 - 12.9	8.0	7.0 - 9.0
Thames Valley	2,692	8.3	7.3 - 9.4	9.9*	8.8 - 11.2	8.2	7.2 - 9.4
Toronto	9,572	9.3**	8.7 - 9.9	11.6*	10.9 - 12.3	9.4**	8.9 - 10.0
Waterloo Region-Wellington-Dufferin	2,376	7.3	6.3 - 8.5	12.6	11.2 - 14.1	8.4	7.3 - 9.7
Total Ontario	**45,728**						
Summary Statistics:							
Minimum:		6.9		9.7		6.7	
25th Percentile:		7.5		11.9		7.8	
Median:		8.1		12.8		8.3	
75th Percentile:		8.7		13.5		8.9	
Maximum		9.3		16.3		10.2	

* Significantly lower than the provincial average (p<0.05) ** Significantly higher than the provincial average (p<0.05)

Data Source: Canadian Institute for Health Information, Ontario Myocardial Infarction Database

EXHIBIT 5.11 Age/Sex-adjusted Acute Myocardial Infarction, Angina and Congestive Heart Failure One-year Readmission Rates per 100 Acute Myocardial Infarction Survivors Aged 20 Years and Over by Municipalities with Populations Greater than 100,000 versus Other Areas within Ontario District Health Councils, 1994/95 - 1996/97

		Acute Myocardial Infarction		Angina		Congestive Heart Failure	
Large Municipality/Other Areas	Volume	Readmission Rate (%)	95% Confidence Interval	Readmission Rate (%)	95% Confidence Interval	Readmission Rate (%)	95% Confidence Interval
Champlain							
Gloucester	375	5.6	3.5 - 8.8	11.0	8.0 - 15.1	9.6	6.6 - 14.0
Nepean	318	8.3	5.7 - 12.3	15.1	11.3 - 20.1	5.5	3.4 - 8.8
Ottawa	1,370	7.0	5.7 - 8.6	12.5	10.7 - 14.6	7.5	6.2 - 9.1
Other	1,901	7.9	6.7 - 9.3	13.1	11.6 - 14.9	7.9	6.7 - 9.3
Durham, Haliburton, Kawartha and Pine Ridge							
Oshawa	615	7.1	5.2 - 9.6	16.2**	13.2 - 19.7	8.7	6.6 - 11.5
Other	2,684	9.8**	8.6 - 11.0	13.9**	12.6 - 15.4	8.5	7.4 - 9.7
Essex, Kent and Lambton							
Windsor	1,044	8.1	6.5 - 10.1	8.8*	7.1 - 10.7	8.0	6.4 - 9.9
Other	1,944	7.8	6.7 - 9.2	14.2**	12.6 - 16.0	9.4	8.1 - 10.9
Halton-Peel							
Brampton	780	9.7	7.4 - 12.7	12.2	9.8 - 15.1	6.3	4.5 - 8.7
Burlington	585	9.2	7.0 - 12.0	16.0**	13.0 - 19.6	6.4	4.7 - 8.8
Mississauga	1,627	9.4	7.9 - 11.1	11.1	9.5 - 12.9	7.1	5.8 - 8.7
Oakville	422	7.7	5.4 - 10.9	16.1**	12.7 - 20.4	7.9	5.6 - 11.1
Other	339	5.3	3.3 - 8.6	10.7	7.7 - 14.9	5.1*	3.1 - 8.3
Hamilton-Wentworth							
Hamilton	1,496	7.6	6.3 - 9.1	9.0*	7.6 - 10.6	8.0	6.7 - 9.6
Other	508	6.8	4.8 - 9.5	12.0	9.3 - 15.5	8.6	6.4 - 11.6
Niagara Region							
St. Catharines	689	8.4	6.5 - 10.8	12.1	9.7 - 15.0	8.5	6.6 - 10.9
Other	1,433	8.2	6.8 - 9.8	13.5	11.7 - 15.6	9.8	8.3 - 11.5
Northwestern Ontario							
Thunder Bay	636	7.8	5.9 - 10.4	11.1	8.8 - 14.1	9.2	7.1 - 11.9
Other	431	7.3	5.0 - 10.7	15.5	12.1 - 19.8	8.1	5.7 - 11.5
Simcoe-York							
Markham	485	9.2	6.7 - 12.6	11.8	8.9 - 15.6	7.4	5.2 - 10.6
Richmond Hill	320	7.3	4.8 - 11.2	11.8	8.6 - 16.3	8.2	5.5 - 12.2
Vaughan	367	10.3	7.4 - 14.4	10.9	7.9 - 15.0	11.6	8.4 - 16.0
Other	2,101	8.5	7.4 - 9.9	11.8	10.4 - 13.3	7.5	6.4 - 8.8
Thames Valley							
London	1,447	7.5	6.2 - 9.0	7.0*	5.8 - 8.5	7.6	6.3 - 9.2
Other	1,245	9.2	7.6 - 11.0	13.3	11.4 - 15.4	9.0	7.5 - 10.8
Waterloo Region-Wellington-Dufferin							
Cambridge	477	9.3	6.9 - 12.5	13.2	10.3 - 17.0	9.0	6.6 - 12.3
Kitchener	696	7.0	5.2 - 9.3	11.3	9.0 - 14.1	9.5	7.4 - 12.2
Other	1,203	6.8	5.5 - 8.5	13.1	11.2 - 15.3	7.6	6.2 - 9.3
Summary Statistics							
Minimum		5.3		7.0		5.1	
25th Percentile		7.3		11.3		7.6	
Median		7.9		12.6		8.2	
75th Percentile		9.2		13.9		9.0	
Maximum		10.3		16.3		11.6	

* Significantly lower than the provincial average ($p<0.05$) ** Significantly higher than the provincial average ($p<0.05$)

Data Source: Canadian Institute for Health Information, Ontario Myocardial Infarction Database

EXHIBIT 5.12 Age/Sex-adjusted Acute Myocardial Infarction (AMI), Angina, Congestive Heart Failure One-year Readmission Rates per 100 AMI Survivors Aged 20 Years and Over by Hospital in Ontario, 1994/95 - 1996/97

TEACHING

Hospital	Volume	Acute Myocardial Infarction		Angina		Congestive Heart Failure	
		Readmission Rate (%)	95% Confidence Interval	Readmission Rate (%)	95% Confidence Interval	Readmission Rate (%)	95% Confidence Interval
Chedoke-McMaster Hospital, Hamilton	381	5.4*	3.6 - 8.3	17.4**	13.6 - 22.2	6.6	4.5 - 9.8
Hamilton Civic Hospitals (General Division)	611	6.6	4.8 - 9.0	8.1*	6.1 - 10.7	9.7	7.4 - 12.6
Hamilton Civic Hospitals (Henderson Division)	647	7.6	5.8 - 10.0	7.9*	6.0 - 10.4	8.9	6.9 - 11.5
Hôtel Dieu Hospital, Kingston	359	11.3	8.3 - 15.4	15.7	12.1 - 20.4	8.7	6.1 - 12.4
Kingston General Hospital	500	9.4	7.1 - 12.5	14.8	11.8 - 18.6	6.3	4.5 - 8.9
Mount Sinai Hospital, Toronto	321	10.3	7.3 - 14.5	10.0	7.1 - 14.2	9.9	6.9 - 14.1
Ottawa Civic Hospital	866	6.1*	4.7 - 8.1	13.7	11.4 - 16.4	6.2*	4.7 - 8.1
Ottawa General Hospital	603	10.0	7.7 - 12.9	14.6	11.8 - 18.0	9.4	7.2 - 12.2
St. Joseph's Health Centre of London	609	9.2	7.1 - 12.0	7.4*	5.5 - 9.9	8.2	6.3 - 10.8
St. Joseph's Hospital, Hamilton	338	11.3	8.3 - 15.5	11.2	8.1 - 15.4	9.3	6.5 - 13.2
St. Michael's Hospital, Toronto	235	6.8	4.0 - 11.4	12.1	8.3 - 17.5	10.5	7.0 - 15.7
Sunnybrook Health Science Centre, Toronto	595	6.2	4.5 - 8.4	10.7	8.3 - 13.8	9.3	7.2 - 12.1
Toronto Hospital Corporation	711	7.4	5.7 - 9.6	8.5*	6.5 - 11.0	10.0	7.9 - 12.5
University Hospital, London	292	6.2	3.8 - 10.0	11.7	8.3 - 16.5	6.6	4.2 - 10.4
Victoria Hospital, London	757	8.1	6.3 - 10.5	5.5*	4.1 - 7.5	8.7	6.7 - 11.3
Wellesley-Central Hospital, Toronto	248	9.5	6.4 - 14.1	11.7	8.1 - 16.7	8.9	5.9 - 13.3
Women's College Hospital, Toronto	108	7.7	3.8 - 15.6	16.1	9.8 - 26.3	7.4	3.4 - 15.7
Summary Statistics							
Minimum		5.4		5.5		6.2	
25th Percentile		6.6		8.5		7.4	
Median		7.7		11.7		8.9	
75th Percentile		9.5		14.6		9.4	
Maximum		11.3		17.4		10.5	

LARGE

Hospital	Volume	Acute Myocardial Infarction		Angina		Congestive Heart Failure	
		Readmission Rate (%)	95% Confidence Interval	Readmission Rate (%)	95% Confidence Interval	Readmission Rate (%)	95% Confidence Interval
Belleville General Hospital	497	8.0	5.9 - 10.9	16.0**	12.9 - 20.0	6.8	4.9 - 9.5
Brantford General Hospital	578	7.0	5.2 - 9.5	14.6	11.8 - 18.1	9.8	7.6 - 12.7
Cambridge Memorial Hospital	490	9.6	7.2 - 12.9	13.1	10.3 - 16.8	8.6	6.3 - 11.7
Centenary Health Centre, Scarborough	652	10.6	8.3 - 13.5	11.3	9.0 - 14.2	9.5	7.3 - 12.2
Credit Valley Hospital, Mississauga	555	11.7**	8.9 - 15.3	13.6	10.8 - 17.2	7.8	5.6 - 11.0
Etobicoke General Hospital	729	8.9	6.9 - 11.6	9.4*	7.4 - 11.9	10.1	7.8 - 13.2
Grand River Hospital Corporation, Kitchener	586	5.8*	4.1 - 8.1	16.0**	13.1 - 19.6	8.2	6.2 - 10.9
Greater Niagara General Hospital	445	9.0	6.6 - 12.3	16.6**	13.2 - 20.8	10.8	8.1 - 14.4
Grey Bruce Regional Health Centre, Owen Sound	333	6.3	4.1 - 9.6	13.5	10.1 - 18.2	8.0	5.4 - 11.9
Guelph General Hospital	380	5.3*	3.4 - 8.2	12.1	9.1 - 16.2	5.6	3.6 - 8.5
Hôpital Montfort, Ottawa	462	5.6*	3.8 - 8.2	12.6	9.7 - 16.2	7.8	5.6 - 10.8
Hôtel Dieu Hospital, St. Catharines	297	6.3	4.0 - 9.9	11.6	8.3 - 16.1	11.1	7.9 - 15.6
Hôtel Dieu Grace Hospital, Windsor	372	6.4	4.3 - 9.6	8.3*	5.9 - 11.9	8.0	5.6 - 11.4

EXHIBIT 5.12

LARGE (CONT'D)

Hospital	Volume	Acute Myocardial Infarction Readmission Rate (%)	Acute Myocardial Infarction 95% Confidence Interval	Angina Readmission Rate (%)	Angina 95% Confidence Interval	Congestive Heart Failure Readmission Rate (%)	Congestive Heart Failure 95% Confidence Interval
Humber Memorial Hospital, Weston	343	10.1	7.2 - 14.1	7.7*	5.3 - 11.3	13.3**	9.9 - 17.8
Joseph Brant Memorial Hospital, Burlington	626	8.0	6.1 - 10.5	15.2	12.4 - 18.6	6.4	4.7 - 8.7
Mississauga Hospital (The)	822	9.2	7.3 - 11.6	11.3	9.2 - 13.9	6.5	4.9 - 8.6
Norfolk General Hospital, Simcoe	417	14.8**	11.6 - 19.0	17.1**	13.6 - 21.6	12.8**	9.8 - 16.7
North York Branson Hospital	718	8.8	6.9 - 11.3	12.2	9.9 - 15.1	9.4	7.5- 11.9
North York General Hospital	1,027	7.3	5.9 - 9.2	10.9	9.0 - 13.1	7.9	6.4 - 9.8
Northwestern General Hospital, Toronto	450	10.9	8.3 - 14.4	12.2	9.3 - 15.9	11.1	8.4 - 14.6
Oakville-Trafalgar Memorial Hospital	482	8.2	6.0 - 11.3	14.9	11.8 - 18.9	8.4	6.1 - 11.5
Orillia Soldiers' Memorial Hospital	366	8.3	5.8 - 11.8	12.5	9.4 - 16.8	8.8	6.3 - 12.4
Oshawa General Hospital	764	8.9	7.0 - 11.3	15.7**	13.1 - 18.8	7.8	6.0- 10.1
Peel Memorial Hospital, Brampton	760	8.7	6.6 - 11.6	11.9	9.5 - 14.8	5.2*	3.7 - 7.4
Peterborough Civic Hospital	636	11.8**	9.4 - 14.8	12.9	10.4 - 16.1	10.1	7.9 - 12.9
Public General Hospital, Chatham	432	8.5	6.1 - 11.8	16.1**	12.8 - 20.4	9.5	6.9 - 13.1
Queensway General Hospital, Etobicoke	591	8.9	6.8 - 11.6	10.5	8.2 - 13.5	7.5	5.6 - 10.1
Queensway-Carleton Hospital, Nepean	441	6.9	4.8 - 9.9	11.6	8.9 - 15.2	6.8	4.7 - 9.9
Riverside Hospital, Ottawa	326	6.6	4.3 - 10.0	10.8	7.8 - 15.1	5.1*	3.2 - 8.3
Ross Memorial Hospital, Lindsay	452	8.5	6.2 - 11.7	11.5	8.7 - 15.2	6.8	4.8 - 9.6
Royal Victoria Hospital, Barrie	513	9.3	7.0 - 12.3	12.0	9.3 - 15.4	7.2	5.2 - 10.0
Salvation Army Scarborough Grace Hospital	549	7.5	5.5 - 10.2	13.4	10.6 - 16.9	9.0	6.7 - 11.9
Sarnia General Hospital	433	8.3	6.0 - 11.5	14.2	11.0 - 18.3	9.2	6.8 - 12.6
Sault Ste. Marie General Hospital	266	8.2	5.4 - 12.5	13.5	9.7 - 18.6	10.1	6.8 - 15.0
Scarborough General Hospital	974	10.5**	8.7 - 12.8	11.5	9.5 - 13.8	10.2	8.4 - 12.5
St. Catharines General Hospital	543	7.9	5.8 - 10.6	10.7	8.3 - 13.9	8.4	6.3 - 11.2
St. Thomas Elgin General Hospital	353	9.9	7.1 - 13.7	12.3	9.1 - 16.6	6.7	4.5 - 10.0
St. Joseph's Health Centre, Toronto	751	9.6	7.6 - 12.2	12.3	10.0 - 15.1	10.7**	8.6 - 13.3
St. Mary's General Hospital, Kitchener	468	6.8	4.7 - 9.8	8.8*	6.5 - 12.0	9.9	7.3 - 13.3
Sudbury General Hospital of the Immaculate Heart of Mary	394	8.9	6.3 - 12.5	14.4	11.1 - 18.8	6.9	4.7 - 10.1
Sudbury Memorial Hospital	446	5.7	3.8 - 8.7	9.8	7.2 - 13.5	7.0	4.7 - 10.3
Toronto East General and Orthopedic Hospital	862	12.9**	10.8 - 15.5	15.2**	12.8 - 18.1	9.0	7.3 - 11.2
Welland County General Hospital	356	9.4	6.7 - 13.2	13.1	9.9 - 17.5	9.6	6.8 - 13.4
York Central Hospital, Richmond Hill	548	7.7	5.7 - 10.4	10.6	8.1 - 13.7	8.3	6.2 - 11.1
York County Hospital, Newmarket	475	5.6*	3.7 - 8.3	12.1	9.4 - 15.7	5.5*	3.7 - 8.4
York-Finch General Hospital, North York	505	10.0	7.4 - 13.4	9.8	7.5 - 13.0	11.6**	8.7 - 15.4
Summary Statistics							
Minimum		5.3		7.7		5.1	
25th Percentile		7.0		11.3		7.0	
Median		8.5		12.3		8.4	
75th Percentile		9.6		14.2		9.9	
Maximum		14.8		17.1		13.3	

EXHIBIT 5.12

MEDIUM

Hospital	Volume	Acute Myocardial Infarction		Angina		Congestive Heart Failure	
		Readmission Rate (%)	95% Confidence Interval	Readmission Rate (%)	95% Confidence Interval	Readmission Rate (%)	95% Confidence Interval
Ajax and Pickering General Hospital	384	7.6	5.3 - 10.8	10.9	8.1 - 14.8	9.0	6.3 - 12.8
Alexandra Hospital, Ingersoll	105	10.9	6.2 - 19.3	16.4	10.2 - 26.5	12.1	7.0 - 20.9
Alexandra Marine and General Hospital, Goderich	96	17.2**	10.4 - 28.6	15.6	9.3 - 26.1	6.6	2.9 - 15.3
Arnprior and District Memorial Hospital	84	9.1	4.2 - 19.5	13.6	7.4 - 24.9	4.4	1.6 - 12.1
Brockville General Hospital	209	8.4	5.0 - 13.9	12.4	8.5 - 18.1	8.2	4.9 - 13.8
Campbellford Memorial Hospital	140	11.7	7.2 - 19.1	13.2	8.2 - 21.2	8.3	4.7 - 14.5
Cobourg District General Hospital	118	6.1	2.5 - 15.1	15.8	10.1 - 24.5	8.6	4.3 - 16.9
Collingwood General and Marine Hospital	194	9.4	5.9 - 14.9	9.9	6.3 - 15.5	9.0	5.6 - 14.4
Cornwall General Hospital	224	4.9	2.7 - 8.9	14.1	9.9 - 20.0	7.0	3.9 - 12.3
Doctors Hospital, Toronto	74	11.8	5.7 - 24.3	9.8	4.3 - 22.5	5.3	1.7 - 16.5
Douglas Memorial Hospital, Fort Erie	108	7.7	3.9 - 15.0	7.1	3.4 - 15.0	20.2**	13.3 - 30.7
Dufferin-Caledon Health Care Corporation, Orangeville	246	11.8	8.2 - 17.0	17.5**	13.0 - 23.6	6.3	3.9 - 10.3
Georgetown and District Memorial Hospital	95	5.5	2.3 - 13.2	9.7	5.0 - 18.6	4.3	1.6 - 11.5
Groves Memorial and Community Hospital, Fergus	120	10.5	5.8 - 19.0	12.5	7.4 - 21.2	7.8	4.1 - 14.5
Hôpital General de Hawkesbury and District General Hospital Inc.	150	4.1	1.8 - 9.1	9.5	5.6 - 16.1	13.8**	8.8 - 21.6
Hôtel Dieu Hospital, Cornwall	280	11.2	7.8 - 15.9	12.4	8.9 - 17.2	8.0	5.3 - 12.2
Hôtel Dieu of St. Joseph Hospital, Windsor	133	4.5	2.0 - 10.1	10.7	6.3 - 18.1	9.8	5.7 - 16.8
Huntsville District Memorial Hospital	171	7.2	4.1 - 12.7	19.1**	13.6 - 26.7	5.6	2.9 - 10.9
Huronia District Hospital, Midland	239	8.5	5.5 - 13.1	11.7	8.1 - 17.0	7.2	4.5 - 11.7
Kirkland and District Hospital	117	7.9	4.1 - 15.2	16.2	10.3 - 25.5	5.9	2.8 - 12.4
Lake of the Woods District Hospital, Kenora	95	6.1	2.5 - 15.0	12.1	6.6 - 22.1	9.7	5.0 - 18.6
Leamington District Memorial Hospital	237	5.7	3.3 - 9.6	12.0	8.3 - 17.4	6.8	4.2 - 10.9
Lennox and Addington County General Hospital, Napanee	161	5.5	2.9 - 10.6	12.8	8.3 - 19.7	7.7	4.5 - 13.3
Markham Stouffville Hospital	301	9.4	6.3 - 13.9	13.2	9.6 - 18.1	9.0	6.1 - 13.4
Memorial Hospital, Bowmanville	157	14.0**	9.1 - 21.7	17.9	12.3 - 26.1	11.2	6.8 - 18.4
Metropolitan General Hospital, Windsor	361	7.6	5.2 - 11.2	7.6*	5.2 - 11.0	10.2	7.3 - 14.3
Milton District Hospital	118	2.7	0.9 - 8.6	13.7	8.3 - 22.5	3.5	1.3 - 9.4
North Bay General Hospital	261	4.9	2.8 - 8.5	9.0	6.0 - 13.7	6.9	4.3 - 11.3
Pembroke Civic Hospital	127	7.0	3.6 - 13.6	8.8	4.8 - 15.9	11.3	6.5 - 19.7
Pembroke General Hospital	103	11.3	6.1 - 20.9	10.5	5.7 - 19.3	8.5	3.9 - 18.2
Perth and Smiths Falls District Hospital	245	9.7	6.5 - 14.6	19.6**	14.8 - 26.1	13.9**	10.0 - 19.3
Plummer Memorial Public Hospital, Sault Ste. Marie	224	10.6	7.1 - 15.8	8.8	5.7- 13.7	5.8	3.4 - 10.0
Port Colborne General Hospital	137	9.9	5.9 - 16.8	19.8**	13.4 - 29.4	7.7	4.4 - 13.4
Prince Edward County Memorial Hospital, Picton	110	5.6	2.5 - 12.4	22.6**	15.3 - 33.5	6.0	2.8 - 12.5
Renfrew Victoria Hospital	99	6.8	3.2 - 14.2	16.4	10.1 - 26.9	9.8	5.3 - 18.4
South Muskoka Memorial Hospital, Bracebridge	176	7.5	4.4 - 13.0	13.6	9.1 - 20.3	8.8	5.3 - 14.7
St. Joseph's General Hospital, Elliot Lake	111	5.2	2.3 - 11.8	17.2	11.1 - 26.8	11.2	6.1 - 20.6
St. Joseph's General Hospital, Thunder Bay	128	8.6	4.9 - 15.3	10.8	6.4 - 17.9	6.3	3.3 - 12.2
St. Joseph's Health Centre of Sarnia	69	9.0	4.2 - 19.0	13.5	6.9 - 26.3	14.5	7.7 - 27.2
St. Joseph's Hospital, Chatham	160	4.2	2.0 - 9.0	18.4**	12.8 - 26.4	7.2	4.1 - 12.9
St. Joseph's Hospital and Health Centre of Peterborough	79	15.9**	9.0 - 28.3	16.1	9.1 - 28.5	11.8	6.0 - 23.3

EXHIBIT 5.12

MEDIUM (CONT'D)

Hospital	Volume	Acute Myocardial Infarction		Angina		Congestive Heart Failure	
		Readmission Rate (%)	95% Confidence Interval	Readmission Rate (%)	95% Confidence Interval	Readmission Rate (%)	95% Confidence Interval
St. Vincent de Paul Hospital, Brockville	66	5.3	2.1 - 13.3	13.5	7.2 - 25.4	11.3	5.8 - 22.0
Stevenson Memorial Hospital, Alliston	205	14.5**	10.1 - 20.9	9.7	6.2 - 15.1	9.8	6.4 - 15.1
Stratford General Hospital	194	5.4	3.0 - 9.8	10.5	6.8 - 16.3	8.4	5.2 - 13.5
Strathroy Middlesex General Hospital	160	9.4	5.7 - 15.7	11.4	7.1 - 18.0	6.7	3.7 - 12.1
Sydenham District Hospital, Wallaceburg	152	12.3	7.8 - 19.3	19.4**	13.5 - 28.0	10.2	6.2 - 16.6
Temiskaming Hospital, New Liskeard	119	8.7	4.6 - 16.3	10.1	5.8 - 17.9	6.6	3.3 - 13.5
Thunder Bay Regional Hospital	576	7.3	5.4 - 9.8	11.3	8.9 - 14.4	9.2	7.0 - 12.1
Tillsonburg District Memorial Hospital	196	5.3	2.8 - 9.9	21.6**	15.9 - 29.3	11.6	7.7 - 17.5
Timmins and District Hospital	246	5.1	2.9 - 9.0	9.3	6.2 - 14.0	7.6	4.8 - 12.1
Trenton Memorial Hospital	230	9.0	5.8 - 13.9	21.5**	16.2 - 28.4	9.5	6.2 - 14.7
West Lincoln Memorial Hospital, Grimsby	224	7.0	4.3 - 11.5	7.0*	4.3 - 11.4	1.2*	0.4 - 3.7
West Nipissing General Hospital, Sturgeon Falls	100	7.3	3.5 - 15.4	9.0	4.7 - 17.2	9.7	5.0 - 18.7
West Parry Sound Health Centre	151	12.1	7.6 - 19.4	14.1	9.3 - 21.6	7.7	4.3- 13.6
Whitby General Hospital	115	6.8	3.2 - 14.5	20.1**	13.1 - 30.8	7.5	3.6 - 16.0
Winchester District Memorial Hospital	151	7.3	4.1 - 13.0	14.0	9.1 - 21.6	6.0	3.2 - 11.3
Windsor Regional Hospital	244	10.6	7.2 - 15.6	8.5	5.4 - 13.2	5.6	3.3 - 9.6
Windsor Western Hospital Centre Incorporated	192	7.1	3.9 - 13.1	12.0	7.7 - 18.7	12.2	7.3 - 20.3
Woodstock General Hospital	232	7.4	4.7 - 11.8	15.1	10.8 - 21.1	9.7	6.4 - 14.6
Summary Statistics							
Minimum		2.7		7.0		1.2	
25th Percentile		5.7		10.1		6.6	
Median		7.6		12.8		8.3	
75th Percentile		10.5		16.2		9.8	
Maximum		17.2		22.6		20.2	

SMALL

Hospital	Volume	Acute Myocardial Infarction		Angina		Congestive Heart Failure	
		Readmission Rate (%)	95% Confidence Interval	Readmission Rate (%)	95% Confidence Interval	Readmission Rate (%)	95% Confidence Interval
Atikokan General Hospital	35	10.7	4.0 - 28.6	14.8	6.6 - 33.0	7.3	2.3 - 22.6
Belleville General Hospital, Bancroft	57	11.1	5.2 - 23.8	9.5	4.2 - 21.7	13.0	6.4 - 26.3
Bruce Peninsula Health Services, Wiarton	83	8.4	3.8 - 18.3	10.6	5.6 - 20.1	3.4	1.1 - 10.6
Carleton Place and District Memorial Hospital	60	2.4	0.6 - 9.6	14.6	7.5 - 28.7	11.2	5.2 - 24.2
Centre Grey General Hospital, Markdale	66	4.5	1.4 - 14.1	17.0	9.4 - 30.8	15.2	8.2 - 28.4
Charlotte Eleanor Englehart Hospital, Petrolia	34	14.0	4.9 - 40.0	11.7	4.5 - 30.5	9.8	3.5 - 27.5
Clinton Public Hospital	50	2.8	0.7 - 11.7	15.8	6.5 - 38.7	1.7	0.2 - 12.1
Community Memorial-Port Perry Hospital, Scugog	48	1.0*	0.1 - 7.5	18.6	9.1 - 37.8	12.9	5.6 - 29.5
Cottage Hospital, Uxbridge	56	6.8	2.5 - 18.3	17.3	9.3 - 32.5	3.6	0.9 - 14.8
County of Bruce General Hospital, Walkerton	57	5.8	2.1 - 15.7	7.0	2.6 - 18.7	7.9	3.3 - 19.2
Dryden District General Hospital	58	8.6	2.8 - 26.6	13.6	6.1 - 30.2	6.7	2.1 - 22.0
Englehart and District Hospital	36	5.7	1.4 - 23.0	11.3	4.1 - 30.7	11.0	4.0 - 29.9
Espanola General Hospital	62	10.5	4.9 - 22.4	14.1	7.1 - 27.9	11.3	5.2 - 24.8

EXHIBIT 5.12

SMALL (CONT'D)

Hospital	Volume	Acute Myocardial Infarction		Angina		Congestive Heart Failure	
		Readmission Rate (%)	95% Confidence Interval	Readmission Rate (%)	95% Confidence Interval	Readmission Rate (%)	95% Confidence Interval
Four Countries General Hospital, Newbury	69	4.8	1.6 - 14.9	12.0	5.5 - 26.1	12.2	6.1 - 24.6
Geraldton District Hospital	37	4.8	1.2 - 19.2	22.1	11.5 - 42.7	5.5	1.4 - 22.0
Haldimand War Memorial Hospital, Dunnville	82	5.7	2.1 - 15.2	6.1	2.7 - 13.6	4.9	1.8 - 13.4
Hanover and District Hospital	54	3.4	0.9 - 13.7	6.8	2.6 - 18.2	6.6	1.4 - 30.8
Kemptville District Hospital	57	3.3	0.8 - 13.6	7.5	3.1 - 18.2	4.7	1.5 - 14.9
Kincardine and District General Hospital	81	6.3	2.6 - 15.1	17.8	10.5 - 30.2	4.7	1.7 - 12.8
Lady Minto Hospital, Cochrane	36	7.3	2.4 - 22.7	17.3	8.3 - 36.3	12.3	5.1 - 29.6
Listowel Memorial Hospital	70	4.1	1.0 - 17.2	14.7	7.8 - 27.6	7.3	3.4 - 15.6
Louise Marshall Hospital, Mount Forest	73	11.1	5.1 - 24.4	10.2	5.1 - 20.4	6.4	2.3 - 17.9
Manitoulin Health Centre, Little Current	52	12.2	5.6 - 26.7	14.6	6.8 - 31.0	15.7	7.7 - 32.2
Manitoulin Health Centre, Mindemoya Unit	56	7.1	2.6 - 18.9	12.3	5.9 - 25.9	8.8	3.6 - 21.1
Mattawa General Hospital	43	11.3	4.7 - 27.4	34.9**	21.2 - 57.4	10.2	4.1 - 25.1
Meaford General Hospital	73	5.7	2.1 - 15.2	16.7	9.5 - 29.6	20.8**	12.7 - 34.1
North Bay Civic Hospital	35	3.2	0.5 - 22.8	10.1	3.7 - 27.9	5.5	1.3 - 23.8
Palmerston and District Hospital	43	5.6	1.4 - 22.6	7.3	2.3 - 23.1	10.5	3.9 - 28.4
Penetanguishene General Hospital	67	7.7	3.2 - 18.5	10.6	5.0 - 22.3	11.1	5.3 - 23.3
Port Hope and District Hospital	75	6.7	2.7 - 16.3	12.3	6.5 - 23.1	7.2	3.2 - 16.2
Riverside Health Care Facilities, Fort Frances	57	5.7	1.8 - 18.0	14.9	7.3 - 30.1	10.8	4.8 - 24.4
Salvation Army Grace Hospital, Windsor	59	16.6	8.2 - 33.7	7.0	2.6 - 19.0	7.7	2.8 - 21.4
Seaforth Community Hospital	49	5.0	1.6 - 15.5	10.2	3.6 - 28.8	5.5	2.0 - 15.1
Sensenbrenner Hospital, Kapuskasing	75	2.4	0.6 - 9.4	13.9	7.2 - 26.6	5.0	1.8 - 13.3
South Huron Hospital Association, Exeter	58	1.5	0.2 - 10.4	10.8	4.8 - 24.2	2.7	0.7 - 10.9
St. Joseph's Hospital and Health Centre of Peterborough, Haliburton	36	5.5	1.4 - 22.1	17.5	7.8 - 39.1	8.1	2.6 - 25.1
St. Joseph's General Hospital of North Bay	81	8.1	3.5 - 18.4	14.0	7.9 - 24.8	7.6	3.2 - 18.4
St. Joseph's Health Centre, Blind River	40	7.3	2.6 - 20.6	24.5**	13.2 - 45.6	1.5	0.2 - 10.3
St. Mary's Memorial Hospital, St. Mary's	56	5.6	1.8 - 17.5	5.2	1.7 - 16.1	9.1	3.8 - 21.8
West Haldimand General Hospital, Hagersville	76	6.8	3.0 - 15.5	14.8	8.1 - 26.9	8.3	3.8 - 17.8
Wingham and District Hospital	75	1.8	0.3 - 13.0	11.6	5.8 - 23.6	6.0	2.4 - 14.6
34 Hospitals with 30 or Less Readmissions	**416**						
Summary Statistics							
Minimum		1.0		5.2		1.5	
25th Percentile		4.5		10.2		5.5	
Median		5.7		13.6		7.7	
75th Percentile		8.1		15.8		11.0	
Maximum		16.6		34.9		20.8	

Note: Readmission rates at hospitals with small volumes of patients should be interpreted with caution because they may be statistically unstable.

* Significantly lower than the provincial average (p<0.05)

** Significantly higher than the provincial average(p<0.05)

Data Source: Canadian Institute for Health Information, Registered Persons Database, Ontario Myocardial Infarction Database

Conclusions

This chapter presents an analysis of 30-day and one-year mortality rates after an AMI, and one-year readmission rates after an AMI in Ontario. Significant variations in short- and long-term outcomes were found at the DHC, major municipality and hospital level. We expect that publication of these data will stimulate further investigations and discussion regarding the reasons for these outcomes differences. Because mortality after an AMI is a reflection of multiple factors, the data should be interpreted cautiously. Although lower mortality rates at some hospitals may be a reflection of better quality of care, other factors such as quicker patient arrival time to hospitals, unmeasured differences in patient severity and random chance variation may also contribute to the lower mortality rates at some institutions.[9] The differences found in mortality rates between the lowest and highest institutions in Ontario were significant but overall, most hospitals in Ontario had similar mortality rates.

We hope that these data will be viewed as a valuable guide for identifying potential areas that may require quality improvement efforts rather than as a punitive tool to embarrass providers. Hospitals with relatively higher 30-day mortality rates (especially those >20%) should conduct detailed audits of their medical records to determine whether AMI coding problems, under use of known effective AMI treatments (e.g. thrombolytics, aspirin, beta-blockers etc.), over use of ineffective AMI treatments (e.g. lidocaine, calcium-channel blockers etc.) or other factors are contributing to the higher mortality rates at their institutions. All hospitals in Ontario must continue to provide high-quality AMI care in the years ahead. It is our belief that the best possible AMI care in Ontario will be achieved by providing all hospitals in Ontario with comparative data on both their processes and outcomes of care, so that they can identify those areas that may require further attention.

We appreciate that some readers may be concerned that unadjusted differences in patient case-mix across institutions could explain the outcomes differences found in our analyses. Although this issue warrants further investigation, we believe that this is unlikely to be the major factor explaining our results. It was not feasible to validate the comorbidities recorded in the CIHI database but it is important to remember that age is by far the most important factor influencing survival after an AMI.[8] Gender is also an important factor. Both age and sex were adjusted for and are very accurately recorded in the CIHI database. After adjusting for age and sex differences across hospitals, adjusting for differences in other comorbidities led to relatively small changes in each hospital's 30-day RAMR, with all changes lying within the 99% confidence interval of a hospital's RAMR.

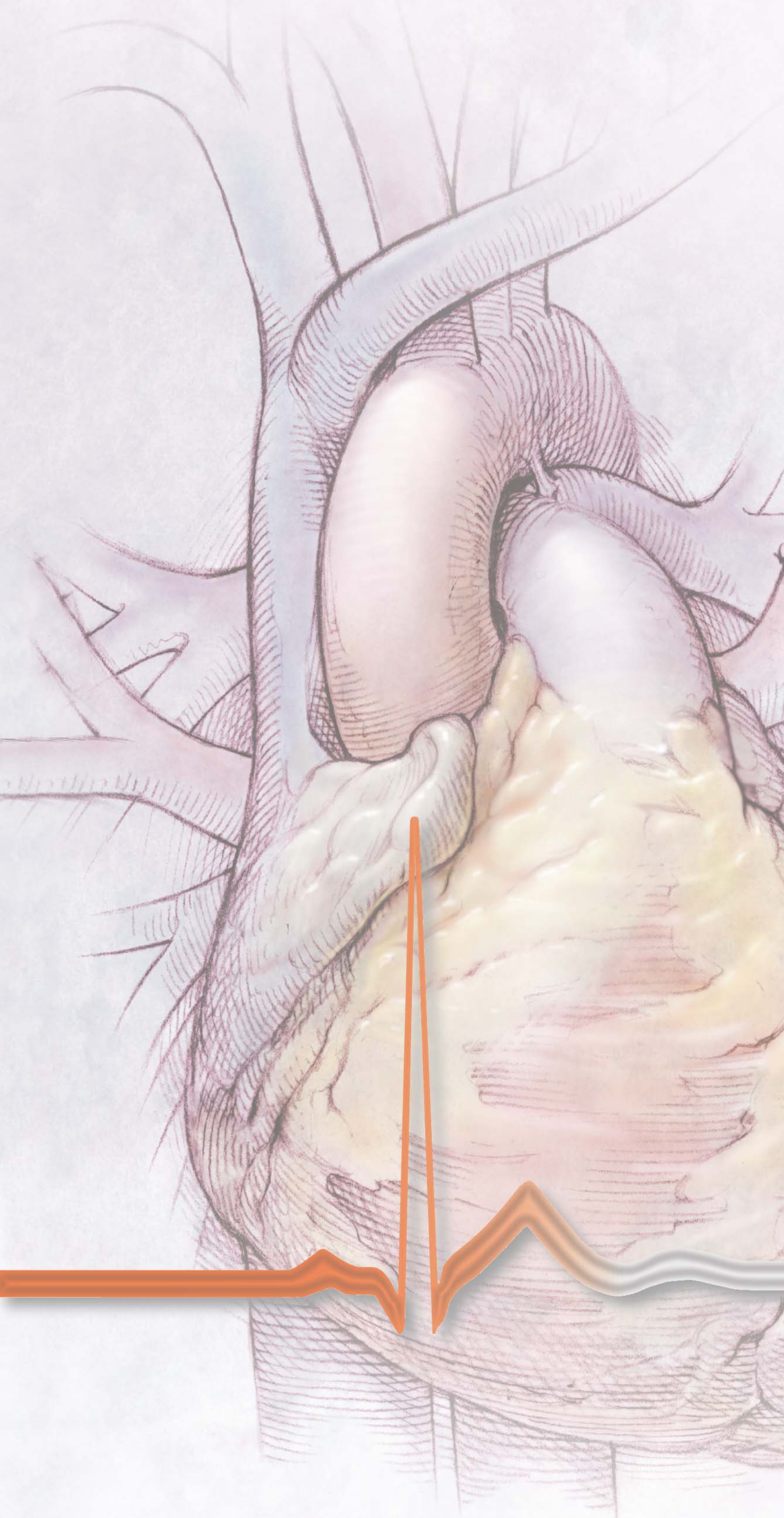
We would also discourage patients from using our data as a guide to select hospitals in the event of an AMI. AMI is a medical emergency and patients should go to their local hospital because the time-to-hospital arrival is one of the most important factors influencing survival. There is variation in AMI mortality rates from year-to-year, and hospitals which had the lowest mortality rates from fiscal 1994/95 to 1996/97 may not be the same hospitals which have the lowest mortality rates in subsequent years. The 99% confidence intervals for over 90% of the hospitals in our analysis include the average provincial mortality rates, suggesting that the mortality rates of AMI are generally comparable across different institutions in Ontario.

There has been surprisingly little research into the frequency of rehospitalizations after an AMI. One study from Seattle, Washington, showed that 40% of AMI survivors were rehospitalized within a year for cardiac reasons, with 16% specifically for a second AMI, in the study period 1988 to 1990.[10] The readmission rates observed in Ontario are lower than this benchmark, although it should be noted that the cohort is a more contemporaneous one.

We did find significant variations in one-year readmission rates after an AMI across hospitals in Ontario. Readmissions after an AMI may reflect premature discharge from hospital, the natural progression of the disease, poor compliance with secondary preventive medications and inadequate outpatient care, among other factors. Institutions with relatively high readmission rates may wish to conduct a more detailed analysis of patients at their institutions to elucidate the relative contribution of these factors.

Congestive Heart Failure Outcomes in Ontario

Jack V. Tu, Hua Zhang



CHAPTER 6

Key messages

- *Congestive heart failure patients in Ontario have a poor prognosis, with a one-year death rate of about 33%. Elderly men and women have much higher 30-day (15.4% for men and 14.5% for women) and one-year mortality rates (42.9% for men and 37.8% for women) than younger patients.*

- *There is a modest amount of inter-District Health Council (DHC) and intermunicipal variation in congestive heart failure mortality rates in Ontario. The vast majority of DHCs have one-year mortality rates that are not different from the provincial average.*

Key Terms & Concepts:

- congestive heart failure
- outcomes
- mortality
- adjusted rates

Background

Congestive heart failure (CHF) is the leading cause of hospitalization in elderly Canadians and a frequent cause of death. Patients with heart failure are often hospitalized and generally have a poor quality of life. Data from clinical trials have suggested that, in stable heart failure patients, the average annual mortality rate is about 10% per year with a 50% five-year survival rate.[1,2] Although there have been many clinical trials involving heart failure patients over the past decade, the outcomes of heart failure patients in the community setting have received little attention. In this chapter, we conduct a population-based analysis of short-term (30-day) and long-term (one-year) mortality rates for CHF patients hospitalized in Ontario between fiscal 1994/95 and 1996/97.

Data Sources

We constructed a cohort of new CHF patients hospitalized in Ontario acute care hospitals between 1994/95 and 1996/97. We identified all patients admitted with a most responsible diagnosis of CHF in the Canadian Institute for Health Information (CIHI) database and then applied eight exclusion criteria (see the Methods Appendix for Chapter 6). Only the patient's first admission for CHF within the study period was included to avoid double-counting of patients. We further refined the cohort by excluding patients who had previously been hospitalized for CHF in the three years prior to the study (1991/92 to 1993/94). This was done to ensure that our subset would include only new CHF patients. After applying the inclusion/exclusion criteria, 39,714 patients were left in our CHF subset. To determine whether and when each patient died, we linked the CIHI data to the Ontario Registered Persons Database (RPDB). Deaths that might have been missed in this database were found by searching for subsequent hospital admissions in the CIHI database that were associated with in-hospital deaths.

How We Did the Analysis

From the linked CIHI/RPDB databases, we calculated 30-day and one-year mortality rates for all patients in our subset. Our analysis was conducted at both the District Health Council (DHC) and major municipality level (cities with populations of 100,000 or greater—see Technical Appendix). Age- and sex-adjusted mortality rates were calculated after adjusting for inter-DHC and intermunicipal variations in patient age and sex using standard statistical methods. We did not report hospital-specific CHF mortality rates because they may not be a valid indicator of the quality of in-hospital CHF care. Regions with lower and higher than expected 30-day and one-year mortality rates were identified with statistical significance determined at the $p<0.05$ level.

Interpretive Cautions

Our analysis of variations in CHF mortality should be interpreted with caution since we did not have information on clinical features which are important prognostic indicators in patients with CHF. For example, data concerning the patient's history (e.g. previous myocardial infarction, viral infection etc.), are very important to individual-level CHF outcomes. On the other hand, it is unlikely that variations in the causes or severity of CHF would substantially affect outcomes considered at the level of municipalities or DHCs.

Findings and Discussion

A total of 39,714 patients met our inclusion/exclusion criteria between 1994/95 and 1996/97. As shown in Exhibit 6.1, the number of cases was similar in men and women (19,419 versus 20,295). CHF is predominantly a disease of the elderly as the largest number of patients were 75 years of age or over. The overall 30-day and one-year mortality rates for CHF patients hospitalized in Ontario are shown in Exhibit 6.2. Outcomes were worse for elderly men and women ages 75 and over. The overall 30-day mortality rates for this age group were 15.4% for men and 14.5% for women while the one-year mortality rates for men and women were 42.9% and 37.8% respectively. There was little change in the total one-year mortality rates between 1994/95 (33.5%) and 1996/97 (32.0%), illustrating that over time, the prognosis for patients hospitalized with this condition was very poor.

An analysis of 30-day and one-year age- and sex-adjusted mortality rates by DHC is shown in Exhibit 6.3. Among the DHCs, the 30-day adjusted mortality rate varied from a low of 8.6% in Northwestern Ontario DHC to 13.6% in Niagara Region DHC. The one-year mortality rate varied from a low of 30.8% in Halton-Peel DHC to a high of 35.5% in the Thames Valley DHC. Across the DHCs, there were few statistically significant differences between their 30-day and one-year mortality rates and the provincial average, suggesting that the outcomes of CHF are fairly comparable across the province. In particular, no DHCs had one-year mortality rates significantly lower than the provincial average. Exhibits 6.4 and 6.5 illustrate the geographic variation across the DHCs. A similar analysis was performed for the major municipalities in the province (Exhibit 6.6). Areas of Halton-Peel DHC, other than the major cities, had the lowest 30-day adjusted mortality rate (5.9%) while Cambridge in Waterloo Region-Wellington-Dufferin DHC had the highest (16.6%). Smaller urban and rural areas in Hamilton-Wentworth DHC and the city of London in Thames Valley DHC had the highest one-year adjusted mortality rates at 37.3%, and other areas in Halton-Peel had the lowest (27.6%). Again, there was not much variation across municipalities and few areas had statistically significant differences from the provincial average.

EXHIBIT 6.1 Age/Sex-specific Numbers of Patients Aged 20 Years and Over Hospitalized for Congestive Heart Failure in Ontario, 1994/95 - 1996/97

MEN

	Fiscal Year				
Age	1994/95	1995/96	1996/97	Total	(%)
20-49	213	219	233	665	1.7
50-64	1,140	1,007	963	3,110	7.8
65-74	2,184	1,930	1,980	6,094	15.3
75+	3,246	3,134	3,170	9,550	24.0
Total Men	**6,783**	**6,290**	**6,346**	**19,419**	**48.9**

WOMEN

	Fiscal Year				
Age	1994/95	1995/96	1996/97	Total	(%)
20-49	119	124	135	378	1.0
50-64	655	664	603	1,922	4.8
65-74	1,585	1,498	1,446	4,529	11.4
75+	4,592	4,466	4,408	13,466	33.9
Total Women	**6,951**	**6,752**	**6,592**	**20,295**	**51.1**
Total Men & Women	**13,734**	**13,042**	**12,938**	**39,714**	**100.0**

Data Source: Canadian Institute for Health Information

EXHIBIT 6.2 Age/Sex-specific Mortality Rates per 100 Congestive Heart Failure Patients Aged 20 Years and Over in Ontario, 1994/95 - 1996/97

MEN

	Fiscal Year			
Age	**1994/95**	**1995/96**	**1996/97**	**Total**
30-day Mortality				
20-49	5.6	2.3	5.2	4.4
50-64	6.1	5.3	4.7	5.4
65-74	8.8	9.2	7.2	8.4
75+	15.7	15.4	15.0	15.4
Total Men	**11.5**	**11.4**	**10.6**	**11.2**
One-year Mortality				
20-49	16.9	13.7	13.3	14.6
50-64	22.6	20.4	17.6	20.3
65-74	29.0	29.2	28.2	28.8
75+	43.6	43.3	41.9	42.9
Total Men	**34.5**	**34.3**	**32.9**	**33.9**

WOMEN

	Fiscal Year			
Age	**1994/95**	**1995/96**	**1996/97**	**Total**
30-day Mortality				
20-49	4.2	1.6	6.7	4.2
50-64	5.0	5.6	5.3	5.3
65-74	7.3	7.1	5.7	6.7
75+	15.2	14.0	14.3	14.5
Total Women	**12.3**	**11.4**	**11.4**	**11.7**
Total Men & Women	**11.9**	**11.4**	**11.0**	**11.5**
One-year Mortality				
20-49	12.6	6.5	13.3	10.9
50-64	20.3	20.8	16.3	19.2
65-74	23.2	24.1	21.3	22.9
75+	38.0	38.5	36.9	37.8
Total Women	**32.5**	**33.0**	**31.1**	**32.2**
Total Men & Women	**33.5**	**33.6**	**32.0**	**33.0**

Data Source: Canadian Institute for Health Information, Registered Persons Database

EXHIBIT 6.3 Age/Sex-adjusted Mortality Rates per 100 Congestive Heart Failure Patients Aged 20 Years and Over by District Health Council in Ontario, 1994/95 - 1996/97

District Health Council	Volume	Crude Rate (%)	30-day Age/Sex-adjusted Mortality Rate (%)	95% Confidence Interval	Crude Rate (%)	One-year Age/Sex-adjusted Mortality Rate (%)	95% Confidence Interval
Algoma, Cochrane, Manitoulin and Sudbury	1,897	11.9	**12.2**	10.7 - 13.9	32.5	**33.0**	30.5 - 35.7
Champlain	3,318	12.8	**12.7**	11.5 - 13.9	34.7	**34.5**	32.5 - 36.5
Durham, Haliburton, Kawartha and Pine Ridge	2,761	11.7	**11.7**	10.5 - 13.1	33.1	**33.2**	31.1 - 35.4
Essex, Kent and Lambton	2,995	11.9	**11.9**	10.8 - 13.3	33.5	**33.6**	31.6 - 35.7
Grand River	1,185	11.8	**11.9**	10.1 - 14.1	31.9	**31.6**	28.6 - 35.0
Grey, Bruce, Huron, Perth	1,571	12.5	**11.8**	10.3 - 13.6	32.8	**31.7**	29.1 - 34.6
Halton-Peel	2,597	9.8	**10.2**	9.0 - 11.6	29.6	**30.8**	28.7 - 33.1
Hamilton-Wentworth	1,705	10.3	**10.4**	8.9 - 12.0	34.0	**34.0**	31.3 - 36.9
Muskoka, Nipissing, Parry Sound and Timiskaming	1,170	11.7	**11.9**	10.1 - 14.1	31.7	**32.0**	28.9 - 35.4
Niagara Region	2,074	13.7	**13.6****	12.1 - 15.2	35.5	**35.2**	32.7 - 37.9
Northwestern Ontario	1,140	8.4	**8.6***	7.1 - 10.6	30.3	**30.9**	27.7 - 34.3
Quinte, Kingston, Rideau	2,124	10.7	**10.7**	9.4 - 12.2	32.8	**32.8**	30.4 - 35.3
Simcoe-York	2,540	12.4	**12.5**	11.2 - 13.9	35.2	**35.2**	33.0 - 37.6
Thames Valley	2,106	12.4	**12.1**	10.7 - 13.7	36.2	**35.5****	33.1 - 38.1
Toronto	8,486	10.3	**10.2***	9.5 - 10.9	32.1	**31.9**	30.7 - 33.1
Waterloo Region-Wellington-Dufferin	2,045	12.8	**12.9**	11.4 - 14.6	32.8	**32.9**	30.5 - 35.5
Total Volume	**39,714**						
Mean Ontario 30-day Mortality Rate %	**11.6**						
Mean Ontario One-year Mortality Rate %	**33.0**						

Summary Statistics:		
Minimum	**8.6**	**30.8**
25th Percentile	**10.6**	**31.8**
Median	**11.9**	**33.0**
75th Percentile	**12.4**	**34.3**
Maximum	**13.6**	**35.5**

* Significantly lower than the provincial average (p<0.05)

** Significantly higher than the provincial average (p<0.05)

Data Source: Canadian Institute for Health Information, Registered Persons Database

Conclusions

Our analysis of mortality in CHF patients in Ontario shows a very high one-year mortality rate associated with this condition. Approximately one out of every three patients in Ontario died within one year of their initial hospitalization for CHF. This contrasts with the outcomes found in clinical trials of new heart failure medications which suggest an average one-year mortality rate of around 10%.[1,2] However, strict inclusion and exclusion criteria for these trials have likely resulted in a patient population that is younger and healthier than the average CHF patient in the community setting.

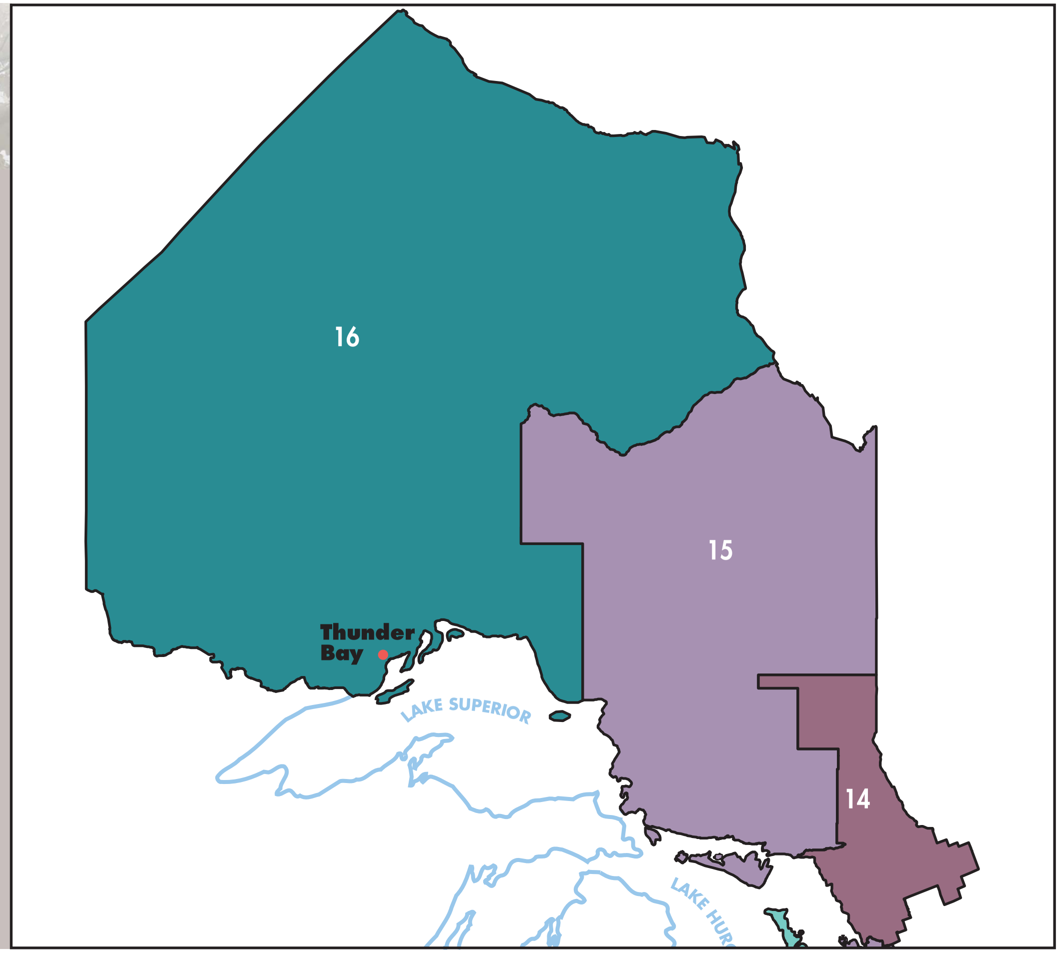
Recently, randomized control trials have shown that medications can improve survival and prevent hospitalization in CHF patients. These drugs include the angiotensin converting enzyme (ACE) inhibitors, angiotensin II receptor blockers and the beta-blocker carvedilol. Whether differences in the use of these medications or other factors contribute to differences in CHF mortality rates across DHCs and municipalities remains to be determined. As demonstrated in this chapter, the outcomes of CHF appear to be fairly comparable across the province. Reduction of the very high mortality rate associated with this condition should be a priority for clinicians and researchers.

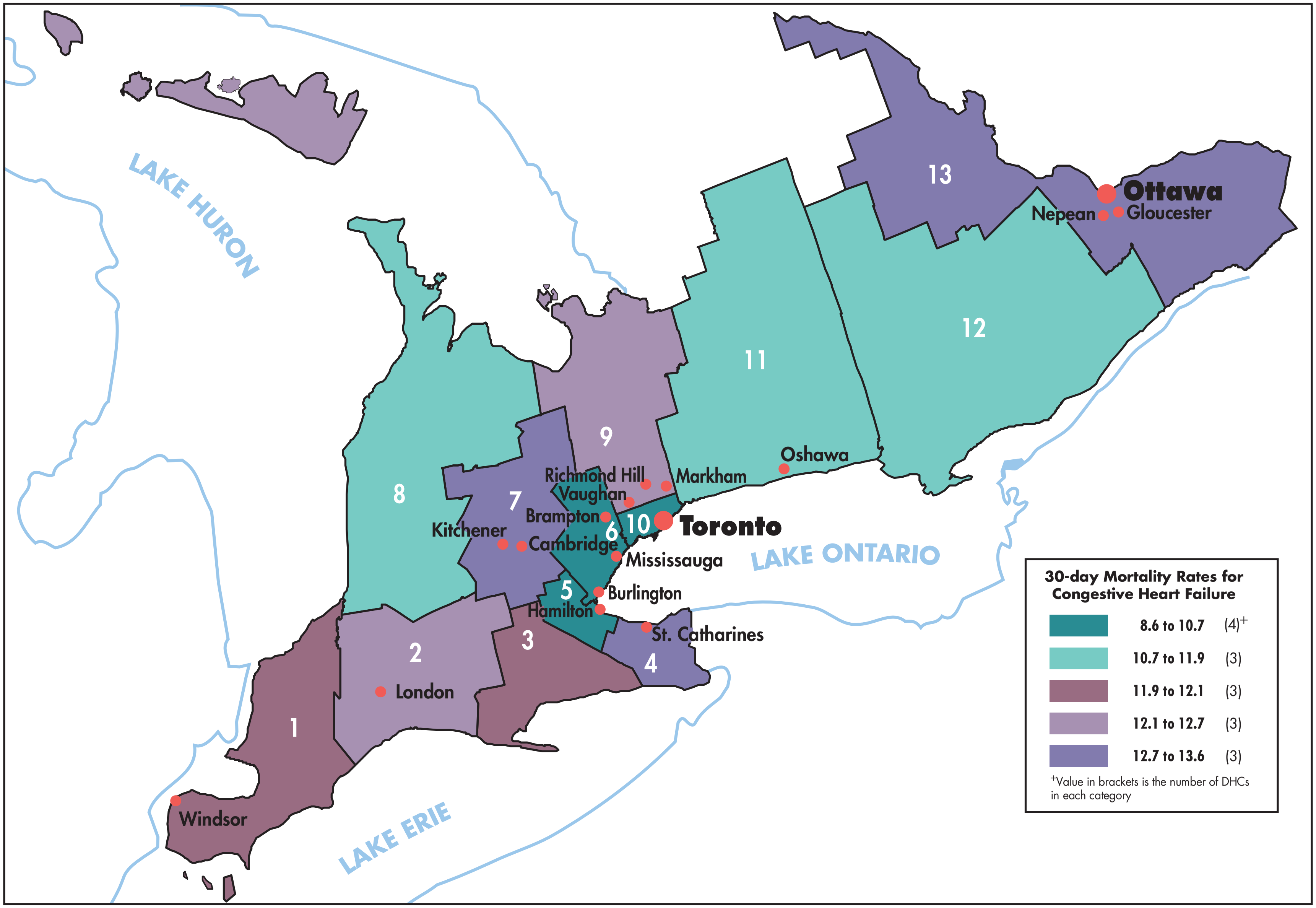
6.4 EXHIBIT

Age/Sex-adjusted 30-day Mortality Rates per 100 Congestive Heart Failure Patients Aged 20 Years and Over by District Health Council in Ontario, 1994/95 - 1996/97

ONTARIO District Health Councils

1. Essex, Kent and Lambton
2. Thames Valley
3. Grand River
4. Niagara Region
5. Hamilton-Wentworth
6. Halton-Peel
7. Waterloo Region-Wellington-Dufferin
8. Grey, Bruce, Huron, Perth
9. Simcoe-York
10. Toronto
11. Durham, Haliburton, Kawartha and Pine Ridge
12. Quinte, Kingston, Rideau
13. Champlain
14. Muskoka, Nipissing, Parry Sound and Timiskaming
15. Algoma, Cochrane, Manitoulin and Sudbury
16. Northwestern Ontario





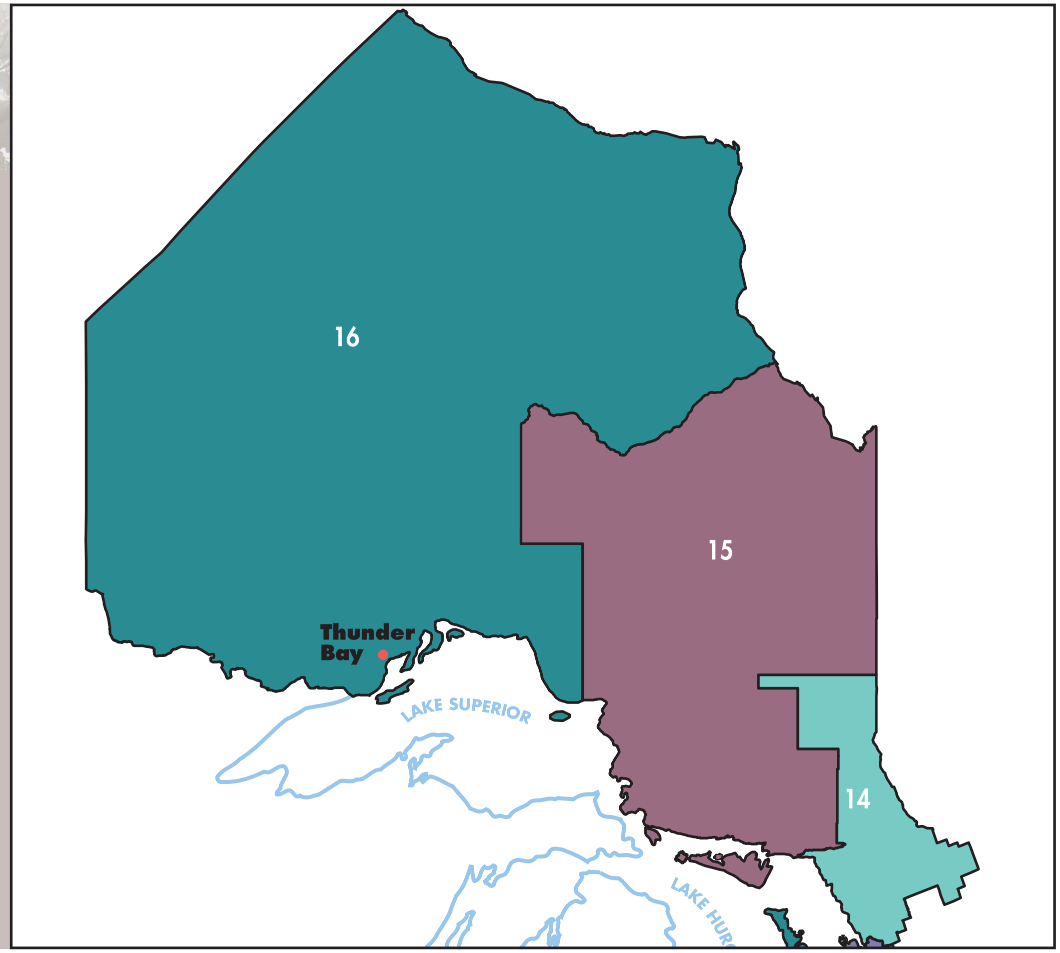
Data Source: Canadian Institute for Health Information, Registered Persons Database

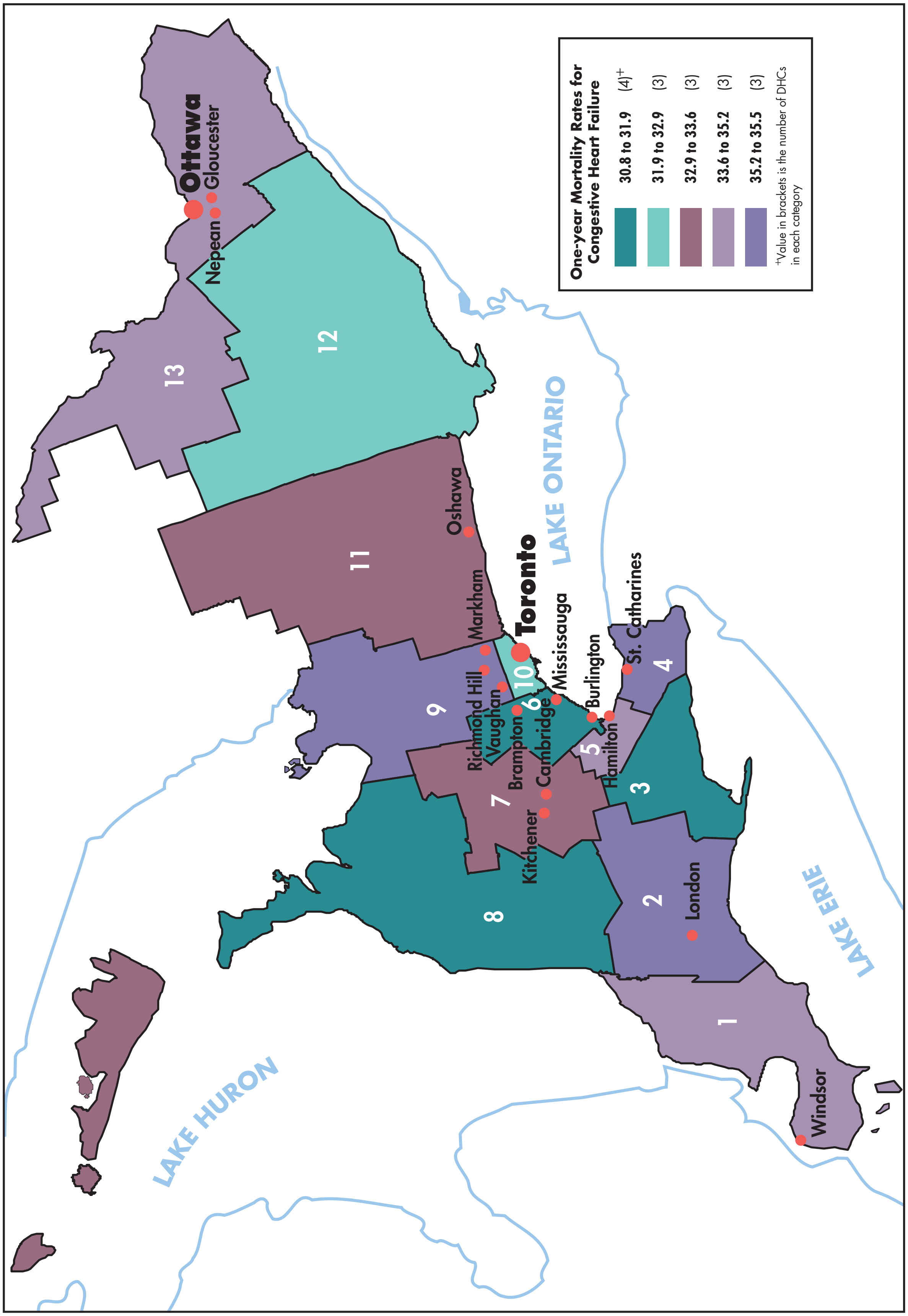
6.5 EXHIBIT

Age/Sex-adjusted One-year Mortality Rates per 100 Congestive Heart Failure Patients Aged 20 Years and Over by District Health Council in Ontario, 1994/95 - 1996/97

ONTARIO District Health Councils

1 Essex, Kent and Lambton
2 Thames Valley
3 Grand River
4 Niagara Region
5 Hamilton-Wentworth
6 Halton-Peel
7 Waterloo Region-Wellington-Dufferin
8 Grey, Bruce, Huron, Perth
9 Simcoe-York
10 Toronto
11 Durham, Haliburton, Kawartha and Pine Ridge
12 Quinte, Kingston, Rideau
13 Champlain
14 Muskoka, Nipissing, Parry Sound and Timiskaming
15 Algoma, Cochrane, Manitoulin and Sudbury
16 Northwestern Ontario





Data Source: Canadian Institute for Health Information, Registered Persons Database

EXHIBIT 6.6 Age/Sex-adjusted Mortality Rates per 100 Congestive Heart Failure Patients Aged 20 Years and Over by Municipalities with Populations Greater than 100,000 Versus Other Areas in Ontario District Health Councils, 1994/95 - 1996/97

Large Municipality/Other Areas	Volume	Crude Rate (%)	30-Day Age/Sex-adjusted Mortality Rate (%)	95% Confidence Interval	Crude Rate (%)	One-year Age/Sex-adjusted Mortality Rate (%)	95% Confidence Interval
Champlain							
Gloucester	201	14.4	**14.3**	9.9 - 20.7	36.8	**36.5**	29.0 - 45.9
Nepean	241	12.4	**12.6**	8.8 - 18.1	32.8	**32.5**	26.0 - 40.6
Ottawa	1,253	12.6	**12.1**	10.4 - 14.2	36.4	**35.7**	32.5 - 39.1
Other	1,623	12.8	**12.9**	11.2 - 14.8	33.3	**33.6**	30.9 - 36.5
Durham, Haliburton, Kawartha and Pine Ridge							
Oshawa	443	11.7	**12.0**	9.2 - 15.8	33.4	**34.3**	29.2 - 40.3
Other	2,318	11.6	**11.7**	10.4 - 13.2	33.0	**33.1**	30.8 - 35.5
Essex, Kent and Lambton							
Windsor	1,140	12.3	**12.1**	10.3 - 14.3	35.1	**34.7**	31.5 - 38.3
Other	1,855	11.7	**11.8**	10.3 - 13.5	32.5	**32.8**	30.2 - 35.5
Halton-Peel							
Brampton	432	9.5	**10.5**	7.7 - 14.4	30.6	**32.5**	27.2 - 38.8
Burlington	398	10.1	**10.2**	7.5 - 14.0	31.9	**32.2**	27.0 - 38.4
Mississauga	1,120	10.6	**11.6**	9.7 - 13.9	29.5	**31.9**	28.6 - 35.6
Oakville	346	10.4	**9.9**	7.1 - 13.7	28.6	**28.8**	23.2 - 35.9
Other	301	6.0	**5.9***	3.7 - 9.4	27.2	**27.6**	22.1 - 34.3
Hamilton-Wentworth							
Hamilton	1,320	9.5	**9.5***	8.0 - 11.3	33.0	**33.0**	30.1 - 36.3
Other	385	13.2	**13.3**	10.1 - 17.6	37.1	**37.3****	31.7 - 44.0
Niagara Region							
St. Catharines	690	14.6	**14.3****	11.8 - 17.4	37.7	**37.1**	32.9 - 42.0
Other	1,384	13.3	**13.1**	11.3 - 15.2	34.4	**34.1**	31.2 - 37.4
Northwestern Ontario							
Thunder Bay	649	8.6	**8.5***	6.6 - 11.1	32.7	**32.2**	28.1 - 36.8
Other	491	8.1	**8.8**	6.4 - 12.0	27.1	**28.4**	23.9 - 33.7
Simcoe-York							
Markham	261	13.0	**12.2**	8.7 - 17.1	33.7	**32.4**	26.1 - 40.1
Richmond Hill	168	8.9	**8.7**	5.2 - 14.6	31.0	**29.7**	22.5 - 39.2
Vaughan	283	13.4	**12.7**	9.2 - 17.5	31.4	**30.9**	25.1 - 38.1
Other	1,828	12.5	**12.7**	11.1 - 14.4	36.4	**36.6****	33.9 - 39.5
Thames Valley							
London	970	12.0	**11.9**	9.9 - 14.3	37.3	**37.3****	33.7 - 41.4
Other	1,136	12.9	**12.3**	10.5 - 14.5	35.2	**34.1**	30.9 - 37.7
Waterloo Region-Wellington-Dufferin							
Cambridge	378	16.1	**16.6****	12.9 - 21.4	36.2	**36.8**	31.1 - 43.6
Kitchener	628	11.0	**11.4**	9.0 - 14.5	32.0	**33.2**	28.9 - 38.1
Other	1,039	12.7	**12.5**	10.5 - 14.8	32.0	**31.7**	28.4 - 35.3

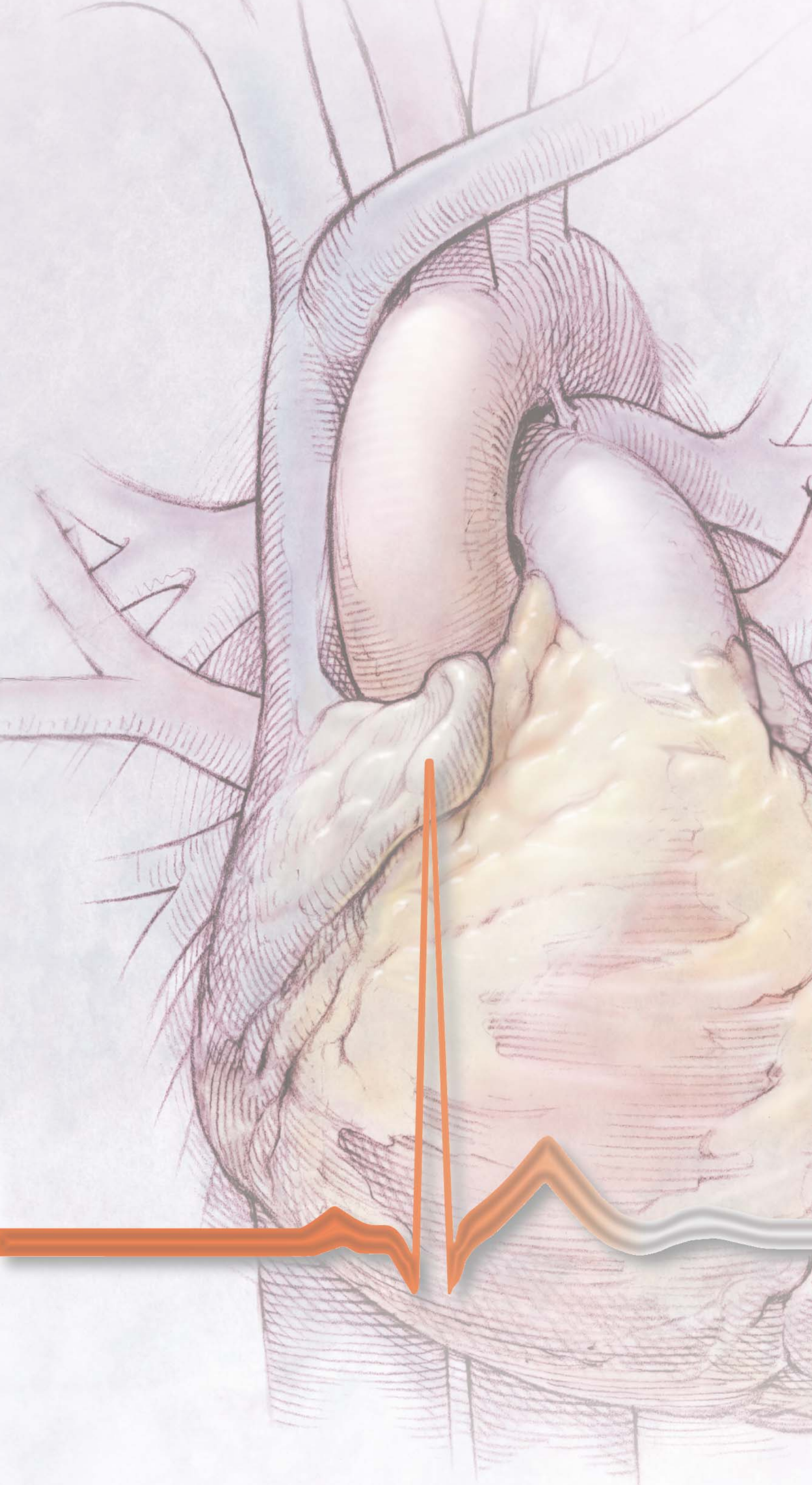
* Significantly lower than the provincial average ($p<0.05$).

** Significantly higher than the provincial average ($p<0.05$).

Data Source: Canadian Institute for Health Information, Registered Persons Database

Procedures for Abdominal Aortic Aneurysm and Peripheral Vascular Disease

Antoni S.H. Basinski



CHAPTER 7

Key messages

- *Overall rates of surgical repair of abdominal aortic aneurysm (AAA) averaged 57/100,000 adult population (ages 50 and over) during the study period. The rates for both non-ruptured and ruptured AAA repair did not change appreciably during this time period.*
- *Peripheral vascular bypass surgery (PVB) rates averaged 101/100,000 for adult men and 50/100,000 for adult women. Rates of PVB surgery decreased during the study period.*
- *AAA procedure rates were 41% higher and PVB procedure rates were 127% higher in areas with the lowest compared to areas with the highest household income.*

Key Terms & Concepts:

- abdominal aortic aneurysm
- peripheral vascular bypass surgery
- area variations
- income quintile

Background

The risk factors that lead to coronary artery disease can also cause atherosclerosis or hardening and blockage of other arteries in the body. In this chapter we examine surgical procedures for two forms of non-coronary atherosclerosis—peripheral vascular disease (PVD) affecting the lower extremities and abdominal aortic aneurysms (AAA).

The abdominal aorta is the main vessel carrying blood to the contents of the abdominal cavity and legs. It splits into the left and right iliac arteries, which eventually supply blood to the legs through the femoral-popliteal systems. Because of its large diameter, the aorta does not block off in the same fashion as smaller arteries affected by atherosclerosis. Instead, as the vessel wall stiffens, the aorta weakens and stretches under the ongoing pressure of blood pumped from the heart, a condition called an aortic aneurysm. Large AAAs can rupture and the risk is heightened with increased aneurysm diameter. The cumulative six-year risk of rupture has been reported as 1%, 2% and 20% for AAA less than 4.0 cm, between 4.0 and 4.9 cm in diameter, and greater than 5.0 cm diameter respectively,[1] and 0.0, 3.3 and 14.4 events per 100 patient years for the same aneurysm sizes.[2]

In a population greater than 55 years of age, the prevalence of AAA greater than 3.5 cm in diameter or 50% dilation of the distal aorta has been reported to be approximately 4% among men and 1% among women.[2] One study found a 1.7% prevalence of AAA greater than 5 cm in men 60 to 80 years.[3] Other international studies show a similar prevalence.[4,5] Risk factors for AAA are male sex, old age, smoking, hypertension, other existing cardiovascular disease and family history.[2,4]

Since the early 1980s the rate of elective repair of AAA has risen around the world.[6-12] The increase has occurred primarily due to the increased rates of elective surgical repair to prevent rupture, which typically occurs when aneurysms exceed 5 cm in diameter.[13] The aging of the population has also contributed to the increase in absolute numbers of AAA surgical repairs. The rates of repair for ruptured AAA (rAAA) have not changed as dramatically in the last two decades,[7,14] presumably because better detection and preventive repairs are counterbalancing the increased incidence expected with an aging population.

The rationale for elective repair rests on its comparative safety as opposed to the high risk of death from rupture. Perioperative mortality for non-ruptured AAA (nrAAA) repair ranges from 4% to 8%.[15,16] In particular, among nrAAA repairs, elective surgery is associated with lower mortality rates (4% to 6%) than emergency surgery for nrAAA (14%).[16-18] However, mortality associated with attempted repair of ruptured AAA is much higher, typically 37% to

54%,[15-18] and as high as 71% for those over 80 years of age.[16] This does not include the mortality from AAA among those who die at home or in hospital before a repair can be attempted.

Atherosclerosis below the aorta typically leads to reduced blood flow to the legs, which causes pain in the leg muscles on walking. These symptoms are often termed "intermittent claudication." When peripheral vascular disease is very severe, there may be pain at rest and gangrene of the tissues. Amputation of portions of the lower leg may become necessary. The surgical procedures to restore blood flow involve placement of grafts to bypass blockages that may occur anywhere between the iliac arteries. We group all these procedures here under the general rubric of peripheral vascular bypass surgery (PVB). Older age, male sex and previous PVB surgery have all been associated with increased rates of surgery for peripheral vascular disease.[19]

Recent trends to decreased rates of PVB surgery have been reported in Ontario[11] and elsewhere. These trends reflect clinical skepticism about the long-term benefits of elective PVB, and increased reliance on medical measures, including lifestyle interventions (e.g. smoking cessation and exercise),[20] and use of both anti-platelet[21] and cholesterol-lowering drugs.

For rAAA, nrAAA and PVB, we describe trends and geographic variations in hospitalization rates during the fiscal years 1992/93 to 1996/97. In addition, we describe trends in average lengths of stay (LOS) over the study period and the variations in LOS by hospital types and hospital geographic location. We also examine the influence of the mean household income of the residence location of the patient as a proxy for the impact of socioeconomic status on disease incidence.

Data Sources

The primary source for procedure and patient information was the hospital separation abstract database maintained by the Canadian Institute for Health Information (CIHI). Population data for denominators for regional rates are from the 1991 and 1996 Statistics Canada censuses, with intercensal interpolation of populations. Patient place of residence for analyses of geographic variations and inferences about neighbourhood income quintiles was determined from the patient postal code.

How We Did the Analysis

We identified all hospital separations with abdominal aortic aneurysm as the most responsible diagnosis, and abdominal aortic vascular repair as the main procedure code. Similarly, all cases of peripheral shunt or bypass and aorta-iliac-femoral bypass without aortic aneurysm coded as the most responsible diagnosis were included in the PVB group. Patient information such as the patient's postal code, age, sex and comorbid diagnoses, hospital issues such as the treating hospital, length of stay, discharge date and disposition (i.e. transfer, in-hospital death) were obtained from the CIHI hospital record abstract. Elective versus emergency/urgent surgery for non-ruptured AAA was identified from the CIHI categorization of admission urgency (see Methods Appendix).

We considered all cases of adults 50 years of age and over with a valid Ontario Health Information Number and an Ontario postal code, who were discharged, transferred or died in hospital during the fiscal years of interest. Transfers were ascertained from the initial hospital separation record and readmission to another acute care hospital within 12 hours of discharge. Incident cases were recorded only for the first hospitalization in a chain of interhospital transfers.

The analyses of hospitalizations by income examined the relationship between the average household incomes in geographic areas and the per capita rates of hospitalization.

Age- and sex-adjusted rates were directly standardized using the average Ontario population during the study period. To assess the statistical influence of ordered variables (e.g. year, income quintile or ALOS quintile) on procedure rates, we performed standard tests of trend.

Interpretive Cautions

The incidence of AAA procedures provides only indirect evidence about the epidemiology of AAA in Ontario. Most procedures, for example, are performed on persons with large aneurysms. The analysis sheds no light on the prevalence of smaller AAA or the number of persons with larger AAA who do not undergo surgery.

The hospitalization rates for rAAA are based on the incidence of surgical procedures to repair ruptured aneurysms. We did not examine the number of cases of ruptured aneurysm that led to death prior to hospitalization or after hospitalization but prior to surgery, as we are not confident about the validity of available data sources in ascertaining these cases.

We have accepted the coding of ruptured versus non-ruptured AAA and emergency/urgent versus elective repairs at face value. Systematic and random errors in coding practices may affect our categorization of types of AAA repair, both in general and across regions. We also emphasize that before any outcomes "report cards" can be generated involving named institutions or surgeon-specific data, these codes must be validated by audits of actual patient records.

Some elective cases of AAA repair and PVB may be referred to Winnipeg from areas of Northwestern Ontario near the Manitoba border. This may decrease the apparent per capita rates of elective repair in that region.

Findings and Discussion

Incidence of Procedures

Overall rates of surgical repair of AAA averaged 57 per 100,000 population 50 years and over during the study period (Exhibit 7.1). The rates for both non-ruptured and ruptured AAA repair did not change appreciably during this time period.

Non-ruptured AAA repair comprised 84% of the AAA procedures. This proportion was constant during the study period. The proportion was also more or less steady across age brackets to age 75 years, but declined to 80% for those 75 years and over. This decline was due to the constant rate of non-ruptured AAA surgery per 100,000 over the age of 65, but an increased incidence of rupture among those greater than 75 years of age compared to those 65 to 75. There was no significant difference between men and women in the proportion undergoing non-ruptured AAA repair.

Among non-ruptured AAA cases, the rate of elective repair was 82.6%. There was no significant difference between men and women in the proportion undergoing elective non-ruptured AAA repair. During the study period, the proportion of elective cases increased from 79% in 1992 to 85% in 1996 (p=0.0001), probably reflecting enhanced detection and early intervention.

The rate of PVB decreased, on average, 1.1% per year during the study period, consistent with the declining Ontario PVB surgery rates previously reported (Exhibit 7.2).[22] The decrease was primarily among men (1.8% decrease per year, p=0.03) rather than women (0.4% decrease per year, p=0.75).

EXHIBIT 7.1 Age/Sex-specific Abdominal Aortic Aneurysm Repair Rates per 100,000 Population Aged 50 Years and Over in Ontario, 1992/93 - 1996/97

Fiscal Year	Overall Rate	Men (Age) 50 - 64	Men (Age) 65 - 74	Men (Age) 75+	Men Overall	Women (Age) 50 - 64	Women (Age) 65 - 74	Women (Age) 75+	Women Overall
Abdominal Aortic Aneurysm									
1992/93	58	41	196	195	107	5	29	27	17
1993/94	60	38	192	222	107	6	34	33	20
1994/95	56	37	176	194	99	5	31	33	18
1995/96	57	35	182	205	101	5	33	38	20
1996/97	55	35	174	206	99	4	28	34	17
Overall	**57**	**37**	**184**	**204**	**102**	**5**	**31**	**33**	**18**
Non-ruptured Abdominal Aortic Aneurysm									
1992/93	49	36	168	159	90	4	27	21	14
1993/94	51	31	166	181	90	5	30	28	17
1994/95	47	31	151	156	83	5	26	27	16
1995/96	48	30	157	162	85	4	28	30	17
1996/97	46	31	147	160	82	4	23	29	15
Overall	**48**	**32**	**158**	**163**	**86**	**5**	**27**	**27**	**16**
Ruptured Abdominal Aortic Aneurysm									
1992/93	9	6	28	36	16	1	3	6	2
1993/94	9	6	27	41	17	1	5	5	3
1994/95	9	6	25	38	16	1	5	6	3
1995/96	9	5	24	42	16	1	5	7	3
1996/97	9	4	27	46	17	0	5	5	3
Overall	**9**	**5**	**26**	**41**	**16**	**1**	**5**	**6**	**3**

Data Source: Canadian Institute for Health Information

EXHIBIT 7.2 Age/Sex-specific Peripheral Vascular Bypass Surgery Rates per 100,000 Population Aged 50 Years and Over in Ontario, 1992/93 - 1996/97

Fiscal Year	Overall Rate	Men (Age) 50 - 64	Men (Age) 65 - 74	Men (Age) 75+	Men Overall	Women (Age) 50 - 64	Women (Age) 65 - 74	Women (Age) 75+	Women Overall
1992/93	78	70	162	158	108	32	73	70	52
1993/94	75	65	152	155	102	27	80	69	51
1994/95	71	66	144	161	101	28	62	65	46
1995/96	68	59	144	128	93	27	65	75	48
1996/97	73	58	154	159	99	25	76	79	51
Overall	**73**	**63**	**151**	**152**	**101**	**28**	**71**	**72**	**50**

Data Source: Canadian Institute for Health Information

Influence of Income

When AAA procedure rates are assessed against income, the incidence rates are substantially higher in areas with the lowest quintile of household income than for the highest household income quintile (Exhibit 7.3). The rates of AAA surgery in the lowest income quintile areas were 41% higher than the highest income quintiles. The discrepancy in incidence is more pronounced among younger persons for both men and women. The proportion of cases of ruptured AAA generally is stable across income quintiles. Rates of AAA did not vary between urban and rural areas for either rAAA or nrAAA.

EXHIBIT 7.3 Age/Sex-specific Abdominal Aortic Aneurysm Repair Rates per 100,000 Population Aged 50 Years and Over by Residence Area Income Quintile in Ontario, 1992/93 - 1996/97

Income Quintile	Overall Rate	Men (Age)				Women (Age)			
		50 - 64	65 - 74	75+	Overall	50 - 64	65 - 74	75+	Overall
Abdominal Aortic Aneurysm									
1 Low	69	55	212	229	124	8	36	37	22
2	61	39	206	201	109	7	34	34	21
3	53	36	165	190	95	4	28	31	17
4	56	38	179	199	101	3	32	28	17
5 High	49	26	161	198	89	3	25	32	16
Non-ruptured Abdominal Aortic Aneurysm									
1 Low	58	47	181	182	104	8	31	31	19
2	52	33	178	165	92	6	29	28	17
3	45	30	146	155	81	4	23	26	14
4	46	33	147	152	82	3	28	24	15
5 High	42	23	139	160	75	3	22	24	13
Ruptured Abdominal Aortic Aneurysm									
1 Low	11	8	32	47	20	1	6	6	3
2	9	7	28	36	17	1	5	6	3
3	8	6	19	37	14	1	5	5	3
4	10	5	31	46	19	0	4	5	3
5 High	8	3	22	38	13	0	3	8	3

Data Source: Canadian Institute for Health Information

EXHIBIT 7.4 Age/Sex-specific Peripheral Vascular Bypass Surgery Rates per 100,000 Population Aged 50 Years and Over by Residence Area Income Quintile in Ontario, 1992/93 - 1996/97

Income Quintile	Overall Rate	Men (Age)				Women (Age)			
		50 - 64	65 - 74	75+	Overall	50 - 64	65 - 74	75+	Overall
1 Low	109	130	207	175	158	48	92	75	66
2	85	83	177	164	121	35	73	78	55
3	69	59	141	136	93	27	69	67	48
4	66	48	134	158	88	20	73	73	47
5 High	48	31	102	121	64	15	44	63	34

Data Source: Canadian Institute for Health Information

When PVB rates are assessed against income (Exhibit 7.4), the income gradient is even more pronounced than for AAA, with rates in the lowest income quintile areas 127% higher than the highest areas. The discrepancy in incidence is again greater among younger persons, without significant urban-rural differences.

Area Variations

The weighted 25th and 75th percentile age- and sex-standardized rates for nrAAA averaged across District Health Council (DHC) for the years of interest were 35 and 54 per 100,000 respectively. The corresponding percentiles are eight and 10 per 100,000 adults for ruptured AAA. The lowest per capita rates of non-ruptured AAA repair are in the metropolitan area of Toronto and Northwestern Ontario. The highest nrAAA rates are in the Quinte-Kingston-Rideau and Thames Valley DHC areas (Exhibits 7.5 to 7.9).

The weighted 25th and 75th percentile age- and sex-standardized rates for PVB are 62 and 83 per 100,000 respectively. The lowest per capita rates for PVB are in Grey, Bruce, Huron, Perth; Halton-Peel; and the metropolitan area of Toronto. The highest PVB rates are in the Hamilton-Wentworth and Grand River DHCs.

Length of Hospital Stay

There has been a steady decrease in overall length of stay for AAA during the study period. The average length of stay after adjustment for patient factors was 18% lower for nrAAA and 14% lower for rAAA in 1996 than it was in 1992. Teaching hospitals had average adjusted lengths of stay 8% to 10% higher than large, non-teaching hospitals. As expected, ALOS increased with age and comorbidity for both rAAA and nrAAA (Exhibit 7.10).

There has also been a decrease in length of stay for PVB during the study period. The average length of stay after adjustment for patient factors was 22% lower in 1996 than it was in 1992. Teaching hospitals had average adjusted lengths of stay equivalent to the large non-teaching hospitals (Exhibit 7.11).

EXHIBIT 7.5 Age/Sex-adjusted Abdominal Aortic Aneurysm and Peripheral Vascular Bypass Surgery Rates per 100,000 Population Aged 50 Years and Over in Ontario, 1992/93 - 1996/97

District Health Council	Non-ruptured Abdominal Aortic Aneurysm		Ruptured Abdominal Aortic Aneurysm		Peripheral Vascular Bypass Surgery	
	Annual Average Number of Cases	Age-adjusted Rate	Annual Average Number of Cases	Age-adjusted Rate	Annual Average Number of Cases	Age-adjusted Rate
Algoma, Cochrane, Manitoulin and Sudbury	55	49	12	10	98	86
Champlain	132	53	20	8	178	71
Durham, Haliburton, Kawartha and Pine Ridge	107	55	23	12	130	68
Essex, Kent and Lambton	86	52	16	9	138	83
Grand River	31	48	6	9	77	122
Grey, Bruce, Huron, Perth	43	46	8	8	52	56
Halton-Peel	104	48	18	8	138	61
Hamilton-Wentworth	71	52	13	10	154	114
Muskoka, Nipissing, Parry Sound and Timiskaming	41	58	10	14	61	89
Niagara Region	76	58	13	10	115	89
Northwestern Ontario	23	34	2	3	59	92
Quinte, Kingston, Rideau	96	65	18	12	109	75
Simcoe-York	99	51	17	9	125	63
Thames Valley	89	59	16	10	117	77
Toronto	234	35	51	8	420	62
Waterloo Region-Wellington-Dufferin	70	49	14	10	95	65

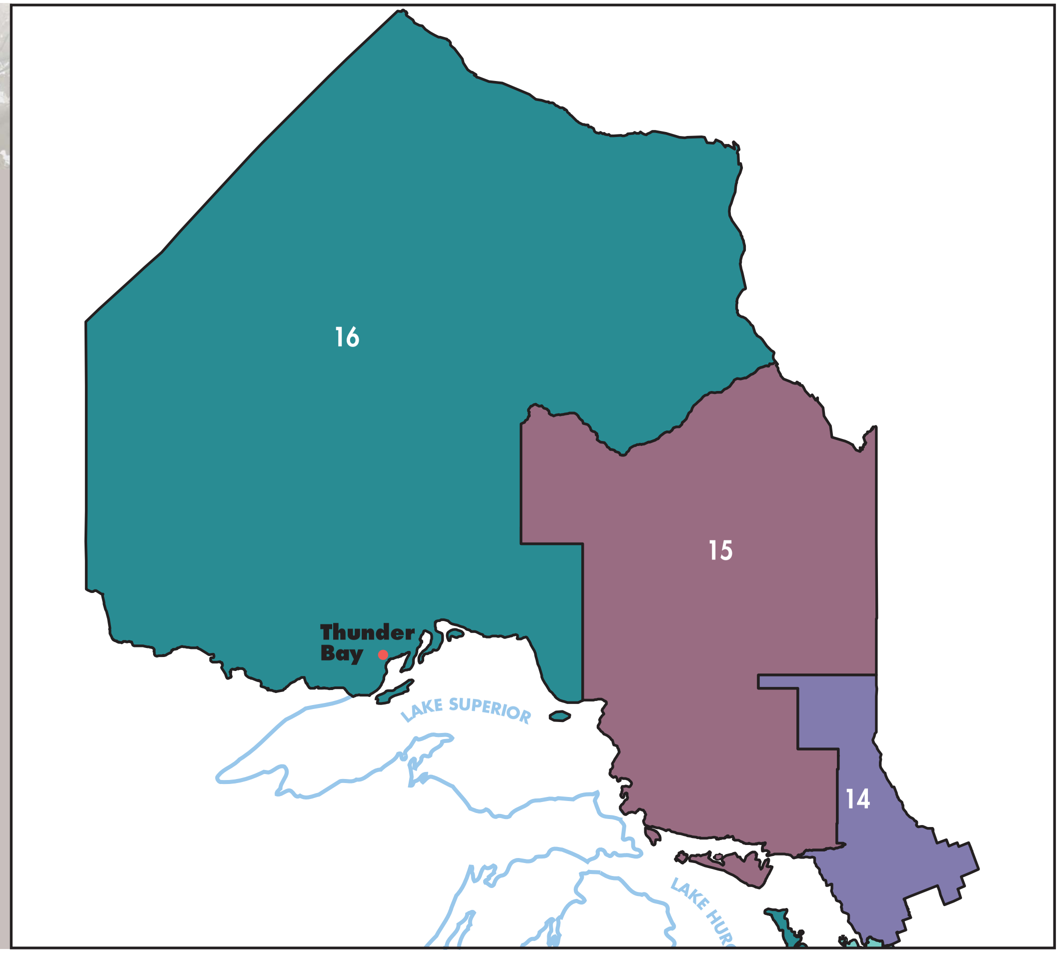
Data Source: Canadian Institute for Health Information

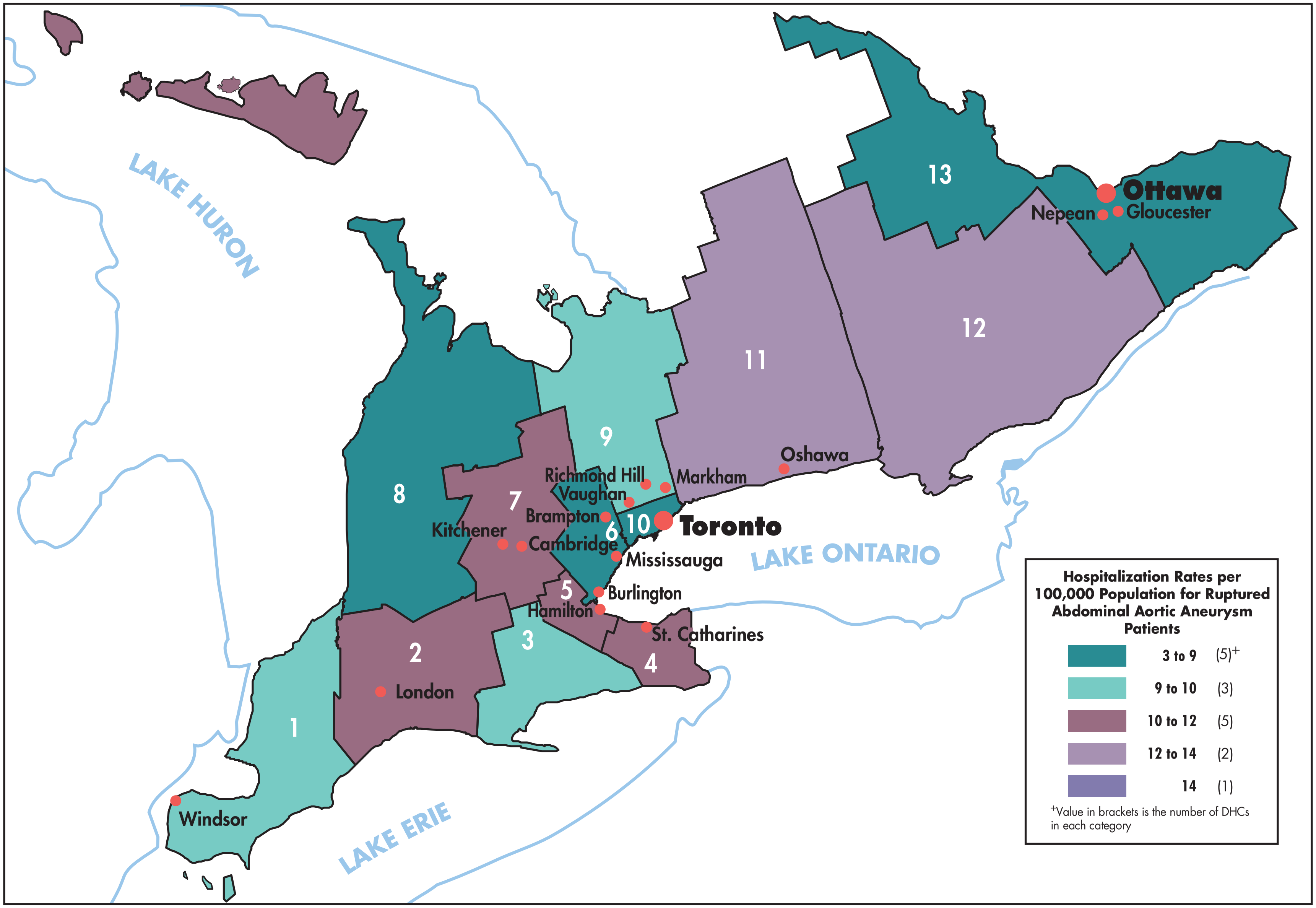
7.6 EXHIBIT

Age/Sex-adjusted Ruptured Abdominal Aortic Aneurysm Repair Rates per 100,000 Population Aged 50 Years and Over by District Health Council in Ontario, 1992/93 - 1996/97

ONTARIO District Health Councils

1. Essex, Kent and Lambton
2. Thames Valley
3. Grand River
4. Niagara Region
5. Hamilton-Wentworth
6. Halton-Peel
7. Waterloo Region-Wellington-Dufferin
8. Grey, Bruce, Huron, Perth
9. Simcoe-York
10. Toronto
11. Durham, Haliburton, Kawartha and Pine Ridge
12. Quinte, Kingston, Rideau
13. Champlain
14. Muskoka, Nipissing, Parry Sound and Timiskaming
15. Algoma, Cochrane, Manitoulin and Sudbury
16. Northwestern Ontario





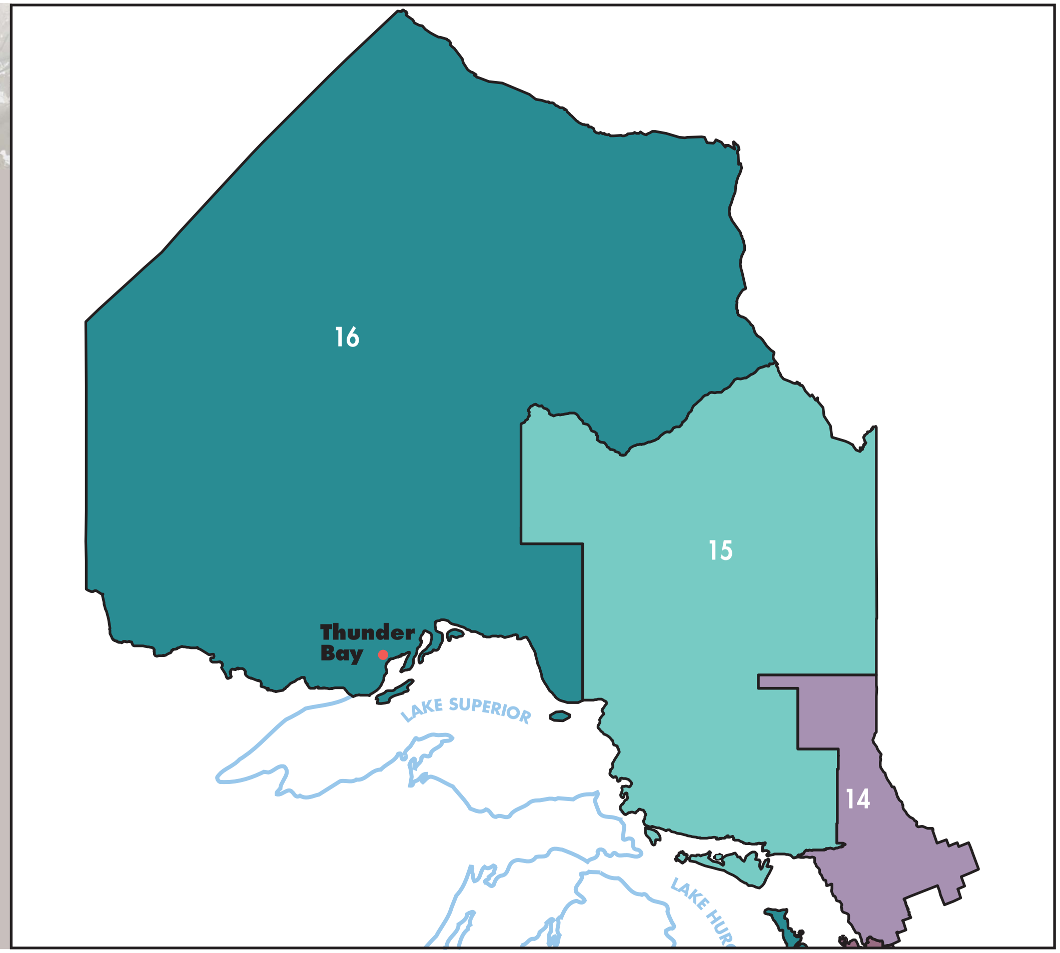
Data Source: Canadian Institute for Health Information, Registered Persons Database

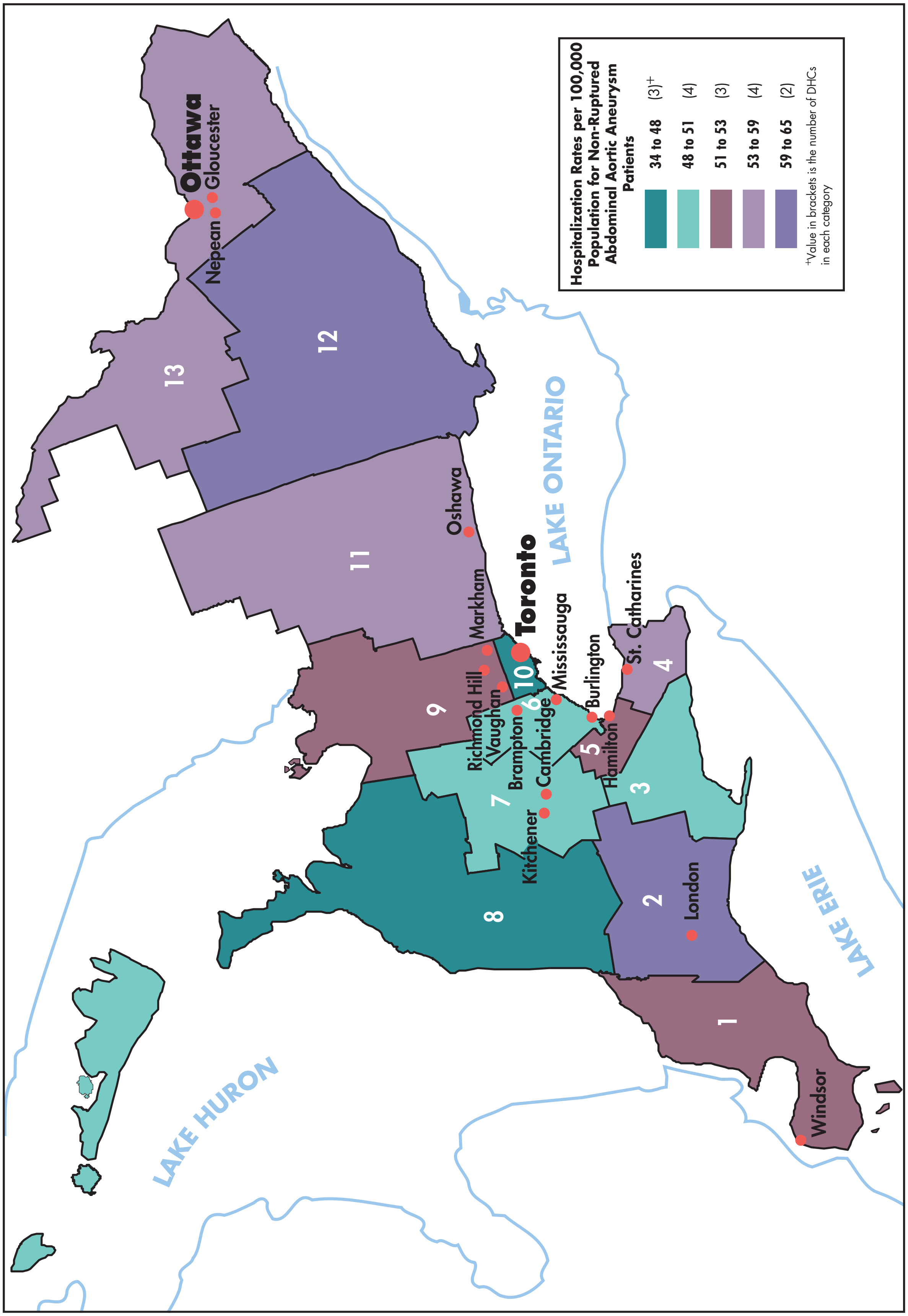
7·7 EXHIBIT

Age/Sex-adjusted Non-ruptured Abdominal Aortic Aneurysm Repair Rates per 100,000 Population Aged 50 Years and Over by District Health Council in Ontario, 1992/93 - 1996/97

ONTARIO District Health Councils

1 Essex, Kent and Lambton
2 Thames Valley
3 Grand River
4 Niagara Region
5 Hamilton-Wentworth
6 Halton-Peel
7 Waterloo Region-Wellington-Dufferin
8 Grey, Bruce, Huron, Perth
9 Simcoe-York
10 Toronto
11 Durham, Haliburton, Kawartha and Pine Ridge
12 Quinte, Kingston, Rideau
13 Champlain
14 Muskoka, Nipissing, Parry Sound and Timiskaming
15 Algoma, Cochrane, Manitoulin and Sudbury
16 Northwestern Ontario





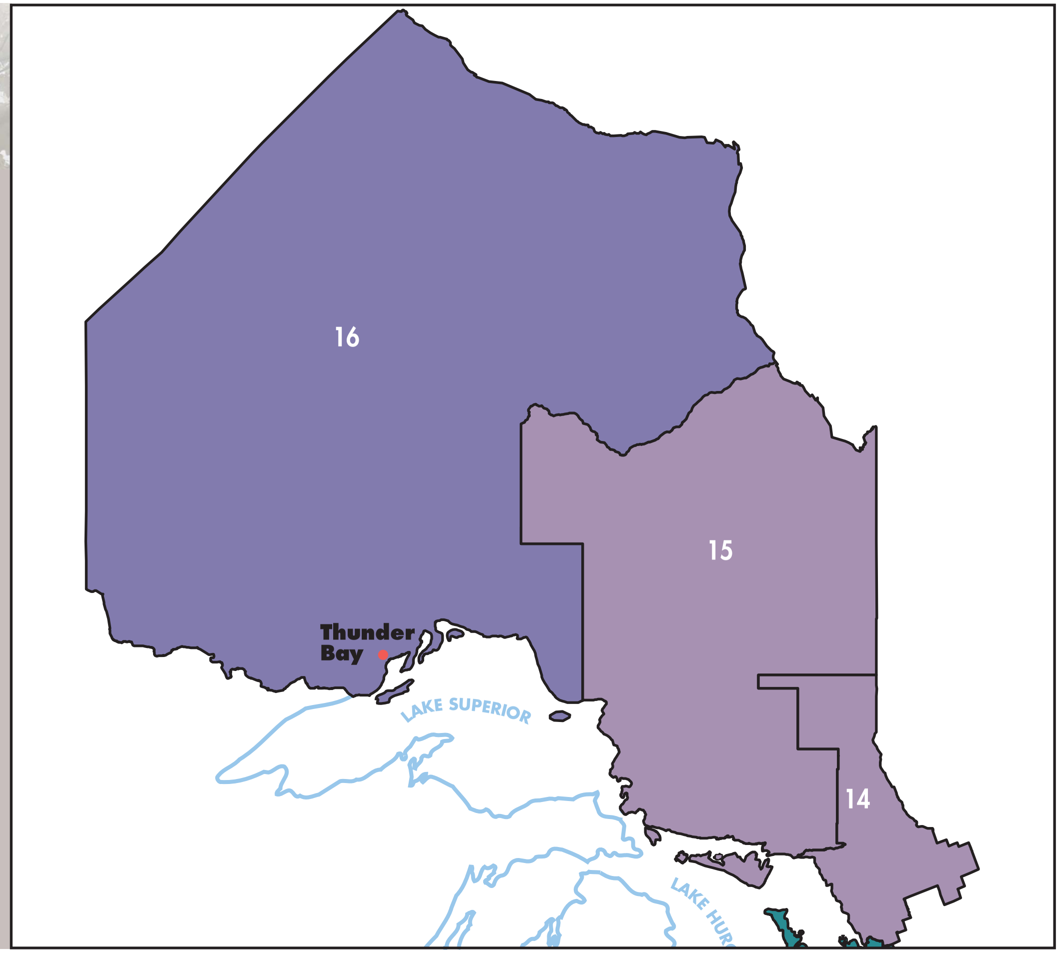
Data Source: Canadian Institute for Health Information, Registered Persons Database

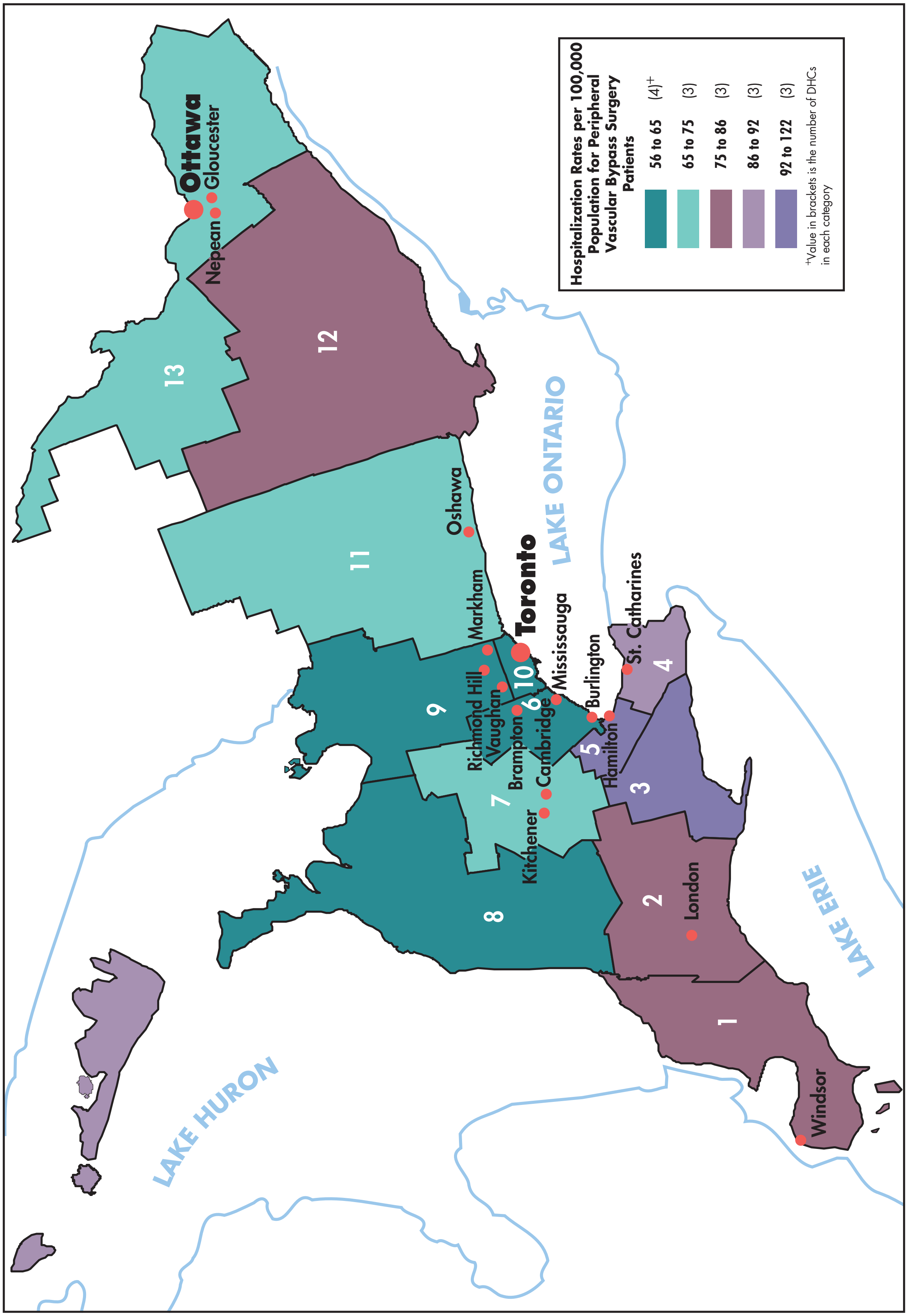
7.8 EXHIBIT

Age/Sex-adjusted Peripheral Vascular Bypass Surgery Rates per 100,000 Population Aged 50 Years and Over by District Health Council in Ontario, 1992/93 - 1996/97

ONTARIO District Health Councils

1. Essex, Kent and Lambton
2. Thames Valley
3. Grand River
4. Niagara Region
5. Hamilton-Wentworth
6. Halton-Peel
7. Waterloo Region-Wellington-Dufferin
8. Grey, Bruce, Huron, Perth
9. Simcoe-York
10. Toronto
11. Durham, Haliburton, Kawartha and Pine Ridge
12. Quinte, Kingston, Rideau
13. Champlain
14. Muskoka, Nipissing, Parry Sound and Timiskaming
15. Algoma, Cochrane, Manitoulin and Sudbury
16. Northwestern Ontario





Data Source: Canadian Institute for Health Information, Registered Persons Database

EXHIBIT 7.9 Age/Sex-adjusted Abdominal Aortic Aneurysm and Peripheral Vascular Bypass Surgery Rates per 100,000 Population Aged 50 Years and Over by Municipalities with Greater than 100,000 Population versus Other Areas in Ontario, District Health Councils 1992/93 - 1996/97

Large Municipality/Other Areas	Age/Sex-adjusted Ruptured Abdominal Aortic Aneurysm Rate	Age/Sex-adjusted Non-ruptured Abdominal Aortic Aneurysm Rate	Age/Sex-adjusted Peripheral Vascular Bypass Surgery Rate
Champlain			
Gloucester	3	48	55
Nepean	8	54	57
Ottawa	9	54	73
Other	9	53	75
Durham, Haliburton, Kawartha and Pine Ridge			
Oshawa	10	60	120
Other	12	55	59
Essex, Kent and Lambton			
Windsor	7	52	94
Other	10	52	76
Halton-Peel			
Brampton	8	29	58
Burlington	7	87	94
Mississauga	8	36	47
Oakville	9	70	75
Other	11	44	55
Hamilton-Wentworth			
Hamilton	9	52	128
Other	12	45	77
Niagara Region			
St. Catharines	8	59	104
Other	10	58	82
Northwestern Ontario			
Thunder Bay	4	50	122
Other	3	16	61
Simcoe-York			
Markham	9	31	29
Richmond Hill	6	61	53
Vaughan	3	28	44
Other	10	57	78
Thames Valley			
London	7	57	87
Other	14	64	67
Waterloo Region-Wellington-Dufferin			
Cambridge	22	47	78
Kitchener	10	35	71
Other	7	57	59

Note: For areas within District Health Councils (DHC), Census 1996 population data were used for rate denominators. This accounts for any apparent inconsistencies in rates as compared with previous DHC-specific tables.

Data Source: Canadian Institute for Health Information, Canadian Census 1996

EXHIBIT 7.10 Average Length of Hospital Stay for Abdominal Aortic Aneurysm Procedures in Ontario, 1992/93 - 1996/97

Diagnosis/ Fiscal Year	Number of Eligible Cases*	Adjusted Length of Stay (Days)**	Alternate Level of Care Days (%)***	Alternate Level of Care or Above Trim Days (%)†
Non-ruptured Abdominal Aortic Aneurysm				
1992/93	1,221	12.8	2.0	5.3
1993/94	1,290	11.8	1.3	3.1
1994/95	1,223	11.5	2.5	4.5
1995/96	1,280	11.2	2.4	4.2
1996/97	1,253	10.4	1.8	3.9
Ruptured Abdominal Aortic Aneurysm				
1992/93	107	19.3	18.9	25.7
1993/94	114	18.0	3.3	10.2
1994/95	100	17.7	1.7	18.9
1995/96	112	19.5	0.9	18.6
1996/97	134	16.6	6.3	13.2

* Eligible Cases: Hospital admissions not including in-hospital deaths and cases transferred in or out of hospital.

** Length of Stay: Average length of hospitalization not including days coded as "alternate level of care" or days above 97.5 percentile for the diagnostic group.

*** Alternate Level of Care Days: Percentage of total hospitalized days coded as "alternate level of care" by hospitals.

† Alternate Level of Care or Above Trim Days: Percentage of total hospitalized days either coded as alternate level of care or above the 97.5 percentile length of stay.

Data Source: Canadian Institute for Health Information

EXHIBIT 7.11 Average Length of Stay for Peripheral Vascular Bypass Procedures in Ontario, 1992/93 - 1996/97

Fiscal Year	Number of Eligible Cases*	Adjusted Length of Stay (Days)**	Alternate Level of Care Days (%)***	Alternate Level of Care or Above Trim Days (%)†
1992/93	1,936	12.5	2.8	6.6
1993/94	1,889	12.0	4.1	9.5
1994/95	1,853	11.3	3.7	8.8
1995/96	1,805	10.9	2.6	6.4
1996/97	1,972	9.8	5.5	11.5

* Eligible Cases: Hospital admissions not including in-hospital deaths and cases transferred in or out of hospital.

** Length of Stay: Average length of hospitalization not including days coded as "alternate level of care" or days above 97.5 percentile for the diagnostic group.

*** Alternate Level of Care Days: Percentage of total hospitalized days coded as "alternate level of care" by hospitals.

† Alternate Level of Care or Above Trim Days: Percentage of total hospitalized days either coded as alternate level of care or above the 97.5 percentile length of stay.

Data Source: Canadian Institute for Health Information

Conclusions

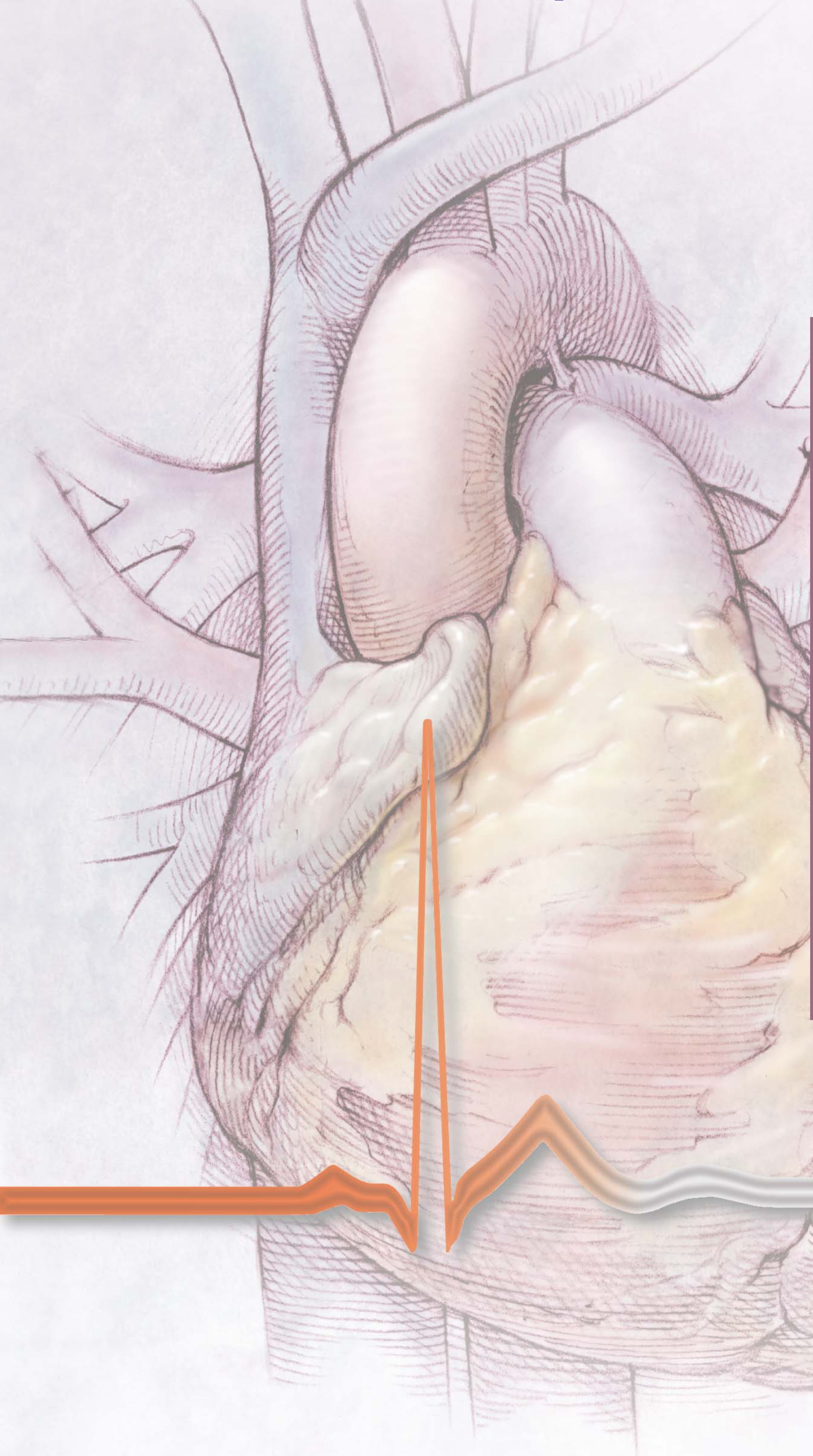
Ontario rates of AAA repair are comparable with those reported in international studies. For example, in the Netherlands, the total AAA operation rate was 47 per 100,000 population over the age of 50, with 17 per 100,000 procedures for ruptured AAA in 1990.[23] Ontario's total AAA rates were very similar: 48 per 100,000, but the rate of procedures for ruptured AAA was much lower at 9 per 100,000. This could reflect coding differences or increased rates of out-of-hospital death among patients with ruptured AAA in Ontario. However, a more optimistic interpretation is that a greater number of patients in Ontario are receiving surgery prior to AAA rupture. Further efforts are needed to enhance detection rates and improve the safety of elective nrAAA repair.

While variations in rates of AAA repair exist among regions of the province, these largely mirror those found for hospital admissions for cardiac diagnoses in general. Since the risk factors for the development of significant AAA are the same as many of the common coronary risk factors, it is likely that these geographic variations reflect underlying variations in the prevalence of AAA more than inequities in access to elective AAA repair. Rates of PVB surgery decreased during the study period, continuing the trend reported earlier. Variations in PVB surgery are likely due to a combination of factors. These include variations in risk factors (cigarette smoking, blood pressure, sedentary lifestyle and diabetes mellitus) and variations in the adoption of secondary prevention maneuvers (e.g. prescribed exercise) and the use of medical therapy.

The rate variations by income regions were clear for AAA repairs and particularly dramatic for PVB surgery. These findings underscore the continuing importance of socioeconomic status as a determinant of cardiovascular health, and the need for programs to address both clinical risk factors and underlying social causes of atherosclerotic disease in disadvantaged populations.

Use of Coronary Angiography, Angioplasty and Bypass Surgery After Acute Myocardial Infarction in Ontario

David A. Alter, Peter Austin, Jack V. Tu



CHAPTER 8

Key messages

- *There are large regional and interinstitutional variations in rates and waiting times for all three invasive procedures after myocardial infarction.*
- *Even after long-term follow-up, patients' chances of undergoing angiography and revascularization are heavily influenced by the type of hospital where they were initially admitted with an AMI.*
- *Access to angiography is a key determinant of rates of, and waiting times for, revascularization.*

Key Terms & Concepts:

- access
- angioplasty
- coronary angiography
- coronary artery bypass surgery
- coronary revascularization
- invasive cardiac facility
- acute myocardial infarction

Background

There are large regional and interhospital differences in the use of coronary angiography, percutaneous transluminal coronary angioplasty (PTCA) and coronary artery bypass (CABG) surgery throughout North America. Many clinical and non-clinical factors likely account for rate variations. For instance, many published studies have determined that when angiography is available in the same hospital where a patient is admitted with a heart attack, the patient is much more likely to receive the invasive test than if he/she is admitted to a hospital without such facilities.[1-3] The availability of invasive services at the admitting hospital is also likely to affect the use of PTCA and CABG procedures.[4,5] In particular, coronary angiography rates are correlated with PTCA and CABG rates. Hartford et al recently demonstrated that referral rates for coronary angiography in Manitoba determine subsequent regional differences in rates of CABG and PTCA procedures.[6] Indeed, Ontario studies of large sex differences in utilization of CABG suggest that once a coronary angiogram is performed, differences between genders are small.[7,8] Coronary angiography may accordingly be the rate-limiting step in the cardiovascular invasive procedure "funnel," with variations in CABG and PTCA existing largely as epiphenomena in the revascularization "spout." Yet, access to coronary angiography has received little attention relative to CABG in Canada. The focus on queues for revascularization procedures has obscured the fact that long waiting lists also exist for coronary angiography.[9,10] Therefore, to fully characterize any inequities in access to invasive cardiac procedures, one has to understand how delays affect the utilization of coronary angiography.

This chapter focuses on District Health Council (DHC), municipality and hospital-level variations in rates and waiting times for invasive cardiac procedures after acute myocardial infarction (AMI) with particular attention being given to the role of coronary angiography as a determinant of the variable use of both PTCA and CABG.

Data Sources

We used data from the Ontario Myocardial Infarction Database (OMID) project (see Methods Appendix for Chapter 5). The OMID project involves the linkage of all of Ontario's major administrative databases to create a comprehensive database that can be used for studying the quality of AMI care in Ontario (Chapter 5).

How We Did the Analysis

With the exception of minor modifications described below, the eligible inception AMI cohort was constructed with inclusion/exclusion criteria identical to those used in the analysis of AMI outcomes reported in Chapter 5 (see Methods Appendix for Chapter 5). Cumulative rates of coronary angiography were examined at six months post-AMI, while cumulative rates of PTCA and CABG were determined at one year post-AMI because patients often wait several months after an angiogram before undergoing PTCA or CABG. The waiting times from AMI to coronary angiography and from angiography to PTCA or CABG were calculated. While raw data were used for the statistical analyses, the Exhibits present data on rates and waiting times rounded to the nearest decimal place and whole number respectively. The majority of analyses aggregated patients admitted to hospitals over the fiscal years of 1994/95 to 1996/97. Because age and sex adjustments may lead to inaccurate results when evaluating small numbers of patients, procedural rates and waiting times across DHCs, municipalities and institutions were left unadjusted. Accordingly, individual hospitals may interpret our results in reference to their own patient populations.

Each hospital was categorized by the type of invasive cardiac facilities present at the institution. Infrequently, pre-merger hospital names were used to reflect original invasive-facility characteristics. Because of the small numbers of patients encountered at each small hospital, the results from the institutions within this category are not presented individually.

In order to identify those institutions associated with the highest and lowest rates of invasive procedures, each institutional rate was compared to the corresponding unadjusted provincial average. An appropriate statistical correction factor was used for multiple comparison (i.e. using the conventional p-value of 0.05 and dividing by the number of comparisons). Outliers for waiting time were not identified because the measure used was a surrogate rather than a true measure (prospectively collected) of waiting time. The frequencies and waiting times for each procedure were also examined by three types of aggregated analysis. These included the type of facilities present at the admitting hospital (i.e. revascularization facilities versus catheterization-only facilities versus no invasive facilities), the hospital grouping (small, medium, large or teaching), and geographical distance from admitting hospital to closest institution with revascularization facilities. For such aggregated analyses, procedural rates and waiting times were adjusted for age and sex in order to allow for more meaningful intergroup comparisons. Geographical distance was estimated using latitude and longitude coordinates and did not incorporate true travel distance owing to normal travel impediments and circuitous routing of roadways. Standard statistical modelling techniques were used to predict procedure use and waiting times. Please refer to Methods Appendices for detail about statistical models.

Interpretive Cautions

We acknowledge several study limitations. First, we are using time from AMI to angiography and angiography to revascularization as reflections of waiting times. Our data do not allow us to determine exactly when and under which clinical circumstances referrals were made. It is possible that some patients were assessed by a specialist several weeks after hospitalization with a heart attack and only then referred for an angiogram. In general, these indirect measures of waiting time will overestimate the extent of delays. However, these measures do reflect overall time to access a procedure, and there is no reason to expect that this will affect regions or hospitals differentially.

Second, we were not able to consider physicians whose primary hospital affiliation is one with no on-site facilities, but who perform cardiac catheterization at revascularization hospitals and therefore have indirect links to specialized services.

Third, administrative data do not fully capture illness severity and comorbidity. Full adjustments for these factors could have altered our results. Nevertheless, across large regions, case mix factors other than age and sex are not expected to substantially vary for a rather homogeneous population of AMI patients. Both crude and age/sex-adjusted rates and waiting times were examined. As expected, either method produced consistent results when patients were analyzed using higher levels of aggregation (e.g. hospital size, facility types, distance categories). However, disparities existed between the two methods at more discrete levels of aggregation (i.e. municipalities and institutions). These differences are likely attributable to smaller sample sizes that result in fewer numbers of patients within particular age and sex categories. Accordingly, procedural rates and waiting times for individual institutions, municipalities and DHCs are presented without adjustment for age and sex. As such, we discourage readers from comparing results across individual institutions, but encourage the comparisons against provincial averages to determine hospital outliers which tend to be more stable and reliable. Statistical models utilized a surrogate rather than true measure of cardiac illness severity (i.e. the per cent rank of angiography waiting times within an institution) and did so for revascularization procedures only. The absence of clinical measures, such as need for angiography, may have accounted for the relatively inferior predictive power of those models when compared to the statistical models for revascularization procedures (see Methods Appendix MA8.16 to MA8.17).

Fourth, we caution readers against quick judgements about overuse or underuse of procedures based on aggregated DHC, municipality and institution-level data since there is disagreement about the optimal rate for each procedure.

Fifth, the influence of geographical factors is measured only by the proximity of the admitting hospital to the closest institutions with revascularization capabilities.

A more in-depth examination of this area-level characteristic requires complex statistical modelling that is beyond the scope of this chapter. Finally, other area-based characteristics such as socioeconomic status were not examined but have been demonstrated in other studies to influence rates of invasive cardiac procedures in the US and Canada.[11,12]

Findings and Discussion

Trends Over Time

Exhibit 8.1 illustrates the trends of rates and median waiting times for each of the three procedures from 1992/93 to 1996/97. The rates of all procedures have increased steadily each year (p=0.001) with the relative increase greatest for PTCA and least for coronary angiography (31.6%, 21.1%, and 17.8% relative increases for PTCA, CABG and coronary angiography respectively). The proportional rate of revascularization relative to angiography was, on average, 64% with minimal fluctuation noted between years (range: 62% to 69%). The observed revascularization to angiography ratio is comparable to those reported in studies elsewhere (three angiography to two revascularization procedures).[13,14]

Absolute waiting times from AMI to angiography appear equivalent to those calculated from coronary angiography to CABG. Median waiting times from angiography to PTCA were significantly shorter than waiting times for each of the other two invasive procedures. Moreover, relative waiting times have diminished most for angiography and least for PTCA over the five years. This finding suggests an increased capacity and/or efficiency for all three invasive procedures in the post-AMI population. It should be noted that a queuing crisis was observed for CABG procedures in 1996 and should have resulted in

EXHIBIT 8.1 Post-acute Myocardial Infarction Cardiac Procedure Rates and Waiting Times in Ontario, 1992/93 - 1996/97

		Procedure Rates (%)			Median Waiting Time (days)		
Fiscal Year	Acute Myocardial Infarction Volume	Six-month Coronary Angiography	One-year Angioplasty	One-year Bypass Surgery	Coronary Angiography	Angioplasty	Bypass Surgery
1992/93	17,047	23.2	6.2	8.2	29	8	28
1993/94	17,256	23.6	6.8	8.3	28	6	27
1994/95	17,072	25.6	7.0	9.3	24	6	23
1995/96	17,353	27.4	7.6	9.2	20	6	29
1996/97	18,068	28.2	9.0	10.4	17	6	19
Overall	**86,796**	**25.6**	**7.3**	**9.1**	**23**	**6**	**23**

Note: Waiting time for coronary angiography = Median time from acute myocardial infarction to coronary angiography
Waiting time for angioplasty = Median time from coronary angiography to angioplasty
Waiting time for bypass surgery = Median time from coronary angiography to bypass surgery

Data Source: Canadian Institute for Health Information, Ontario Health Insurance Plan, Registered Persons Database, Ontario Myocardial Infarction Database

longer waiting times. The fact that the expected findings of longer waiting times for CABG were not observed suggests that worsening delays in procedures primarily affected elective patient populations rather than the relatively more urgent patients comprising the post-AMI population.

Age and Sex Comparisons

Exhibit 8.2 illustrates the age- and sex-specific rates and waiting times for all three procedures aggregated over 1994/95 to 1996/97. Women received significantly fewer procedures than men ($p<0.0001$). Despite proportionately lower rates of coronary angiography compared to men, median waiting times for all procedures were significantly shorter for women (i.e. $p<0.0001$ for coronary angiography, PTCA and CABG) suggesting physicians triaged women in accordance with either a perceived or a real difference in clinical urgency. These results are consistent with earlier Ontario studies indicating lower acceptance rates for CABG among women, despite greater illness severity. However, once accepted, the shorter waiting times noted for women appropriately reflect their higher urgency.[7,8] Overall median waiting times from AMI to coronary angiography, and angiography to revascularization were inversely correlated with age, possibly reflecting greater clinical urgency among elderly patients. Finally, along with the highest rates of angiography among the youngest age categories ($p<0.001$), the ratio of revascularization to angiography was lowest in this group. This possibly reflects less appropriate use of coronary angiography or alternatively, may reflect a state of enhanced vigilance among physicians for fear of missing a lesion potentially amenable to PTCA or CABG in the young. There is, however, no proven mortality benefit from adopting an aggressive approach to angiography and revascularization in these post-AMI patients.[15,16]

EXHIBIT 8.2 Age/Sex-specific Cardiac Procedure Rates and Median Post-acute Myocardial Infarction Waiting Time in Ontario, 1994/95 - 1996/97

Rates and Waiting Times	Women (Age)					Men (Age)				
	20 - 49	50 - 64	65 - 74	75+	Overall	20 - 49	50 - 64	65 - 74	75+	Overall
Procedure Rate (%)										
Angiography*	50.7	37.0	25.1	6.0	**19.6**	52.9	41.1	28.7	9.2	**31.5**
Angioplasty**	16.0	12.7	7.4	1.8	**6.1**	18.5	12.0	6.6	1.8	**8.9**
Bypass Surgery**	8.1	11.3	10.1	1.9	**6.4**	12.1	15.6	13.4	4.0	**11.6**
Median Waiting Time (Days)										
Angiography*	22	18	18	17	**18**	22	23	19	18	**21**
Angioplasty**	7	5	4	4	**5**	7	7	6	6	**7**
Bypass Surgery**	28	25	13	11	**15**	51	37	19	13	**27**
Acute Myocardial Infarction	977	3,483	5,810	9,124	**19,394**	4,797	10,783	9,384	8,135	**33,099**

* Mean six-month coronary angiography rates

** One-year angioplasty and bypass rates

Note: Waiting time for coronary angiography = Median time from acute myocardial infarction to coronary angiography
Waiting time for angioplasty = Median time from coronary angiography to angioplasty
Waiting time for bypass surgery = Median time from coronary angiography to bypass surgery

Data Source: Canadian Institute for Health Information, Ontario Health Insurance Plan, Registered Persons Database, Ontario Myocardial Infarction Database

EXHIBIT 8.3 Crude Coronary Angiography, Angioplasty and Coronary Artery Bypass Surgery Rates and Corresponding Waiting Times per 100 Acute Myocardial Infarction Patients by District Health Council in Ontario, 1994/95 - 1996/97

District Health Council	Acute Myocardial Infarction Volume	Procedure Rates (%) Six-month Coronary Angiography	One-year Angioplasty	One-year Bypass Surgery	Median Waiting Time (days) Coronary Angiography	Angioplasty	Bypass Surgery
Algoma, Cochrane, Manitoulin and Sudbury	2,481	37.4**	10.8**	12.4**	23	14	46
Champlain	4,516	33.7**	13.8**	9.8	11	5	16
Durham, Haliburton, Kawartha and Pine Ridge	3,710	27.2	7.4	10.7	30	6	41
Essex, Kent and Lambton	3,476	25.5	6.4*	8.5	22	9	35
Grand River	1,412	18.7*	4.5*	7.6	36	4	13
Grey, Bruce, Huron, Perth	1,689	17.3*	4.4*	6.0*	37	2	17
Halton-Peel	4,202	34.2**	8.7	12.9**	26	8	18
Hamilton-Wentworth	2,314	25.8	8.6	10.0	14	2	22
Muskoka, Nipissing, Parry Sound and Timiskaming	1,446	25.9	7.1	10.0	44	5	39
Niagara Region	2,458	19.2*	5.2*	8.2	35	7	36
Northwestern Ontario	1,210	17.3*	3.7*	5.8*	51	48	81
Quinte, Kingston, Rideau	2,839	26.0	7.3	10.5	24	3	51
Simcoe-York	3,726	24.0*	6.7	8.2*	28	7	29
Thames Valley	3,098	30.8**	10.2**	10.5	8	1	12
Toronto	11,204	27.4	7.6	9.6	17	7	19
Waterloo Region-Wellington-Dufferin	2,712	20.9*	5.8*	8.1	23	3	14
Summary Statistics							
Minimum	1,210	17.3	3.7	5.8	8	1	12
25th Percentile	2,002	20.1	5.5	8.2	20	3	16
Median	2,776	25.8	7.2	9.7	25	6	25
75th Percentile	3,718	29.1	8.6	10.5	36	8	40
Maximum	11,204	37.4	13.8	12.9	51	48	81

Note: Outliers for waiting times are not presented because the measure used is a surrogate, rather than a true measure.

* Significantly lower than provincial average p<0.001

** Significantly higher than provincial average p<0.001

Data Source: Canadian Institute for Health Information, Ontario Health Insurance Plan, Registered Persons Database, Ontario Myocardial Infarction Database

Regional and Institution-specific Rates and Waiting Times

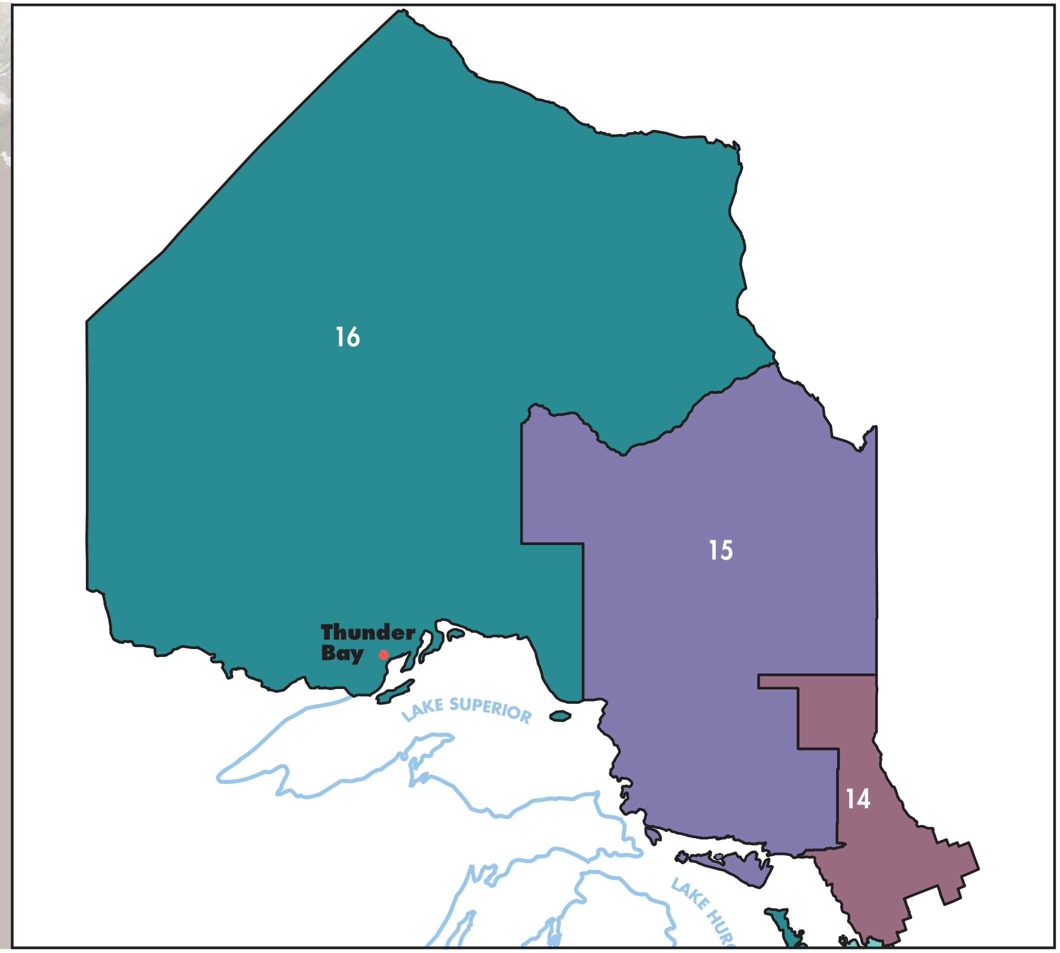
Exhibits 8.3 to 8.7 illustrate the unadjusted cardiac procedure rates and waiting times among DHCs and municipalities throughout Ontario. When compared to the overall provincial angiography rate (27.1%), Algoma, Cochrane, Manitoulin and Sudbury DHC had the highest unadjusted post-AMI cardiac catheterization rate (37.4%), while Northwestern Ontario and Grey, Bruce, Huron, Perth DHCs had the lowest (17.3%). Gloucester (42.3%), Nepean (39.5%) and Oakville (37.6%) had the highest crude municipal angiography rates. Only seven municipalities had institutions with angiography facilities. On average, these municipalities had significantly higher rates (30.0% versus 24.6%, p<0.001) and shorter waiting times (39 days versus 53 days, p<0.0001) for coronary angiography than those municipalities without such facilities.

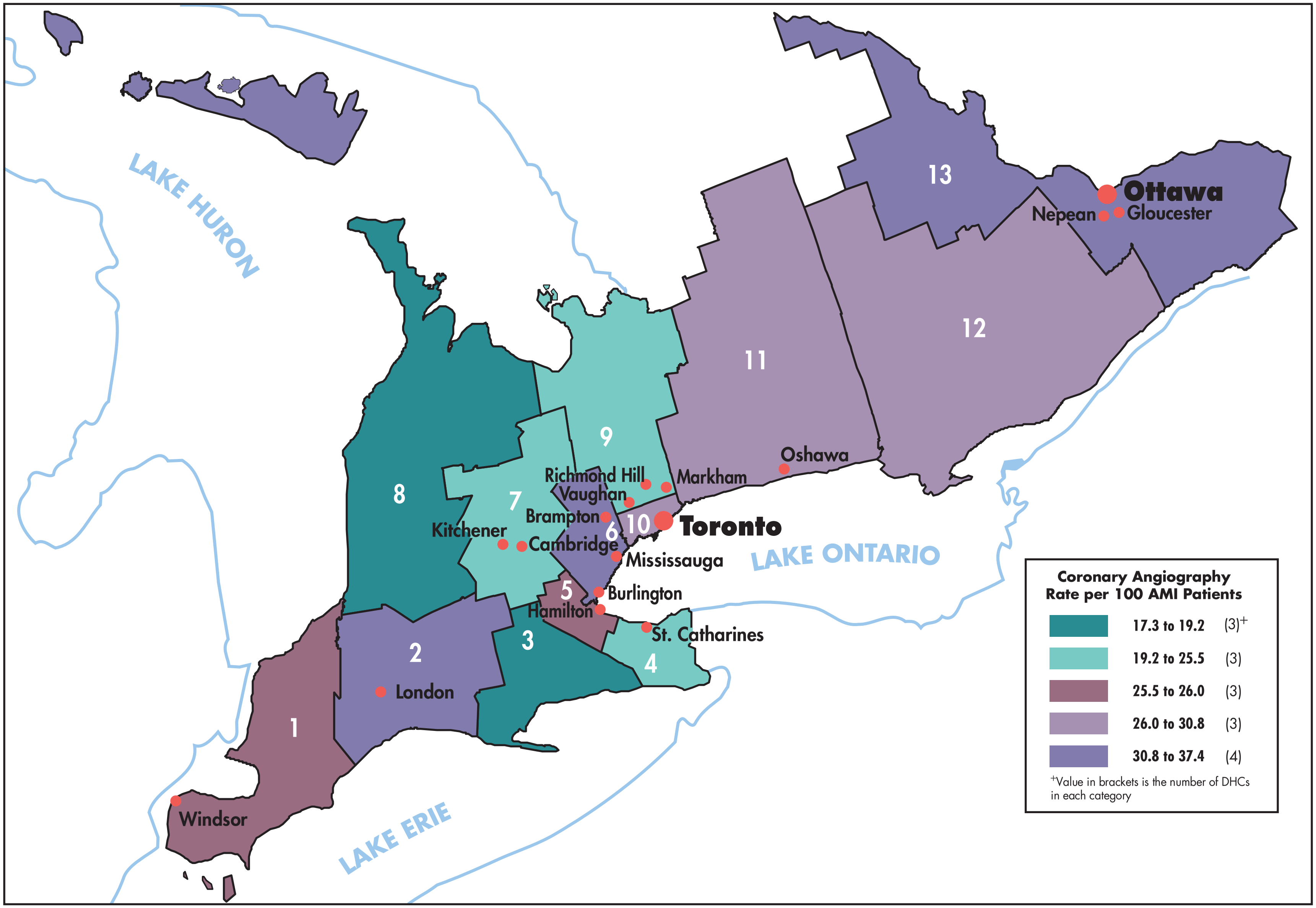
8.4 EXHIBIT

Crude Coronary Angiography Rates per 100 Acute Myocardial Infarction Patients Aged 20 Years and Over by District Health Council in Ontario, 1994/95 - 1996/97

ONTARIO District Health Councils

1. Essex, Kent and Lambton
2. Thames Valley
3. Grand River
4. Niagara Region
5. Hamilton-Wentworth
6. Halton-Peel
7. Waterloo Region-Wellington-Dufferin
8. Grey, Bruce, Huron, Perth
9. Simcoe-York
10. Toronto
11. Durham, Haliburton, Kawartha and Pine Ridge
12. Quinte, Kingston, Rideau
13. Champlain
14. Muskoka, Nipissing, Parry Sound and Timiskaming
15. Algoma, Cochrane, Manitoulin and Sudbury
16. Northwestern Ontario





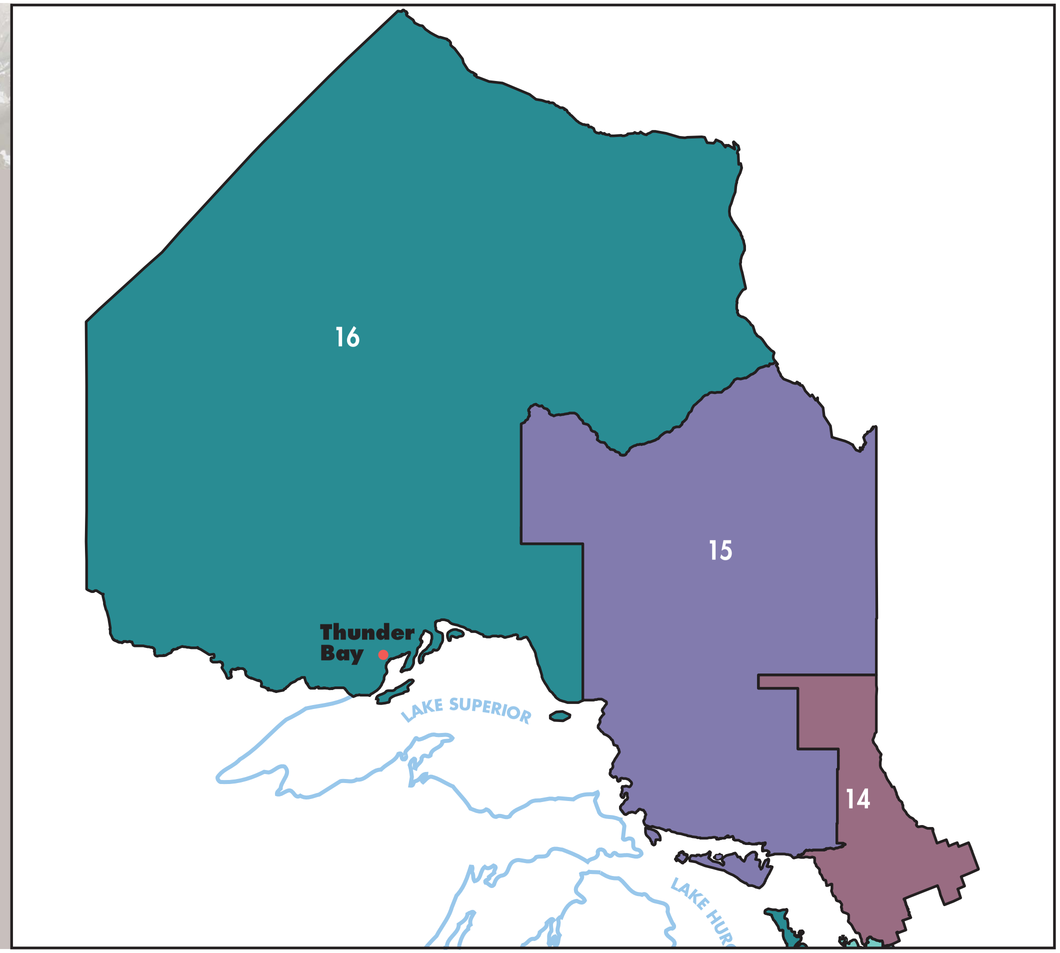
Data Source: Canadian Institute for Health Information, Ontario Health Insurance Plan, Registered Persons Database, Ontario Myocardial Infarction Database

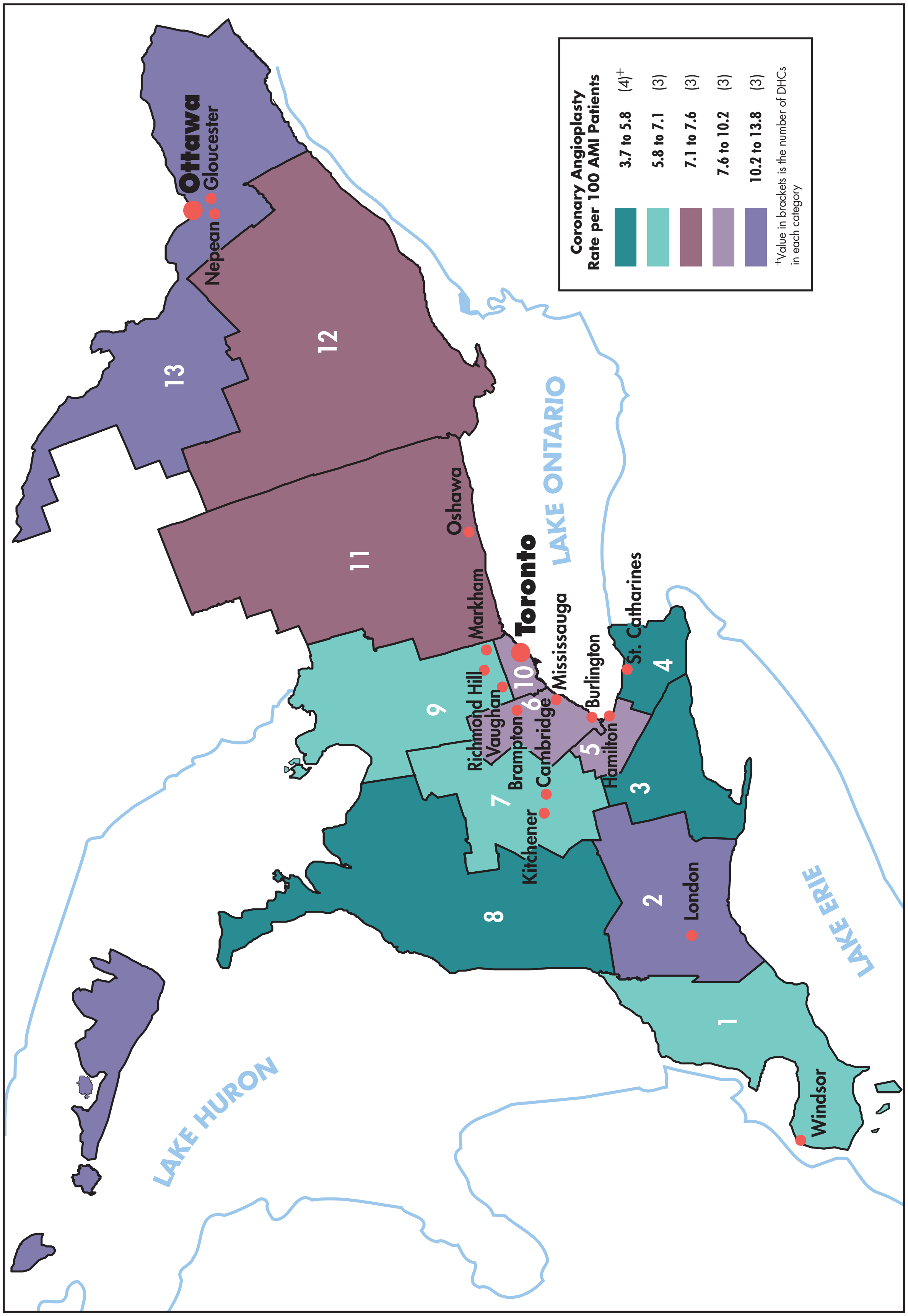
8.5 EXHIBIT

Crude Coronary Angioplasty Rates per 100 Acute Myocardial Infarction Patients Aged 20 Years and Over by District Health Council in Ontario, 1994/95 - 1996/97

ONTARIO District Health Councils

1. Essex, Kent and Lambton
2. Thames Valley
3. Grand River
4. Niagara Region
5. Hamilton-Wentworth
6. Halton-Peel
7. Waterloo Region-Wellington-Dufferin
8. Grey, Bruce, Huron, Perth
9. Simcoe-York
10. Toronto
11. Durham, Haliburton, Kawartha and Pine Ridge
12. Quinte, Kingston, Rideau
13. Champlain
14. Muskoka, Nipissing, Parry Sound and Timiskaming
15. Algoma, Cochrane, Manitoulin and Sudbury
16. Northwestern Ontario





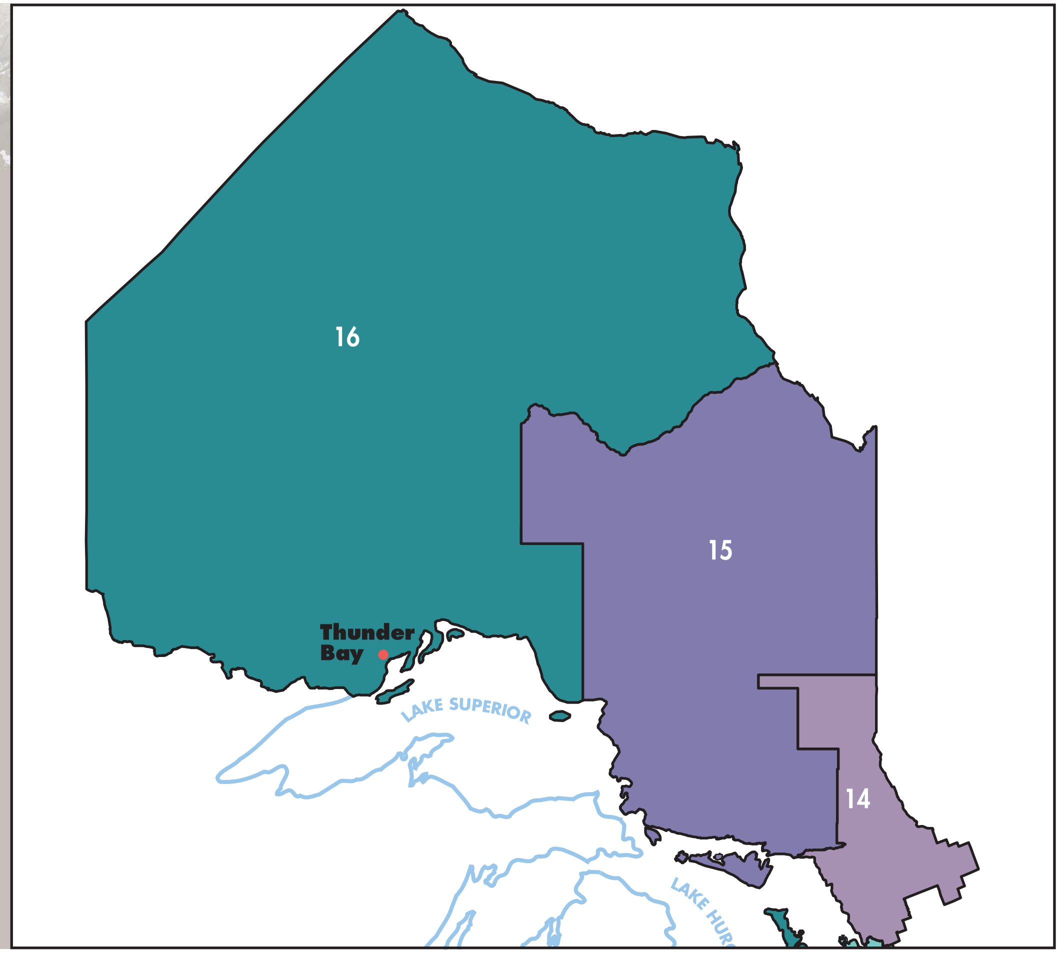
Data Source: Canadian Institute for Health Information, Ontario Health Insurance Plan, Registered Persons Database, Ontario Myocardial Infarction Database

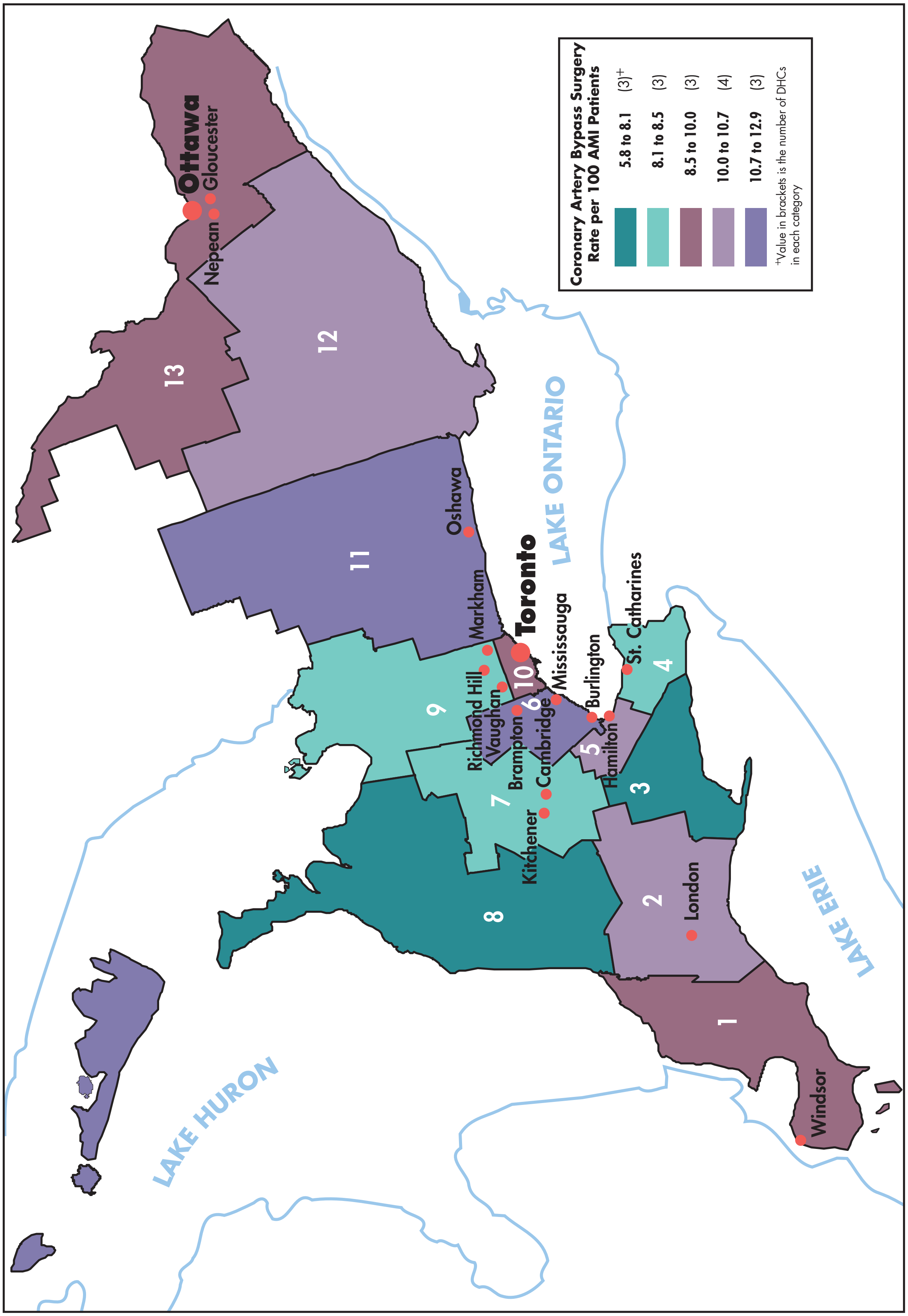
8.6 EXHIBIT

Crude Bypass Surgery Rates per 100 Acute Myocardial Infarction Patients Aged 20 Years and Over by District Health Council in Ontario, 1994/95 - 1996/97

ONTARIO *District Health Councils*

1. Essex, Kent and Lambton
2. Thames Valley
3. Grand River
4. Niagara Region
5. Hamilton-Wentworth
6. Halton-Peel
7. Waterloo Region-Wellington-Dufferin
8. Grey, Bruce, Huron, Perth
9. Simcoe-York
10. Toronto
11. Durham, Haliburton, Kawartha and Pine Ridge
12. Quinte, Kingston, Rideau
13. Champlain
14. Muskoka, Nipissing, Parry Sound and Timiskaming
15. Algoma, Cochrane, Manitoulin and Sudbury
16. Northwestern Ontario





Data Source: Canadian Institute for Health Information, Ontario Health Insurance Plan, Registered Persons Database, Ontario Myocardial Infarction Database

EXHIBIT 8.7 Crude Coronary Angiography, Angioplasty and Bypass Surgery Rates and Corresponding Waiting Times per 100 Acute Myocardial Infarction Patients Aged 20 Years and Over in Municipalities with Populations Greater than 100,000 versus Other Areas in Ontario District Health Councils, 1994/95 - 1996/97

Large Municipalities/Other Areas	Acute Myocardial Infarction Volume	Procedure Rate (%)			Median Waiting Time (Days)		
		Six-month Coronary Angio-graphy	One-year Angio-plasty	One-year Bypass Surgery	Coronary Angio-graphy	Angio-plasty	Bypass Surgery
Champlain							
Gloucester	421	42.3**	16.4**	10.7	9	5	11
Nepean	357	39.5**	18.5**	7.8	7	5	67
Ottawa	1,578	34.3**	15.0**	10.5	8	4	15
Other	2,160	30.6**	11.7**	9.4	15	5	15
Durham, Haliburton, Kawartha and Pine Ridge							
Oshawa	694	27.2	6.9	9.8	21	6	34
Other	3,016	27.2	7.5	10.9	35	6	43
Essex, Kent and Lambton							
Windsor	1,208	33.1**	8.4	11.1	14	11	20
Other	2,268	21.5*	5.4*	7.2*	37	7	43
Halton-Peel							
Brampton	863	34.6**	9.0	13.4	57	14	48
Burlington	658	33.1	8.8	14.7**	16	6	14
Mississauga	1,822	34.9**	8.6	12.7**	22	9	14
Oakville	474	37.6**	10.3	13.5	21	7	22
Other	385	27.3	6.0	8.6	59	9	32
Hamilton-Wentworth							
Hamilton	1,733	25.6	8.9	10.0	14	5	20
Other	581	26.3	7.6	10.0	14	0	26
Northwestern Ontario							
Thunder Bay	743	20.5*	4.0*	7.4	51	56	81
Other	467	12.2*	3.2*	3.2*	51	33	88
Niagara Region							
St. Catharines	799	15.1*	4.3*	6.3*	47	3	17
Other	1,659	21.1*	5.7*	9.2*	34	12	40
Simcoe-York							
Markham	540	34.6**	9.3	11.7	26	7	41
Richmond Hill	358	33.2	6.7	12.3	27	8	77
Vaughan	396	30.1	9.1	10.6	30	12	27
Other	2,432	19.3*	5.7*	6.4*	31	6	20
Thames Valley							
London	1,676	33.4**	12.3**	11.3	6	1	11
Other	1,422	27.6	7.7	9.6	21	1	13
Waterloo Region-Wellington-Dufferin							
Cambridge	552	22.8	7.8	8.5	32	5	22
Kitchener	784	21.2*	5.1*	8.0	18	1	16
Other	1,376	20.1*	5.4*	8.1	26	4	11

Note: Outliers for waiting times are not presented because the measure used is a surrogate, rather than a true measure.

* Significantly lower than provincial average p<0.001

** Significantly higher than provincial average p<0.001

Data Source: Canadian Institute for Health Information, Ontario Health Insurance Plan, Registered Persons Database, Ontario Myocardial Infarction Database

Exhibit 8.8 illustrates the unadjusted cardiac procedure rates and waiting times at the hospital level among large- and medium-volume hospitals throughout Ontario. When compared to the overall unadjusted provincial average rates (27.1%, 7.9%, 9.7% for coronary angiography, PTCA and CABG respectively), those with on-site angiography facilities, as well as those categorized as teaching or large-volume institutions comprised the majority of the high-rate angiography outliers (50% of high-rate angiography outlying institutions had on-site angiography facilities and 89% were teaching or large-volume hospitals). The Ottawa Civic Hospital (49.7%), St. Michael's Hospital (46.8%), Sudbury Memorial Hospital (46.6%), and Hôpital Montfort, Ottawa (40.8%) were associated with the highest rates of coronary angiography. While the majority of low-rate angiography outliers were among large-volume hospitals (56%), no such institutions had on-site angiography capabilities. Generally, there was a moderate but significant inverse relationship between angiography rates and waiting times such that those regions and institutions with higher rates often had lower waiting times.

The Effects of Hospital Group, Facility and Proximity

Variability in the rates and waiting times of cardiac procedures may be attributable to many contributing patient-level and area-level factors. Accordingly, we examined three such area-based factors: size of hospital, the presence or absence of on-site invasive cardiac facilities, and proximity of the admitting institution to the closest revascularization centre. These are illustrated in Exhibits 8.9, 8.10 and 8.11 respectively. All three tables illustrate significant gradations with higher procedure rates and shorter waiting times correlating with larger-volume institutions, on-site invasive facilities and closer proximity to revascularization centres. In general, these relationships were most significant for coronary angiography ($p<0.0001$), and least or non-significant for bypass surgery (see Methods Appendix MA8.2 to MA8.4).

Since our geographical definition incorporated proximity to revascularization facilities, there is a strong relationship between distance and facility types. Assessing the impact of either factor on utilization and access is difficult if evaluated simultaneously. However, when examining geographical factors only among those institutions without any invasive cardiac facilities, distance still strongly affected angiography utilization and waiting times after age and sex adjustments ($p<0.0001$). Although significant, these effects were less striking for PTCA and CABG (Methods Appendix MA8.5). Our findings are consistent with other population-based US studies demonstrating the relationship between proximity to cardiac centres and service intensity following acute myocardial infarction.[14,17]

EXHIBIT 8.8 Crude Coronary Angiography, Angioplasty and Coronary Artery Bypass Surgery Rates and Corresponding Waiting Times per 100 Acute Myocardial Infarction Patients Aged 20 Years and Over by Hospital in Ontario, 1994/95 - 1996/97

TEACHING

Hospital	Facility Type	Acute Myocardial Infarction Volume	Procedure Rate (%) Six-month Coronary Angiography	Procedure Rate (%) One-year Angioplasty	Procedure Rate (%) One-year Bypass Surgery	Median Waiting Time (Days) Coronary Angiography	Median Waiting Time (Days) Angioplasty	Median Waiting Time (Days) Bypass Surgery
Chedoke-McMaster Hospital, Hamilton		453	18.8*	6.0	8.2	13	0	15
Hamilton Civic Hospitals (General Division)	R	685	28.5	11.7	8.9	12	0	21
Hamilton Civic Hospitals (Henderson Division)		767	29.1	7.7	11.9	14	5	21
Hôtel Dieu Hospital Kingston		403	28.5	5.2	11.4	13	0	47
Kingston General Hospital	R	569	32.0	9.1	12.5	10	0	70
Mount Sinai Hospital, Toronto		368	39.9**	12.8	11.1	6	6	13
Ottawa Civic Hospital	R	970	49.7**	25.1**	11.0	5	2	42
Ottawa General Hospital		674	26.1	9.8	9.2	33	2	18
St. Joseph's Health Centre of London		709	30.0	8.9	13.3	7	5	11
St. Joseph's Hospital, Hamilton		388	22.4	7.5	9.3	23	7	26
St. Michael's Hospital, Toronto	R	267	46.8**	19.5**	9.0	6	0	77
Sunnybrook Health Science Centre, Toronto	R	684	35.4**	16.7**	9.6	5	1	14
Toronto Hospital Corporation	R	867	39.0**	10.1	10.1	4	1	7
University Hospital, London	R	329	37.1**	10.6	11.6	6	0	19
Victoria Hospital, London	R	882	39.7**	16.4**	12.7	5	0	7
Wellesley-Central Hospital, Toronto		301	28.2	8.6	8.0	9	7	8
Women's College Hospital, Toronto		125	30.4	7.2	12.0	12	7	9
Summary Statistics								
Minimum		125	18.8	5.2	8.0	4	0	7
25th Percentile		368	28.5	7.7	9.2	6	0	11
Median		569	30.4	9.8	11.0	9	1	18
75th Percentile		709	39.0	12.8	11.9	13	5	26
Maximum		970	49.7	25.1	13.3	33	7	77

LARGE

Hospital	Facility Type	Acute Myocardial Infarction Volume	Procedure Rate (%) Six-month Coronary Angiography	Procedure Rate (%) One-year Angioplasty	Procedure Rate (%) One-year Bypass Surgery	Median Waiting Time (Days) Coronary Angiography	Median Waiting Time (Days) Angioplasty	Median Waiting Time (Days) Bypass Surgery
Belleville General Hospital		545	20.9*	4.8	9.9	38	7	19
Brantford General Hospital		668	21.9	5.1	9.6	43	4	13
Cambridge Memorial Hospital		567	23.5	8.3	8.8	32	5	24
Centenary Health Centre, Scarborough	C	751	34.9**	6.9	14.1	13	12	18
Credit Valley Hospital, Mississauga		616	38.6**	8.6	14.0	47	15	57
Etobicoke General Hospital		828	17.8*	4.0*	7.2	59	24	21
Grand River Hospital Corporation, Kitchener		650	22.6	5.1	9.5	15	1	11
Greater Niagara General Hospital		518	25.5	5.6	10.0	26	12	42
Grey Bruce Regional Health Centre, Owen Sound		380	16.3*	3.7*	7.1	64	1	26
Guelph General Hospital		440	18.4*	5.5	9.1	40	4	10

EXHIBIT 8.8

LARGE (CONT'D)

Hospital	Facility Type	Acute Myocardial Infarction Volume	Procedure Rate (%)			Median Waiting Time (Days)		
			Six-month Coronary Angiography	One-year Angioplasty	One-year Bypass Surgery	Coronary Angiography	Angioplasty	Bypass Surgery
Hôpital Montfort, Ottawa		539	40.8**	14.8**	14.3	7	6	8
Hôtel Dieu Hospital, St. Catharines		348	16.4*	4.0*	6.6	61	5	36
Hôtel Dieu Grace Hospital, Windsor		427	34.2	9.6	12.6	11	9	15
Humber Memorial Hospital, Weston		435	23.7	3.9*	4.8	23	24	85
Joseph Brant Memorial Hospital, Burlington		704	32.4	8.4	14.6**	17	0	14
Mississauga Hospital (The)		931	35.8**	9.6	14.5**	15	9	10
Norfolk General Hospital, Simcoe		463	15.1*	3.9*	5.2*	37	5	9
North York Branson Hospital		843	25.1	6.5	9.4	16	6	17
North York General Hospital		1,172	27.3	7.2	11.0	31	17	44
Northwestern General Hospital, Toronto		542	19.7*	4.8	6.5	50	14	12
Oakville-Trafalgar Memorial Hospital		538	37.9**	11.3	13.4	21	7	22
Orillia Soldiers' Memorial Hospital		441	18.4*	4.5	7.7	40	3	9
Oshawa General Hospital		862	26.9	7.0	10.7	23	10	23
Peel Memorial Hospital, Brampton		840	35.1**	9.3	13.5	58	14	42
Peterborough Civic Hospital		715	29.9	9.0	12.6	51	4	83
Public General Hospital, Chatham		494	14.0*	2.6*	6.1	90	3	76
Queensway General Hospital, Etobicoke		672	27.2	7.7	9.4	53	13	21
Queensway-Carleton Hospital, Nepean		504	26.8	11.1	7.5	45	11	35
Riverside Hospital, Ottawa		367	34.9	13.4	9.8	12	8	20
Ross Memorial Hospital, Lindsay		513	12.7*	3.7*	7.4	59	10	10
Royal Victoria Hospital, Barrie		595	19.7*	4.9	6.2*	24	5	19
Salvation Army Scarborough Grace Hospital		606	31.8	8.9	14.9**	34	14	50
Sarnia General Hospital		490	24.1	6.5	8.8	45	0	15
Sault Ste. Marie General Hospital		318	39.0**	11.0	12.3	22	29	31
Scarborough General Hospital		1,116	28.4	6.7	12.2	16	9	20
St. Catharines General Hospital		631	14.9*	4.3*	6.3	67	0	28
St. Thomas Elgin General Hospital		403	23.8	5.5	8.7	37	0	33
St. Joseph's Health Centre, Toronto		893	16.6*	5.7	5.3*	28	5	26
St. Mary's General Hospital, Kitchener		547	18.3*	5.7	6.8	21	0	17
Sudbury General Hospital of the Immaculate Heart of Mary		464	35.3**	11.2	11.0	21	15	44
Sudbury Memorial Hospital	R	519	46.6**	14.1**	15.4**	9	3	41
Toronto East General & Orthopedic Hospital		1,030	29.1	7.6	10.7	39	26	40
Welland County General Hospital		405	22.7	7.4	10.9	35	19	27
York Central Hospital, Richmond Hill		614	32.2	7.3	12.2	34	11	69
York County Hospital, Newmarket		554	17.3*	5.2	4.5*	24	8	32
York-Finch General Hospital, North York		563	22.0	7.3	6.4	73	15	77
Summary Statistics								
Minimum		318	12.7	2.6	4.5	7	0	8
25th Percentile		464	18.4	4.9	7.1	21	4	15
Median		551	24.6	6.8	9.6	34	8	23
75th Percentile		704	32.4	8.9	12.3	47	14	41
Maximum		1,172	46.6	14.8	15.4	90	29	85

EXHIBIT 8.8

MEDIUM

Hospital	Facility Type	Acute Myocardial Infarction Volume	Procedure Rate (%) Six-month Coronary Angiography	One-year Angioplasty	One-year Bypass Surgery	Median Waiting Time (Days) Coronary Angiography	Angioplasty	Bypass Surgery
Ajax and Pickering General Hospital		420	39.8**	10.5	13.6	21	6	21
Alexandra Hospital, Ingersoll		110	36.4	7.3	9.1	15	4	39
Alexandra Marine and General Hospital, Goderich		112	28.6	10.7	9.8	21	4	27
Arnprior and District Memorial Hospital		98	28.6	13.3	9.2	39	6	5
Brockville General Hospital		240	30.8	10.8	10.4	55	7	62
Campbellford Memorial Hospital		169	26.0	5.3	11.8	55	45	90
Cobourg District General Hospital		131	24.4	8.4	11.5	49	8	93
Collingwood General and Marine Hospital		227	16.7*	4.0	7.9	104	29	33
Cornwall General Hospital		268	23.1	8.6	6.7	13	5	18
Doctors Hospital, Toronto		86	18.6	4.7	7.0	56	5	34
Douglas Memorial Hospital, Fort Erie		130	6.2*	2.3*	2.3*	42	4	39
Dufferin-Caledon Health Care Corporation, Orangeville		274	25.5	5.8	8.4	24	7	19
General Hospital of Port Arthur, Thunder Bay #	C	164	24.4	3.7	7.3	72	70	66
Georgetown and District Memorial Hospital		108	25.9	3.7	7.4	80	56	70
Groves Memorial and Community Hospital, Fergus		131	15.3*	5.3	3.1*	41	0	7
Hôpital General de Hawkesbury and District General Hospital Inc.		165	38.2	15.8	12.1	13	7	13
Hôtel Dieu Hospital, Cornwall		338	19.5*	7.7	5.6	35	6	9
Hôtel Dieu of St. Joseph Hospital, Windsor		150	34.0	12.7	12.0	10	13	8
Huntsville District Memorial Hospital		193	33.7	9.8	11.4	58	2	15
Huronia District Hospital, Midland		264	18.2*	5.7	6.1	78	16	16
Kirkland and District Hospital		144	25.7	5.6	9.0	64	51	92
Lake of the Woods District Hospital, Kenora		104	0.0*	0.0*	0.0*	-	-	-
Leamington District Memorial Hospital		282	20.6	5.3	7.4	52	6	36
Lennox and Addington County General Hospital, Napanee		190	14.7*	2.6*	9.5	56	0	119
Markham Stouffville Hospital		338	36.1	9.2	11.5	24	8	19
McKellar General Hospital, Thunder Bay		275	18.9	2.9*	6.9	47	22	90
Memorial Hospital, Bowmanville		183	22.4	6.0	6.6	26	11	22
Metropolitan General Hospital, Windsor		411	32.6	6.3	9.7	24	41	76
Milton District Hospital		134	28.4	6.0	9.7	71	9	42
North Bay General Hospital		299	22.4	7.7	8.4	88	4	52
Pembroke Civic Hospital		137	24.1	5.1	6.6	78	5	53
Pembroke General Hospital		118	29.7	10.2	8.5	42	7	24
Perths and Smiths Falls District Hospital		279	31.9	9.3	9.3	28	5	12
Plummer Memorial Public Hospital, Sault Ste. Marie	C	256	38.7**	10.2	13.3	27	42	29
Port Colborne General Hospital		154	20.1	5.8	6.5	20	16	12
Prince Edward County Memorial Hospital, Picton		128	17.2	4.7	7.0	50	6	126

EXHIBIT 8.8

MEDIUM (CONT'D)

Hospital	Facility Type	Acute Myocardial Infarction Volume	Procedure Rate (%)			Median Waiting Time (Days)		
			Six-month Coronary Angiography	One-year Angioplasty	One-year Bypass Surgery	Coronary Angiography	Angioplasty	Bypass Surgery
Renfrew Victoria Hospital		115	30.4	12.2	11.3	61	4	31
South Muskoka Memorial Hospital, Bracebridge		201	29.9	8.5	12.9	53	10	27
St. Joseph's General Hospital, Elliot Lake		128	34.4	6.3	13.3	75	12	68
St. Joseph's General Hospital, Thunder Bay		158	17.1	2.5*	7.6	75	97	119
St. Joseph's Health Centre of Sarnia		89	18.0	4.5	10.1	68	38	61
St. Joseph's Hospital, Chatham		196	16.8*	5.6	3.6*	71	13	87
St. Joseph's Hospital and Health Centre of Peterborough		88	27.3	4.5	14.8	47	0	50
St. Vincent de Paul Hospital, Brockville		74	21.6*	5.4	10.8	14	4	13
Stevenson Memorial Hospital, Alliston		228	18.9	5.7	4.8	28	10	33
Stratford General Hospital		227	16.7*	2.6*	4.8	79	2	12
Strathroy Middlesex General Hospital		196	11.7*	5.1	5.1	23	6	11
Sydenham District Hospital, Wallaceburg		176	19.3	6.8	4.5	68	0	81
Temiskaming Hospital, New Liskeard		137	21.9	5.1	10.2	23	3	24
Thunder Bay Regional Hospital #	C	217	24.9	8.3	8.3	25	46	48
Tillsonburg District Memorial Hospital		220	25.0	6.4	10.5	38	1	49
Timmins and District Hospital		280	31.1	7.9	11.4	50	30	28
Trenton Memorial Hospital		262	24.8	7.3	10.3	46	8	42
West Lincoln Memorial Hospital, Grimsby		255	14.1*	4.7	6.7	43	5	51
West Nipissing General Hospital, Sturgeon Falls		119	28.6	4.2	9.2	58	84	32
West Parry Sound Health Centre		173	32.9	7.5	17.3	31	2	48
Whitby General Hospital		132	16.7	5.3	4.5	65	0	63
Winchester District Memorial Hospital		167	33.5	9.6	11.4	18	6	66
Windsor Regional Hospital #	C	285	33.3	7.4	7.7	12	14	44
Windsor Western Hospital Centre Incorporated#	C	234	38.0	8.5	13.7	10	8	23
Woodstock General Hospital		278	26.3	7.9	8.6	22	1	8
Summary Statistics								
Minimum		74	0.0	0.0	0.0	10	0	5
25th Percentile		131	18.9	5.1	6.7	24	4	19
Median		176	24.9	6.0	9.0	45	7	35
75th Percentile		256	30.8	8.5	11.3	63	15	63
Maximum		420	39.8	15.8	17.3	104	97	126

EXHIBIT 8.8

SMALL

Hospital	Facility Type	Acute Myocardial Infarction Volume	Procedure Rate (%) Six-month Coronary Angiography	Procedure Rate (%) One-year Angioplasty	Procedure Rate (%) One-year Bypass Surgery	Median Waiting Time (Days) Coronary Angiography	Median Waiting Time (Days) Angioplasty	Median Waiting Time (Days) Bypass Surgery
Summary Statistics								
Minimum		1	0.0	0.0	0.0	6	0	1
25th Percentile		14	9.1	0.0	0.0	31	3	13
Median		44	16.1	3.2	4.7	57	11	57
75th Percentile		66	27.0	8.1	8.6	76	42	87
Maximum		95	50.0	31.1	33.3	161	90	218

ALL HOSPITALS

Hospital	Facility Type	Acute Myocardial Infarction Volume	Procedure Rate (%) Six-month Coronary Angiography	Procedure Rate (%) One-year Angioplasty	Procedure Rate (%) One-year Bypass Surgery	Median Waiting Time (Days) Coronary Angiography	Median Waiting Time (Days) Angioplasty	Median Waiting Time (Days) Bypass Surgery
Summary Statistics								
Minimum		1	0.0	0.0	0.0	4	0	1
25th Percentile		61	16.6	3.7	5.1	21	3	15
Median		158	23.7	6.0	8.4	40	7	33
75th Percentile		427	32.0	8.9	11.0	62	15	63
Maximum		1,172	50.0	31.1	33.3	161	97	218

C = Hospital provides only coronary angiography services
R = Hospital provides only angiography and revascularization services
# Although these hospitals were involved in merger processes during the study time period, they are presented separately here because two sites were operational. We have tagged both sites as catheterization facilities due to mergers, although only one site was operating a catheterization laboratory. (see Methods Appendix for more details)
~ Mount Sinai Hospital has had a catheterization laboratory used for research purposes only since 1994. Since routine angiography is not otherwise performed at this institution, the hospital was considered as having no invasive facilities for the purpose of this study.

Note: Outliers for waiting times are not presented because the measure used here is a surrogate, rather than a true measure
* Significantly lower than provincial average ($p<0.0005$)
** Significant higher than provincial average ($p<0.0005$)

Data Source: Canadian Institute for Health Information, Ontario Health Insurance Plan, Registered Persons Database, Ontario Myocardial Infarction Database

The Funnel, Filter and Spout for Access

Several statistical models (Methods Appendix MA8.6 to MA8.17) were used to determine if angiography accounts for the majority of the variation in access to invasive cardiac procedures (Exhibit 8.12 and 8.13). Exhibit 8.12 illustrates the adjusted probabilities of receiving coronary angiography and revascularization procedures (i.e. PTCA or CABG among those patients having undergone angiography) across the three facility types, revascularization versus catheterization-only versus none. A typical AMI patient (68-year-old male) has a 39%, versus 31% versus 24% probability of receiving angiography if admitted to a revascularization facility versus "cath-only" facility versus no invasive facility respectively ($p<0.0001$ for each facility compared to revascularization centres). In contrast, there are smaller differences in the probabilities of receiving revascularization procedures between each of the three facility types.

EXHIBIT 8.9 Age/Sex-adjusted Procedure Rates and Waiting Times for Acute Myocardial Infarction Patients Aged 20 Years and Over by Hospital Type in Ontario, 1994/95 - 1996/97

Hospital Type	Acute Myocardial Infarction Volume	Mean Procedure Rates (%) Six-month Coronary Angiography	One-year Angioplasty	One-year Bypass Surgery	Median Procedure Waiting Time (days) Coronary Angiography	Angioplasty	Bypass Surgery
Small	3,146	19.7	5.4	6.5	48	10	44
Medium	11,845	25.3	6.9	8.8	33	9	37
Large	28,061	26.0	7.1	9.9	26	9	27
Teaching	9,441	34.9	12.7	11.0	7	1	20
Overall	**52,493**	**26.5**	**8.0**	**9.1**	**30**	**9**	**32**

EXHIBIT 8.10 Age/Sex-adjusted Procedure Rates and Waiting Time for Acute Myocardial Infarction Patients Aged 20 Years and Over by Facility Type in Ontario, 1994/95 - 1996/97

Facility Type	Acute Myocardial Infarction Volume	Mean Procedure Rate (%) Six-month Coronary Angiography	One-year Angioplasty	One-year Bypass Surgery	Median Procedure Waiting Time (days) Coronary Angiography	Angioplasty	Bypass Surgery
Catheterization Only	1,907	31.8	7.1	11.3	17	17	30
Revascularization	5,772	39.3	15.3	11.1	6	1	25
Other	44,814	25.3	7.0	9.4	28	7	29
Overall	**52,493**	**32.1**	**9.8**	**10.6**	**17**	**7**	**29**

EXHIBIT 8.11 Age/Sex-adjusted Procedure Rates and Waiting Times for Acute Myocardial Infarction Patients Aged 20 Years and Over by Proximity to Revascularization Centres in Ontario, 1994/95 - 1996/97

Distance	Acute Myocardial Infarction Volume	Mean Procedure Rate (%) Six-month Coronary Angiography	One-year Angioplasty	One-year Bypass Surgery	Median Prodedure Waiting Time (days) Coronary Angiography	Angioplasty	Bypass Surgery
0 - 10 km	17,742	32.7	11.0	11.0	11	4	22
11 - 50 km	14,408	25.5	6.7	9.6	30	8	31
>50 km	18,413	22.3	6.0	8.3	37	7	35
Overall	**50,563**	**26.9**	**7.9**	**9.6**	**30**	**7**	**31**

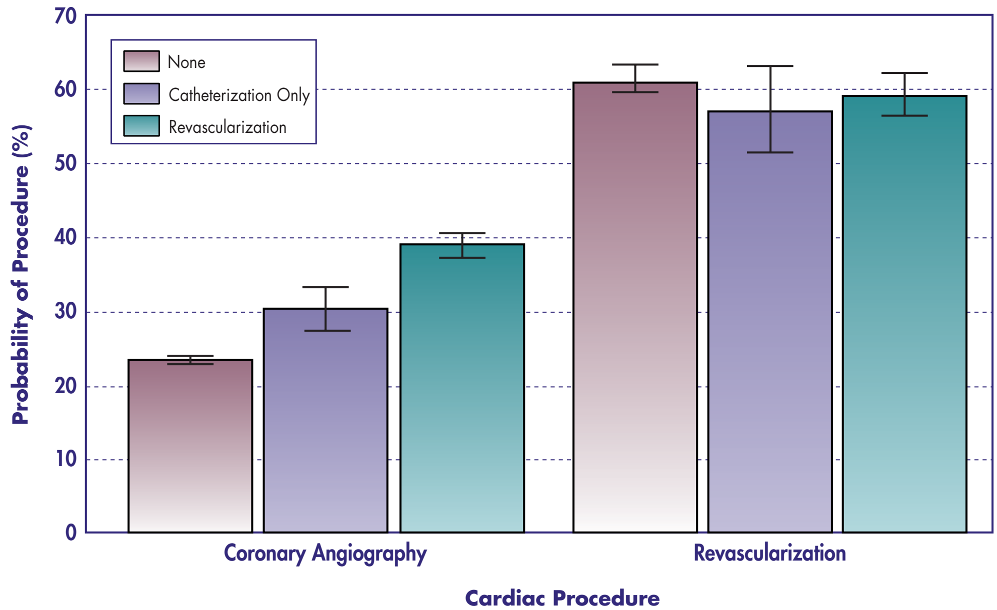
Note: Admission to "cath-only" facilities excluded

Waiting time for coronary angiography = Median time from acute myocardial infarction to coronary angiography
Waiting time for angioplasty = Median time from coronary angiography to angioplasty
Waiting time for bypass surgery = Median time from coronary angiography to bypass surgery

Statistical comparisons for procedure rates and waiting times across hospital, facility and distance categories were most significant for coronary angiography ($p<0.0001$), and least significant or not significant for coronary artery bypass surgery (see Methods Appendix for details)

Data Source: Canadian Institute for Health Information, Ontario Health Insurance Plan, Registered Persons Database, Ontario Myocardial Infarction Database

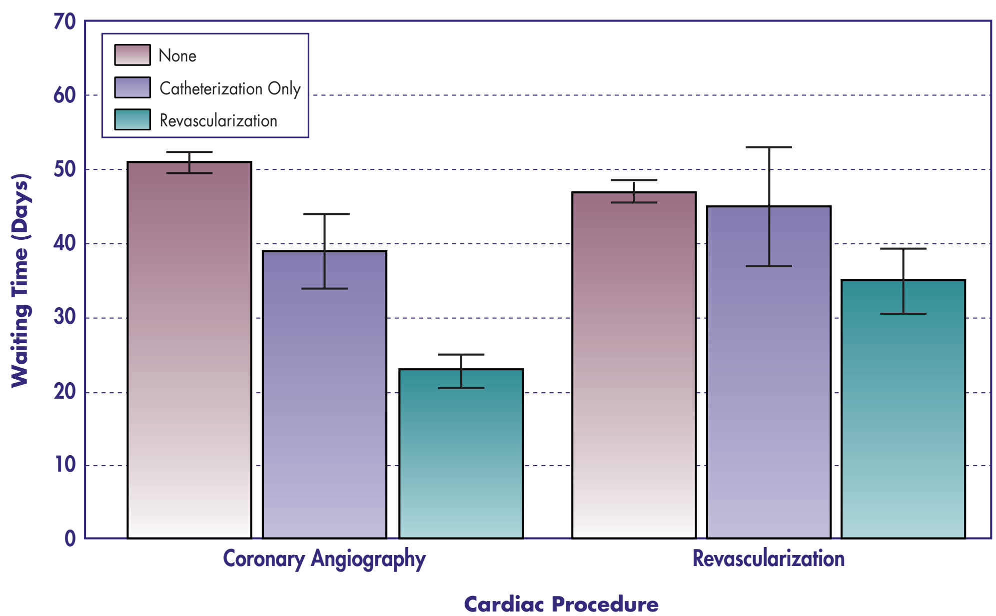
EXHIBIT 8.12: Predicted Probability of Coronary Angiography and Revascularization for a Typical* Acute Myocardial Infarction Patient Admitted to a Hospital with No Invasive Facilities, Catheterization-only, or Revascularization Services in Ontario, 1994/95 - 1996/97



*** 68 year old male**

Data Source: Ontario Myocardial Infarction Database

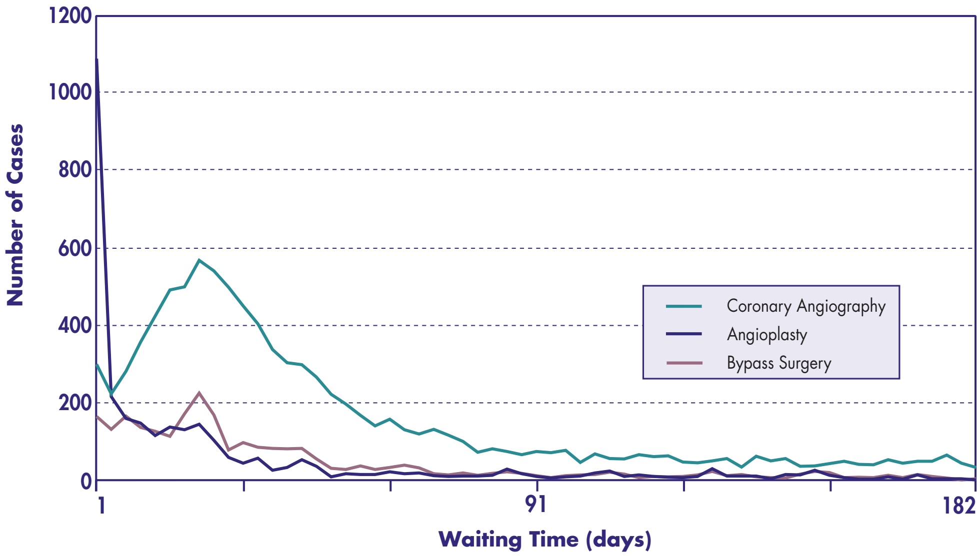
EXHIBIT 8.13: Predicted Waiting Times for Coronary Angiography and Revascularization for a Typical* Acute Myocardial Infarction Patient Admitted to a Hospital with No Invasive Facilities, Catheterization-only, or Revascularization Services in Ontario, 1994/95 - 1996/97



*** 68 year old male**

Data Source: Ontario Myocardial Infarction Database

EXHIBIT 8.14: Waiting Times versus Number of Patients for Coronary Angiography, Angioplasty and Bypass Surgery in Ontario, 1994/95 - 1996/97



Data Source: Ontario Myocardial Infarction Database

Exhibit 8.13 illustrates that angiography waiting times are longest for hospitals without invasive facilities. However, variability in access across facility types for revascularization is again less apparent than for angiography.

These results suggest that coronary angiography is associated with the greatest degree of inequitable access. However, once patients have received angiography, the institutional-level bias and access impediments to myocardial revascularization are substantially reduced. This is further illustrated in Exhibit 8.14 which demonstrates that coronary angiography is associated with the greatest variability in waiting times for the greatest number of patients. This phenomenon can be conceptualized as "funnel and filter" effects (i.e. access to coronary angiography determines the absolute numbers and speed of throughput for cardiac patients proceeding into the PTCA/CABG "spout"). A "funnel, filter and spout" relationship is not surprising given other studies that show the availability of on-site facilities predicts regional rate variations for coronary angiography, while the more explicit clinical measures of coronary anatomy more accurately predict rate variations for myocardial revascularization.[1-5]

Conclusions

We have demonstrated that the availability and capacity of on-site invasive cardiac facilities, as well as the proximity of other hospitals to such facilities, exert significant influences on rates and waiting times for invasive cardiac procedures.

Moreover, coronary angiography not only drives revascularization, but also largely accounts for the differences in waiting times across hospitals. With relatively few post-AMI indications considered inappropriate for angiography,[18,19] coronary angiography serves as the funnel and filter for access to invasive cardiac procedures. The indications for myocardial revascularization are clear once coronary angiography has been undertaken and accordingly, access to PTCA or CABG occurs on a more equitable basis after angiography.

Our results have potential implications for health services policy in the province of Ontario. First, policies aimed at improving access to invasive cardiac procedures must find ways to level out access to coronary angiography. Currently, invasive cardiac facilities are regionally allocated using volume standards per 100,000 adults residing within large catchment areas. Yet, within such regions, geographical proximity to institutions with on-site facilities continues to affect access. Our results suggest that distance should be a stronger consideration in decisions about distribution of coronary angiography facilities. We acknowledge that if angiography facilities are to be decentralized to improve geographic access to cardiovascular procedures, there is a risk of supplier-induced demand. Careful volume and quality standards are required. A potential alternative would be increased capacity for these procedures at regional tertiary centres, but with catheterization slots reserved on a geographic basis, perhaps used by local cardiologists travelling to catheterization centres. Moreover, rate and waiting time disparities in access to cardiovascular services in Ontario are not likely to be eliminated entirely even if greater decentralization of coronary angiography or capacity reservation on a geographic basis were to occur. Therefore, the measurement and management of queues remains a priority. Future research and demonstration projects should develop and evaluate methods to ensure more equitable delivery of invasive cardiac services in Ontario's health care system.

Patterns of Revascularization

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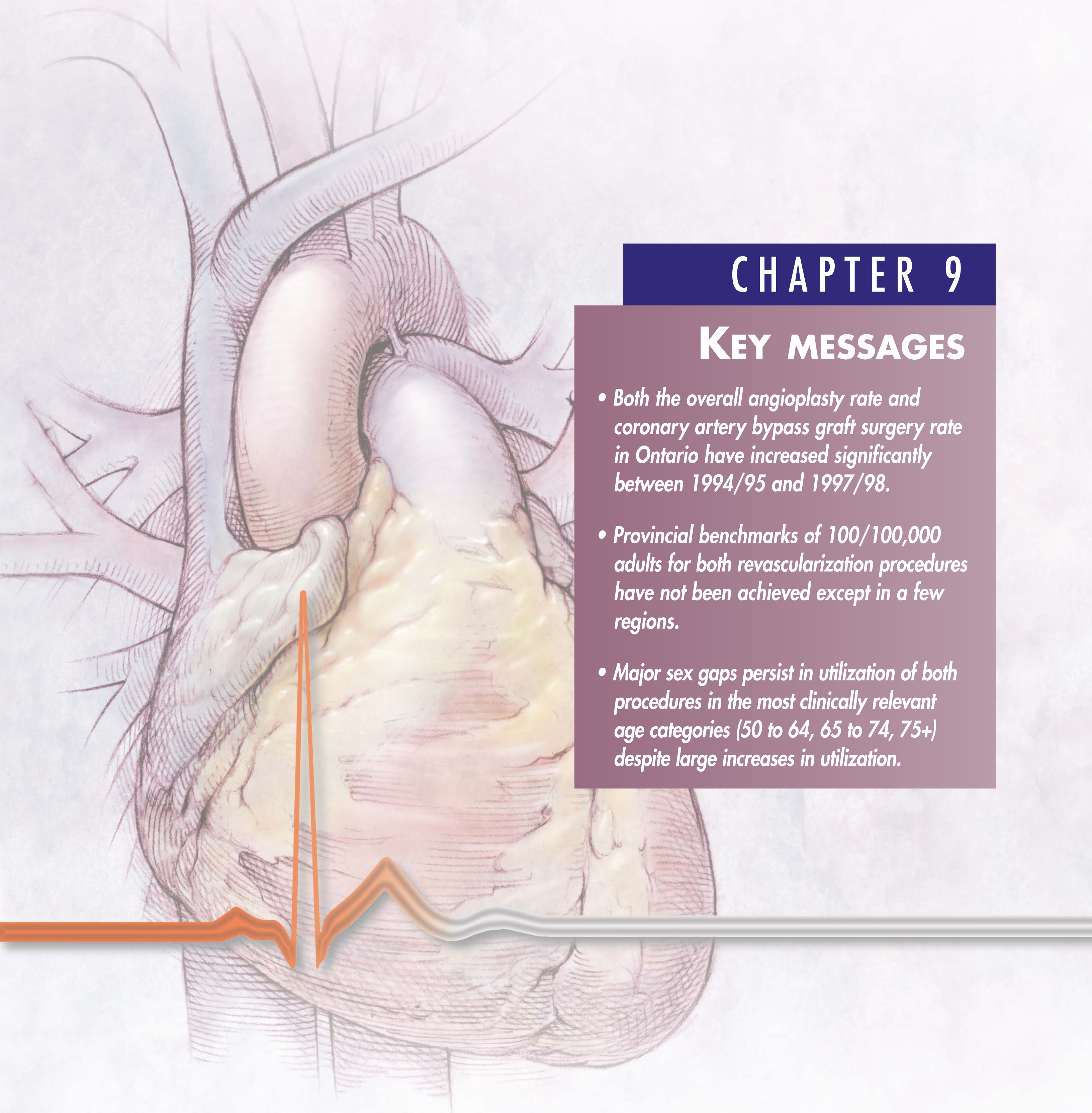


CHAPTER 9

KEY MESSAGES

- *Both the overall angioplasty rate and coronary artery bypass graft surgery rate in Ontario have increased significantly between 1994/95 and 1997/98.*
- *Provincial benchmarks of 100/100,000 adults for both revascularization procedures have not been achieved except in a few regions.*
- *Major sex gaps persist in utilization of both procedures in the most clinically relevant age categories (50 to 64, 65 to 74, 75+) despite large increases in utilization.*

Key Terms & Concepts:

- coronary revascularization
- percutaneous transluminal coronary angioplasty
- coronary artery bypass graft surgery
- area variation

Background

Chapter 4 summarized the relationships between atherosclerosis—or hardening and blockage of the arteries—and various risk factors such as smoking, high blood pressure, diabetes mellitus and high cholesterol levels. When coronary arteries are blocked, oxygenated blood flow to the heart muscle is reduced (ischemia), producing pain and tightness or pressure in the chest—commonly referred to as angina. A more serious complication—heart attack or acute myocardial infarction (AMI)—was discussed in Chapter 5. We noted then that heart attacks occur when the coronary arteries obstruct abruptly, blocking the flow of blood entirely and causing death of heart muscle from the lack of oxygen. Two mechanical interventions are used to deal with reduced blood flow to the heart muscle—percutaneous transluminal coronary angioplasty (PTCA) and coronary artery bypass graft surgery (CABG).

PTCA is used primarily to treat patients with blockage in one or two vessels. The procedure is also done occasionally for selected patients with more extensive disease. The procedure is performed using only local anesthesia and involves a brief stay in hospital. An angioplasty "balloon" is passed up the femoral artery into the narrowed artery and positioned across the blood flow-restricting lesion. The balloon is inflated to widen the lumen of the affected artery, thereby restoring blood flow through the artery to the myocardium. Since 1996, over 60% of all angioplasty procedures have also involved placing a small metallic mesh tube (similar to chicken wire) called a stent into the coronary artery to help prevent blocking of the artery.[1] Cohen and colleagues have reported that the short-term mortality after PTCA is under 1%.[2]

Coronary artery bypass grafting is done for the same reasons as angioplasty: to improve blood flow to the heart muscle for purposes of symptom relief. It is also used for more extensive coronary artery blockages that, if left untreated, can be life-threatening. Indications for CABG generally include blockages in two or more vessels, complex blockages not amenable to PTCA, or blockages in a critical vessel such as the left main coronary artery. Bypass surgery requires general anesthesia, splitting the breastbone (sternum), stopping the heart and rerouting blood through a heart-lung bypass pump during surgery to provide adequate circulation to the brain and other vital organs. Generally, three types of "grafts" are used to bypass blockages: the left and/or right internal mammary arteries; vein grafts, harvested from the legs; and portions of the radial artery, taken from the forearm. After the operation, the median stay in hospital is approximately six days. Tu et al have used administrative data to track trends over time for in-hospital mortality following CABG in Ontario.[3] Between 1986/87 and 1995/96 the unadjusted death rate decreased by 52% from 5% to 2.4%.

Newer, less invasive bypass surgery techniques are being studied. Minimally invasive direct (or keyhole) coronary artery bypass techniques use a smaller chest incision, do not require that patients go onto cardiopulmonary bypass (heart-lung machine) and have a shorter recovery time, with an average post-operative hospital stay of two to three days. Research is continuing, but the long-term results of keyhole bypass surgery appear closer to conventional open heart surgery than to angioplasty.

PTCA and CABG are available in Ontario in nine referral centres: Hamilton Health Sciences Corporation, General Campus; the Victoria Campus and the University Campus of the London Health Sciences Centre; Kingston General Hospital; University of Ottawa Heart Institute; Memorial Site of the Sudbury Regional Hospital; Sunnybrook Health Science Centre; the Toronto Hospital and St. Michael's Hospital.

The volume of PTCA performed at these centres varies from approximately 300 to more than 1,200 procedures annually, involving 35 interventional cardiologists with an average annual volume of 180 coronary angioplasty cases.[2] For isolated bypass surgery, the volume of cases at each hospital currently varies from approximately 350 cases to over 1,500 cases. Forty-nine cardiovascular surgeons with a median annual volume of 136 CABG cases perform the operations.[4]

For several years, researchers at the Institute for Clinical Evaluative Sciences (ICES) have worked closely with the Cardiac Care Network (CCN) and a large number of cardiovascular specialists to maintain and improve the quality of care for CABG patients in Ontario. The initiatives have included outcomes monitoring[5] (also see Chapter 10), and assessments of case selection. In the latter respect, practice audits using chart reviews[6] and practice profiling using the CCN registry[7] show that case selection for CABG is conservative and follows established guidelines, with well over 90% of all patients readily meeting explicit criteria for appropriate surgery. However, ICES has also documented moderate to marked variation in the use of CABG across the counties of Ontario.[8,9] These variations have been tracked in parallel with variable utilization of coronary angiography and, to a lesser extent, utilization of PTCA.

To reduce these regional variations in access to and utilization of coronary revascularization procedures, the CCN and Ministry of Health have agreed on population-based minimum target rates for bypass surgery, angioplasty and coronary angiography.[4,10] Ontario has moved rapidly toward an overall population-based target of 100 bypass surgeries per 100,000 adult Ontario residents but what remains uncertain is whether regional variation has been reduced. Moreover, reports from the field suggest that during 1997/98 angioplasty fell more than 20% short of the volume necessary to achieve an overall targeted 1:1 ratio with bypass surgery. Shortfalls were attributed to lack of human resources and to capital expenditures required before cases could be increased.[11]

Our goal in this chapter is to examine overall trends in the utilization of CABG and PTCA, as well as to review use of CABG and PTCA on a regional basis. In particular, we shall examine recent population-based rates of utilization of CABG and PTCA along with the extent of regional variation in coronary revascularization procedures.

Data Sources

The main sources of data for this chapter were hospital discharge abstracts from the Canadian Institute for Health Information (CIHI) for procedure counts and Statistics Canada census data for population counts.

How We Did the Analysis

We included all procedures coded as angioplasty and coronary artery bypass surgery (in separate analyses) in the CIHI database (see Methods Appendix for Chapter 9 for codes used and inclusion/exclusion criteria). Thus, we included CABG procedures performed with or without concomitant valve surgery, although isolated CABG typically accounts for over 90% of the total in this category.

For angioplasty, data were examined for the years 1994/95 to 1997/98. Coding concerns and variable diffusion of the technology led us to forego examination of earlier years. Bypass surgery data have been examined for 1991/92 through 1997/98. Both angioplasty and bypass surgery data were age- and sex-adjusted. For angioplasty, small area rate variation (SARV) analyses were performed for fiscal periods 1994/95 to 1995/96, and 1996/97 to 1997/98 (two-year aggregates). For bypass surgery, SARVs were performed for comparison using three-year periods: fiscal 1991/92 to 1993/94, and 1994/95 to 1996/97. We examined 1997/98 in isolation given the recent infusion of funds.

The denominator was all persons in Ontario or the relevant health districts, aged 20 years and over in 1996, as determined by the Canadian census. We constructed appropriate age groupings and adjusted directly for age and sex differences in analyses of temporal trends and comparisons across District Health Councils (DHCs).

Interpretive Cautions

Because of extensive experience with the CABG data, we are confident in the accuracy of the procedure counts. However, comparisons with other published analyses may show differences attributable to the effects of statistical adjustment, use of different geographic units, or exclusion of patients undergoing concomitant valve surgery.

There were some inconsistencies in coding PTCA data, as outlined in the Methods Appendix. Standardization of angioplasty coding in CIHI by all centres is desirable and important for future work in this area. However, we believe these coding anomalies have been satisfactorily addressed in our analysis. We also note that there may be some ongoing underreporting of angioplasty cases, although the numbers of missed cases are likely to be small.

We emphasize that the same patient could be counted multiple times in a given year; an individual might have one angioplasty, suffer restenosis and undergo a second procedure, again suffer restenosis, requiring CABG referral. The impact of these multiple counts of single individuals is likely to be small, and our main focus is on overall procedure utilization. Thus, we have not adjusted the analysis. Please note for areas within District Health Councils (DHCs), Census 1996 population data were used for rate denominators. This accounts for any apparent inconsistencies in rates as compared with previous DHC-specific tables.

Last, we acknowledge that the window of analysis does not take into account the caseload expansions that have been ongoing in the latter part of the last year. We are optimistic that some of the findings below will already have changed in a positive direction by the time this Atlas is published.

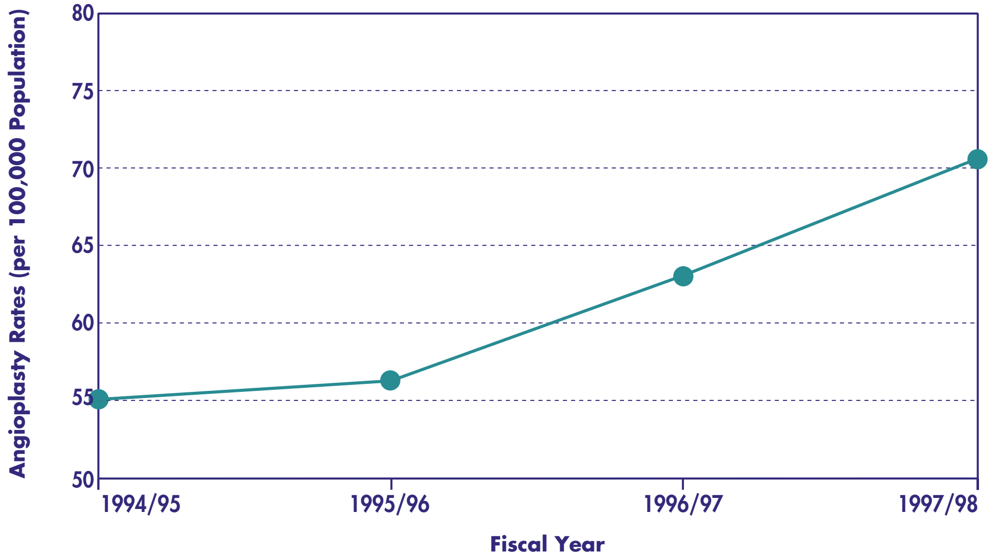
Findings and Discussion

Angioplasty

Overall Trends and Age/Sex Breakdowns

The overall rate of angioplasty in the province of Ontario has increased from 55/100,000 in 1994/95 to 71/100,000 in 1997/98 (Exhibit 9.1). Utilization of PTCA among younger individuals also shows obvious sex differences (Exhibit 9.2). These differences partly reflect the protective effect of estrogen and reduced incidence of CVD among premenopausal women. In the population, the incidence of ischemic heart disease evens out between the sexes from the seventh decade onward. The rate of angioplasty in men aged 65 to 74 increased from 222/100,000 in 1994/95 to 270/100,000 in 1997/98, and in women the same age, from

EXHIBIT 9.1: Age/Sex-adjusted Angioplasty Rates per 100,000 Population Aged 20 Years and Over in Ontario, 1994/95 - 1997/98



Data Source: Canadian Institute for Health Information

109/100,000 to 136/100,000. The rate of angioplasty in men over 75 years of age doubled from 76/100,000 in 1994/95 to 151/100,000 in 1997/98; for women, the rate increased from 42/100,000 to 73/100,000. Thus, major sex gaps persist in utilization of this procedure, despite the fact that the incidence of ischemic heart disease is similar across the sexes by the age of 70.

Small Area Rate Variation Analysis Results

We examined rates of angioplasty by District Health Council and compared changes for the years 1994/95 to 1995/96 and 1996/97 to 1997/98 (Exhibit 9.3). During these time periods of interest, the highest procedure rates per 100,000 population were in Algoma, Cochrane, Manitoulin and Sudbury with rates of 87 to 115 cases/100,000 (fiscal 1997/98 rate of 124/100,000) and the Champlain DHC (Gloucester, Nepean, Ottawa), with the rate ranging from 99 to 107/100,000 population (fiscal 1997/98 rate of 105/100,000). The lowest population-based use of angioplasty, also similar across both time periods, was found in the DHCs of Waterloo Region-Wellington-Dufferin, with rates ranging from 36 to 39/100,000 (1997/98 rate of 43/100,000), and Grey, Bruce, Huron, Perth where the rates ranged from 31 to 43/100,000 population (1997/98 rate of 45/100,000).

In Durham, Haliburton, Kawartha and Pine Ridge the rate of angioplasty has moved upwards from 47 to 69/100,000 population (the 1997/98 rate was 75/100,000); Northwestern Ontario has risen from 31 to 56/100,000 population (the 1997/98 rate was 64/100,000). Conversely, Thames Valley rates have been stable or even declining, running from 66 to 60/100,000 (61 in the most recent period).

EXHIBIT 9.2 Overall and Age/Sex-specific Angioplasty Rates per 100,000 Population Aged 20 Years and Over in Ontario, 1994/95 - 1997/98

MEN

Age	Fiscal Year 1994/95	1995/96	1996/97	1997/98
20-34	2	2	2	2
35-49	56	57	58	61
50-64	194	197	226	247
65-74	222	207	243	270
75+	76	94	117	151

WOMEN

Age	Fiscal Year 1994/95	1995/96	1996/97	1997/98
20-34	1	1	1	1
35-49	11	12	12	13
50-64	61	66	71	86
65-74	109	115	118	136
75+	42	45	64	73
Overall Rate Men and Women	55	56	63	71

Data Source: Canadian Institute for Health Information

EXHIBIT 9.3 Age/Sex-adjusted Angioplasty Rates per 100,000 Population Aged 20 Years and Over by District Health Council Area of Patient Residence in Ontario, 1994/95 - 1997/98

District Health Council	1994/95 - 1995/96 Number of Angioplasties per Year	Age/Sex-adjusted Rate	Rank	1996/97 - 1997/98 Number of Angioplasties per Year	Age/Sex-adjusted Rate	Rank	1997/98 Number of Angioplasties per Year	Age/Sex-adjusted Rate	Rank
Algoma, Cochrane, Manitoulin and Sudbury	286	87**	2	386	115**	1	417	124**	1
Champlain	721	99**	1	819	107**	2	815	105**	2
Durham, Haliburton, Kawartha and Pine Ridge	258	47*	11	397	69	6	440	75	5
Essex, Kent and Lambton	250	56	7	275	58*	10	303	64	10
Grand River	85	50	10	94	53*	13	100	56*	13
Grey, Bruce, Huron, Perth	72	31*	16	106	43*	15	111	45*	15
Halton-Peel	410	53	8	527	63	7	578	68	7
Hamilton-Wentworth	253	70**	3	270	71	5	263	68	6
Muskoka, Nipissing, Parry Sound and Timiskaming	112	61	6	144	77	4	146	78	4
Niagara Region	181	53	9	180	52*	14	187	53	14
Northwestern Ontario	55	31*	15	103	56	11	118	64	9
Quinte, Kingston, Rideau	262	67**	4	339	84**	3	376	92**	3
Simcoe - York	264	42*	13	378	55*	12	434	63*	11
Thames Valley	274	66**	5	258	60	9	267	61*	12
Toronto	820	45*	12	1,151	61*	8	1,223	65*	8
Waterloo Region - Wellington - Dufferin	150	36*	14	176	39*	16	197	43*	16

* Significantly lower than the provincial average ($p<0.05$)

** Significantly higher than the provincial average ($p<0.05$)

Data Source: Canadian Institute for Health Information

EXHIBIT 9.4 Age/Sex-adjusted Angioplasty Rates per 100,000 Population Aged 20 Years and Over by Municipalities with Populations Greater than 100,000 versus Other Areas in Ontario District Health Councils, 1994/95 - 1997/98

Large Municipalities/Other Areas	1994/95 - 1995/96		1996/97 - 1997/98		1997/98	
	Number of Angio-plasties per Year	Age/Sex-adjusted Rate	Number of Angio-plasties per Year	Age/Sex-adjusted Rate	Number of Angio-plasties per Year	Age/Sex-adjusted Rate
Champlain						
Gloucester	77	113**	82	123**	76	114**
Nepean	70	88**	88	111**	83	106**
Ottawa	265	107**	290	117**	277	111**
Other	310	93**	361	109**	379	114**
Durham, Haliburton, Kawartha and Pine Ridge						
Oshawa	44	46	79	84	84	90
Other	215	47*	319	70	356	78
Essex, Kent and Lambton						
Windsor	105	69**	112	74	121	79
Other	145	49	163	55*	182	61*
Halton-Peel						
Brampton	82	51	124	80	141	92**
Burlington	65	60	80	73	91	84
Mississauga	168	49	226	66	242	70
Oakville	58	62	66	73	65	72
Other	37	47	32	39*	39	48*
Hamilton-Wentworth						
Hamilton	193	79**	191	77	175	70
Other	60	53	79	70	88	78
Niagara Region						
St. Catharines	54	50	53	49*	50	46*
Other	127	55	127	56*	137	60*
Northwestern Ontario						
Thunder Bay	39	45	76	85	87	98**
Other	16	18*	28	31*	31	35*
Simcoe-York						
Markham	52	42*	71	58	81	67
Richmond Hill	23	34*	37	58	40	64
Vaughan	32	37*	53	63	71	87
Other	158	43*	217	59*	242	66*
Thames Valley						
London	165	72**	155	68	153	67
Other	110	60	103	57*	114	63*
Waterloo Region-Wellington-Dufferin						
Cambridge	25	37*	34	50	43	63
Kitchener	44	36*	49	40*	54	45*
Other	82	34*	93	39*	100	42*

* Significantly lower than the provincial average ($p<0.05$).

** Significantly higher than the provincial average ($p<0.05$).

Note: For areas within District Health Councils (DHCs), Census 1996 population data were used for rate denominators. This accounts for any apparent inconsistencies in rates as compared with previous DHC-specific tables.

Data Source: Canadian Institute for Health Information

EXHIBIT 9.5 Summary Statistics for Degree of Variation in the Use of Angioplasty in Ontario, 1994/95 - 1997/98

Fiscal Year	Coefficient of Variation	Ratio of Third Quartile Over First Quartile	Systematic Component of Variation	Adjusted Chi-square
1994/95	30.6	1.6	89.5	382
1995/96	36.8	1.5	133.4	555
1996/97	31.3	1.5	99.4	467
1997/98	26.2	1.3	80.7	385

Data Source: Canadian Institute for Health Information

Only two DHCs achieved rates at the benchmark recommended by a CCN expert panel in 1997 of 100/100,000 population: Algoma, Cochrane, Manitoulin and Sudbury DHC at 124/100,000 population, and Champlain with a rate of 105/100,000. All other DHCs were substantially lower, ranging from a rate of 43/100,000 (Waterloo Region-Wellington-Dufferin) to a rate of 92/100,000 (Quinte, Kingston, Rideau). Exhibit 9.4 summarizes rates by municipalities with populations over 100,000 versus other areas within each Ontario DHC for further comparison. Summary variation statistics for angioplasty are displayed in Exhibit 9.5. Exhibit 9.6 maps the age- and sex-adjusted rates of angioplasty in the province.

Coronary Artery Bypass Graft Surgery

Overall Trends and Age/Sex Breakdowns

The overall rate of CABG in the province of Ontario has increased from 75/100,000 in 1991/92 to 99/100,000 in 1997/98 (Exhibit 9.7). However, as noted above, this is likely an underestimate, as further caseload expansion during 1998 was projected to bring the overall provincial average above 100/100,000 cases.

In Ontario, the rate of CABG in men between the ages of 65 and 74 has increased from 432/100,000 in 1991/92 to 601/100,000; in women of the same age, the rate has increased from 134/100,000 to 197/100,000 (Exhibit 9.8). However, the rate of CABG in men over 75 years of age has increased more dramatically from 141/100,000 in 1991/92 to 326/100,000 in 1997/98; the rate for women in the same age group has gone from 41/100,000 to 103/100,000. A substantial gender gap persists.

Small Area Rate Variation Analysis Results

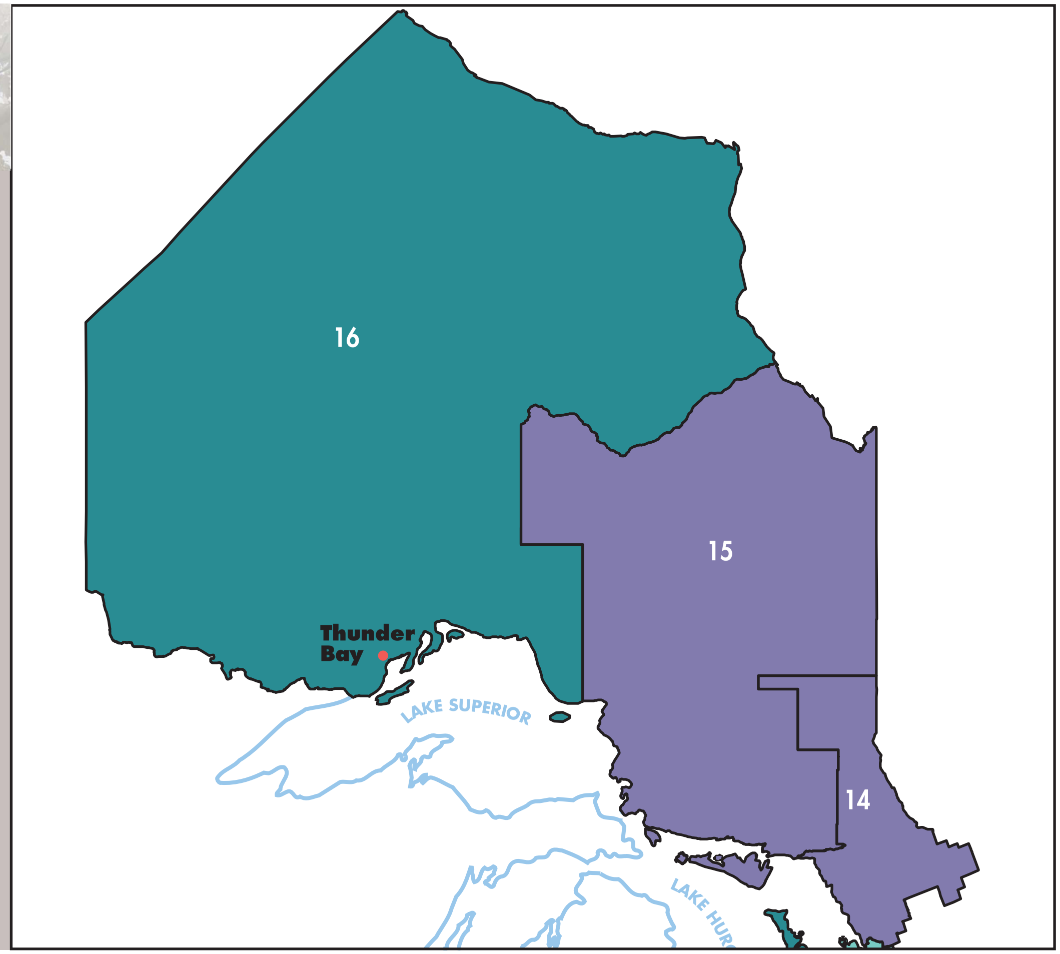
We examined rates of CABG by DHC and compared rates for the years 1991/92 to 1993/94 to those for the years 1994/95 to 1996/97. We are also able to present data for 1997/98 (Exhibit 9.9). In the time periods of interest, the highest rates per 100,000 population were in Algoma, Cochrane, Manitoulin and Sudbury, with the rate of bypass surgery remaining more or less constant between the periods (132 cases and 127 cases/100,000 population for 1991/92 to 1993/94, as

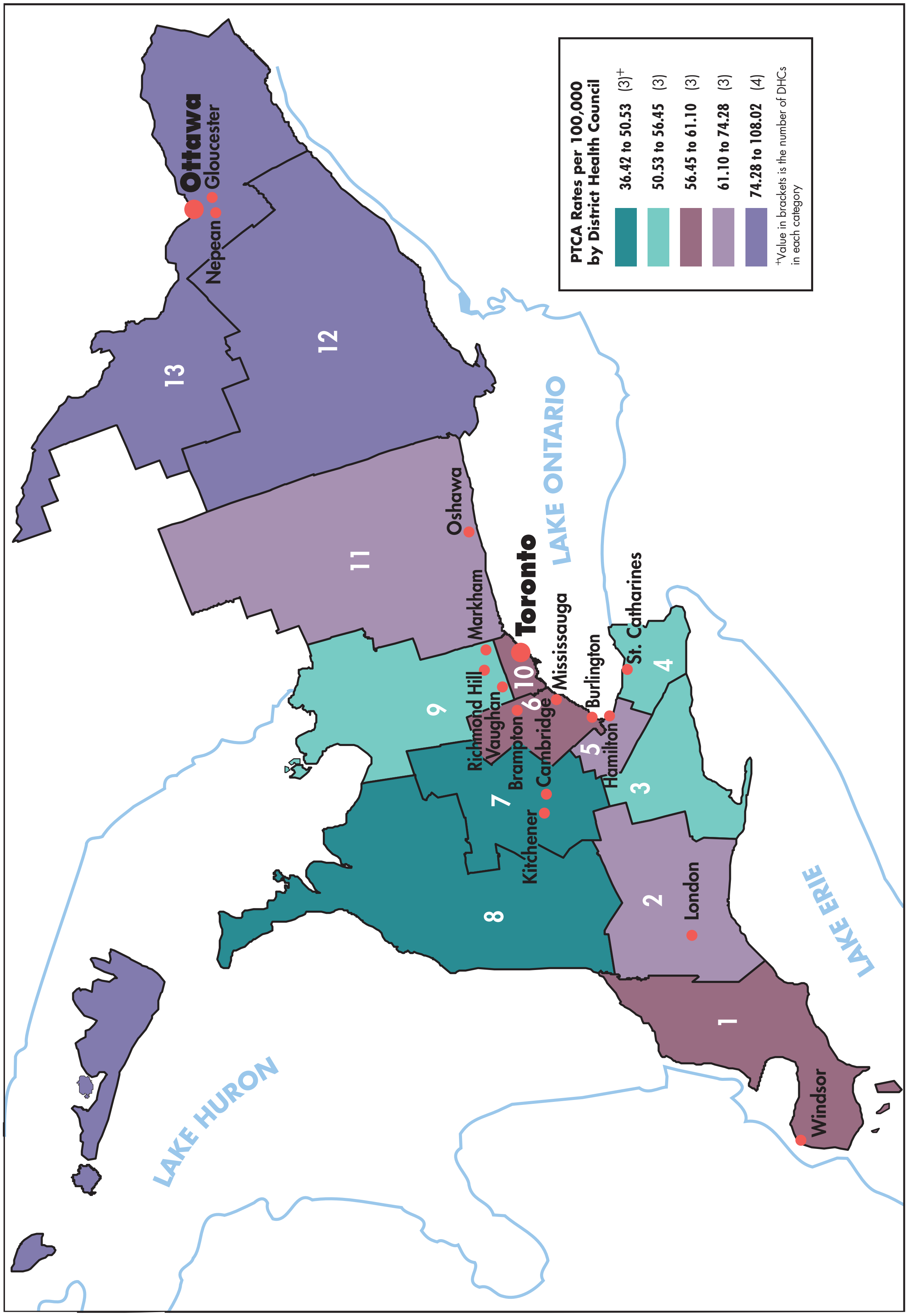
9.6 EXHIBIT

Age/Sex-adjusted Percutaneous Transluminal Coronary Angioplasty (PTCA) Rates per 100,000 Population Aged 20 Years and Over by District Health Council in Ontario, 1995/96 - 1997/98

ONTARIO District Health Councils

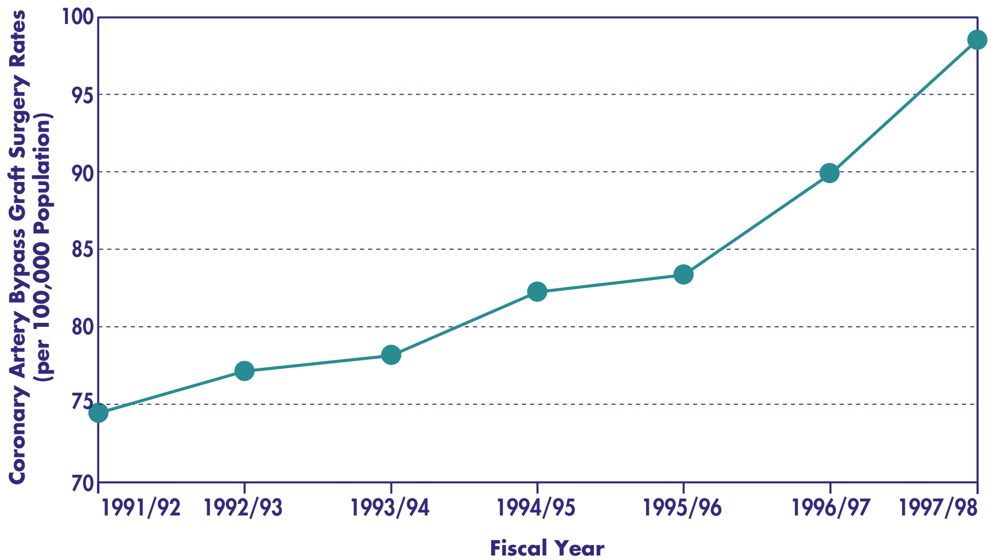
1. Essex, Kent and Lambton
2. Thames Valley
3. Grand River
4. Niagara Region
5. Hamilton-Wentworth
6. Halton-Peel
7. Waterloo Region-Wellington-Dufferin
8. Grey, Bruce, Huron, Perth
9. Simcoe-York
10. Toronto
11. Durham, Haliburton, Kawartha and Pine Ridge
12. Quinte, Kingston, Rideau
13. Champlain
14. Muskoka, Nipissing, Parry Sound and Timiskaming
15. Algoma, Cochrane, Manitoulin and Sudbury
16. Northwestern Ontario





Data Source: Canadian Institute for Health Information

EXHIBIT 9.7: Overall Coronary Artery Bypass Graft Surgery Rates per 100,000 Population Aged 20 Years and Over in Ontario, 1991/92 - 1997/98



Data Source: Canadian Institute for Health Information

EXHIBIT 9.8 Overall and Age/Sex-specific Coronary Artery Bypass Graft Surgery Rates per 100,000 Population Aged 20 Years and Over in Ontario, 1991/92 - 1997/98

MEN

	FISCAL YEAR						
Age	**1991/92**	**1992/93**	**1993/94**	**1994/95**	**1995/96**	**1996/97**	**1997/98**
20-34	1	1	1	1	1	1	2
35-49	50	51	48	46	47	47	46
50-64	286	294	292	299	297	310	339
65-74	432	448	468	509	503	537	601
75+	141	154	188	211	226	261	326

WOMEN

	FISCAL YEAR						
Age	**1991/92**	**1992/93**	**1993/94**	**1994/95**	**1995/96**	**1996/97**	**1997/98**
20-34	0	0	1	0	1	1	1
35-49	8	8	7	7	7	9	9
50-64	61	67	61	65	63	69	71
65-74	134	136	139	155	165	192	197
75+	41	45	49	57	69	80	103
Overall Rate Men and Women	**74**	**77**	**78**	**82**	**83**	**90**	**99**

Data Source: Canadian Institute for Health Information

EXHIBIT 9.9 Age/Sex-adjusted Coronary Artery Bypass Surgery Rates per 100,000 Population Aged 20 Years and Over by District Health Council Area of Patient Residence in Ontario, 1991/92 - 1997/98

District Health Council	1991/92 - 1993/94			1994/95 - 1996/97			1997/98		
	Number of Coronary Artery Bypass Surgeries per Year	Age/ Sex-adjusted Rate	Rank	Number of Coronary Artery Bypass Surgeries per Year	Age/ Sex-adjusted Rate	Rank	Number of Coronary Artery Bypass Surgeries per Year	Age/ Sex-adjusted Rate	Rank
Algoma, Cochrane, Manitoulin and Sudbury	415	132**	1	417	127**	1	565	167**	1
Champlain	587	87**	4	680	93**	5	742	97	9
Durham, Haliburton, Kawartha and Pine Ridge	408	81	6	503	90	7	652	111**	4
Essex, Kent and Lambton	314	72	9	392	85	9	511	106	6
Grand River	115	70	10	143	83	10	189	105	7
Grey, Bruce, Huron, Perth	146	63*	15	147	60*	15	204	81*	15
Halton-Peel	550	84	5	694	93	4	872	108**	5
Hamilton-Wentworth	286	80	7	318	85	8	382	97	8
Muskoka, Nipissing, Parry Sound and Timiskaming	177	98**	3	193	100**	3	235	120**	2
Niagara Region	229	69	11	267	76*	12	317	86*	13
Northwestern Ontario	119	68	12	104	57*	16	169	91	12
Quinte, Kingston, Rideau	386	104**	2	448	112**	2	475	115**	3
Simcoe - York	343	63*	14	458	72*	13	627	94	11
Thames Valley	309	78	8	382	91	6	413	95	10
Toronto	1,178	67*	13	1,460	79*	11	1,639	86*	14
Waterloo Region - Wellington - Dufferin	195	50*	16	289	68	14	348	77	16

* Significantly lower than the provincial average ($p<0.05$)

** Significantly higher than the provincial average ($p<0.05$)

Data Source: Canadian Institute for Health Information

compared to 1994/95 to 1996/97) and Quinte, Kingston, Rideau (104 and 112/100,000 for the same period, with a 1997/98 rate of 115). Algoma, Cochrane, Manitoulin and Sudbury had a rate of 167/100,000 for 1997/98, reflecting a one-time queue-clearing initiative launched in this period. Champlain (Gloucester, Nepean, Ottawa) and Muskoka, Nipissing, Parry Sound and Timiskaming also had significantly higher rates than average for the time periods examined; however, the rate for Champlain (Gloucester, Nepean, Ottawa) was no longer above average.

The lowest rates of bypass surgery, similar across the study time periods, were found in Waterloo Region-Wellington-Dufferin with rates of 50 and 68/100,000 and Grey, Bruce, Huron, Perth with rates of 63 and 60/100,000. In the data available for 1997/98, both maintained the lowest provincial rates but rose to 77 and 81/100,000 respectively, reflecting the new funding strategy mentioned above. Encouragingly, these 1997/98 rates are closer to the benchmark of 100/100,000 population. Exhibit 9.10 demonstrates findings by municipalities with populations over 100,000 versus other areas within each Ontario DHC for further comparison.

EXHIBIT 9.10 Age/Sex-adjusted Coronary Artery Bypass Surgery Rates per 100,000 Population Aged 20 Years and Over by Municipalities with Populations Greater than 100,000 versus Other Areas in Ontario District Health Councils, 1994/95 - 1997/98

District Health Council	1991/92 - 1993/94		1994/95 - 1996/97		1997/98	
	Number of Coronary Artery Bypass Surgeries per Year	Age/Sex-adjusted Rate	Number of Coronary Artery Bypass Surgeries per Year	Age/Sex-adjusted Rate	Number of Coronary Artery Bypass Surgeries per Year	Age/Sex-adjusted Rate
Champlain						
Gloucester	54	84	67	107	71	115
Nepean	55	69	66	85	69	92
Ottawa	245	99**	260	104**	262	102
Other	234	71	286	88	340	104
Durham, Haliburton, Kawartha and Pine Ridge						
Oshawa	68	73	94	100	113	120
Other	340	74	409	89	539	118**
Essex, Kent and Lambton						
Windsor	117	78	155	102	190	123**
Other	196	65	237	79	321	106
Halton-Peel						
Brampton	106	70	148	102	187	133**
Burlington	84	76	104	94	127	115
Mississauga	224	67	299	93	385	120**
Oakville	81	90	83	94	106	121
Other	55	71	61	79	67	88
Hamilton-Wentworth						
Hamilton	212	84**	231	90	285	110
Other	74	66	87	77	97	86
Niagara Region						
St. Catharines	78	69	92	81	96	85*
Other	152	66	175	75*	221	93
Northwestern Ontario						
Thunder Bay	86	96**	82	91	134	148**
Other	32	36*	22	25*	35	41*
Simcoe-York						
Markham	66	56*	85	74	118	103
Richmond Hill	36	55*	49	78	81	128
Vaughan	41	51*	56	69	75	105
Other	200	55*	268	73*	353	97
Thames Valley						
London	158	70	204	90	239	105
Other	151	82	178	96	174	94
Waterloo Region-Wellington-Dufferin						
Cambridge	35	53	48	72	70	106
Kitchener	56	47*	82	69*	101	85*
Other	104	44*	160	68*	177	75*

* Significantly lower than the provincial average ($p<0.05$). ** Significantly higher than the provincial average ($p<0.05$).

Note: For areas within District Health Councils (DHCs), Census 1996 population data were used for rate denominators. This accounts for any apparent inconsistencies in rates as compared with previous DHC-specific tables.

Data Source: Canadian Institute for Health Information

EXHIBIT 9.11 Summary Statistics for Degree of Variation in the Use of Coronary Artery Bypass Graft Surgery in Ontario, 1991/92 - 1997/98

Fiscal Year	Coefficient of Variation	Ratio of Third Quartile Over First Quartile	Systematic Component of Variation	Adjusted Chi-Square
1991/92	22.3	1.4	66.7	261
1992/93	22.6	1.3	66.7	284
1993/94	21.0	1.3	51.9	248
1994/95	19.7	1.4	54.1	255
1995/96	16.9	1.2	41.8	191
1996/97	14.6	1.2	29.3	160
1997/98	17.7	1.2	41.2	243

Data Source: Canadian Institute for Health Information

Examining data for 1997/98 to see the initial impact of additional funding provided during this period, we note that seven of the 16 DHCs have rates which surpass the 100/100,000 benchmark (Exhibit 9.9). Although the other nine DHCs are below 100/100,000, the gap is narrowing. Exhibit 9.11 provides summary statistics for CABG for 1991/92 to 1997/98. There was a clear decline in interregional variation up to 1996/97, but variation has risen again in 1997/98, probably because of one-time queue-clearing increases. Exhibit 9.12 maps the age- and sex-adjusted rates of CABG in the province.

Total Revascularization

When we look at the combination of angioplasty and CABG as a "total revascularization rate" in the 1996/97 to 1997/98 data presented (Exhibit 9.13), the highest rates are found in Algoma, Cochrane, Manitoulin and Sudbury; Champlain (Gloucester, Nepean, Ottawa); and Quinte, Kingston, Rideau. Exhibit 9.14 summarizes rates by municipalities with populations over 100,000 versus other areas within each Ontario DHC for further comparison. Exhibit 9.15 maps total revascularization for another perspective.

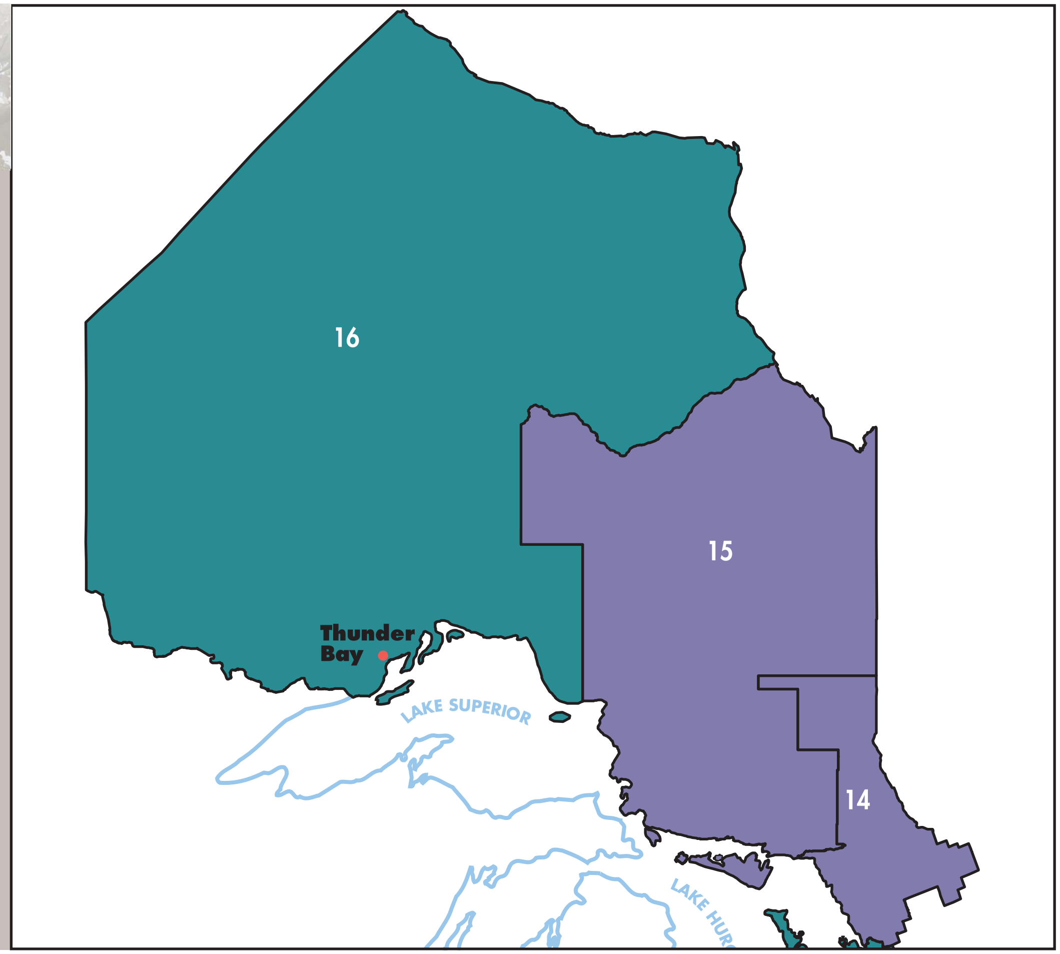
In Exhibit 9.16 we demonstrate ratios of PTCA to CABG. Using this strategy, we show that Champlain has a high rate of angioplasty but falls roughly in the middle of the rankings for rates of CABG. Toronto falls in the middle of the rankings for rates of angioplasty, but has a much lower ranking for CABG rates. Conversely, Grand River has a higher rate of CABG with a lower rate of angioplasty in these rankings. The lowest rates of PTCA and CABG, similar across the time periods of interest, were found in the DHCs of Waterloo Region-Wellington-Dufferin and Grey, Bruce, Huron, Perth.

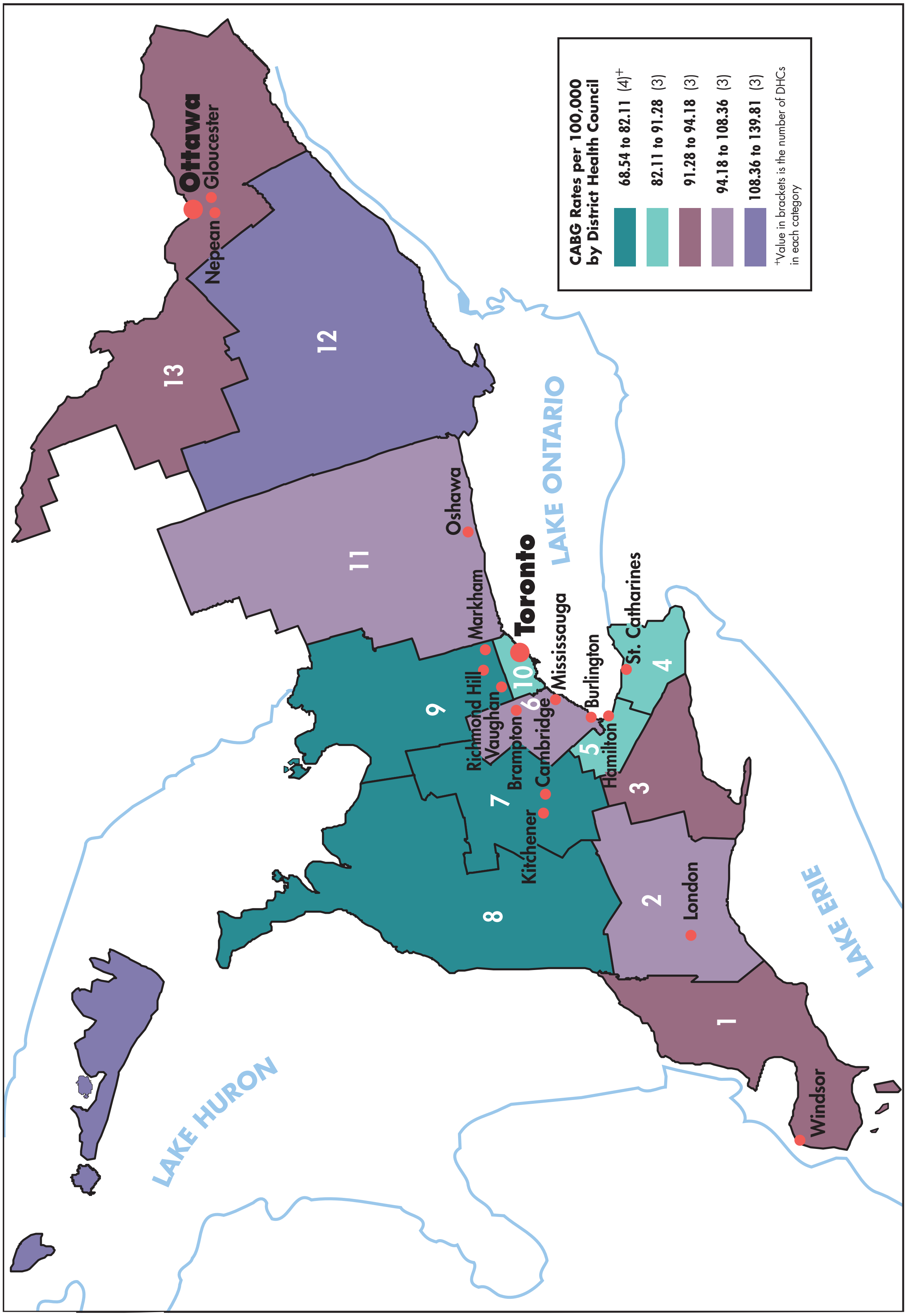
9.12 EXHIBIT

Age/Sex-adjusted Coronary Artery Bypass Graft Surgery (CABG) Rates per 100,000 Population Aged 20 Years and Over by District Health Council in Ontario, 1995/96 - 1997/98

ONTARIO District Health Councils

1. Essex, Kent and Lambton
2. Thames Valley
3. Grand River
4. Niagara Region
5. Hamilton-Wentworth
6. Halton-Peel
7. Waterloo Region-Wellington-Dufferin
8. Grey, Bruce, Huron, Perth
9. Simcoe-York
10. Toronto
11. Durham, Haliburton, Kawartha and Pine Ridge
12. Quinte, Kingston, Rideau
13. Champlain
14. Muskoka, Nipissing, Parry Sound and Timiskaming
15. Algoma, Cochrane, Manitoulin and Sudbury
16. Northwestern Ontario





Data Source: Canadian Institute for Health Information

EXHIBIT 9.13 Age/Sex-adjusted Revascularization Rates per 100,000 Population Aged 20 Years and Over by District Health Council of Patient Residence in Ontario, 1994/95 - 1997/98*

District Health Council	1994/95 - 1995/96			1996/97 - 1997/98			1997/98		
	Number of Procedures	Age/Sex-adjusted Rate	Rank	Number of Procedures	Age/Sex-adjusted Rate	Rank	Number of Procedures	Age/Sex-adjusted Rate	Rank
Algoma, Cochrane, Manitoulin and Sudbury	696	214	1	870	259	1	974	289	1
Champlain	1,363	188	2	1,536	202	2	1,544	200	3
Durham, Haliburton, Kawartha and Pine Ridge	732	134	9	989	171	5	1,085	185	5
Essex, Kent and Lambton	623	138	8	731	154	9	804	168	7
Grand River	218	127	10	268	151	10	287	159	9
Grey, Bruce, Huron, Perth	203	84	16	293	118	15	312	125	15
Halton-Peel	1,060	144	7	1,333	165	6	1,441	175	6
Hamilton-Wentworth	554	151	5	628	163	7	643	165	8
Muskoka, Nipissing, Parry Sound and Timiskaming	291	156	4	367	191	4	378	197	4
Niagara Region	427	123	11	486	136	13	502	139	14
Northwestern Ontario	152	84	15	244	132	14	287	154	12
Quinte, Kingston, Rideau	700	178	3	802	197	3	849	207	2
Simcoe - York	705	115	13	921	137	12	1,053	155	10
Thames Valley	625	150	6	672	156	8	673	155	11
Toronto	2,202	119	12	2,742	145	11	2,851	150	13
Waterloo Region - Wellington - Dufferin	416	99	14	512	115	16	540	119	16

* Revascularization admissions were counted. Because residual double-counting is possible, outlier statistics are not reported.

Data Source: Canadian Institute for Health Information

EXHIBIT 9.14 Age/Sex-adjusted Revascularization Rates per 100,000 Population Aged 20 Years and Over by Municipalities with Populations Greater than 100,000 versus Other Areas in Ontario District Health Councils, 1994/95 - 1997/98*

District Health Council	1994/95 - 1995/96		1996/97 - 1997/98		1997/98	
	Number of Procedures	Age/Sex-adjusted Rate	Number of Procedures	Age/Sex-adjusted Rate	Number of Procedures	Age/Sex-adjusted Rate
Champlain						
Gloucester	136	206	155	244	147	228
Nepean	137	173	150	193	151	196
Ottawa	503	203	560	224	531	210
Other	588	178	671	204	715	217
Durham, Haliburton, Kawartha and Pine Ridge						
Oshawa	127	135	190	203	195	208
Other	605	132	799	175	890	195
Essex, Kent and Lambton						
Windsor	257	169	282	184	307	200
Other	366	122	450	150	497	165
Halton-Peel						
Brampton	212	141	303	207	326	224
Burlington	168	153	194	177	215	197
Mississauga	453	137	572	175	623	189
Oakville	129	142	170	191	171	193
Other	98	125	95	122	106	136
Hamilton-Wentworth						
Hamilton	411	163	456	179	459	179
Other	143	127	172	153	184	163
Niagara Region						
St. Catharines	135	122	155	138	146	130
Other	292	125	331	143	356	153
Northwestern Ontario						
Thunder Bay	115	130	188	209	221	246
Other	37	42	56	65	66	76
Simcoe-York						
Markham	135	115	173	147	199	169
Richmond Hill	74	114	100	158	121	192
Vaughan	82	100	122	154	145	191
Other	415	113	527	144	588	161
Thames Valley						
London	352	154	385	169	388	170
Other	274	148	287	156	285	155
Waterloo Region-Wellington-Dufferin						
Cambridge	64	96	100	150	112	168
Kitchener	119	99	145	122	152	127
Other	234	98	267	113	276	116

* Revascularization admissions were counted. Because residual double-counting is possible, outlier statistics are not reported.

Note: For areas within District Health Councils (DHCs), Census 1996 population data were used for rate denominators. This accounts for any apparent inconsistencies in rates as compared with previous DHC-specific tables.

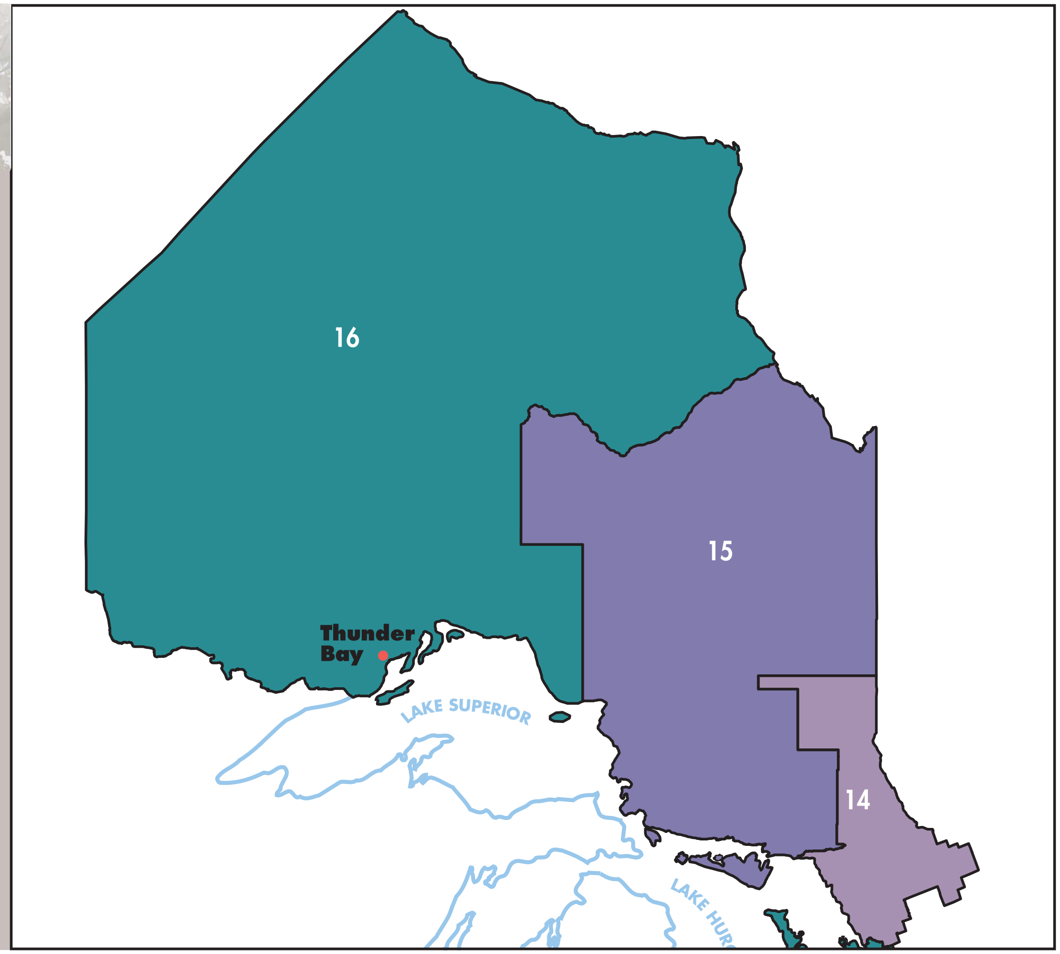
Data Source: Canadian Institute for Health Information

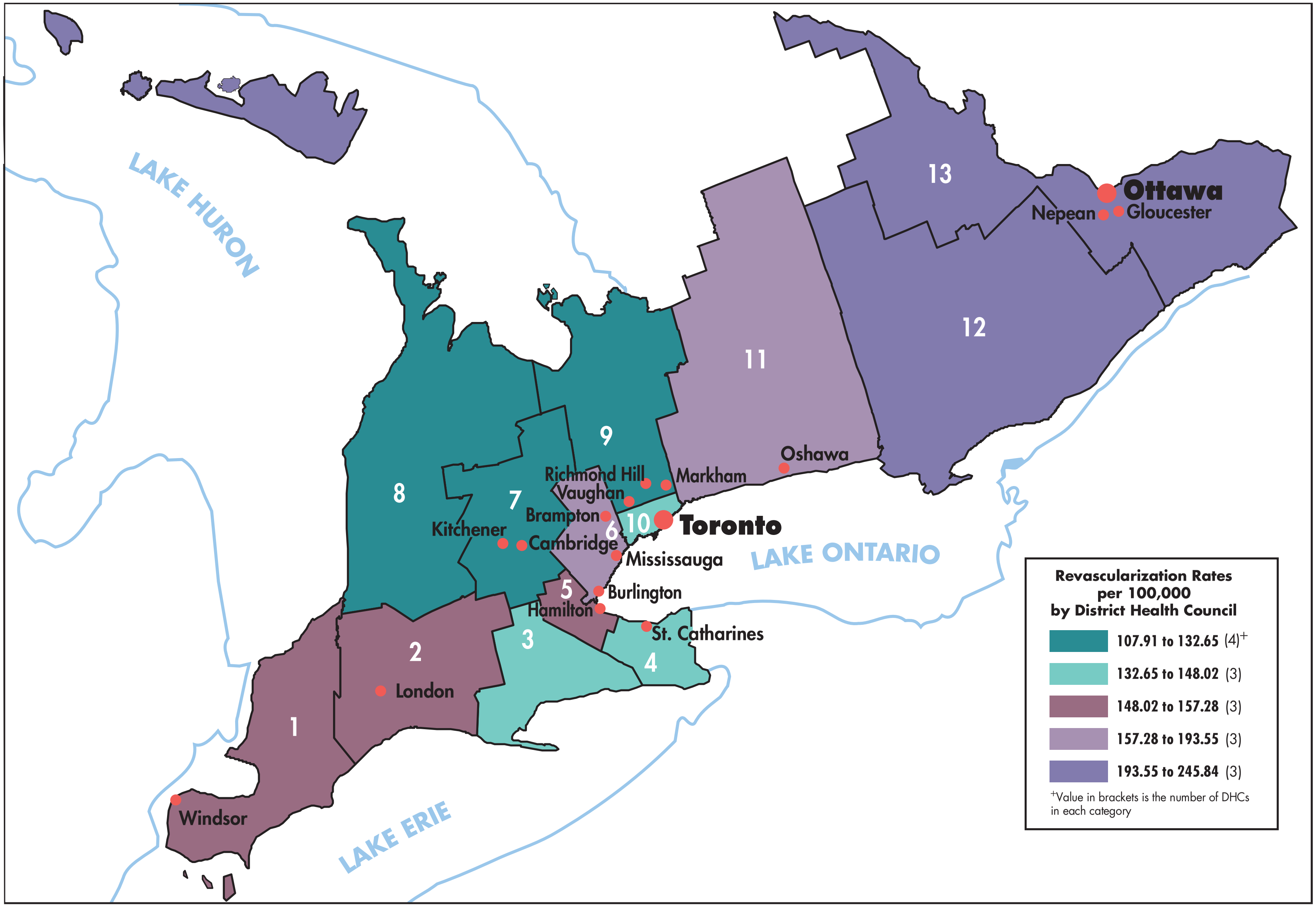
9.15 EXHIBIT

Age/Sex-adjusted Revascularization Rates per 100,000 Population Aged 20 Years and Over by District Health Council in Ontario, 1995/96 - 1997/98

ONTARIO *District Health Councils*

1. Essex, Kent and Lambton
2. Thames Valley
3. Grand River
4. Niagara Region
5. Hamilton-Wentworth
6. Halton-Peel
7. Waterloo Region-Wellington-Dufferin
8. Grey, Bruce, Huron, Perth
9. Simcoe-York
10. Toronto
11. Durham, Haliburton, Kawartha and Pine Ridge
12. Quinte, Kingston, Rideau
13. Champlain
14. Muskoka, Nipissing, Parry Sound and Timiskaming
15. Algoma, Cochrane, Manitoulin and Sudbury
16. Northwestern Ontario





Data Source: Canadian Institute for Health Information

EXHIBIT 9.16 Total Revascularization Rate and Ratio by District Health Council in Ontario, 1997/98*

District Health Council	Angioplasty (Percutaneous Transluminal Coronary Angioplasty)		Coronary Artery Bypass Graft Surgery		Total Revascularization		Ratio of Percutaneous Transluminal Coronary Angioplasty/ Coronary Artery Bypass Surgery
	Rate	Rank	Rate	Rank	Rate	Rank	
Algoma, Cochrane, Manitoulin and Sudbury	124	1	167	1	289	1	0.74
Champlain	105	2	97	9	200	3	1.08
Durham, Haliburton, Kawartha and Pine Ridge	75	5	111	4	185	5	0.68
Essex, Kent and Lambton	64	10	106	6	168	7	0.60
Grand River	56	13	105	7	159	9	0.54
Grey, Bruce, Huron, Perth	45	15	81	15	125	15	0.56
Halton-Peel	68	7	108	5	175	6	0.63
Hamilton-Wentworth	68	6	97	8	165	8	0.70
Muskoka, Nipissing, Parry Sound and Timiskaming	78	4	120	2	197	4	0.65
Niagara Region	53	14	87	13	139	14	0.61
Northwestern Ontario	64	9	91	12	154	12	0.71
Quinte, Kingston, Rideau	92	3	115	3	207	2	0.80
Simcoe - York	63	11	94	11	155	10	0.67
Thames Valley	61	12	95	10	155	11	0.65
Toronto	65	8	86	14	150	13	0.75
Waterloo Region-Wellington-Dufferin	43	16	77	16	119	16	0.56

* Revascularization admissions were counted. Because residual double-counting is possible, outlier statistics are not reported.

Data Source: Canadian Institute for Health Information

Conclusions

The percentage change in revascularization rates across fiscal periods suggests that, despite major increases in utilization, the gender gap persists for these procedures in the most clinically relevant age categories (50 to 64, 65 to 74, 75+). Further research to investigate causes and consequences of these discrepancies is needed. At present, it appears that these sex differences originate not with surgeons' or interventional cardiologists' decisions when women are considered for revascularization, but rather higher in the "referral funnel," where fewer women are positioned as candidates for angiography than men. Indeed, previous research has shown that once women have undergone a coronary angiogram, their care is not substantially different than for men for either angioplasty or bypass surgery.[12,13] Data presented in Chapter 8 confirm sex differences in angiography rates.

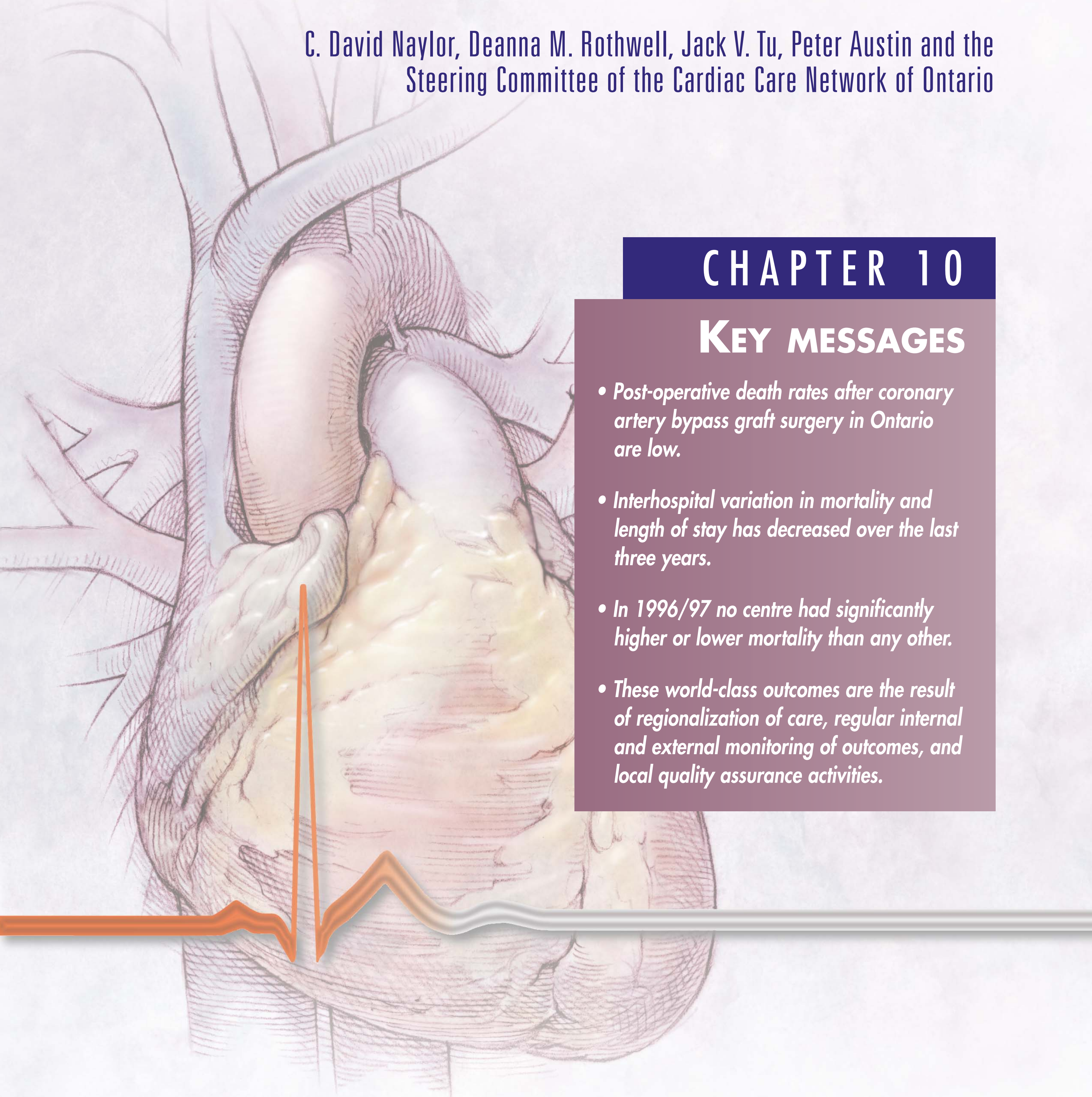
Growth in angioplasty rates is notable, but from a population perspective, the target of 100 per 100,000 cases has been met in only two regions. There are marked regional variations in use of this procedure.

With CABG, regional variations in utilization have been decreasing as a result of the funding policies initiated through consultation among CCN, ICES and the Ministry of Health. The minimum target of 100 cases per 100,000 adults has been met by many regions. However, 1997/98 data show that intra- and interregional variations persist. In part the 1997/98 variations are attributable to one-time increases in CABG capacity designed to clear waiting lists in some centres. The high rates of CABG in Northeastern Ontario are at least partly attributable to an increased incidence of IHD. However, other regions with higher-than-average incidences of IHD show dramatically lower CABG utilization, and conversely, some regions with low utilization of CABG and PTCA have higher-than-average burdens of IHD.

When we look at the total revascularization rate, reflecting the combination of angioplasty and CABG, the highest rates are consistently found in the DHCs of Algoma, Cochrane, Manitoulin and Sudbury; Champlain (Gloucester, Nepean, Ottawa); and Quinte, Kingston, Rideau. The lowest rates of angioplasty and bypass surgery, similar across all time periods, were found in the DHCs of Waterloo Region-Wellington-Dufferin and Grey, Bruce, Huron, Perth. These variations suggest that continued efforts are necessary to match local needs with mechanisms to ensure timely access to coronary angiography and revascularization services.

Outcomes of Coronary Artery Bypass Surgery in Ontario

C. David Naylor, Deanna M. Rothwell, Jack V. Tu, Peter Austin and the
Steering Committee of the Cardiac Care Network of Ontario



CHAPTER 10

KEY MESSAGES

- *Post-operative death rates after coronary artery bypass graft surgery in Ontario are low.*
- *Interhospital variation in mortality and length of stay has decreased over the last three years.*
- *In 1996/97 no centre had significantly higher or lower mortality than any other.*
- *These world-class outcomes are the result of regionalization of care, regular internal and external monitoring of outcomes, and local quality assurance activities.*

Key Terms & Concepts:

- Cardiac Care Network
- coronary artery bypass graft surgery
- length of stay
- mortality rates
- outcomes report card

Background

Patients, providers, administrators and policy-makers all share an interest in measuring and improving the quality of cardiac care. Quality measures generally can be broken down into those reflecting processes or outcomes of care. For example, data on the use of drugs to improve patients' long-term prognosis after a heart attack are process-of-care measures, while in contrast, data on one-year death rates after heart attacks measure an important outcome.

In assessing quality of care, process measures are often more useful than outcome measures for several reasons.[1] First, many therapies have only a small positive impact on outcomes. In such instances, outcome measures are less sensitive to quality problems than process measures that examine whether the right therapy was given. Also, if each hospital sees only a limited number of patients with a specific clinical problem, apparent differences in outcomes for those patients may reflect the play of chance alone. Furthermore, patients vary across institutions. Bad outcomes in one institution may occur if sicker patients are treated there, and have nothing to do with the quality of care provided.

For these reasons, outcomes reports are only useful in measuring quality of care when institutions are treating large numbers of fairly similar patients.[2] These reports must still include adjustments for differences in the types of patients undergoing treatment, lest competent providers treating complex patients be penalized inadvertently.[2] The reports should also consider the amount of variation that might be expected on the basis of chance alone.

Even with such safeguards, there has been controversy about the impact of public report cards that have tried to compare outcomes across hospitals or physicians.

New York and Pennsylvania led the way in the early 1990s with public reports on outcomes of coronary artery bypass graft surgery (CABG). Since the start of annual report cards, mortality after CABG has fallen in both states. However, similar improvements have occurred elsewhere without any public report cards on surgical outcomes.[3-6] Critics have charged that public report cards have led to a spuriously large improvement in risk-adjusted outcomes because centres now over-report the extent to which their patients are at risk for operative complications.[7]

Referring physicians—usually cardiologists—apparently make limited use of the report cards.[8,9] One of their concerns is that the report cards capture only early deaths as a complication of surgery; they are silent on important outcomes such as long-term mortality or degree of relief from chest pain caused by reduced blood flow to the heart muscle. Moreover, outcomes report cards do not reflect a key aspect of surgical judgement: deciding which patients truly need surgery.

Another concern is that heart surgeons will stop operating on very sick patients who have the most to gain in the longer-term, but are also at greatly increased risk of complications and death from surgery itself. However, the New York State experience has somewhat allayed this concern.[10]

Despite the controversy in professional circles, most patients undergoing CABG apparently know nothing about the report cards.[11] Researchers and quality managers have not developed systematic means to put such information in the hands of patients, nor have they studied what types of information would be clearest and most helpful to patients and their families.

An alternative approach is to provide the report cards on a confidential basis to providers, leaving them the option of public disclosure.[3,6] Until now, this is the approach that has been taken in Ontario. The nine cardiac surgery centres collaborate in the Cardiac Care Network of Ontario (CCN) (see Appendix A10.1 for a list of Steering Committee members). They submit data regularly on the characteristics of patients undergoing different types of heart operations. Scientists at the Institute for Clinical Evaluative Sciences (ICES) link these data to hospitalization data from the Canadian Institute for Health Information (CIHI) and generate reports on in-hospital death rates and post-operative lengths of stay.

These data are distributed to the leaders of each cardiac surgery centre, including the hospital CEOs. Fortunately, the quality of CABG care has been excellent, with generally low mortality rates and limited variation in outcomes across all nine centres. ICES researchers have reported these results elsewhere.[3] The overall mortality rate after CABG was 3.01% and the risk-adjusted mortality rate declined from 3.17% in 1991/92 to 2.93% in 1993/94. In any given year that a hospital has suboptimal results, or at any other time that the hospital wishes to explore its data in more detail, ICES scientists work with the centre to break down the results for each surgeon working there.

In this chapter of the Atlas, ICES and the CCN have collaborated to produce the first public report card on CABG outcomes for the nine cardiac surgery centres in Ontario. Despite the continuing uncertainties around the impact of such report cards, we have taken this step for several reasons. First, the data have been audited for accuracy, and we know the risk-adjustment models are sound. Second, the volumes of surgery are high enough in each centre to generate reasonably robust and consistent results. (This is not the case for annual surgeon-specific data, which show substantial random variation.) Third, because providers are accustomed to these report cards, there is less chance of defensive or dysfunctional responses. Fourth, and most importantly, dissemination of these data respects the basic principle that so long as the data are accurate, reliable and meaningful, those who fund and use the system—the taxpaying public—have a right to institution-specific information about the performance of their health care system. We include results for in-hospital mortality and post-operative lengths of stay for each centre.

Data Sources

The Cardiac Care Network database was used as the source of information for procedure type, procedure date and risk factors (except non-cardiac comorbidity). This database is maintained by each of the nine cardiac surgery centres and has been in existence since late 1991. The data are derived from patient interviews by nurse-coordinators and by review of patients' clinical records by trained data abstractors. In the past, audits of the CCN database have shown about 97-98% accuracy for key variables that might affect risk-adjusted outcomes.

In each year, we linked the CCN and CIHI databases, and ultimately restricted the data to those patients who had isolated CABG surgery. Details of the linkage are outlined in the Methods Appendix for Chapter 10.

In this analysis we continued to adjust outcomes according to the same risk factors from CCN as we have in previous analyses. These included: age, sex, urgency category, previous CABG, left ventricular function, anatomical pattern of coronary obstructions, recent myocardial infarction and severity of angina symptoms scored by the Canadian Cardiovascular Society classification scheme. Information on in-hospital mortality, discharge dates and non-cardiac comorbidity was taken from the CIHI database. Post-operative length of stay was calculated using the surgery date in CCN and the discharge date in CIHI.

There were few missing data for the risk factors used. Proportions of missing data and the method of handling such data are outlined in more detail in the Methods Appendix.

How We Did the Analysis

We used standard statistical methods to adjust for interhospital differences in the populations of patients undergoing CABG (see Methods Appendix MA10.1 and MA10.2). The statistical models showed excellent performance in predicting mortality and very good performance in predicting length of stay.

The centre-specific mortality results are shown only in "adjusted" form as these are most relevant from a quality of care perspective. Crude mortality outcomes are potentially misleading in the absence of adjustment for differences in the types of patients undergoing surgery across hospitals and are not shown here. The adjusted outcomes are those that would be expected if each hospital's case mix were identical to the provincial average. We have extensive experience in making such adjustments as fairly as possible. The Methods Appendix for Chapter 10 contains detailed information on the methods we used.

Interpretive Cautions

We have included outcomes only for isolated CABG procedures—i.e. straightforward bypass surgery. This is the most common form of open heart surgery. Many other types of open heart surgery are offered at the nine hospitals profiled here. However, the data on these procedures are not complete enough for us to make fair adjustments for interhospital differences in the types of patients and procedures.

Patients are sometimes admitted many days earlier for cardiac treatment or investigation and then later undergo CABG. This will not affect any of our results for lengths of stay, which are all calculated starting from the day of the procedure itself.

A fair amount of variation in outcomes occurs randomly. A high or low mortality rate in a given year is probably notable only if it is "statistically significant" compared to the provincial average, i.e. there was less than a 5% chance that a difference of this size occurred on the basis of the play of chance alone. At that, consistent findings are more important than those which occur in only a single year.

Findings and Discussion

Exhibit 10.1 summarizes the outcomes of CABG surgery across all nine centres between fiscal 1994/95 and 1996/97. Volumes of surgery are rising. In-hospital mortality was significantly lower in 1995/96 and 1996/97 than in 1994/95. This is part of a general positive trend in CABG outcomes over the last several years.[5]

EXHIBIT 10.1 Summary of Coronary Artery Bypass Graft Surgery Outcomes in Ontario, 1994/95 - 1996/97

Surgery Outcomes	Fiscal Year 1994/95	1995/96	1996/97	Overall 1994/95 - 1996/97
Number of Procedures	5,811	5,936	6,399	18,146
Crude In-hospital Mortality Rate (%)	2.75	2.32	2.41	2.49
Risk-adjusted* In-hospital Mortality Rate (%)	2.75	2.19†	2.23†	
Crude Post-operative Length of Stay (Average Days)	8.65	7.88	7.43	7.97

* Risk-adjustment using 1994/95 data. See Methods Appendix for Chapter 10.

† Significantly different than provincial average in 1994/95 ($p<0.05$)

Data Source: Cardiac Care Network, Canadian Institute for Health Information

The crude and adjusted mortality rates are identical for 1994/95, because we used 1994 as our baseline year. In 1995/96 and 1996/97 the adjusted mortality was lower than the crude mortality. This is because, compared to 1994/95, patients undergoing surgery in later years were slightly older and sicker. The post-operative length of stay has also fallen over time.

Exhibits 10.2, 10.2i and 10.2ii show the risk-adjusted in-hospital mortality rates, as well as the crude and risk-adjusted post-operative length of stay for each of the nine centres by fiscal year.

In 1994/95, Kingston and Sudbury attained a mortality rate under 2%, albeit not significantly below the provincial average using our data model (Exhibit 10.2). St. Michael's Hospital was a high outlier. These findings were drawn to the attention of the leadership at St. Michael's Hospital. After some appropriate changes, St. Michael's was no longer an outlier in later years.

Length of stay showed some parallels to mortality outcomes, suggesting that prolonged length of stay was partly a proxy for non-fatal, post-operative complications. Sudbury and Kingston both had significantly shorter lengths of stay than the provincial average, as did Sunnybrook. The University of Ottawa Heart Institute had significantly longer lengths of stay.

EXHIBIT 10.2 Risk-adjusted In-hospital Mortality Rates and Post-operative Length of Stay for Isolated Coronary Artery Bypass Graft Surgery by Hospital in Ontario, 1994/95

Hospital	Number of Procedures	Risk-adjusted In-hospital Mortality Rate (%)		Crude Mean Post-operative Length of Stay (Days)	Risk-adjusted Mean Post-operative Length of Stay (Days)
		95% Confidence Interval	Point Estimate		
Kingston General Hospital	320	0.00 - 3.06	1.28	7.48	7.51†
Sudbury Memorial Hospital	450	0.00 - 2.77	1.31	7.12	7.24†
The Toronto Hospital	1,465	1.84 - 3.42	2.63	9.18	8.91
Sunnybrook Health Science Centre	535	1.02 - 4.05	2.53	6.90	7.17†
Hamilton Civic Hospital (now Hamilton Health Sciences Corporation)	719	1.11 - 3.47	2.29	8.81	8.83
University of Ottawa Heart Institute	869	2.16 - 4.16	3.16	10.18	10.01†
St. Michael's Hospital	547	3.02 - 5.66	4.34†	8.17	8.22
Victoria Hospital (now Victoria Campus, London Health Sciences Centre)	489	2.03 - 4.99	3.51	8.63	8.69
University Hospital (now University Campus, London Health Sciences Centre)	417	1.41 - 4.78	3.10	8.74	9.21
Overall	**5,811**			**8.65**	

Note: Risk-adjustment was performed using 1994/95 data. See Methods Appendix MA10.1 for mortality adjustment and Methods Appendix MA10.2 for length of stay adjustment

† Significantly different than provincial average in 1994/95 ($p<0.05$)

Data Source: Cardiac Care Network, Canadian Institute for Health Information

EXHIBIT 10.2i Risk-adjusted In-hospital Mortality Rates and Post-operative Length of Stay for Isolated Coronary Artery Bypass Graft Surgery by Hospital in Ontario, 1995/96

Hospital	Number of Procedures	Risk-adjusted In-hospital Mortality Rate (%)		Crude Mean Post-operative Length of Stay (Days)	Risk-adjusted Mean Post-operative Length of Stay (Days)
		95% Confidence Interval	Point Estimate		
Kingston General Hospital	377	0 - 1.84	0.29†	6.58	6.57†
Sudbury Memorial Hospital	437	0.24 - 2.97	1.61	6.93	7.07†
The Toronto Hospital	1,463	1.37 - 2.78	2.08	7.99	7.80
Sunnybrook Health Science Centre	605	1.22 - 3.54	2.38	6.86	6.87†
Hamilton Civic Hospital (now Hamilton Health Sciences Corporation)	755	1.81 - 4.06	2.94	7.64	7.85
University of Ottawa Heart Institute	807	0.50 - 2.40	1.45	9.29	9.29†
St. Michael's Hospital	518	1.98 - 4.48	3.23	7.64	7.65
Victoria Hospital (now Victoria Campus, London Health Sciences Centre)	588	1.79 - 4.23	3.01	8.30	8.32
University Hospital (now University Campus, London Health Sciences Centre)	416	3.30 - 6.17	4.74†	8.60	8.73
Overall	**5,966**			**7.88**	

Note: Risk-adjustment was performed using 1995/96 data. See Methods Appendix MA10.1 for mortality adjustment and Methods Appendix MA10.2 for length of stay adjustment

† Significantly different than provincial average in 1995/96 ($p<0.05$)

Data Source: Cardiac Care Network, Canadian Institute for Health Information

EXHIBIT 10.2ii Risk-adjusted In-hospital Mortality Rates and Post-operative Length of Stay for Isolated Coronary Artery Bypass Graft Surgery by Hospital in Ontario, 1996/97

Hospital	Number of Procedures	Risk-adjusted In-hospital Mortality Rate (%)		Crude Mean Post-operative Length of Stay (Days)	Risk-adjusted Mean Post-operative Length of Stay (Days)
		95% Confidence Interval	Point Estimate		
Kingston General Hospital	341	1.45 - 4.21	2.83	7.30	6.99
Sudbury Memorial Hospital	432	0.29 - 3.25	1.77	6.85	7.22
The Toronto Hospital	1,455	1.00 - 2.42	1.71	7.93	7.71
Sunnybrook Health Science Centre	621	1.98 - 4.45	3.21	6.63	6.63†
Hamilton Civic Hospital (now Hamilton Health Sciences Corporation)	776	1.97 - 4.23	3.10	7.90	8.03†
University of Ottawa Heart Institute	1,038	1.18 - 2.97	2.08	7.61	7.58
St. Michael's Hospital	613	2.24 - 4.46	3.35	6.75	6.82†
Victoria Hospital (now Victoria Campus, London Health Sciences Centre)	595	1.27 - 3.90	2.58	7.43	7.55
University Hospital (now University Campus, London Health Sciences Centre)	528	0.82 - 3.54	2.18	7.29	7.44
Overall	**6,399**			**7.43**	

Note: Risk-adjustment was performed using 1996/97 data. See Methods Appendix MA10.1 for mortality adjustment and Methods Appendix MA10.2 for length of stay adjustment

† Significantly different than provincial average in 1996/97 ($p<0.05$)

Data Source: Cardiac Care Network, Canadian Institute for Health Information

In 1995/96, Kingston and Ottawa had the lowest risk-adjusted in-hospital mortality, although only Kingston was significantly lower than the provincial average (Exhibit 10.2i). In that year, University Hospital showed significantly increased mortality. Follow-up surgeon-specific analyses guided the steps necessary to improve quality. Mortality in 1996/97 fell sharply (Exhibit 10.2ii).

Again in 1995/96 the low outliers for length of stay were Sudbury, Kingston and Sunnybrook, while the University of Ottawa Heart Institute was a high outlier.

By 1996/97, no institution was a mortality outlier in either direction (Exhibit 10.2ii). However, Sudbury's continued lower-than-average mortality made it a significant outlier across the three years in aggregate (results not shown).

Lengths of stay were clearly shorter in 1996/97. Sunnybrook remained a low outlier, joined by St. Michael's Hospital. Post-operative stays were sharply reduced at Ottawa. While Hamilton Health Sciences Corporation became a high outlier, the absolute differences in adjusted stay across centres were now small (about a day-and-a-half maximum).

Conclusions

These results demonstrate that the outcomes of coronary artery surgery in Ontario are excellent. The variation in outcomes among centres is small, with no centre as a significant outlier in 1996/97, in part as a result of ongoing quality assurance exercises. As well, postoperative lengths of stay are falling and intercentre variation in duration of hospitalization is shrinking.

One of the more important lessons of the annual profiles shown above is the variation in centre-specific performance over time. With the exception of Sudbury, which had in-hospital mortality consistently under 2%, and St. Michael's Hospital which was above 3% throughout the period, all the centres varied from year to year. Moreover, preliminary analysis of St. Michael's Hospital data for 1997/98 suggest that its mortality has now fallen below 3%. Much of the year-to-year variation appears to be caused by the play of chance alone.

Appendix A10.1 Steering Committee Members, Cardiac Care Network of Ontario

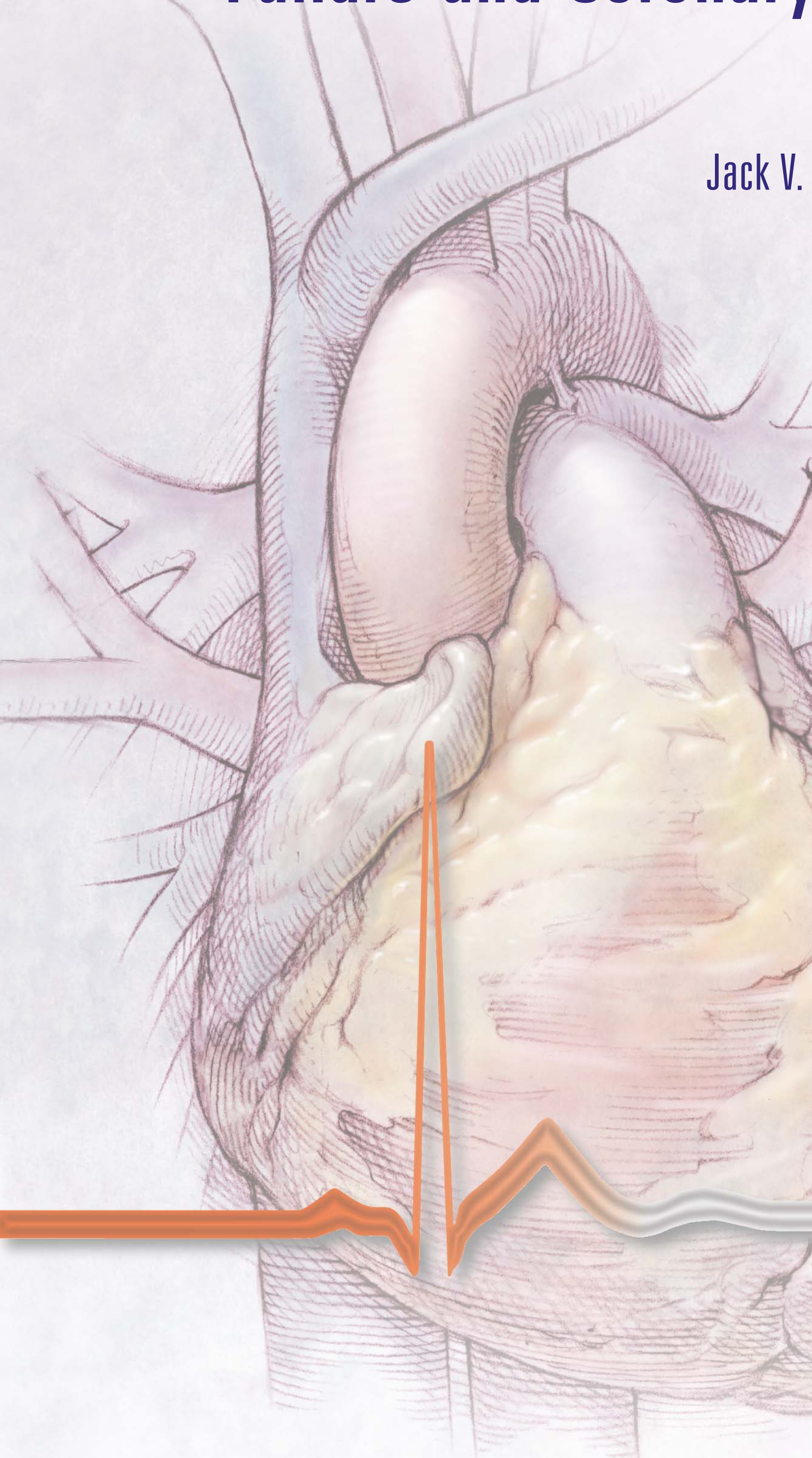
Current (August 20, 1998)	(Membership Dates)
Dr. S. Sewa Aul	(1995 -)
Ms. Wynne de Jong	(1998 -)
Mr. David Garlin (Recorder)	(1996 -)
Dr. Lyall A.J. Higginson	(1997 -)
Dr. Robert J. Howard	(1997 -)
Dr. Chris Lai	(1996 -)
Mr. Jeff Lozon	(1992 -)
Dr. John S. Marshall	(1996 -)
Dr. Alan Menkis	(1997 -)
Mr. Barry J. Monaghan (Chair)	(1994 -)
Dr. Christopher D. Morgan (Vice-Chair)	(1992 -)
Dr. Donald G.S. Peat	(1998 -)
Prof. George Pink	(1996 -)
Ms. Laura Pisko-Bezruchko	(1996 -)
Ms. Cathy Seguin	(1997 -)
Dr. B. William Schragge	(1990 -)
Mr. Mark Vimr (Executive Director - ex officio)	(1995 -)
Mr. Lorne Zon	(1998 -)

Former Members	(Membership Dates)
Dr. Alnoor Abdulla	(1990 - 1994)
Dr. Paul Armstrong	(1990 - 1991)
Dr. Donald S. Beanlands	(1990 - 1997)
Dr. Ronald Baigrie	(1990 - 1992)
Dr. Glen Bartlett (Chair)	(1990 - 1994)
Ms. Lorna Bickerton	(1996 - 1998)
Dr. Robert Chisholm	(1991 - 1997)
Dr. Tirone David	(1990 - 1991)
Ms. K. Fisher	(1990)
Dr. Myrna Francis	(1990 - 1992)
Dr. Martin Goldbach	(1991 - 1997)
Dr. Joe Homer	(1996 - 1997)
Ms. June Hylands	(1996)
Ms. Vicki Kaminski	(1994 - 1995)
Dr. Edwin Knight	(1990 - 1991)
Mr. G. Kumagai	(1990)
Ms. Patricia McGee	(1990 - 1994)
Dr. Neil McKenzie	(1990 - 1997)
Ms. Monita O'Connor	(1994)
Dr. John Pym	(1990 - 1996)
Mr. Donald Sanderson	(1990)
Dr. Hugh Scully	(1991 - 1998)
Dr. Jim Swan	(1991 - 1996)
Mr. Mario Tino	(1994 - 1996)
Mr. Bob Youtz	(1996 - 1997)

Secondary Prevention After Acute Myocardial Infarction, Congestive Heart Failure and Coronary Artery Bypass Graft Surgery in Ontario

Jack V. Tu, Peter Austin, Paula Rochon, Hua Zhang

CHAPTER 11



KEY MESSAGES

- *There are wide regional and interhospital variations in the use of secondary prevention drug therapies for Ontario's acute myocardial infarction (AMI) and congestive heart failure (CHF) patients.*
- *Rates of beta-blocker, ACE inhibitor and statin use in elderly AMI survivors in Ontario may reflect significant underuse of these medications.*
- *ACE inhibitors were prescribed within 90 days of hospital discharge for only 67% of new CHF patients in Ontario.*
- *Only 23% of elderly post-coronary artery bypass graft patients received a statin within 90 days of hospital discharge.*

Key Terms & Concepts:

- secondary prevention
- beta-blockers
- ACE inhibitors
- statins
- calcium channel blockers

Introduction

Coronary heart disease is the leading cause of mortality in Canada. Patients who develop coronary heart disease may present with a wide variety of symptoms ranging from an occasional episode of angina (chest pain) to a severe acute myocardial infarction (AMI). Patients who survive an initial AMI often go on to develop complications such as congestive heart failure (CHF), which may present as fluid accumulation in the lungs and/or legs. Other patients may require coronary artery bypass graft (CABG) surgery to relieve the blockages in their coronary arteries. All of these cardiac patients are at an increased risk of death when compared to the general population. Fortunately, several medications have been developed that may reduce the risk of a second cardiac event or death in these patients. These drugs are considered secondary prevention medications. In this chapter, we focus on a number of cardiac medications that are useful for secondary prevention in patients with a previous AMI, CHF or CABG surgery. These analyses are presented in three separate sections of the chapter.

ACUTE MYOCARDIAL INFARCTION

Background

Each year, thousands of Canadians are hospitalized with an acute myocardial infarction.[1] Although 10% to 15% of these patients die during their hospital stay, the vast majority survive and are at high risk for cardiac death or a second infarction. In large clinical trials, a number of medications have been shown to prevent reinfarction and improve survival after an AMI. These medications include aspirin, which reduces the risk of death by 12% and the risk of reinfarction by 31%,[2] and beta-blockers, which reduce long-term mortality by 20% and sudden cardiac deaths by 34%.[3] Angiotensin converting enzyme (ACE) inhibitors have also been shown to improve survival by 23% in patients with left ventricular dysfunction after an infarct.[4] More recently in the 4S (Scandinavian Simvastatin Survival Study) and the Cholesterol and Recurrent Events (CARE) trials,[5,6] the cholesterol-lowering statin drugs were shown to reduce coronary events and the need for revascularization procedures. In contrast, there is no evidence to support the routine use of calcium channel blockers in post-myocardial infarction patients and some studies have suggested that these agents may cause harm.[7]

In this section, we present the first population-based analyses of the use of these therapies in a large Canadian cohort of elderly post-myocardial infarction survivors. We focus on persons aged 65 and over because of our ability to access anonymous data on prescription drug use provided to them under the universal Ontario Drug Benefit (ODB) program. Our results are presented at the District Health Council (DHC), major municipality and hospital level. Our intent in publishing these profiles is to encourage clinicians in Ontario to optimize their use of these effective secondary prevention medications in seniors surviving an acute myocardial infarction. This could potentially lead to significant improvements in the long-term outcomes of elderly AMI patients in Ontario.

Data Sources

We draw upon linked administrative data from the Ontario Myocardial Infarction Database (OMID) project for our analyses (see the Methods Appendix for Chapter 5). For this chapter, we used a subset of OMID, consisting of elderly (aged 65 and over) AMI survivors in Ontario hospitalized during the three-year time period between fiscal 1994/95 and 1996/97. The AMI patients were identified using the inclusion/exclusion criteria listed in the Methods Appendix MA11.1. The use of outpatient cardiac drugs was determined by linking patient data from the ODB database to the Canadian Institute for Health Information (CIHI) database using anonymous, scrambled Ontario health card numbers. We did not study aspirin use because some patients may have purchased it over-the-counter rather than through the ODB program. Ninety-day post-discharge rates of use were calculated for drugs proven beneficial for AMI survivors (beta-blockers, ACE inhibitors, statins) and for those with no proven benefit (calcium channel blockers). A ninety-day window was chosen to allow a reasonable amount of time for either the patient's hospital physician, primary care physician or other specialists to initiate secondary prevention drug therapy. Ninety-eight per cent of the AMI patients who survived to discharge received one or more cardiac medications from the ODB program within one year of hospital discharge. A list of all the different brands of medications within each drug class available from the ODB is shown in the Methods Appendix MA11.4.

How We Did the Analysis

Our analyses of secondary prevention medications were conducted at the DHC, major municipality and hospital levels. Hospitals were classified as teaching, large, medium, or small based on their total level of cardiovascular clinical activity (see Technical Appendix). We calculated the lowest and highest rates, 25th and 75th percentile, and median rates of use. We identified as "top performers," the top 10% of DHCs, major municipalities, and hospitals (with 15 or more AMI patients over the three-year period) with the highest rates of use of beta-blockers, ACE inhibitors and statins and the lowest rates of use of calcium channel blockers. These top performers can be considered institutions whose drug prescription rates are at a level that can serve as a benchmark for other institutions to improve their rates under the assumption that patient severity and contraindications to therapy should be similar across institutions.

In general, beta-blockers should be used in all post-MI patients without contraindications. ACE inhibitors should also be used in post-AMI patients with left ventricular dysfunction. Although there is increasing evidence for the benefits of the lipid-lowering statin drugs in post-MI patients,[5,6] the upper limit on the right rate of use remains to be determined. In contrast, calcium channel blockers should not be routinely used in post-MI patients and a lower rate is generally desirable.

Interpretive Cautions

We did not calculate 95% confidence intervals around individual drug usage rates. Instead, we developed an interpretive guide to drug tables that could be used to estimate the 95% confidence limits around individual drug usage rates, given a certain prescription rate and volume of AMI cases (Appendix A11.1). For example, if a hospital had a prescription rate of 50% for beta-blockers and it discharged 200 AMI survivors, the 95% confidence limits for that hospital's beta-blocker rate would be 50% plus or minus 7% (i.e. 43% to 57%). We caution that rates of use of therapies in hospitals with small numbers of patients should be interpreted cautiously because of the wide confidence limits. We do not present hospital-specific drug rates for institutions treating less than 15 elderly AMI survivors over the three-year period because their results are likely to be statistically unstable.

The results of our analysis reflect the crude rates of drug use rather than the age- and sex-adjusted rates. Although we did not include age- and sex-adjusted rates in this Atlas, we did calculate them and found they were identical to the crude rates for most hospitals. They did not differ from the crude rates by more than 4% across all teaching, large and medium-sized hospitals. The use of crude rates was also chosen in part so hospitals could more readily compare the 90-day utilization rates published in the Atlas with rates at hospital discharge by reviewing AMI charts at their institutions.

An important limitation of our analyses is that we did not have detailed data available on contraindications to each of these drug therapies. For example, we would never expect rates of use for beta-blockers to reach 100% because there will always be some patients in whom these drugs are contraindicated and in whom they may actually be harmful.

Clinical uncertainty regarding the appropriate use of these medications in seniors in the oldest age groups may also be a factor contributing to lower rates of drug use at some institutions. The scientific evidence supporting the use of many of these therapies in the oldest age groups (aged 75 and over) is not well established since older people are often excluded from clinical trials of new cardiac medications. Our analyses include the period when the first major study (Scandinavian Simvastatin Survival Study [4S]) was published showing the benefits of statins for secondary prevention after an AMI.[5] One might reasonably have expected a delay in the rate of use of this class of drugs as clinicians waited for additional studies to verify their effectiveness.

Our primary outcome was the 90-day post-discharge rates of use of these drugs. Because the 90-day rate is a reflection of both decisions made in-hospital during the initial hospitalization and those made by the family doctor or other specialists after the patient has left the hospital, the results should not be solely attributed to clinicians at the admitting hospital. We were only able to study prescriptions that were filled by patients and it is possible that some patients may have been prescribed an appropriate medication but did not fill their prescription.

Findings and Discussion

The overall 90-day post-discharge rates of beta-blocker, ACE inhibitor, statin and calcium channel blocker use in elderly Ontario AMI patients during the three-year time frame of our study are shown in Exhibit 11.1. The use of beta-blockers increased slightly from 48% in fiscal 1994/95 to 51% in 1996/97 while the use of calcium channel blockers declined from 39% in fiscal 1994/95 to 34% in 1996/97. There was a significant increase in the rates of ACE inhibitor use from 45% in fiscal 1994/95 to 52% in 1996/97. However, the largest increase was in the use of statins which rose from 7% in fiscal 1994/95 to 20% in 1996/97.

While the rates of use of each of these therapies were similar in men and women, there were significant age differences. For example, the use of statins was very low in AMI patients aged 85 and over. The major clinical trials of the statins have excluded the very elderly and thus, this low rate may be entirely appropriate.

EXHIBIT 11.1 Overall and Age/Sex-specific 90-day Post-discharge Utilization Rates for Beta-blockers, ACE Inhibitors, Statins and Calcium Channel Blockers per 100 Acute Myocardial Infarction Patients Aged 65 Years and Over in Ontario, 1994/95 - 1996/97

	1994/95 - 1996/97									Total
	Women (Age)			Men (Age)			Overall			1994/95 - 1996/97
	65-74	75-84	85+	65-74	75-84	85+	1994/95	1995/96	1996/97	
Number of Acute Myocardial Infarction Patients	5,034	4,813	1,749	8,312	5,076	1,070	8,305	8,579	9,170	**26,054**
Utilization Rate (%)										
Beta-blocker	58	48	34	57	45	34	48	53	51	**51**
ACE Inhibitor	48	52	53	46	51	49	45	50	52	**49**
Statin	21	10	2	18	9	2	7	14	20	**14**
Calcium Channel Blocker	38	40	32	33	36	32	39	34	34	**36**

Data Source: Canadian Institute for Health Information, Ontario Drug Benefit Program

EXHIBIT 11.2 Ninety-day Post-discharge Utilization Rates for Beta-blockers, ACE Inhibitors, Statins and Calcium Channel Blockers per 100 Acute Myocardial Infarction Patients Aged 65 Years and Over in Ontario by District Health Council, 1994/95 - 1996/97

District Health Council	Number of Acute Myocardial Infarction Patients	Utilization Rate (%)			
		Beta-blockers	ACE Inhibitors	Statins	Calcium Channel Blockers
Algoma, Cochrane, Manitoulin and Sudbury	1,080	42	47	9	40
Champlain	2,194	57*	47	12	29*
Durham, Haliburton, Kawartha and Pine Ridge	1,840	48	49	18*	41
Essex, Kent and Lambton	1,722	51	49	12	33
Grand River	724	47	53	11	35
Grey, Bruce, Huron, Perth	896	50	43	10	34
Halton-Peel	1,837	53	48	16	41
Hamilton-Wentworth	1,201	56*	57*	14	30*
Muskoka, Nipissing, Parry Sound and Timiskaming	661	51	51	11	33
Niagara Region	1,277	55	54*	12	38
Northwestern Ontario	586	42	48	9	37
Quinte, Kingston, Rideau	1,431	44	44	9	41
Simcoe-York	1,708	48	49	13	34
Thames Valley	1,581	48	44	13	37
Toronto	6,025	52	51	17*	36
Waterloo Region-Wellington-Dufferin	1,291	54	49	13	31
Summary Statistics	**26,054**				
Minimum		42	43	9	29
25th Percentile		48	47	11	33
Median		51	49	12	36
75th Percentile		54	51	14	39
Maximum		57	57	18	41

* Top performers are those in the top 10%.

Data Source: Canadian Institute for Health Information, Ontario Drug Benefit Program

An analysis of the four drugs by DHC is shown in Exhibit 11.2. Overall, there were significant variations in the use of all four drugs. Among the DHCs, the highest rate of beta-blocker use was found in the Champlain DHC (57%) while the highest ACE inhibitors rate was in the Hamilton-Wentworth DHC (57%). Durham, Haliburton, Kawartha and Pine Ridge DHC had the highest rate of statin use (18%) while the Champlain DHC had the lowest rate of calcium channel blocker use (29%). These results are also highlighted in the regional maps shown in Exhibits 11.3 to 11.6.

The results for the major municipalities are shown in Exhibit 11.7. Nepean had the highest beta-blocker rate (69%), Richmond Hill the highest ACE inhibitor rate (63%), Cambridge the highest statin rate (28%), and other areas in the Hamilton-Wentworth DHC, the lowest calcium channel blocker rate (23%).

Hospital-specific profiles of the use of each of these medications are shown in Exhibit 11.8. There were wide variations in the use of all four therapies. The median rate of beta-blocker use (56%) was highest in the teaching hospitals. Among the teaching and large hospitals, St. Michael's Hospital had the highest beta-blocker rate (74%), Salvation Army Grace Hospital had the highest ACE inhibitor rate (64%), Cambridge Memorial Hospital had the highest statin rate (29%) and Chedoke-McMaster Hospital had the lowest calcium channel blocker rate (18%).

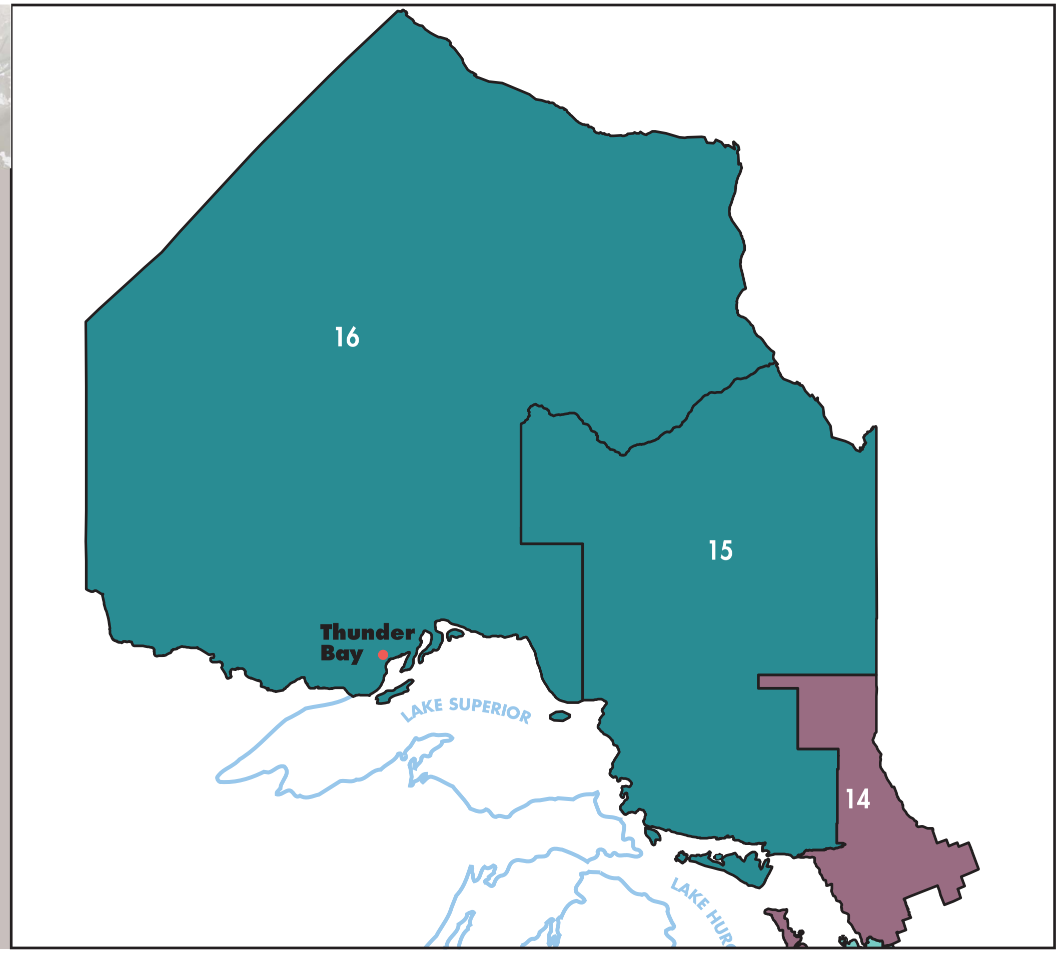
Among medium-sized hospitals, Sydenham District Hospital had the highest beta-blocker rate (78%), Doctors Hospital had the highest ACE inhibitor rate (78%), Milton District Hospital had the highest statin rate (28%) and Metropolitan General Hospital had the lowest calcium channel blocker rate (20%). It should be noted that most medium- and small-sized hospitals had relatively low volumes of AMI patients and thus, there are wide confidence limits around their individual hospital drug use rates.

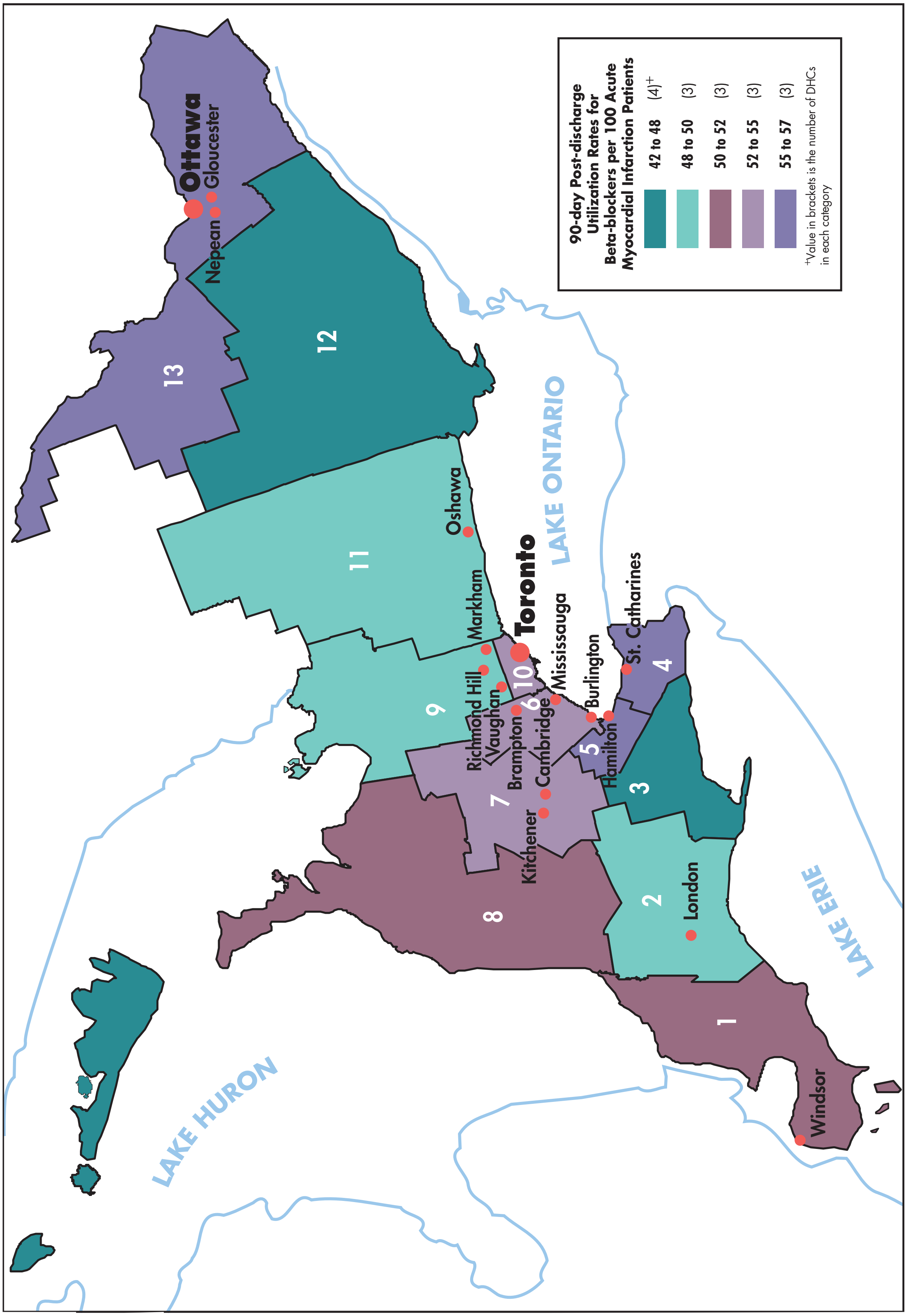
11.3 EXHIBIT

Ninety-day Post-discharge Utilization Rates for Beta-blockers per 100 Acute Myocardial Infarction Patients Aged 65 Years and Over by District Health Council in Ontario, 1994/95 - 1996/97

ONTARIO District Health Councils

1. Essex, Kent and Lambton
2. Thames Valley
3. Grand River
4. Niagara Region
5. Hamilton-Wentworth
6. Halton-Peel
7. Waterloo Region-Wellington-Dufferin
8. Grey, Bruce, Huron, Perth
9. Simcoe-York
10. Toronto
11. Durham, Haliburton, Kawartha and Pine Ridge
12. Quinte, Kingston, Rideau
13. Champlain
14. Muskoka, Nipissing, Parry Sound and Timiskaming
15. Algoma, Cochrane, Manitoulin and Sudbury
16. Northwestern Ontario





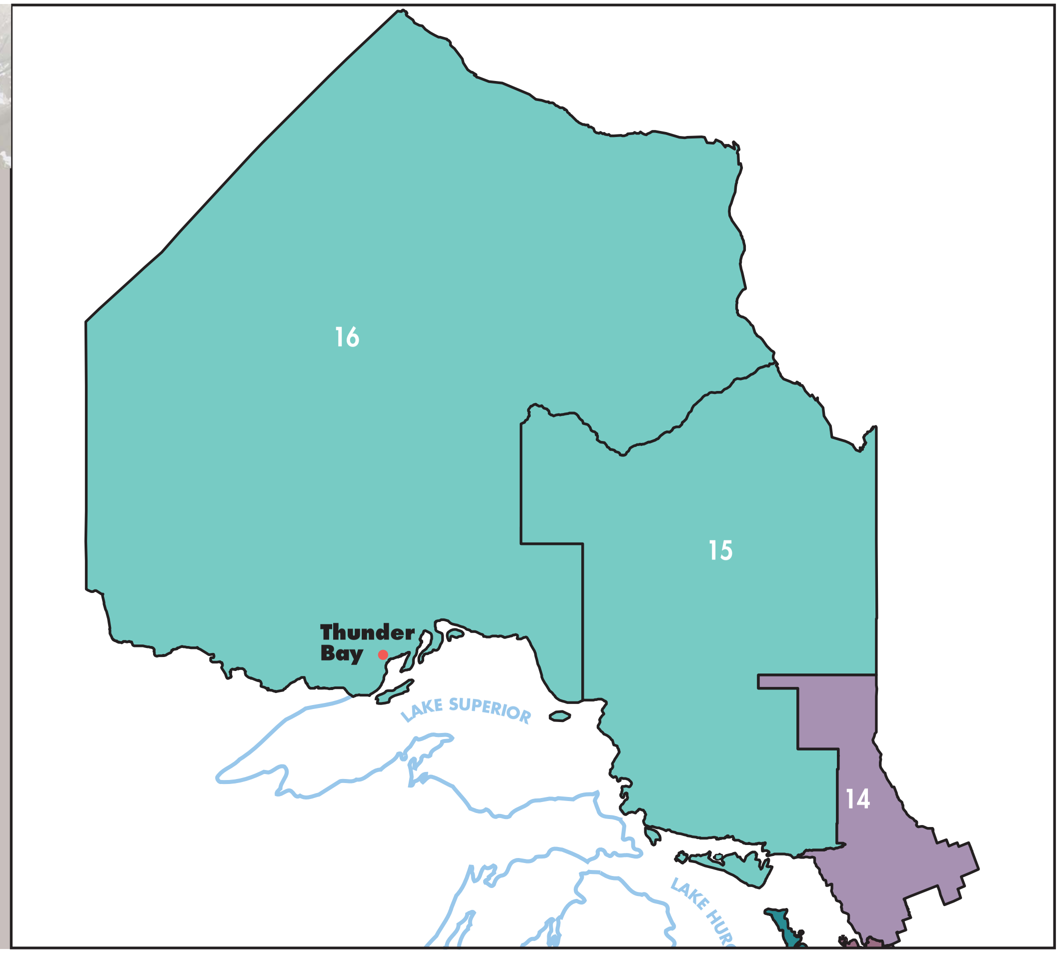
Data Source: Canadian Institute for Health Information, Ontario Drug Benefit Program

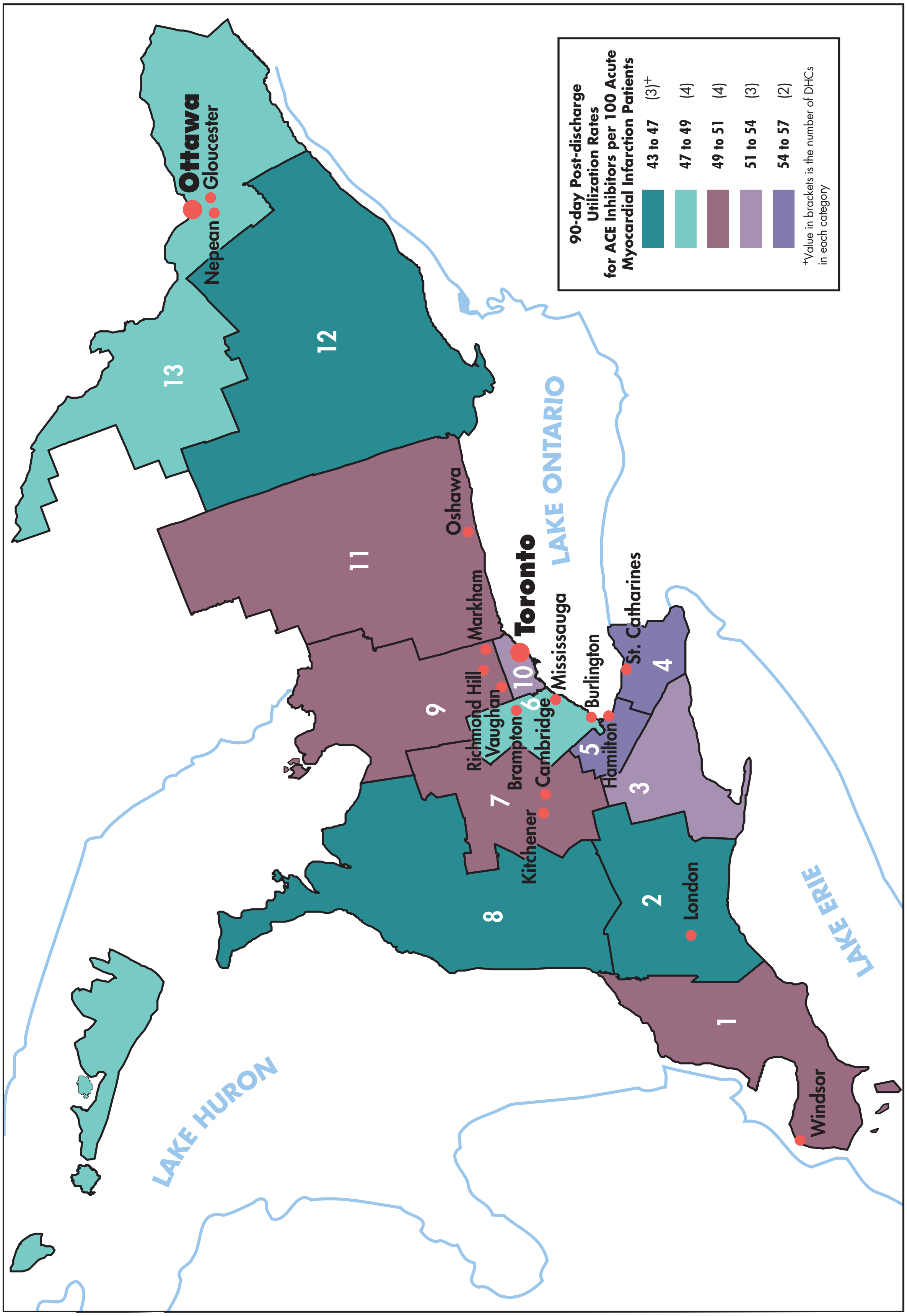
11.4 EXHIBIT

Ninety-day Post-discharge Utilization Rates for ACE Inhibitors per 100 Acute Myocardial Infarction Patients Aged 65 Years and Over by District Health Council in Ontario, 1994/95 - 1996/97

ONTARIO District Health Councils

1. Essex, Kent and Lambton
2. Thames Valley
3. Grand River
4. Niagara Region
5. Hamilton-Wentworth
6. Halton-Peel
7. Waterloo Region-Wellington-Dufferin
8. Grey, Bruce, Huron, Perth
9. Simcoe-York
10. Toronto
11. Durham, Haliburton, Kawartha and Pine Ridge
12. Quinte, Kingston, Rideau
13. Champlain
14. Muskoka, Nipissing, Parry Sound and Timiskaming
15. Algoma, Cochrane, Manitoulin and Sudbury
16. Northwestern Ontario





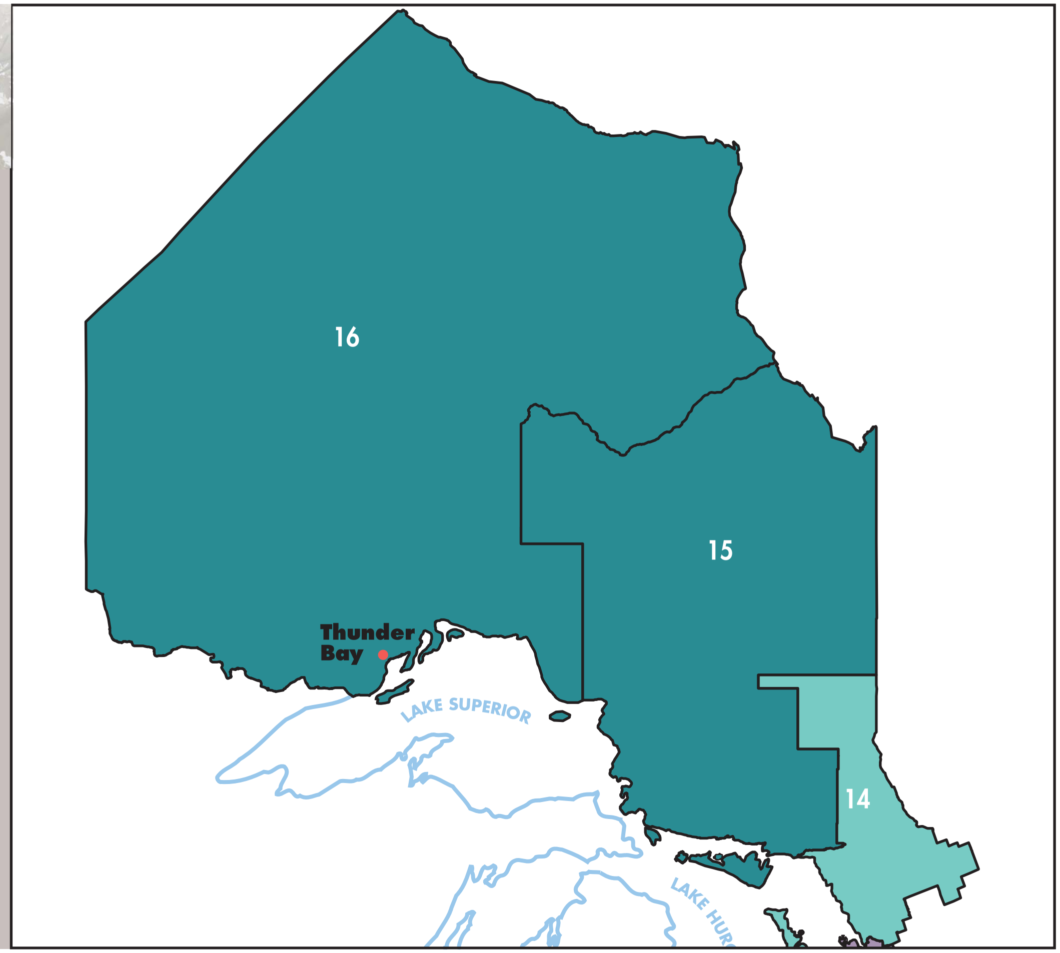
Data Source: Canadian Institute for Health Information, Ontario Drug Benefit Program

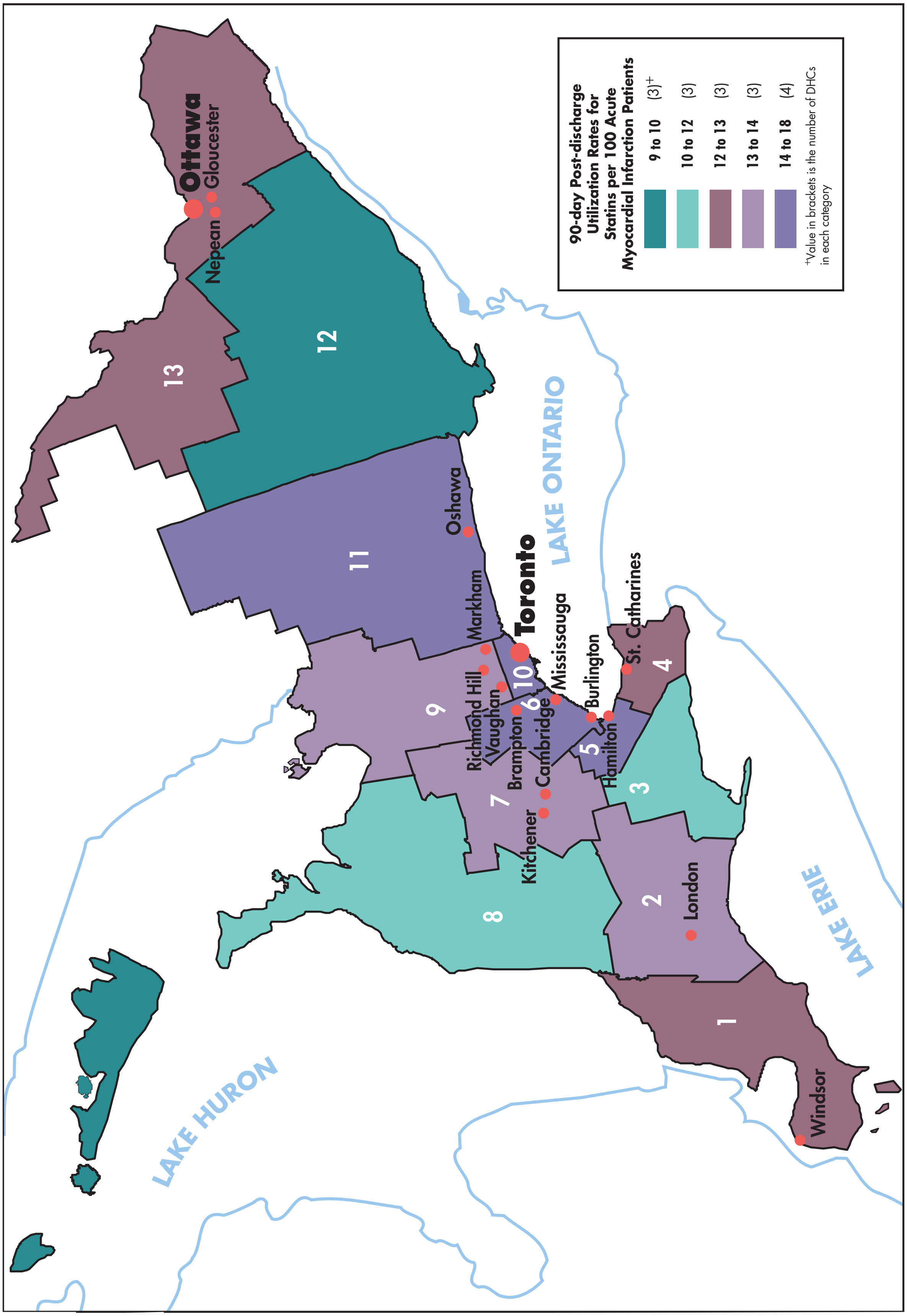
11.5 EXHIBIT

Ninety-day Post-discharge Utilization Rates for Statins per 100 Acute Myocardial Infarction Patients Aged 65 Years and Over by District Health Council in Ontario, 1994/95 - 1996/97

ONTARIO District Health Councils

1. Essex, Kent and Lambton
2. Thames Valley
3. Grand River
4. Niagara Region
5. Hamilton-Wentworth
6. Halton-Peel
7. Waterloo Region-Wellington-Dufferin
8. Grey, Bruce, Huron, Perth
9. Simcoe-York
10. Toronto
11. Durham, Haliburton, Kawartha and Pine Ridge
12. Quinte, Kingston, Rideau
13. Champlain
14. Muskoka, Nipissing, Parry Sound and Timiskaming
15. Algoma, Cochrane, Manitoulin and Sudbury
16. Northwestern Ontario





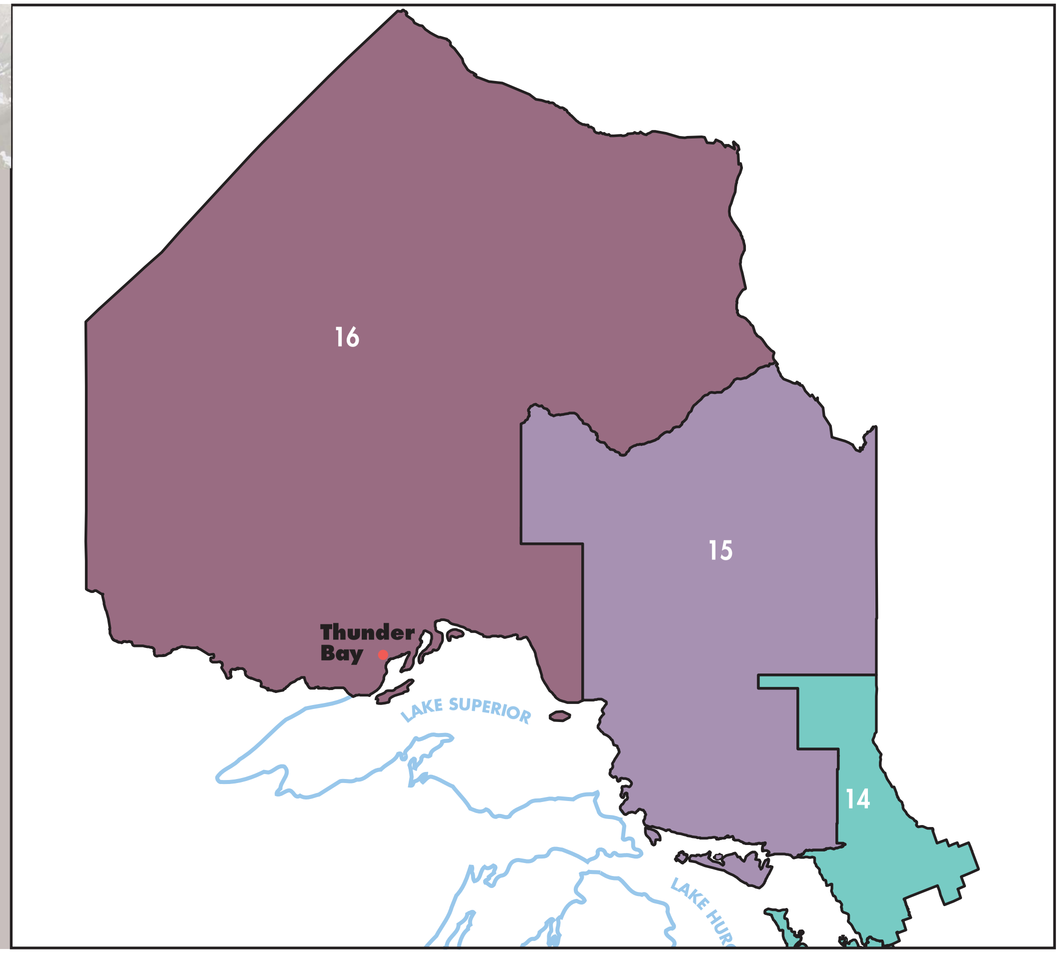
Data Source: Canadian Institute for Health Information, Ontario Drug Benefit Program

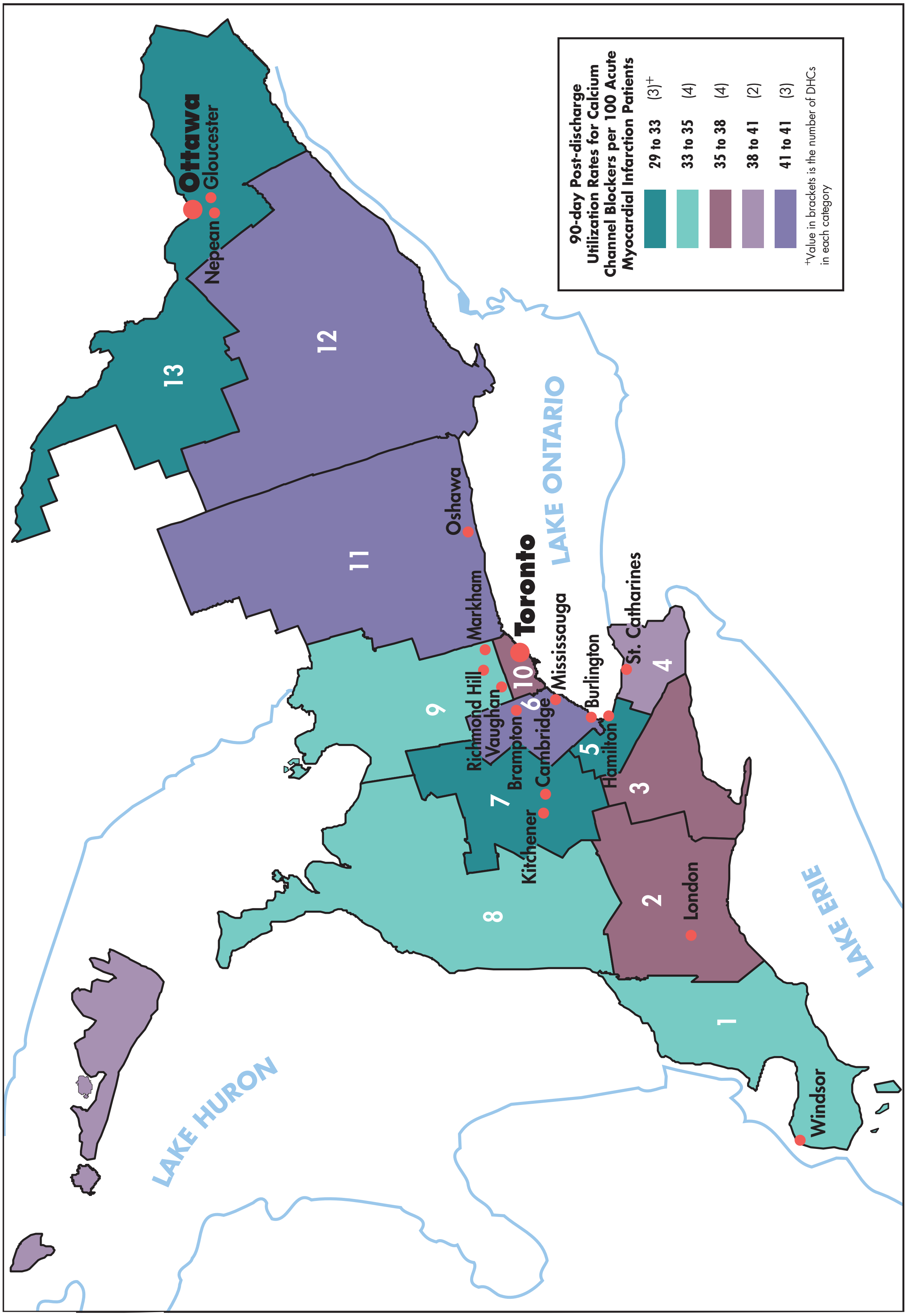
11.6 EXHIBIT

Ninety-day Post-discharge Utilization Rates for Calcium Channel Blockers per 100 Acute Myocardial Infarction Patients Aged 65 Years and Over by District Health Council in Ontario, 1994/95 - 1996/97

ONTARIO District Health Councils

1. Essex, Kent and Lambton
2. Thames Valley
3. Grand River
4. Niagara Region
5. Hamilton-Wentworth
6. Halton-Peel
7. Waterloo Region-Wellington-Dufferin
8. Grey, Bruce, Huron, Perth
9. Simcoe-York
10. Toronto
11. Durham, Haliburton, Kawartha and Pine Ridge
12. Quinte, Kingston, Rideau
13. Champlain
14. Muskoka, Nipissing, Parry Sound and Timiskaming
15. Algoma, Cochrane, Manitoulin and Sudbury
16. Northwestern Ontario





Data Source: Canadian Institute for Health Information, Ontario Drug Benifit Program

EXHIBIT 11.7 Ninety-day Post-discharge Utilization Rates for Beta-blockers, ACE Inhibitors, Statins and Calcium Channel Blockers per 100 Acute Myocardial Infarction Patients Aged 65 Years and Over by Municipality with Population Greater than 100,000 versus Other Areas in Ontario District Health Councils, 1994/95 - 1996/97

Municipalities/Other Areas	Number of Acute Myocardial Infarction Patients	Utilization Rate (%)			
		Beta-blockers	ACE Inhibitors	Statins	Calcium Channel Blockers
Champlain					
Gloucester	165	57	51	15	35
Nepean	172	69*	47	10	26*
Ottawa	848	63*	51	13	29
Other	1,009	50	44	11	30
Durham, Haliburton, Kawartha and Pine Ridge					
Oshawa	328	51	53	14	46
Other	1,512	47	48	19*	40
Essex, Kent and Lambton					
Windsor	594	52	46	16	28
Other	1,128	50	51	10	36
Halton-Peel					
Brampton	327	55	55	17	34
Burlington	351	44	40	19*	45
Mississauga	747	52	45	14	45
Oakville	239	61*	54	17	38
Other	173	57	58*	18	29
Hamilton-Wentworth					
Hamilton	897	57	57	14	32
Other	304	56	57	12	23*
Niagara Region					
St. Catharines	418	55	60*	14	36
Other	859	55	50	12	38
Northwestern Ontario					
Thunder Bay	375	46	48	11	39
Other	211	36	48	5	32
Simcoe-York					
Markham	225	54	53	19*	37
Richmond Hill	164	55	63*	15	41
Vaughan	181	44	51	13	36
Other	1,138	47	46	11	33
Thames Valley					
London	854	52	46	15	34
Other	727	44	43	10	41
Waterloo Region-Wellington-Dufferin					
Cambridge	240	57	50	28*	40
Kitchener	350	51	52	9	27*
Other	701	55	48	10	30
Summary Statistics					
Minimum		36	40	5	23
25th Percentile		49	47	11	30
Median		53	51	14	36
75th Percentile		57	54	17	40
Maximum		69	63	28	46

* Top performers are those in the top 10%.

Note: Utilization rates in areas with small volumes should be interpreted with caution. See Appendix A11.1 for information on determining confidence intervals.

Data Source: Canadian Institute for Health Information, Ontario Drug Benefit Program

EXHIBIT 11.8 Crude 90-Day Post-discharge Utilization Rates for Beta-blockers, ACE Inhibitors, Statins and Calcium Channel Blockers per 100 Acute Myocardial Infarction Patients Aged 65 Years and Over by Hospital in Ontario, 1994/95 - 1996/97

TEACHING

Hospital	Number of Acute Myocardial Infarction Patients	Utilization Rate (%)			
		Beta-blockers	ACE Inhibitors	Statins	Calcium Channel Blockers
Chedoke-McMaster Hospital, Hamilton	253	57	61*	11	18*
Hamilton Civic Hospitals (General Division)	318	64*	61*	19	28
Hamilton Civic Hospitals (Henderson Division)	410	52	50	10	29
Hôtel Dieu Hospital, Kingston	201	39	40	2	49
Kingston General Hospital	271	47	46	7	55
Mount Sinai Hospital, Toronto	228	51	46	18	33
Ottawa Civic Hospital	502	69*	52	11	27
Ottawa General Hospital	323	62	57	17	21*
St. Joseph's Health Centre of London	384	52	40	15	42
St. Joseph's Hospital, Hamilton	220	59	56	15	45
St. Michael's Hospital, Toronto	118	74*	58	15	36
Sunnybrook Health Science Centre, Toronto	386	60	48	11	23
Toronto Hospital Corporation	467	56	58	11	27
University Hospital, London	160	56	40	14	36
Victoria Hospital, London	407	50	49	14	27
Wellesley-Central Hospital, Toronto	153	71*	49	10	42
Women's College Hospital, Toronto	71	44	39	13	38
Summary Statistics					
Minimum		39	39	2	18
25th Percentile		51	46	11	27
Median		56	49	13	33
75th Percentile		62	57	15	42
Maximum		74	61	19	55

LARGE

Hospital	Number of Acute Myocardial Infarction Patients	Utilization Rate (%)			
		Beta-blockers	ACE Inhibitors	Statins	Calcium Channel Blockers
Belleville General Hospital	272	39	43	11	40
Brantford General Hospital	330	51	59	10	35
Cambridge Memorial Hospital	248	56	50	29*	39
Centenary Health Centre, Scarborough	296	56	55	25*	35
Credit Valley Hospital, Mississauga	258	55	47	13	46
Etobicoke General Hospital	361	48	50	14	34
Grand River Hospital Corporation, Kitchener	337	56	44	10	26
Greater Niagara General Hospital	261	63*	51	11	56
Grey Bruce Regional Health Centre, Owen Sound	191	56	41	13	41
Guelph General Hospital	222	68*	57	9	23
Hôpital Montfort, Ottawa	249	64*	50	11	49
Hôtel Dieu Hospital, St. Catharines	178	54	61*	12	33
Hôtel Dieu Grace Hospital, Windsor	235	49	51	22*	27

EXHIBIT 11.8

LARGE (CONT'D)

Hospital	Number of Acute Myocardial Infarction Patients	Utilization Rate (%)			
		Beta-blockers	ACE Inhibitors	Statins	Calcium Channel Blockers
Humber Memorial Hospital, Weston	228	42	50	20*	32
Joseph Brant Memorial Hospital, Burlington	375	43	43	19	45
Mississauga Hospital (The)	419	49	42	13	50
Norfolk General Hospital, Simcoe	258	41	48	11	37
North York Branson Hospital	511	50	44	17	34
North York General Hospital	639	51	45	17	35
Northwestern General Hospital, Toronto	298	61	62*	18	25
Oakville-Trafalgar Memorial Hospital	266	62	55	16	38
Orillia Soldiers' Memorial Hospital	217	57	31	10	41
Oshawa General Hospital	399	51	54	16	45
Peel Memorial Hospital, Brampton	320	54	57	16	32
Peterborough Civic Hospital	378	56	44	23*	31
Public General Hospital, Chatham	235	45	42	4	47
Queensway General Hospital, Etobicoke	343	49	44	13	46
Queensway-Carleton Hospital, Nepean	224	62	39	9	21*
Riverside Hospital, Ottawa	192	44	42	11	33
Ross Memorial Hospital, Lindsay	299	39	43	16	55
Royal Victoria Hospital, Barrie	288	45	48	11	33
Salvation Army Scarborough Grace Hospital	297	54	64*	20*	46
Sarnia General Hospital	244	55	55	9	30
Sault Ste. Marie General Hospital	156	48	52	16	27
Scarborough General Hospital	593	55	54	17	47
St. Catharines General Hospital	324	54	59	15	38
St. Thomas Elgin General Hospital	223	52	44	13	44
St. Joseph's Health Centre, Toronto	516	41	53	16	44
St. Mary's General Hospital, Kitchener	220	47	54	11	25
Sudbury General Hospital of the Immaculate Heart of Mary	201	42	51	8	42
Sudbury Memorial Hospital	208	40	51	9	41
Toronto East General and Orthopedic Hospital	524	40	47	27*	39
Welland County General Hospital	205	56	51	14	24
York Central Hospital, Richmond Hill	295	53	63*	17	38
York County Hospital, Newmarket	214	50	53	10	33
York-Finch General Hospital, North York	256	54	50	12	31
Summary Statistics					
Minimum		39	31	4	21
25th Percentile		45	44	11	32
Median		52	50	13	38
75th Percentile		56	54	17	44
Maximum		68	64	29	56

EXHIBIT 11.8

MEDIUM

Hospital	Number of Acute Myocardial Infarction Patients	Utilization Rate (%) Beta-blockers	ACE Inhibitors	Statins	Calcium Channel Blockers
Ajax and Pickering General Hospital	182	46	65*	21*	27
Alexandra Hospital, Ingersoll	62	35	56	6	34
Alexandra Marine and General Hospital, Goderich	65	48	37	11	38
Arnprior and District Memorial Hospital	54	57	30	4	41
Brockville General Hospital	100	39	36	9	35
Campbellford Memorial Hospital	86	48	62*	16	44
Cobourg District General Hospital	63	32	30	17	35
Collingwood General and Marine Hospital	108	50	44	9	28
Cornwall General Hospital	120	38	45	12	28
Doctors Hospital, Toronto	45	49	78*	16	36
Douglas Memorial Hospital, Fort Erie	65	45	55	12	35
Dufferin-Caledon Health Care Corporation, Orangeville	142	35	52	13	32
Georgetown and District Memorial Hospital	48	69*	56	10	33
Groves Memorial and Community Hospital, Fergus	78	51	31	8	60
Hôpital General de Hawkesbury and District General Hospital Inc.	71	42	55	13	30
Hôtel Dieu Hospital, Cornwall	150	47	33	15	39
Hôtel Dieu of St. Joseph Hospital, Windsor	74	57	38	8	47
Huntsville District Memorial Hospital	87	54	46	11	32
Huronia District Hospital, Midland	137	47	45	13	23
Kirkland and District Hospital	60	33	42	3	42
Lake of the Woods District Hospital, Kenora	47	32	60	11	30
Leamington District Memorial Hospital	145	36	48	26*	48
Lennox and Addington County General Hospital, Napanee	97	36	33	5	31
Markham Stouffville Hospital	145	58	46	15	39
Memorial Hospital, Bowmanville	83	28	58	12	35
Metropolitan General Hospital, Windsor	189	58	38	11	20*
Milton District Hospital	61	59	75*	28*	31
North Bay General Hospital	128	52	60	9	30
Pembroke Civic Hospital	79	35	35	8	25
Pembroke General Hospital	51	43	35	12	27
Perth and Smiths Falls District Hospital	155	68*	50	15	37
Plummer Memorial Public Hospital, Sault Ste. Marie	115	31	37	4	44
Port Colborne General Hospital	92	59	51	10	23
Prince Edward County Memorial Hospital, Picton	70	40	43	11	36
Renfrew Victoria Hospital	63	57	56	8	37
South Muskoka Memorial Hospital, Bracebridge	100	61	57	26*	27
St. Joseph's General Hospital, Elliot Lake	54	43	37	15	37
St. Joseph's General Hospital, Thunder Bay	83	46	61*	18	35
St. Joseph's Health Centre of Sarnia	43	47	58	5	26
St. Joseph's Hospital, Chatham	98	49	47	6	32
St. Joseph's Hospital and Health Centre of Peterborough	58	43	40	17	43
St. Vincent de Paul Hospital, Brockville	46	24	43	4	39
Stevenson Memorial Hospital, Alliston	121	36	51	15	31

MEDIUM (CONT'D)

Hospital	Number of Acute Myocardial Infarction Patients	Utilization Rate (%)			
		Beta-blockers	ACE Inhibitors	Statins	Calcium Channel Blockers
Stratford General Hospital	113	59	56	13	25
Strathroy Middlesex General Hospital	96	44	46	8	33
Sydenham District Hospital, Wallaceburg	93	78*	71*	8	33
Temiskaming Hospital, New Liskeard	61	49	56	7	33
Thunder Bay Regional Hospital	316	44	45	9	40
Tillsonburg District Memorial Hospital	111	41	41	15	44
Timmins and District Hospital	125	42	40	5	59
Trenton Memorial Hospital	122	36	55	15	43
West Lincoln Memorial Hospital, Grimsby	141	46	38	9	39
West Nipissing General Hospital, Sturgeon Falls	49	37	27	12	37
West Parry Sound Health Centre	93	67*	55	17	32
Whitby General Hospital	61	44	54	20*	43
Winchester District Memorial Hospital	93	41	54	11	22*
Windsor Regional Hospital	125	48	54	19	24
Windsor Western Hospital Centre Incorporated	94	55	50	13	29
Woodstock General Hospital	131	36	39	6	51
Summary Statistics					
Minimum		24	27	3	20
25th Percentile		37	38	8	30
Median		46	47	11	35
75th Percentile		54	56	15	39
Maximum		78	78	28	60

SMALL

Hospital	Number of Acute Myocardial Infarction Patients	Utilization Rate (%)			
		Beta-blockers	ACE Inhibitors	Statins	Calcium Channel Blockers
Almonte General Hospital	20	40	50	15	0*
Atikokan General Hospital	19	37	63*	5	42
Belleville General Hospital, Bancroft	38	37	50	21*	24
Bruce Peninsula Health Services, Wiarton	52	50	44	6	17*
Carleton Place and District Memorial Hospital	33	64*	39	6	24
Centre Grey General Hospital, Markdale	45	64*	44	18	44
Charlotte Eleanor Englehart Hospital, Petrolia	29	45	69*	7	31
Chesley and District Memorial Hospital	21	33	38	0	52
Clinton Public Hospital	27	44	33	15	44
Community Memorial-Port Perry Hospital, Scugog	33	64*	48	6	45
Cottage Hospital, Uxbridge	34	44	32	21*	35
County of Bruce General Hospital, Walkerton	38	45	29	5	47
Deep River and District Hospital Corporation	20	65*	35	25*	25
Dryden District General Hospital	28	43	43	4	29
Durham Memorial Hospital	22	32	41	0	41
Englehart and District Hospital	21	43	48	5	14*

EXHIBIT 11.8

SMALL (CONT'D)

Hospital	Number of Acute Myocardial Infarction Patients	Utilization Rate (%)			
		Beta-blockers	ACE Inhibitors	Statins	Calcium Channel Blockers
Espanola General Hospital	30	53	50	3	30
Four Countries General Hospital, Newbury	51	29	37	4	33
Geraldton District Hospital	17	53	59	0	12*
Haldimand War Memorial Hospital, Dunnville	46	35	63*	20*	33
Hanover and District Hospital	30	57	30	0	23
Kemptville District Hospital	28	68*	43	11	29
Kincardine and District General Hospital	56	54	41	9	34
Listowel Memorial Hospital	50	54	52	8	22*
Louise Marshall Hospital, Mount Forest	44	43	55	2	45
Manitoulin Health Centre, Little Current	32	50	56	0	9*
Manitoulin Health Centre, Mindemoya Unit	34	38	44	9	15*
Mattawa General Hospital	20	55	55	10	65
Meaford General Hospital	48	40	48	6	29
North Bay Civic Hospital	17	41	71*	6	18*
Palmerston and District Hospital	22	59	36	9	23
Penetanguishene General Hospital	41	29	49	7	29
Port Hope and District Hospital	44	43	43	16	30
Riverside Health Care Facilities, Fort Frances	31	35	39	0	29
Salvation Army Grace Hospital, Windsor	33	42	52	0	27
Seaforth Community Hospital	28	54	43	11	25
Sensenbrenner Hospital, Kapuskasing	35	54	43	20*	34
South Huron Hospital Association, Exeter	37	46	27	8	49
St. Joseph's Hospital and Health Centre of Peterborough, Haliburton	18	72*	50	39*	44
St. Joseph's General Hospital of North Bay	41	51	61*	2	29
St. Joseph's Health Centre, Blind River	21	24	38	29*	48
St. Mary's Memorial Hospital, St. Mary's	36	50	44	6	28
West Haldimand General Hospital, Hagersville	45	53	47	27*	36
Wingham and District Hospital	52	27	46	10	15*
Summary Statistics					
Minimum		24	27	0	0
25th Percentile		39	39	4	24
Median		45	44	7	29
75th Percentile		54	51	15	42
Maximum		72	71	39	65

* Top performers are those in the top 10%.

Hospitals with 15 or fewer acute myocardial infarction survivors have been excluded. Utilization rates in hospitals with small volumes should be interpreted with caution. See Appendix A11.1 for information on determining confidence intervals.

Data Source: Canadian Institute for Health Information, Ontario Drug Benefit Program

Conclusions

We have presented the first population-based analysis of secondary prevention medication use after myocardial infarction in Ontario. Overall, the utilization rates of these secondary prevention therapies appear to be reasonably high. It is difficult for us to make direct comparisons with studies of rates of use of these therapies in other jurisdictions because of differences in inclusion and exclusion criteria. The most comparable data may come from the United States' Cardiovascular Cooperative Project.[8] In that study, the rate of beta-blocker use for elderly American patients was 44% which is similar to our observations in Ontario.

However, our results also show significant inter-DHC, intermunicipal and interhospital variations in the use of each of these therapies. Clinicians at hospitals with relatively low rates of therapy use may wish to undertake a detailed examination of their current secondary prevention strategies to ensure that all potentially eligible patients receive these therapies. Use of standardized discharge order sheets, care maps or the introduction of specialized secondary prevention clinics are all means by which hospitals may be able to improve their rates of secondary preventive therapy. Given the strong scientific evidence supporting each of these therapies, maximizing the rate of use of beta-blockers, ACE inhibitors and statins represents an excellent opportunity for clinicians to improve the long-term outcomes of elderly myocardial infarction patients in Ontario.

Congestive Heart Failure

Background

Congestive heart failure is a leading cause of hospitalization among elderly Canadians. In this section we examine the use of the drug furosemide and the angiotensin-converting enzyme inhibitors in the treatment of CHF among elderly Ontario patients. Furosemide, a loop diuretic, is a commonly-used treatment for heart failure patients that helps to reduce fluid accumulation. In several major clinical trials in the late 1980s and early 1990s, ACE inhibitors were shown to decrease the need for repeat hospitalizations and improve the survival of patients with heart failure. A recent meta-analysis of all the major ACE inhibitor trials showed a 23% relative reduction in mortality and a 35% relative reduction in the combined endpoint of mortality or hospitalization when ACE inhibitors are used to treat CHF patients.[4] ACE inhibitors are currently recommended as first line therapy for the treatment of heart failure in Canada by the 1994 Congestive Heart Failure Consensus guidelines of the

Canadian Cardiovascular Society.[9] Furosemide should not be used alone in place of ACE inhibitors for the treatment of CHF patients.

Data Sources

For these analyses, we drew upon a linked cohort of new, elderly CHF patients in Ontario discharged alive from hospital between fiscal 1994/95 and 1996/97. These cohorts were created by extracting patients with a most responsible diagnosis of CHF (ICD-9: 428) from the Canadian Institute for Health Information (CIHI) database and then applying a series of exclusion criteria as shown in Methods Appendix MA11.2. Overall 29,513 patients met the inclusion/exclusion criteria for this analysis. We determined 90-day post-discharge rates of use of furosemide and ACE inhibitors by linking the patients in this cohort to their outpatient drug claims in the Ontario Drug Benefit database. Our analysis of post-discharge prescribing patterns was restricted to a patient's first admission for CHF in this time period. Sensitivity analyses, including all patient CHF admissions, were performed and showed similar levels of ACE inhibitor use but were not included in the Atlas.

How We Did the Analysis

Our analyses were conducted at the DHC, major municipality and hospital level. We did not study the use of diuretics other than furosemide because the utilization of these other drugs was low in CHF patients. We calculated 90-day post-discharge rates of furosemide use alone (without ACE inhibitors) because at some institutions, clinicians may be prescribing furosemide alone in place of ACE inhibitors, which is not desirable. We studied 90-day rates of use of all ACE inhibitors together (with or without furosemide) but did not study individual types of ACE inhibitors (captopril, enalapril, etc.) because of the low frequency of individual ACE inhibitor use at the hospital level. A list of the different types of ACE inhibitors included in our analysis is shown in Methods Appendix MA11.4. We calculated the frequency distribution of drug use including the lowest and highest rates, 25th and 75th percentiles, and median rates of use. We also identified as "top performers," the DHCs, municipalities and hospitals in the top 10th percentile of ACE inhibitor use and lowest 10th percentile of furosemide use alone.

Interpretive Cautions

Our analysis of CHF prescribing patterns should be interpreted in light of several caveats. First, we did not have data on important contraindications to ACE inhibitor use (e.g. renal artery stenosis) that may partially account for lower prescribing rates at some institutions. Second, we did not have data on the in-hospital use of ACE inhibitors and there may have been some patients who were given ACE inhibitors appropriately in hospital but could not tolerate them well enough to take them as outpatients. Third, the prescribing rates at hospitals with small numbers of patients should be interpreted cautiously because of wide confidence limits surrounding their prescribing rates. Readers are advised to use the interpretive guide for drug tables (Appendix A11.1) to determine confidence limits around individual drug use rates.

We did not analyze a number of other drugs that may be of benefit in CHF patients because the major studies supporting their use were published after the fiscal 1994/95 and 1996/97 time frame of our analysis. For example, the beta-blocker carvedilol has recently been shown to improve survival and decrease the need for hospitalization in CHF patients.[10] Similarly, the Evaluation of Losartan in the Elderly (ELITE) study suggests the angiotensin II antagonist losartan may be superior to the ACE inhibitor captopril in the treatment of CHF.[11] Finally, digoxin, an old mainstay of CHF treatment, has recently been shown in the Digoxin Investigation Group trial to reduce hospitalizations for CHF although it did not have any effect on survival.[12]

Findings and Discussion

The overall results of our analysis of furosemide and ACE inhibitor use are shown in Exhibit 11.9. The use of furosemide and ACE inhibitors in Ontario was relatively constant between fiscal 1994/95 and 1996/97. By fiscal 1996/97, 23% of new CHF patients in Ontario were discharged on furosemide alone while 67% of patients were sent home on ACE inhibitors. The use of these agents was similar in both the young elderly (aged 65 to 74) and the oldest elderly (aged 85 and over). There were no major gender differences in the use of these therapies.

The overall use of these drugs by DHCs and major municipalities is shown in Exhibits 11.10 and 11.11. There were significant variations among the DHCs in the use of ACE inhibitors ranging from a low of 61% in Northwestern Ontario DHC to a high of 73% in Grand River DHC. There was a strong inverse correlation between the rates of furosemide use alone and ACE inhibitor use (r= -0.93). A map of ACE inhibitor use in CHF patients by DHC is shown in Exhibit 11.12. Among the major municipalities, Burlington had the highest rate of ACE inhibitor use (76%).

EXHIBIT 11.9 Overall and Age/Sex-specific 90-day Post-discharge Utilization Rates for Furosemide and ACE Inhibitors per 100 Congestive Heart Failure Patients Aged 65 Years and Over in Ontario, 1994/95 - 1996/97

	1994/95 - 1996/97									Total
	Women			Men			Overall			1994/95 -
	65-74	75-84	85+	65-74	75-84	85+	1994/95	1995/96	1996/97	1996/97
Number of Congestive Heart Failure Patients	4,255	6,766	4,706	5,670	5,860	2,256	10,121	9,663	9,729	**29,513**
Utilization Rate (%)										
Furosemide Alone	23	24	29	19	22	30	24	24	23	**24**
ACE Inhibitor	68	66	61	71	69	59	66	67	67	**67**

Data Source: Canadian Institute for Health Information, Ontario Drug Benefit Program

EXHIBIT 11.10 Crude 90-day Post-discharge Utilization Rates for Furosemide and ACE Inhibitors per 100 Congestive Heart Failure Patients Aged 65 Years and Over by District Health Council in Ontario, 1994/95 - 1996/97

District Health Council	Number of Congestive Heart Failure Patients	Utilization Rate (%) Furosemide Alone	Utilization Rate (%) ACE Inhibitor
Algoma, Cochrane, Manitoulin and Sudbury	1,404	24	65
Champlain	2,471	23	67
Durham, Haliburton, Kawartha and Pine Ridge	2,073	23	65
Essex, Kent and Lambton	2,218	24	65
Grand River	901	18*	73*
Grey, Bruce, Huron, Perth	1,196	21	67
Halton-Peel	1,833	21	70
Hamilton-Wentworth	1,275	21	69
Muskoka, Nipissing, Parry Sound and Timiskaming	831	22	70
Niagara Region	1,543	20*	71*
Northwestern Ontario	848	28	61
Quinte, Kingston, Rideau	1,612	27	62
Simcoe-York	1,907	23	68
Thames Valley	1,563	28	62
Toronto	6,367	26	65
Waterloo Region-Wellington-Dufferin	1,471	20*	71*
Total Ontario	**29,513**	**20**	**71**
Summary Statistics			
Minimum		18	61
25th Percentile		21	65
Median		23	67
75th Percentile		25	70
Maximum		28	73

* Top performers are those in the top 10%.

Data Source: Canadian Institute for Health Information, Ontario Drug Benefit Program

EXHIBIT 11.11 Crude 90-day Post-discharge Utilization Rates for Furosemide and ACE Inhibitors per 100 Congestive Heart Failure Patients Aged 65 Years and Over by Municipality with Population Greater than 100,000 versus Other Areas in Ontario District Health Councils, 1994/95 - 1996/97

Municipality/Other Areas	Number of Congestive Heart Failure Patients	Utilization Rate (%)	
		Furosemide Alone	ACE Inhibitor
Champlain			
Gloucester	142	20	71
Nepean	182	22	66
Ottawa	943	20	71
Other	1,204	25	63
Durham, Haliburton, Kawartha and Pine Ridge			
Oshawa	312	18*	71
Other	1,761	24	64
Essex, Kent and Lambton			
Windsor	837	27	61
Other	1,381	23	67
Halton-Peel			
Brampton	289	21	69
Burlington	295	18*	76*
Mississauga	753	22	68
Oakville	269	22	69
Other	227	20	72*
Hamilton-Wentworth			
Hamilton	988	21	70
Other	287	22	68
Niagara Region			
St. Catharines	508	21	69
Other	1,035	19	72*
Northwestern Ontario			
Thunder Bay	499	31	60
Other	349	24	63
Simcoe-York			
Markham	203	22	67
Richmond Hill	120	23	68
Vaughan	210	27	64
Other	1,374	22	68
Thames Valley			
London	710	28	61
Other	853	28	63
Waterloo Region-Wellington-Dufferin			
Cambridge	248	29	63
Kitchener	461	20	70
Other	762	18*	75*
Total Ontario	17,202		
Summary Statistics			
Minimum		18	60
25th Percentile		20	64
Median		22	68
75th Percentile		25	71
Maximum		31	76

* Top performers are those in the top 10%.

Note: Utilization rates in areas with small volumes should be interpreted with caution. See Appendix A11.1 for information on determining confidence intervals.

Data Source: Canadian Institute for Health Information, Ontario Drug Benefit Program

Ninety-day post-discharge utilization rates of furosemide alone and ACE inhibitors in Ontario hospitals are shown in Exhibit 11.13. The median rates of ACE inhibitor use and furosemide alone were similar at teaching, large, medium and small hospitals in Ontario. However, there were significant inter-hospital variations in the use of ACE inhibitors. Among the teaching and large hospitals, ACE inhibitor use ranged from a low of 55% at Hôtel Dieu Hospital in Kingston to a high of 81% at Guelph General Hospital. Similarly, among the medium-sized hospitals, ACE inhibitor use ranged from a low of 45% at Arnprior and District Memorial Hospital and Cobourg District General Hospital to a high of 85% at Lake of the Woods Hospital in Kenora. There was also a strong inverse correlation between the furosemide alone rate and the ACE inhibitor rate of use (r= -0.88) suggesting that furosemide alone is being used as a substitute for ACE inhibitors in the chronic treatment of CHF at some hospitals in Ontario.

Conclusions

In this section, we present the first DHC, major municipality and hospital-specific analysis of furosemide and ACE inhibitor use in elderly CHF patients in Ontario. Our results show a significant amount of regional and interhospital variation in the use of these therapies. However, the overall rates of use of ACE inhibitors do appear to compare favourably with those reported in other jurisdictions. For example, the United States Cardiovascular Health Study found that in a community-wide sample of residents 65 years and over, the rate of ACE inhibitor use in newly diagnosed CHF patients was only 40%.[13] A recent study from a National Ambulatory Medical Care Survey showed that 30% of elderly Americans with CHF in 1991/92 were on ACE inhibitors.[14] Thus, Ontario's overall rates are better than these American benchmarks.

The Canadian Cardiovascular Society consensus guidelines supporting the use of ACE inhibitors as first line therapy for CHF were published at the beginning of the period of our analysis in 1994.[9] In spite of this, our data show there has been little change in ACE inhibitor therapy in Ontario over the past several years. From our analysis alone, we cannot determine the right rate of use but in general, higher rates of ACE inhibitor use are preferable as these drugs have been shown to substantially reduce morbidity and mortality in large clinical trials.[4] Clinicians at hospitals with relatively low rates of ACE inhibitor use may wish to undertake more detailed chart reviews of their own patients to determine whether underprescribing is an important factor to be addressed.

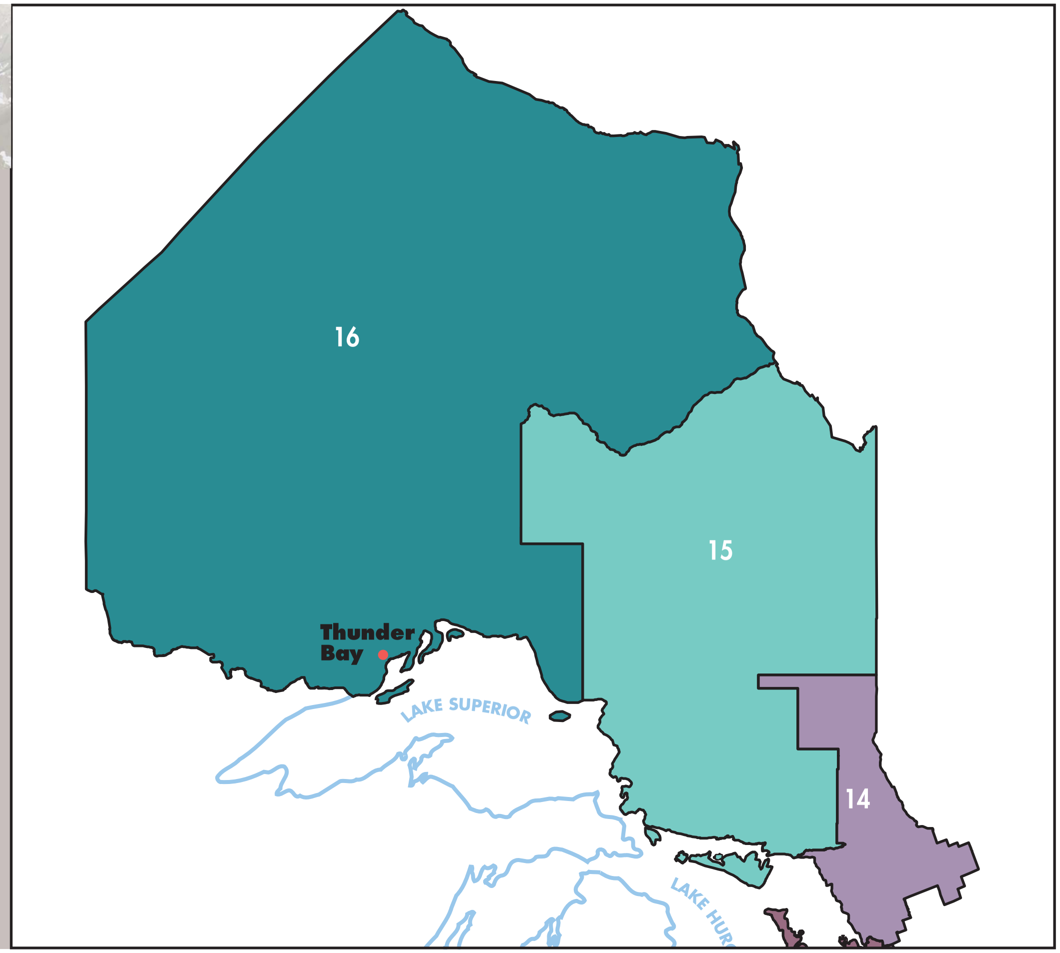
In summary, we found that ACE inhibitors were used to treat approximately two out of every three CHF patients in Ontario in fiscal 1994/95 to 1996/97; the diuretic furosemide was used alone in about one out of every four CHF

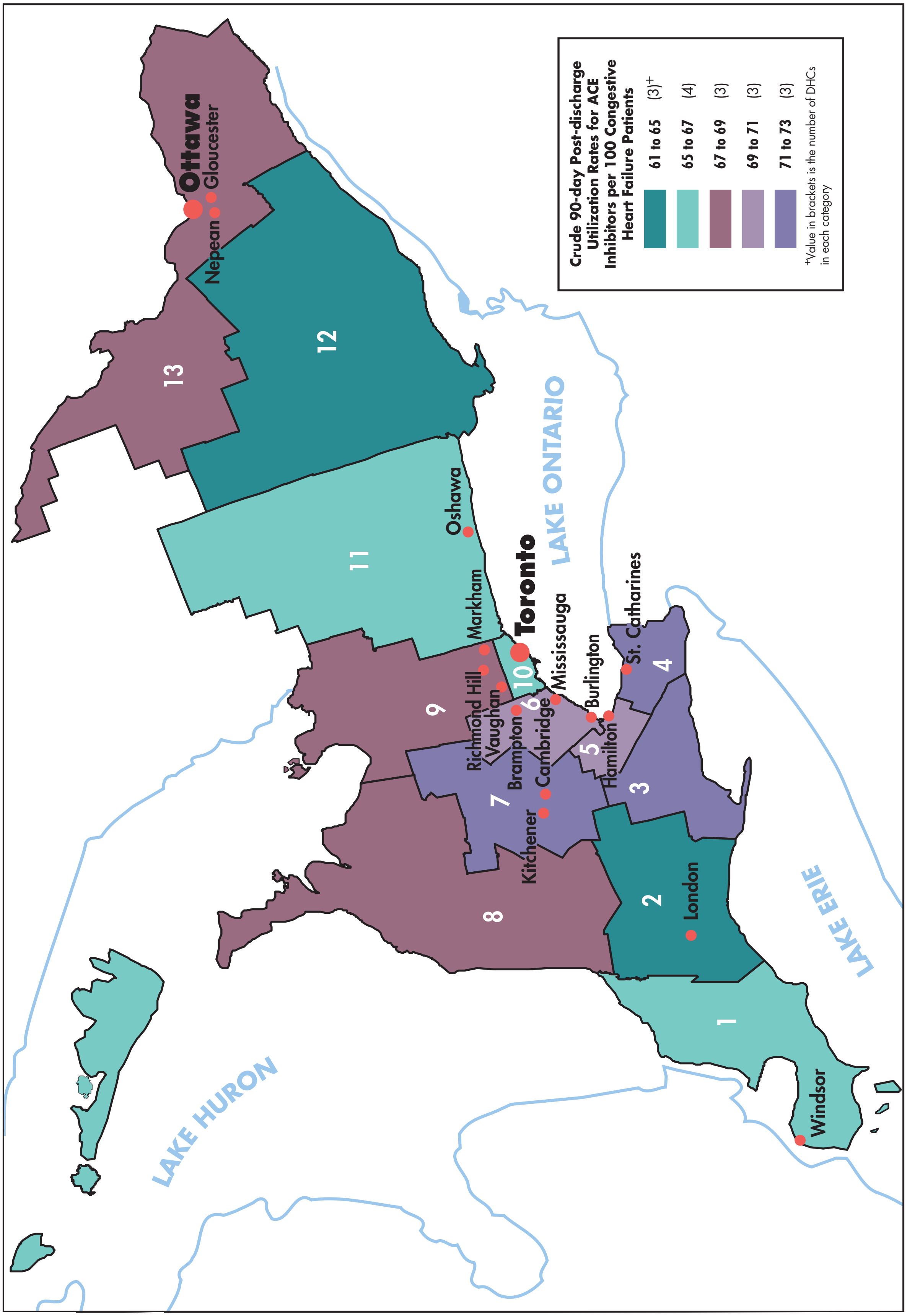
11.12 EXHIBIT

Crude 90-day Post-discharge Utilization Rates for ACE Inhibitors per 100 Congestive Heart Failure Patients Aged 65 Years and Over by District Health Council in Ontario, 1994/95 - 1996/97

ONTARIO *District Health Councils*

1. Essex, Kent and Lambton
2. Thames Valley
3. Grand River
4. Niagara Region
5. Hamilton-Wentworth
6. Halton-Peel
7. Waterloo Region-Wellington-Dufferin
8. Grey, Bruce, Huron, Perth
9. Simcoe-York
10. Toronto
11. Durham, Haliburton, Kawartha and Pine Ridge
12. Quinte, Kingston, Rideau
13. Champlain
14. Muskoka, Nipissing, Parry Sound and Timiskaming
15. Algoma, Cochrane, Manitoulin and Sudbury
16. Northwestern Ontario





Data Source: Canadian Institute for Health Information, Ontario Drug Benefit Program

EXHIBIT 11.13 Crude 90-day Post-discharge Utilization Rates for Furosemide and ACE Inhibitors per 100 Congestive Heart Failure Patients Aged 65 Years and Over by Hospital in Ontario, 1994/95 - 1996/97

TEACHING

Hospital	Number of Congestive Heart Failure Patients	Utilization Rate (%)	
		Furosemide Alone	ACE Inhibitor
Chedoke-McMaster Hospital, Hamilton	230	21	72
Hamilton Civic Hospitals (General Division)	429	21	70
Hamilton Civic Hospitals (Henderson Division)	386	22	70
Hôtel Dieu Hospital, Kingston	191	32	55
Kingston General Hospital	225	33	56
Mount Sinai Hospital, Toronto	209	25	59
Ottawa Civic Hospital	531	20	72
Ottawa General Hospital	238	19	71
St. Joseph's Health Centre of London	368	28	60
St. Joseph's Hospital, Hamilton	247	22	66
St. Michael's Hospital, Toronto	171	26	61
Sunnybrook Health Science Centre, Toronto	425	21	68
Toronto Hospital Corporation	595	27	64
University Hospital, London	135	23	62
Victoria Hospital, London	317	26	64
Wellesley-Central Hospital, Toronto	172	24	69
Women's College Hospital, Toronto	111	32	56
Summary Statistics			
Minimum		19	55
25th Percentile		21	60
Median		24	64
75th Percentile		27	70
Maximum		33	72

LARGE

Hospital	Number of Congestive Heart Failure Patients	Utilization Rate (%)	
		Furosemide Alone	ACE Inhibitor
Belleville General Hospital	278	24	69
Brantford General Hospital	415	16	76
Cambridge Memorial Hospital	248	29	63
Centenary Health Centre, Scarborough	339	33	57
Credit Valley Hospital, Mississauga	201	24	68
Etobicoke General Hospital	389	24	70
Grand River Hospital Corporation, Kitchener	344	22	70
Greater Niagara General Hospital	334	16	76
Grey Bruce Regional Health Centre, Owen Sound	226	17	76
Guelph General Hospital	198	14*	81*
Hôpital Montfort, Ottawa	253	19	71
Hôtel Dieu Hospital, St. Catharines	261	22	67
Hôtel Dieu Grace Hospital, Windsor	353	27	61

EXHIBIT 11.13

LARGE (CONT'D)

Hospital	Number of Congestive Heart Failure Patients	Utilization Rate (%) Furosemide Alone	Utilization Rate (%) ACE Inhibitor
Humber Memorial Hospital, Weston	392	24	66
Joseph Brant Memorial Hospital, Burlington	309	19	74
Mississauga Hospital (The)	435	21	69
Norfolk General Hospital, Simcoe	280	20	69
North York Branson Hospital	562	35	58
North York General Hospital	483	30	61
Northwestern General Hospital, Toronto	362	24	67
Oakville-Trafalgar Memorial Hospital	321	20	70
Orillia Soldiers' Memorial Hospital	247	34	57
Oshawa General Hospital	385	19	70
Peel Memorial Hospital, Brampton	276	20	69
Peterborough Civic Hospital	415	22	67
Public General Hospital, Chatham	182	30	64
Queensway General Hospital, Etobicoke	383	23	68
Queensway-Carleton Hospital, Nepean	263	23	66
Riverside Hospital, Ottawa	202	23	69
Ross Memorial Hospital, Lindsay	291	29	63
Royal Victoria Hospital, Barrie	295	18	75
Salvation Army Scarborough Grace Hospital	215	19	74
Sault Ste. Marie General Hospital	258	21	66
Sarnia General Hospital	276	19	68
Scarborough General Hospital	510	23	69
St. Catharines General Hospital	376	20	70
St. Thomas Elgin General Hospital	271	36	59
St. Joseph's Health Centre, Toronto	522	27	66
St. Mary's General Hospital, Kitchener	331	20	69
Sudbury General Hospital of the Immaculate Heart of Mary	204	21	73
Sudbury Memorial Hospital	285	21	73
Toronto East General Orthopedic Hospital	617	27	66
Welland County General Hospital	218	21	68
York Central Hospital, Richmond Hill	255	21	69
York County Hospital, Newmarket	309	17	74
York-Finch General Hospital, North York	243	25	67
Summary Statistics			
Minimum		14	57
25th Percentile		20	66
Median		22	69
75th Percentile		25	70
Maximum		36	81

EXHIBIT 11.13

MEDIUM

Hospital	Number of Congestive Heart Failure Patients	Utilization Rate (%)	
		Furosemide Alone	ACE Inhibitor
Ajax and Pickering General Hospital	147	24	67
Alexandra Hospital, Ingersoll	69	22	68
Alexandra Marine and General Hospital, Goderich	73	22	70
Arnprior and District Memorial Hospital	71	41	45
Brockville General Hospital	122	28	61
Campbellford Memorial Hospital	108	21	60
Cobourg District General Hospital	104	36	45
Collingwood General and Marine Hospital	181	25	63
Cornwall General Hospital	125	30	55
Doctors Hospital, Toronto	68	15*	79*
Douglas Memorial Hospital, Fort Erie	140	14*	78*
Dufferin-Caledon Health Care Corporation, Orangeville	148	20	68
Georgetown and District Memorial Hospital	73	11*	84*
Groves Memorial and Community Hospital, Fergus	99	13*	80*
Hôpital General de Hawkesbury and District General Hospital Inc.	91	21	76
Hôtel Dieu Hospital, Cornwall	147	27	54
Hôtel Dieu of St. Joseph Hospital, Windsor	145	26	61
Huntsville District Memorial Hospital	130	22	70
Huronia District Hospital, Midland	137	26	64
Kirkland and District Hospital	62	27	61
Lake of the Woods District Hospital, Kenora	59	10*	85*
Leamington District Memorial Hospital	176	15*	80*
Lennox and Addington County General Hospital, Napanee	89	20	61
Markham Stouffville Hospital	118	19	67
Memorial Hospital, Bowmanville	138	19	68
Metropolitan General Hospital, Windsor	208	21	67
Milton District Hospital	72	31	63
North Bay General Hospital	179	22	73
Pembroke Civic Hospital	100	25	60
Pembroke General Hospital	103	25	63
Perth and Smiths Falls District Hospital	208	29	56
Plummer Memorial Public Hospital, Sault Ste. Marie	110	20	69
Port Colborne General Hospital	115	25	64
Prince Edward County Memorial Hospital, Picton	101	39	50
Renfrew Victoria Hospital	86	30	59
South Muskoka Memorial Hospital, Bracebridge	97	19	72
St. Joseph's General Hospital, Elliot Lake	58	31	59
St. Joseph's General Hospital, Thunder Bay	141	32	61
St. Joseph's Health Centre of Sarnia	108	28	60
St. Joseph's Hospital, Chatham	128	28	61
St. Joseph's Hospital and Health Centre of Peterborough	60	22	65
St. Joseph's Hospital, Guelph	36	11*	81*
St. Vincent de Paul Hospital, Brockville	128	28	63

EXHIBIT 11.13

MEDIUM (CONT'D)

Hospital	Number of Congestive Heart Failure Patients	Utilization Rate (%)	
		Furosemide Alone	ACE Inhibitor
Stevenson Memerial Hospital, Alliston	106	22	68
Stratford General Hospital	154	13*	76
Strathroy Middlesex General Hospital	131	23	69
Sydenham District Hospital, Wallaceburg	113	11*	81*
Temisakaming Hospital, New Liskeard	61	18	70
Thunder Bay Regional Hospital	384	32	59
Tillsonburg District Memorial Hospital	153	32	59
Timmins and District Hospital	145	27	62
Trenton Memorial Hospital	138	16	78*
West Lincoln Memorial Hospital, Grimsby	65	20	68
West Nipissing General Hospital, Sturgeon Falls	63	27	59
West Parry Sound Health Centre	108	17	78*
Whitby General Hospital	93	15*	67
Winchester District Memorial Hospital	102	11*	83*
Windsor Regional Hospital	166	27	62
Windsor Western Hospital Centre Incorporated	166	30	57
Woodstock General Hospital	166	23	62
Summary Statistics			
Minimum		10	45
25th Percentile		19	61
Median		23	65
75th Percentile		28	71
Maximum		41	85

SMALL

Hospital	Number of Congestive Heart Failure Patients	Utilization Rate (%)	
		Furosemide Alone	ACE Inhibitor
Almonte General Hospital	36	22	75
Anson General Hospital	18	56	33
Atikokan General Hospital	20	15*	70
Belleville General Hospital, Bancroft	61	20	66
Bruce Peninsula Health Services, Wiarton	55	25	62
Carleton Place and District Memorial Hospital	41	12*	80*
Centre Grey General Hospital, Markdale	48	21	65
Charlotte Eleanor Englehart Hospital, Petrolia	59	20	64
Chesley and District Memorial Hospital	31	48	45
Clinton Public Hospital	45	24	64
Community Memorial-Port Perry Hospital, Scugog	58	24	69
Cottage Hospital, Uxbridge	38	37	47
County of Bruce General Hospital, Walkerton	62	21	68
Deep River and District Hospital Corporation	30	33	60

EXHIBIT 11.13

SMALL (CONT'D)

Hospital	Number of Congestive Heart Failure Patients	Utilization Rate (%)	
		Furosemide Alone	ACE Inhibitor
District Health Centre Sioux Lookout	20	35	55
Dryden District General Hospital	46	15*	67
Durham Memorial Hospital	25	12*	72
Englehart and District Hospital	26	31	62
Espanola General Hospital	31	23	74
Four Countries General Hospital, Newbury	48	25	65
Geraldton District Hospital	21	29	43
Glengarry Memorial Hospital, Alexandria	45	36	51
Haldimand War Memorial Hospital, Dunnville	80	13*	78*
Hanover and District Hospital	45	20	71
Kemptville District Hospital	46	20	67
Kincardine and District General Hospital	63	27	54
Lady Minto Hospital, Cochrane	33	27	58
Listowel Memorial Hospital	47	15*	77
Louise Marshall Hospital, Mount Forest	52	17	69
Manitoulin Health Centre, Little Current	38	21	68
Manitoulin Health Centre - Mindemoya Unit	27	44	48
Meaford General Hospital	90	31	52
Nipigon District Memorial Hospital	26	46	38
North Bay Civic Hospital	62	26	71
Notre Dame Hospital, Hearst	19	53	42
Palmerston and District Hospital	43	16	79*
Penetanguishene General Hospital	60	30	53
Plummer Memorial Hospital - Thessalon Unit	18	28	56
Port Hope and District Hospital	84	19	69
Red Lake Margaret Cochenour Memorial Hospital	22	9*	86*
Riverside Health Care Facilities, Fort Frances	57	35	56
Salvation Army Grace Hospital, Ottawa	42	21	71
Salvation Army Grace Hospital, Windsor	55	36	62
Saugeen Memorial Hospital, Southhampton	34	21	68
Seaforth Community Hospital	30	23	60
Sensenbrenner Hospital, Kapuskasing	48	25	60
South Huron Hospital Association, Exeter	41	29	49
St. Joseph's Hospital and Health Centre of Peterborough, Haliburton	18	28	67
St. Francis Memorial Hospital, Barry's Bay	39	18	64
St. Joseph's General Hospital of North Bay	35	17	77
St. Joseph's Health Centre, Blind River	17	47	41
St. Joseph's Hospital, Brantford	21	10*	90*
St. Mary's Memorial Hospital, St. Mary's	52	31	60
West Haldimand General Hospital, Hagersville	61	11*	82*
Wingham and District Hospital	84	21	68

EXHIBIT 11.13

SMALL (CONT'D)

Hospital	Number of Congestive Heart Failure Patients	Utilization Rate (%) Furosemide Alone	Utilization Rate (%) ACE Inhibitor
Summary Statistics			
Minimum		9	33
25th Percentile		20	56
Median		24	65
75th Percentile		24	65
Maximum		56	90

* Top performers are those in the top 10%.

Note: Hospitals with 15 or fewer congestive heart failure survivors have been excluded. Utilization rates for hospitals with small volumes should be interpreted with caution. See Appendix A11.1 for information on determining confidence intervals.

Data Source: Canadian Institute for Health Information, Ontario Drug Benefit Program

patients in Ontario. Although the rates of ACE inhibitor use appear to be moderately high, opportunities do exist to increase their use. Our analyses show that at some hospitals in Ontario more than 80% of CHF patients are being discharged home with ACE inhibitors, whereas at other centers less than 50% of all patients are receiving this therapy. Further work is needed to determine factors contributing to these variations in the use of ACE inhibitors in Ontario and to determine whether it will be possible to increase the overall frequency of use of ACE inhibitors in CHF patients in Ontario. Higher rates of use will likely decrease the need for hospitalization and improve long-term survival in Ontario's CHF patients.

Coronary Artery Bypass Graft Surgery

Background

Blockages developing in grafts after coronary artery bypass grafting are a common clinical problem. It has been estimated that approximately 20% of all vein grafts occlude within the first year after the procedure and by 10 years after surgery 50% have closed because of progressive atherosclerosis.[15] Although internal mammary artery grafts have a better patency rate (90% after more than 10 years), there is a limited supply of arterial grafts and vein grafts continue to be used frequently for CABG surgery. The Post Coronary Artery Bypass Graft Trial investigators have shown that aggressive lipid lowering with lovastatin and/or cholestyramine significantly reduces the progression of atherosclerosis in CABG vein grafts.[16] In this section, we study the frequency of use of the lipid-lowering statin drugs in elderly CABG patients in Ontario.

Data Sources and How We Did the Analysis

All elderly patients aged 65 or over who received CABG surgery (with or without concomitant valve surgery) in Ontario between fiscal 1994/95 to 1996/97 were identified from the CIHI database. After applying the exclusion criteria shown in Methods Appendix MA11.3, a total of 9,561 CABG patients was left for our analysis. Only patients surviving their index hospitalization for CABG surgery were included. We determined the 90-day post-discharge rates of statin use in these post-CABG patients by linking their CIHI records to their outpatient prescriptions for the statin drugs in the ODB database.

Interpretive Cautions

We did not have data on contraindications to the statin drugs, such as liver dysfunction, that may explain why some post-CABG patients were not put on these drugs. We also did not have information on patients' cholesterol levels, although it is likely that many of these patients would have elevated cholesterol levels.

Lower rates of statin use may also reflect the fact that the Post-CABG Trial results, which provided compelling evidence for aggressive lipid lowering with statins, were not published until 1997,[16] after the period of our analysis. However, previous studies have shown the benefits of lipid lowering in CABG patients.[15] Similarly, the benefits of the statin drugs in patients aged 75 and over have not been conclusively established and there is uncertainty about the benefits of lowering cholesterol in these patients.

Findings and Discussion

Ninety-day post-CABG rates of statin use are shown in Exhibit 11.14. The use of statins post-CABG increased from 14% in fiscal 1994/95 to 32% in 1996/97. The rates of use of these drugs were similar in men and women. Elderly patients aged 65 to 74 were more likely than those over age 75 to receive statins post-CABG.

Interhospital variations in statin use post-CABG are shown in Exhibit 11.15. The 90-day rates of statin use varied from a low of 17% at Ottawa Civic Hospital to a high of 29% at Sunnybrook Health Science Centre, with a median rate of use of 23%.

EXHIBIT 11.14 Overall and Age/Sex-specific 90-day Post-discharge Utilization Rates for Statins per 100 Coronary Artery Bypass Patients Aged 65 Years and Over in Ontario, 1994/95 - 1996/97

	1994/95 - 1996/97							
	Women		Men		Overall			Total
	65 - 74	75+	65 - 74	75+	1994/95	1995/96	1996/97	1994/95 - 1996/97
Number of Coronary Artery Bypass Graft Patients	2,131	640	5,464	1,326	2,947	3,088	3,526	**9,561**
Statin Utilization Rate (%)	28	17	24	13	14	22	32	**23**

Data Source: Canadian Institute for Health Information, Ontario Drug Benefit Program

EXHIBIT 11.15 Crude 90-Day Post-discharge Utilization Rates for Statins per 100 Coronary Artery Bypass Patients Aged 65 Years and Over by Cardiac Care Network Hospital in Ontario, 1994/95 - 1996/97

Cardiac Care Network Hospital	Number of Coronary Artery Bypass Graft Patients	Statin Utilization Rate (%)
Hamilton Civic Hospitals (General Division)	1,262	24
Kingston General Hospital	541	21
Ottawa Civic Hospital	1,271	17
St. Michael's Hospital	910	27
Sudbury Memorial Hospital	685	18
Sunnybrook Health Science Centre, Toronto	922	29
Toronto Hospital Corporation	2,357	24
University Hospital, London	765	23
Victoria Hospital, London	848	21

Data Source: Canadian Institute for Health Information, Ontario Drug Benefit Program

Conclusions

We found relatively low rates of statin use in elderly post-CABG patients in Ontario although there was a trend towards greater use by fiscal 1996/97. While the optimal rate of use of these drugs remains to be determined, there is increasing evidence to support their use in most patients with established coronary heart disease.[5,6] By delaying the progression of atherosclerosis in CABG vein grafts, the need for repeat CABGs is likely to be reduced. Thus, the observed rates of use of statins in post-CABG patients may represent significant underprescribing and an important opportunity for improving post-CABG care in Ontario.

APPENDIX A11.1 Interpretive Guide for Drug Tables

The 95% confidence limits for a particular drug prescription rate at an institution can be estimated from the following table. The table shows the number that shall be used to determine the confidence limit for a particular prescription rate.

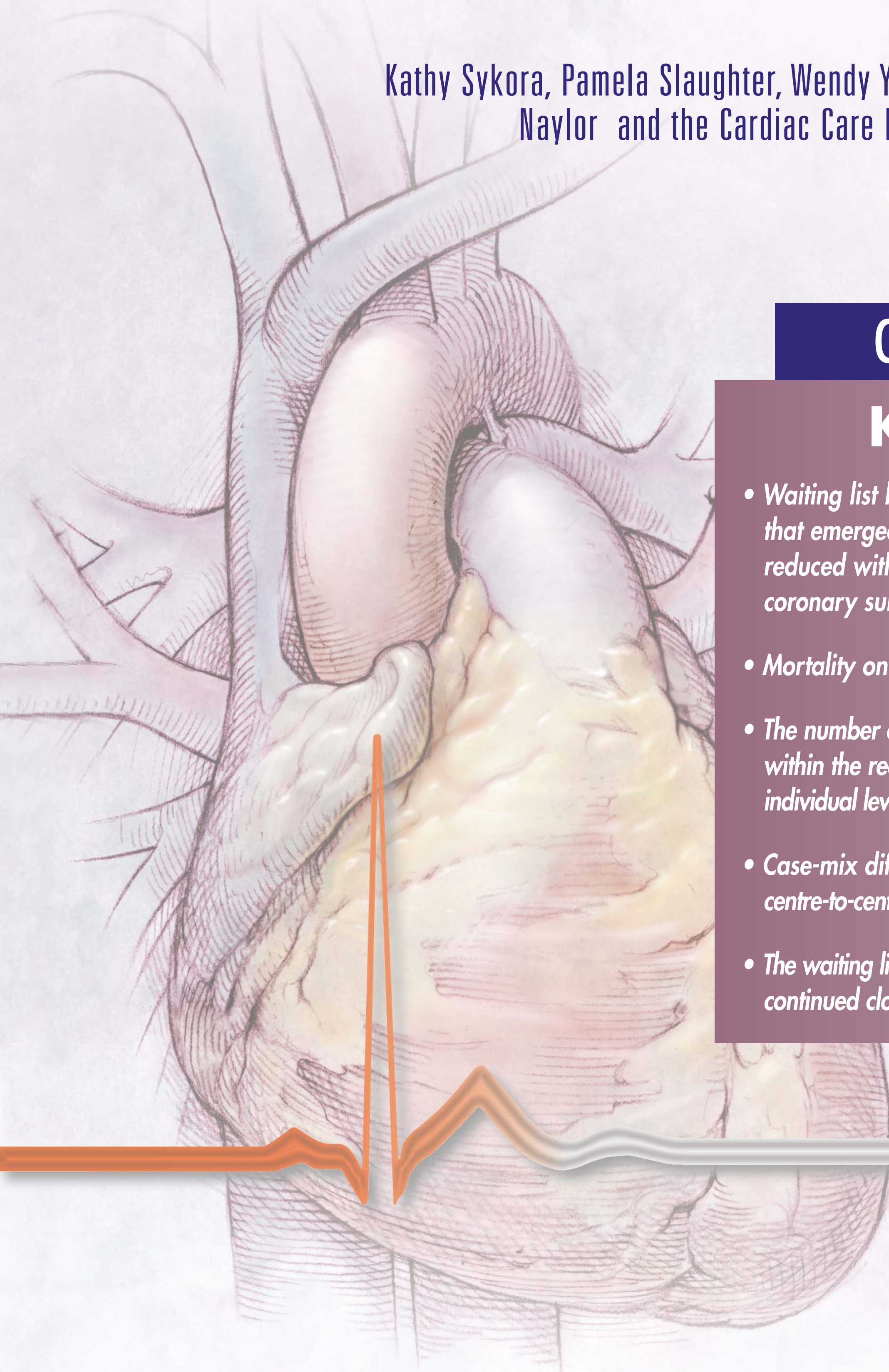
Example: If a hospital treated 100 patients and prescribed a certain drug to 50% of its patients, the 95% confidence limits for its prescription rate would be 50% +\– 10% (i.e. 40% to 60%).

	Number of Patients								
Drug Rate (%)	**15**	**30**	**50**	**100**	**200**	**300**	**400**	**500**	**600**
10	15	11	8	6	4	3	3	3	2
20	20	14	11	8	6	5	4	4	3
30	23	16	13	9	6	5	4	4	4
40	25	18	14	10	7	6	5	4	4
50	25	18	14	**10**	7	6	5	4	4
60	25	18	14	10	7	6	5	4	4
70	23	16	13	9	6	5	4	4	4
80	20	14	11	8	6	5	4	4	3
90	15	11	8	6	4	3	3	3	2

Note: These confidence limits are based on a normal approximation to the binomial distribution.

Waiting Lists for Cardiac Surgery

Kathy Sykora, Pamela Slaughter, Wendy Young, David Garlin, C. David Naylor and the Cardiac Care Network Steering Committee



CHAPTER 12

Key messages

- *Waiting list backlogs for cardiac surgery that emerged in 1996/97 have been reduced with one-time increases in coronary surgery capacity.*
- *Mortality on the waiting list remains low.*
- *The number of patients undergoing surgery within the recommended wait time for their individual levels of acuity has also increased.*
- *Case-mix differences partly account for centre-to-centre variation in numbers waiting.*
- *The waiting list situation remains unstable and continued close monitoring is recommended.*

Key Terms & Concepts:

- coronary artery bypass surgery
- urgency score
- Cardiac Care Network
- patient registry
- mortality
- waiting list (queue) management

Background

In the late 1980s, cardiovascular specialists and patients raised concerns about long waiting lists for open-heart surgery in Ontario.[1] A public inquiry and work by a variety of provider groups led to several interrelated conclusions. Waiting lists for heart surgery were not being measured and managed systematically. There was no set of common criteria for determining which patients deserved highest priority. As well, there was inconsistent monitoring of the status of patients awaiting surgery.

The Cardiac Care Network of Ontario (CCN) was initiated in the early 1990s with the mandate of helping to ensure timely and appropriate access to cardiac surgery. The CCN supported the establishment of a province-wide registry aimed at monitoring the flow of patients through Ontario's open-heart surgery centres. With CCN support, each centre established data collection mechanisms and arranged for ongoing support of patients awaiting procedures.

In the same period, a panel of cardiologists and cardiac surgeons developed criteria for assessing patients' priority for coronary revascularization.[2-4] The CCN incorporated these criteria into its queue-monitoring processes.[5] The criteria assign numeric values to various patient symptoms, results of stress tests, blockages of the coronary arteries seen on angiography and indicators of heart pump function (left ventricular function).[3,4] Those patients with the most severe symptoms and a greater risk of irreversible events based on this system have higher priority for surgery.

Based on data from tens of thousands of patients, it is now clear that queuing according to this system limits the risk of death for patients awaiting surgery.[6] Currently about one in 200 to 250 patients will die while awaiting isolated coronary artery bypass surgery (CABG) in Ontario.[6,7]

On the other hand, mortality is not the only adverse outcome of awaiting cardiac surgery. Patients awaiting open heart procedures suffer considerable anxiety, may be off work, and carry an avoidable burden of continuing cardiac symptoms and medication side-effects.[8,9] Thus, regardless of the low death rates on the waiting list, extreme delays are undesirable.

After a period of relative stability, waiting lists (queues) for cardiac surgery began lengthening in several Ontario centres during 1995. The problem worsened in late 1996, leading the CCN, the Institute for Clinical Evaluative Sciences (ICES) and the Ministry of Health to develop strategies for caseload expansion with a view to reducing both the number of patients waiting and their average waiting times.[10] ICES recommended a combination of one-time funding/caseload increases and recurrent increases, designed to simultaneously clear backlogs in some centres and bring other centres up toward a target regional rate of 100 CABG procedures per 100,000 population.[10]

The Ministry of Health provided a major increase in funding to support this expansion in cardiac surgery capacity. However, with bed pressures and shortages of operating rooms and skilled surgical personnel, many centres have been unable to complete the desired number of cases. This shortfall could mean that waiting times will remain longer than optimal in some centres. Furthermore, concurrent investments in cardiac catheterization capacity have allowed more patients to undergo definitive pre-operative investigation. In turn, this leads to greater numbers of referrals for surgery.

We accordingly review recent data on waiting lists for cardiac surgery in this chapter.

Data Sources

The sources used for this chapter include CCN registry data, the CCN 1997/98 Annual Report, the CCN 1997/98 Statistical Summary and CCN rolling quarterly reports from the October-December quarter 1996 through March-May 1998. We also updated the information found in an ICES Technical Report—*Waits and Rates: The 1997 ICES Report on Coronary Surgery Capacity for Ontario.*[10]

How We Did the Analysis

A preliminary file of registry data for 1997/98 was available from the CCN and used along with earlier CCN registry data for waiting list analyses. Much of the material here is drawn from other published sources, which in some cases were updated using CCN's rolling quarterly reports. The findings are largely descriptive and self-explanatory.

Interpretive Cautions

As a result of ongoing ICES-CCN research, CCN has revised its urgency rating scores (URS) for bypass surgery. Slightly greater weight has been given to grade 3 (moderately severe) and grade 4 (severe) dysfunction of the heart pumping mechanism (left ventricular function). This has led to a shortening of the Recommended Maximum Waiting Time (RMWT) for some patients. For this reason, CCN statistics on URS and the associated Recommended Maximum Waiting Time after March-May 1997 are no longer directly comparable to earlier statistics.

To obtain the number of patients waiting for cardiac surgery at any given time, a "snapshot" of the registry is taken. However, as information on some patients who get on the list just prior to the end of the month may not get into the database until after the snapshot is taken, the number obtained may be an underestimate (see Exhibit 12.4).

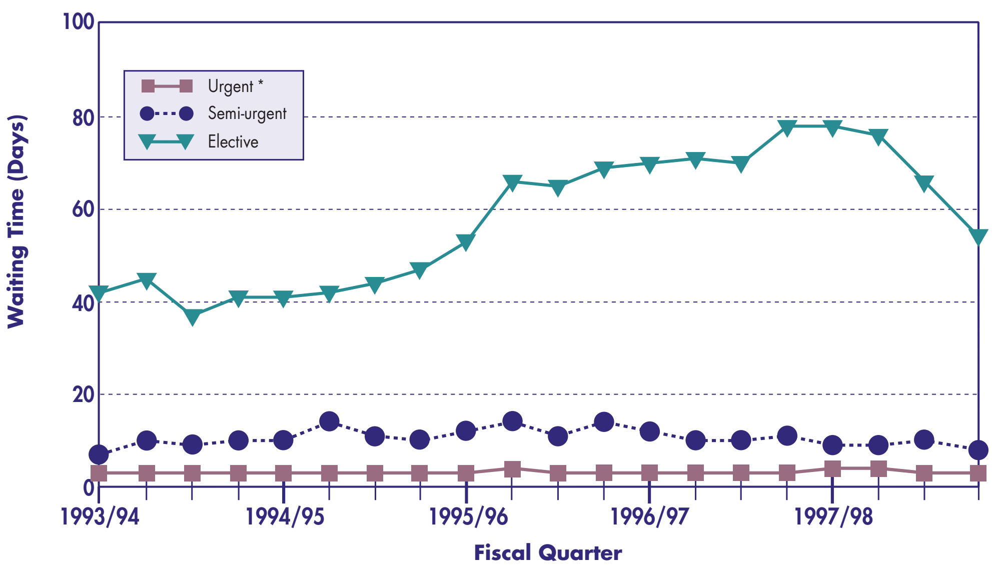
There are two ways of calculating a patient's waiting time. One way is to compute the number of days between the patient's acceptance to the waiting list (or their reinstatement, if they came off the list temporarily), and their removal (surgery or death). This is how waiting time has been calculated in much of the formal research published by ICES and CCN, where the goal is to capture events in relation to total duration of delay. Another way is to "restart the clock" if the patient has had a change in their urgency, and so compute the time that the patient has been waiting with their new urgency rating score. This is how CCN has calculated waiting times for their reports. Exhibits 12.6, 12.7 and 12.8 all take the first approach. However, Exhibits 12.1 and 12.2, which are taken directly from CCN's ongoing reports, use waiting time as defined by the second approach. Fortunately, only a small proportion of patients destabilize and undergo an urgency upgrade, so the results are reasonably comparable.

Last, waiting for cardiac surgery begins only after a patient has undergone a cardiac catheterization. There are queues for cardiac catheterization as suggested by the findings in Chapter 8 and there may also be queues for the specialist consultation that is required before a referral to catheterization is made. Hence, these findings do not reflect the cumulative delays that affect heart patients as they move through the Ontario health care system.

Findings and Discussion

Exhibit 12.1 illustrates the trends in median waiting times for isolated CABG from fiscal 1993/94 to the end of fiscal 1997/98 (March 31,1998). Although urgency rating scores are calculated on a linear and continuous scale, patients are grouped for simplicity into three general categories: urgent, semi-urgent and elective. The efficiency of waiting list management in Ontario is highlighted by the fact that waiting times for urgent and semi-urgent patients varied little throughout this period. The lengthening of the queue affected primarily elective patients, those for whom waiting was less likely to lead to an irreversible event (e.g. myocardial infarction or death). Maximum delays occurred in late fiscal 1996/97 and early 1997/98. There was a drop in median waiting times for isolated CABG thereafter.

EXHIBIT 12.1: Median Waiting Times for Isolated Coronary Artery Bypass Graft Surgery in Ontario, 1993/94 - 1997/98

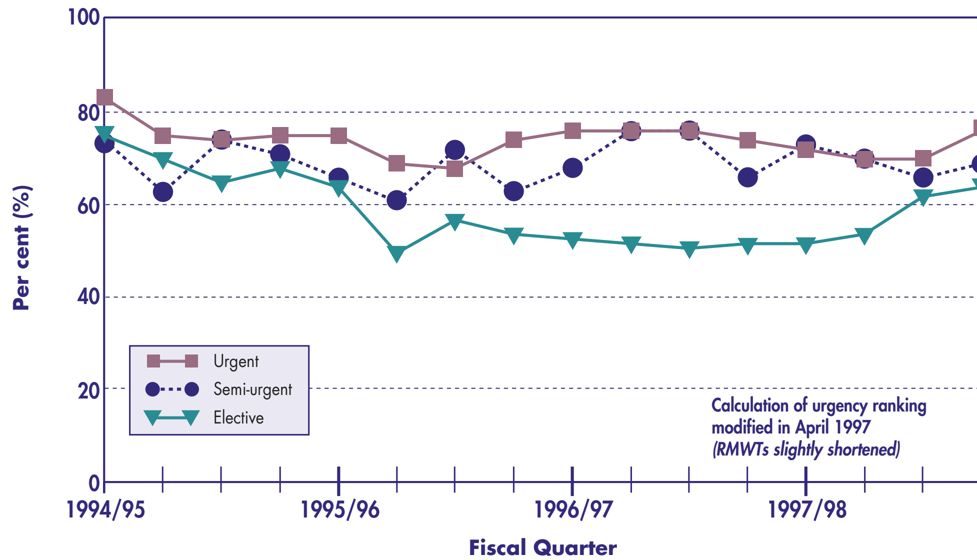


***Note: Urgent cases include emergency patients**

Data Source: Cardiac Care Network

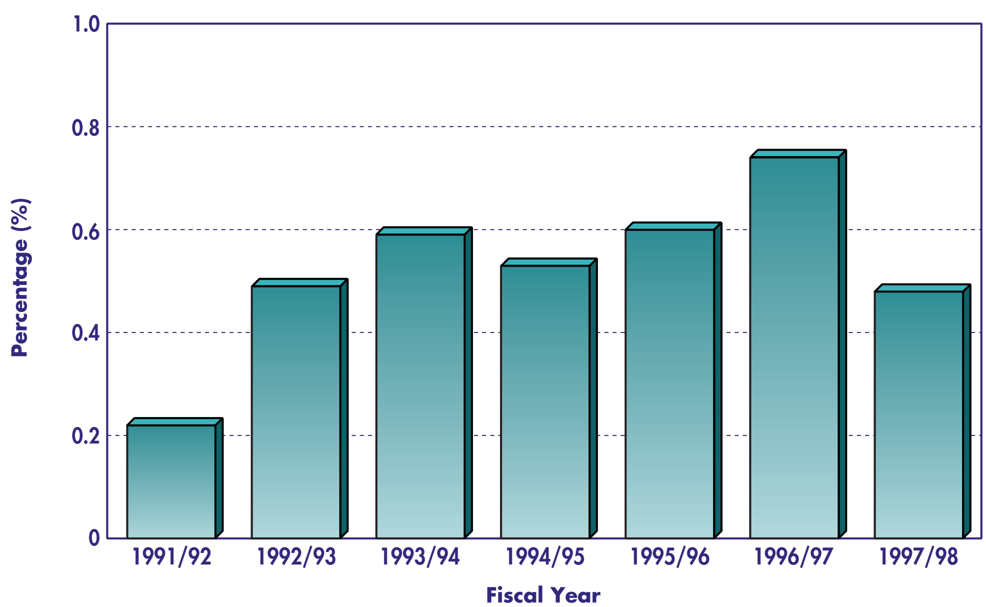
Another way of approaching this issue is shown in Exhibit 12.2. Each urgency rating score is associated with a maximum recommended waiting time. For example, a score of 2.0 connotes surgery within 24 hours, while a score of 5.0 connotes a maximum six-week delay. We have calculated the percentages of patients undergoing surgery within the maximum waiting time that corresponds to their personal score and grouped patients into three categories as above. The elective patients are those who show the clearest decline in chances of being done "on time," and this situation improves somewhat by the end of 1997/98. Nonetheless, the proportion of elective patients completed inside the desired time-frame is still significantly lower than in 1994.

EXHIBIT 12.2: Per cent of Coronary Artery Bypass Graft Surgery within Recommended Maximum Waiting Time (RMWT) in Ontario, 1994/95 - 1997/98



Data Source: Cardiac Care Network

EXHIBIT 12.3: Waiting List Mortality for Cardiac Surgery in Ontario, 1991/92 - 1997/98



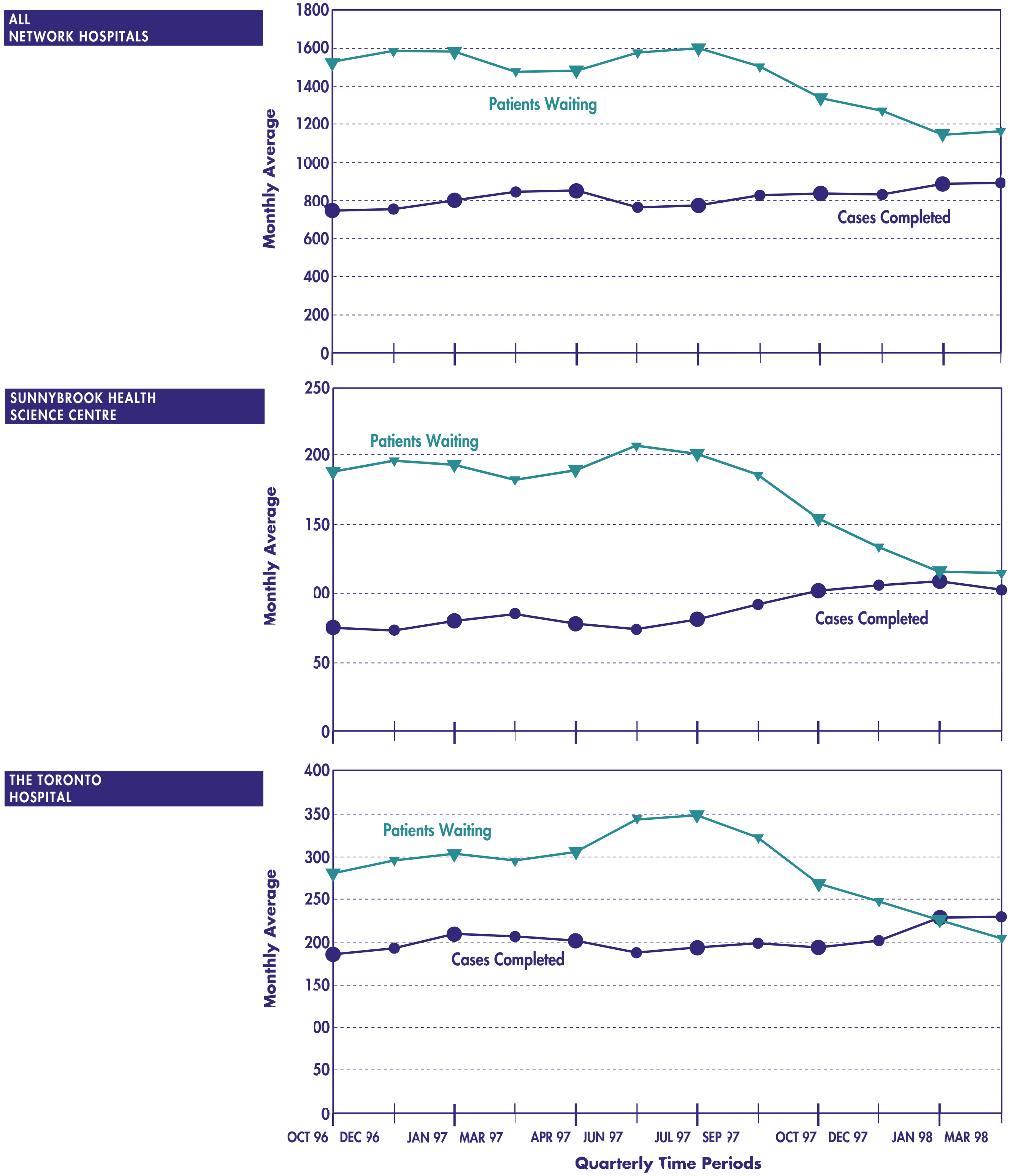
Data Source: Cardiac Care Network

Exhibit 12.3 shows overall mortality in the queue for all scheduled cases, including isolated CABG, isolated valve surgery and combined CABG/valve procedures. The overall mortality is higher than for isolated CABG alone. This is because, as we have reported elsewhere,[7] patients undergoing valve surgery or combined procedures are at significantly higher risk of death in the queue than those undergoing isolated CABG. (ICES and the CCN have recently developed queuing criteria for these classes of patients as well.)

Mortality clearly rose in 1996/97 as the queues lengthened. It is important to remember, however, that most patients with cardiac disease are at increased risk of sudden death compared to the general population. In fact, the increased death rate in the queue is a function of the number of days that patients are under observation and does not reflect an increase in the vital risk per day waiting. With the increased resources for cardiac surgery and shorter waiting times, mortality fell sharply in 1997/98.

Exhibit 12.4 shows that, with the increased funding and caseloads, the number of patients waiting for cardiac surgery was clearly reduced. (Because the elective cases wait longer than the urgent cases, the proportion of electives among patients waiting will always be much larger than the proportion among cases actually done). On the other hand, when one examines the numbers waiting in relation to the monthly capacity for each centre, the impact of the caseload increase is inconsistent. Only a few centres are in or near the "comfort zone" where the number of patients waiting matches the monthly capacity (see Exhibits 12.4). However, this centre-to-centre variation in numbers waiting could be due to differences in case-mix, with more elective patients at some centres than others.

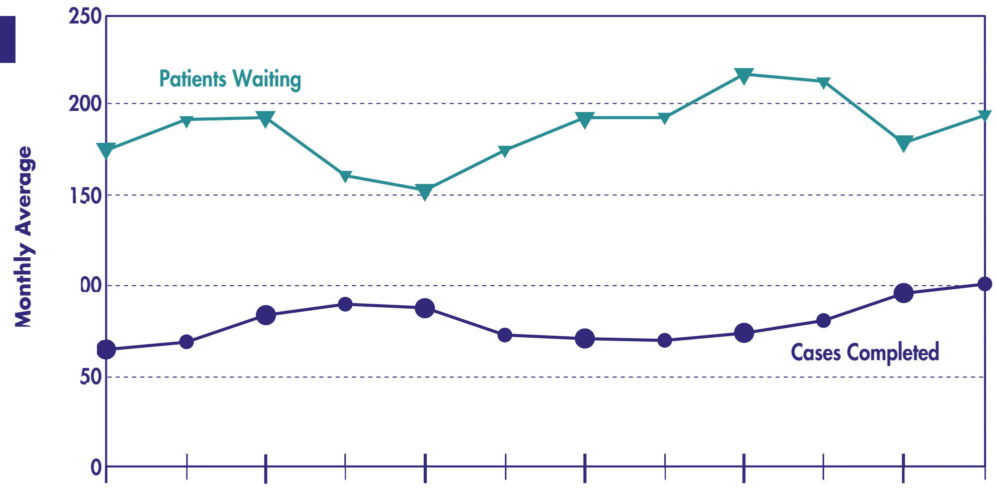
EXHIBIT 12.4: Number of Patients Waiting for Cardiac Surgery and Number of Cases Completed in Ontario, October 1996 - May 1998



**Note: Each large data point represents the monthly average for the fiscal quarter, small data points represent interim quarterly reporting*

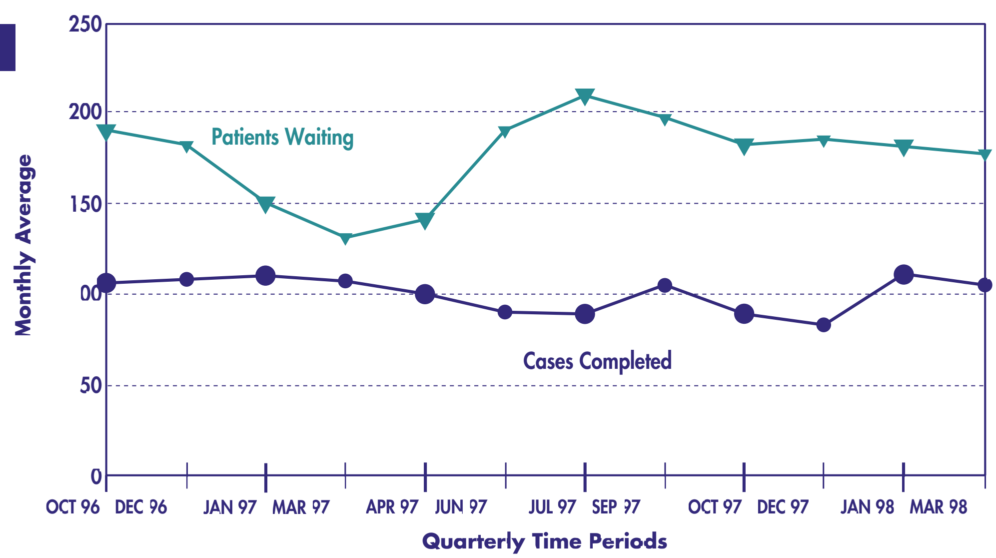
Data Source: Cardiac Care Network

ST. MICHAEL'S HOSPITAL



KINGSTON GENERAL HOSPITAL

UNIVERSITY OF OTTAWA HEART INSTITUTE

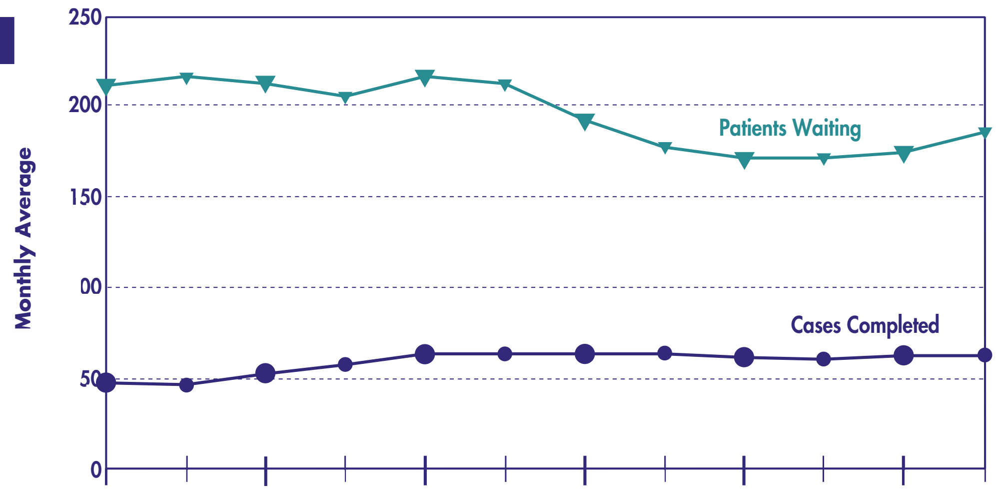


Note: Each large data point represents the monthly average for the fiscal quarter, small data points represent interim quarterly reporting

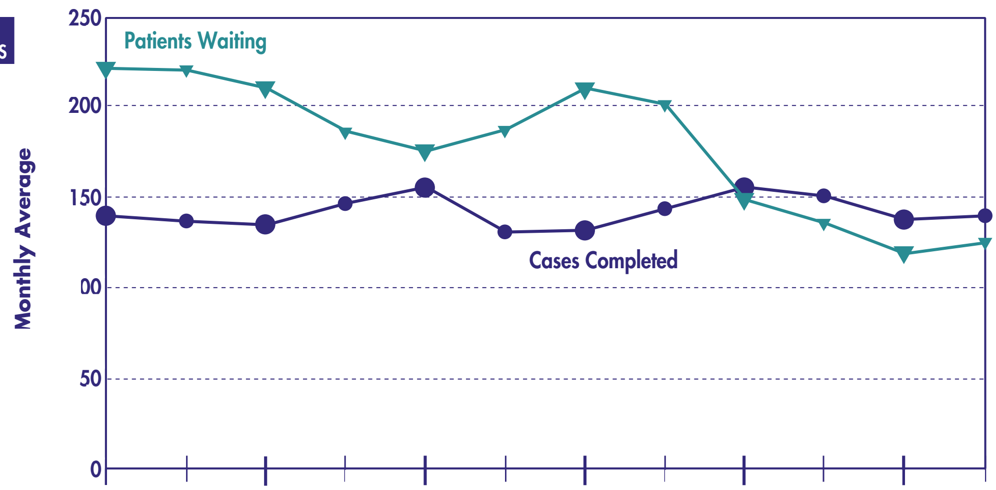
Data Source: Cardiac Care Network

EXHIBIT 12.4 (Cont'd): Number of Patients Waiting for Cardiac Surgery and Number of Cases Completed in Ontario, October 1996 - May 1998

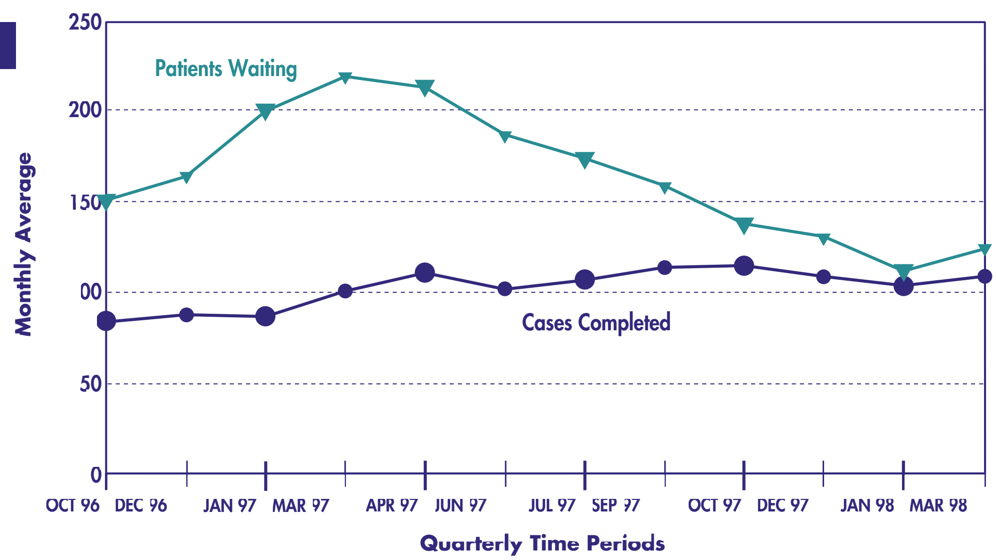
SUDBURY MEMORIAL HOSPITAL



LONDON HEALTH SCIENCES CENTRE – VICTORIA AND UNIVERSITY CAMPUSES



HAMILTON HEALTH SCIENCES CORPORATION

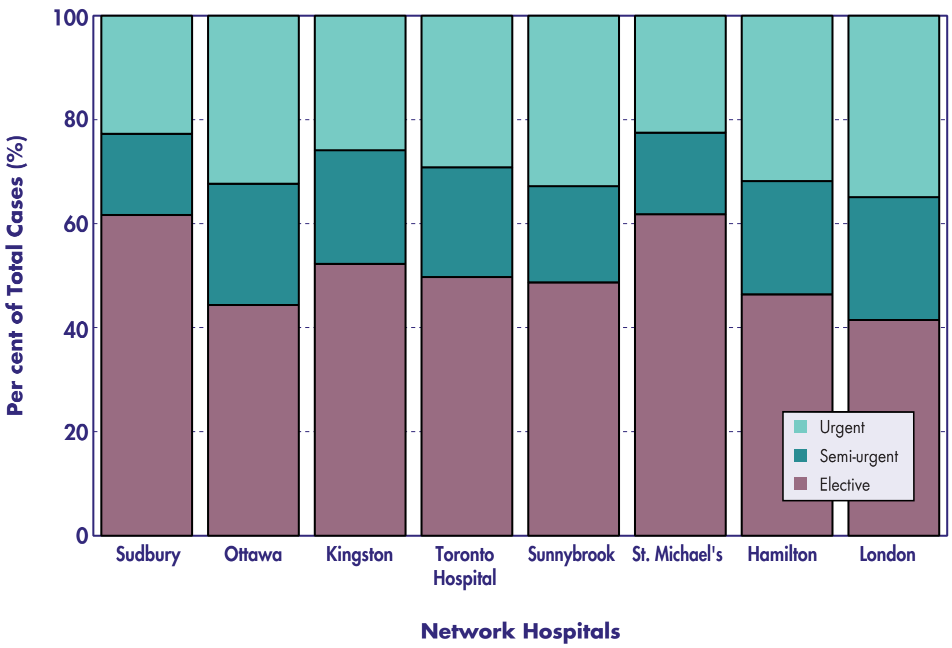


****Note: Each large data point represents the monthly average for the fiscal quarter, small data points represent interim quarterly reporting***

Data Source: Cardiac Care Network

Exhibit 12.5 confirms that the distribution of elective patients varies by hospital. For example, Sudbury Memorial Hospital and St. Michael's Hospital both show larger numbers of patients waiting than many of the other centres, yet both also have larger proportions of elective cases.

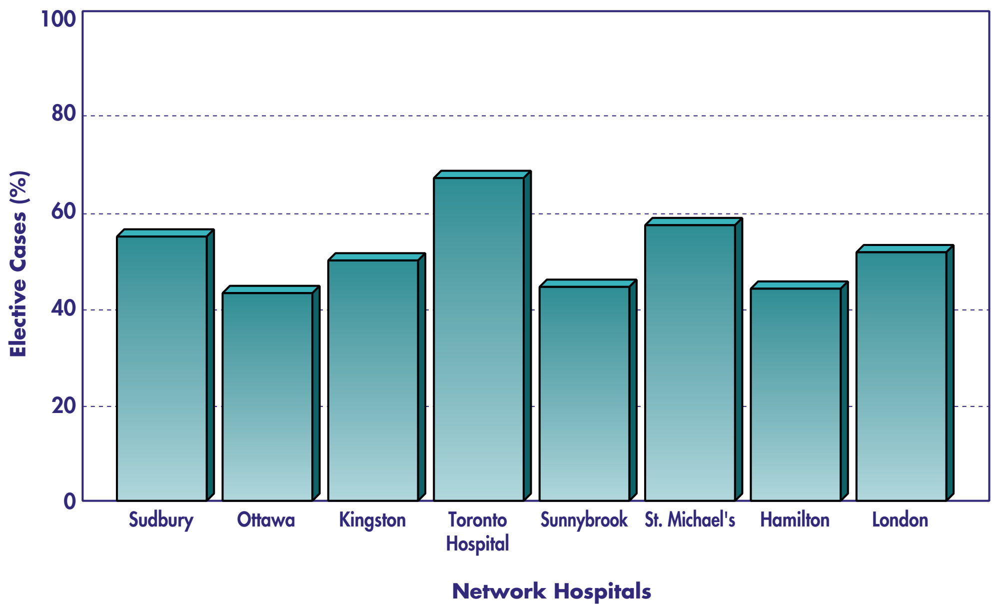
EXHIBIT 12.5: Per cent of Isolated Coronary Artery Bypass Graft Surgery Cases by Urgency Category in Ontario, 1995/96 - 1997/98



Data Source: Cardiac Care Network

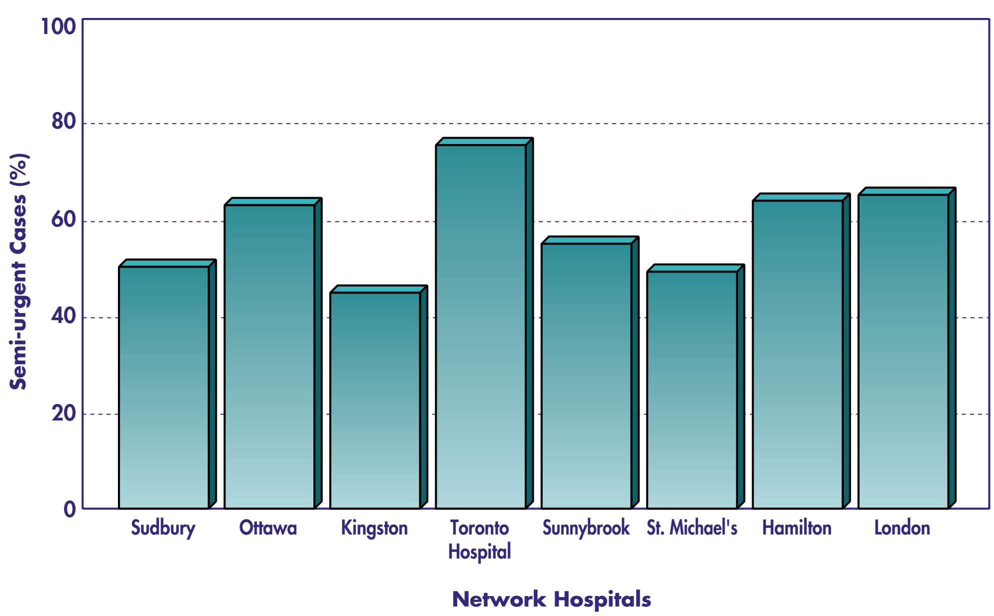
The result, as shown in Exhibits 12.6i, ii and iii is that the overall proportion of cases done "on time" in these two centres is not different than other cardiac surgery programs.

EXHIBIT 12.6i: Per cent of Elective Coronary Artery Bypass Surgery Cases Done within the Recommended Maximum Waiting Time in Ontario, 1995/96 - 1997/98



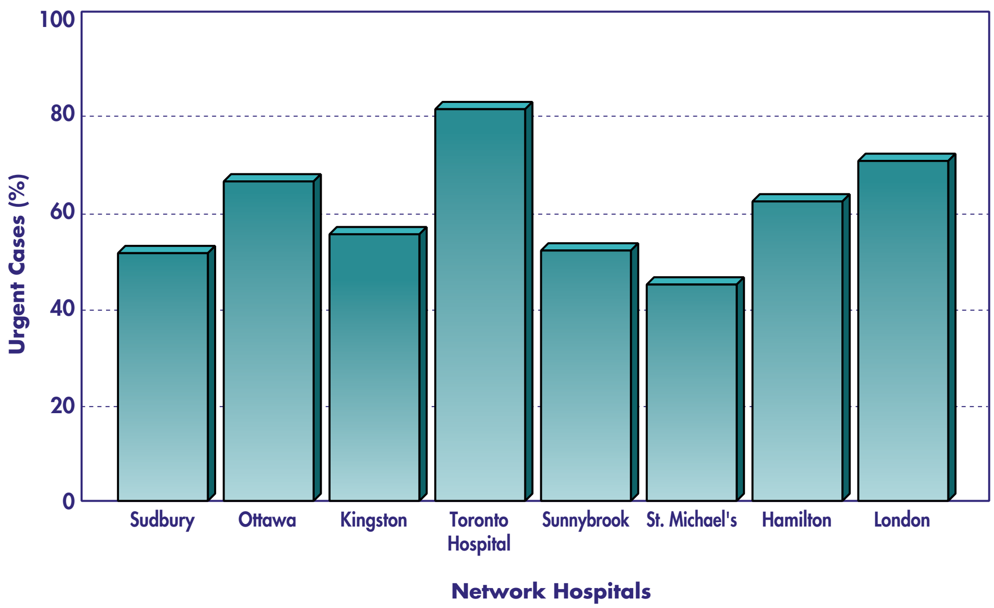
Data Source: Cardiac Care Network

EXHIBIT 12.6ii : Per cent of Semi-urgent Coronary Artery Bypass Surgery Cases Done within the Recommended Maximum Waiting Time in Ontario, 1995/96 - 1997/98



Data Source: Cardiac Care Network

EXHIBIT 12.6iii: Per cent of Urgent Coronary Artery Bypass Surgery Cases Done within the Recommended Maximum Waiting Time in Ontario, 1995/96 - 1997/98



Data Source: Cardiac Care Network

EXHIBIT 12.7 Median Waiting Times for Isolated Coronary Artery Bypass Surgery for Each Institution by Urgency Rating Score and Recommended Maximum Waiting Time, 1995/96 - 1997/98

Health Planning Region	Institution	Urgency Rating Score 1-2	2-3	3-4	4-5	5-6	6-7
		Recommended Maximum Waiting Time (days) 0-1	1-3	3-14	14-42	42-90	91+
North	Sudbury	0	3	7	27	66	76
East	Ottawa	0	3	5	10	93	88
	Kingston	0	3	6	34	69	83
Central East	Toronto Hospital	0	1	3	5	40	59
	Sunnybrook	0	4	7	23	83	90
	St. Michael's	1	4	7	26	70	90
Central West	Hamilton	0	2	5	12	80	83
South West	London	0	3	5	12	62	78
Ontario		**0**	**2**	**5**	**12**	**66**	**77**

Note: Includes patients who were waiting for isolated CABG who either received isolated CABG or died in the queue (n=21,284).
Data Source: Cardiac Care Network

Exhibit 12.7 shows the median waiting times for a finer division of urgency values. It confirms the effectiveness of the general approach to management of waiting lists for isolated CABG. Note the stepwise shifts in waiting times from 0-1 day for emergencies (urgency score = 1 - 2) to several weeks for elective patients (scores 6-7).

Exhibit 12.8 shows the median time waiting for patients with different clinical characteristics undergoing isolated CABG between 1994/95 and 1996/97. It also confirms that those patients with greatest need are, in fact, being serviced more quickly.

Notwithstanding careful management of patients according to clinical priority and overall decreases in waiting times, there are grounds for ongoing concern. The Ministry of Health recommended targets for total throughput in each centre during 1997/98 which include all cardiac surgery (see Appendix A12.1 for more detail). Only one centre (the University of Ottawa Heart Institute) was able to reach the target, with variances ranging in relative terms from 5% to 15% lower than desired. This means that some centres have failed to clear their earlier backlogs and remain at high risk for rapid increases in waiting times in the event that demand rises or throughput falls during the remainder of 1998 or early 1999.

EXHIBIT 12.8 Median Time Waiting for Isolated Coronary Artery Bypass Surgery for Patients with Different Clinical Characteristics, 1995/96 - 1997/98

Clinical Characteristic	%	Median Waiting Time (Days)	Inter-quartile Range 25th Percentile	Inter-quartile Range 75th Percentile
Urgency				
Elective (Urgency Rating Score >5)	49	69	28	117
Semi-urgent (Urgency Rating Score 4-5)	21	12	4	49
Urgent (Urgency Rating Score <4)	30	3	1	7
Canadian Cardiovascular Society (CCS) Class				
I/II	16	81	40	131
III	35	68	29	111
IV A	18	8	4	35
IV B	19	5	2	8
IV C	12	1	1	5
Anatomy				
Limited	21	32	5	95
Multi-vessel	61	29	5	88
Left-main	18	7	2	31
Left Ventricular Function				
Grade 1-2	74	24	4	83
Grade 3	18	18	4	78
Grade 4	5	19	3	83
Grade Unknown	2	6	1	39
Non-invasive Test Results (Only Includes Patients with CCS Class I ,II, III or IV A)				
Low	6	67	24	123
High	71	54	14	105
Missing/Unknown	23	45	9	96

Note: Includes patients who were waiting for isolated CABG who either received isolated CABG or died in the queue (n=21,284).
Data Source: Cardiac Care Network

Conclusions

Ontario remains a world leader in measuring and managing waiting lists for cardiac surgery. Funding responses to lengthening cardiac surgery queues have been reasonably rapid and have reflected a two-pronged policy thrust: reducing backlogs through one-time increases and expanding capacity on a recurrent basis to level out some of the long-standing interregional discrepancies in CABG utilization. Mortality on the waiting list remains low, and the increased throughput of cases in 1997/98 has had the desired effects of reducing waiting times and increasing the proportion of patients receiving surgery inside the maximum allowable delay recommended for their individual levels of acuity. The situation remains unstable, however, with several centres having fallen well below the recommended caseload targets required to reduce backlogs to levels achieved in 1992/93. Some centres still had large queues into 1998 (e.g. Sudbury and St. Michael's Hospital), although this was largely explicable by the proportion of elective cases booked for surgery at those centres. We recommend continued close monitoring of median waiting times, total numbers of patients waiting and proportion of persons done "on time."

APPENDIX A12.1 Cardiac Surgery: Comparison of Actual Cases Completed to Ministry of Health Targets by Hospital

Hospital	1997-1998 One-time Incremental Cases Recommended by Ministry of Health*	1997-1998 Adjusted Target Volume Recommended by Ministry of Health*	Actual Cases Completed	Variance from Ministry of Health Adjusted Target (cases)†	Variance from Ministry of Health Adjusted Target (%)‡
Sudbury	177	799	759	-40	-5
Ottawa	87	1,162	1,169	7	1
Kingston	85	568	486	-82	-14
Toronto Hospital	219	2,743	2,454	-289	-11
Sunnybrook	154	1,191	1,122	-69	-6
St Michael's	158	1,179	999	-180	-15
Hamilton	127	1,393	1,309	-84	-6
London	134	1,841	1,753	-88	-5
Ontario	**1,141**	**10,876**	**10,051**	**-825**	**-8**

Notes: *Includes the number of funded and approved cases for CMGs 177-180 and 182 (cardiac valve procedures with/without cardiac catheterization, coronary bypass with/without cardiac catheterization and other cardio-thoracic procedures with pump)*

* Includes 1997/98 one-time cases, other approved cases, additional cases to reach base, plus 1996/97 one-time cases still remaining to complete.

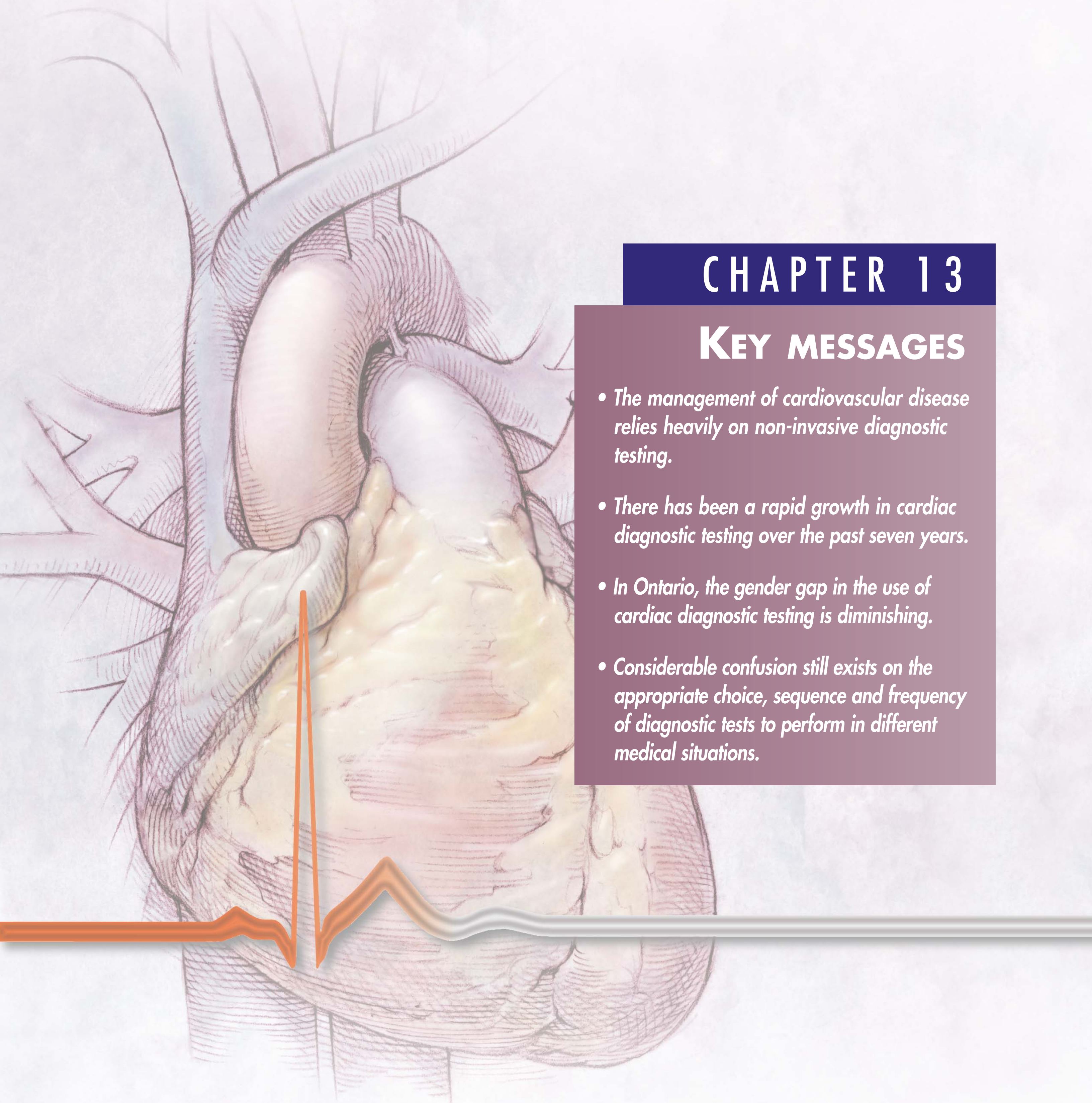
† Actual cases completed – adjusted target volume recommended by Ministry of Health

‡ (Variance (cases)/adjusted target) x 100

Data Source: Cardiac Care Network

Non-invasive Cardiac Diagnostic Testing

Ben Chan



CHAPTER 13

KEY MESSAGES

- *The management of cardiovascular disease relies heavily on non-invasive diagnostic testing.*
- *There has been a rapid growth in cardiac diagnostic testing over the past seven years.*
- *In Ontario, the gender gap in the use of cardiac diagnostic testing is diminishing.*
- *Considerable confusion still exists on the appropriate choice, sequence and frequency of diagnostic tests to perform in different medical situations.*

Key Terms & Concepts:

- non-invasive diagnostic testing
- electrocardiogram
- arrhythmias
- exercise stress test
- doppler echocardiography
- ambulatory electrocardiography

Background

The management of cardiovascular disease relies heavily on non-invasive diagnostic testing. These tests provide information on both structural abnormalities of the heart and impairment of its function. Such tests not only help establish the diagnosis of cardiovascular disease but also guide decisions on drug therapy, surgery and other interventions, as well as provide important information on prognosis.

The most basic test is the electrocardiogram (ECG). The ECG measures minute electrical impulses in the heart and can detect arrhythmias (changes in the heart rhythm), aberrations in electrical conduction and some anatomical abnormalities.[1] The ECG can help detect the presence of myocardial ischemia (compromised blood flow to the heart muscle) and myocardial infarction (death of the heart muscle due to poor blood flow, or heart attack). Ambulatory electrocardiography, also known as Holter monitoring, records ECG rhythms over an extended period to detect transient arrhythmias.[2] Exercise stress testing (EST) examines the ECG while the patient is exercising, to see if the stress of exercise will precipitate myocardial ischemia which then becomes visible on the ECG.[3]

Nuclear medicine plays an important role in diagnosing cardiac disease. In myocardial perfusion scintigraphy, red blood cells are tagged with a radioactive substance such as thallium. Poor uptake of the radioactive substance in areas within the heart muscle is evidence of ischemia.[4] The ischemia can be further highlighted by having the patient exercise or by injecting substances (such as dipyridamole) that simulate a state of exercise in the body. Radionuclide angiography (RNA) is another nuclear medicine test that measures ventricular function, the adequacy of the pumping action of the heart.[5]

Two-dimensional echocardiography uses ultrasound waves to measure changes in the structure of the heart and valves.[6,7] Examination of the degree of movement of the walls of the heart between full contraction (systole) and relaxation (diastole) allows for the evaluation of ventricular function, in a similar fashion to RNA. Doppler echocardiography, a special technique, detects Doppler shifts from sound waves deflected from moving blood, thereby allowing the clinician to measure blood flow through the heart.

In this chapter we review trends in the use of each of the above six groups of tests. Exhibit 13.1 summarizes the role of these tests in cardiac disease management. A more detailed description of each type of test appears in the Methods Appendix. In a previous study,[8] we found that these procedures had a significant and growing impact on provincial fee-for-service physician expenditures from 1989/90 to 1992/93. The largest growth was for nuclear medicine and echocardiography. We also found significant regional variation in testing and a gender

EXHIBIT 13.1 Summary of the Role of Non-invasive Cardiac Diagnostic Testing

	Ischemic Heart Disease	Congestive Heart Failure	Arrhythmias	Valvular Disease
Electrocardiography	Helps to identify acute myocardial infarction and ischemia at a moment in time*		Can identify an arrhythmia if taken during episode*	
Ambulatory Electrocardiography (Holter Monitor)	Helps to identify silent ischemia*		Helps to identify transient arrhythmias**	
Exercise Stress Test	Main test for diagnosing ischemic heart disease**			
Myocardial Perfusion Scintigraphy	Important test for diagnosing ischemic heart disease**			
Echocardiography	Used to assess ventricular function after acute myocardial infarction; yields prognostic information*	Important test of ventricular function; echocardiography or radionuclide angiocardiography recommended by congestive heart failure guidelines**		Provides information on valve structure and flow abnormalities**
Radionuclide Angiocardiography	Used to assess ventricular function after acute myocardial infarction; yields prognostic information*	Important test of ventricular function; echocardiography or radionuclide angiocardiography recommended by congestive heart failure guidelines**		

* Has some role in diagnosis and management.

** Plays a critical role in diagnosis and management.

gap in testing that diminished over time. In this study, we extend the time-frame to 1996/97 to observe whether growth in use of these tests has continued and re-evaluate the state of the regional variations and gender differences in testing.

Data Sources

The data on diagnostic testing came from the Ontario Health Insurance Plan (OHIP), which receives bills for each test performed by fee-for-service physicians in the province. In this chapter, we used the National Physician Database (NPDB), which maintains summary files of OHIP billing activity over fiscal quarters and years. The data exclude tests done by the 5% of practising Ontario physicians who are paid by means other than fee-for-service, as well as services performed on inpatients in hospitals.[9] Physicians not on fee-for-service include general practitioners and family physicians (GP/FPs) practising in Health Services Organizations which tend to be concentrated in the Central South region and academic specialists who are part of the South Eastern Academic Medical Organization (SEAMO) in Kingston.

How We Did the Analysis

For any given OHIP service, we linked an anonymous identifier for the physician who billed for a test to the physician's specialty and postal code. Rates of testing by region were calculated based on the number of tests performed by physicians whose registered postal code fell within each region. Information on the age and sex of the patient receiving the test was used to create profiles showing use of tests at different age groups. We also calculated the age-adjusted rate of testing for men and women using this information.

Information in the NPDB on physician specialty was used to calculate the number of different types of specialists who perform various tests. The specialty information in NPDB is incomplete in that subspecialties are often not coded (for example, a cardiologist may be coded as an internist). Therefore, we did not attempt to distinguish between internists and cardiologists in this study.

Regional rates of testing per capita were calculated using population data from Statistics Canada. These population data are derived from the 1991 and 1996 census, with interpolations made for intercensal years.

Interpretive Cautions

The creation of SEAMO in 1994/95 may have resulted in an underestimation of the South Eastern region's utilization rates. However, the proportion of specialists affected is small and would have a very minimal effect on overall growth in the use of these services.

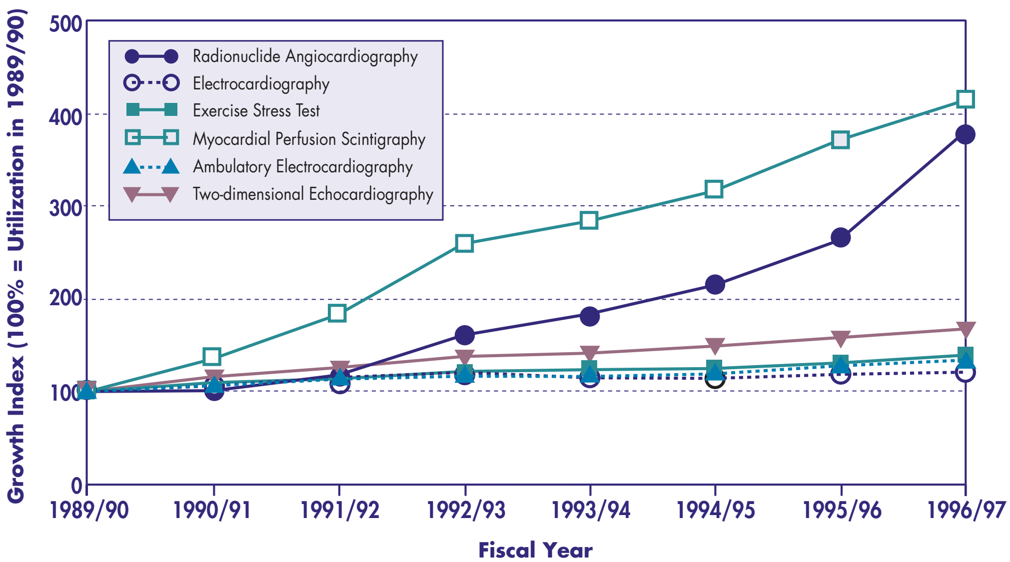
Regional variations data are based on the physician's postal code, which is not the same as a patient's postal code. Hence, if patients in a remote region are travelling to a more populated region for tests, it will appear as if patients in the remote region are receiving fewer tests than is actually the case. The regional variations shown here should accordingly be interpreted with caution. On the other hand, we expect that local residents can access these non-invasive tests close to home throughout most of Ontario. Interregional travel for these tests would be the exception, not the norm. Moreover, even if this cross-regional traffic is occurring, large variations would indicate that patients cannot conveniently receive services in their region of residence, and an impediment to access exists.

Last, because we are using aggregated data, we cannot control for repeat tests on the same patient. Thus, the numbers reported reflect numbers of tests rather than numbers of patients.

Findings and Discussion

Exhibit 13.2 shows the growth in cardiac diagnostic testing over time in Ontario. From 1989/90 to 1996/97, the rate of growth in testing exceeded the overall growth rate for OHIP expenditures (25.6%) for all non-invasive tests except routine electrocardiography. Growth was most rapid for the newer technologies such as myocardial perfusion scintigraphy and RNA.

EXHIBIT 13.2: Growth Rates for Various Cardiac Diagnostic Tests in Ontario, 1989/90 - 1996/97



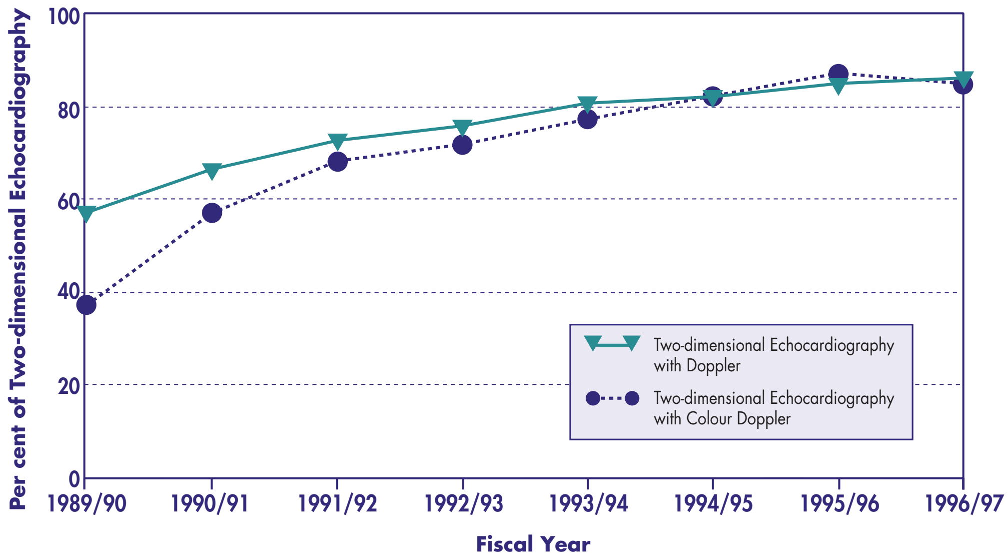
Data Source: National Physician Database

Exhibit 13.3 shows the use of Doppler and colour Doppler with conventional two-dimensional (2-D) echocardiography. There has been a steady increase in the use of Doppler studies in conjunction with conventional 2-D echocardiography. Elsewhere we have shown that Doppler studies add little information to routine echocardiography in those cases where there is no suggestion of valvular disease.[10] Some cardiologists have argued in favour of the use of Doppler to evaluate diastolic dysfunction, which is believed to be a form of left ventricular failure.[11,12] However, this claim is controversial, as there is no clear evidence yet to suggest that attempts to treat diastolic dysfunction lead to meaningful improvements in quality of life.[13] At the time of printing, the fee for colour Doppler was slated for removal from the OHIP Schedule of Benefits.

Profile of Physicians Providing Tests

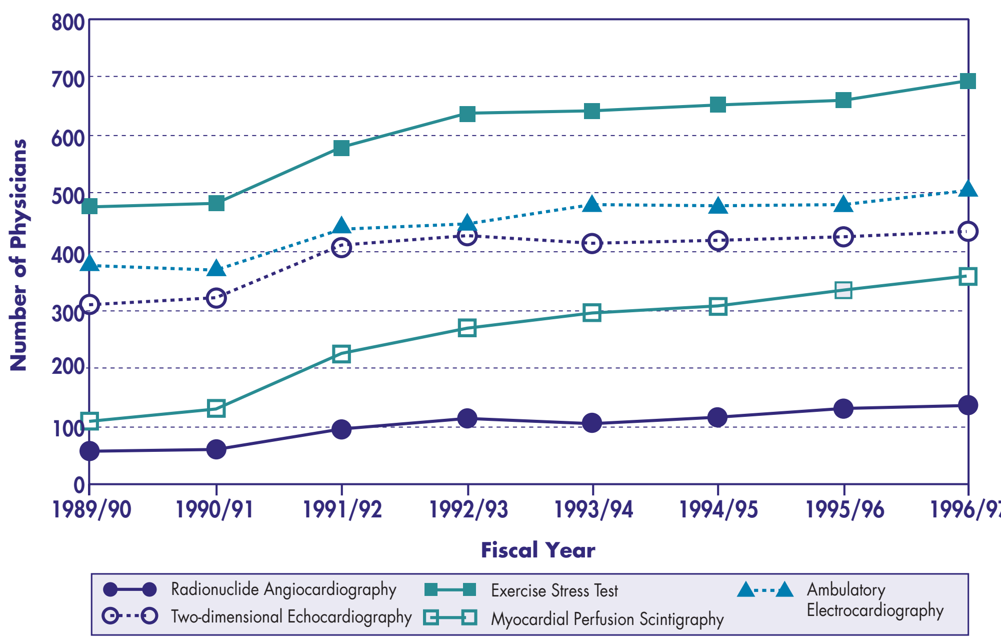
Growth in testing as shown in Exhibit 13.2 is related to more physicians opting to provide these tests to their patients. Exhibit 13.4 shows the growth in the number of physicians providing different tests. A physician had to perform at least 12 tests in one year to be included. Part of the growth from 1990/91 to 1991/92

EXHIBIT 13.3: Use of Doppler with Two-dimensional Echocardiography in Ontario, 1989/90 - 1996/97



Data Source: National Physician Database

EXHIBIT 13.4: Growth in Number of Physicians Performing Various Cardiac Diagnostic Tests in Ontario, 1989/90 - 1996/97*



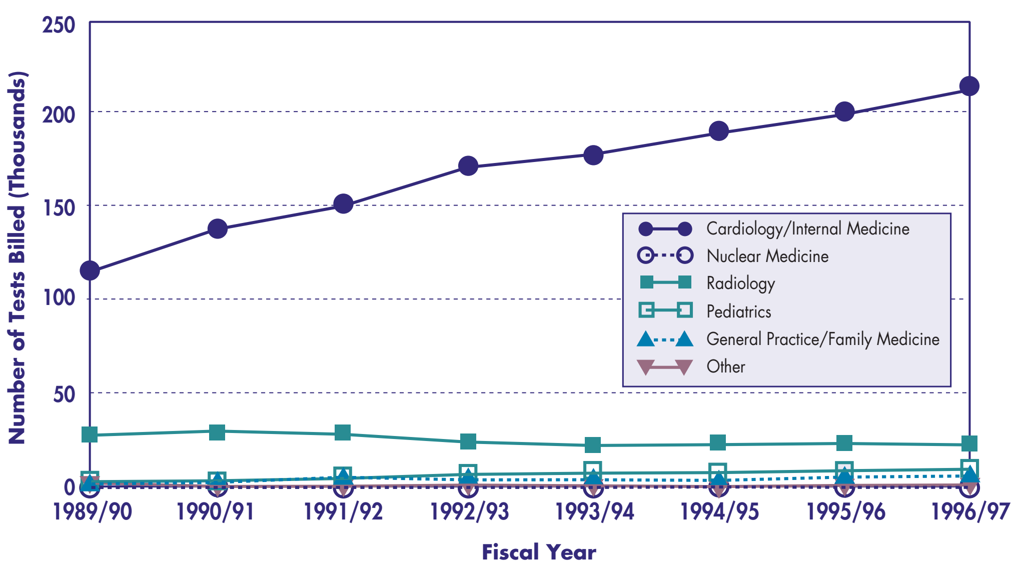
Physicians had to bill at least 12 tests per year to be considered as having performed the test

Data Source: National Physician Database

was due to an OHIP policy change under which radiologist and nuclear medicine groups previously billing under a single physician's billing number were required to bill individually, thereby resulting in an artefactual increase in physicians. If we consider only the period from 1991/92 to 1996/97, however, we still see a large increase in the number of physicians performing procedures over time: 40% for RNA and 58% for myocardial perfusion scintigraphy, compared to an increase of 5% in the physician supply over this same time period.

Exhibit 13.5 shows changes in echocardiography billing over time. Much of the increase in echocardiography testing is among cardiologists and internists. This represents a major shift away from radiologists who now play a minor role in the provision of this service.

EXHIBIT 13.5: Growth in the Use of Echocardiography by Physician Specialty in Ontario, 1989/90 - 1996/97



Data Source: National Physician Database

EXHIBIT 13.6 Ratio of Male to Female Age-adjusted Cardiovascular Testing Rates per Capita in Ontario, 1989/90 and 1996/97*

Test	1989/90	1996/97
Electrocardiogram	1.00	1.00
Exercise Stress Test	1.75	1.56
Myocardial Perfusion Scintigraphy	1.70	1.35
Ambulatory Electrocardiography	0.89	0.79
Two-dimensional Echocardiography	0.90	0.96
Radionuclide Angiocardiography	1.27	1.28

* Age-standardized number of tests per capita for men divided by the number of tests per capita for women.

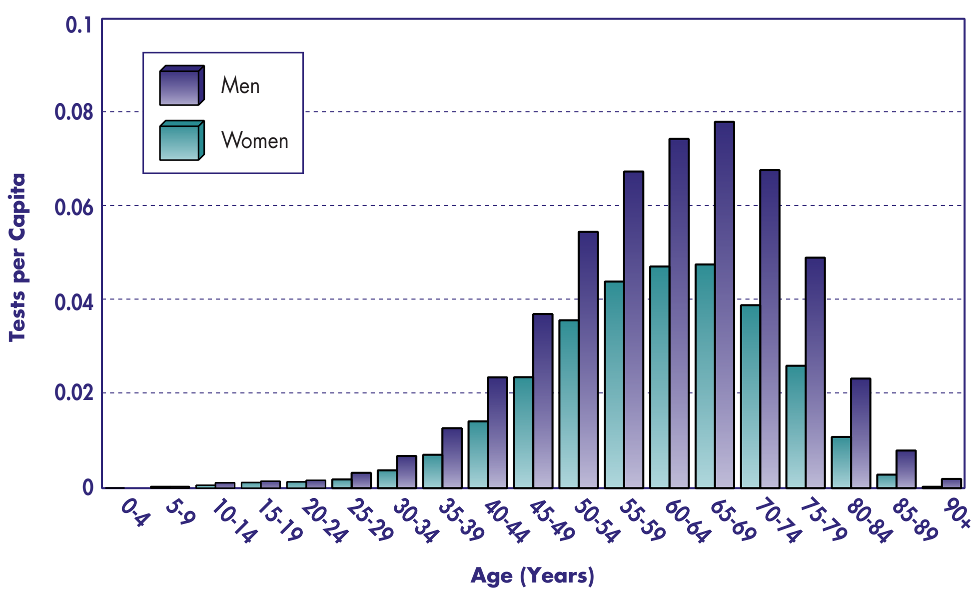
Data Source: National Physician Database

Test Use by Patient Age/Sex Groups

Exhibit 13.6 describes differences in age-adjusted rates of cardiac diagnostic testing by gender in 1996/97 in Ontario. In previous studies we found higher rates of testing over time for men for coronary artery disease tests (EST, RNA, stress thallium) and higher rates for women for echocardiography and ambulatory ECG tests. We also found that these differences diminished over time. These more up-to-date figures confirm our previous findings. This may be an indication that coronary artery disease in women is being investigated more extensively.

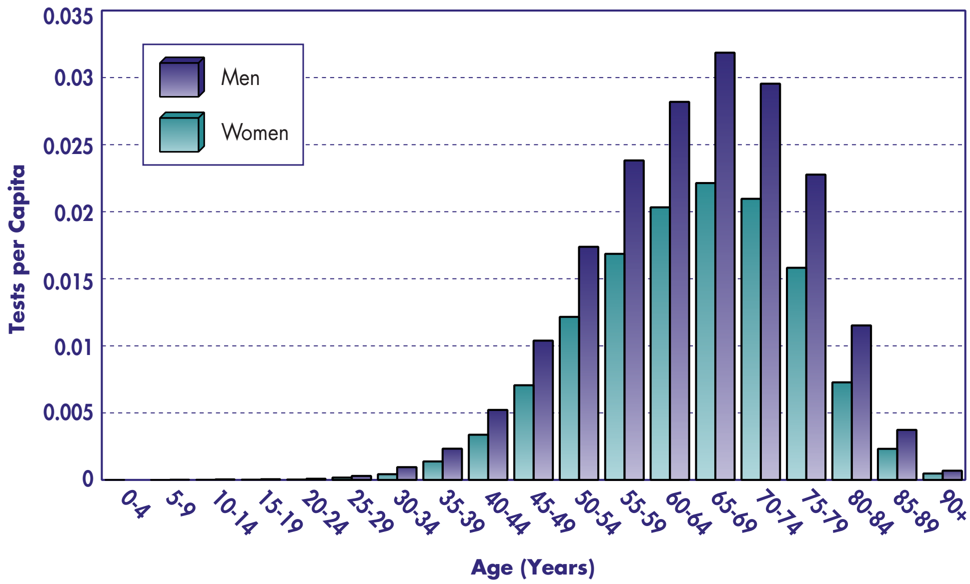
Exhibits 13.7 to 13.9 profile testing patterns in different age/sex groups. Use of myocardial perfusion scintigraphy and EST peak at ages 65 to 69, while echocardiography use peaks later, at the 75 to 79 age group. Interestingly, echocardiography use is greater among women than men in young age groups and lower among older age groups. The greater use among younger women may be related to testing for mitral valve prolapse.

EXHIBIT 13.7: Age/Sex-specific Exercise Stress Tests per Capita in Ontario, 1996/97



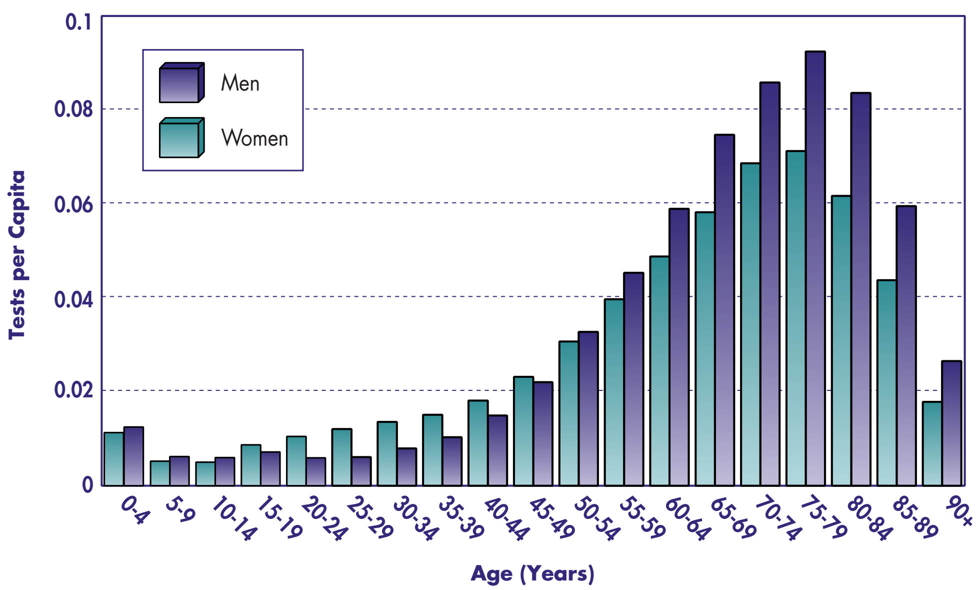
Data Source: National Physician Database

EXHIBIT 13.8: Age/Sex-specific Myocardial Perfusion Scintigraphy Tests per Capita in Ontario, 1996/97



Data Source: National Physician Database

EXHIBIT 13.9: Age/Sex-specific Two-dimensional Echocardiography Tests per Capita in Ontario, 1996/97



Data Source: National Physician Database

EXHIBIT 13.10 Regional Variations in the Number of Cardiovascular Tests per 1,000 Population in Ontario, 1996/97

Health Planning Region	Electrocardiography	Radionuclide Angiocardiography	Myocardial Perfusion Scintigraphy	Two-dimensional Echocardiography	Exercise Stress Test
Central East	224	0.5	3.6	23	15
Central West	164	3.1	8.9	19	18
Central South	187	3.0	9.8	26	18
East	182	1.0	3.8	13	15
North	216	3.0	5.5	18	31
South West	163	2.8	3.5	16	22
Toronto	310	5.1	11.2	37	24
Total	**215**	**2.8**	**6.9**	**23**	**20**

Data Source: National Physician Database

Regional Variations in Testing

Exhibit 13.10 shows the per capita rates of testing for various cardiac diagnostic tests by Ministry of Health planning region. Despite its physician shortage, the North has a higher rate of exercise stress testing than any other regions. This may reflect the higher prevalence of heart disease in the North (see Chapter 1). It may also reflect a greater preference for EST over myocardial perfusion scintigraphy. Rates of the latter are lower in the North than the provincial average, perhaps due to lower availability of the service. More generally, we see wide variation in preference for EST over myocardial perfusion scintigraphy. The ratio between these two tests is 18:10 in Central South, compared to 56:10 in the North.

For all tests other than EST, Toronto has the highest rate of testing, while the Eastern region has many of the lowest rates. This latter finding, however, should be interpreted with caution given that activity in SEAMO is not captured.

Conclusions

The data presented here demonstrate a rapid growth in cardiac diagnostic testing over the past seven years. This growth has not abated in recent years and does not appear to have been affected by the stringent expenditure control policies that were in place from 1992/93 to 1996/97.

Several factors may have contributed to the growth in the use of these procedures. First, clinical practice guidelines emerged in the 1990s that may have promoted the use of many of these tests. Specifically, guidelines emphasizing the importance of risk-stratifying patients following myocardial infarction[14-17] could have contributed to the increasing utilization of both EST and myocardial perfusion scintigraphy. Similarly, guidelines on management of congestive heart failure emphasized the need to obtain an objective assessment of left ventricular function using either echocardiography or RNA.[18,19] A similar British study covering the years from 1988 to 1993 found a similar increase in echocardiography use that was attributed to more aggressive documentation of left ventricular dysfunction.[20]

Technology diffusion may have also contributed to utilization growth. The newer technologies, such as myocardial perfusion scintigraphy and RNA, showed the greatest growth. This growth was strongly related to an increase in the number of physicians billing for the tests, which suggests that physicians were rapidly gaining greater access to testing equipment. In the cases of echocardiography and nuclear medicine, declines in radiologists' billings may indicate a diffusion of tests beyond traditional provider settings; physicians who used to refer patients for these tests may now be more comfortable performing them themselves.

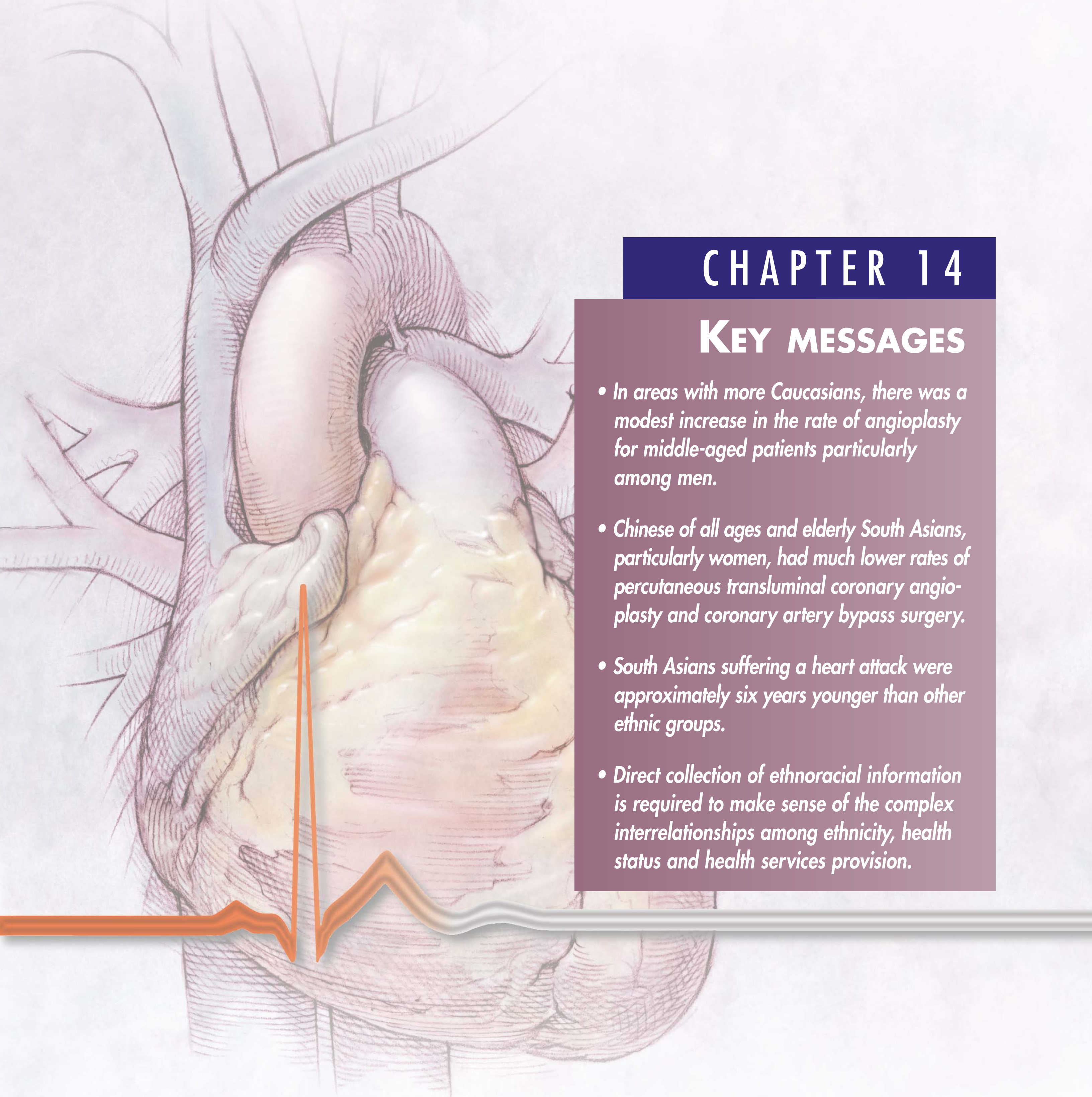
Studies in other jurisdictions have suggested that there is sex bias in testing, noting that women undergo fewer non-invasive diagnostic procedures than men.[21,22] This study shows that in Ontario, the gender gap in cardiac diagnostic testing is diminishing. More rapid utilization growth among female patients may reflect increased awareness of the burden of cardiac disease among women. It is not possible, given the nature of the data, to determine whether higher utilization growth for women represents an appropriate move towards a similar level of testing among men and women, or whether women and men alike are somehow being over-tested. However, it is encouraging that the greatest differential growth in utilization was for myocardial perfusion scintigraphy. This test is especially useful for women since they often have false positive or false negative ESTs. Thallium scintigraphy has particular utility in assessing younger women or those with atypical chest pain.

In a previous examination of cardiac diagnostic tests,[8] we noted that much of the utilization growth may have occurred because newer, more sophisticated technologies had only recently been widely available outside of teaching centres.

We predicted that eventually higher growth rates from increased access to these procedures would level off. The analysis in this chapter suggests that no plateau has been reached. We emphasize that these data alone cannot provide information about the appropriateness of the tests performed and that high growth in the use of these tests may be desirable if these tests provide diagnostic value to the physician and patient. Considerable confusion still exists on the appropriate choice, sequence and frequency of diagnostic tests to perform in different medical situations. This remains a critical area for further research.

Ethnoracial Origins and Heart Disease

Anne Y. Shin, Sonia S. Anand, Claus Wall, Jack V. Tu, Salim Yusuf, C. David Naylor



CHAPTER 14

Key messages

- *In areas with more Caucasians, there was a modest increase in the rate of angioplasty for middle-aged patients particularly among men.*
- *Chinese of all ages and elderly South Asians, particularly women, had much lower rates of percutaneous transluminal coronary angioplasty and coronary artery bypass surgery.*
- *South Asians suffering a heart attack were approximately six years younger than other ethnic groups.*
- *Direct collection of ethnoracial information is required to make sense of the complex interrelationships among ethnicity, health status and health services provision.*

Key Terms & Concepts:

- mortality rates
- area-based ethnicity analysis
- outcomes
- ethnoracial status
- socioeconomic status
- surname analysis

Background

Terms such as race and ethnicity may be controversial and mean different things to different people. Most commonly, the term race is used to imply a biologic entity that distinguishes groups of people, whereas ethnicity refers to cultural phenomena that are sometimes related to race, including language and customs.[1] Given the potential overlap between these concepts, we shall use the term ethnoracial status in this chapter to denote both.

The prevalence of ischemic heart disease (IHD) varies significantly among different cultures and nationalities. The prevalence also differs among immigrants in contrast to those native-born.

In Canada, the interwoven issues of ethnicity, immigration status and nationality have not been extensively studied in relation to health status generally, or IHD specifically. However, what we do know is enough to emphasize the need to start taking closer notice of ethnoracial group membership as a determinant of health status—a point that may well be the key message of this chapter.

For example, at least 3% of the Canadian population are Aboriginal peoples.[2] IHD mortality rates among men are similar for Aboriginal Canadians and the general population, but the IHD mortality rate is markedly higher among Aboriginal Canadian women than the general female population. Various risk factors are much more common among Aboriginal Canadians than in the general population, including diabetes and glucose intolerance (about four to five times more prevalent), smoking and obesity.[3] Such observations highlight the need for ongoing surveillance and, above all, culturally appropriate health promotion and clinical prevention activities.

More generally, ethnoracial health research is crucial because of the shifting patterns of immigration into Canada. Less than half of those entering Canada in 1996 were of European origin, and over 30% came from Asia. Census data do include a self-defined ethnicity category, but epidemiologically meaningful information on ethnoracial group membership and health status or health service utilization remains sparse.

In one study,[4] a Statistics Canada team found that first-generation immigrants, who now make up one-sixth of Canadians, have higher rates of IHD than those native-born. IHD was the number one cause of death in immigrants from South Asia (i.e. India, Pakistan, Sri Lanka, Bangladesh). Intriguingly, African immigrants have the highest overall age-standardized mortality rate from IHD, but many immigrants to Canada from Africa are originally of South Asian origin. These findings emphasize the difficulties in drawing inferences about the relationship of ethnoracial status and IHD. According to the Heart and Stroke Foundation of Canada, South East Asians (e.g. Japanese, Chinese, Koreans) have the lowest rates of IHD.[5] These data are corroborated by an analysis of national mortality data by Sheth et al,[6] covering the years 1979 to 1993. IHD mortality was slightly higher in South Asians than European Canadians, while those of Chinese origin had about one-third the mortality from IHD.

In the United States, many studies have shown the relationship between ethnoracial group and IHD is further confounded by socioeconomic status (SES). For example, half of all deaths from IHD in African-Americans in the United States are explained by SES.[7] Reduced access to health care may partly explain these health care disparities.[8] Data elsewhere in this Atlas confirm that Canadians in the lower SES groups have a markedly higher burden of IHD, including excess mortality. However, these relationships may not be consistent across ethnoracial groups. Sheth et al found that the relationship between SES and mortality appears to be stronger among those with European (Caucasian) surnames than those of Chinese and South Asian extraction.[9]

One of the reasons for the lack of studies on ethnicity may be that information on ethnoracial status is rarely collected directly from individuals. Large databases, particularly administrative ones, often lack this key information. Thus, other methods have been used to try to obtain indirect information on ethnicity.

One method that has been used in Canada is to examine the ethnoracial make-up of the area of residence in which a person lives.[10] This area-based method does not assume that the ethnic make-up of the area reflects the individual person directly, but does give an idea of the ethnoracial composition of the area in which a person lives. Several studies have shown that the social characteristics of the area in which a person lives have a significant impact on the health status of its inhabitants,[11-13] but the extent to which these inferences can be extended to individual ethnoracial group membership is uncertain.

Another method utilized is to presume ethnicity based on the surname of the individual and the country of birth. This method has been used in Canada to determine that South Asians, compared to Caucasians and the Chinese, have high rates of mortality from IHD.[14]

A variety of studies have generated useful information about mortality and cardiac risk factors for Aboriginal Canadians and, increasingly, about Canadians in other ethnoracial groups. However, little is known about revascularization (percutaneous transluminal coronary angioplasty [PTCA], or coronary artery bypass surgery [CABG]) and outcomes after heart attack by ethnicity in Canada. In the US, rates of PTCA and CABG are much lower in African-Americans than Caucasians;[15-18] African-Americans also have higher death rates after heart attack.[19] In most of these studies, there was an effect of ethnoracial status even after controlling for SES and health insurance status. Whether the universal health-care system in Ontario will avoid these ethnoracial differences has not been established.

In this chapter, we use both the area-based method and surname analysis to examine patterns of utilization of PTCA and CABG among ethnoracial groups. We also use surname analysis to examine mortality rates after a heart attack (acute myocardial infarction or AMI), and cardiac drug use in elderly patients after a heart attack. The area-based method utilizes the proportion of Caucasians who live in a residential area. For the surname-based method, we identified three ethnic groups: South Asian, Chinese and "other." These divisions are useful for cardiac disease because South Asians are one of the ethnic groups with the highest rates of disease and Chinese one of the lowest. Although Canadians of African origin have increased IHD rates similar to South Asians, their surnames are not distinguishable. Other South East Asians have low rates of disease similar to Chinese people, but may be more difficult to identify by surname. In particular, there are approximately 100 basic Chinese surnames, with others being variations on this set.[20] South Asians are defined in this study as those whose ancestors originate from India, Pakistan, Bangladesh and Sri Lanka. Chinese are defined as those whose ancestors originate from China, Hong Kong and Taiwan. We have set aside, for purposes of this chapter, the important issue of IHD and Aboriginal peoples, as various other groups with special expertise are working on that topic.

We emphasize that these analyses represent only an initial exploration of a complex topic, and that the methods used would be able to detect only major differences in ischemic heart disease outcomes and use of revascularization by ethnoracial status in Ontario. However, we include these data in large measure to highlight the need for much more study of ethnoracial health issues, not only for cardiovascular disease, but across the full spectrum of health determinants and illness outcomes.

Data Sources

Coronary Artery Bypass Surgery and Percutaneous Angioplasty

For this analysis, we obtained information from hospital discharge abstracts from the Canadian Institute for Health Information (CIHI) on patients who had coronary artery bypass surgery and angioplasty between April 1, 1991 and March 31, 1997 inclusive (fiscal years 1991/92 to 1996/97) in one of the nine centres equipped to provide mechanical revascularization. All patients who resided outside of Ontario were excluded.

Area-based Ethnicity

The postal codes of the residence of patients who underwent either CABG or PTCA from the dataset described above were identified. Patients who had rural postal codes were excluded because their postal code reflects the area of the local post office, and not the area of residence. Ethnicity information for the area of residence of the patient was then obtained from the 1991 Census. For the analysis of CABG, ethnicity and SES, information were also obtained from the 1991 Census. Population sizes (actual and predicted) were provided by Statistics Canada.

Surname-based Analysis

Surnames defined as South Asian or Chinese were obtained from work done previously by Sheth et al.[14] This dataset of surnames was developed by the Study of Heart Assessment and Risk in Ethnic Groups (SHARE) investigators at McMaster University.[21] The surnames were originally derived from a subset of the Canadian Mortality Database 1979-1993, using the names of people who had died and who themselves, or their parents, were born in countries with large South Asian or Chinese populations. Thus, surnames and countries of birth were used to determine ethnicity categories for individuals. Because country of birth information was not available for our study, we could not use the SHARE surname list without modification to eliminate surnames that were not specific for an ethnic group (e.g. Lee or Brown for Chinese, and Wilson or Alexander for South Asian). We therefore modified this list of surnames using the Registered Persons Database (RPDB) of Ontario as a guide. The list of patients who had CABG or PTCA, and the RPDB were stripped of all information other than names in order to protect privacy. The two files were manually inspected and compared to accept or reject the classification of Chinese or South Asian. For the Chinese names, we used the sex-specific list created by Choi et al, using Ontario's mortality data in 1982 to 1989 as a guide.[20] When first and/or second given names were also likely to be Chinese or South Asian, the name was accepted as such. We therefore rejected such hypothetical names as John George Lee, but accepted Tom Tse-tung Lee. Ontario's population sizes for the three ethnic groups were obtained from the Canadian census.

Post-myocardial Infarction Cohort

All patients who had an AMI between fiscal 1994/95 and 1996/97 were identified from hospital discharge abstracts (CIHI) and assembled into the Ontario Myocardial Infarction Database (OMID) (please refer to Methods Appendices for Chapters 5 and 11 for more detail). Follow-up data were obtained with linkage to the Ontario RPDB. An elderly subset of this group (those aged 65 years and over) was assessed for drug utilization for secondary prevention of cardiac disease using a link to the Ontario Drug Benefit database.

How We Did the Analysis

Area-based Ethnicity

In determining the category of ethnicity of a person's residence, all Ontarians who claimed a single ethnic origin in the 1991 Canadian Census, comprising 67% of the Ontario population in 1991, were included. We determined the proportion of Caucasian inhabitants for each area, designated by the first three digits of the postal code of residence of the patients. Each area was then ranked from the lowest to highest proportions of Caucasians. Next, 20% of the urban provincial population was assigned to each ethnicity quintile, from the lowest proportion of Caucasians (quintile 1) to the highest (quintile 5). For the analysis that included SES, quintiles from lowest (1) to highest (5) were similarly obtained from the 1991 Census. SES information was represented by average individual, sex-specific income for a given postal code area.

To determine the rate of CABG or PTCA, the years 1991/92 to 1993/94 and 1994/95 to 1996/97 were assessed separately. The numerator included those urban Ontarians, between the ages of 45 and 99 years, who had CABG or PTCA. The total count for each three-year period was divided by three to give the average count per year. The denominator of the rate was age- and sex-specific for both the rural and urban population of Ontario, projected for 1992 and 1995 for the years 1991 to 1993 and 1994 to 1996 respectively. Because the denominator includes the 20% of the Ontario population living in rural areas without corresponding counts for procedures, the absolute rates of mechanical revascularization for urban dwellers are deflated by approximately 20%. However, for our purposes it is the relationship of the rates among quintiles defined by ethnoracial composition which is most important.

The Methods Appendix provides more detail on the statistical tests used to determine whether age, sex and quintile of ethnicity were associated with the area rates of PTCA or CABG.

For the analysis that included SES, we included patients who had surgery between fiscal 1991/92 and 1995/96 inclusive (see Methods Appendix MA14.3). We examined whether age, sex, year of surgery, quintile of ethnicity and quintile of SES were associated with the rate of CABG.

Surname-based Ethnicity

For the rate of PTCA and CABG, the numerator was the number of patients of Chinese, South Asian and "other" ethnic origin who had the procedure over the six years studied. The "other" population was that of Ontario excluding the Chinese and South Asian subpopulations. Chinese people in the 1991 Census were noted to be those whose ancestors were from China, Hong Kong or Taiwan.

South Asian people in the 1996 Census were identified as being East Indian, Sri Lankan, Punjabi, Pakistani, Tamil, Bangladeshi, as well as South Asian without further descriptors (not otherwise specified). The denominator information for the rate was provided by the 1991 and 1996 census.

Post-myocardial Infarction Cohort

We examined whether ethnicity inferred from surnames was related to outcomes after a heart attack, after controlling statistically for the influence of age, sex, other diseases and other risk factors for death. Again, details can be found in the Methods Appendices.

Interpretive Cautions

The area-based analyses do not reflect the ethnic group of the individual, but describe the ethnic composition of the area in which the patient lives. The conclusions from these analyses are best understood in terms of neighbourhoods. To that end, we have taken neighbourhood SES into account. However, for this analysis, we have defined area ethnicity only in terms of the proportion of Caucasians. Neighbourhoods in the lowest quintile by this measure—those with more non-Caucasians—could be a blend of areas with high proportions of South East Asians (and therefore low expected rates of IHD) or high proportions of Canadians of South Asian or African origin (which would lead to higher-than-average rates of IHD). This analysis is accordingly best interpreted only as a rough screening test to determine if neighbourhoods with more Caucasians have higher rates of use of revascularization procedures.

The surname analysis has the great advantage in that it may be applied to individuals. One potential limitation is that the "other" group includes persons from a variety of ethnoracial backgrounds. For example, by focusing on Chinese surnames, we would identify about half the South East Asians in Ontario, while the rest would move to the "other" category. Similarly, some Canadians of South Asian or African descent would also be placed in this group. However, the vast majority of persons in this category would be classified as Caucasian or European in origin.

Another potential problem is the accuracy of ethnicity assignment by surname. Using our final surname list, we found that 3.5% of people in the RPDB were designated as South Asian and 4.2% as Chinese. Although we did not perform a validity study, these numbers are consistent with census data, which indicate that in 1991, the Ontario population was 3.7% South Asian and 4.4% Chinese. Sheth et al have assessed the validity of their original list (which, as noted, we have modified) by contacting a random sample of 100 South Asians and 100 Caucasians in the Hamilton-Wentworth area; they found a sensitivity of 96%

and a specificity of 95% for South Asian surnames.[14] Choi et al demonstrated a sensitivity and specificity of approximately 96% for Chinese surnames using Ontario mortality data.[20] Given that we removed some of the surnames from these lists, the sensitivity for both ethnic groups is probably lower and the specificity may be slightly higher. Our preference was a slightly higher specificity compared to sensitivity. This could lead to some undercounting of both Chinese and South Asians, and incorrect assignments to the "other" category. However, given that the proportions of Ontarians identified with our surname list are similar to the proportions of Chinese and South Asians reported in the census, we doubt that serious undercounting has occurred.

Because of relatively small absolute numbers of persons suffering heart attacks in the ethnoracial groups of interest, we have only limited statistical power to make outcome comparisons between groups. Furthermore, as is invariably true with administrative data, we have limited clinical detail and inferences must be drawn with caution.

Findings and Discussion

Percutaneous Transluminal Coronary Angioplasty and Coronary Artery Bypass Surgery

Area-based Ethnicity

The relationship between area ethnicity and rate of PTCA varied by sex and across age brackets (Exhibit 14.1). Examining service rates for younger men in the most recent period (1994/95 to 1996/97), areas with higher proportions of Caucasians showed higher rates of PTCA, but this relationship was not consistent among women and the elderly. Nonetheless, examining the relationship across age and sex brackets, the lowest quintile generally had lower rates of PTCA than ethnicity quintiles 2 to 5 (Exhibit 14.2). There was little change across the six-year period, other than an increase in the rate of PTCA for the elderly (see Methods Appendix MA14.1).

For CABG, the relationship of rates and area ethnicity was weak and showed inconsistencies across age brackets. With the increase in the rate of CABG over time, the relationship was effectively abolished (Exhibits 14.3 and 14.4). There was no meaningful relationship between area ethnicity and rate of CABG for the most recent period (Exhibit 14.4). We repeated the analysis of the contribution of area ethnicity to CABG rates after controlling for area SES, with similar findings (see Methods Appendix MA14.2 and MA14.3).

EXHIBIT 14.1 Age/Sex-specific Rates for Coronary Angioplasty per 100,000 Population Aged 45 Years and Over by Ethnicity Group Quintile in Ontario, 1991/92 - 1996/97

Fiscal Year	Ethnicity Group Quintile	Men (Age)				Women (Age)			
		45-54	55-64	65-74	75+	45-54	55-64	65-74	75+
1991/92 - 1993/94	1 - Low	81.7	121.1	123.2	57.9	17.7	35.5	54.7	24.2
	2	90.6	150.5	159.3	71.4	20.9	55.0	78.1	34.9
	3	98.4	177.3	153.2	64.8	26.9	56.9	80.5	31.8
	4	98.4	164.8	168.5	54.3	30.2	59.1	64.0	24.9
	5 - High	115.5	181.2	161.6	46.6	34.6	56.5	65.8	20.3
1994/95 - 1996/97	1 - Low	83.3	141.6	166.9	70.0	20.0	51.5	79.5	35.1
	2	109.3	181.5	209.5	116.4	22.2	64.0	109.6	55.6
	3	109.0	183.2	171.4	89.1	25.3	69.4	99.3	53.8
	4	104.6	166.2	161.5	57.6	23.6	51.3	78.8	40.4
	5 - High	124.0	202.0	189.0	70.0	24.2	75.2	94.0	33.6

Quintile 1 = 0 - 70% Caucasians (as proportion of population in an area); Quintile 2 = 70 - 82%; Quintile 3 = 82 - 89%; Quintile 4 = 89 - 94%; Quintile 5 = 94 - 100%

Data Source: Canadian Institute for Health Information, Canadian Census 1991 and 1996

EXHIBIT 14.2 Age, Sex and Area Ethnicity Quintile Odds Ratios for Angioplasty Patients Aged 45 Years and Over in Ontario, 1991/92 - 1996/97

Factor Comparison	Fiscal Year 1991/92 - 1993/94		Fiscal Year 1994/95 - 1996/97	
	Odds Ratio	95% Confidence Interval	Odds Ratio	95% Confidence Interval
Age				
Over 65 Years : Under 65 Years	1.07	0.99 - 1.16	1.27	1.18 - 1.36
Sex				
Men : Women	2.87	2.64 - 3.12	2.70	2.50 - 2.90
Area Ethnicity Quintile				
2 : 1	1.27	1.12 - 1.44	1.31	1.18 - 1.47
3 : 1	1.35	1.20 - 1.54	1.25	1.12 - 1.40
4 : 1	1.31	1.16 - 1.49	1.09	0.97 - 1.22
5 : 1	1.38	1.22 - 1.57	1.30	1.16 - 1.45

Note: Area ethnicity quintiles relate to the proportion of Caucasians of the area population.

Quintile 1 = 0 - 70% Caucasians (as proportion of population in an area); Quintile 2 = 70 - 82%; Quintile 3 = 82 - 89%;
Quintile 4 = 89 - 94%; Quintile 5 = 94 - 100%

Data Source: Canadian Institute for Health Information, Canadian Census 1991 and 1996

EXHIBIT 14.3 Age/Sex-specific Rates of Coronary Artery Bypass Surgery per 100,000 Population Aged 45 Years and Over by Ethnicity Group Quintile in Ontario, 1991/92 - 1996/97

Fiscal Year	Ethnicity Group Quintile	Men (Age)				Women (Age)			
		45-54	55-64	65-74	75+	45-54	55-64	65-74	75+
1991/92 - 1993/94	1 - Low	98.8	273.7	320.6	139.3	19.1	54.3	108.5	34.5
	2	102.8	235.5	367.2	139.3	15.0	55.5	98.4	39.3
	3	102.1	251.4	307.7	123.0	13.3	53.1	104.6	36.0
	4	122.6	277.5	379.5	119.2	23.2	55.9	118.7	40.2
	5 - High	130.8	303.0	366.6	118.1	27.7	73.3	110.1	36.0
1994/95 - 1996/97	1 - Low	116.2	286.2	442.9	203.6	19.3	66.6	137.1	53.8
	2	103.5	271.6	398.4	217.0	13.3	60.2	136.3	58.3
	3	105.4	270.9	378.9	182.2	17.3	56.5	118.6	61.7
	4	113.7	277.1	404.1	174.0	22.4	69.7	144.1	51.2
	5 - High	127.6	324.5	421.4	164.3	21.7	72.0	150.4	58.3

Quintile 1 = 0 - 70% Caucasians (as proportion of population in an area); Quintile 2 = 70 - 82%; Quintile 3 = 82 - 89%; Quintile 4 = 89 - 94%; Quintile 5 = 94 - 100%

Data Source: Canadian Institute for Health Information, Canadian Census 1991 and 1996

EXHIBIT 14.4 Age, Sex and Area Ethnicity Quintile Odds Ratios for Coronary Artery Bypass Surgery Patients Aged 45 Years and Over in Ontario, 1991/92 - 1996/97

Factor Comparison	Fiscal Year 1991/92 - 1993/94		Fiscal Year 1994/95 - 1996/97	
	Odds Ratio	95% Confidence Interval	Odds Ratio	95% Confidence Interval
Age				
Over 65 Years : Under 65 Years	1.63	1.53 - 1.73	1.98	1.87 - 2.09
Sex				
Men : Women	4.09	3.81 - 4.40	3.85	3.61 - 4.11
Area Ethnicity Quintile				
2 : 1	0.99	0.90 - 1.09	0.94	0.86 - 1.02
3 : 1	0.95	0.86 - 1.05	0.90	0.83 - 0.98
4 : 1	1.10	1.00 - 1.21	0.96	0.88 - 1.05
5 : 1	1.15	1.04 - 1.26	1.04	0.96 - 1.13

Note: Area ethnicity quintiles relate to the proportion of Caucasians of the area population.

Quintile 1 = 0 - 70% Caucasians (as proportion of population in an area); Quintile 2 = 70 - 82%; Quintile 3 = 82 - 89%; Quintile 4 = 89 - 94%; Quintile 5 = 94 - 100%

Data Source: Canadian Institute for Health Information, Canadian Census 1991 and 1996

EXHIBIT 14.5: Average Angioplasty Rate per 100,000 Population by Surname Ethnicity in Ontario, 1991/92 - 1996/97

Data Source: Canadian Institute for Health Information, ICES-modified SHARE Database, Canadian Census 1991 and 1996

EXHIBIT 14.6 Age, Sex and Surname Ethnicity Odds Ratios for Angioplasty Patients Aged 45 Years and Over in Ontario, 1991/92 - 1996/97

Factor Comparison	Odds Ratio	95% Confidence Interval
Age		
Over 65 Years : Under 65 Years	2.82	2.65 - 3.01
Sex		
Men : Women	2.96	2.77 - 3.17
Surname Ethnicity		
Chinese : Other	0.19	0.13 - 0.27
South Asian : Other	0.65	0.53 - 0.80

Note: South Asian includes ancestors from India, Pakistan, Sri Lanka and Bangladesh. Chinese includes ancestors from China, Taiwan and Hong Kong. Other excludes South Asians and Chinese.

Data Source: Canadian Institute for Health Information, Canadian Census 1991 and 1996, ICES-modified SHARE Database

Surname-based Ethnicity

PTCA results are displayed graphically in Exhibit 14.5 (please refer to Methods Appendix MA14.1 for more details). No changes over time were found. However, there was a clearly significant relationship between ethnicity and rate of PTCA (Exhibit 14.6). For all age groups and both sexes, Chinese patients had approximately 15% to 20% the rates of PTCA of the "other" group. Non-elderly South Asians had more comparable rates to the "other" group. However, elderly South Asians had much lower rates than "others," albeit higher than those of elderly Chinese persons. Non-elderly South Asian and Chinese women had

EXHIBIT 14.7: **Average Coronary Artery Bypass Surgery Rate per 100,000 Population by Surname Ethnicity in Ontario, 1991/92 - 1996/97**

Data Source: Canadian Institute for Health Information, ICES-modified SHARE Database, Canadian Census 1991 and 1996

much lower rates than their male counterparts compared to women in the "other" group (women:men ratios 0.19 for both versus 0.28 for the "other"). Undercounting from our methodology is unlikely to fully explain these findings.

CABG results are displayed graphically in Exhibit 14.7 (please refer to Methods Appendix MA14.2 for more details). Although not shown, there were no major time trends. There was a significant relationship between CABG rates and ethnicity (Exhibit 14.8). As observed for angioplasty, Chinese patients had much lower rates of CABG, particularly women (approximately 12% to15% that of "other" versus Chinese men 20% to 23% of "other"). Non-elderly South Asian men had slightly higher CABG rates than the "other" group (roughly 1.1-fold). However, these rates in the elderly were less than half of the "other" group. Non-elderly Chinese women had the lowest rate of CABG relative to men, followed by South Asian women, and the rest of the ethnic groups (women:men ratios 0.10, 0.16 and 0.21 respectively). Elderly Chinese women also had the lowest rates (women:men ratio 0.21, compared to 0.29 for the other two groups).

The slightly higher rate of CABG among non-elderly South Asian men is consistent with disease rates and may approximate that which is appropriate. However, the low rate among the elderly, as was seen with angioplasty, is difficult to explain. The very low rates among the Chinese for both age groups, and particularly among women, are at least partly attributable to lower disease rates. The coronary artery disease mortality rate for the Chinese population has

EXHIBIT 14.8 Age, Sex and Surname Ethnicity Odds Ratios for Coronary Artery Bypass Surgery Patients Aged 45 Years and Over in Ontario, 1991/92 - 1996/97

Factor Comparison	Odds Ratio	95% Confidence Interval
Age		
Over 65 Years : Under 65 Years	4.78	4.55 - 5.02
Sex		
Men : Women	4.08	3.85 - 4.33
Surname Ethnicity		
Chinese : Other	0.20	0.15 - 0.27
South Asian : Other	0.77	0.66 - 0.90

Note: South Asian includes ancestors from India, Pakistan, Sri Lanka and Bangladesh. Chinese includes ancestors from China, Taiwan and Hong Kong. Other excludes South Asians and Chinese.

Data Source: Canadian Institute for Health Information, Canadian Census 1991 and 1996, ICES-modified SHARE Database

previously been found to be threefold lower than that of "other" (i.e. Caucasians) in Canada.[14] A similar threefold difference was found for coronary artery disease prevalence in the UK.[22] While the differences in CABG rates are larger, about five times lower among Chinese Canadians, we are unable to determine whether this represents inappropriate undertreatment.

Post-myocardial Infarction Cohort

There were 52,616 patients who had an AMI between fiscal 1994/95 to 1996/97 and who had identifiable surnames. Exhibit 14.9 presents the distribution of these patients by ethnicity and sex. Of these, only 572 were Chinese (1.1%) and 1,164 (2.2%) were South Asian by surname. These proportions are much lower than one would expect based on the respective Ontario population proportions. We do not know whether this represents undercounting with our method, differences in disease prevalence, or out-of-hospital deaths. One possibility is that the difference partly reflects underdiagnosis. African-Americans in the US are only half as likely to be identified as having heart attacks, despite the greater prevalence and mortality of IHD in this population.[23,24] On the other hand, in a study in the UK, South Asians were just as likely as Caucasians to seek medical care for angina symptoms.[25]

There were 219 Chinese women (38% of Chinese people), 315 South Asians (27%) and 18,894 "other" (37%) (Exhibit 14.9). The average age of the Chinese patients was 68.6 years, South Asians 61.5 years and "other" 67.7 years. The average ages of Chinese women and men were 74.2 and 65.1 years respectively, South Asians were 67.2 and 59.5, and "other" were 72.4 and 64.7. Thus, the South Asian patients are much younger at disease presentation than the other two groups, which is consistent with greater disease prevalence. The disproportionately low number of South Asian women is difficult to explain. There is little information available in Canada on sex differences by ethnicity for disease rates. However, it appears that South Asian women, also present with coronary artery disease at a much younger age than other ethnic groups.

EXHIBIT 14.9 Number and Average Age of the Post-acute Myocardial Infarction Cohort by Ethnic Surname and Sex in Ontario, 1994/95 - 1996/97

Ethnic Surname Group	Sex	Number	Per cent	Average Age
Chinese	Men	353	61.7	65.1
	Women	219	38.3	74.2
South Asian	Men	849	72.9	59.5
	Women	315	27.1	67.2
Other	Men	31,986	62.9	64.7
	Women	18,894	37.0	72.4

Note: South Asian includes ancestors from India, Pakistan, Sri Lanka and Bangladesh. Chinese includes ancestors from China, Taiwan and Hong Kong. Other excludes South Asians and Chinese.

Data Source: Canadian Institute for Health Information, Registered Persons Database, ICES-modified SHARE Database, Ontario Myocardial Infarction Database

EXHIBIT 14.10 Ethnicity-specific Cardiac Procedure Rates One Year Following an Acute Myocardial Infarction for Patients Aged 45 Years and Over in Ontario, 1994/95 - 1996/97

Ethnic Surname Group	Number	Coronary Angiography Rate (%)	Coronary Angioplasty Rate (%)	Coronary Bypass Surgery Rate (%)
Chinese	572	28	8	9
South Asian	1,164	42	8	10
Other	50,880	30	11	15

Note: South Asian includes ancestors from India, Pakistan, Sri Lanka and Bangladesh. Chinese includes ancestors from China, Taiwan and Hong Kong. Other excludes South Asians and Chinese.

Data Source: Canadian Institute for Health Information, ICES-modified SHARE Databas, Ontario Myocardial Infarction Database

From the entire cohort, about 30% went on to have angiography, and 10% went on to have either PTCA or CABG (Exhibit 14.10). Age- and sex-adjusted rates were very similar to crude rates reported in Exhibit 14.10. Women were much less likely to undergo procedures; for example, only 3% of Chinese women went on to CABG. Given the very small numbers of patients, especially in the Chinese ethnic group, we were unable to detect any significant difference by ethnicity in rates of revascularization (PTCA and CABG) after an AMI.

The 30-day and one-year mortality rates after an AMI are illustrated in Exhibit 14.11. The 30-day crude rate was 18.4% for the Chinese, 10.1% for South Asians and 14.8% for "other." The mortality rates were higher for women than for men. After adjustment for multiple risk factors (please refer to the Methods Appendix for Chapter 5), the overall rate increased slightly for South Asians and reduced slightly for the Chinese. The adjusted 30-day rates were not significantly different by ethnicity. The one-year crude mortality rates were 24.7% for Chinese, 15.0% for South Asians and 23.3% for "other," with the South Asian group significantly lower than the two other groups. The mortality rates were much higher for women than men. Largely because South Asians were younger at disease onset, their expected survival was higher. Thus, the death rate after risk-adjustment rose among South Asians. Again, adjustment led to a slight reduction in the death rate

EXHIBIT 14.11 Ethnicity-specific 30-day and One-year Mortality Rates after an Acute Myocardial Infarction in Ontario, 1994/95 - 1996/97

Ethnic Surname Group	Overall		Women		Men		Risk-adjusted (%)
	Number	(%)	Number	(%)	Number	(%)	
30-day Mortality							
Chinese	105	18.4	56	25.6	49	13.9	16.5
South Asian	117	10.1	46	14.6	71	8.4	13.7
Other	7,547	14.8	3,650	19.3	3,897	12.2	14.8
One-year Mortality							
Chinese	141	24.7	75	34.3	66	18.7	22.0
South Asian	175	15.0	65	20.6	110	13.0	20.1*
Other	11,850	23.3	5,625	29.8	6,225	19.5	23.2

* Statistically different ($p<0.05$)

Note: South Asian includes ancestors from India, Pakistan, Sri Lanka and Bangladesh. Chinese includes ancestors from China, Taiwan and Hong Kong. Other excludes South Asians and Chinese.

Data Source: Canadian Institute for Health Information, Registered Persons Database, ICES-modified SHARE Database, Ontario Myocardial Infarction Database

EXHIBIT 14.12 Age/Sex-adjusted Drug Utilization Rates for Acute Myocardial Infarction Patients Aged 65 Years and Over in Ontario, 1994/95 - 1996/97

Ethnic Surname Group	Number	Acetylsalicylic Acid %	Beta-blockers %	Statins %	ACE Inhibitors %	Calcium Channel Blockers %
Chinese	284	65	53	15	56	35
South Asian	436	72	54	17	54	39
Other	25,334	62	51	14	49	36

Note: South Asian includes ancestors from India, Pakistan, Sri Lanka and Bangladesh. Chinese includes ancestors from China, Taiwan and Hong Kong. Other excludes South Asians and Chinese.

Data Source: Canadian Institute for Health Information, ICES-modified SHARE Database, Ontario Drug Benefit Program, Ontario Myocardial Infarction Database

among persons with Chinese surnames, reflecting in part their more advanced age. The adjusted mortality rates were 22.0%, 20.1% and 23.2% respectively. The adjusted rate for South Asians was statistically different than the provincial average ($p<0.05$). Reasons for the persisting differences are uncertain, but the discrepancies clearly narrow a large amount after accounting for age and sex differences alone.

Of those patients who had an AMI, 26,054 were over age 65. Among the elderly, 284 were Chinese (1.1%) and fewer patients, compared to the entire cohort, were South Asian (436 or 1.7%). This is again difficult to explain. One would expect, at this age, a greater proportion of both ethnic groups would present with AMI, more comparable to the general population. Among all elderly patients, there were no differences by ethnicity in use of aspirin, beta-blockers, statins (cholesterol-lowering agents), ACE inhibitors and calcium channel blockers (Exhibit 14.12). Age- and sex-adjusted rates were very similar to unadjusted rates reported in Exhibit 14.12. This suggests that patients are being similarly treated across the ethnic groups with respect to medications.

Conclusions

Our findings suggest that there may be differences in identification and non-medical treatment of coronary artery disease according to markers of ethnicity. South Asians appear to clinically manifest IHD at a younger age, highlighting the need for preventive outreach programs that will target this vulnerable population. Ethnoracial differences in rates at which population groups undergo procedures are clearest for PTCA, without obvious gradients in the use of other treatments. However, further investigation is needed. We cannot determine based on this study whether these differences, if they truly exist, are medically appropriate or represent the possibility of inequitable access to, or provision of, tertiary cardiac services.

This situation cannot be clarified unless Canadians resolve to collect direct information from individuals on ethnicity and to strengthen the nation's commitment to ethnoracial health research that will be inclusive of Aboriginal peoples and reflect the multicultural character of our nation. Until we gather data relating reliable ethnoracial information to a wide range of health indicators, we shall remain uncertain if there are hidden inequities in our universal health care system, and unable to address those inequities if indeed they exist.

Cardiac Arrest Care and Emergency Medical Services

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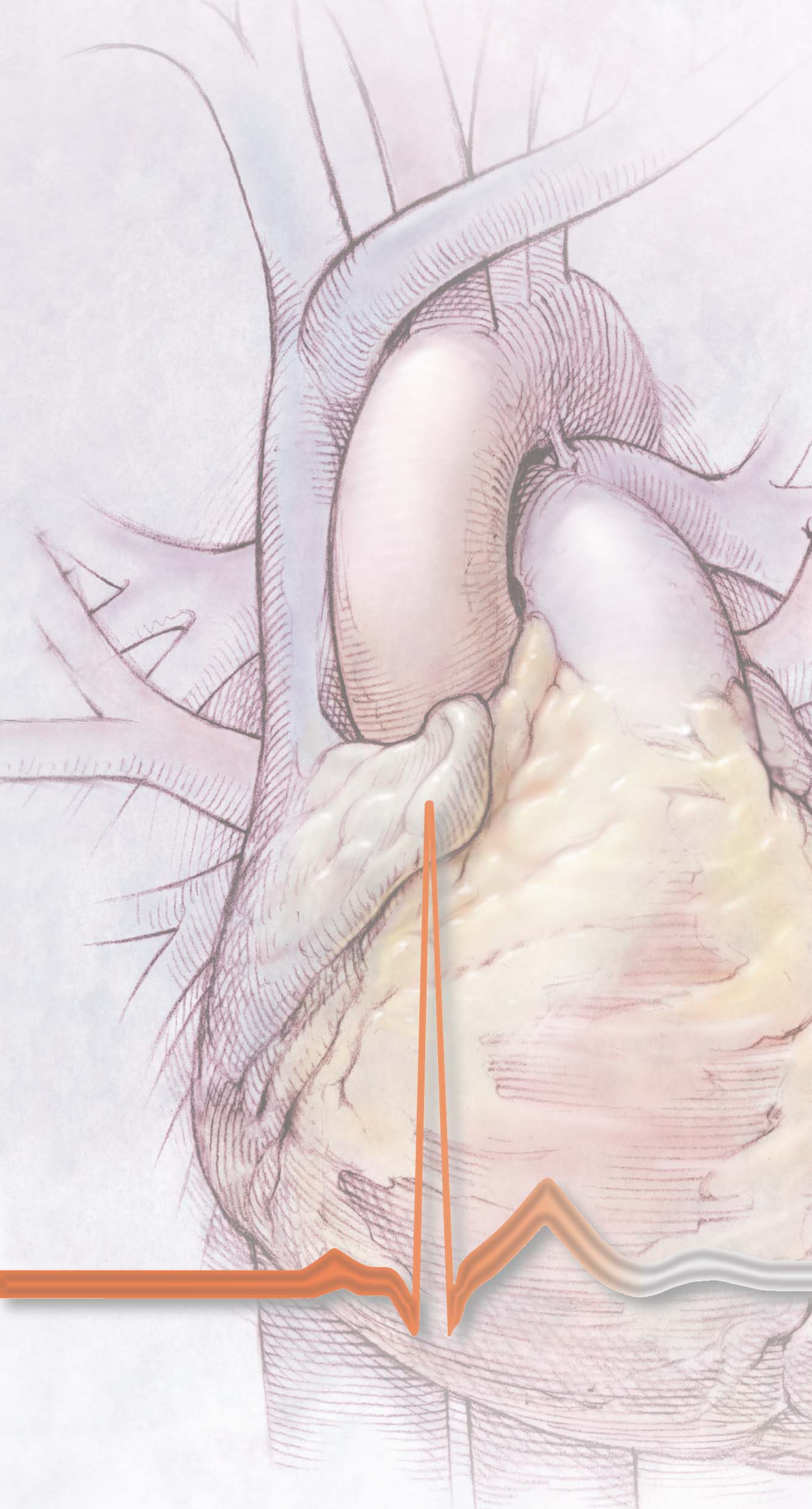


CHAPTER 15

Key messages

- *The incidence of cardiac arrest in Ontario is under-reported.*
- *Overall only 5% of cardiac arrest victims survive, although survival is higher for those discovered with ventricular fibrillation as the initial cardiac rhythm.*
- *While virtually all ambulance services have basic life support and defibrillator capacity, other emergency personnel are not consistently trained or equipped for these roles.*
- *Greater public participation in initiating/performing cardiopulmonary resuscitation (CPR), along with rapid first responder CPR and defibrillation is necessary to optimize the delivery of out-of-hospital emergency care.*

Key Terms & Concepts:

- sudden cardiac death
- cardiac arrest
- cardiac arrhythmias
- cardiopulmonary resuscitation
- outcomes
- emergency medical services
- chain of survival

Background

Sudden cardiac death is a major contributor to premature mortality in Canada. The precise number of sudden cardiac deaths is unknown, but this condition has been estimated to account for about 11% of all deaths in Canada annually.[1] Sudden cardiac death occurs as a direct consequence of cardiac arrest. Cardiac arrest has been described as a clinical disorder in which the normal rhythmic pumping capabilities of the heart are disrupted, compromising normal circulation and resulting in loss of consciousness and certain death if not treated. The disruption in the pumping capacity of the heart is often due to changes in the electrical activity of the heart, the most common of which is ventricular fibrillation (VF). Other irregularities include asystole, where electrical activity stops altogether, pulseless electrical activity (PEA) in which the electrical beat of the heart continues without any cardiac output, and ventricular tachycardia (VT).

Unfortunately, survival rates following an out-of-hospital cardiac arrest are low throughout North America, with survival rates in Canadian cities reported below 11%.[2-4] Unlike care for other cardiac conditions discussed earlier in this Atlas, the successful management of out-of-hospital cardiac arrest patients often requires the involvement of trained lay persons and the performance of procedures and interventions by trained health care personnel outside a hospital setting.

Who Suffers a Cardiac Arrest?

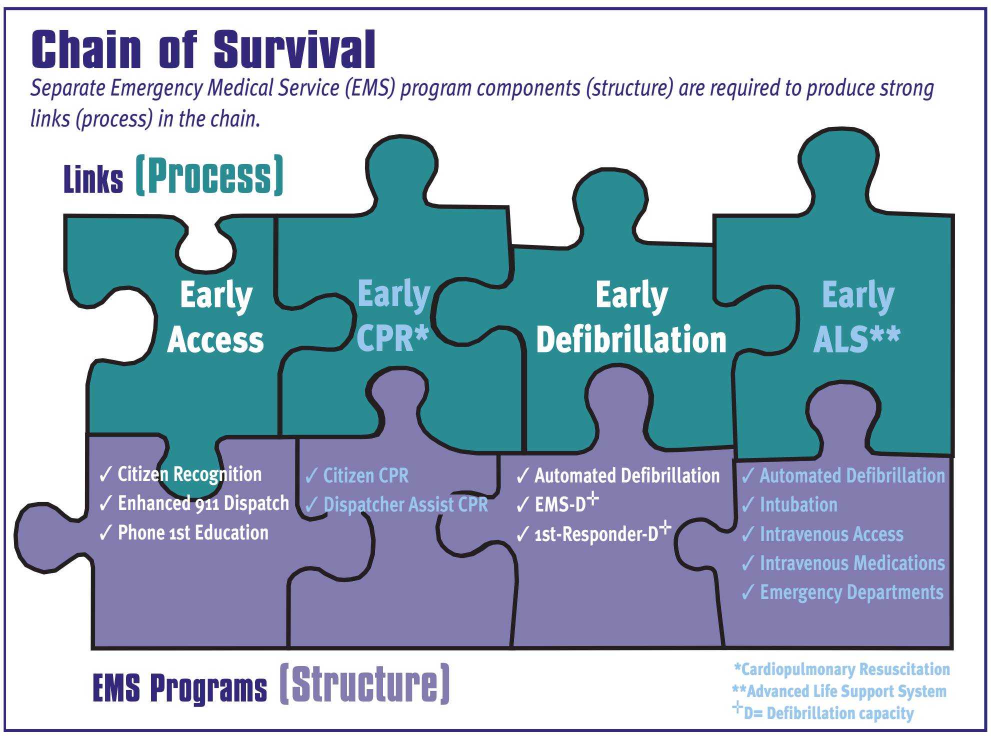
Cardiac arrest often occurs without warning, frequently in an out-of-hospital setting. Numerous factors have been identified (and others implicated) as precipitants of cardiac arrest. The most common cardiac causes of cardiac arrest are ischemia or infarction related to coronary heart disease. However, any cardiac condition that predisposes to serious arrhythmias will increase the risk of cardiac arrest. Patients suffering from various non-cardiac diseases may also experience a cardiac arrest (such as advanced cancer, renal failure and electrolyte disturbances or massive pulmonary thrombo-embolus).

Because cardiac arrest is a final common pathway to death for so many disease processes, death records often cite an underlying disease as the cause of death. For example, mortality statistics published for 1995 by Statistics Canada suggest cardiac arrest caused only 552 deaths in Ontario.[4] Yet unexpected cardiac arrest, often from cardiac causes, is far more common than these statistics would suggest. On examining cardiac arrest rates for Toronto, we find that approximately 1,000 persons annually in Toronto suffer a cardiac arrest, with a survival rate of about 8%.[5] In other words, in Toronto alone over 900 deaths are attributable to cardiac arrest, suggesting that the breadth of the problem in communities across Ontario is far greater than vital statistics would imply.

The Process and Rationale for Delivering Emergency Prehospital Cardiac Care

The *chain of survival* [6,7] for cardiac arrest victims involves various steps and providers, as shown in Exhibit 15.1. Weaknesses or delays in any link will reduce survival rates. For example, Larsen et al have modelled the expected outcomes of patients suffering out-of-hospital cardiac arrest with witnessed ventricular fibrillation.[8] This model is not generalizable for overall community survival rates because of the assumption concerning witnessed status and initial cardiac rhythm. However, the findings are illuminating. Larsen et al projected a 0% survival rate if there is no bystander, if the emergency medical services (EMS) start cardiopulmonary resuscitation (CPR) at five minutes and if there is no defibrillation or advanced life support (ALS) until 20 minutes later at a hospital.[8] In contrast, a 34% survival rate is projected if 50% of bystanders can initiate CPR, if CPR is started within three minutes of cardiac arrest, if the EMS provide defibrillation at five minutes, and if paramedics can perform ALS in the field starting 10 minutes after the patient collapses.[8]

EXHIBIT 15.1: Links in the Chain of Survival



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There is continuing debate about the relative efficiency of different strategies for optimizing survival. For example, training various personnel to defibrillate in the field with automatic defibrillators is a simple strategy that has been widely adopted. In contrast, widespread implementation across Canada of prehospital ALS programs would be costly and the yields are less certain.

In this chapter we will assess individual components of the *chain of survival* [6,7] as they relate to communities across Ontario. We will also report on the survival rate after cardiac arrest in selected communities.

Data Sources

The standardized definition of a cardiac arrest is: absence of a detectable pulse, unresponsiveness, and apnea, which occurs without concurrent evidence of trauma, ingestion of a poison or other inhalants capable of precipitating a cardiac arrest. In addition, other data definitions have been developed to assist in standardized reporting about cardiac arrest (the Utstein format).[9] Cardiac arrest data presented in this chapter comply with these requirements.

We compiled data from four separate sources: a survey of the 26 Base Hospital Programs (BHPs), including four associate programs; a study of Metro Toronto Ambulance services;[5,10] data obtained directly from the Peel BHP; and a major initiative called the Ontario Prehospital Advanced Life Support (OPALS) study.[11] The OPALS study data are unique in their degree of standardization and quality control.[11] More importantly, data comparable to the OPALS study or according to the Utstein format[9] are not available from most Base Hospital Programs.

Survey of 26 Base Hospital Programs

We surveyed the 26 base hospitals to ask about processes of care related to the *chain of survival* for cardiac arrest victims. Questions included: whether a 911 emergency response system was in place, whether or not defibrillation equipment and staff trained in its use were available, whether or not public CPR training programs were available in the region, whether written tiered response agreements were in place with police and/or firefighters to provide CPR, whether the first responding team has the capacity to defibrillate and whether ALS-trained personnel were accessible.

Metro Toronto Ambulance Service

The Metro Toronto Ambulance (MTA) study examined the outcome of over 6,000 cardiac arrest patients in Metropolitan Toronto during a six-year time period (1988 to 1993).[5,10] Ambulance data were abstracted from ambulance call report forms (ACR) generated during this time period. Cardiac arrest patients were identified in accordance with the Utstein definitions.[9] Outcomes following resuscitative efforts made on behalf of these patients were established by linking individual patient ACR records to data from Canadian Institute for Health Information (CIHI) and Vital Statistics. We have used cardiac arrest data from patients above 18 years of age during the calendar year 1992 for this Atlas as 1993 data were limited.[5,10] Recent data for Toronto were not available.

The Brampton Associate Base Hospital Program

The Brampton BHP provides emergency services to the city of Brampton and portions of adjacent jurisdictions. In 1995, the ambulances serving this area were equipped and staff trained to provide basic life support with defibrillation. The Brampton BHP provided data on all cardiac arrests and their outcomes for 1997. Data used for the study were manually abstracted from relevant cardiac arrest ambulance call report forms and entered into a local database. Patient outcomes data were abstracted from emergency department and hospital records. These data are routinely collected by the Brampton program for ongoing monitoring purposes.

The Ontario Prehospital Advanced Life Support (OPALS) Study

The OPALS study aims to examine costs and patient outcomes as participating communities move from rapid defibrillation programs to full-scale prehospital ALS programs.[11] The study includes not only cardiac arrest victims, but also Ontarians suffering major trauma or acute respiratory distress.

OPALS study data were collected for 21 communities by 11 participating Base Hospital Program sites and compiled at the University of Ottawa data collection centre. Data are abstracted from the ambulance call records, rhythm records, dispatch reports, in-hospital records, Ontario Trauma Registry and telephone interviews. Collection of data began in July 1991. We limit the data here to 1995, 1996 and 1997.

How We Did the Analysis

BHPs provided data for individual ambulance services within their jurisdiction. These data were then aggregated at the BHP level. The data for the Cornwall, Pembroke and Ottawa BHPs were further aggregated, as were data for the Cambridge and Cambridge-Wellington-Dufferin BHPs and for Thunder Bay and Sioux Lookout BHPs, leaving 22 BHPs for analysis. Data for individual communities within BHPs are presented in Methods Appendix MA15.1.

Emergency coverage to Algonquin Park is a shared responsibility among BHPs surrounding the park. No data were collected for this region.

Other data were compiled from a variety of centres across Ontario and cover slightly different time periods. Hence, the analyses were conducted separately for each individual dataset (OPALS study, Toronto and Brampton). Specifically, survival rates for Toronto and Brampton were considered for the available calendar year—1992 and 1997 respectively. Rates for OPALS study centres represent data for a three-year time period (1995 to 1997). Fort Erie is no longer an OPALS study community; however, data for the area were collected and reported within the OPALS study framework.

Population data necessary to calculate incidence rates for individual communities were obtained from 1996 Census data, except for Toronto where 1991 Census data were relevant.

Interpretive Cautions

Data supplied by the Metro Toronto Ambulance service and the Brampton Base Hospital Program were compiled for ongoing administrative purposes and therefore were not subject to the same quality controls as the OPALS study. We used the Brampton data as provided. In earlier studies, we reviewed and validated the Toronto data. We used data linkage techniques[5,10] to ascertain the outcome of the cardiac arrest cohort identified by the Metro Toronto ambulance databases. However, although we undertook statistical procedures to deal with limitations in the Toronto data, we cannot be certain that all biases or sources of imprecision have been eliminated.

OPALS study data are from an ongoing study.[11] We cannot draw precise inferences from those centres with a limited number of cardiac arrests (e.g. Fort Erie, Lindsay, Grimsby, Port Colborne and Port Hope).

Findings and Discussion

Early optimal therapy for cardiac arrest victims in the out-of-hospital setting requires a multilayered response by individuals with various levels of training. We use the chain of survival (Exhibit 15.1) as our framework for evaluating components of care in Ontario and how they compare to other North American centres.

First Link—Early Access to Care

The first two links (early access and CPR) of the chain of survival depend upon citizens in the community and the availability of a 911 telephone service or an equivalent emergency switchboard. The bystander/witness of a cardiac arrest can not only summon professional emergency help, but also provide immediate CPR. Emergency calls for cardiac arrest have been greatly facilitated by the introduction of the 911 systems, begun in 1982 across Ontario. Today over 70% of the province benefits from this service (Exhibit 15.2). Operators continuously staffing these lines route the calls to the responsible Central Ambulance Control Centers (CACCs). This centralized dispatching mechanism is responsible for identifying the gravity of each individual emergency, sending out an ambulance and/or firefighters as appropriate, and, in some jurisdictions, providing CPR instructions over the telephone.

Individual ambulance services for communities across Ontario are grouped geographically into Base Hospital Programs. The 26 BHPs assist individual ambulance services within their jurisdictions. The BHPs were designed to allow more local and regional input about special community needs, to monitor the quality of pre-hospital care and to provide ongoing medical education for paramedics.

Second Link—Early CPR

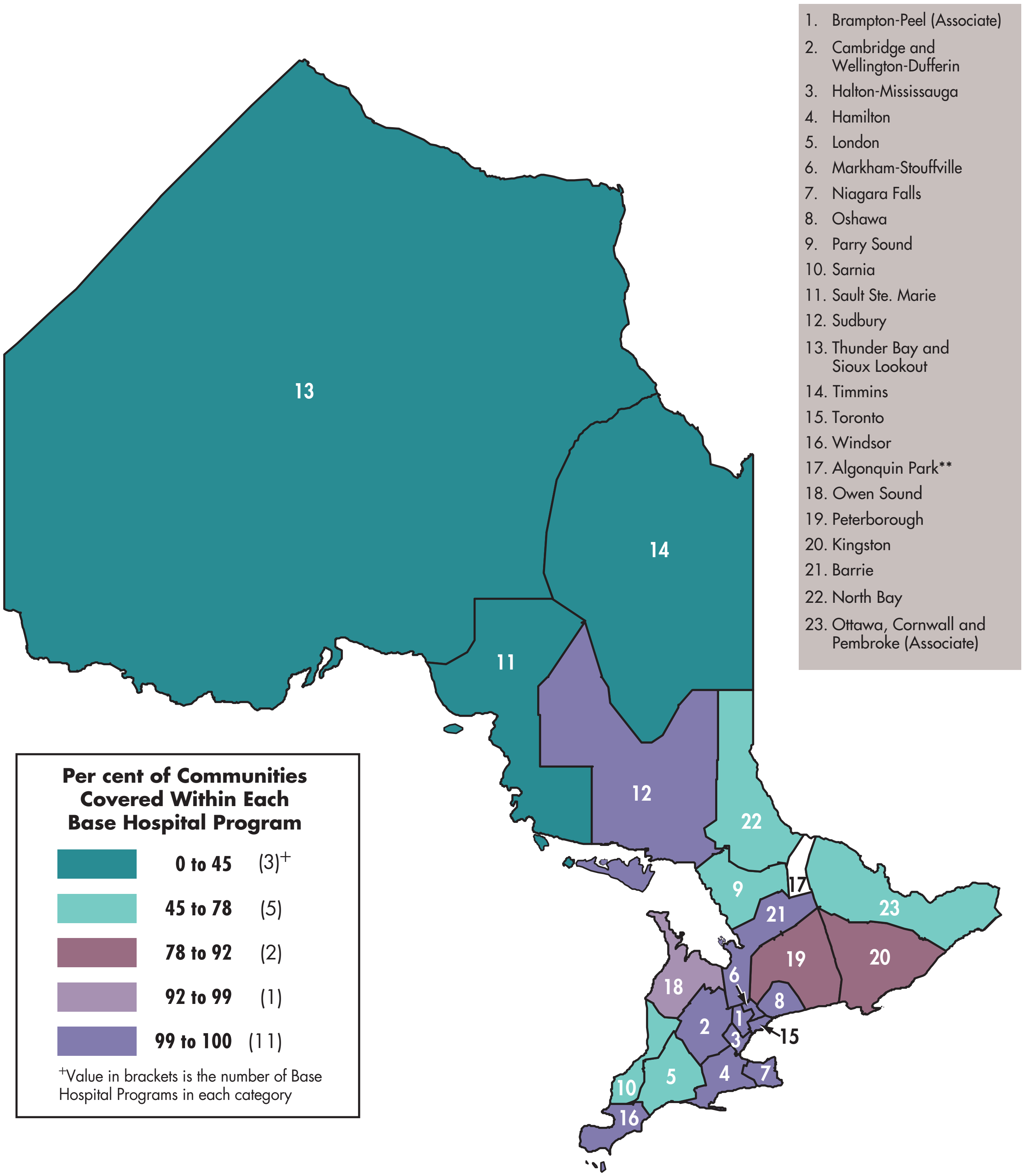
There are two fundamental aspects to early initiation of CPR: citizen or bystander CPR, and CPR administered by first responders from emergency services.

Bystanders may variously witness the arrest, discover an individual who has suffered an unwitnessed arrest or come to the assistance of others who are attempting to help the victim. In an ideal world, 100% of bystanders would be able to initiate effective CPR, but historically they have been reluctant.[12] This is only partly explained by lack of training. Cardiac arrest victims may vomit or become incontinent at the time of collapse, and bystanders may also be fearful of acquiring infectious diseases (e.g. HIV/AIDS or hepatitis) from the cardiac arrest victim.[13] We emphasize that, to date, no case of HIV or hepatitis has been reported as a consequence of bystanders performing CPR.

In Ontario, a number of organizations (e.g. Heart and Stroke Foundation of Canada, Canadian Red Cross, St. John's Ambulance Service and the Advanced Coronary Treatment Foundation) provide CPR training to communities in venues as varied as agency offices and school gymnasia. Special events have been staged in Ontario to train large numbers en masse.

Unfortunately, the global availability of these training programs has not translated into high performance rates by residents of Ontario (Exhibits 15.3 and 15.4). Citizen-initiated CPR rates vary but, in general, are extremely low throughout Ontario, even though initial intervention has been repeatedly shown to influence

EXHIBIT 15.2: Availability of 911 Service by Base Hospital Programs in Ontario, 1998*



* See Methods Appendix for a list of the regional base hospitals.

** Coverage for Algonquin Park is provided by surrounding Base Hospital Programs.

Data Source: Base Hospital Survey, 1998

EXHIBIT 15.3 Prehospital Cardiopulmonary Resuscitation and Defibrillation Response in Selected Ontario Communities, 1997*

Communities	Cardiopulmonary Resuscitation Rates			Arrival at Scene With Defibrillator**		
	Citizen (%)	Fire/Police (%)	Ambulance (%)	Median Interval (min)	8 Minutes or Less (%)	Firefighters First (%)
Ontario Prehospital Advanced Life Support Study Communities						
Lindsay	22.2	5.6	66.7	6.2	93.8	0.0
Grimsby	50.0	25.0	25.0	4.8	100.0	0.0
Port Colborne	26.7	6.7	66.7	4.8	92.3	15.4
Port Hope/Cobourg	20.7	17.2	58.6	4.8	95.8	16.7
Welland	10.9	34.8	52.2	5.1	89.7	64.1
Peterborough	15.2	50.0	27.3	5.2	86.9	72.1
Sarnia	20.8	13.2	64.2	5.8	97.7	18.2
Niagara Falls	15.7	27.5	54.9	5.1	97.7	44.2
Cambridge	11.0	57.5	30.1	4.4	98.5	60.0
Sudbury	14.3	30.4	48.2	5.2	86.5	38.5
Oakville	8.3	51.7	36.7	5.1	92.5	73.6
Kingston	15.1	30.2	50.0	5.8	90.9	35.1
Thunder Bay	9.7	22.6	66.1	4.4	96.2	37.7
St. Catharines	11.5	42.7	42.7	5.2	96.3	65.4
Burlington	16.2	48.5	35.3	5.1	95.2	64.5
Windsor/Tecumseh	17.3	16.3	59.2	5.8	86.0	23.7
Kitchener/Waterloo	12.4	43.1	43.1	4.5	97.7	67.4
London	17.3	22.2	58.9	5.4	86.0	27.4
Mississauga	12.6	45.7	43.1	5.1	97.9	68.6
Ottawa/Nepean/Gloucester	14.9	48.4	35.7	5.0	92.8	74.8
Totals	**14.8**	**36.9**	**45.6**	**5.1**	**92.6**	**53.3**
Other Communities						
Brampton (1996)	13.4	22.5	40.6	7.0	75.9	N/A
Toronto (1992)	10.4	48.6	33.3	5.0	91.7	N/A
Fort Erie (1997)	36.4	9.1	54.5	8.0	50.0	0.0

* Time periods for Toronto, Brampton and Fort Erie are specified.

** Time interval of call received by dispatch to arrival at scene by first responding unit with defibrillator.

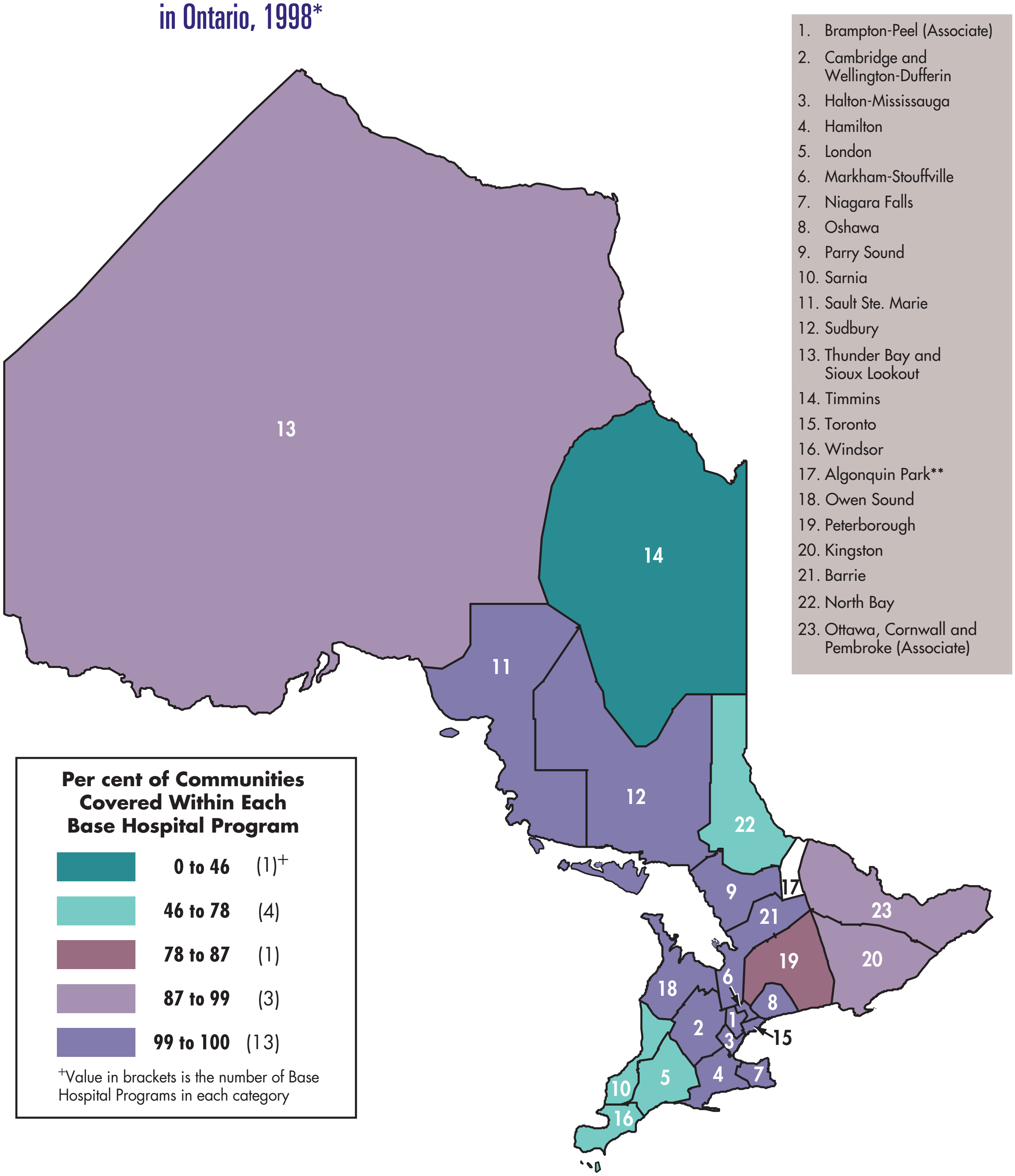
N/A Data not available

Data Source: Base Hospital Survey, 1998

the outcome of cardiac arrest patients.[14] The Toronto data show that citizen-initiated CPR rates were about 10% in 1992. More recent data from the OPALS study communities again demonstrate that, on average, only a fraction (15%) received CPR from a bystander (Exhibit 15.3 and 15.5).

OPALS phase I data[15] have already unequivocally shown the importance of bystander CPR. In particular, a multivariate analysis of 5,335 patients accrued in the first five years of the study showed that bystander CPR was a strong and independent predictor of survival (odds ratio: 2.98, 95% CI: 2.07, 4.29).

EXHIBIT 15.4: Availability of Cardiopulmonary Resuscitation Training Programs by Base Hospital Programs in Ontario, 1998*



* See Methods Appendix for a list of the regional base hospitals.

** Coverage for Algonquin Park is provided by surrounding Base Hospital Programs.

Data Source: Base Hospital Survey, 1998

EXHIBIT 15.5 **Demographic and Clinical Characteristics of Cardiac Arrest Patients in Selected Ontario Communities, 1997***

Communities	Incidence Rate			Patient Characteristics			Initial Rhythm at Arrest		
	Population**	Cardiac Arrests per Year	Incidence Rates per 100,000 Population	Men (%)	Median Age	Citizen Witnessed (%)	Ventricular Fibrillation or Ventricular Tachycardia (%)	Pulseless Electrical Activity (%)	Asystole (Absence of Electrical Activity) (%)
Ontario Prehospital Advanced Life Support Study Communities									
Lindsay	17,638	18	102	55.6	72.2	38.9	22.2	22.2	55.6
Grimsby	19,585	4	20	100.0	72.5	75.0	50.0	25.0	25.0
Port Colborne	18,451	15	81	53.3	66.5	26.7	35.7	14.3	50.0
Port Hope/Cobourg	27,725	29	105	69.0	70.6	37.9	37.0	33.3	29.6
Welland	48,411	46	95	65.2	68.8	37.0	42.2	31.1	26.7
Peterborough	69,535	66	95	57.6	70.0	36.4	34.4	24.6	41.0
Sarnia	72,738	53	73	75.5	68.2	41.5	43.8	31.3	25.0
Niagara Falls	76,917	51	66	62.0	67.8	54.9	42.9	30.6	26.5
Cambridge	101,429	73	72	64.4	69.7	49.3	42.3	23.9	33.8
Sudbury	92,059	58	63	63.8	67.8	46.6	35.7	33.9	30.4
Oakville	128,405	60	47	58.3	70.4	41.7	31.0	25.9	43.1
Kingston	55,947	86	154	66.3	68.6	47.7	33.7	33.7	32.6
Thunder Bay	113,662	62	55	71.0	65.3	25.8	25.0	13.3	61.7
St. Catharines	130,926	96	73	68.8	67.1	44.8	39.8	32.3	28.0
Burlington	136,976	68	50	67.6	66.5	51.5	43.9	25.8	30.3
Windsor/Tecumseh	210,522	99	47	61.2	69.3	50.5	27.4	28.4	44.2
Kitchener/Waterloo	256,369	137	53	61.3	69.5	45.3	37.8	19.3	43.0
London	325,646	185	57	66.8	67.5	40.5	33.9	23.0	43.1
Mississauga	544,382	151	28	57.0	70.1	41.7	28.6	27.9	43.5
Ottawa/Nepean/Gloucester	542,462	308	57	59.7	67.9	41.6	36.1	27.2	36.7
Totals	**2,989,785**	**1,665**	**56**	**63.2**	**68.4**	**43.2**	**35.3**	**26.4**	**38.2**
Other Communities									
Brampton (1996)	268,251	187	70	69.5	66.0	33.2	26.2	17.1	56.7
Toronto (1992)	2,275,771	1,314	58	63.8	71.0	48.7	26.4	17.0	46.3
Fort Erie (1997)	27,183	11	40	60.0	58.0	63.6	40.0	20.0	40.0

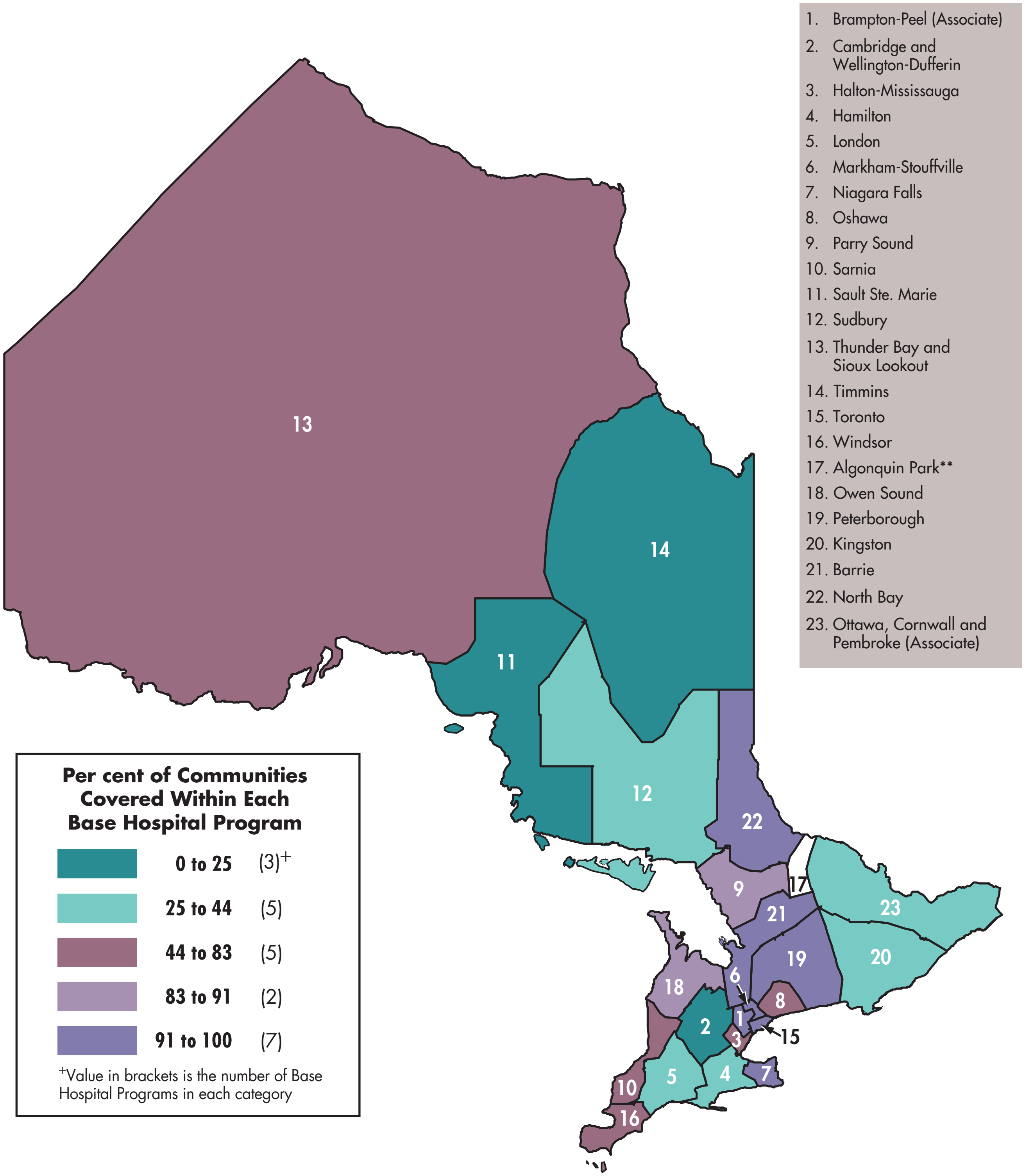
* Time periods for Toronto, Brampton and Fort Erie are specified.

** Population data are from 1996 Canada Census except for Toronto, 1991 Census data.

Data Source: Ontario Prehospital Advanced Life Support Study, Brampton Base Hospital Program, Metro Toronto Ambulance Service

What then of the second element: first responder CPR by firefighters/police? In the same multivariate analysis from the OPALS study phase I results,[15] first responder CPR was an independent predictor of survival with almost the same impact as bystander CPR (odds ratio: 2.20, 95% CI: 1.46, 3.31). Yet, as Exhibit 15.3 shows, the rate of firefighter/police CPR varied across communities from a low of 5% to a high of 58%. This is a concern because firefighters are frequently the first emergency services personnel to arrive at the scene of a cardiac arrest. Exhibit 15.6 reinforces this observation. It appears that while many communities have written tiered-response agreements involving firefighters to ensure that the first emergency personnel on the scene carry out CPR without fail, few such agreements exist with regional police departments (see Method Appendix). This

EXHIBIT 15.6: Firefighter Tiered Response Agreements by Base Hospital Programs in Ontario, 1998*



* See Methods Appendix for a list of the regional base hospitals.

** Coverage for Algonquin Park is provided by surrounding Base Hospital Programs.

Data Source: Base Hospital Survey, 1998

can unquestionably be remedied. For example, phase II of the OPALS study[16] included tiered-response arrangements among the initiatives designed to improve the quality of EMS care in participating communities and achieved a highly significant increase in fire/police CPR rates (from 24.7% in phase I to 31.1% in phase II, p<0.001). Survival-to-hospital discharge in OPALS phase II was again associated independently with first-responder CPR rates, among other factors.[16,17]

Third Link—Early Defibrillation

Defibrillation has the potential to convert aberrant cardiac rhythms back to sinus rhythm. The likelihood of survival increases when the interval between the onset of such a rhythm and delivery of defibrillation is as short as possible.[18,19]

Newer automatic defibrillators have the capacity to analyze the patient's heart rhythm and deliver an appropriately-timed shock as needed. Thus, as noted earlier, ambulance attendants or firefighters trained in Basic Life Support (BLS) can effectively use these automatic devices with little additional training. However, not all EMS services in Ontario currently have the capacity to defibrillate at the scene. Ambulances with BLS capacity and defibrillators provide 100% area coverage for 20 of the 24 BHPs; the residual four are also reasonably well covered. However, firefighters equipped with defibrillators provide only limited coverage in most parts of the province (Exhibit 15.7). Police forces are neither trained nor equipped to provide defibrillation.

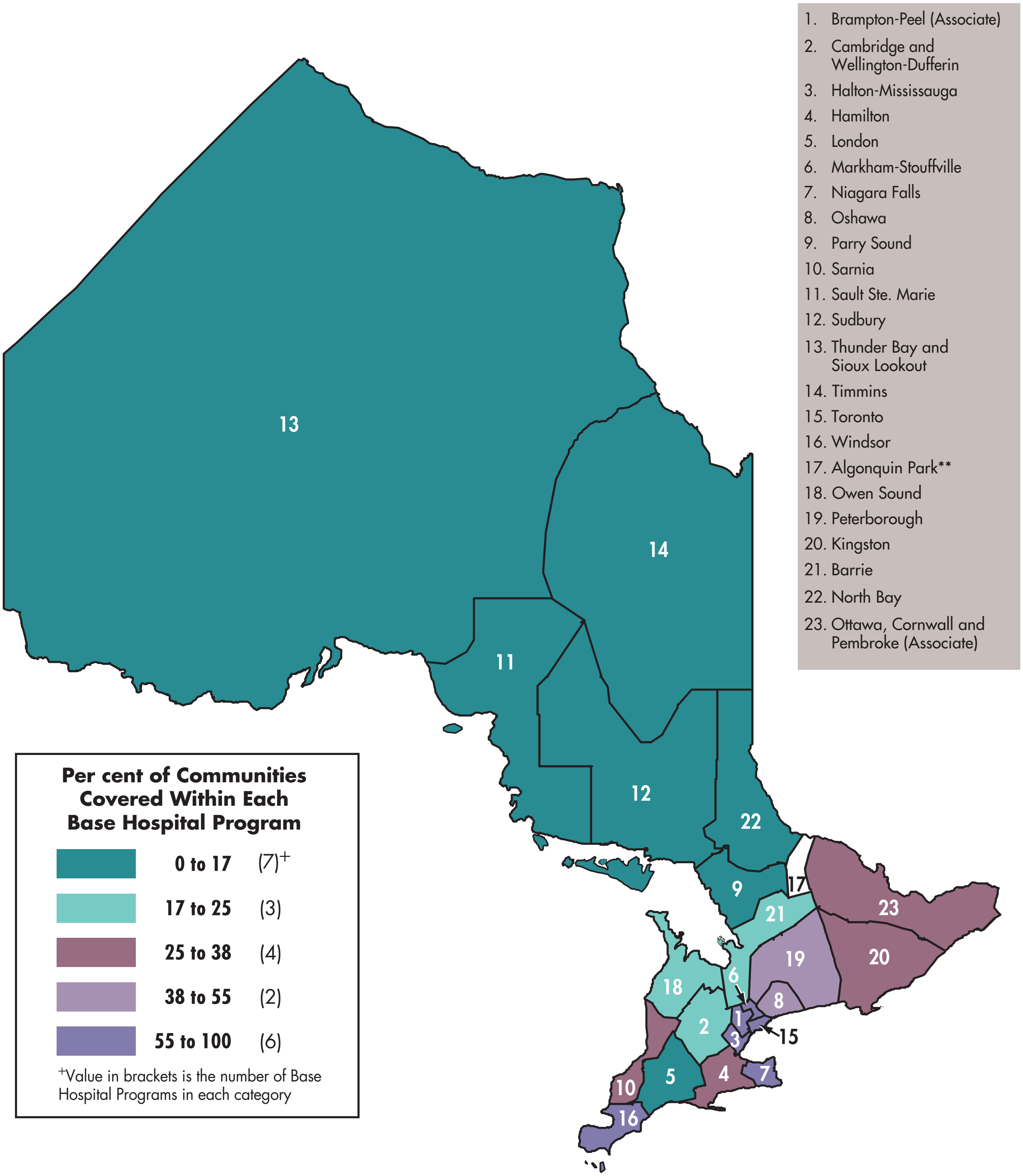
Rapid response, defined as the time period from the receipt of the 911 call to the arrival of an EMS at the scene is crucial if defibrillation and other life-support measures are to be successful.[18] In this respect, the Phase II OPALS study[16] is instructive. Along with a variety of quality improvement initiatives, the communities also implemented firefighter defibrillation programs. The goal was to ensure that EMS personnel able to provide defibrillation arrived on the scene within eight minutes in 90% of all cardiac arrest calls. Since firefighters were often the first to arrive, equipping them with defibrillators significantly increased the proportion of cases in which response with a defibrillator occurred within eight minutes (from 76.7% to 92.5%, p<0.001).[16,17] Of note, overall survival rates also improved from 3.9% to 5.2%.[16,17]

Exhibit 15.3 sheds a very positive light on times to arrival with a defibrillator in the communities under study. However, there is an urgent need to ensure that all communities in Ontario are achieving the benchmark of 90% defibrillator-ready response within eight minutes of an emergency call. Data should be collected to assess response times across the province.

Fourth Link—Early ALS

Ambulance personnel trained in Advanced Life Support (ALS) are able to perform endotracheal intubation (inserting a tube down the windpipe to

EXHIBIT 15.7: Availability of Firefighter Defibrillation by Base Hospital Programs in Ontario, 1998*

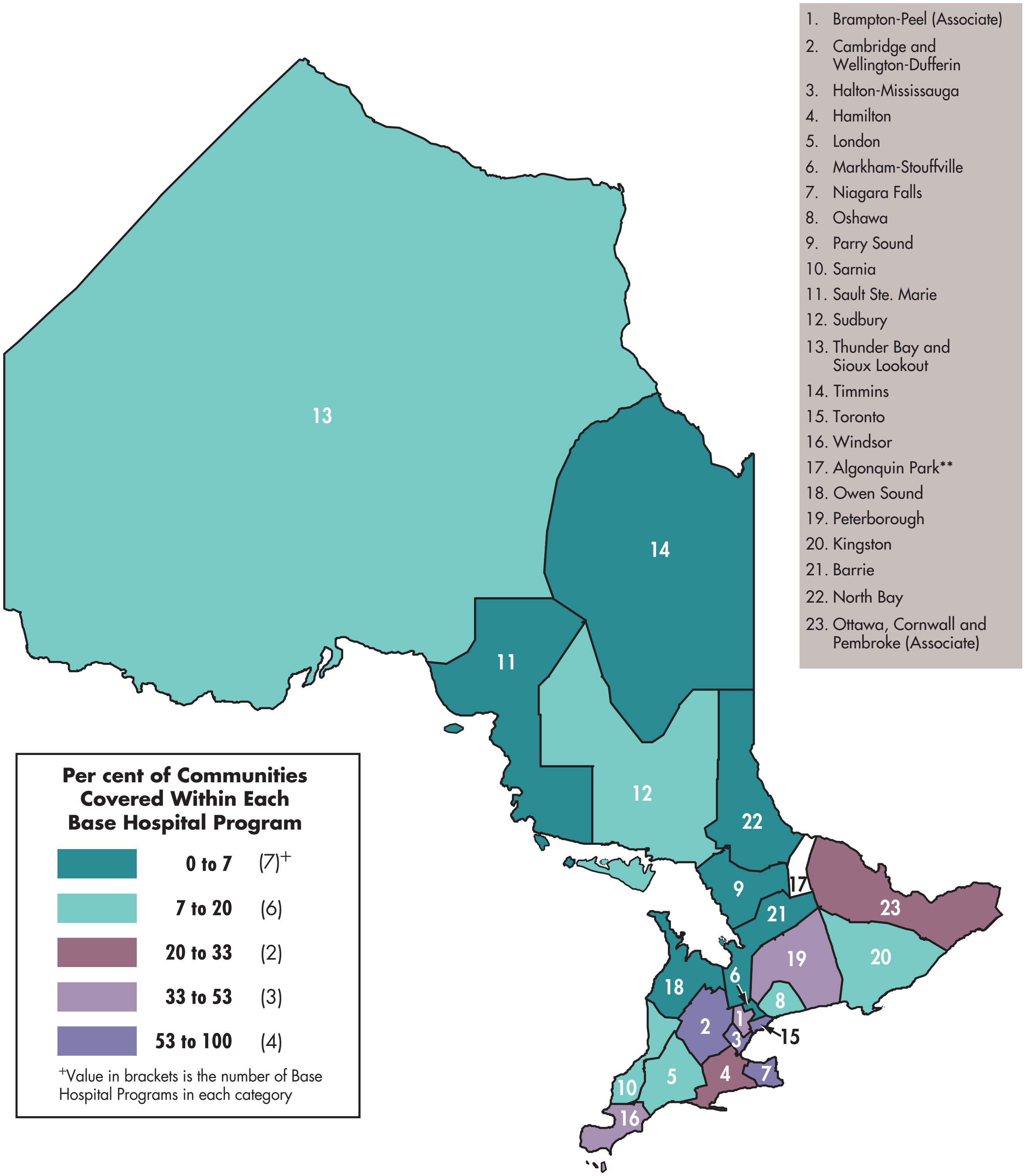


* See Methods Appendix for a list of the regional base hospitals.

** Coverage for Algonquin Park is provided by surrounding Base Hospital Programs.

Data Source: Base Hospital Survey, 1998

EXHIBIT 15.8: Availability of Advanced Life Support Systems by Base Hospital Programs in Ontario, 1998*



* See Methods Appendix for a list of the regional base hospitals.

** Coverage for Algonquin Park is provided by surrounding Base Hospital Programs.

Data Source: Base Hospital Survey, 1998

ensure airflow to the lungs) and obtain intravenous access to inject medications. One argument made for training more ambulance personnel in ALS rests on the fact that these individuals provide on-site care not only for victims of cardiac arrest but also for other critical conditions, including trauma and various cardio-respiratory emergencies. In 1997, ambulances across Ontario transported over 130,000 individuals who were subsequently admitted to hospital.[20]

On the other hand, the costs of training, equipment and maintenance for ALS personnel are substantial. In most Ontario communities, the majority of ambulance services have only BLS capability. Perhaps most importantly, there is considerable uncertainty about the value of major investments in ambulance ALS capacity.[21]

These uncertainties extend to ambulance ALS for cardiac arrest. For example, one option favoured by some is a two-tiered system with only a few ALS-staffed ambulances. As is currently the case, ambulances would be staffed by personnel trained in BLS and equipped with defibrillators; firefighters would be trained to use defibrillators because, as noted above, this sharply increases the proportion of cardiac arrest victims who receive care from defibrillator-equipped personnel within eight minutes. This two-tiered model of care does exist for some communities in Ontario (Exhibits 15.7 and 15.8).

However, it is hard to make a case for widespread adoption of a two-tiered model when current services have not been optimized. Moreover, there is no consensus on the incremental benefits for cardiac arrest patients from increasing the availability of ALS capability in ambulance services. As noted, the benefits must be weighed not only for cardiac arrest victims but trauma victims and those afflicted with a variety of acute cardiorespiratory emergencies. Phase III of the OPALS study is designed to determine the incremental benefits of ALS interventions.[11]

Survival Rates

Survival rates after cardiac arrest remain disappointingly low for communities in Ontario, ranging from no survivors to 11.8% (Exhibit 15.9). Moreover, we have obtained data for only some of Ontario's communities. These communities include the OPALS study participants and may, if anything, be performing better than others for which data remain unavailable.

EXHIBIT 15.9 Cardiac Arrest Survival Rates for Selected Ontario Communities, 1995 - 1997*

Communities	Number of Cardiac Arrests	Overall Survival Rates %	Overall Survival Rates 95% Confidence Interval	Survival by Initial Cardiac Rhythm: Ventricular Fibrillation/ Ventricular Tachycardia (%)	Survival by Initial Cardiac Rhythm: Pulseless Electrical Activity (%)	Survival by Initial Cardiac Rhythm: Asystole (Absence of Electrical Activity) (%)
Ontario Prehospital Advanced Life Support Study Communities						
Lindsay	58	6.9	0.4 - 13.4	20.0	0.0	0.0
Grimsby	17	11.8	0.0 - 27.1	20.0	0.0	0.0
Port Colborne	47	0.0	0.0 - 0.0	0.0	0.0	0.0
Port Hope/Cobourg	84	1.2	0.0 - 0.0	3.6	0.0	0.0
Welland	114	7.0	2.3 - 11.7	14.5	0.0	0.0
Peterborough	172	6.4	2.7 - 10.1	16.7	0.0	0.0
Sarnia	165	6.7	2.9 - 10.5	15.4	0.0	1.8
Niagara Falls	165	4.2	1.1 - 7.3	8.6	0.0	0.0
Cambridge	205	5.9	2.7 - 9.1	13.6	2.1	0.0
Sudbury	217	4.1	1.5 - 6.7	9.3	3.6	0.0
Oakville	166	3.6	0.8 - 6.4	7.9	2.6	0.0
Kingston	209	5.3	2.3 - 8.3	13.5	1.7	0.0
Thunder Bay	223	5.4	2.4 - 8.4	16.7	0.0	0.9
St Catharines	313	3.5	1.5 - 5.5	6.2	1.2	1.1
Burlington	207	2.9	0.6 - 5.2	5.3	1.8	0.0
Windsor/Tecumseh	388	5.4	3.2 - 7.6	13.0	5.0	0.0
Kitchener/Waterloo	385	4.2	2.2 - 6.2	9.5	0.0	0.7
London	569	7.1	5.0 - 9.2	20.6	1.4	1.3
Mississauga	420	4.0	2.1 - 5.9	10.7	1.8	0.0
Ottawa/Nepean/Gloucester	908	4.6	3.2 - 6.0	13.5	1.4	0.0
Totals	**5,069**	**4.9**	**4.3 - 5.5**	**12.2**	**1.5**	**0.4**
Other Communities						
Brampton (1996)	187	8.0	4.1 - 10.4	28.6	28.6	0.0
Toronto (1992)	1,314	7.8	6.7 - 8.9	16.8	16.8	0.0
Fort Erie (1995-1997)	37	2.7	0.0 - 7.9	4.8	4.8	0.0

* Time periods for Toronto, Brampton and Fort Erie are specified.

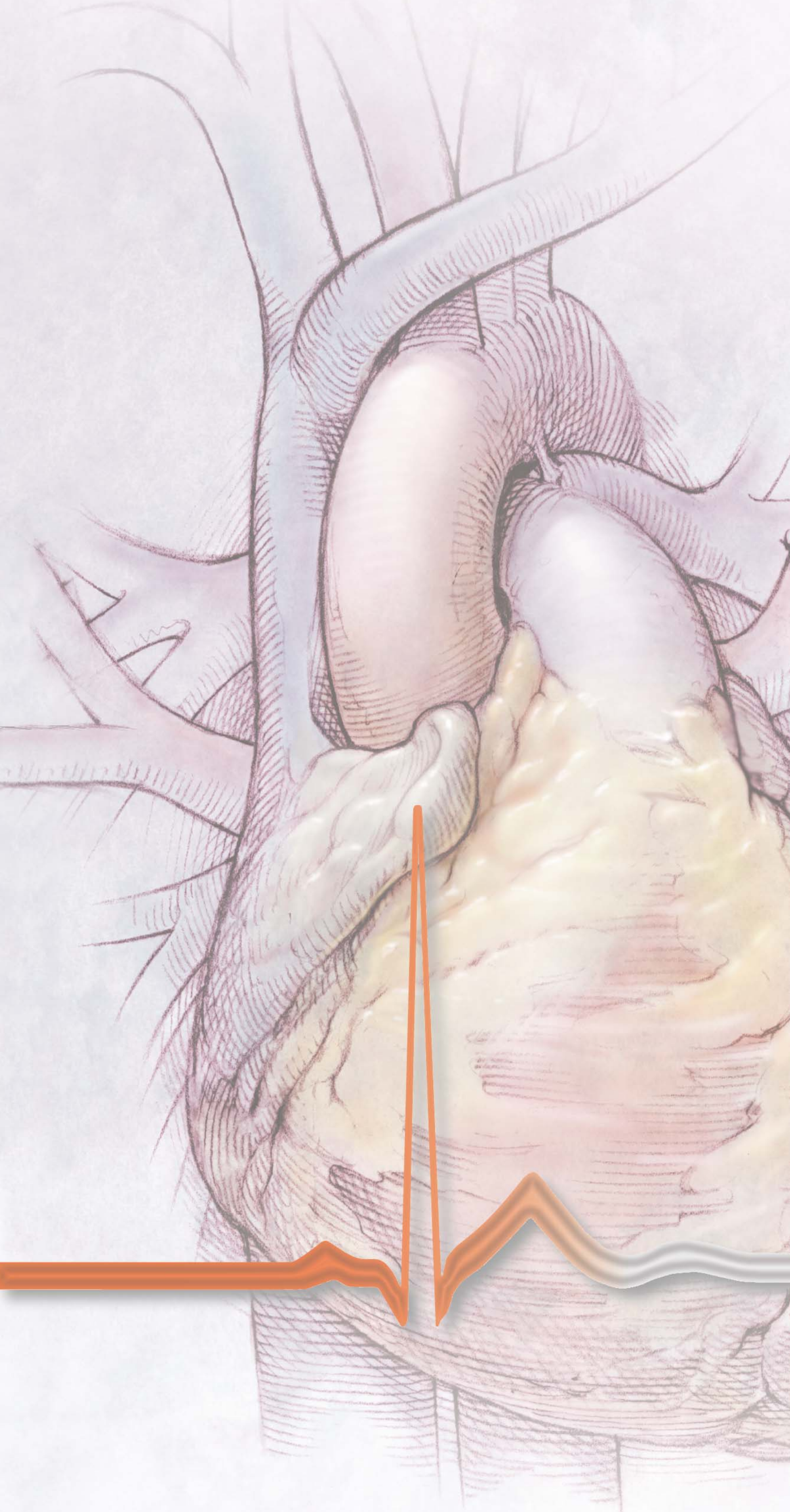
Data Source: Ontario Prehospital Advanced Life Support Study, Brampton Base Hospital Program, Metro Toronto Ambulance Service

Conclusions

Given the low survival rates after cardiac arrest in Ontario, we suggest that all communities aim to collect and pool data according to the standardized Utstein template. This is an urgent priority. Concurrently, quality improvement initiatives should be directed at each link in the chain of survival (Exhibit 15.1). For the first link, all communities should strive to have 911 response systems. For the second link, communities should institute more active training of the general public concerning cardiac arrest and CPR. Also, as OPALS phase II data show, performance feedback and tiered-response agreements between firefighters and police can sharply increase the rates of first-responder CPR. For the third link, potential steps include the optimization of ambulance defibrillator programs through better deployment of existing ambulances, along with improved dispatch policies. However, gains can also be made by instituting programs that equip firefighters with automatic defibrillators and train them appropriately. Last, as to ALS programs, the jury is out. Given the uncertainties about the marginal yields of ALS programs, we suggest that communities should focus in the first instance on monitoring the processes and outcomes of their current emergency services and ensuring these programs have been optimized.

Access to Physician Services and Patterns of Practice

Ben Chan



CHAPTER 16

KEY MESSAGES

- *Heart attack patients in Northern Ontario wait 9 weeks to see cardiac specialists after discharge from hospital, (compared to five to six weeks elsewhere in the the province) and are more likely not to see a specialist at all in the six months after their heart attack.*
- *Surgeons who perform the most complex cardiac surgeries have high surgical volumes. Surgical volumes are lower for less complex surgeries and the impact of this finding on patients' outcomes deserves further research.*
- *The retirement of older physicians may adversely affect the supply of specialists in rural areas.*

Key Terms & Concepts:

- access
- area variation
- full-time equivalent
- volume-outcome relationship

Background

Physicians play diverse roles in the management of cardiovascular disease. Family physicians, as the gatekeepers to the health care system, provide the first line of care for patients. General internists and cardiologists either act as episodic consultants to the family physician or provide some level of concurrent care. General and cardiovascular surgeons perform surgical interventions at all levels of the cardiovascular system. Such interventions range from procedures on peripheral blood vessels, performed predominantly by general surgeons, to open-heart procedures, such as coronary artery bypass graft surgery (CABG) or transplantations, performed by highly-specialized cardiac surgeons.

This chapter examines the patterns of practice among physicians who manage cardiovascular disease. In the calculation of the disease costs for Chapter 1, we found that cardiovascular disease accounts for about 10% of physician expenditures in Ontario. This chapter expands on that analysis, exploring in greater detail the types of diagnoses which physicians see in their practices. It also examines the characteristics of physicians who treat cardiovascular disease and the proportion of office visits and consultations devoted to cardiovascular disease.

A second objective of this chapter is to profile surgeons who perform different types of procedures. What types of surgical volumes do surgeons typically have? What level of specialty corresponds with what type of procedure performed? Do services appear to be regionalized in the province? All of these questions are germane to the debate within the surgical community on the appropriate minimum surgical volume necessary to maintain good skills and the best possible patient outcomes.

The third objective of this chapter is to profile access to services. Patients and health planners need to understand how accessible services are. For this analysis, we chose acute myocardial infarction (AMI) as a sentinel event and used it to track how access to physician care after an AMI varies by region.

Data Sources

The Ontario Health Insurance Plan (OHIP) database provides comprehensive information on the services provided by all fee-for-service physicians in Ontario. The database records each billable patient encounter, including the fee code for the service performed, the date of service and number of services performed.

The OHIP database does not capture the activity of physicians in alternate payment plans (APPs). This exclusion particularly affects about 5% of physicians in the province. These physicians include general practitioners and family physicians (GP/FPs) working in Health Service Organizations concentrated in the Central South region and academic specialists working for the South Eastern Academic Medical Organization (SEAMO) in Kingston. There are also eight emergency departments scattered across the province that are on alternate payment plans, in addition to the Kingston region. As a result, any apparent shortages in physician supply noted in the regions mentioned above should be interpreted with great caution.

We used two versions of OHIP data: data which have all individual claims, and the National Physician Database (NPDB), which gives quarterly tabulations of billings of each physician by fee code. The latter is particularly useful for examining physician activity characteristics. Disaggregated data are more useful for patient-level analyses, such as the diagnosis and analysis of services received for cohorts of patients.

The information on specialty designation in the NPDB/OHIP files is generally considered inaccurate when compared with other databases such as the records of the College of Physicians and Surgeons of Ontario (CPSO) or the Royal College of Physicians and Surgeons (RCPS). One reason is that physicians often report only their broad specialty group to OHIP (e.g. internal medicine) instead of their subspecialty (e.g. cardiology). The Southam Medical Database on physician human resources draws information from a variety of sources, such as CPSO and RCPS records. We accordingly used Southam data to improve the accuracy of the specialty coding on NPDB. However, we had access to Southam data only for 1995 and 1996; hence, we were not able to improve the accuracy of the specialty coding for preceding years. (This explains why, in Chapter 13, we were not able to distinguish between cardiologists and internists in analyses of trends in use of cardiac diagnostic tests from 1989/90 to 1995/96, but were able to do so in this chapter.)

How We Did the Analysis

Physicians in the Southam database and NPDB were matched on birth dates, gender, postal codes and broad specialty categories. The matching process was successful in 98% of the cases. For the purpose of this study, we did not attempt to distinguish between cardiovascular and cardiothoracic surgeons.

Not all physicians practice at the same level of activity. Some physicians practice part-time, while others see double the number of patients of other physicians.

Any description of physician supply must account for these differences. In this study, we used a modified version of the Health Canada methodology for defining full-time equivalent (FTE). This methodology is explained in detail in the Methods Appendix. A dataset on post-AMI care was constructed from hospitalization records from the Canadian Institute for Health Information (CIHI). We extracted patient records with a discharge diagnosis of AMI in an acute care hospital from 1992/93 to 1996/97. We then linked this file to Vital Statistics data to obtain the date of death, where applicable. Next, we excluded all patients who had a major complication within the first six months after discharge, consisting of either a readmission to hospital for any reason, a transfer to a rehabilitation or chronic care facility, or death. Lastly, we linked, using the patient's health card number, the hospitalization record to all OHIP billings for patient encounters in the six months after discharge from the AMI.

Interpretive Cautions

Although alternate payment plans account for a small proportion of billings, they are concentrated in certain regions of the province. As noted above, this may cause some distortions in regional rates, particularly among GP/FP services in the Central South and specialist services in the East.

For analytical simplicity, the post-AMI cohort only looks at those patients who have the fewest complications. Yet, the patients who perhaps deserve the greatest attention from the standpoint of access to care are those who have multiple complications. We are planning further studies of physician follow-up for AMI to assess this high-risk subgroup.

Some patients who may appear to have no follow-up after an AMI may actually have left the province, either permanently or temporarily. However, less than 1% of the population moves out of Ontario permanently each year.[1]

Last, we emphasize that there will inevitably be some coding and classification errors in these analyses. Diagnostic data on OHIP claims, in particular, may be unreliable, as one diagnosis must be applied, howsoever arbitrarily. On the other hand, because our focus is on OHIP diagnoses at a high level of aggregation, we have assumed that much of this random diagnostic coding error is washed out. The Southam database offers greater specificity in classifying physician specialty compared to OHIP or NPDB, but is unlikely to perfectly differentiate all physicians. Indeed, many specialists have mixed practices (e.g. cardiology plus some internal medicine, general and vascular surgery, cardiothoracic and vascular surgery etc.).

Findings and Discussion

Exhibit 16.1 shows the supply of selected types of physicians in Ontario who handle a significant volume of cardiovascular disease. On average, there is one cardiologist for every 38 GP/FPs and one general internist for every nine GP/FPs. Cardiologists have the highest gross billings of the specialists listed in this table; however, it should be emphasized that cardiologists also have high billings for cardiac diagnostic tests, which are associated with high practice costs. This contrasts with cardiac surgeons who, on average, have lower overheads.

EXHIBIT 16.1 Physician Supply and Billings in Ontario, 1996/97

Physician Specialty	Number of Full-time Equivalents	Full-time Equivalents per 10,000 Population	Average Billings* per Full-time Equivalents	25th Percentile of Billings*	75th Percentile of Billings*
General Practitioner/Family Physician	9,316	8.28	$179,000	$83,000	$231,000
Internal Medicine	984	0.88	$234,000	$68,000	$336,000
Cardiology	245	0.22	$472,000	$245,000	$597,000
General Surgery	514	0.46	$253,000	$104,000	$321,000
Cardiovascular Surgery	61	0.05	$424,000	$260,000	$544,000
Vascular Surgery	58	0.05	$348,000	$235,000	$411,000
Total (All Physicians)	**18,830**	**16.73**	**$219,000**	**$87,000**	**$268,000**

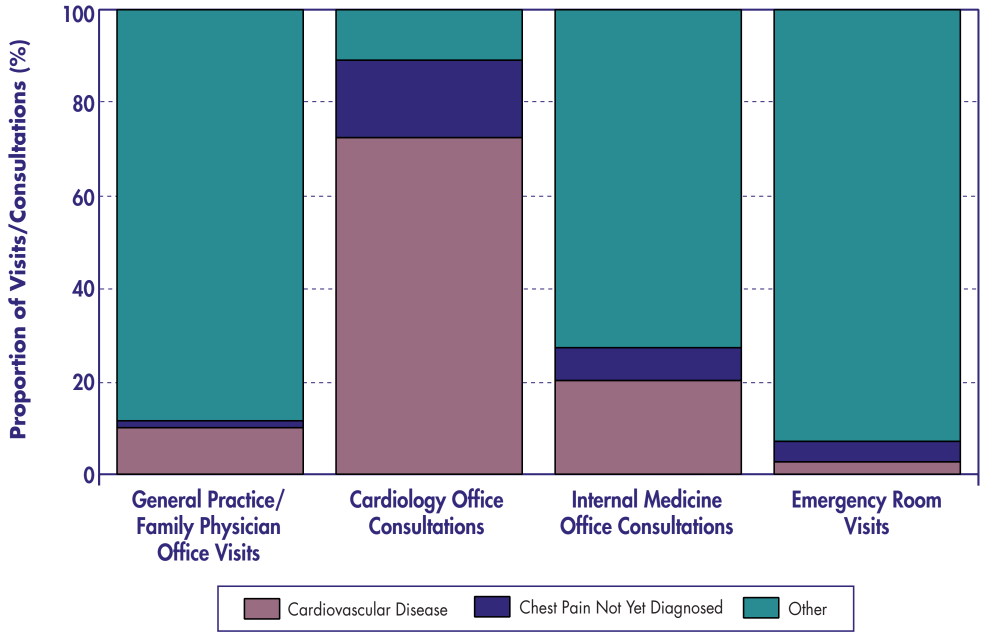
* Billing figures represent annual gross billings *before* expenses. Expenses may be particularly high for cardiologists who perform diagnostic and therapeutic procedures in their office.

Data Source: National Physician Database, Southam Medical Database

Exhibits 16.2 and 16.3 show the patient case mix for different types of physicians. GP/FPs devote 12% of their office visits to cardiovascular disease and chest pain not yet diagnosed. Emergency physicians spend an even smaller proportion of their visits on these conditions. Not surprisingly, 89% of cardiology consultations were for cardiovascular and chest pain diagnoses. Among general internists, more than one in four consultations were for cardiovascular and chest pain diagnoses.

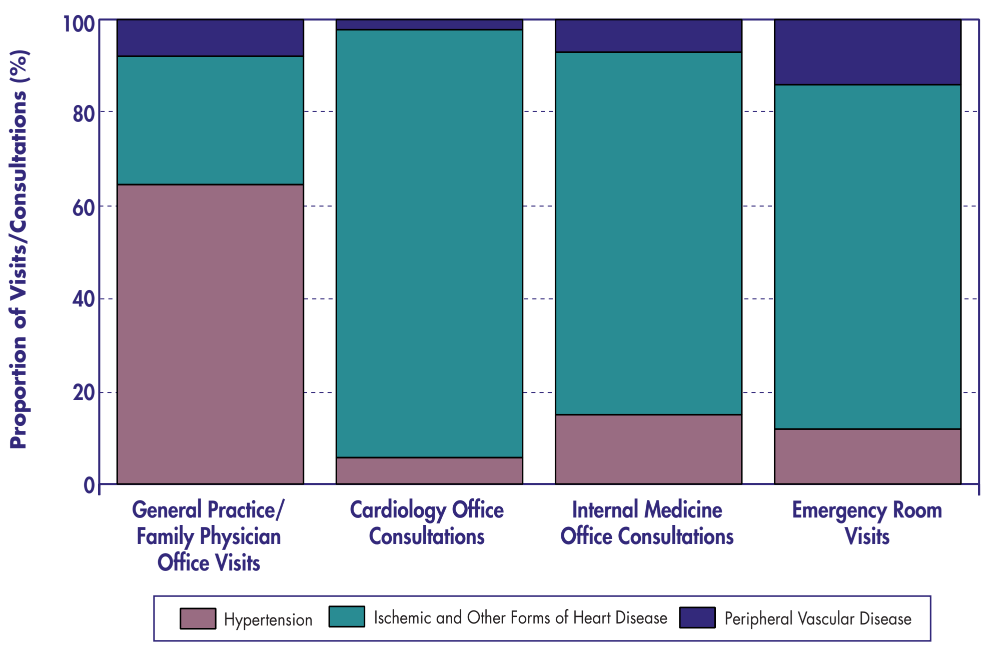
Among cardiovascular cases, GP/FPs devote most of their visits to managing hypertension, while internists and cardiologists devote most of their consultations to ischemic and other heart disease. Most of the cardiovascular cases seen by emergency department physicians are to evaluate chest pain.

EXHIBIT 16.2: Proportion of Selected Services Devoted to Cardiovascular Disease in Ontario, 1996/97



Data Source: National Physician Database, Southam Medical Database

EXHIBIT 16.3: Proportion of Visits Devoted to Different Types of Cardiovascular Disease in Ontario, 1996/97



Data Source: National Physician Database, Southam Medical Database

EXHIBIT 16.4 Per cent of Physicians in Different Practice Stages by Selected Specialties in Ontario, 1996/97

Selected Specialties	Per Cent of Full-time Equivalent Physicians who are:		
	Recent Graduates* (%)	Established Physicians** (%)	Over Age 65 (%)
General Practitioner/Family Physician	13	80	6.5
Internal Medicine	13	71	15
Cardiology	23	77	0.0
General Surgery	15	68	17
Cardiovascular Surgery	20	77	2.4

* Recent graduate defined as graduation from specialty in past five years.

** Established physician defined as neither recent graduate nor over age 65.

Data Source: Southam Medical Database, National Physician Database

Exhibit 16.4 examines the age distribution of physicians treating cardiovascular disease. Subspecialists tend to be younger, while generalists tend to be older. This observation may reflect the trend in recent years towards greater specialization in postgraduate medical training programs. The impending retirement of older physicians will have a minimal impact on the supply of cardiologists and cardiovascular surgeons, but could impact the supply of general surgeons and internists who may be practising in relatively rural areas.

Exhibit 16.5 shows the regional variation in physician supply (FTE per 10,000 population) and activity level (average FTE per physician). Consistent with previous analyses,[2] Toronto has the highest supply of specialists. Central East had one of the lowest numbers of cardiologists and cardiovascular surgeons, but this region is adjacent to Toronto, which likely services the region. Workload is particularly heavy for general internists in Northern Ontario (where there is a relative shortage of subspecialists).

Exhibit 16.6 is a profile of cardiologists' and internists' practice mix over time. (For this analysis, we did not use Southam data to clarify the distinction between cardiologists and internists because we had data only for 1995 and 1996). Among cardiologists and internists, the profile of practice has changed substantially. There is now a greater proportion of practice activity devoted to performing procedures. This is consistent with our analyses in Chapter 13 in which we found rapid growth in certain diagnostic procedures, particularly nuclear medicine and echocardiography. There is also a steady decline in the proportion of practice derived from hospital visits. This phenomenon may reflect the hospital restructuring process in Ontario and concomitant reductions in length of stay, resulting in services being shifted from the hospital to the community.

EXHIBIT 16.5 Regional Variation in Supply and Activity of Selected Specialties in Ontario, 1996/97

Health Planning Region	Cardiologists	General Practitioners/ Family Physicians	General Surgeons	Internists	Cardiovascular Surgeons
Average Full-time Equivalent Activity Level					
Central East	1.22	1.02	0.87	1.10	1.47
Central West	1.10	0.96	0.81	1.06	1.00
Central South	0.93	0.86	0.82	0.95	0.88
East	0.78	0.76	0.76	0.76	0.73
North	1.04	0.91	0.82	1.21	0.90
South West	0.83	0.98	0.98	1.00	0.99
Toronto	0.92	0.91	0.92	0.92	1.04
Ontario	**0.94**	**0.91**	**0.87**	**0.96**	**0.95**
Full-time Equivalent per 10,000 Population					
Central East	0.13	7.61	0.34	0.50	0.017
Central West	0.17	7.30	0.32	0.50	0.005
Central South	0.26	6.65	0.55	1.07	0.069
East	0.22	8.25	0.39	0.72	0.061
North	0.16	7.81	0.50	0.70	0.059
South West	0.13	7.58	0.55	1.04	0.072
Toronto	0.38	10.80	0.56	1.40	0.089
Ontario	**0.22**	**8.28**	**0.46**	**0.88**	**0.053**

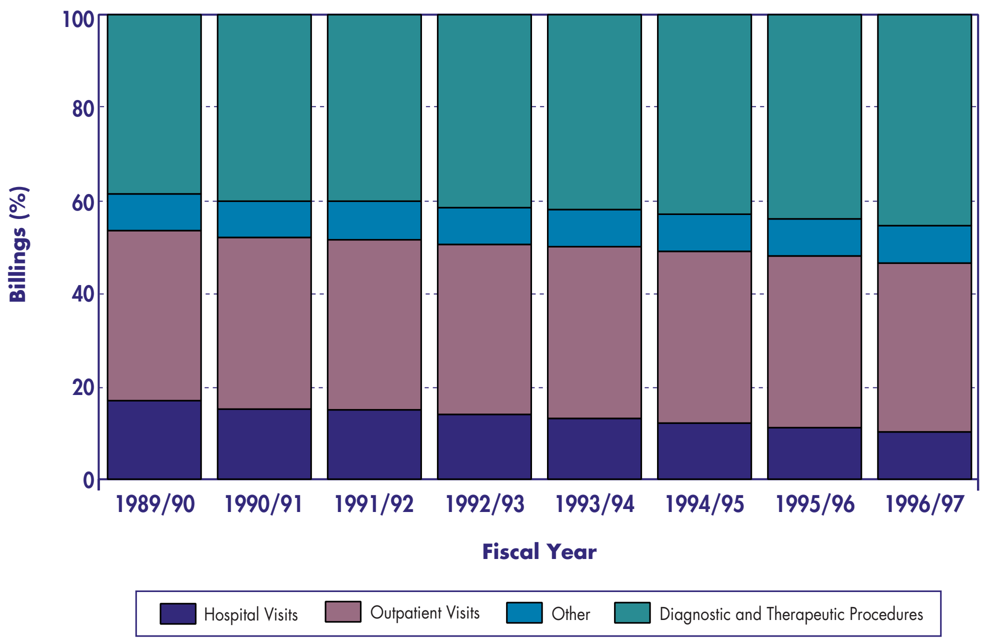
Data Source: Southam Medical Database, National Physician Database

In Exhibit 16.7, we compare the practice mix of cardiologists and internists for fiscal 1996/97, using Southam specialty data to distinguish between the two. Cardiologists derive a higher proportion of their billings from diagnostic and therapeutic procedures than internists.

Exhibits 16.8 and 16.9 examine the number of physicians who perform certain types of procedures. There are 47 surgeons who perform CABG. This finding is consistent with other data showing that Ontario has 46 cardiovascular surgeons in nine cardiovascular surgical units, or 0.46 surgeons per 100,000 population.[3] Almost all surgeons who perform (CABG) and valve procedures are cardiovascular surgeons, except for one pediatric surgeon and one recent graduate (who may not yet have reported a new subspecialty to OHIP).

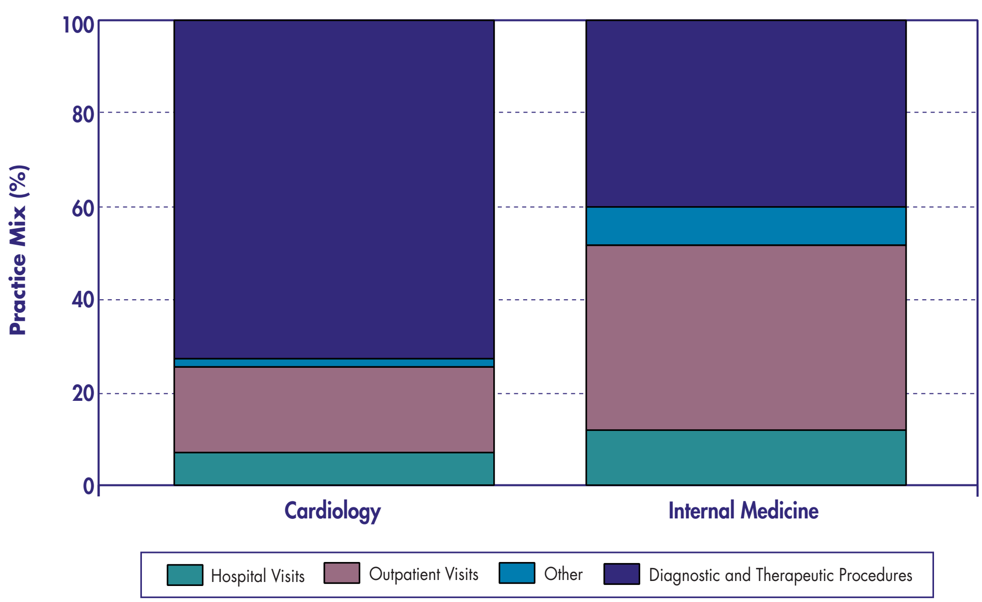
Exhibit 16.9 shows average annual surgical volumes and number of physicians with relatively low surgical volumes defined as less than one procedure a month on average (we omitted surgeons who billed only one surgery per year, because such cases were probably the result of coding error. These surgeons accounted for less than 1% of all procedures). Surgical volumes are low for cardiac transplantation, but there appear to be only 41 procedures performed in the entire province per year. This raises the question of whether or not transplantation should be centralized further. However, further centralization could lead to a reliance on a very small number of surgeons for these procedures, which may lead to other problems such as managing call schedules.

EXHIBIT 16.6: Practice Mix of Cardiologists/Internists in Ontario, 1989/90 - 1996/97



Data Source: National Physician Database

EXHIBIT 16.7: Differences in Practice Mix Between Cardiologists and Internists in Ontario, 1996/97



Data Source: National Physician Database, Southam Medical Database

EXHIBIT 16.8 Specialists and Laboratories Performing Catheterization in Ontario, 1995

	Number	Number per 100,000 Population
Interventional Cardiologists	37	0.37
Catheterizing Cardiologists	98	0.97
Catheterization Laboratories	17	0.17

Note: Based on population 10,084,885

Data Source: Can J Cardiol 1997;13 (Suppl D):p 59D.

The surgical volumes are very good for coronary artery bypass grafts (CABG). This reflects the large degree of regionalization of cardiac surgical services to nine tertiary hospitals in Ontario. There are very few surgeons with low volumes and some of these low volumes may be due to either coding errors or scheduling anomalies (e.g. doctor leaving on sabbatical with only six months' billings on record).

One-third of surgeons perform a low volume of aortic aneurysm surgery. This finding may be of concern, given the well-documented relationship between surgical volume and outcomes.[4-8] On the other hand, some of these procedures may be ruptured aneurysms performed in emergency cases. In such situations, it may be justifiable to perform the surgery immediately rather than risk a delay in transferring patients to a centre with more experience.

Exhibits 16.10 to 16.10ii show the geographic location of physicians performing different surgical services. These maps show greater centralization with more complex surgical procedures. The literature on volume-outcome relationship suggests this is desirable.[9-12] However, surgeries with lower complexity have a greater proportion of surgeons who practice at low volume. The impact of low surgeon volumes in these cases merits further research. Low volumes may be acceptable when the risks of surgery are low, such that the absolute impact of any variation in surgeons' technical skills will be small. In this instance, lower volumes may also be a reasonable tradeoff in cases where patients live remotely and have to travel to get specialized service.

Exhibit 16.9 Surgical Volumes for Different Types of Procedures in Ontario, 1996/97

Procedure	Number of Surgeons Performing Procedures			Average Number of Procedures per Year per Surgeon	Number of Surgeons Performing <12 Procedures per Year
	Cardiovascular Surgeon	Other Surgeon	Total		
Transplantation	10	0	10	4.1	10
Coronary Artery Bypass	45	2	47	155.4	3
Valve Surgery	42	2	44	53.1	6
Abdominal Aortic Aneurysm	17	96	113	21.6	39
Carotid Endarterectomy	10	43	53	18.8	22
Pacemaker Procedures	28	82	110	46.4	32
Peripheral Vascular Disease Procedures	11	64	75	16.8	40
Major Varicose Vein Procedures	9	277	286	34.2	151

Data Source: National Physician Database, Southam Medical Database

Post-AMI Cohort

How good is access to physician services for patients recently hospitalized with an AMI? To answer this question, we examined only patients who did not have a major complication in the six months after their AMI. A major complication could be readmission to hospital for any reason, a transfer to a chronic care or rehabilitation unit, or death.

As shown in Exhibit 16.11, we find that there is very little regional variation in post-AMI follow-up by family physicians. Patients tend to be seen within two weeks of discharge and have follow-up visits about once every five to six weeks. Nonetheless, about one in eight patients appear to have no follow-up by a family physician and almost one-quarter are not seen at all by a cardiologist or internist after discharge. Part of this phenomenon may be due to some physicians being on alternate payment plans, resulting in follow-up not being recorded. However, such physicians comprise only 5% of the total physician population which is not enough to explain all of the apparent lack of follow-up.

There is also major geographical variation in the access to specialty care in Northern Ontario. The median wait for a patient is nine weeks to see a specialist following discharge, compared to five to six weeks elsewhere in the province. Furthermore, 35% of patients have no specialist follow-up at all.

Recent guidelines published by the American College of Cardiology and the American Heart Association for the management of patients with AMI do not have a specific recommendation for the number of follow-up visits in the post-AMI period.[13] However, the guidelines do emphasize the importance of prescriptive exercise training, diet control, education about coronary risk factor modification and counselling on employment during the post-hospitalization period. The guidelines also recommend long-term aspirin use, beta-blockers in all patients for whom a contraindication does not exist and selective use of lipid-lowering agents and angiotensin-converting enzyme (ACE) inhibitors. It is difficult to see how all of these recommendations can be promoted if there is no primary care physician follow-up in the six months following an AMI. These findings raise important questions about the adequacy of follow-up and barriers to care.

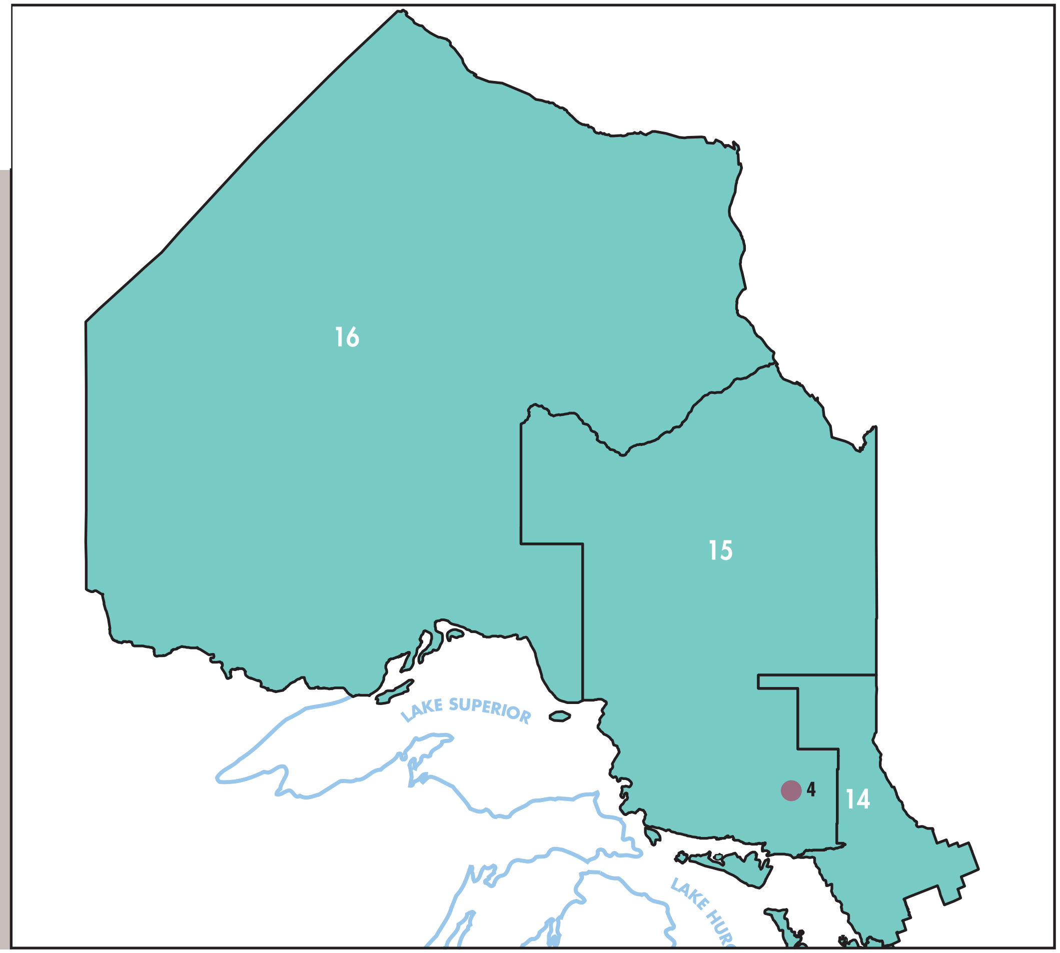
At present, we do not know if this reduced access to specialists has any impact on quality of care and long-term patient outcomes. Future studies should also examine whether GP/FPs in regions with fewer specialists adapt by becoming more proficient at handling more complex clinical management cases, such as post-AMI care.

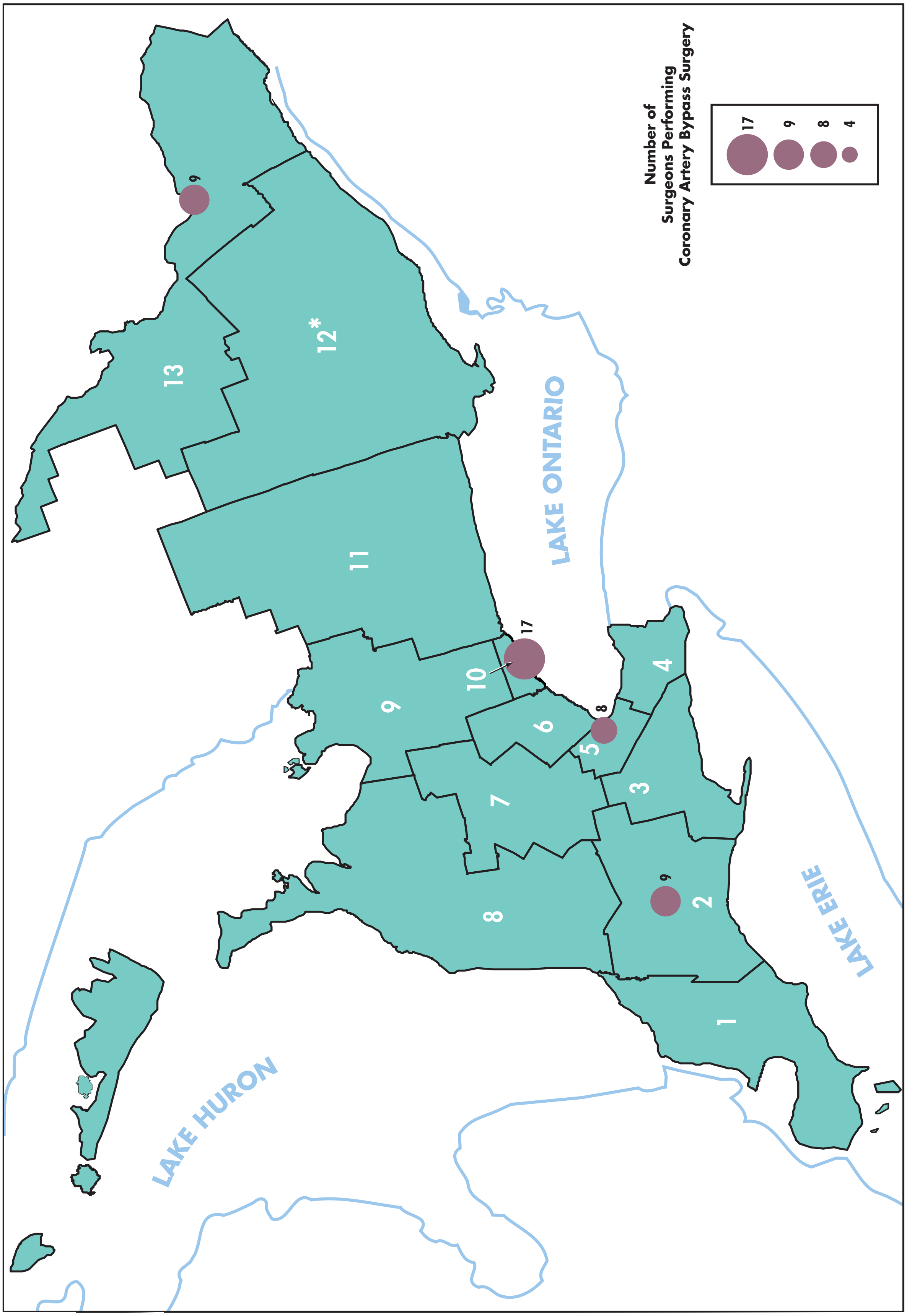
16.10 EXHIBIT

ONTARIO District Health Councils

Number and Location of Surgeons Performing Coronary Artery Bypass Surgery by District Health Council in Ontario, 1996/97

1. Essex, Kent and Lambton
2. Thames Valley
3. Grand River
4. Niagara Region
5. Hamilton-Wentworth
6. Halton-Peel
7. Waterloo Region-Wellington-Dufferin
8. Grey, Bruce, Huron, Perth
9. Simcoe-York
10. Toronto
11. Durham, Haliburton, Kawartha and Pine Ridge
12. Quinte, Kingston, Rideau
13. Champlain
14. Muskoka, Nipissing, Parry Sound and Timiskaming
15. Algoma, Cochrane, Manitoulin and Sudbury
16. Northwestern Ontario





*Surgeons in Quinte/Kingston/Rideau who are part of the South Eastern Academic Medical Organization are not represented in this map.

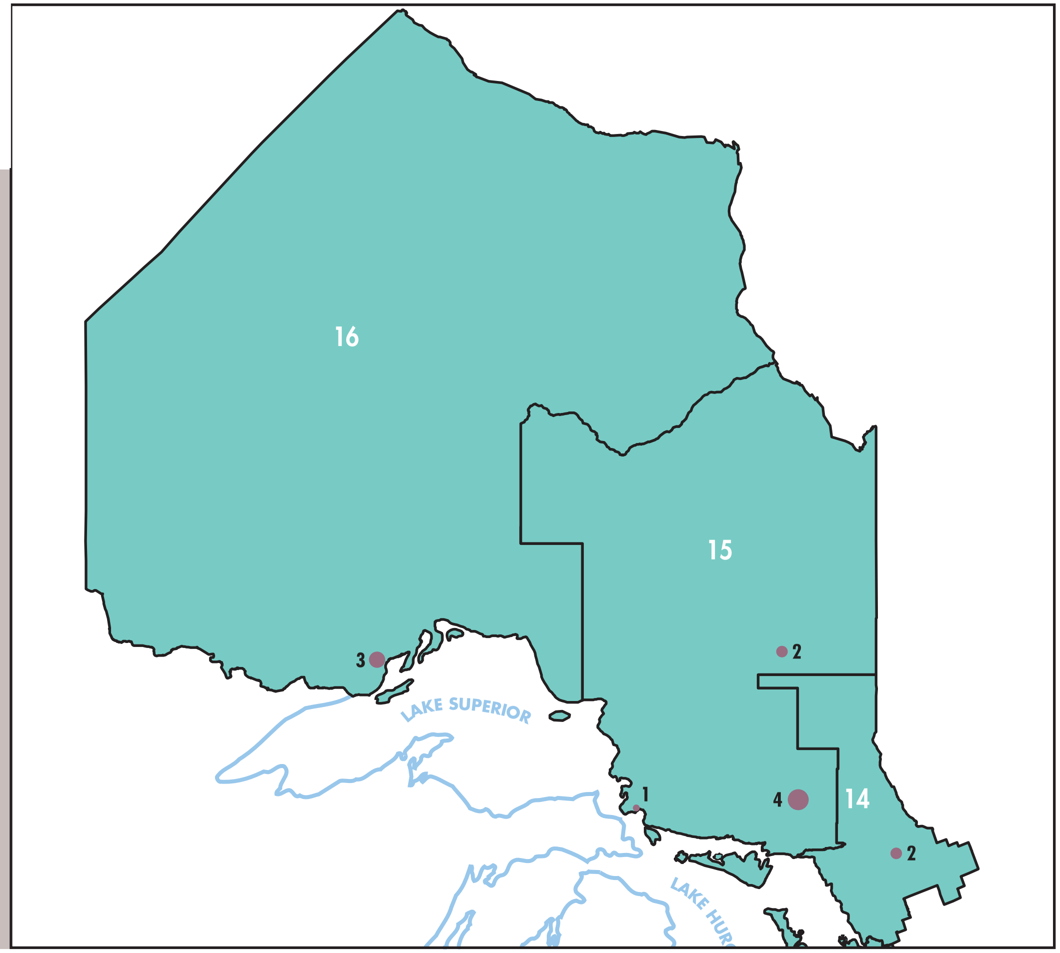
Data Source: National Physician Database

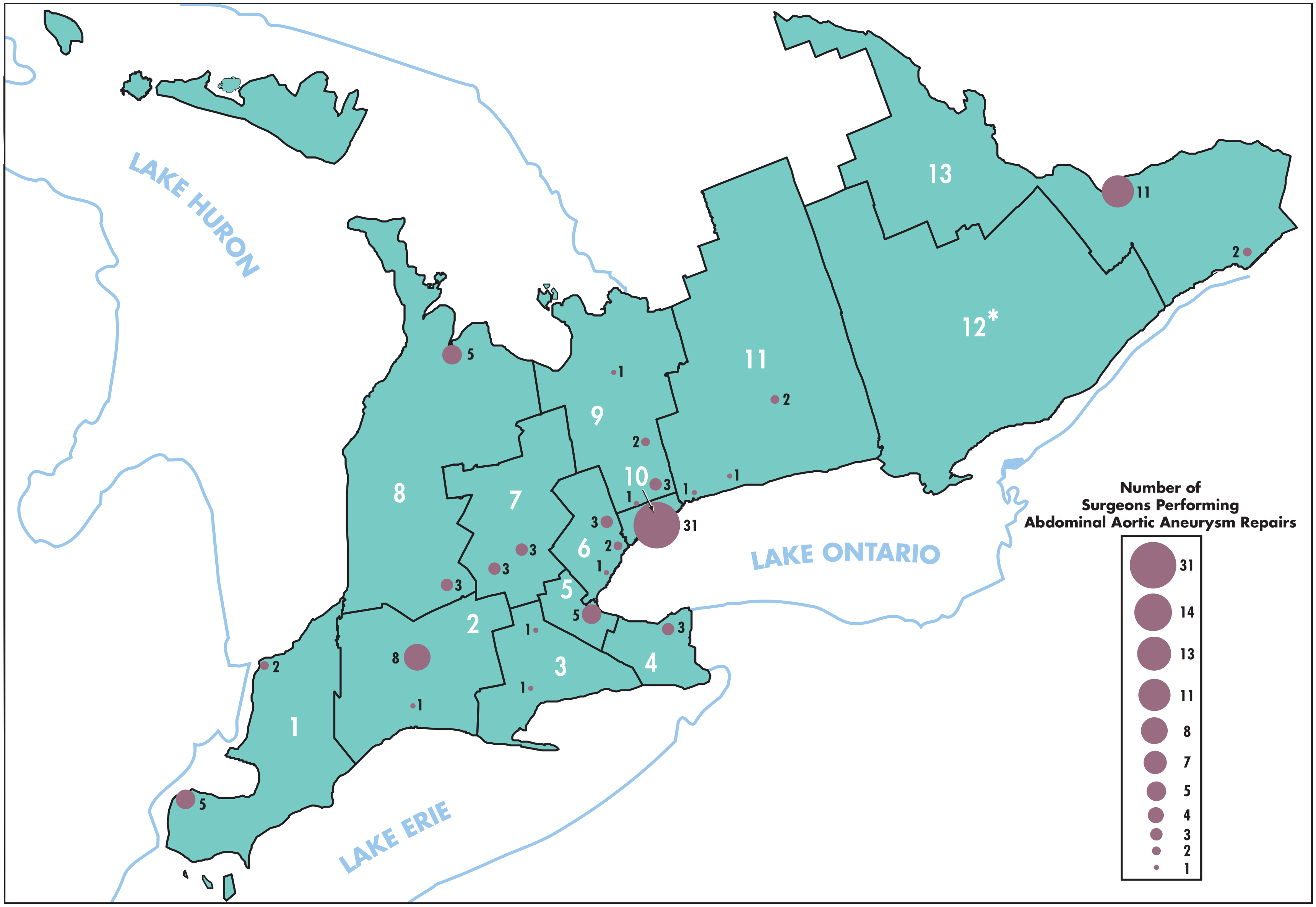
16.10i EXHIBIT

ONTARIO District Health Councils

Number and Location of Surgeons Performing Abdominal Aortic Aneurysm Repairs by District Health Council in Ontario, 1996/97

1 Essex, Kent and Lambton
2 Thames Valley
3 Grand River
4 Niagara Region
5 Hamilton-Wentworth
6 Halton-Peel
7 Waterloo Region-Wellington-Dufferin
8 Grey, Bruce, Huron, Perth
9 Simcoe-York
10 Toronto
11 Durham, Haliburton, Kawartha and Pine Ridge
12 Quinte, Kingston, Rideau
13 Champlain
14 Muskoka, Nipissing, Parry Sound and Timiskaming
15 Algoma, Cochrane, Manitoulin and Sudbury
16 Northwestern Ontario





*Surgeons in Quinte/Kingston/Rideau who are part of the South Eastern Academic Medical Organization are not represented in this map.

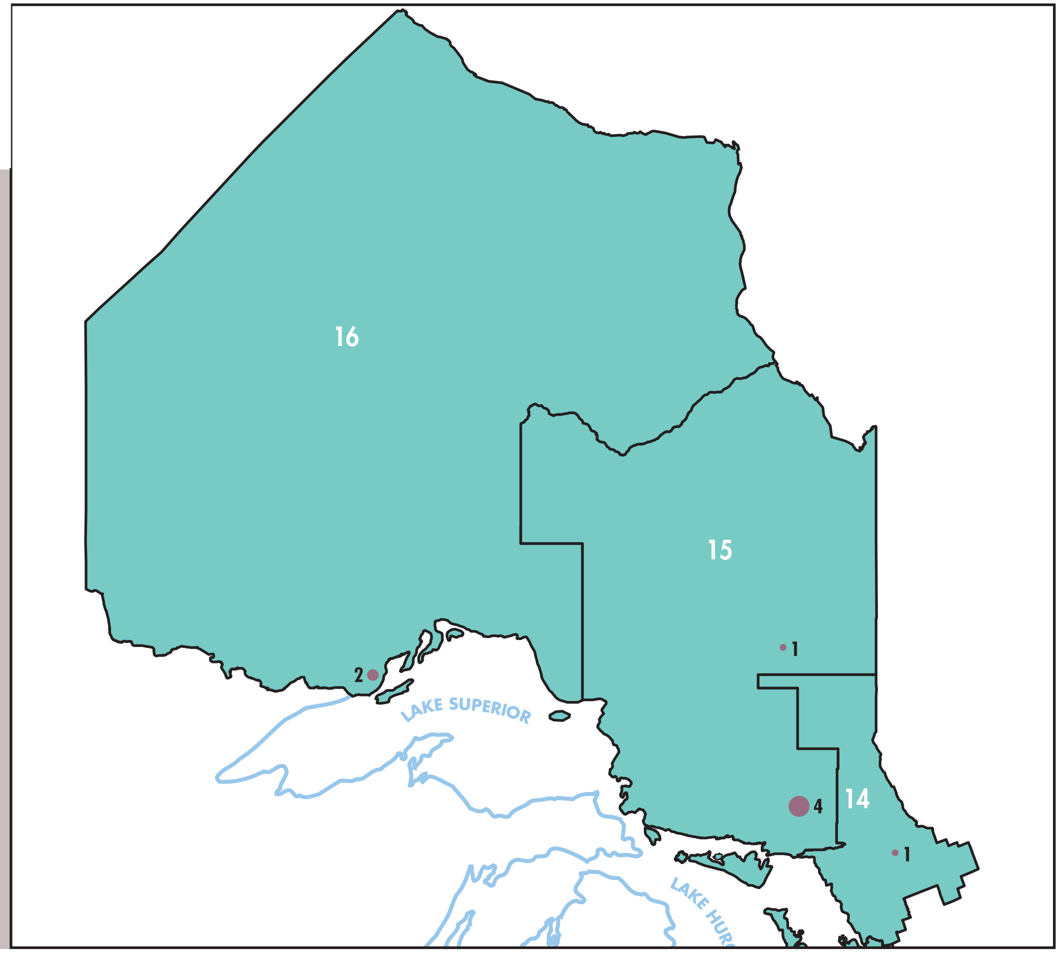
Data Source: National Physician Database

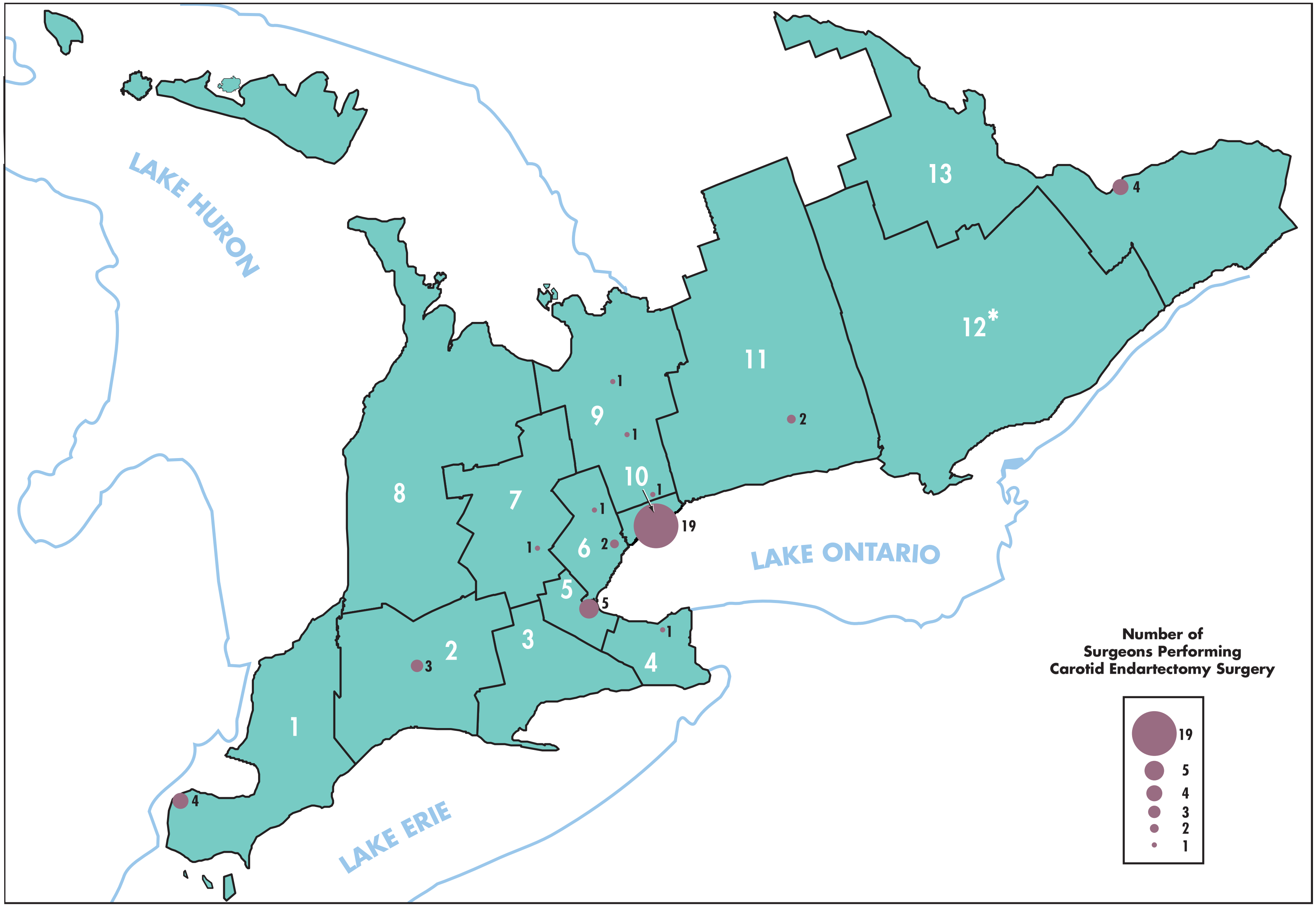
16.10ii EXHIBIT

ONTARIO District Health Councils

Number and Location of Surgeons Performing Carotid Endarterectomy by District Health Council in Ontario, 1996/97

1. Essex, Kent and Lambton
2. Thames Valley
3. Grand River
4. Niagara Region
5. Hamilton-Wentworth
6. Halton-Peel
7. Waterloo Region-Wellington-Dufferin
8. Grey, Bruce, Huron, Perth
9. Simcoe-York
10. Toronto
11. Durham, Haliburton, Kawartha and Pine Ridge
12. Quinte, Kingston, Rideau
13. Champlain
14. Muskoka, Nipissing, Parry Sound and Timiskaming
15. Algoma, Cochrane, Manitoulin and Sudbury
16. Northwestern Ontario





*Surgeons in Quinte/Kingston/Rideau who are part of the South Eastern Academic Medical Organization are not represented in this map.

Data Source: National Physician Database

EXHIBIT 16.11 Primary Care and Specialist Follow-up After Myocardial Infarction by Ministry of Health Planning Region in Ontario, 1994/95 - 1996/97

	North	South West	Central South	Central West	Central East	Toronto	East	Province
Median Number of Days to First Visit with Cardiologist/Internist After Discharge	60	36	31	35	34	36	43	37
Median Number of Days to First Visit with a General Practitioner/Family Physician After Discharge	14	12	14	13	13	13	15	13
Median Number of Cardiologist/Internist Visits in Six Months	1	2	2	2	2	2	1	2
Median Number of General Practitioner/ Family Physician Visits in Six Months	4	5	4	4	4	5	4	4
Proportion of Patients with no Cardiologist/ Internist Follow-up	35%	22%	18%	16%	20%	16%	29%	21%
Proportion of Patients with no General Practitioner/Family Physician Follow-up	11%	8%	18%	16%	7%	9%	14%	12%

Data Source: Ontario Health Insurance Plan, Canadian Institute for Health Information, Registered Persons Database 1994/95 - 1997/98

Conclusions

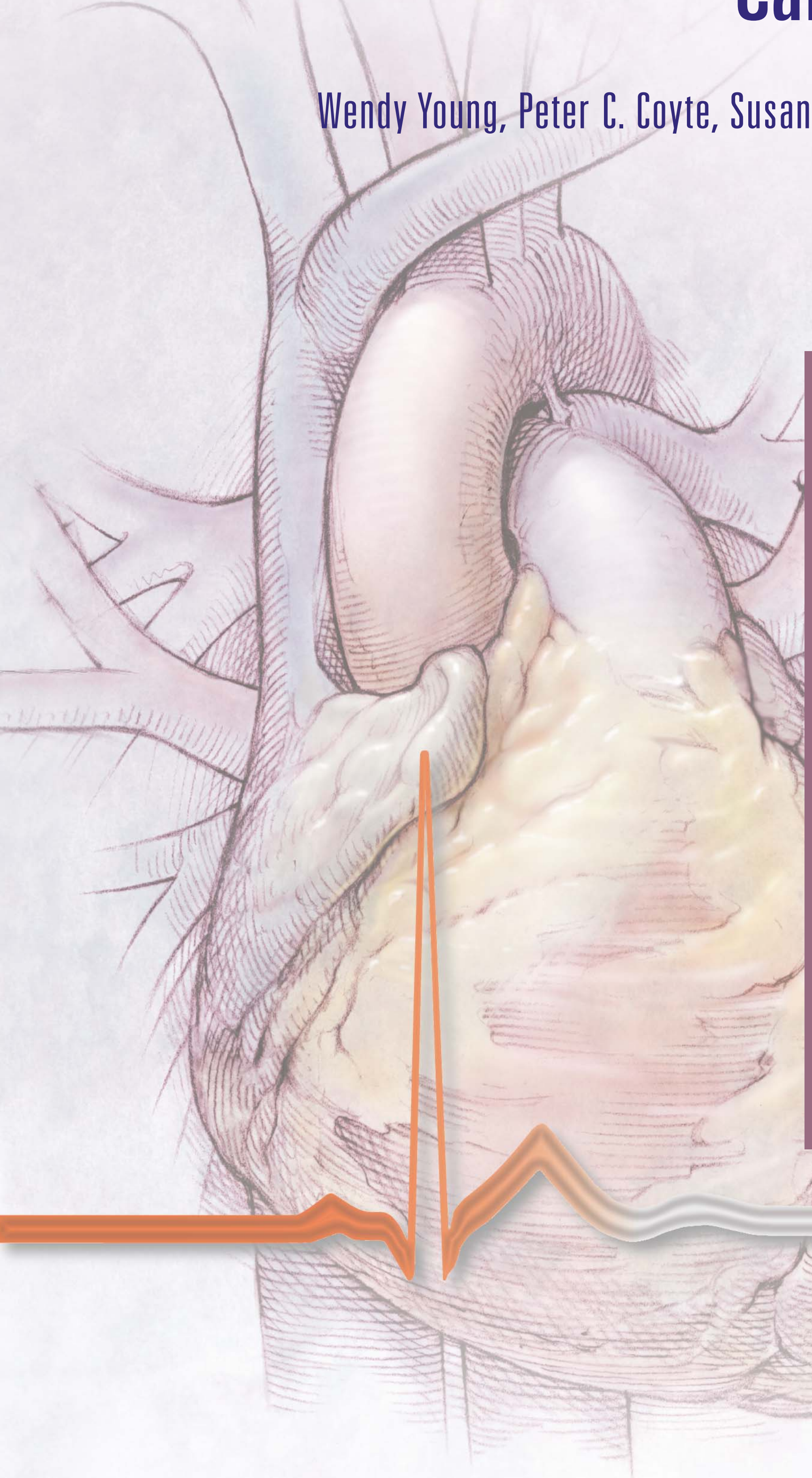
Cardiovascular disease accounts for at least 10% of physician expenditures in Ontario. As expected, different specialties tend to focus on different types of conditions: family physicians manage hypertension, emergency physicians evaluate chest pain, and internists and cardiologists treat ischemic and other heart disease. There are also important variations in the supply of physicians and relative shortages in specialists in Northern and Central East Ontario.

Complex cardiovascular surgery is well-centralized in Ontario and surgical volumes for these procedures are generally high. For less complex procedures we have noted that a substantial proportion of surgeons appear to perform low volumes of surgery, leading to concern about possible adverse volume-outcome relationships.

Last, we have also shown gaps in access to physician care. For example, among patients hospitalized with an AMI, one in eight is not seen by a family physician within six months of his or her AMI and one in four will not see a specialist at all. The situation is worse in Northern Ontario where 35% of patients do not see a specialist for follow-up and there is a significant delay for those who do see one. Further research is needed to identify the factors behind this lack of follow-up which clearly falls below the desired standard of care for Ontario.

Home Care Utilization Following A Hospitalization for Cardiovascular Disease

Wendy Young, Peter C. Coyte, Susan Jaglal, Donald P. DeBoer, C. David Naylor



CHAPTER 17

Key messages

- *The home is rapidly becoming a major site for health care in Canada.*
- *Diagnosis is a powerful determinant of the probability of receipt of cardiovascular home care.*
- *The rationalization of post-acute home care through implementation of guidelines covering the continuum of care is urgently needed if Ontarians are to enjoy the greatest possible return on their growing investment in community-based services.*
- *There are significant and unexplained variations across DHCs in the use of post-acute home care for cardiovascular conditions.*

Key Terms & Concepts:

- access
- Community Care Access Centre (CCAC)
- randomized controlled trial
- area variation
- substitution
- home care

Background

The home is rapidly becoming a major site for health care in Canada. Whereas health care spending has been level for several years, home care has expanded rapidly. Many factors, including the aging of our population, the reduction in average length of hospital stay, reduced numbers of admissions to hospital and an increase in the use of procedures outside the hospital, have combined to fuel this expansion in home care use.

Canadian cardiac patients frequently receive formal home care services. The results of a 1994/95 survey indicated that more than 25% of adult Canadians who received formal home care services in 1994/95 had heart disease which had been diagnosed by a health professional.[1]

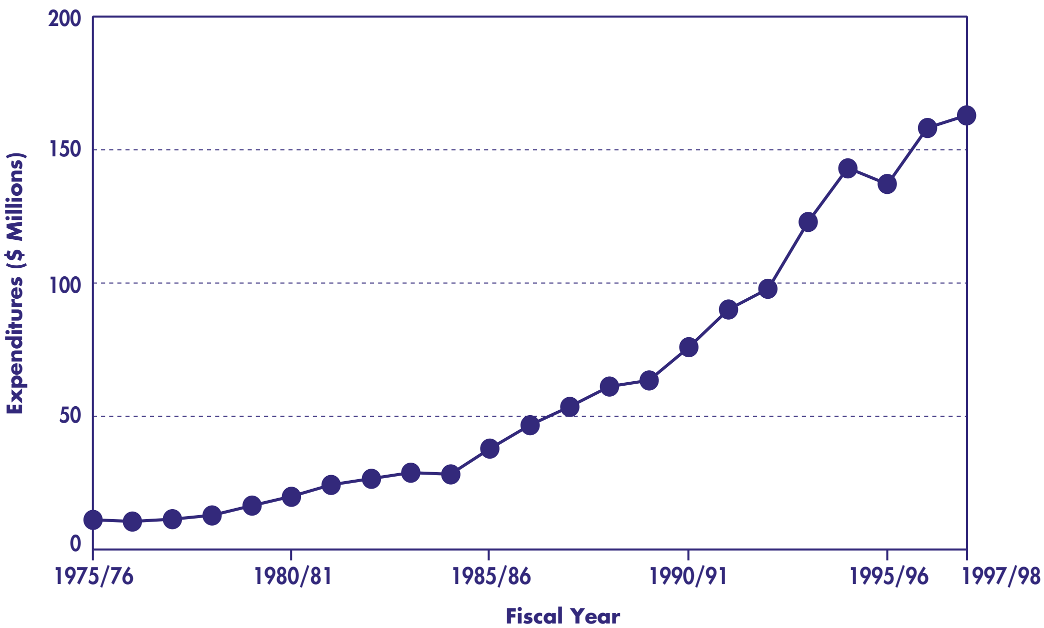
Today, any resident of Ontario may apply for formal home care services. The application for home care may be made by making a phone call to a local Community Care Access Centre (CCAC). The CCACs provide single point access to more than 1,200 community agencies. CCACs are accountable to the Ontario Ministry of Health (MOH) and are governed by independent non-profit boards of directors composed of consumers and community members.

In keeping with national trends, spending on home care in Ontario has risen rapidly. In 1990/91 our government spent $506 million on home care (in constant 1992 dollars)[2] or 2.75% of the total public health expenditures.[3] Based on MOH statistics, we estimate that $75.9 million (15% of total home care expenditures) was spent on cardiac-related home care. In 1997/98 our government spent approximately $1 billion or 5.30% of the total public health expenditures. We now estimate that in 1997/98, $163 million was spent on cardiac-related home care (see Exhibit 17.1).

Potential home care benefits include lower costs, better outcomes and improved access. Costs can be reduced if home care substitutes for acute care[4] or if it focuses on a high-cost group such as those with congestive heart failure (CHF).[5,6] Home care may not always have a measurable impact on functional ability[7] but as the National Forum on Health has argued, many Canadians would prefer to recover from illness at home with family and friends.[8] Last, home care may be the only way for patients who have physical or emotional difficulty leaving their home or for those suffering from a terminal illness to access health care.

Canadian women are more likely than men to use home care This appears to be explicable by the fact that women outlive men, are more likely to have chronic conditions and more likely to need help with activities of daily living.[1]

EXHIBIT 17.1: Estimated Home Care Expenditures for Cardiac-related Diagnoses* in Ontario, 1975/76 - 1997/98 (in constant 1992 dollars)



** Public home care expenditures by province with estimate of cardiac-related expenditures based on percentage of all total home care days that were related to patients with a cardiac diagnosis code (ICD-9: 390-459)*

Data Source: Health Canada, Home Care Administration System

Men and women may respond differently to home-based programs. For example, Frasure-Smith et al[9] conducted a randomized trial of the impact of a home-based psychosocial nursing intervention for patients recovering from acute myocardial infarction. For women, the all-cause mortality rate was 10.3% in the intervention arm and 5.4% in the control arm (p=0.051). For men, the all-cause mortality rate was 3.1% in both arms.

Canada's multicultural communities may not be taking full advantage of existing home care services. In a study of three home care agencies in Southern Ontario, Majumdar et al[10] found only 11.7% of clients belonged to ethnocultural minorities compared to an expected uptake of 24% based on population proportions. Peat and Boyce[11] suggest that in the future, community programs will have to be provided in ways that take into account cultural differences.

Last, we note that two previous studies have examined post-acute home care utilization for cardiac patients, i.e. services occurring in the wake of an admission to a general hospital. Coyte et al[12] identified all "post-acute" cardiac patients who were discharged from an acute care institution between 1993/94 and 1995/96. There were on average 112,539 patients with a cardiac problem discharged in each of these years. Of these, 18.8% received home care within 30 days of their discharge. Woodward and McGurran[13] looked at cardiac patients who were discharged from only one institution. They reported that the rate of home care utilization following a hospitalization for a cardiac diagnosis at the Toronto East General Hospital was 7.8% with considerable variation between diagnoses.

Data Sources

We examined Canadian Institute for Health Information (CIHI) inpatient discharges from Ontario hospitals for the three fiscal years, 1994/95, 1995/96 and 1996/97. This covered the period between April 1, 1994 and March 30, 1997. We drew on data from the Ontario Home Care Administration System (OHCAS) for the same period.

How We Did the Analysis

From CIHI data, we classified each cardiac admission, using the most responsible diagnosis and primary procedure code, in a broad hierarchy of 19 categories. There were six surgical/procedural groups and 13 medical groups. The six surgical groups were: coronary artery bypass graft surgery (CABG); percutaneous transluminal coronary angioplasty (PTCA); open heart valve procedures (aortic and mitral procedures); pacemakers; aortic and peripheral vascular surgery; and varicose vein procedures. The 13 medical groups were: acute myocardial infarction (AMI); angina; other forms of chronic ischemic heart disease; hypertension; cardiac dysrhythmias; CHF; phlebitis and thrombophlebitis; syncope and collapse; chest pain (this should imply non-cardiac causes, but it is included because the admissions usually reflect a desire to rule out cardiac disease); other forms of heart disease; diseases of arteries, arterioles and capillaries; diseases of veins and lymphatics and other circulatory system; and other.

Next we linked the CIHI data with OHCAS and identified the patients from this group who received a home care visit within 30 days of discharge from the acute care institution. For each District Health Council (DHC), the total number of discharges and the total number of home care recipients for each of the 19 groups was determined. The proportion of patients within each group who received home care services was established by dividing the number of home care recipients by the total number of patients assigned to that group. This proportion was defined as the actual home care utilization rate. These home care utilization rates were adjusted for the age and sex of home care clients, using the direct method of standardization. The rate denominator is therefore the number of inpatient discharges. Please refer to the Methods Appendix for Chapter 17 for more detail.

Interpretive Cautions

The clinical categories created here are necessarily arbitrary and may be heterogeneous. For example, we have combined extensive aortic reconstructive procedures with what may be fairly minor peripheral arterial procedures in a single category. In some cases, the diagnosis codes are ambiguous so that it is difficult to assign patients to one category or another. The analysis is based on most responsible diagnosis or primary procedure, as these tend to be the most accurate CIHI codes. Nonetheless, we emphasize that we have not validated the coding of most of the procedures and diagnoses considered here. Also, our geographic analysis is by DHC area of patient residence. It is implausible that the coding or actual case-mix within one of these categories would differ so sharply across DHCs that the categories would be non-comparable. However, several of the diagnostic and procedure categories have small numbers so that there is a risk of unbalanced allocation of different types of patients across the DHCs.

We also note that the chapter covers only "post-acute" home care. This is accordingly a partial examination of the range of home care services. Many home care services specifically related to cardiovascular care are provided in the absence of a triggering admission to hospital. Indeed, they may be offered in hopes of avoiding such admissions. Community care agencies also provide general support for independent living to a variety of individuals who, for whatever reasons, have difficulty with activities of daily living.

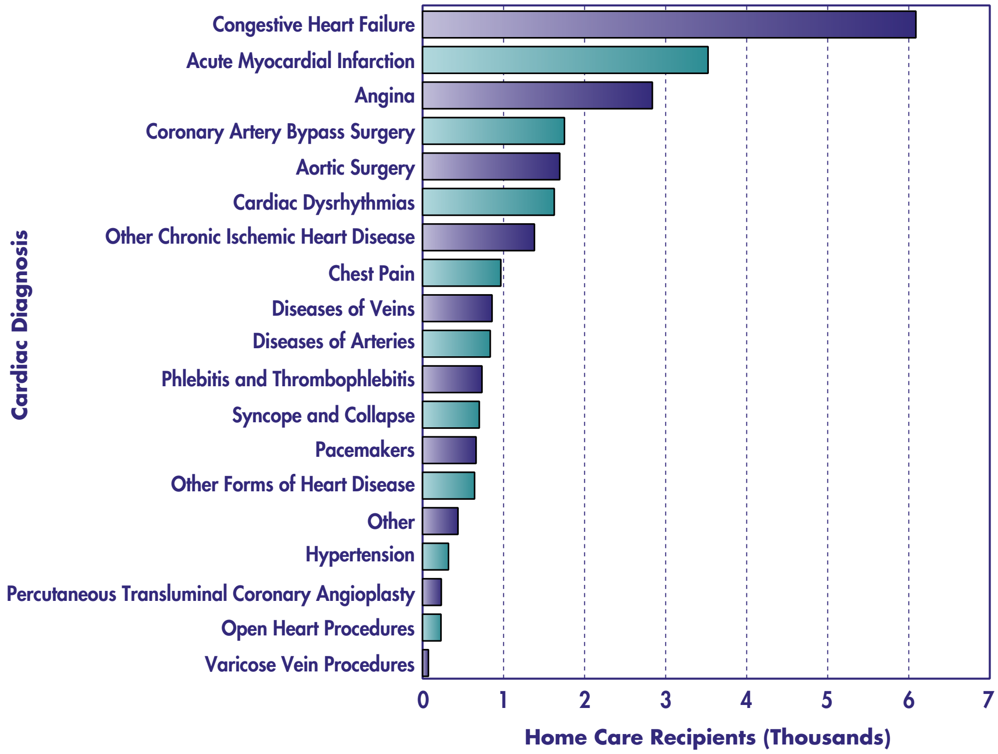
We took only the first admission for each patient within each of the 19 groups. Some individuals with multiple admissions for different diagnoses/procedures in a year may be counted several times.

Findings and Discussion

During this three-year period (1994/95 to 1996/97), we examined records for an average of 123,871 cardiac patients (102,860 medical and 21,011 surgical) per year. Of these, 20.7% received home care within 30 days of their discharge from hospital (20.4% medical, 22.1% surgical).

Exhibit 17.2 shows the number of home care recipients for each diagnostic category. In each year, an average of 6,088 home care recipients were discharged with CHF; 3,523 with AMI; 2,836 with angina, 1,751 with CABG; 1,693 with

EXHIBIT 17.2: Number of Home Care Recipients After Discharge from Hospital by Cardiac Diagnosis in Ontario, 1994/95 - 1996/97



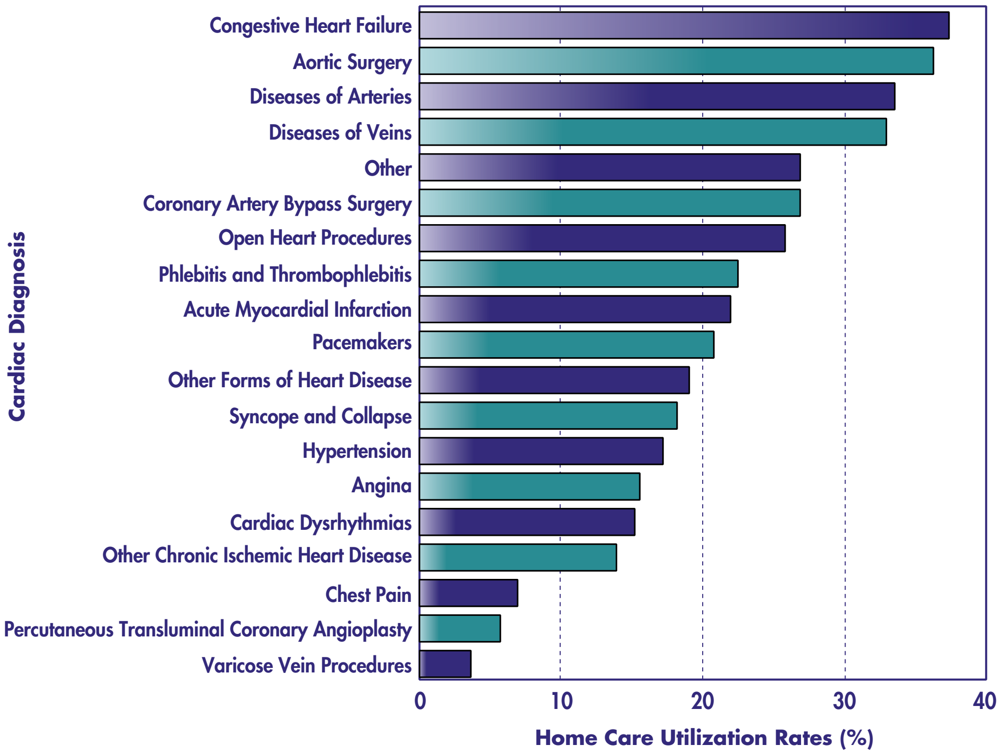
Data Source: Canadian Institute for Health Information, Ontario Home Care Administration System

aortic and peripheral vascular surgery; 1,626 with cardiac dysrhythmias; and 1,381 other forms of chronic ischemic heart disease (IHD).

Exhibit 17.3 shows the home care utilization rate after discharge from hospital for each cardiac procedure/diagnosis. As noted, about one in five cardiac patients overall receives home care. However, that proportion varies widely depending on the person's reason for the hospital stay. For patients who had aortic and peripheral vascular surgery, the home care utilization rate was 36.5%, contrasting with only 232 of 3,965 PTCA patients (less than 6%). About 37% of CHF patients received home care, but utilization rates were lower with other medical diagnoses (cardiac dysrhythmias 15%, angina patients 16%).

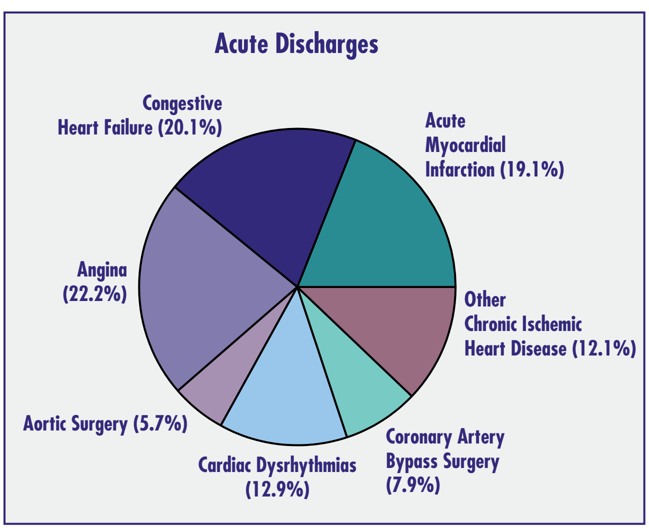
Exhibit 17.4 compares the number of people discharged from hospital to the number who then received home care, taking into consideration only the seven procedures/diagnoses with over 1,000 home care recipients. Patients with CHF represented 20% of the acute care discharges in these seven groups but 32% of the home care recipients.

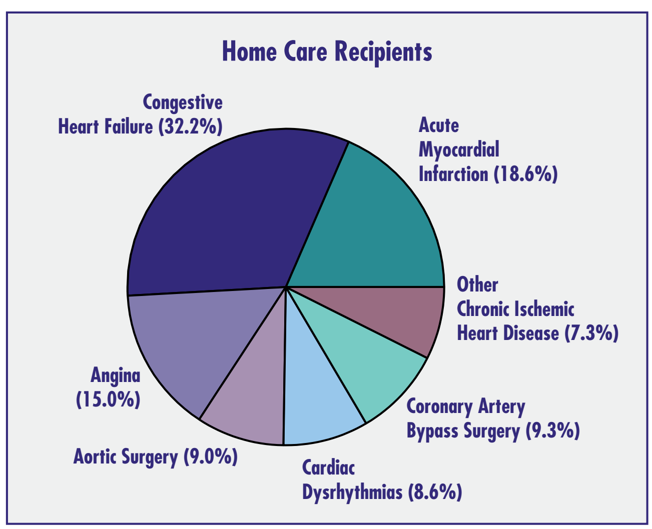
EXHIBIT 17.3: Home Care Utilization Rates After Discharge from Hospital by Cardiac Diagnosis in Ontario, 1994/95 - 1996/97



Data Source: Canadian Institute for Health Information, Ontario Home Care Administration System

EXHIBIT 17.4: Proportions of Acute Discharges and Home Care Recipients with Cardiac Diagnosis in Ontario, 1994/95 - 1996/97

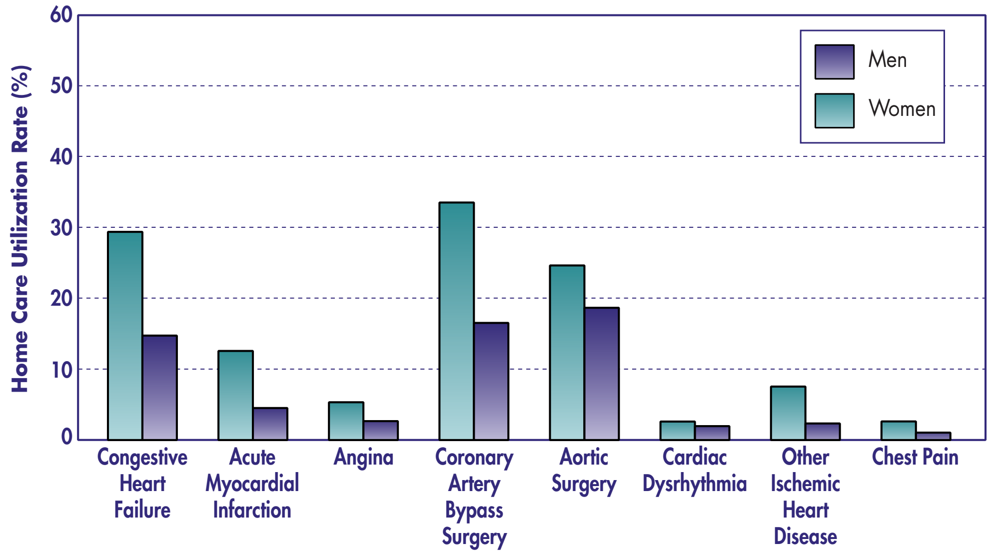




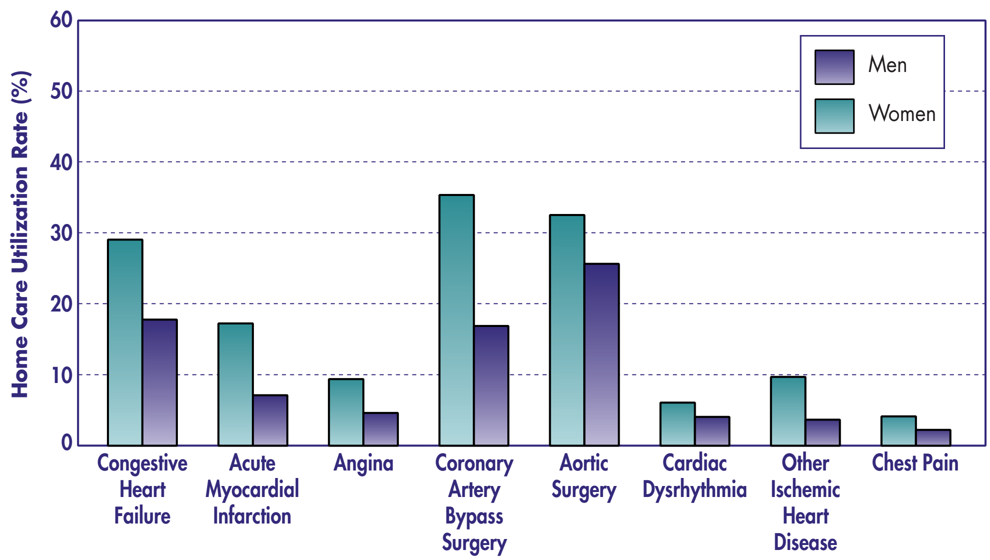
Data Source: Canadian Institute for Health Information, Ontario Home Care Administration System

EXHIBIT 17.5: Age/Sex-specific Post-acute Home Care Utilization Rates for Cardiac Procedures and Diagnoses in Ontario, 1994/95 - 1996/97

0-44 Years of Age



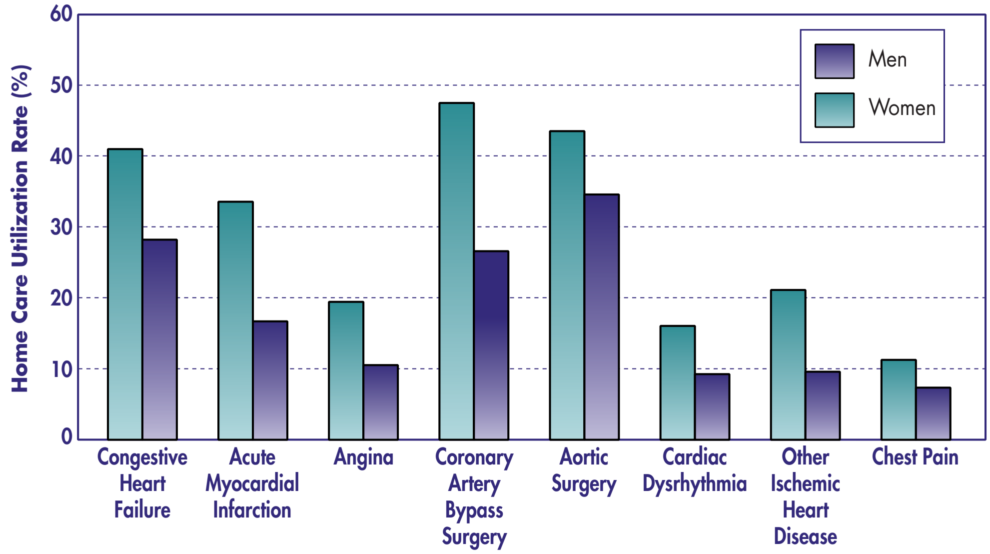
45-64 Years of Age



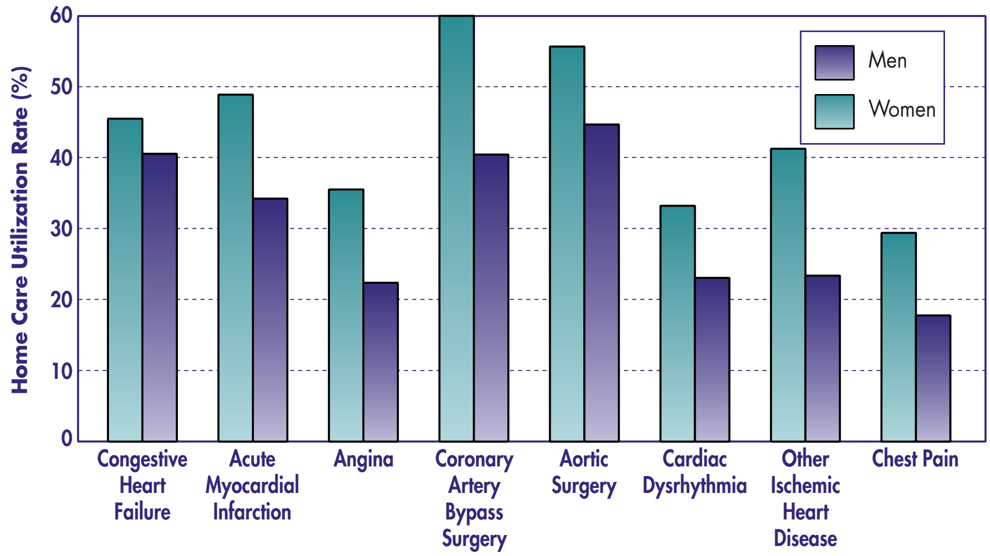
Data Source: Canadian Institute for Health Information, Ontario Home Care Administration System

The home care utilization rates for women are consistently higher than those for men across various diagnoses but the gap narrows among older patients (see Exhibit 17.5). Home care utilization rates tend to increase with age across various diagnoses. Nonetheless, the diagnosis remains a powerful determinant of the probability of receipt of home care. For example, patients 44 years or younger who were discharged with CHF, CABG or aortic and peripheral vascular surgery were more likely to receive home care than patients 75 or over who were discharged with angina, other forms of chronic IHD, or cardiac dysrhythmias.

65-74 Years of Age



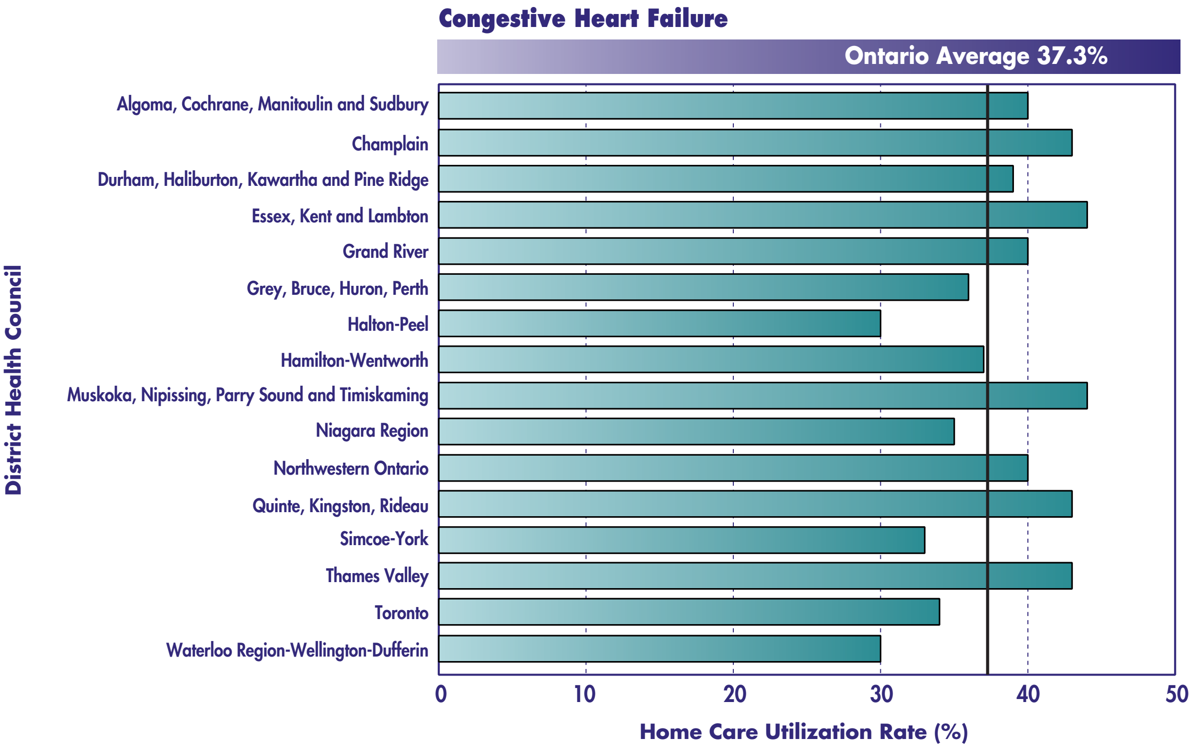
75+ Years of Age



Data Source: Canadian Institute for Health Information, Ontario Home Care Administration System

Exhibit 17.6 and Exhibit 17.7 show the overall home care utilization rate following an acute cardiac admission by DHC, along with a breakdown by procedures/diagnoses with the most home care recipients. DHCs that tended to be significantly above the provincial average for one cardiac procedure/diagnosis tended to be significantly above the provincial average on most of the diagnoses examined. For example, Quinte's post-acute age- and sex-adjusted home care utilization rate for CABG patients was 66% compared to the provincial average of 27%. For AMI patients, Quinte's rate was 29% versus a provincial average of

EXHIBIT 17.6: Age/Sex-adjusted Home Care Utilization Rates Following an Acute Cardiac Admission: Comparison by District Health Council and Cardiac Diagnosis in Ontario, 1994/95 - 1996/97



Data Source: Canadian Institute for Health Information, Ontario Home Care Administration System

22%. For CHF the corresponding rates were 43% and 37%, and for angina, 21% versus a provincial average of 15%. Conversely, DHCs that appear to be significantly below the provincial average for one cardiac diagnosis tended to be significantly below the provincial average on most of the procedures/diagnoses examined. For example, Simcoe's post-acute home care utilization rates for CABG, AMI, CHF and angina are consistently below the provincial average.

There was one DHC that did not fit this pattern. Champlain had a lower-than-average home care rate for CABG patients and higher-than-average home care rate for CHF, angina, cardiac dysrhythmias and other forms of chronic IHD.

EXHIBIT 17.6i: Age/Sex-adjusted Home Care Utilization Rates Following an Acute Cardiac Admission: Comparison by District Health Council and Cardiac Diagnosis in Ontario, 1994/95 - 1996/97

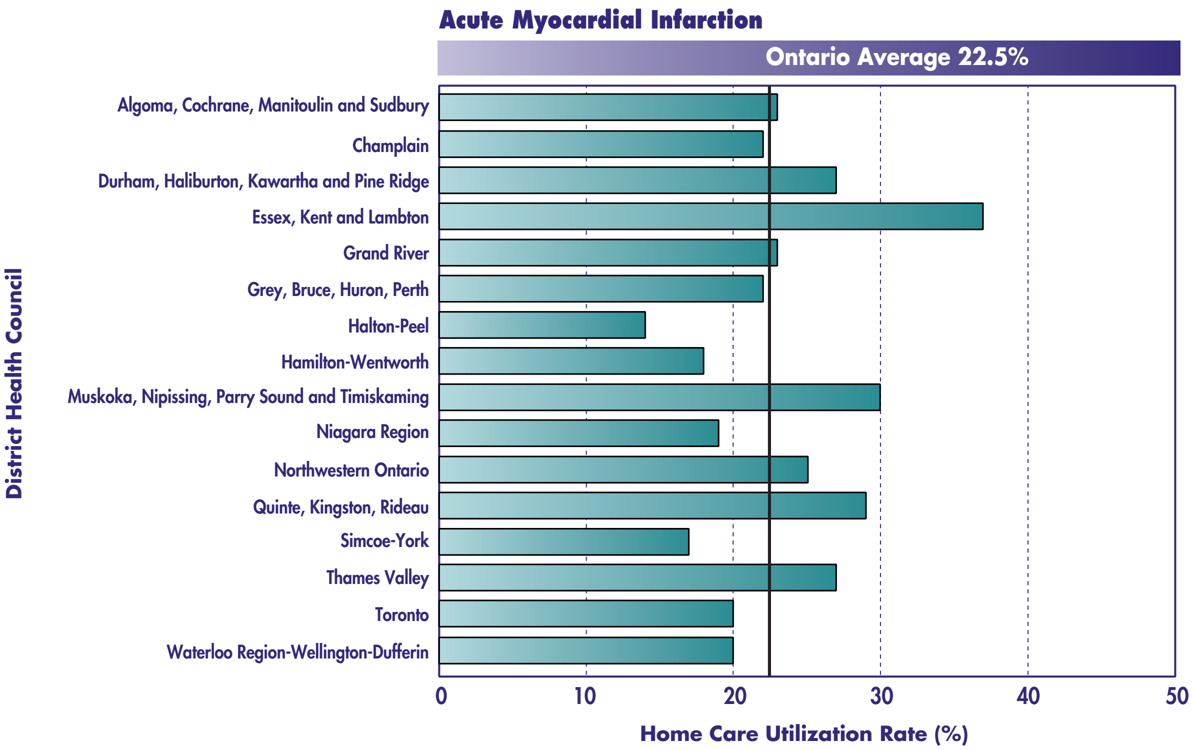
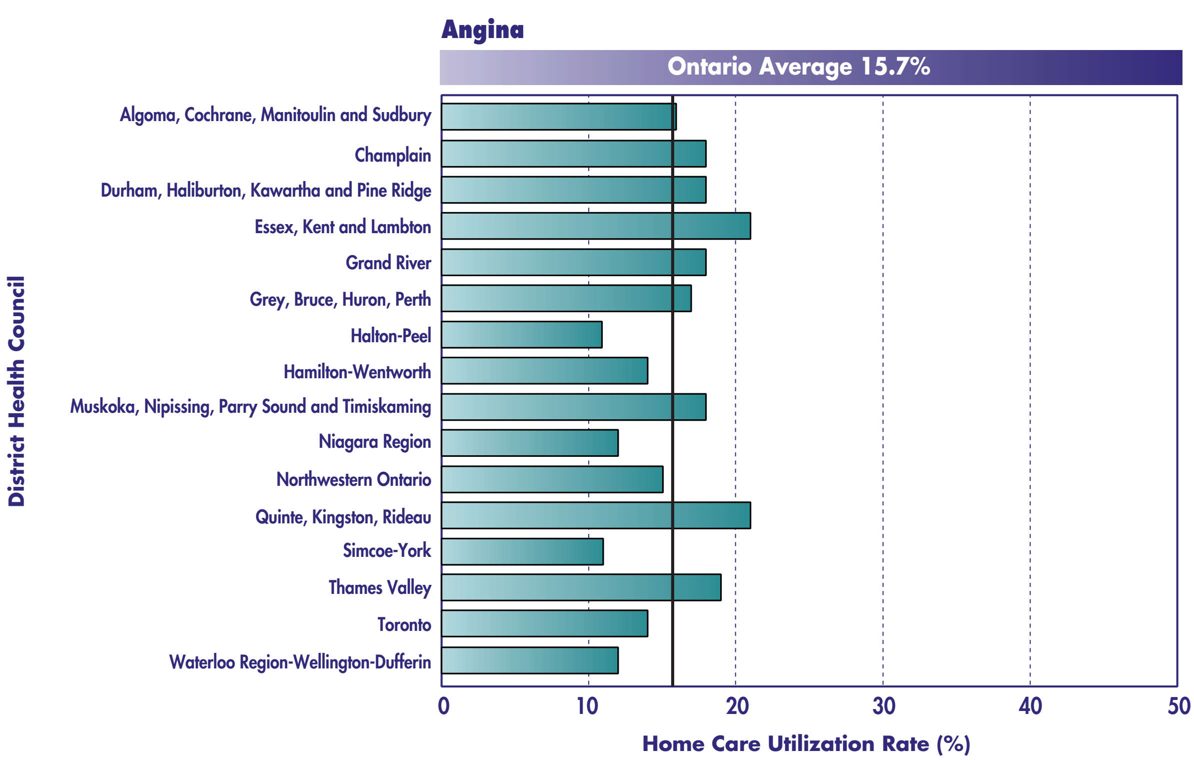


EXHIBIT 17.6ii:



Data Source: Canadian Institute for Health Information, Ontario Home Care Administration System

EXHIBIT 17.6iii: Age/Sex-adjusted Home Care Utilization Rates Following an Acute Cardiac Admission: Comparison by District Health Council and Cardiac Diagnosis in Ontario, 1994/95 - 1996/97

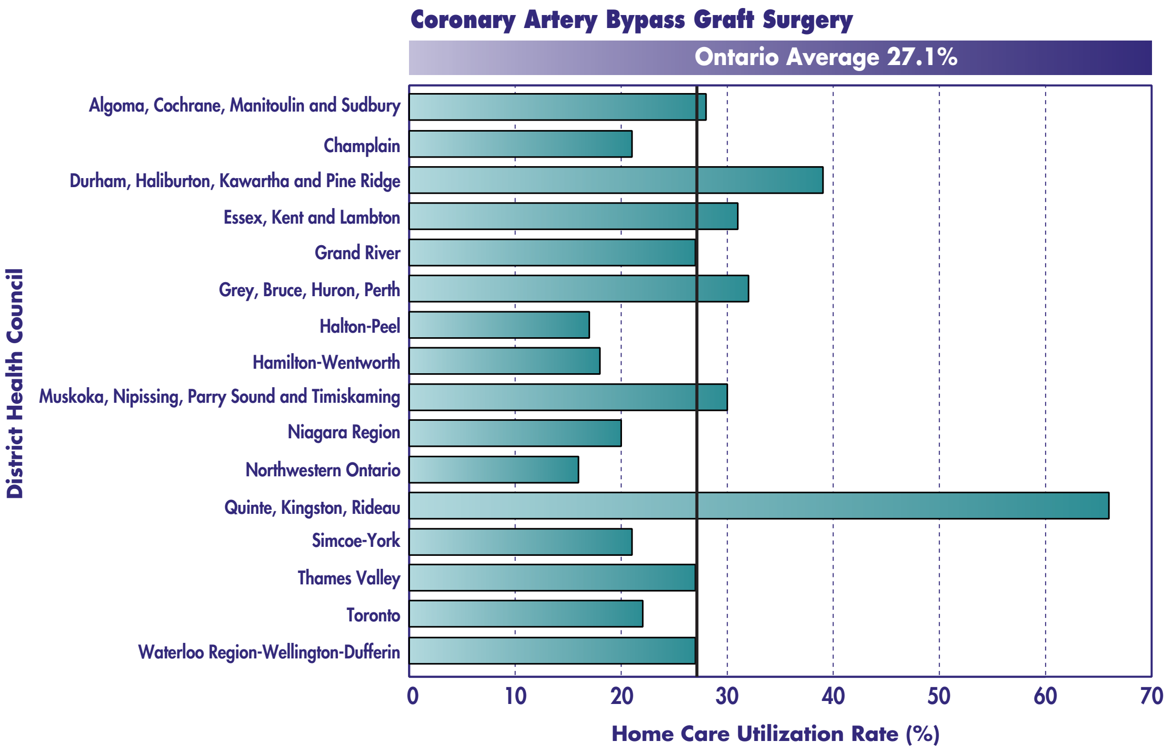
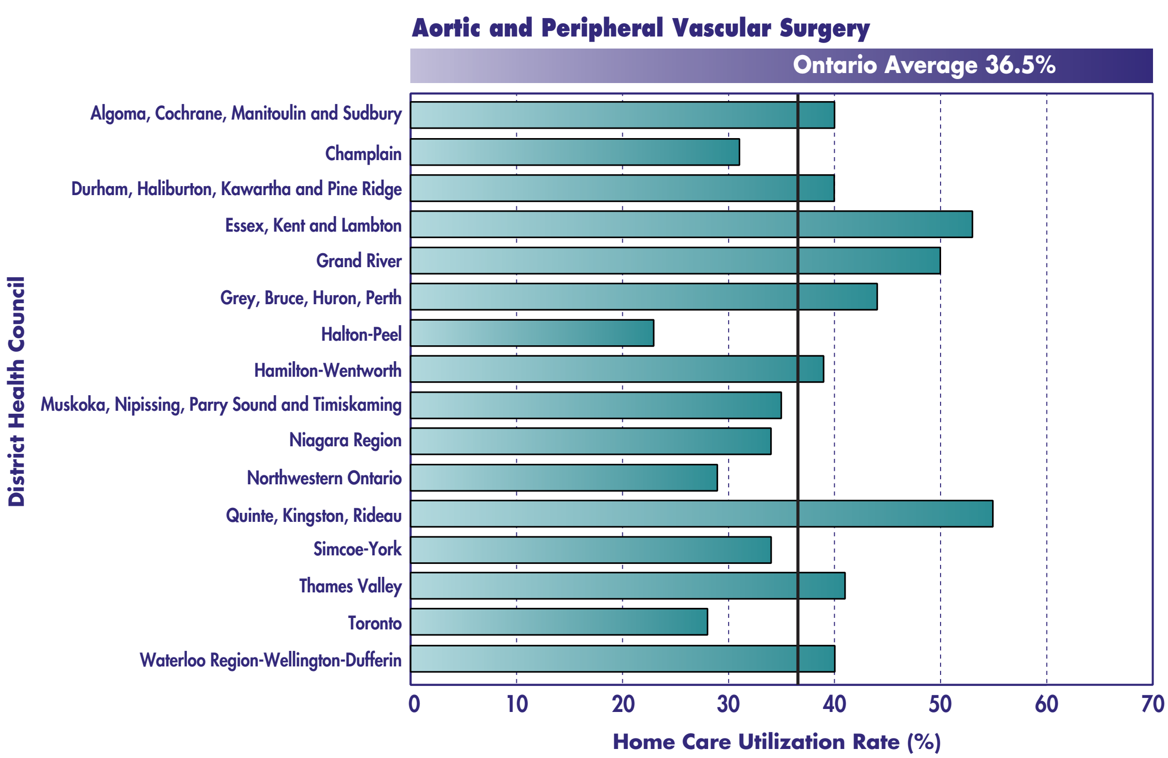


EXHIBIT 17.6iv:



Data Source: Canadian Institute for Health Information,Ontario Home Care Administration System

EXHIBIT 17.6v: Age/Sex-adjusted Home Care Utilization Rates Following an Acute Cardiac Admission: Comparison by District Health Council and Cardiac Diagnosis in Ontario, 1994/95 - 1996/97

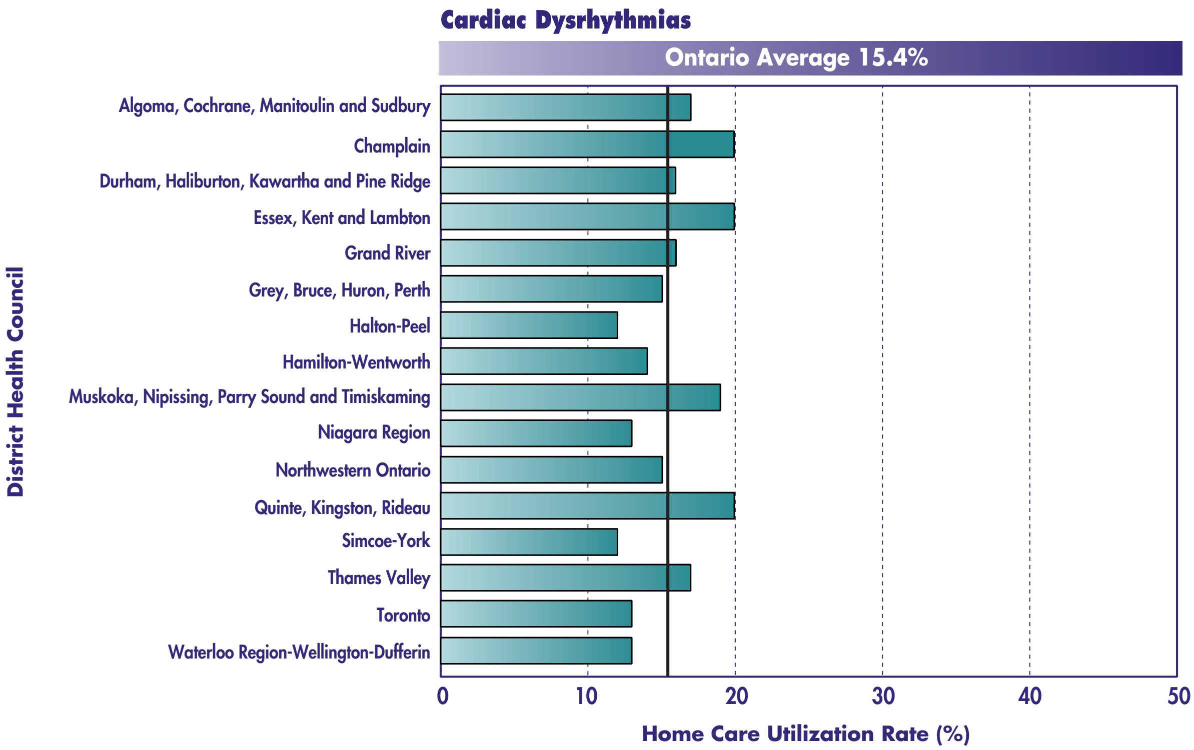
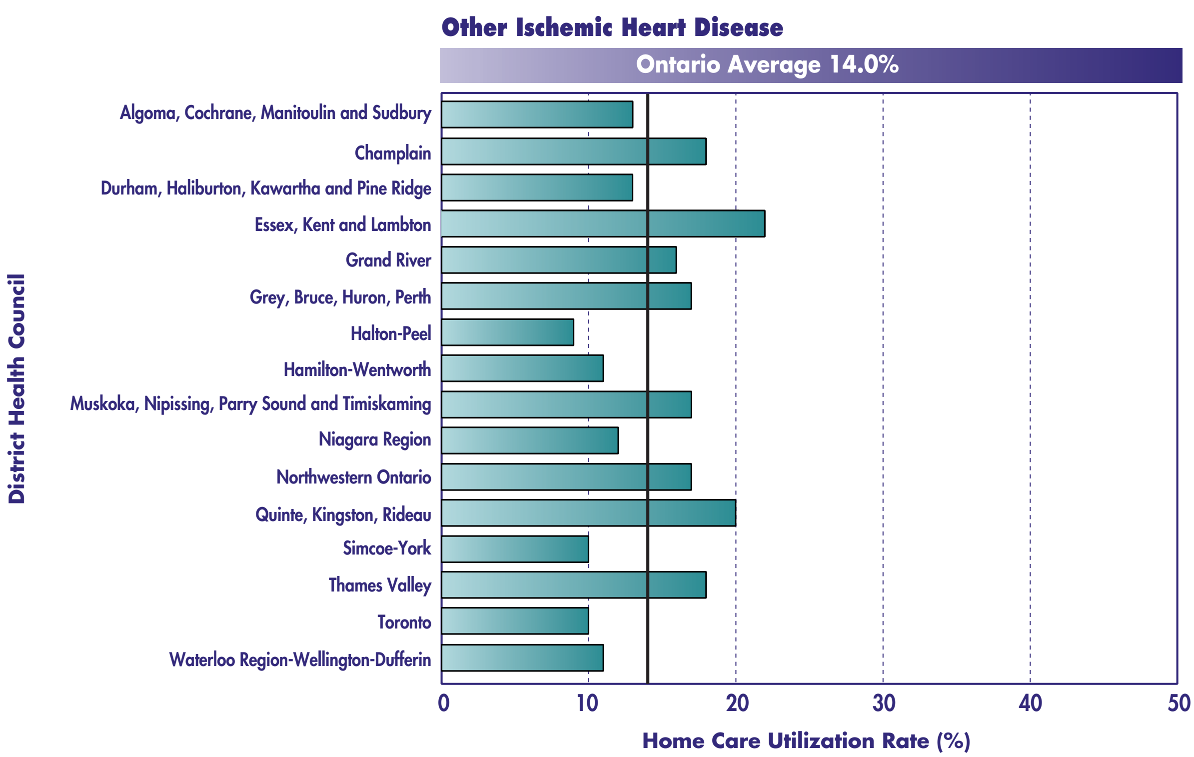
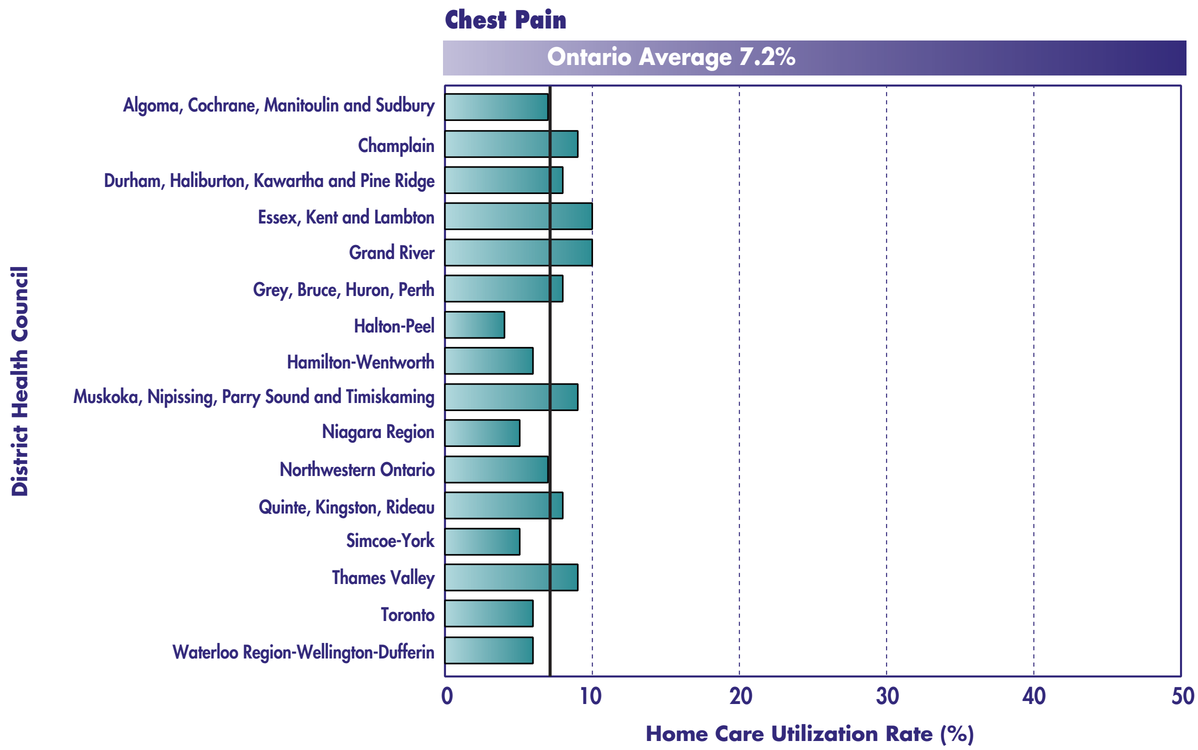


EXHIBIT 17.6vi:



Data Source: Canadian Institute for Health Information, Ontario Home Care Administration System

EXHIBIT 17.6vii: Age/Sex-adjusted Home Care Utilization Rates Following an Acute Cardiac Admission: Comparison by District Health Council and Cardiac Diagnosis in Ontario, 1994/95 - 1996/97



Data Source: Canadian Institute for Health Information, Ontario Home Care Administration System

EXHIBIT 17.7 Summary of Home Care Utilization Rates Following an Acute Cardiac Admission by District Health Councils in Ontario, 1994/95 - 1996/97

District Health Council	Congestive Heart Failure	Acute Myocardial Infarction	Angina	Coronary Artery Bypass Graft	Aortic and Peripheral Vascular Surgery	Dysrhythmias	Other Ischemic Heart Disease
Algoma, Cochrane, Manitoulin and Sudbury	--	--	--	--	--	--	--
Champlain	●	--	●	○	--	●	●
Durham, Haliburton, Kawartha and Pine Ridge	--	●	--	●	--	--	--
Essex, Kent and Lambton	●	●	●	--	●	●	●
Grand River	--	--	--	--	●	--	--
Grey, Bruce, Huron, Perth	--	--	--	--	--	--	--
Halton-Peel	○	○	○	○	○	○	○
Hamilton-Wentworth	--	○	--	○	--	--	--
Muskoka, Nipissing, Parry Sound and Timiskaming	●	●	--	--	--	--	--
Niagara Region	--	--	○	○	--	--	--
Northwestern Ontario	--	--	--	○	--	--	--
Quinte, Kingston, Rideau	●	●	●	●	●	●	●
Simcoe-York	○	○	○	○	--	○	○
Thames Valley	●	●	●	--	--	--	●
Toronto	○	○	○	○	○	○	○
Waterloo Region-Wellington-Dufferin	○	--	○	--	--	--	--

-- Not significantly different from provincial age- and sex-adjusted rate
● Significantly higher than provincial age- and sex-adjusted rate
○ Significantly lower than provincial age- and sex-adjusted rate

Data Source: Canadian Institute for Health Information, Ontario Home Care Administration System

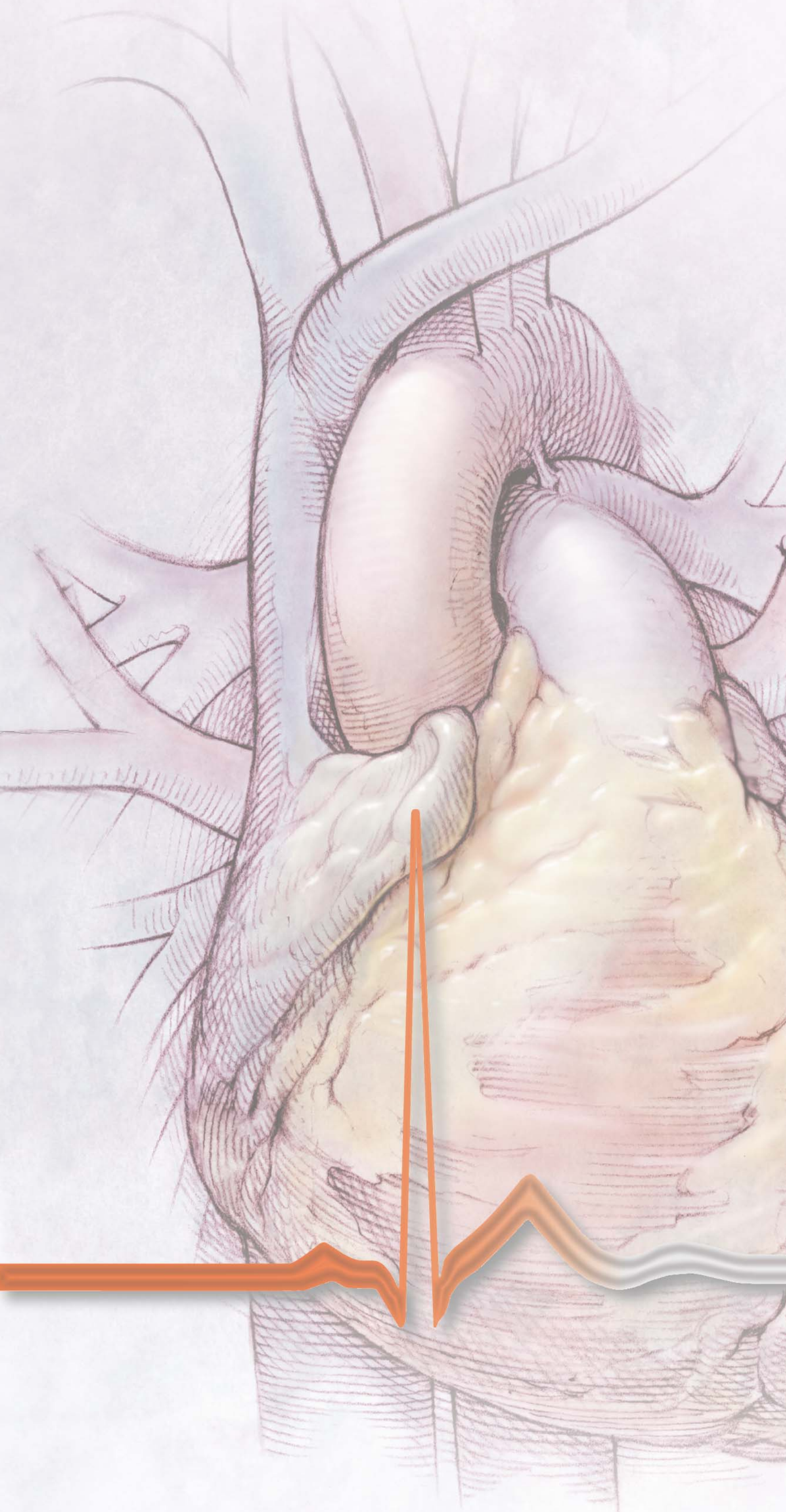
Conclusions

Our results illustrate the substantial and growing use of home care services by patients with cardiovascular disease in Ontario. We expect that these utilization rates will continue to rise. For example, the number of patients with CHF will clearly increase as our population ages and as cardiac patients live longer with their disease,[14] and more than one-third of admissions for this condition will lead to referrals for home care services. Executive Directors of many CCACs have recently expressed concerns about their ability to deliver current levels of service within existing budgets. Careful monitoring and reinvestments may be needed to ensure that adequate post-acute home care services are available in future.

We also found considerable variation in the post-acute home care utilization rates. These variations, when unrelated to the prevalence of disease or patient preferences, raise concerns about differences in access to health care or inappropriate use of services with resultant waste of scarce resources. DHCs that tended to be significantly above the provincial average for surgical cases tended to be significantly above the provincial average for medical cases. This finding argues against the simplistic view that variations in post-acute home care use are related primarily to individual physician practice styles. The finding is instead consistent with the hypothesis that there are variations in both the level of availability of home care and clinical cultures that promote access to home care services for patients discharged from hospital. With the data available we cannot determine if the observed variation is also related to patient preferences and perceptions. It is likely, however, that these variations could be mitigated by the development and implementation of clinical guidelines covering the continuum of care from hospital to home and back again. The rationalization of post-acute home care by these and other measures is urgently needed if Ontarians are to enjoy the greatest possible return on their growing investment in community-based services.

Women and Heart Disease

Anne Y. Shin, Susan Jaglal, Pamela Slaughter, Karey Iron



CHAPTER 18

KEY MESSAGES

- *Large sex differences persist.*

- *Some of the differences can be explained clinically, such as lower hospitalization rates for heart disease in middle-aged women compared to men, because of lower rates of heart disease among women of that age group. Others are harder to explain, such as much lower rates of angiography for women who have had a heart attack compared to men.*

- *Some of the differences are narrowing over time, such as the use of non-invasive diagnostic tests for women, but others persist, such as bypass surgery after a heart attack.*

Key Terms & Concepts:

- gender differences
- risk factors
- access
- outcomes
- mortality rates
- secondary prevention

Background

Extensive evaluation of gender differences for most phases of cardiac care has been undertaken in Canada, the United States and Britain.[1-8] This research has confirmed that the evaluation and treatment of coronary artery disease by physicians is different for women and men.[3] While some differences are anticipated because of the epidemiology of the disease, the available evidence suggests that women with angina are sometimes evaluated incompletely, perhaps because of assumptions that chest pain is due to non-cardiac causes. Studies have shown that women with suspected ischemic heart disease (IHD) also underwent fewer non-invasive and invasive diagnostic tests, while those with proven disease had fewer interventional procedures such as percutaneous transluminal coronary angioplasty (PTCA) and coronary artery bypass graft surgery (CABG). Women also suffer more short-term morbidity and mortality as a consequence of acute myocardial infarction (AMI). Detailed studies based in single centres have provided some reassurance that sex differences in diagnostic tests and treatments may be defensible,[1,9] and have called into question the extent to which outcome differences reflect remediable deficiencies in processes of care. However, serious questions persist about potential gender bias in the treatment of ischemic heart disease.

We have accordingly drawn together some of the findings of this Atlas as they relate to sex differences in disease prevalence, risk factors, access to physicians and diagnostic testing, hospital utilization, access to treatment modalities (PTCA and CABG) and home care, secondary prevention (specifically pharmacological therapies), and outcomes after hospitalization for AMI and congestive heart failure (CHF). We have also attempted to relate these findings to other research on sex differences in IHD.

Data Sources

This chapter summarizes and cross-tabulates findings from earlier chapters in this Atlas.

How We Did the Analysis

Please consult the earlier chapters for information on how each analysis was performed. Pertinent details can also be found in the Methods Appendix.

Interpretive Cautions

Because we relied on administrative data for many of the findings presented, we lack detailed information to compare the clinical conditions of men and women. Moreover, we do not have information about the knowledge, attitudes and beliefs of the physicians or patients involved in the tens of thousands of clinical encounters reflected by our data. Thus, we cannot definitively state whether the sex differences described here are truly due to biases of one sort or another. On the other hand, some of the sex differences described here are inexplicable and suggest systematic inequities that require further appraisal.

Findings and Discussion

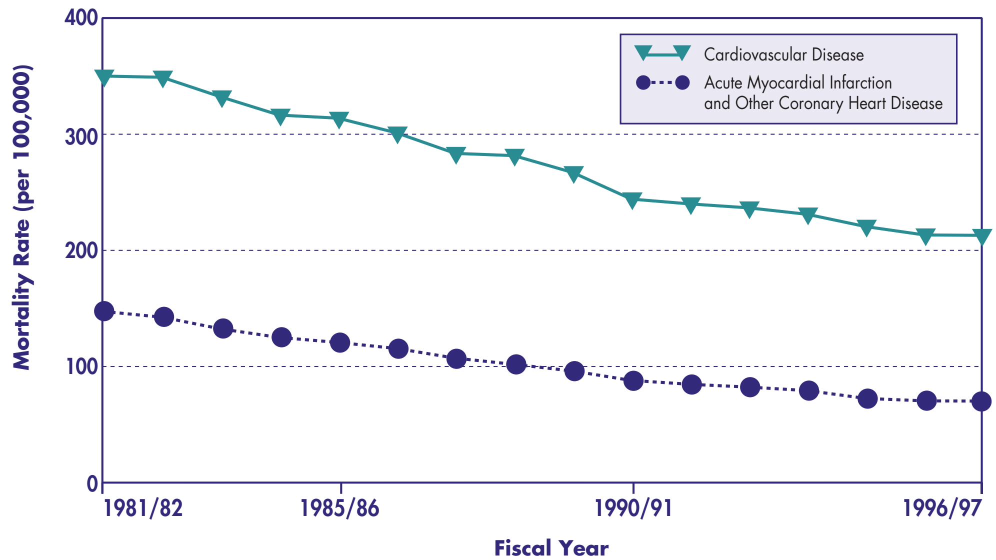
Prevalence

As Chapter 1 indicated, cardiovascular disease is the leading single cause of morbidity and mortality in Ontario. Historically, IHD was held to be more of a "male" disease because its prevalence is roughly fourfold higher, while the mortality rate is almost twice as high for men than for women in all age groups except among the elderly. However, cardiovascular disease is the overall leading cause of death in women. Research suggests that normal estrogen levels in premenopausal women confer a protective benefit against the development of ischemic heart disease, but in the decades following menopause, heart disease death rates in women and men are essentially the same. With the aging of the population and general extension of life expectancies, it is perhaps time to recognize that the prevalence of IHD in men and women is actually more similar than different. IHD is merely deferred by a decade or so in women, and older age then compounds the impact of the disease.

From a population-wide perspective, the good news is that cardiovascular mortality has been declining steadily since the mid-1960s. The 1992 death rates are almost half those of 1969 and this decline applies to all major categories of cardiac diseases for both sexes[10,11] (Exhibit 18.1). However, population projections prepared by the provincial government suggest that the number of all-cause cardiovascular deaths would almost double (an increase of 90%) by the year 2018, due to population growth and aging. Assuming the slow decline in age- and sex-specific mortality rates continues, the impact of the population aging may be blunted somewhat (Exhibit 18.2).

Gender effects on mortality rates from cardiovascular disease differ by age. Cardiovascular disease accounts for approximately the same number of deaths in both women and men but affects men earlier in life. As illustrated in

EXHIBIT 18.1: Age/Sex-adjusted Cardiovascular Mortality Rates per 100,000 Population in Ontario, 1981/82 - 1996/97



Data Source: Statistics Canada

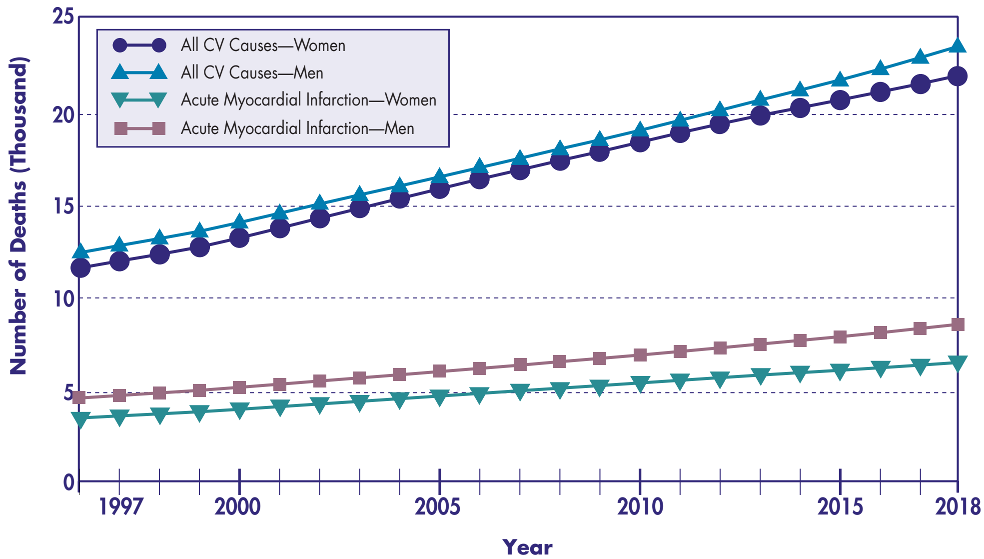
Exhibit 18.3, at middle-age, the mortality rate is threefold higher in men, twofold higher in those age 65 to 74, approaches 1:1 in those in their late 70s and is greater than 3:2 when comparing women to men aged 80 years and over.

Risk Factors

The risk factors for IHD in women are similar to those of men—diabetes, hypertension, dyslipidemia, family history and modifiable risk factors such as smoking, high fat diet, obesity and sedentary lifestyle—but the magnitude of the effects may differ. Some cardiovascular risk factors have more important ramifications for women. Chapter 4 analyzed survey data to elucidate the prevalence of risk factors for IHD. As Exhibit 18.4 confirms, high blood pressure is more common in women than in men over age 65. High blood pressure raises the risk of IHD by three and one-half times for women. People in lower-income households and with lower levels of education also reported high blood pressure more often.

Diabetes mellitus negates the premenopausal protective effect in women on the risk of developing cardiac disease.[12] The prevalence of diabetes in the population is estimated at approximately 5%, with some regional variation.[13] In the Ontario Health Survey (OHS) data, self-report of diabetes shows that the disease affects 7% of women age 65 and over. Women with diabetes have the same rates of IHD as men without, and thus diabetes is a strong risk factor for IHD. This occurs even among diabetic women who use hormone replacement therapy. The distribution of diabetes by socioeconomic status indicators was similar to that of high blood pressure.

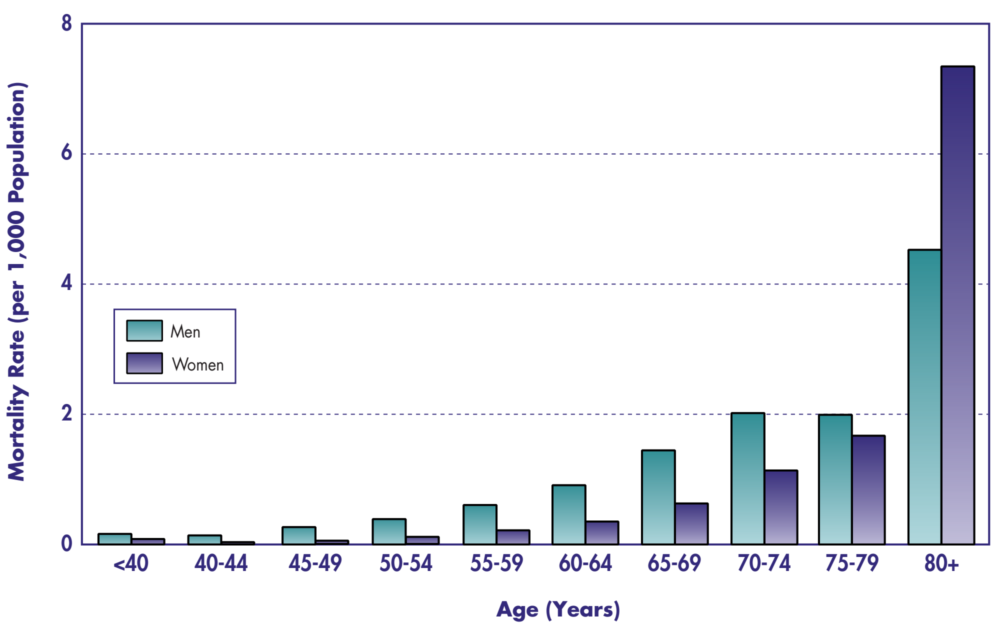
EXHIBIT 18.2: Projected Number of Deaths from All Cause Cardiovascular Disease and Acute Myocardial Infarction Only in Ontario, 1997 to 2018*



***Note: Projected deaths based on assumption that age-sex mortality remains constant from 1996 onwards.**

Data Source: Office of the Registrar General, Ministry of Consumer and Commerical Relations, Annual Report, 1997, Ontario Ministry of Finance, and County Population Projections, April 1995

EXHIBIT 18.3: Age/Sex-specific Cardiovascular Disease Mortality Rates per 1,000 Population in Ontario, 1996



Data Source: Ministry of Consumer and Commercial Relations, 1997

EXHIBIT 18.4 Age/Sex-specific Prevalence of Ischemic Heart Disease Risk Factors and Self-reported Prevalence of Heart Disease for Population Aged 20 Years and Over in Ontario, 1990

MEN

	AGE					
Risk Factor	**20-34**	**35-49**	**50-64**	**65-74**	**75+**	**Total**
"Do You Have High Blood Pressure?"* (% yes)	2	6	18	25	22	10
"Do You Have Diabetes?"* (% yes)	<1	2	5	10	9	3
Daily Smoker (%)	33	30	26	17	12	29
Low Physical Activity (% inactive)	59	69	76	71	77	67
Body Mass Index (% >27)**	24	35	39	30	22	31
More Than 30% of Total Calories From Fat (%)	92	90	88	88	80	90
Any 3 or More of Above Risk Factors*** (%)	29	38	42	35	25	35
"Do You Have Heart Disease?"* (% yes)	<1	2	9	18	22	5

WOMEN

	AGE					
Risk Factor	**20-34**	**35-49**	**50-64**	**65-74**	**75+**	**Total**
"Do You Have High Blood Pressure?"* (% yes)	2	5	18	32	33	11
"Do You Have Diabetes?"* (% yes)	<1	1	4	7	7	3
Daily Smoker (%)	29	28	21	16	9	25
Low Physical Activity (% inactive)	73	81	81	84	89	79
Body Mass Index (% >27)**	15	24	32	28	21	23
More Than 30% of Total Calories From Fat (%)	86	86	81	79	78	84
Any 3 or More of Above Risk Factors*** (%)	25	32	33	32	27	30
"Do You Have Heart Disease?"* (% yes)	<1	2	5	13	15	4

* Response provided by one knowledgeable adult per household and so information may have been provided by proxy.

** It is often recommended that body mass index not be used for adults over 65 years of age.

*** Calculated as the percentage of people with information for each of the described risk factors with any three or more of the other risk factors; approximately 30% of survey respondents were missing information for at least one of these risk factors.

Data Source: Ontario Health Survey, 1990

Women with markedly elevated cholesterol may have double the risk of other women of the same age. Just as with men, the risk doubles again in female smokers, and doubles yet again to eight times the risk of other women among women with hypertension. The prevalence of a high intake of dietary fat (greater than 30% of total calories) was higher for men than women in the OHS. About 90% of men compared to 84% of women ate a high fat diet. This declined slightly with older age and was somewhat more common among rural respondents. A diet with more than 30% calories from fat was significantly correlated with adjusted mortality rates for all cardiovascular causes and for IHD (see Chapter 4 Methods Appendix).

More than three-quarters of women (79%) surveyed in the OHS were physically inactive and the proportion increased with age. Individuals with a lower household income and lower levels of education were also more likely to be physically inactive.

Women were less likely than men to be obese (23% versus 31% prevalence of body mass index ≥27). This is based on self-report, and may be slightly biased by sex differences in reporting height and weight. For obese women, the prevalence peaked around 50 to 64 years of age. Obesity was also related to low household income status and lower education levels and was more common among rural respondents. The adjusted rates of high body mass index (BMI) and high fat diet were significantly correlated with adjusted mortality rates for all cardiovascular causes and for IHD.

Despite the higher overall prevalence of smoking among men, we noted no sex differences in smoking among youth and young adults. This is of concern, and will have a significant impact on the rate of IHD among women in the next few decades. Older women were more likely to have never smoked (reflecting historical patterns), but an association was found between indicators of lower socioeconomic status and smoking. Smoking as a single risk factor was also significantly correlated with reported rates of heart disease and remains the single most important and modifiable risk factor for IHD.

Lower socioeconomic status is associated with a greater burden of IHD and its risk factors. The OHS showed a higher prevalence of several risk factors among both women and men of lower education and income, including smoking, high blood pressure, high fat diet, diabetes, inactivity and obesity. This is illustrated in Exhibit 18.5.

Thirty per cent of women reported at least three heart disease risk factors in the OHS. This percentage appeared to peak in the middle (50 to 64) years. Rural respondents, those in a low-income household and people with fewer years of completed education were more likely to report three or more risk factors.

EXHIBIT 18.5 Prevalence of Selected Ischemic Heart Disease Risk Factors and Self-reported Prevalence of Heart Disease by Socioeconomic Status for Population Aged 20 Years and Over in Ontario, 1990

	Household Income Status†		Highest Level of Education Attained		
	Low	Adequate	Less Than Secondary	Completed Secondary	Some or Completed Post-secondary
"Do You Have High Blood Pressure?"* (% yes)	17	9	16	9	7
"Do You Have Diabetes?"* (% yes)	6	2	5	2	2
Daily Smoker (%)	32	26	33	29	20
Low Physical Activity (% inactive)	79	72	81	72	68
Body Mass Index (% >27)**	30	26	34	26	22
More Than 30% of Total Calories From Fat (%)	84	87	87	88	86
Any 3 or More of Above Risk Factors*** (%)	36	32	39	34	26
"Do You Have Heart Disease?"* (% yes)	9	4	7	4	3

* Response provided by one knowledgeable adult per household and so information may have been provided by proxy.

** It is often recommended that body mass index not be used for adults over 65 years of age. They are included here for comparison purposes.

*** Calculated as the percentage of people with information for each of the described risk factors with any three or more of the other risk factors; approximately 30% of survey respondents were missing information for at least one of these risk factors.

† Statistics Canada derived variable (see Methods Appendix).

Data Source: Ontario Health Survey, 1990

Cardiovascular Disease-Related Hospital Admissions

Markedly more men than women were hospitalized for an AMI (311 men versus 172 women per 100,000) and for angina (307 men versus 231 women per 100,000) and less so for chest pain (183 men versus 159 women per 100,000) and CHF (296 men versus 279 women per 100,000) during fiscal 1992/93 to 1996/97, according to the discussion on hospitalization for cardiovascular diseases in Chapter 2 (see Exhibit 18.6 for data from the most recent years). As expected, the rates all increased with age for both sexes. Although the overall hospitalization rates for the above conditions remained constant (AMI and angina/chest pain) or decreased (CHF) over the study period, a trend to increased hospitalizations for women compared to men was clear (Exhibit 18.7). This pattern is consistent with relative increases in rates of cardiac disease in women reported elsewhere.[14-16]

Chapter 2 also revealed that income was a factor that influenced hospitalization, more so for men than for women (Exhibit 18.8). This was mainly because the influence of income was more striking at younger ages, and IHD affected younger men far more often than younger women. Women in rural areas have higher age-adjusted hospitalization rates than those in urban areas for all studied diagnoses.

EXHIBIT 18.6 Age/Sex-specific Hospitalization Rates for Selected Cardiac Diagnoses per 100,000 Population Aged 20 Years and Over in Ontario, 1992/93 - 1996/97

Fiscal Year	Total	Men (Age) 20-49	Men 50-64	Men 65-74	Men 75+	Men Total	Women (Age) 20-49	Women 50-64	Women 65-74	Women 75+	Women Total
Acute Myocardial Infarction											
1995/96	234	66	512	939	1,498	302	14	163	497	987	170
1996/97	241	62	517	986	1,585	309	13	162	523	1,046	176
Congestive Heart Failure											
1995/96	280	12	247	1,008	2,693	281	7	143	617	2,290	278
1996/97	277	13	235	1,033	2,726	283	8	134	608	2,220	271
Angina											
1995/96	264	57	552	996	1,297	299	23	302	700	1,091	230
1996/97	277	59	577	1,065	1,363	315	25	316	742	1,113	241
Chest Pain											
1995/96	171	96	333	377	340	179	60	302	377	368	162
1996/97	163	88	329	354	338	171	57	289	363	354	155
Angina and Chest Pain											
1995/96	435	154	884	1,373	1,637	479	82	604	1,078	1,459	393
1996/97	440	147	905	1,418	1,701	486	82	605	1,105	1,467	396

Data Source: Canadian Institute for Health Information

EXHIBIT 18.7 Age-adjusted Annual Changes in Hospitalization Rates for Selected Cardiac Diagnoses per 100,000 Population Aged 20 Years and Over in Ontario, 1992/93 - 1996/97

Diagnosis	Annual Change (%)	p Trend	Annual Change for Men (%)	p Trend	Annual Change for Women (%)	p Trend	Annual Change for Women - Men (%)	p Trend
Acute Myocardial Infarction	−0.3	0.22	−1.2	0.00	0.6	0.12	1.8	0.00
Congestive Heart Failure	−1.6	0.00	−2.4	0.00	−0.7	0.01	1.7	0.00
Angina	1.4	0.00	0.7	0.02	2.1	0.00	1.4	0.00
Chest Pain	−1.9	0.00	−3.3	0.00	−0.5	0.23	2.8	0.00
Angina and Chest Pain	0.1	0.58	−0.9	0.00	1.1	0.00	2.0	0.00

Data Source: Canadian Institute for Health Information

Non-invasive Ischemic Testing and Access to Physicians

Not only is IHD relatively uncommon in premenopausal women, but it also may present differently in women than in men. Women are more likely than men to get angina pain which is atypical; sometimes the pain may be very vague or not in the chest at all. Men more frequently recognize angina as a premonitory sign of heart attack, while women often diminish or dismiss chest pain.[1] Women tend to undergo fewer tests for heart disease than men, perhaps because the tests may be more difficult to interpret or the results suboptimal.[17,18] Among women, exercise stress tests are less likely to detect disease or to rule out its presence.[19] Chapter 13 of this Atlas showed that, in Ontario, the gender gap in cardiac diagnostic testing seems to be diminishing. The rapid growth in the utilization of these non-invasive tests among female patients may reflect the increased awareness of cardiac disease

EXHIBIT 18.8 Age/Sex-specific Hospitalization Rates for Selected Cardiac Diagnoses per 100,000 Population Aged 20 Years and Over by Residence Area Income Quintile in Ontario, 1992/93 - 1996/97

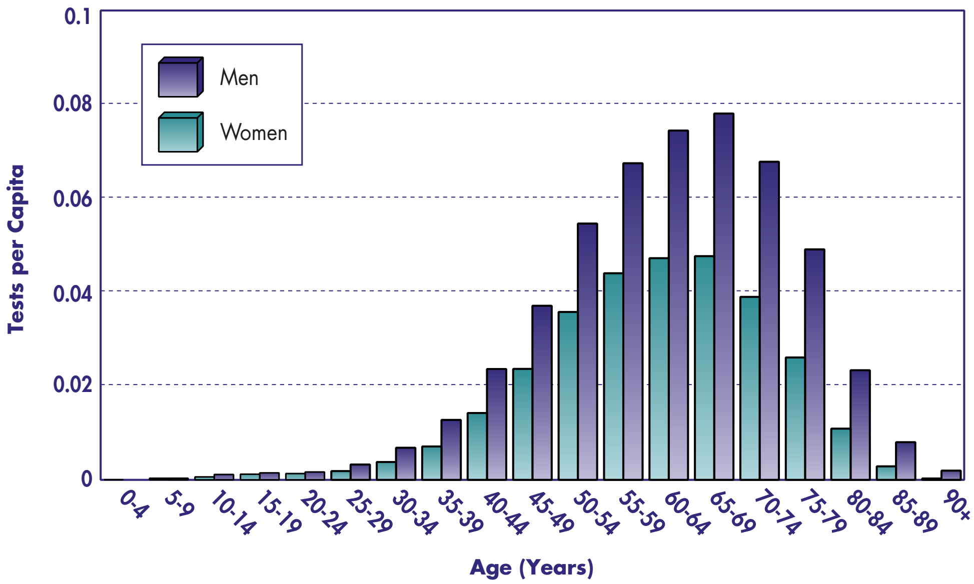
Income Quintile	Overall For Men & Women	Men (Age)					Women (Age)				
		20-49	50-64	65-74	75+	Overall	20-49	50-64	65-74	75+	Overall
Acute Myocardial Infarction											
1 - Low	305	106	753	1,210	1,684	409	25	268	581	1,007	206
2	271	84	609	1,067	1,629	351	20	202	569	1,085	196
3	232	70	522	910	1,488	304	14	163	466	953	164
4	220	54	467	906	1,470	281	10	144	469	1,000	162
5 - High	190	44	405	798	1,360	248	6	107	387	885	135
Overall	**240**	**66**	**528**	**976**	**1,540**	**311**	**13**	**170**	**500**	**994**	**172**
Congestive Heart Failure											
1 - Low	359	24	464	1,476	3,122	394	16	267	815	2,261	325
2	342	19	345	1,215	3,311	354	11	180	751	2,643	330
3	288	16	261	1,078	2,800	298	8	148	628	2,253	278
4	258	10	204	917	2,572	257	6	121	568	2,169	259
5 - High	218	7	153	766	2,314	218	3	74	424	1,962	217
Overall	**287**	**13**	**257**	**1,064**	**2,834**	**296**	**7**	**145**	**636**	**2,271**	**279**
Angina											
1 - Low	366	107	861	1,309	1,455	428	47	496	900	1,154	308
2	314	80	674	1,183	1,520	366	34	362	791	1,174	265
3	261	65	567	974	1,240	303	24	299	687	1,001	222
4	238	48	462	936	1,260	269	16	250	648	1,067	210
5 - High	186	33	379	813	1,003	219	11	169	490	821	155
Overall	**268**	**60**	**558**	**1,042**	**1,318**	**307**	**23**	**303**	**716**	**1,066**	**231**
Chest Pain											
1 - Low	248	163	512	472	423	271	103	445	441	405	226
2	209	133	422	433	408	230	79	352	405	408	190
3	165	99	336	354	320	179	60	278	365	321	153
4	136	75	274	306	299	145	41	235	307	315	127
5 - High	112	53	220	284	276	117	32	197	279	260	106
Overall	**171**	**99**	**341**	**376**	**358**	**183**	**59**	**297**	**370**	**358**	**159**

Data Source: Canadian Institute for Health Information

among women. It is encouraging that the greatest differential growth in utilization was for myocardial perfusion scintigraphy—a test especially useful for women since they often have false positive or false negative exercise stress tests (Exhibits 18.9 and 18.9i display these changes).

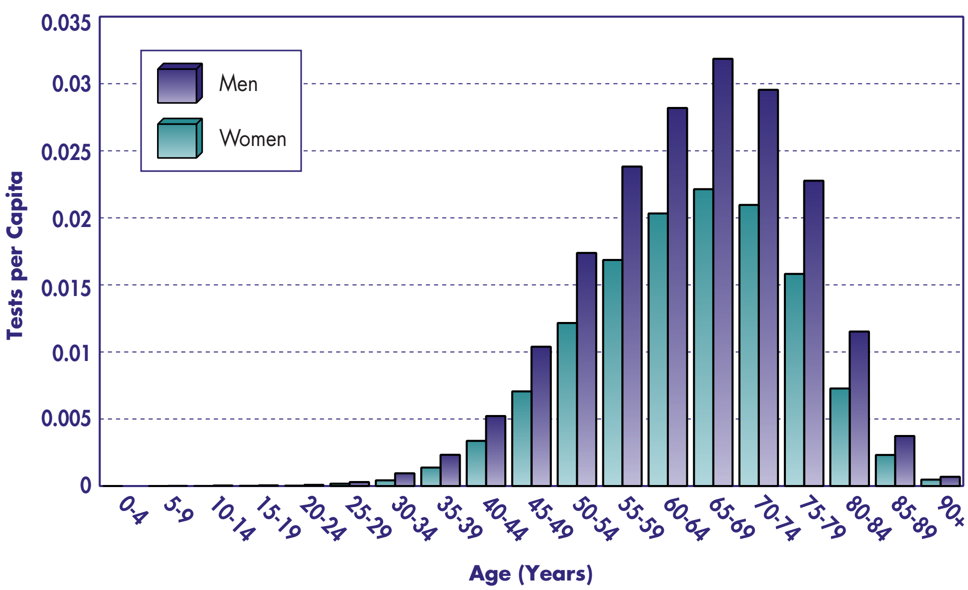
Importantly, among patients hospitalized with an AMI, it appears that one in eight is not seen by a family physician within six months of his or her AMI and one in four will not see a specialist at all. The situation is worse in Northern Ontario where 35% of patients do not see a specialist for follow-up and there is a significant delay for those who do. Further analysis to tease out sex differences in access to specialist care and diagnostic testing is warranted.

EXHIBIT 18.9: Age/Sex-specific Exercise Stress Tests per Capita in Ontario, 1996/97



Data Source: National Physician Database

EXHIBIT 18.9i: Age/Sex-specific Myocardial Perfusion Scintigraphy Tests per Capita in Ontario, 1996/97



Data Source: National Physician Database

Access to Coronary Angiography

Women are much less likely than men to undergo angiography or be referred for revascularization (angioplasty and/or bypass surgery[20,21]) after suffering a heart attack. Angiography appears to be the main barrier to revascularization among women.[3] Overall, women, especially the elderly, have less than two-thirds the rate of angiography than men after AMI. Data presented in Chapter 8 confirm these sex differences in angiography rates. At present, it appears that these sex differences originate not with surgeons' or interventional cardiologists' decisions when women are considered for revascularization, but rather higher in the referral funnel or referral chain (from symptoms to diagnosis) where fewer women are positioned as candidates for angiography than men. Further research to investigate the causes and consequences of these discrepancies is needed.

After a heart attack, the youngest age groups have the highest procedural rates. Women tend to be older at the time of presentation and are more likely to remain on medical treatment. Based on these data, we are unable to determine whether this represents appropriate clinical judgement, or an epiphenomenon of ageism, sexism—or both.

Women wait shorter periods of time for procedures than men: three days less for angiography after AMI, two days less for PTCA after angiography; and ten days less for CABG after angiography (Exhibit 18.10). Based on other studies using more detailed data, this almost certainly reflects more urgent need for these procedures for women compared to men.[22] Once women have had angiography, their access to PTCA or CABG is the same as men.

EXHIBIT 18.10 Age/Sex-specific Cardiac Procedure Rates and Median Post-acute Myocardial Infarction Waiting Time in Ontario, 1994/95 - 1996/97

Rates and Waiting Times	Women (Age)					Men (Age)				
	20 - 49	50 - 64	65 - 74	75+	Overall	20 - 49	50 - 64	65 - 74	75+	Overall
Procedure Rate (%)										
Angiography*	50.7	37.0	25.1	6.0	19.6	52.9	41.1	28.7	9.2	31.5
Angioplasty**	16.0	12.7	7.4	1.8	6.1	18.5	12.0	6.6	1.8	8.9
Bypass Surgery**	8.1	11.3	10.1	1.9	6.4	12.1	15.6	13.4	4.0	11.6
Median Waiting Time (Days)										
Angiography*	22	18	18	17	18	22	23	19	18	21
Angioplasty**	7	5	4	4	5	7	7	6	6	7
Bypass Surgery**	28	25	13	11	15	51	37	19	13	27
Acute Myocardial Infarction	977	3,483	5,810	9,124	19,394	4,797	10,783	9,384	8,135	33,099

* Mean six-month coronary angiography rates

** One-year angioplasty and bypass rates

Note: Waiting time for coronary angiography = Median time from acute myocardial infarction to coronary angiography
Waiting time for angioplasty = Median time from coronary angiography to angioplasty
Waiting time for bypass surgery = Median time from coronary angiography to bypass surgery

Data Source: Canadian Institute for Health Information, Ontario Health Insurance Plan, Registered Persons Database, Ontario Myocardial Infarction Database

Access to Revascularization (Angioplasty and Bypass Surgery)

The overall angioplasty rate and CABG rate in Ontario have increased significantly between fiscal 1994/95 and 1997/98 (Exhibits 18.11 and 18.12). However, major gender gaps persist in utilization of both procedures in the most clinically-relevant age categories (50 to 64, 65 to 74, 75+), despite the fact that the incidence of IHD is similar across the sexes by the age of 65. The rate of angioplasty in men 65 years and over is double that of women. Research has shown that women in this age group tend to have more diffuse coronary disease. This might argue for substitution of CABG for PTCA. However, the rate of CABG in women still lags substantially behind that of men, both between the ages of 65 to 74 and over the age of 75 years.

Despite proportionately lower rates of coronary angiography compared to men, median waiting times for all procedures (angiography, PTCA and CABG) were significantly shorter for symptomatic women suggesting that physicians triaged women in accordance with either a perceived or a real difference in clinical urgency.

Secondary Prevention (Therapeutic Medications) and Home Care

No gender differences were found in the rates of use of medications in the population over the age of 65 who have suffered AMI (aspirin, beta-blockers, ACE inhibitors, statins [cholesterol-lowering drugs] and calcium-channel blockers); after admission to hospital for heart failure (ACE inhibitors and furosemide [water pills]); after angioplasty (aspirin); and after bypass surgery (aspirin and statins)(see Chapter 11).

EXHIBIT 18.11 Overall and Age/Sex-specific Angioplasty Rates per 100,000 Population Aged 20 Years and Over in Ontario, 1994/95 - 1997/98

MEN

	Fiscal year			
Age	**1994/95**	**1995/96**	**1996/97**	**1997/98**
20-34	2	2	2	2
35-49	56	57	58	61
50-64	194	197	226	247
65-74	222	207	243	270
75+	76	94	117	151

WOMEN

	Fiscal year			
Age	**1994/95**	**1995/96**	**1996/97**	**1997/98**
20-34	1	1	1	1
35-49	11	12	12	13
50-64	61	66	71	86
65-74	109	115	118	136
75+	42	45	64	73
Overall Rate Men and Women	55	56	63	71

Data Source: Canadian Institute for Health Information

EXHIBIT 18.12 Overall and Age/Sex-specific Coronary Artery Bypass Graft Surgery Rates per 100,000 Population Aged 20 Years and Over in Ontario, 1991/92 - 1997/98

MEN

	Fiscal Year						
Age	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98
20-34	1	1	1	1	1	1	2
35-49	50	51	48	46	47	47	46
50-64	286	294	292	299	297	310	339
65-74	432	448	468	509	503	537	601
75+	141	154	188	211	226	261	326

WOMEN

	Fiscal Year						
Age	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98
20-34	0	0	1	0	1	1	1
35-49	8	8	7	7	7	9	9
50-64	61	67	61	65	63	69	71
65-74	134	136	139	155	165	192	197
75+	41	45	49	57	69	80	103
Overall Rate Men and Women	74	77	78	82	83	90	99

Data Source: Canadian Institute for Health Information

After being admitted to hospital for cardiac disease, women use more home care, regardless of age. This is shown in Exhibit 18.13. Canadian women are more likely than men to use home care, probably because women outlive men, are more likely to have chronic conditions and are more likely to need help with activities of daily living. The home care utilization rates for women are consistently higher than those for men across various diagnoses but the gap narrows among older patients.

Outcomes and Mortality

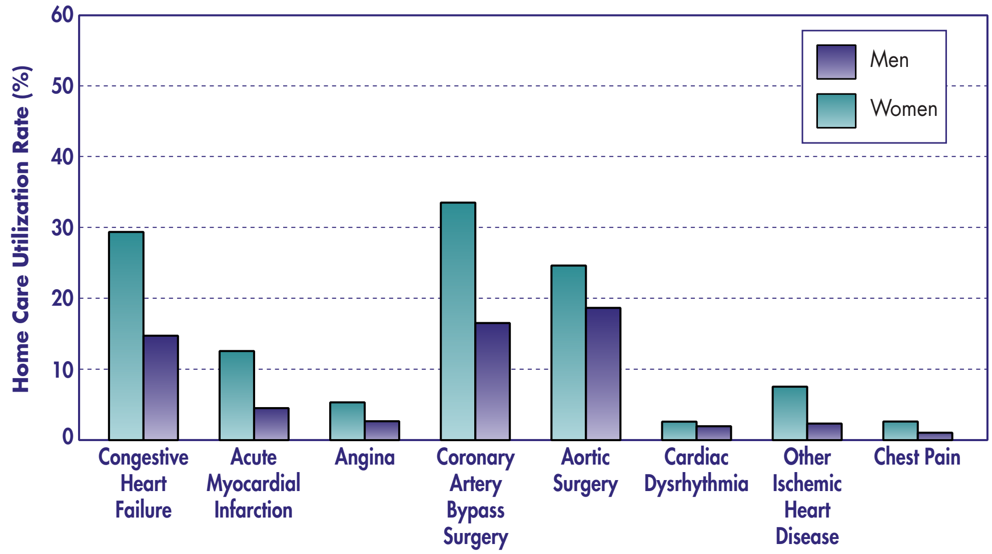
Acute Myocardial Infarction, Congestive Heart Failure and Angina

Chapters 2 and 5 discuss the outcomes of cardiovascular disease in Ontario. The overall 30-day mortality rate after acute myocardial infarction is 14.8% and one-year mortality rate is 23.1% for fiscal years 1994/95 to 1996/97. Age is by far the most important factor influencing survival after an AMI; however, gender is also important.

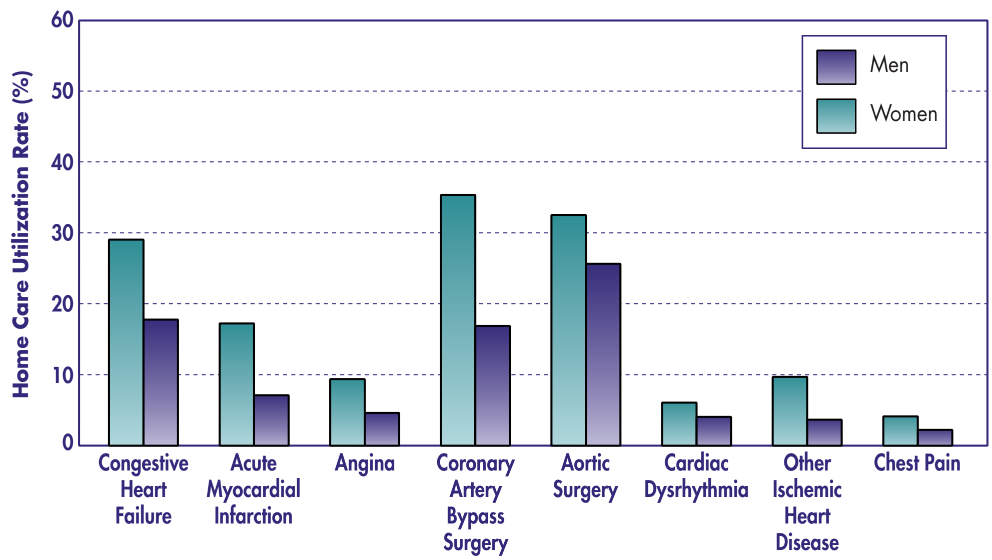
Short-term and long-term mortality rates after an AMI were higher for women than men in Ontario (19% and 30% respectively for women, 12% and 19% for men). This is largely a function of differences in the average age at presentation. Survival differences are summarized in Exhibit 18.14.

EXHIBIT 18.13: Age/Sex-specific Post-acute Home Care Utilization Rates for Cardiac Procedures and Diagnoses in Ontario, 1994/95 - 1996/97

0-44 Years of Age



45-64 Years of Age

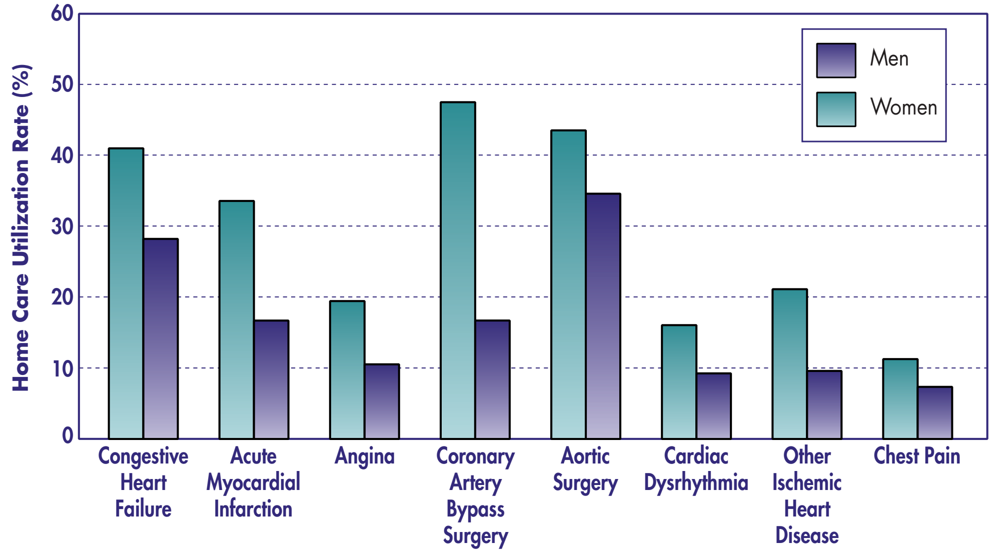


Data Source: Canadian Institute for Health Information, Ontario Home Care Administration System

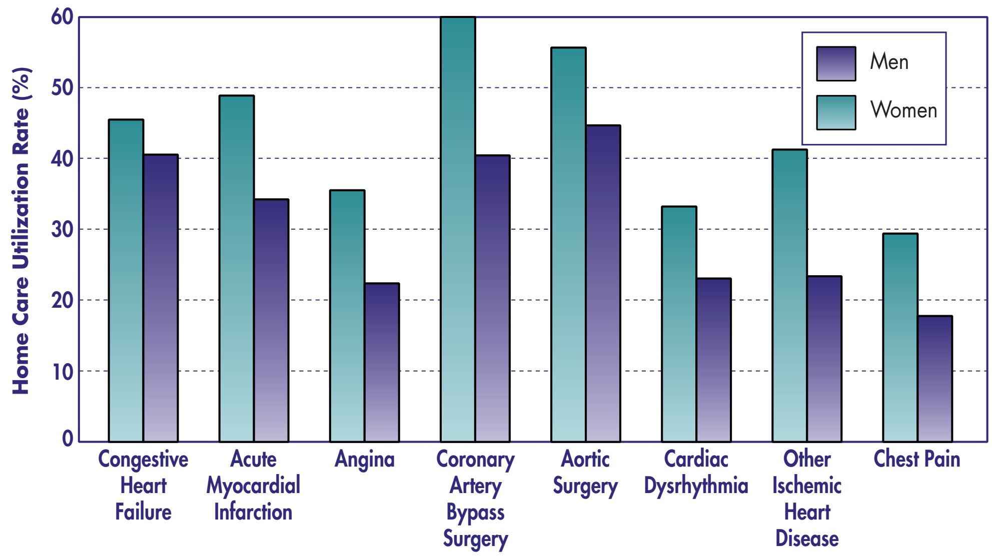
Nine per cent of AMI survivors were readmitted within one year of the index hospitalization with a second AMI, 12% were readmitted with angina, and almost 9% readmitted with CHF. The readmission rates were higher in the elderly for both AMI and CHF. Angina readmissions were more common in young female AMI survivors. Female patients were also more likely to be readmitted for CHF and angina within all age groups.

EXHIBIT 18.13: Age/Sex-specific Post-acute Home Care Utilization Rates for Cardiac Procedures and Diagnoses in Ontario, 1994/95 - 1996/97 (Cont'd)

65-74 Years of Age



75+ Years of Age



Data Source: Canadian Institute for Health Information, Ontario Home Care Administration System

Exhibit 18.15 demonstrates that the mortality rates from heart failure are similar between the sexes: overall 11.2% compared to 11.7% for men compared to women respectively at 30 days, and 33.9% compared to 32.2% respectively at one year. Both sexes showed a trend towards more admissions and a higher death rate with decreasing socioeconomic status.

EXHIBIT 18.14 Age/Sex-specific 30-day and One-year Acute Myocardial Infarction Mortality Rates per 100 Patients Aged 20 Years and Over in the Ontario Myocardial Infarction Database Cohort, 1994/95 - 1996/97

		Women (Age)					Men (Age)				
Fiscal Year	Total	20 - 49	50 - 64	65 - 74	75+	Total	20 - 49	50 - 64	65 - 74	75+	Total
30-day Mortality Rate (%)											
1994/95	15.0	2.9	7.5	14.8	29.7	19.6	2.4	5.3	14.2	26.1	12.3
1995/96	14.7	2.6	7.7	14.5	28.1	19.0	1.5	5.5	12.9	26.4	12.1
1996/97	14.7	3.1	6.5	15.6	27.8	19.4	2.4	4.7	12.7	25.3	11.9
Total	**14.8**	**2.9**	**7.3**	**15.0**	**28.5**	**19.3**	**2.1**	**5.2**	**13.2**	**25.9**	**12.1**
One-year Mortality Rate (%)											
1994/95	23.4	5.4	12.2	23.9	43.6	29.7	3.5	8.7	22.5	41.9	19.8
1995/96	22.6	3.2	12.0	22.8	43.1	29.3	3.0	8.8	19.8	40.2	18.7
1996/97	23.3	4.7	11.9	23.9	42.6	30.0	3.3	7.8	21.6	40.4	19.4
Total	**23.1**	**4.4**	**12.0**	**23.5**	**43.1**	**29.7**	**3.3**	**8.5**	**21.3**	**40.8**	**19.3**

Data Source: Canadian Institute for Health Information, Registered Persons Database

Conclusions

While some of the observed sex differences in IHD management patterns and outcomes in Ontario are explicable by differences in disease burden, others are difficult to understand or explain. There are reasonable grounds for concern that heart disease is still relatively underdiagnosed among women, and that women do not have equitable access to the full range of modern interventions to improve the outcomes of this disease. Reasons for this are likely to be multifactorial. For example, patients themselves may not be aware that the symptoms they are experiencing are due to heart disease. Furthermore, as noted above, women tend to present more commonly with atypical chest pain, highlighting the need for targeted professional and public education.[23] Other possible contributors to reduced rates of intervention are the effects of sex and age as risk factors for bad outcomes from procedures. Early studies of bypass surgery on women reported higher perioperative mortality. However, more recent data demonstrate that long-term outcomes from angioplasty and bypass surgery are equivalent in men and women.[24,25] Furthermore, recent Ontario studies of bypass surgery show that the elderly of both sexes enjoy excellent results.[26]

There are many possible approaches to improving the care of women with heart disease. First of all, health promotion and primary prevention is very important. The smoking behaviour of young women is sowing the seeds for an epidemic of IHD in pre- and peri-menopausal women early in the new millennium. More generally, women need to appreciate their true cardiac risk. Pilote and Hlatky[27] reported that 73% of women surveyed estimated their risk of heart disease to be less than 1% by the age of 70, and 39% estimated their risk to be as low as 0.1%. There also appears to be a need to target women in lower socioeconomic groups who are more likely to be at risk for IHD. Physicians should be encouraged to identify and attempt to reduce all modifiable risk factors among women, such as

EXHIBIT 18.15 Age/Sex-specific Mortality Rates per 100 Congestive Heart Failure Patients Aged 20 Years and Over in Ontario, 1994/95 - 1996/97

MEN

	Fiscal Year			
Age	1994/95	1995/96	1996/97	Total
30-day Mortality				
20-49	5.6	2.3	5.2	4.4
50-64	6.1	5.3	4.7	5.4
65-74	8.8	9.2	7.2	8.4
75+	15.7	15.4	15.0	15.4
Total Men	**11.5**	**11.4**	**10.6**	**11.2**
One-year Mortality				
20-49	16.9	13.7	13.3	14.6
50-64	22.6	20.4	17.6	20.3
65-74	29.0	29.2	28.2	28.8
75+	43.6	43.3	41.9	42.9
Total Men	**34.5**	**34.3**	**32.9**	**33.9**

WOMEN

	Fiscal Year			
Age	1994/95	1995/96	1996/97	Total
30-day Mortality				
20-49	4.2	1.6	6.7	4.2
50-64	5.0	5.6	5.3	5.3
65-74	7.3	7.1	5.7	6.7
75+	15.2	14.0	14.3	14.5
Total Women	**12.3**	**11.4**	**11.4**	**11.7**
Total Men & Women	**11.9**	**11.4**	**11.0**	**11.5**
One-year Mortality				
20-49	12.6	6.5	13.3	10.9
50-64	20.3	20.8	16.3	19.2
65-74	23.2	24.1	21.3	22.9
75+	38.0	38.5	36.9	37.8
Total Women	**32.5**	**33.0**	**31.1**	**32.2**
Total Men & Women	**33.5**	**33.6**	**32.0**	**33.0**

Data Source: Canadian Institute for Health Information, Registered Persons Database

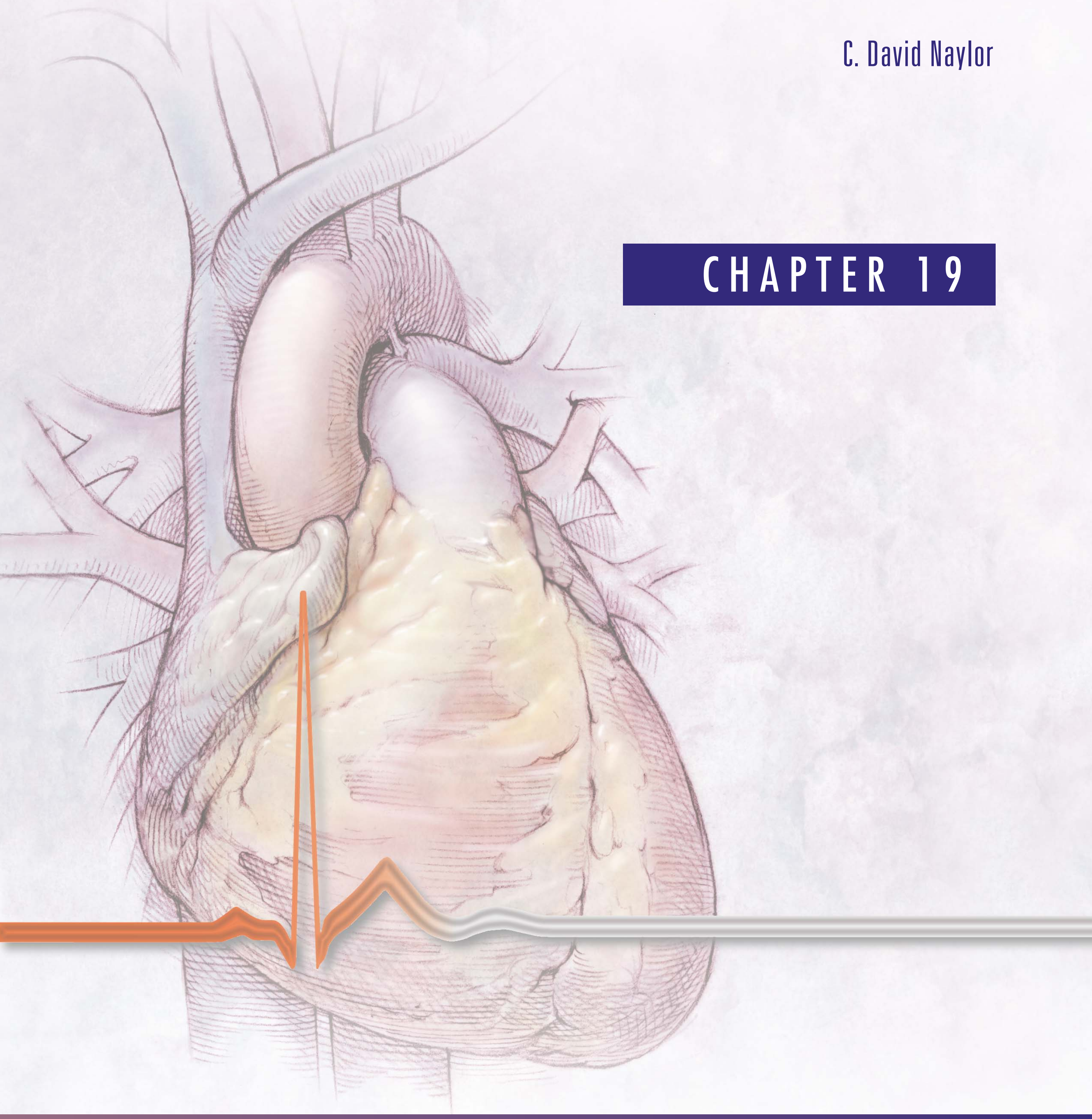
smoking, diabetes and high blood pressure, in order to attempt to prevent or delay the onset of heart disease. Moreover, the evidence suggests that physicians must be more assiduous in their efforts to obtain detailed information on possible IHD symptoms from younger women, who may not believe they have IHD, and older women, who may present with atypical symptoms. Non-invasive tests such as myocardial scintigraphy appear to be particularly useful in reducing uncertainties about whether symptoms in women are due to IHD. With respect to treatment, studies show that women benefit as much as men from lipid-lowering drugs, thrombolysis, aspirin, beta-blocking agents, angioplasty and bypass surgery.[21] Elderly patients of both sexes also benefit from these treatments. Again, wider adoption of proven treatments may help to improve outcomes for women of all ages.

We conclude that all parties must be more vigilant in trying to understand and eliminate or reduce inexplicable sex differences in IHD prevention and care. This remains a challenge for patients, doctors and other health care personnel, researchers and policy-makers alike.

Summary, Reflections and Recommendations

C. David Naylor

CHAPTER 19



Background

Based on the cardiovascular research literature and coverage in the mass media, one might imagine that industrialized nations are winning the war against ischemic heart disease (IHD). Public awareness of the risk factors for IHD is increasing, accompanied by positive trends in diet and lifestyle. From a population-based perspective, these secular shifts in lifestyle and preventive practices are reducing the age-adjusted incidence of IHD in North America and Europe. Reports from clinical trials regularly suggest that new technologies are limiting the adverse outcomes of various IHD syndromes. Population-based studies also show improvements in the age- and sex-adjusted outcomes of major IHD conditions and complications, such as acute myocardial infarction. Unfortunately, as the findings in this cardiovascular Atlas illustrate, the war against IHD is far from over in Canada or, by inference, other industrialized nations.

This chapter summarizes some key findings of *Cardiovascular Health and Services in Ontario*, and offers reflections on them along with recommendations for action.

A Continuing Toll

Even after excluding stroke, cardiovascular disease remains the single leading cause of mortality in Ontario, and the second highest cause of potential years of life lost at 277,000 person-years per annum. The Atlas estimates the annual direct and indirect costs of cardiovascular disease to be $5.5 billion.

Data showing a decline in age- and sex-adjusted incidence and mortality from IHD are encouraging, but also somewhat misleading. IHD and related atherosclerotic diseases disproportionately afflict those in middle-age and beyond. While the proportion of persons getting IHD is slowly dropping within each age bracket, the aging of the “baby boom” generation is driving up the total burden of disease.

As well, the prevalence of IHD may rise as a paradoxical result of medical progress. More patients now survive acute ischemic syndromes, such as unstable angina and acute myocardial infarction (AMI). This phenomenon has underpinned the transition of IHD to a more chronic disease.

Data from other provinces are less complete, but generally consistent with the Ontario findings. It is therefore urgent that Canadian policy-makers work with health agencies and health care providers to devise strategies that will mitigate the national toll of atherosclerosis.

"Hot Spots": Regional Variation in Disease Burden

The burden of cardiovascular disease in general and IHD specifically is unequally distributed across Ontario. At a regional level, Northern Ontario and, to a lesser extent, Eastern Ontario suffer an excess burden. At the local level, several counties in Southern Ontario emerge as "hot spots." The top five counties for cardiovascular and IHD mortality were Kent, Prescott and Russell, Bruce, Haldimand-Norfolk, and Prince Edward County. Three of these counties had dramatically increased hospitalization rates for acute myocardial infarction. Other counties, such as Manitoulin, also figure strongly in the "league tables" of cardiovascular disease burden.

The seriousness of these geographic disparities can be seen on comparing, say, the Ottawa-Carleton Regional Municipality to Kent County. In the 1990s Ottawa had less than half the AMI hospitalization rate of Kent County, and an adjusted IHD death rate of 195.9 per 100,000 adults for 1994/95 to 1996/97 versus 383.8 in Kent.

The excess mortality and morbidity in many Ontario counties is attributable in part to higher levels of traditional risk factors such as hypertension, diabetes, smoking, obesity, a rich diet, and sedentary lifestyle. Indeed, even with data that allowed only rough ecological correlations, Atlas authors found that about 30% of the regional variation in death rates in the 1990s was explicable by differing levels of these risk factors.

Conversely, the majority of the variation in IHD incidence remains unexplained. To date, hundreds of different markers have been associated with IHD. The Heart and Stroke Foundation has contracted with health geographers at McMaster University to do additional work on the distribution of both traditional and non-traditional risk factors for IHD. We hope that our colleagues will be able to update the findings here using the 1996 Ontario Health Survey (OHS), which unfortunately were only released by the province at the end of 1998.

Health Promotion and Clinical Prevention

The burden of IHD on our society could be reduced if more Canadians followed a healthy diet, were physically active, did not smoke, remained at or close to ideal body weight and achieved optimum control of modifiable risk factors such as hypertension, glucose intolerance and genetically-conditioned dyslipidemias. How can these health goals best be achieved?

Primary prevention by clinical intervention is moderately effective, but not very efficient. For example, clinical trial evidence suggests that a family physician would need to treat about 70 dyslipidemic men for five years to prevent one heart attack.[1] Risk factors tend to cluster in individuals, and the return on multifactorial efforts at primary prevention may be better than single-factor randomized trials suggest. However, as Geoffrey Rose has argued[2,3] focusing clinical prevention on high-risk individuals with multiple risk factors has limited population-wide yields. This is because the majority of cases of IHD occur among persons with modest increases in risk profiles who cannot reasonably be made the subjects of individualized preventive manoeuvres.

In other words, our success in preventing IHD is largely dependent on a continuation of positive community-wide trends to healthier diets[4] and lifestyles. Many researchers have tried to pin down the extent to which community-based "heart health" programs and other health promotion efforts will accelerate these positive trends. However, studies of health promotion programs are unlikely ever to yield answers as clear-cut as randomized trials of therapeutic interventions. Groups rather than individuals are the unit of randomization, and members of the "control" groups inevitably receive many of the same preventive services and public health messages as those in the "intervention" groups.[5] Moreover, massive sample sizes and years of follow-up are required to show any difference in actual disease incidence or critical events.

The issue then becomes: What should be done in cities and counties with sharply elevated IHD incidence and mortality rates? Can residents of, say, Kent County really be expected to stand by pending more definitive evidence on the merits of health promotion and risk factor modification? It is probable that the impact of traditional risk factors on Ontario's cardiac "hot spots" is augmented by local factors such as environmental or other determinants. But while further research is under way to explore non-traditional factors, we suggest that immediate action is warranted to improve cardiovascular health and reduce the levels of traditional risk factors in many "hot spots" identified in this Atlas.

More generally, the Atlas shows striking rural-urban disparities in IHD burden. These, too, are attributable in part to well-established and modifiable risk factors. The 1990 Ontario Health Survey (OHS) shows that rural areas have more smokers, more obese or sedentary persons and more individuals eating a high-fat diet, as compared to urban areas. Specific environmental agents or socioeconomic factors may also contribute to the higher incidence of IHD in farming communities. Again, however, while additional research is under way, an ethical argument can be made for health promotion and clinical prevention strategies aimed at reducing the toll of atherosclerosis in remote and rural areas.

Report Cards on Clinical Care

Prior to the first Atlas of health care released by the Institute for Clinical Evaluative Sciences (ICES) in 1994,[6] there was no Canadian precedent for systematic reporting on health system performance measures with open identification of institutions and geographic locales. Gratifyingly, the intervening years have seen a growing interest in, and widespread support for, better measurement and greater public disclosure of health and health care indicators.

Cardiovascular Health and Services in Ontario follows the precedents established throughout the ICES Atlas series. Indicators are disaggregated to whatever level makes sense given the reliability of the data, the site of care delivery and the responsibility for quality improvement. For example, congestive heart failure (CHF) outcomes are not reported by hospital because CHF outcomes are heavily influenced by ambulatory care, and most individuals also undergo repeated admissions. On the other hand, we have reported on various indicators of care for AMI patients by institution, given a reasonably high degree of confidence in the data and the potential for clinicians and managers in the admitting hospital to improve short-term outcomes and influence post-discharge secondary preventive drug use.

Readers will doubtless have noted that the Atlas reports on a blend of process and outcome indicators. Both are required for quality measurement and management,[7-9] but it is important to appreciate their respective strengths and weaknesses.

Report cards focusing on outcomes are most useful in assessing technical competence, especially with respect to invasive procedures. They are more meaningful if two conditions are met. First, there must be adjustment for prognostic differences in the groups of patients undergoing procedures or receiving treatment at different centres or with different providers. Second, whether one is comparing hospitals or individual surgeons, there must be enough patients to permit statistically reliable detection of differences in outcomes.

On the negative side of the ledger, outcomes report cards that rely on administrative data may fail to cover the full range of outcomes that concern patients and referring physicians.[7] As well, few therapies in modern medicine are so effective that one can rapidly detect a negative impact on outcomes if they are underused. A concrete example may help to illustrate this latter point. Let us say that one group of physicians prescribes beta-blockers to only 70% of ideal patients in the year following a heart attack. That equates to an anticipated 0.2% increase in one-year mortality compared to patients of another group of physicians making optimum use of these drugs. Detecting such a small difference in mortality would require tens of thousands of patients per practice. In contrast, we could simply examine charts to see whether eligible patients were getting beta-blockers or not—a process-of-care audit. If a better practice had over 90% beta-blocker prescriptions for eligible patients, versus 70% in another, we would only need to examine 75 charts in each practice to reliably pinpoint a quality-of-care problem.[8] Last, outcomes indicators are insensitive to overtreatment unless the treatment has major side effects. By this metric, the best way for a centre to achieve excellent outcomes would be to offer a service to large numbers of healthy individuals who don't need it![8]

Process-of-care measures also have pluses and minuses.[9] The most rigorous process-of-care measures use explicit criteria and collect detailed data to audit appropriateness of clinical decision-making at the individual patient level.[9] Such audits are sensitive to variations in provider judgement, and can detect over- and under-treatment with moderate reliability,[10] but are expensive to undertake. The various process-of-care measures in this Atlas lack that level of specificity. For example, we have examined patterns of drug utilization by hospital or region, without delineating how often use of a particular drug is indicated or contraindicated in the patients who are under study. Other profiles in the Atlas are even less specific, e.g. geographic analyses of procedure utilization where the denominator is an entire population with a variable incidence rate of cardiovascular disease.

In sum, the major issues about public report cards on health care include ensuring the validity and reliability of the data, judiciously selecting process and outcome indicators and communicating the findings in responsible ways that acknowledge their inherent limitations. The aim must be to inform and empower, rather than alarm or confuse patients and providers. We turn now to a brief review of the findings by condition and procedure.

Acute Myocardial Infarction

Survival

"Heart attacks" are common and frequently lethal on the index admission. Our report card on AMI outcomes shows moderate and unexplained variations in short- and longer-term survival at both the institutional and regional levels. Why do more than one in five patients die within 30 days of admission to some Ontario hospitals, while less than one in eight die at other hospitals? And why is the one-year risk-adjusted mortality after AMI 20.8% in the Halton-Peel District Health Council (DHC) but 27.4% in the Muskoka, Nipissing, Parry Sound and Timiskaming DHC?

It appears that scores of lives could be saved annually if better outcomes achieved at some hospitals and in some regions were replicated across Ontario. This is a situation where outcomes variations are sufficiently meaningful that follow-up is vital. We recommend the development of a program of detailed process-of-care audits to understand the reasons for these outcome differences. Many studies have now demonstrated the positive impact of quality improvement programs on care of AMI,[11,12] as well as other diseases and conditions.[13] If the audit findings show opportunities for improvement, investments to that end should be made promptly by leaders in the hospital sector.

Readmissions

The Atlas contains two analyses of readmissions after hospitalization for an AMI. One analysis examines urgent and emergent readmissions occurring within 30 days of discharge. This short-term perspective is useful for determining whether shorter stays in hospital are linked to rapid readmissions or increased rates of out-of-hospital death. Fortunately, length of stay is not a major determinant of early readmissions or post-discharge mortality.

The second analysis of readmissions takes a longer-term view. It focuses on readmissions for cardiac diagnoses within a year of discharge. These data are not straightforward to interpret. For example, high-risk patients might have lower short-term survival if admitted to a hospital with unmet quality challenges, and their early deaths would mitigate the higher-than-average readmission rate that they might otherwise be expected to incur. Readmissions for angina or CHF are also confounded by practitioners' varying thresholds for hospitalization and local access to effective ambulatory care. On the other hand, the data show several-fold variations in readmission rates with a primary diagnosis of AMI— a level far higher than expected on the basis of coding "noise" alone. Again, follow-up audits would be illuminating.

Secondary Prevention

Our window on secondary prevention after a heart attack is limited to drug therapy in the elderly. It is a non-specific process-of-care analysis, but does show puzzling variations in prescribing patterns. Why did 18% of elderly AMI survivors at Chedoke-McMaster Hospital in Hamilton receive calcium channel blockers as opposed to 55% at Kingston General? Why did 74% of elderly patients receive beta-blockers within 90 days of leaving St. Michael's Hospital versus 40% or fewer of the patients at many other Ontario hospitals? Use of cholesterol-lowering statin drugs is also highly variable. Among larger hospitals prescription rates range from 29% at Cambridge Memorial Hospital and 27% at Toronto East General to under 10% at a number of institutions. These findings lend weight to the recommendation above concerning the need for systematic audits of AMI care to identify and share "best practices."

Physician Visits

One potential source of variation in processes and outcomes of post-AMI care is access to physician services after discharge. The Atlas showed little regional variation in the timing or frequency of visits to general and family practitioners following an AMI. However, in the North 35% of patients do not see a specialist within six months of their heart attack, as compared to 29% in the East and 16% to 20% in other regions. Patients in the North wait 60 days to see a specialist versus 30 to 40 days elsewhere.

The Atlas also shows sharp regional variations in the availability of cardiologists. Full-time equivalent (FTE) cardiologists per 10,000 population range from 0.13

in the Central East and South West and 0.16 to 0.17 in the Central West and North, to 0.38 in Toronto. It is likely that the Central West and Central East both refer patients to Toronto, but the current distribution of specialists does force hundreds of cardiac patients per annum to travel substantial distances for consultations and procedures.

Some American studies have suggested advantages for specialist over generalist care of cardiac patients.[14-17] While we doubt that the findings are fully applicable in Canada, these regional disparities in ambulatory care highlight the fact that access to physician services remains uneven for cardiac patients in Ontario.

Congestive Heart Failure

With the aging of the "baby boomers" and the transformation of IHD into a more chronic condition, heart failure has emerged as a very important health problem. CHF is the leading single cause of hospitalization among elderly Canadians. Moreover, while many citizens particularly fear the diagnosis of cancer, a failing heart requiring in-hospital treatment is actually more lethal than most major malignancies, with a one-year death rate running about 30%.

Survival for CHF patients is similar across most geographic areas of Ontario, with slightly lower survival for CHF patients in the Niagara Region and the Thames Valley DHCs. Causes of these variations remain unclear. Notwithstanding its higher mortality, the Niagara Region actually shows higher-than-average use of ACE inhibitors and lower-than-average reliance on diuretics alone. In contrast, elderly patients from the Thames Valley DHC had the lowest rate of use of ACE inhibitors.

Prevention of CHF is vital. This can be achieved by limiting left ventricular damage at the time of the initial AMI, preventing second heart attacks, and otherwise mitigating the progression of atherosclerosis through comprehensive secondary prevention strategies. In the latter respect, recent evidence shows that statin drugs significantly reduce both the frequency of heart failure and its severity among patients with IHD and no previous CHF.[18] An integrated strategy for improved IHD management will accordingly pay dividends in respect of both acute and chronic manifestations of heart disease.

Given the complex natural history of CHF, administrative data are not very helpful at pinpointing opportunities for improving care. The Atlas reports solely on CHF survival and drug therapy. Administrative data do not reliably capture functional status or non-pharmacological interventions such as exercise training. We urge that far more attention be paid to CHF as a major health care issue. Logical steps include development of disease-specific registries and systematic exploration of ways to improve patient outcomes through better adherence to practice guidelines.

Coronary Artery Bypass Graft Surgery (CABG)

Waiting Lists for CABG

Few issues have drawn as much media attention or sparked the degree of provider and patient anxiety as waiting lists for cardiac surgery. However, with the support of the Ministry of Health, the Cardiac Care Network of Ontario (CCN) has created a population-wide monitoring and management system for dealing with waiting lists for CABG that is regarded as an international model.

Data in the Atlas drawn from many thousand of patients show that about 0.4% to 0.5% of patients die waiting for surgery. Any death of this nature is profoundly upsetting for bereaved relatives and demoralizing for providers. However, the vital risk for Ontarians awaiting CABG is actually lower than that expected for a population of older persons with significant coronary disease.

Although surgical queues lengthened during 1995 and 1996, increases in capacity during fiscal 1997/98 reduced the median waiting times for elective patients. Waiting times for urgent and semi-urgent patients have remained more or less constant—a positive indication of how the "triage" practices of cardiologists and cardiac surgeons protect higher-risk patients from untoward delays.

Significant hospital-to-hospital variation in waiting times was demonstrable, but partly explicable by intercentre differences in the proportion of elective patients undergoing surgery. Institutional data from 1994/95 to 1997/98 also showed strong relationships between recommended maximum waiting times and median waiting times in each centre. This illustrates excellent physician compliance with Ontario's guidelines for assessing priority of need for CABG. Despite these positive findings, some issues remain unresolved.

First, about half the patients in the least urgent group waited more than three months for CABG. Such long waiting times impose quality-of-life burdens on patients, without any meaningful efficiency advantages in care delivery. Indeed, there are clinical risks and economic disadvantages when elective patients destabilize while waiting and require urgent admission and revascularization.

Second, waiting lists for elective CABG have still not fallen to the levels seen in the early 1990s. This may improve, however, with planning under way for three new CABG facilities in Ontario.

Third, to date there has not been an access-monitoring mechanism for other IHD procedures, notably percutaneous transluminal coronary angioplasty (PTCA) and coronary angiography. In December 1998 the Minister of Health announced that CCN will receive funding to expand its information system to cover both these procedures. This is a welcome and important step that should pay tangible dividends for cardiac patients in years to come.

Postoperative Outcomes

Strict regionalization of cardiac surgery in Ontario has ensured high volumes for all centres and surgeons and helped maintain high technical standards. As well, for several years CEOs and chiefs of cardiac surgery in Ontario have received confidential scorecards on risk-adjusted post-operative mortality and lengths of stay after open heart procedures, particularly isolated CABG. This system has catalyzed concrete quality improvement initiatives.

The Atlas reports that in 1996/97 the risk-adjusted mortality rate for isolated CABG was 2.23%, with a crude mortality marginally higher at 2.41% and no significant variation in mortality across the nine centres providing this procedure. The mean post-operative length of stay showed very minor intercentre variation, ranging from 6.63 to 8.03 days. All those involved with the Cardiac Care Network of Ontario, particularly the cardiac surgery community, deserve commendation for these results.

Secondary Prevention

Based on available evidence, many patients should receive cholesterol-lowering therapy after undergoing CABG. Potential benefits include retardation of atherosclerosis in native vessels and bypass grafts, thereby reducing the chance of recurrent symptoms, repeated hospitalizations and additional procedures. In the latter respect, repeat revascularization procedures are particularly hazardous for elderly patients who now constitute the majority of bypass recipients.

The proportion of elderly patients receiving cholesterol-lowering statin drugs after CABG has risen from 14% of elderly patients in 1994/95 to 32% in 1996/97. However, elderly patients hospitalized at different centres varied in their chances of receiving lipid-altering drugs after discharge. For the three-year period under study the prescription rate ranged from 17% to 18% for those receiving surgery in Sudbury and Ottawa to 29% at Sunnybrook Health Science Centre.

We urge each cardiac surgery centre to assume responsibility for ensuring that every patient undergoing a coronary bypass receives services aimed at modifying not just lipid levels, but the full range of atherosclerosis risk factors.

Cardiac Arrest Care

One manifestation of heart disease is sudden death occurring outside of health care facilities. The Atlas accordingly includes Ontario's first community-based report card on processes and outcomes of cardiac arrest care. It draws heavily on a pioneering research project—the Ontario Prehospital Advanced Life Support Study (OPALS).

From a process standpoint, survival for cardiac arrest victims can be improved if witnesses recognize the condition and can immediately call a 911 emergency line. The next step in the "chain of survival" is early cardiopulmonary resuscitation (CPR) by trained bystanders and emergency services personnel. For some patients, rapid defibrillation is also important. This can be achieved by equipping ambulances and firefighters with automatic defibrillators and ensuring that well-trained emergency services personnel arrive quickly on the scene of the cardiac arrest.

Citizen CPR rates in Ontario are disappointingly low, running about 10% in communities such as Oakville, Thunder Bay, Cambridge, and Welland. Only a few communities are above 20%. Early CPR is therefore heavily dependent on emergency personnel. However, some areas of Ontario do not have explicit agreements that CPR will be initiated by whichever emergency personnel (firefighters, police or ambulance attendants) first arrive at the scene of a cardiac arrest. Firefighters or ambulance personnel do respond very quickly; in the overwhelming majority of cardiac arrests, they arrived with an automatic defibrillator within eight minutes. Nonetheless, survival after a cardiac arrest in the cities studied was extremely low, ranging from 0% to 11.8%.

The Atlas authors who assessed cardiac arrest care in Ontario have issued a call to action that should not be ignored. More communities must collect standardized data and initiate quality improvement strategies to strengthen each link in the chain of survival.

Patterns of Service for Coronary Revascularization and Angiography

Population-based Analyses

As noted in the Atlas, the Ministry of Health and CCN agreed in 1995 on a benchmark rate for CABG of 100 per 100,000 adults. To this end, the government has made major investments in CABG capacity. The provincial rate has risen from 75 in 1991/92 to 99 per 100,000 adults in 1997/98, and is still climbing. Most of the increase has been in men and women aged 65 or over who tend to have extensive multivessel disease that is not readily amenable to angioplasty. However, moderate regional variations persist despite a CCN/Ministry policy of investing preferentially to expand capacity in centres serving lower-rate regions.

For PTCA, overall utilization has grown from 55 per 100,000 adults in 1994/95 to 71 per 100,000 adults in 1997/98. This is well below the benchmark, which has also been set at 100 procedures per 100,000 adults. Moreover, the regional variation in use of PTCA is larger than for CABG by all measures. How do the variations in PTCA and CABG track when considered together, and how do they relate to the data in the Atlas on the burden of IHD by region?

Only the Champlain DHC, served by the University of Ottawa Heart Institute, shows a pattern of overall service that approximates the benchmarks set by policy-makers and providers. Its total revascularization rate in 1997/98 was about 200 per 100,000, composed more or less equally of angioplasty and bypass surgery. In most regions, angioplasty substantially lags behind CABG provision.

The northeast and eastern parts of Ontario have higher-than-average mortality or AMI admission rates, and these regions have high revascularization rates. However, the Atlas also shows that Windsor residents are more likely to undergo revascularization than rural residents of Essex county, or residents of Lambton and Kent counties. Some rural communities with high IHD burdens may be underserved.

Post-AMI Cohort Analyses

As noted earlier, analysis of procedure variations by site of patient residence is confounded by regional differences in disease incidence or severity. This problem can be avoided if researchers examine area variations among cohorts of patients who all have the condition of interest.[19] Atlas authors used this technique in examining the use of coronary angiography and revascularization procedures among patients surviving a hospitalization for AMI.

The median waiting time from AMI admission to angiography has fallen from 29 days in 1992/93 to 17 days in 1996/97. However, waiting times varied dramatically according to site of patient residence, from a median of about two weeks in Champlain, Toronto, Hamilton-Wentworth, and Thames Valley, to more than twice as long in several other DHCs.

There were also regional differences in angiography rates. Whereas 37.4% of AMI patients in Algoma, Cochrane, Manitoulin and Sudbury DHC underwent an angiogram within six months, only 17.3% of AMI patients did so in the Grey, Bruce, Huron and Perth DHC and the Northwestern Ontario DHC. These variations, in turn, are driven by the ease with which clinicians can access angiography. Residents of municipalities with hospitals that have angiography facilities undergo angiography faster and more often than residents of areas without such facilities.

Institution-level analyses corroborate these findings. The likelihood of undergoing angiography within six months of hospitalization for an AMI varies about three-fold depending on which hospital admitted the patient in the first instance. Most of the hospitals where patients underwent angiography significantly more often than the provincial average either had on-site angiography facilities or were teaching/high-volume centres.

Another window on site of residence and access can be opened by examining the distance that post-AMI patients must travel to undergo coronary angiography or revascularization procedures. After age and sex adjustment, distance to a revascularization centre is significantly and inversely related to the probability and waiting time for angiography and PTCA. These relationships, fortunately, were weaker for CABG.

Such findings emphasize the need to ensure more equitable access to angiography and illustrate one of the drawbacks of regionalization. Although restriction of tertiary cardiac services to a limited number of regional centres has positive effects on quality of care, access can be compromised.

In December 1998 the Minister of Health announced that York-Simcoe and Waterloo-Wellington would each receive full-service tertiary cardiac centres, including angiography, PTCA and CABG. Review of data in the Atlas confirms that both regions have been underserved in relative terms. However, volumes could be borderline unless the two hospitals chosen to provide tertiary cardiac services for these areas rapidly command most of the local market, and until the areas reach provincial benchmarks for both PTCA and CABG.

For low-density areas that cannot support new tertiary facilities, alternative policies will be needed to address regional access disparities. One possibility is to peg envelope funding for specialized procedures to local disease burdens and give local practitioners and administrators a budget to buy specialized services from the nearest tertiary centre.

The creation of two new full-service tertiary centres, along with a third centre for Mississauga announced earlier in 1998, will profoundly alter the way that residents of Ontario access invasive cardiac procedures in the future. It will be important to re-evaluate geographic variations in access to tertiary cardiac services as these facilities ramp up in the new millennium.

Aortic and Peripheral Arterial Surgery

Coding of abdominal aortic aneurysm (AAA) surgery is not sufficiently reliable to permit the generation of hospital-specific outcomes report cards for this complex procedure. However, in 1996/97, 42 surgeons performed less than one AAA procedure per month. These low volumes are worrisome, but may be partly explicable by some emergency procedures that local surgeons must attempt when patients present *in extremis* with ruptured aneurysms. Although vascular bypass surgery for peripheral arterial disease (PVB) is lower risk, it is also technically demanding, and episodic surgery cannot be rationalized on the grounds of emergent need. Twenty-five surgeons apparently performed less than one PVB procedure per month in 1996/97. Many surgical procedures have a clear volume-outcome relationship, i.e. higher volumes are associated with better outcomes. We do not know the exact volume threshold below which surgical competence begins to diminish for these two procedures, nor can we assume that this threshold is the same for all surgeons. However, a provincial case registry and quality management system for AAA surgery could be a worthwhile investment.

As to regional variations in procedure rates, aortic and peripheral arterial atherosclerosis share risk factors with IHD. One might therefore expect that the rates of AAA and PVB surgery would run parallel to IHD mortality or the rates of admission for AMI. In fact, the parallels are weak.

High rates of PVB surgery are seen in Oshawa, Hamilton and Thunder Bay, with 120 or more procedures per 100,000 residents aged 50 and over, as opposed to half the rate in Brampton. The situation in Oshawa is particularly striking, with a PVB rate in the city that is twice the rate in other parts of the Durham-Haliburton-Kawartha-Pine Ridge DHC. Follow-up analyses in selected high and low rate areas would be useful to delineate causes of these variations.

Regional variations for AAA surgery are smaller than for PVB. With the available data we cannot determine whether these represent variations in disease incidence, in detection patterns, or in thresholds for performing elective AAA repair. Again, a disease-management registry would be helpful.

Relative Deprivation and Cardiovascular Disease

It is not just rural Ontarians or those in some counties who are stricken with IHD at an increased rate. Across the province, citizens living in areas with lower socioeconomic status (SES) have sharply higher burdens of atherosclerotic disease.

Canadians justifiably pride themselves on their social safety net, such as universal health care, social assistance programs and universal public education. Although influential or wealthy patients may still get some degree of preferential access to cardiac services,[20] many studies indicate that, in general, universal health insurance in Canada has mitigated income-related inequities in service use.[21,22] Our findings, however, are entirely consistent with a massive amount of international evidence demonstrating that social class has remained a potent determinant of health status throughout the twentieth century.[23]

It is important to note that SES in the Atlas is inferred from mean incomes for areas of residence rather than measured directly at the individual level. Nonetheless, the differences observed are large and consistent. Admissions for angina and chest pain in recent years were twice as common for the lowest income group as the highest. AMI admission rates ranged from 305 per

100,000 adults for those in the lowest income quintile to 190 in the highest quintile. Modest income gradients were demonstrated in rates of aortic aneurysm surgery. For peripheral arterial surgery, the differences were more dramatic. The PVB rate for the lowest income quintile was 109 per 100,000 persons aged 50 and over versus 48 for the highest.

Tellingly, Atlas authors also found from the 1990 OHS that low-income Ontarians were much more likely to have high blood pressure or diabetes, and be daily smokers, obese or sedentary. Education levels were also striking predictors of risk factor status. Indeed, the prevalence of three or more risk factors was 39% among high school drop-outs versus 26% among those who had completed some post-secondary education.

The Atlas has not systematically explored whether Ontarians with less education or lower incomes are less likely to receive or take full advantage of preventive services. That topic is worthy of further study. However, one must ask whether further investments in traditional health promotion programs will reinforce rather than reduce socioeconomic differentials in heart-healthy lifestyles. The Atlas authors cogently argue that we need to develop and test prevention programs aimed primarily at promoting healthier lifestyles and managing IHD risk factors among disadvantaged Canadians. More generally, the dramatic relationship between SES and IHD suggests that policies and programs aimed at limiting the impact of social class divisions may pay tangible dividends from a health and health care perspective.

Cardiac Health and Services in a Multicultural Society

The prevalence of IHD varies sharply across ethnoracial groups. For example, researchers have shown that IHD is very common among First Nations women, a finding that is linked to their high prevalences of diabetes and obesity and high rates of cigarette consumption. Analyses of IHD mortality among other ethnoracial groups in Canada mirror British findings, with the highest mortality among South Asians. In contrast, Chinese Canadians have about one-third the IHD mortality of European Canadians.[24]

Analyses for this Atlas were seriously constrained by the paucity of reliable data on ethnicity and health status or service use in Canada. Some data on ethnicity were developed by identifying Chinese and South Asian names. This required multiple compartmentalized steps with stringent safeguards to generate anonymized ethnicity tags whilst protecting patients' confidentiality and privacy. No other ethnic groups could be identified, including those with Chinese or South Asian surnames but mixed heritage.

The authors did find that persons with South Asian surnames who suffered an AMI were six years younger on average than AMI patients in the general population. Such findings, along with other information in the research literature, underscore the need for investments in culturally appropriate health promotion and clinical preventive practices targeting high-risk ethnoracial groups such as Aboriginal peoples and Canadians of South Asian descent.

Beyond that, the data in the Atlas raise tantalizing hypotheses but permit few conclusions. As the authors of this section stated: "The situation cannot be clarified unless Canadians resolve to collect direct information from individuals on ethnicity, and to strengthen the nation's commitment to ethnoracial health research that will be inclusive of Aboriginal peoples and reflect the multicultural character of our nation. Until we gather data relating reliable ethnoracial information to a wide range of health indicators, we shall remain uncertain if there are hidden inequities in our universal health care system and unable to address those inequities if indeed they exist."

The Gender Gap

The preceding chapter reviewed and summarized information on gender and cardiac health and services from the entire Atlas. However, a few points bear repetition here.

First, cigarette smoking among women is known to be a major accelerator of the onset of IHD. Based on the 1992 Ontario Heart Health Survey, the level of smoking among women in their teens and twenties is at a level of undesirable equality with young men. The adverse impact of tobacco addiction on world health remains staggering. Stronger anti-smoking efforts must be targetted at young women (and men) by all the relevant authorities.

Although IHD is much less likely to be a cause of premature mortality among women, the absolute number of IHD deaths among women and men was very similar in 1996. The explanation, in brief, is that the toll of IHD on women lags that on men by about a decade up to and including the comparison of women aged 65 to 69 with men aged 55 to 59. Thereafter, however, the gap narrows. As a result, age and sex influences on disease incidence and decision-making in cardiac care are intertwined in a rather complex web.

On the positive side, data in the Atlas show minimal sex disparities in drug utilization for AMI and CHF, and shifts in non-invasive testing that are presumably favourable for detection of IHD in women. Among post-AMI patients from across Ontario, there were no sex differences in waiting times for major procedures. Indeed, if anything, women received procedures more quickly than men.

The Atlas does show that rates of intervention after AMI are much lower for women. For example, only 19.6% of women underwent angiography within six months, as compared to 31.5% of men. Yet these findings are largely driven by age differences in AMI onset. The age- and sex-specific rates are very similar among men and women for both angiography and PTCA. The main difference lies in bypass surgery where post-AMI utilization rates for men are about 4% higher in absolute terms across all age brackets.

On the other hand, population-based data show continuing age-specific sex differences in the use of revascularization procedures, despite major growth in the PTCA and CABG rates. Whether these differences represent undertreatment of women remains unknown, but the magnitude of the disparities is surprising.

As many observers have suggested, more research is needed to understand gender-related differences in IHD pathophysiology, symptoms and optimum disease management. We are hopeful that this research agenda, along with delineation and dissemination of best practices in cardiac care for women, will be accelerated by the recent launch of the Women's Health Council in Ontario.

Uneven Cardiac Home Care

Ontario is making an ever-larger investment in community-based health services. Many of these services, with costs totalling hundreds of millions of dollars per annum, are provided on a post-acute basis for patients who have recently been discharged from hospital. Earlier ICES research has shown that post-acute home care is provided in a highly variable fashion across Ontario.[25] For many diagnoses and procedures, the likelihood that a patient will receive home care is very strongly influenced by where the patient resides or where s/he was hospitalized.

The Atlas findings for cardiovascular services are similar. Post-acute home care for cardiovascular services cost Ontario $163 million in 1997/98. As is appropriate, diagnosis and age were strong determinants of home care utilization. For example, about one in three hospitalized CHF patients received home care versus one in five AMI patients. Tallied another way, over 6,000 CHF admissions were associated with follow-up home care versus 3,000 for AMI. But there was also striking variability in home care use across DHCs, with DHCs that were higher than average for one procedure or diagnosis tending to be higher for others. These patterns are incompatible with evidence-based practice. We urge the rationalization of post-acute home care through province-wide guideline development and implementation initiatives involving providers and managers from the institutional and community care sectors.

Where is the Accountability?

Repeatedly in *Cardiovascular Health and Services in Ontario*, we have seen indications—sometimes direct, often indirect—of a gap between evidence and practice. Inferences must be drawn cautiously from administrative data. We noted earlier that many of the findings in the Atlas must be taken as tantamount to screening tests in clinical practice: they suggest the need for further evaluation, but do not definitively prove that a quality problem exists. Nonetheless, the preceding chapters document a large number of unsettling inconsistencies in disease burden across cities and counties, and in processes and outcomes of cardiac care across hospitals and regions.

As argued in the conclusion to the first ICES Atlas in 1994,[26] information of this nature can strengthen the culture of assessment and accountability in Canada's health care system. We recognize, however, that stronger accountability in Canada's health care system will not be created simply by publishing report cards on care and urging patients to "shop around." In the US, some "shopping" is possible by insurers and managed care organizations on behalf of subscribers, and consumers themselves have a plethora of prepayment choices. In contrast, each Canadian province has a single-payer system without excess hospital capacity, with smaller proportions of medical and surgical subspecialists and with waiting lists for many specialized cardiac services. As well, report cards designed to influence consumer choices appear most applicable in non-urgent situations of potential self-referral with decentralized service provision, such as primary care and obstetrics. The contrast with cardiac care is obvious.

On the other hand, public pressure can lead to more rapid and consistent responses to research findings. The authors are accordingly hopeful that this Atlas may be informative to patients and taxpayers as health care consumers and advocates. We encourage heart patients and concerned citizens to draw on our findings in pressing providers, community agencies and policy-makers for positive changes in health promotion and clinical services.

Investor-owned industries are also potential catalysts for change. Industry has a substantial interest in closing the "care gap" if it means higher prescriptions or utilization rates of new drugs and devices, and may be a welcome partner in responding to some of our findings. However, other issues raised in the Atlas have to do with underdevelopment of health promotion or potential overuse of new technologies and established procedures. As well, modern medicine faces a conundrum when it comes to the promotion of older drugs—low-cost items, often available in generic formulations, that have no industry champions. The term "orphan drugs" has been coined to describe pharmacotherapies for uncommon conditions, the connotation being that such drugs are less likely to be developed given the limited market. Today, we have another class of "orphan drugs" —compounds such as aspirin, thiazide diuretics for hypertension, or beta-blockers for secondary prevention after an AMI. Available over the counter (in the case of aspirin) or in generic formulations (thiazides and beta-blockers), and still unequivocally effective for a variety of cardiovascular indications, these drugs have no marketing champions, apart perhaps from professionals concerned with the promotion of low-cost, evidence-based medicine.

Since many positive changes can only be driven from the "supply side," and may not always garner support from industry, we must ask: Where are the mechanisms to ensure systematic and multisectoral accountability for the improvement of health and health care?

The College of Physicians and Surgeons of Ontario (CPSO) has taken some positive steps to assess and improve quality in free-standing health facilities, and undertakes random audits of primary care practices; but is largely complaints-driven. The Canadian Council on Health Facilities Accreditation examines the quality assurance mechanisms adopted by hospitals but cannot monitor each hospital's performance in detail. The Ontario Hospital Association (OHA) has commissioned University of Toronto researchers, including ICES faculty, to develop performance report cards based on hospitalization data from the Canadian Institute for Health Information (CIHI). Although the OHA's first report card was aggregated at the regional level, plans are afoot for the release of hospital-specific information in late 1999. These report cards include important new data on hospital finance and patient satisfaction, but do not extend beyond CIHI data into trans-sectoral process and longitudinal outcome analyses. Most importantly, no single organization in the traditional acute care sector is dedicated to facilitating positive, rapid and integrated responses when evidence is presented that suggests opportunities for quality improvement.

As for the community service sector, leaders in home care recognize the need to develop and implement a variety of evidence-based standards and guidelines. However, Ontario's Community Care Access Centres vary in their capacity to evaluate and manage services. Some have taken steps to rationalize care from an evidence-based and quality-oriented standpoint; others seem to be simply bidding down the price of services. No agency is examining community-based care on a province-wide basis, addressing regional variations of the type demonstrated in this Atlas, or working to ensure the cross-regional integration of institutional and home-based services.

Last, the dramatic evidence in this Atlas for county-level hot spots raises the issue of accountability for health promotion activities. Here again, the structures are ambiguous. The Ontario government has devolved public health functions to the municipalities. Although cancer prevention responsibilities are vested within Cancer Care Ontario, the province otherwise lacks a set of coordinated strategies for non-communicable disease control. Had the Heart and Stroke Foundation of Ontario not initiated analyses aimed at elucidating regional variation in cardiovascular mortality, it is unclear whether these matters would ever have gained much public attention. It remains unclear how they will now be addressed.

These continuing concerns have led a number of ICES researchers to call for the creation of a multi-stakeholder agency that would serve as an "overarching forum to generate firmer accountability for quality, access and efficiency with a systemic orientation."[26] In 1994[26] and 1996,[27] we lamented the lack of intersectoral collaboration, and noted that health programs, including community and public health, home care, acute and chronic/rehabilitation hospitals, physician services and drug benefits, were all largely managed independently of each other. We also noted the challenges faced by conscientious managers and clinicians on the front lines of care delivery who needed support to understand local practice variations, run programs of utilization audits, set benchmarks for underservicing and excessive waiting times, implement practice guidelines on a variety of topics, develop clinical registries for quality improvement and research and prioritize technologies and services in the face of budgetary constraints.[27]

In 1996 and again in 1997, Ontario's Health Minister announced the pending creation of a "Health Quality Council" that would include equal public and provider representation, and have a wide-ranging mandate to help make Ontario's health care system better. No such agency has ever been created.

This situation contrasts with the comprehensive strategy for better health and higher quality health care now being unfolded in the United Kingdom (UK). Among the efforts in the UK is a massive redevelopment of the health information systems of the British National Health Service (NHS), designed not only for more efficient care, but also to facilitate closer quality management. About 1% of NHS operating expenditures are reserved for research and development aimed at improving health and health services, quite apart from basic and independent investigator-initiated research funded by the British Medical Research Council. Waiting list data and league tables on various hospital performance indicators are widely available. Hospitals have already developed a strong culture of clinical audit, and recently, quality monitoring has been given additional impetus by the creation of the National Institute for Clinical Excellence and the Commission for Health Improvement. Taken together, these latter two bodies have aims very similar to those of the proposed Ontario Health Quality Council.

The new British agencies are designed on the premise that successful quality enhancement depends on the trust and respect of health professionals and managers who, with few exceptions, are well-intentioned and keenly interested in providing better care to their patients. As Deming's disciples in health care have rightly argued, most quality problems relate first and foremost to the design of production systems, not the goodwill of the people working within them. Quality must therefore be built into processes of care and cannot be created post hoc by inspecting outcomes. Moreover, to paraphrase T.S. Eliot, it is futile to build systems so perfect that people no longer need to be good. This all leads to the conclusion that any quality-oriented agency must reserve the right to refer refractory problems to the appropriate authorities, but seek first and always to catalyze and support positive and voluntary change.

Too Little Knowledge

The preceding section argued for mechanisms to help ensure that evidence is put into action on a consistent basis to improve health and health care. However, even with more successful attempts at heart health promotion and clinical prevention, or with optimized cardiovascular health services that closed the current care gaps, atherosclerosis-related illnesses would continue to take an enormous toll on our society.

How can that pessimistic assessment be reconciled with the positive trends and positive clinical studies noted at the outset of this chapter? First, even the most detailed disease models, using extensive and individualized profiles of risk factors, leave unexplained a substantial proportion of the variation in incidence of IHD. Put simply, our molecular and epidemiological understanding of atherosclerosis is still limited.

Second, many of the clinical trials in cardiovascular care generate outcomes that are unduly optimistic owing to selection biases in patient recruitment. For example, large-scale trials of acute therapy for AMI show hospital discharge and 30-day mortality rates running at 7% to 8% while population-wide data for Ontario show an average 30-day mortality of 14.8% in the period 1994/95 to 1996/97. For CHF, patients in the large clinical trials suffered an average one-year mortality around 10%, while our population-wide data show 33.0% dead within one year of an index hospitalization with CHF. A key reason for the differences in outcomes is that the clinical trials tend to enroll younger, lower-risk patients.[28] In theory, treatments validated in selected lower-risk patients should save more lives if applied to higher-risk patients. But until more trials broaden their inclusion criteria, many clinicians will be justifiably uneasy about the side effects and net benefits of new treatments for high-risk cardiac patients who are often elderly, otherwise frail, or already taking multiple drugs.

Third, the pharmaceutical and medical device industries invest extraordinary sums in research, and their understandable drive to recoup those investments sometimes leads to the design and conduct of clinical trials that test technologies with small marginal improvements over older, cheaper therapies. Put another way, modern cardiovascular research has seen an enormous proliferation of what Lewis Thomas called “half-way technologies”: technologies that palliate or mitigate a disease process to a minor but meaningful extent, perhaps prolonging the course of illness in the process, but not offering definitive cures or transformational improvements in health status.[29] The impetus to use the newest drugs, devices and procedures is nonetheless reinforced not only by marketing departments of multinationals, but also by the secular religion of our times—faith in scientific progress.

In fact, it is precisely because we have made too little progress in understanding IHD and related atherosclerotic disorders that publicly-funded research remains the cornerstone of the campaign against IHD. Enhanced research capacity is needed on four fronts.

First and foremost, Canada must increase its investment in fundamental investigation, seeking to elucidate the underlying mechanisms of atherosclerosis and vascular biology in hopes of mitigating the impact of various recognized risk factors and identifying new modifiable factors. Fortunately, molecular biologists in laboratories around the world are fomenting the most profound revolution in diagnostics and therapeutics that has occurred since vaccine therapy and antibiotics transformed the epidemiology of infectious diseases. It is possible that we may some day have vaccinations that limit the impact of atherosclerosis in the general population, or "designer drugs" that normalize the lipid profiles of individuals with genetic dyslipidemias. Imagine, too, the change in the management and outcomes of CHF if we had mechanisms to stimulate the regeneration of myocardial muscle by the combination of a gene-based therapy and, say, a graduated exercise program.

Second, the revolution in molecular biology must be coupled with clinical and epidemiological studies designed to identify populations at risk and determine the risks and benefits of new gene-based tools in those populations. Moreover, the move to a molecular footing in diagnosis and therapeutics will be gradual. In the interim there is no shortage of opportunities for innovative clinical studies testing more traditional pharmaceuticals, medical devices and procedures. Some of these studies can be conducted with industry support; others will require public funding. We also need investments in research concerning the cardiovascular ELSIs—the ethical, legal and social issues—that have become increasingly complex as medicine embraces more fundamental and expensive technologies.

Third, as *Cardiovascular Health and Services in Ontario* illustrates, there is a continuing need for clinical evaluation, health services research and epidemiological studies of health and health care. Our national heart-health surveys, while ambitious and useful, lacked sufficient sample size to permit profiling of risk factors at the local level. And Canada has yet to develop the equivalent of a Framingham or Whitehall Study that would help researchers untangle the causes and consequences of IHD.

We have emphasized throughout the Atlas and in this concluding chapter that many of our findings are tentative, requiring detailed follow-up studies at a local or regional level. Some of that follow-up work is not evaluative research in the traditional sense, but rather consists in clinical audits and guideline implementation initiatives that should be supported as an integral part of quality maintenance and improvement in every provincial health care system. As well, various of the analyses in this Ontario Atlas might usefully be replicated for other provinces. We believe that Canadian patients and taxpayers, along with health professionals, researchers, administrators, policy-makers, and other provincial Heart and Stroke Foundations, should routinely have access to this type of information no matter where they live and work.

Fourth, even as intersectoral integration has become a focal point for reform in the Canadian health care system, so also has the research community evinced much greater interest in interdisciplinary research. Investments to foster integrative research could pay enormous dividends. For example, unless vascular biologists, epidemiologists and social scientists collaborate, we shall never delineate how relative deprivation acts to generate such dramatic increases in the incidence of atherosclerotic disease. Ongoing integrative research is already illuminating how the genotype of Aboriginal peoples predisposes them to diabetes and atherosclerosis. Longer term, we need more research of this nature so that superficial ethnoracial characterizations that are crudely linked to differing levels of IHD risk can be replaced by exact genotypic profiles.

In sum, Canadian cardiovascular researchers are limited not by a lack of challenges, or by a shortage of ideas and tools that could usefully expand our knowledge, but rather by insufficient funding and a risk-averse culture that is an outgrowth of two decades in which scarcity has made "safe science" the national norm.

Post Script

This conclusion has explicitly or implicitly suggested a wide range of initiatives in areas such as research, health promotion, clinical prevention, quality enhancement in acute and community-based care, and health policy-making. Some may object that the agenda of initiatives set out above is unduly ambitious. Given the continuing toll of ischemic heart disease and related atherosclerotic conditions on our society, and given, too, the information in the preceding chapters, we believe the exact opposite is true. The burden of proof is surely no longer on those who propose positive changes that may improve cardiovascular health and services, but rests instead on those who seek to defend the status quo.

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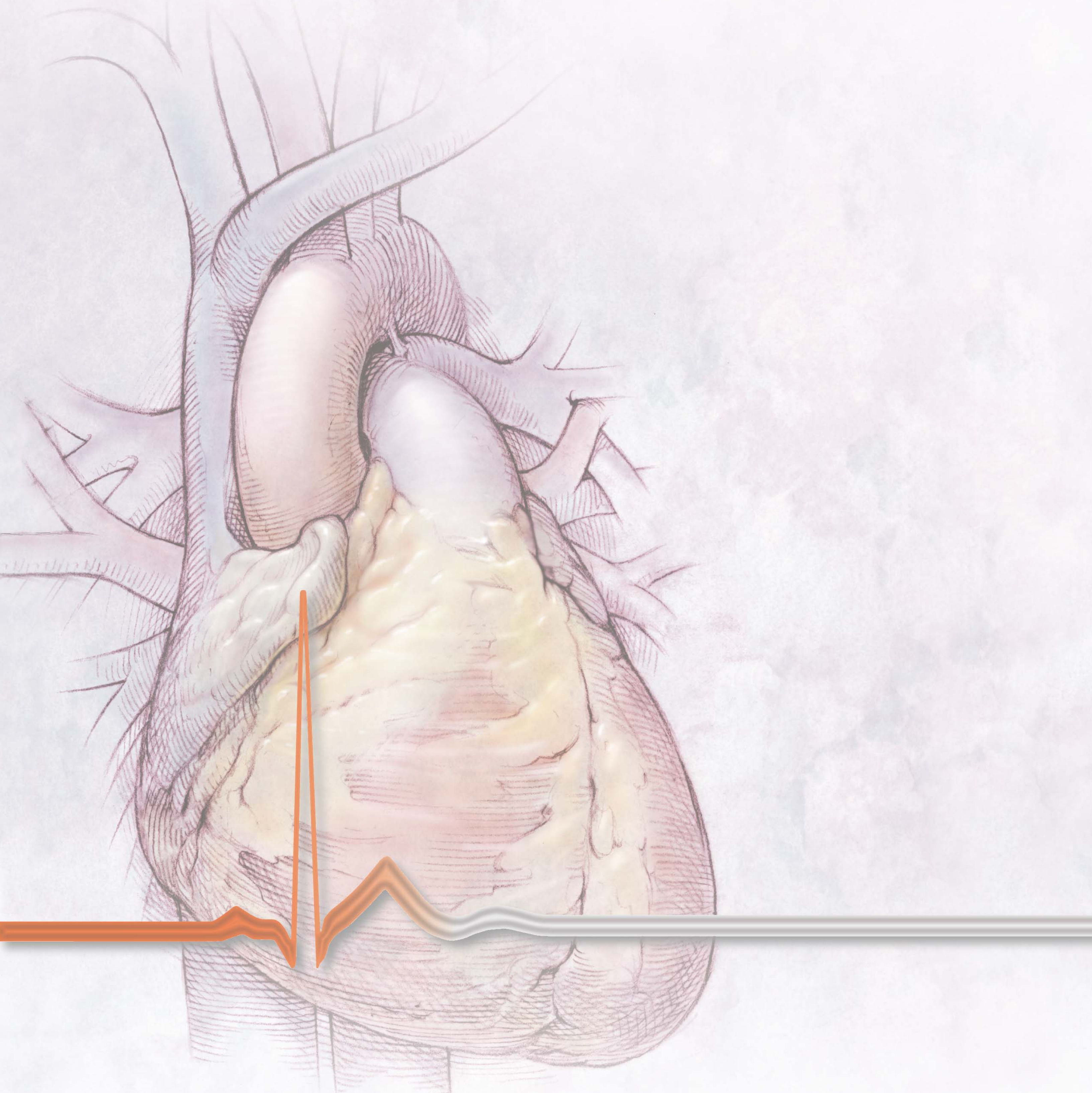

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