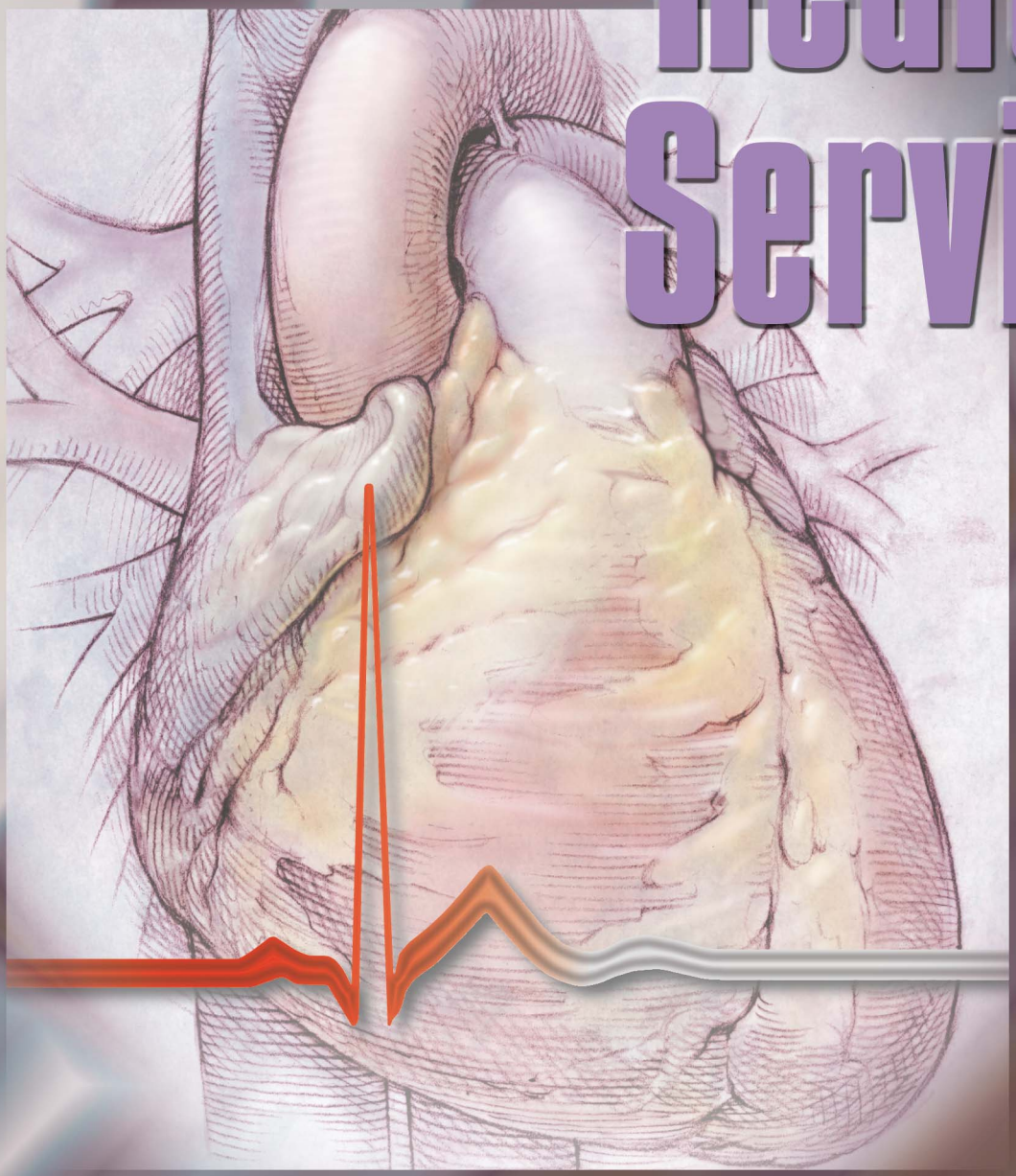
Technical and Methods Appendices

Cardiovascular Health & Services

IN ONTARIO

AN ICES ATLAS



ICES

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HEART AND STROKE FOUNDATION OF ONTARIO

Cardiovascular Health & Services

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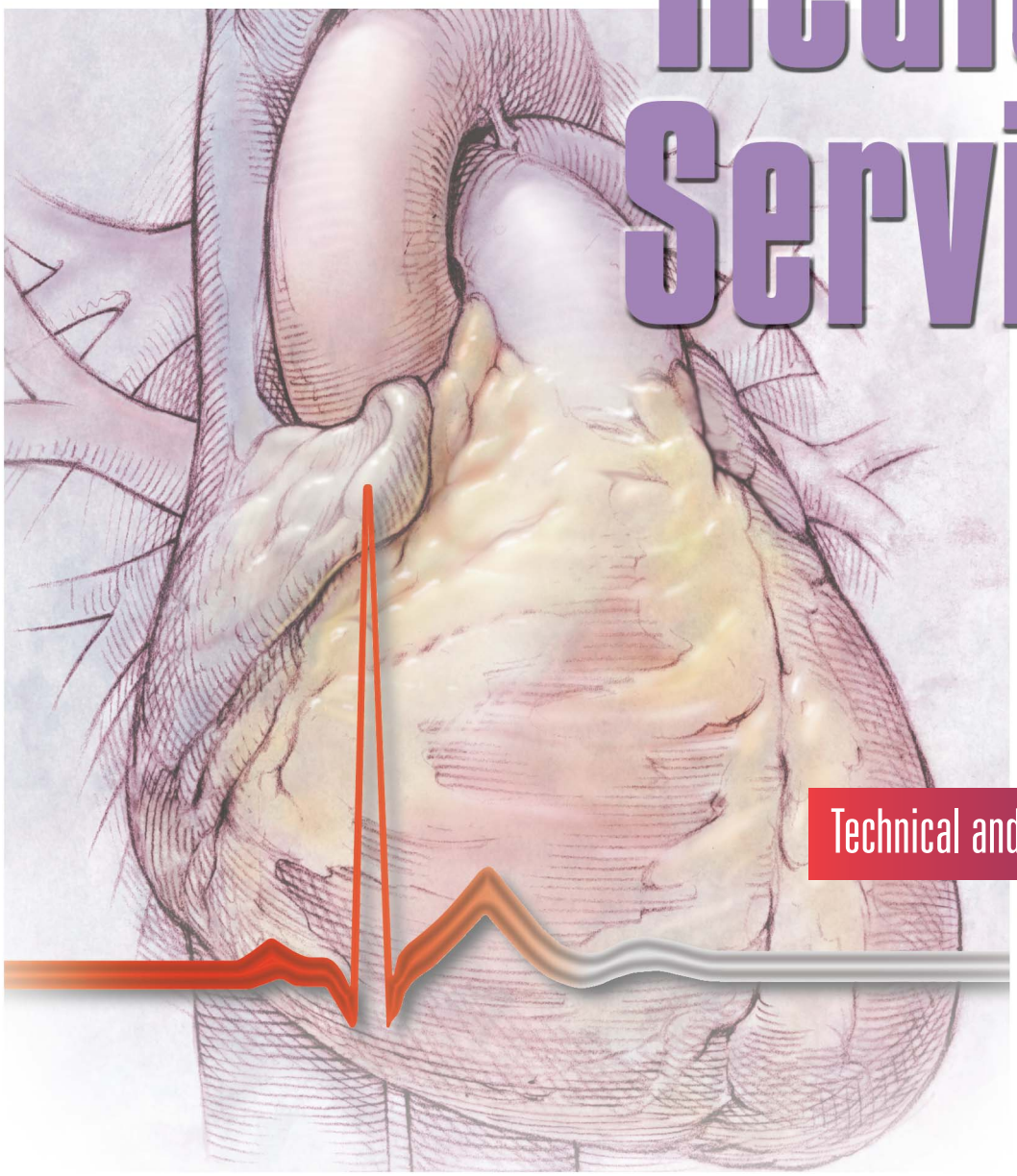

Technical and Methods Appendices

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The opinions, results and conclusions are those of the authors and no endorsement by the Ministry of Health, the Heart and Stroke Foundation of Ontario or the Institute for Clinical Evaluative Sciences is intended or should be inferred.

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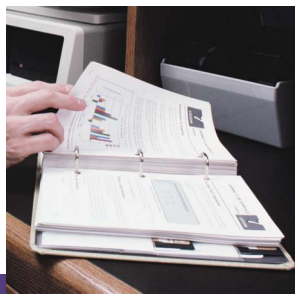

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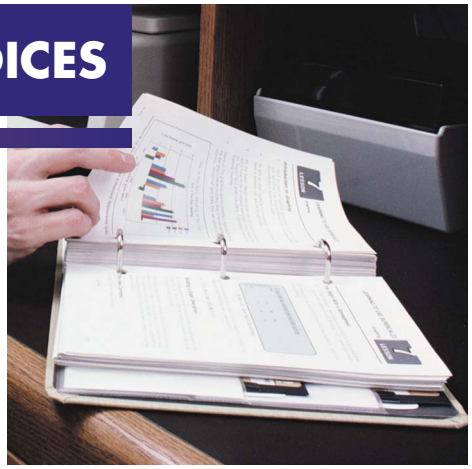

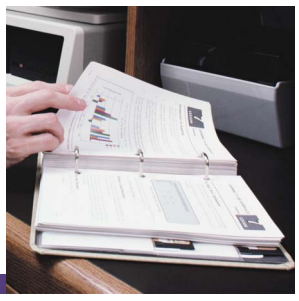

Technical Appendix

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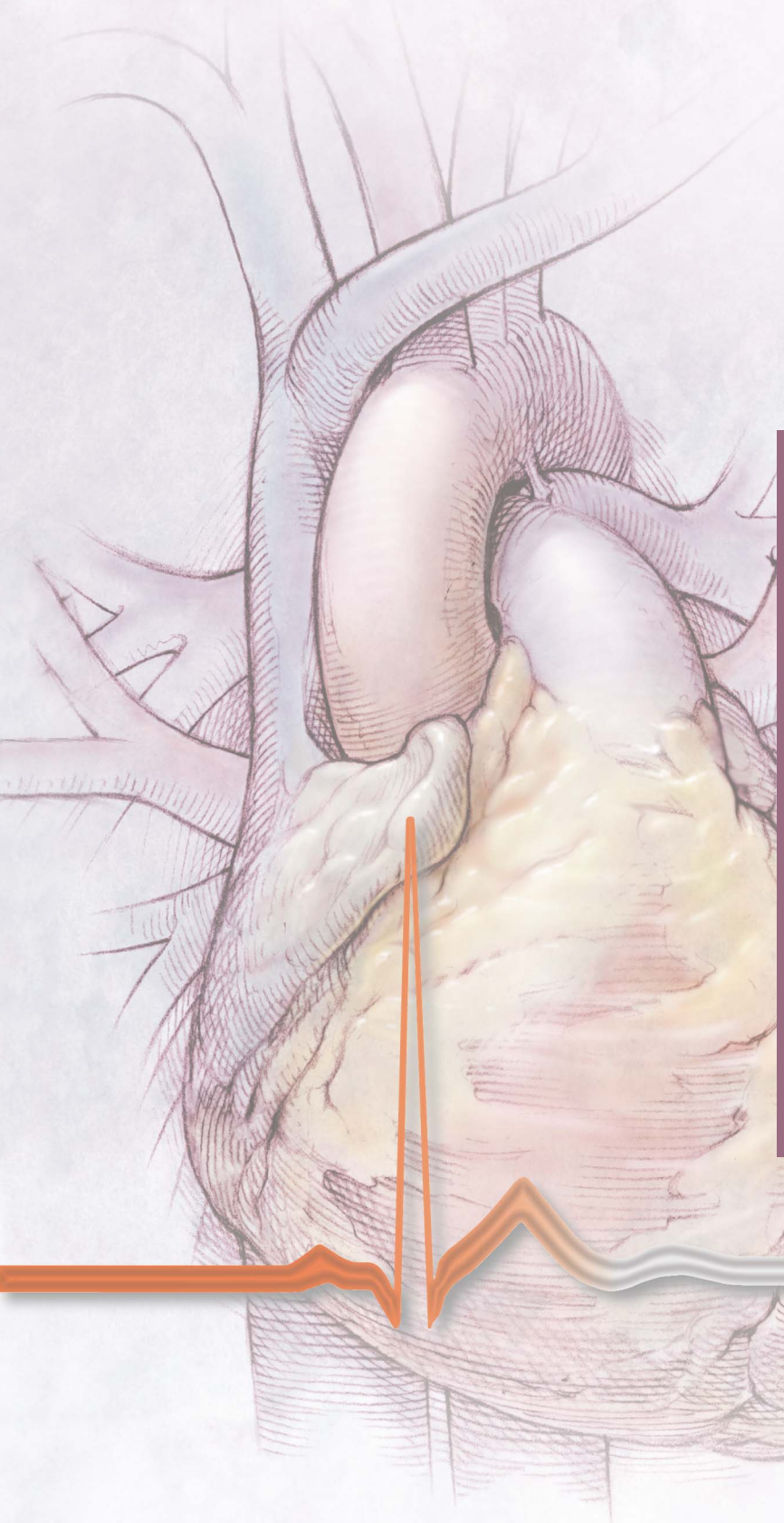
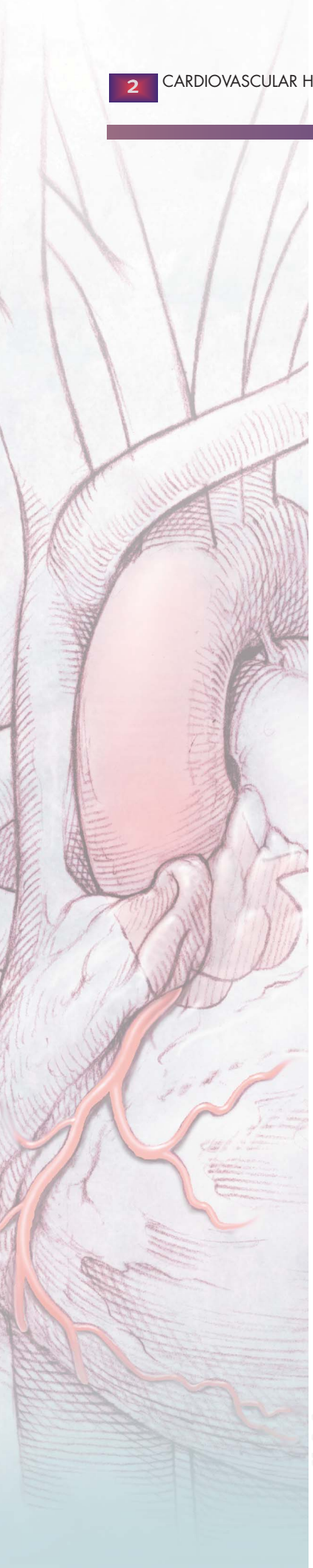


Key messages

- *The purpose of this Technical Appendix is to provide more detail about the data sources used and the rationale behind some of the methodological and presentation decisions that were made in developing Cardiovascular Health & Services in Ontario. We present a description of the common data sources that were used, their advantages and limitations and provide background for the analyses at the District Health Council (DHC), municipality and hospital level. For chapter-specific technical or methodological information, please refer to the Methods Appendix for the appropriate chapter.*



About the Data

The findings and conclusions that result from research are only as meaningful as the data that are used for the analyses. In this Atlas, we draw heavily on administrative data that are routinely collected for financial or administrative purposes and population-based survey data. Although health services researchers and planners routinely use these sources of information, the data have limitations. General health surveys require a high response rate to render the survey results valid and generalizable to the population. Also, most surveys rely on self-report and proxy responses which may be sources of bias. Since administrative data are not collected for research, we may not be able to answer pressing research questions because the desired information is not present in the database. Also, systematic and random variations in coding occur, and therefore, experience in working with the data and clinical expertise are necessary when analyzing and interpreting information from these data.

Administrative and large survey data are very useful however, because they comprehensively cover an entire population or geographic area, are low cost, and are generally subjected to standardization of coding and other data quality checks. Traditionally, these databases were used independently to provide "snapshots" of different health care sectors (e.g. hospitals, physician service patterns, use of prescription drugs, health-related behaviours or conditions from surveys). However, using computer-generated linking strategies with anonymous identifiers to safeguard patient privacy, we are now able to combine some of these databases to gain a more comprehensive view of the health system.

Since most of the data used in this Atlas were not collected by the Institute for Clinical Evaluative Sciences (ICES), how sure are we that the information is complete and accurate? In the second ICES Practice Atlas, Williams and Young summarized the studies that examined the quality of health care administrative databases in Canada.[1] Overall, the following conclusions were made:

- demographic information is relatively complete and reliable;
- hospital surgical procedure codes and major procedure codes reflecting claims to the Ontario Health Insurance Plan (OHIP) are reasonably accurate;
- primary diagnosis coding for in-hospital services varies in accuracy but is generally reliable;
- clinical data regarding co-existing conditions and especially complications are not consistently coded;
- the coding systems have not kept pace with the changes in medical technology and clinical practice;
- billing claims for physician services are complete and relatively accurate; however, the accompanying diagnosis codes are useful primarily at the aggregate level, owing to interindividual variability in coding accuracy.

In the light of these points, it is necessary to consider the constraints and limitations of each dataset in the interpretations and conclusions made from each analysis.

Data Sources

Technical Appendix TA.1 is a chapter-by-chapter summary of the many data sources that were used in this Atlas. More detailed information is found below.

Canadian Institute for Health Information (CIHI)

Most of the chapters in this Atlas utilize hospital discharge data organized by CIHI. All hospitals in Ontario are required to submit demographic and clinical information about all hospital admissions and discharges, including transfers and deaths, to CIHI which collate these data. Trained hospital medical records staff transcribe information from each patient's medical chart using standard diagnosis and procedure codes (International Classification of Diseases-9th revision and Canadian Classification of Procedures—see Glossary). We use this dataset for information on each patient's age, sex and location of residence, as well as hospital-based services (procedures and diagnoses), in-hospital outcomes and length of hospital stay.

Cardiac Care Network Database (CCN)

Chapters 9, 10 and 12 use data from the Cardiac Care Network (CCN). The CCN is an advisory body dedicated to ensuring equitable, timely and appropriate access to cardiac services in Ontario. The CCN database contains records for all patients on the waiting list for open heart surgery in Ontario. Patients are removed from the waiting list once they receive surgery, if it is decided for any reason that surgery will not be performed, or if the patient dies without having received surgery. Both the intended procedure and the actual procedure received are recorded. The database is organized according to the date of removal from the waiting list.

The information includes demographic, clinical and administrative data (such as date of acceptance to and removal from the list). An Urgency Rating Score (URS —see Glossary) is computed for all patients waiting for bypass surgery. Based on the URS, a Recommended Maximum Waiting Time (RMWT) is derived. No information about the outcomes of the surgery is available in this database. An audit of the 1996/97 CCN data showed that 96% of the information for key fields was accurate.

Intercontinental Medical Statistics (IMS)

IMS Canada is a private organization that provides a national source of information for the health industry. IMS collects, codes and processes information from physicians, pharmacies and hospitals about diagnoses, disease patterns and treatments, effects of government cost containment programs and cost-benefit analyses for new therapies. Information from IMS is found in Chapter 16.

Metropolitan Toronto Ambulance (MTA) Database

The MTA service maintains a database which contains data abstracted from Ambulance Call Report (ACR) forms. These forms are generated each time an ambulance responds to an emergency call. They are completed by the responding ambulance staff.

The ACR form collects demographic (age, sex and accepting hospital), clinical (symptoms and nature of the emergency) and procedural (procedures and interventions used) information. This database is used in Chapter 15.

National Physicians Database (NPDB)

The NPDB is an aggregated file containing OHIP information—that is, the claims submitted to and the reimbursements provided by OHIP, grouped by age, sex, physician type and diagnostic service. Because the datasets in this format are much smaller, they are much easier to use than OHIP individual data. However, we cannot combine or link this dataset with others because of its aggregated nature. Chapters 13 and 16 utilize the NPDB.

Ontario Drug Benefit (ODB) Program

Chapters 11 and 14 use Ontario Drug Benefit (ODB) data. The ODB program provides drug benefits for senior citizens and those receiving social assistance in Ontario. Pharmacists submit claims for each prescribed drug that is covered under the ODB formulary. These claims form the basis of the ODB database. Information in the database includes: dispensing date, quantity of pills dispensed (but not dosage) and cost. The ODB database was designed to facilitate financial reimbursement to the pharmacist who dispenses the drug—not for research. However, we are able to link the ODB information with other information, such as hospital discharges from CIHI, in order to gain more clinical information about those who are prescribed certain drugs. We are not able to consistently capture use of non-prescription drugs, such as aspirin.

Ontario Health Insurance Plan (OHIP)

In Ontario, physicians submit claims to OHIP for reimbursement for provided services. These services include: physician consults or assessments in private offices, acute care and long-term care facilities; technical and professional components of diagnostic and therapeutic procedures; surgical procedures; and laboratory services. These service data are relatively accurate because the information submitted is associated with a reimbursement fee and can be linked or combined with other data, such as hospital discharge abstracts. The database also includes some associated diagnostic and demographic information which, unfortunately, is not very reliable at the individual level. OHIP data only capture information for those physicians who work on a fee-for-service basis. Those physicians who are reimbursed by Alternate Funding Plans or salary are not represented. Chapters 8 and 16 use OHIP data.

Ontario Health Survey (OHS) and the National Population Health Survey (NPHS)

Chapter 1 and 4 rely on information from surveys. The 1990 OHS was a household survey initiated by the Ontario Ministry of Health to understand the health of the Ontario population while the NPHS (1994) was a national effort. Information was collected in two parts. In the first part, a person from each sample household answered questions from an interviewer about all the members of the household. This part included information about demographics, economics and labour force, disability, chronic conditions and health care utilization. The second part was a self-administered questionnaire for one person aged 12 years and over in each household and concentrated on health behaviours.

Survey responses differ from administrative data in that they are most often collected for research purposes and often include many variables of interest. Survey information provides a level of understanding about health practices and behaviours that is unattainable from other data sources. However, surveys are often cross-sectional—the information captured in them describes the state of the population at one point in time. Also, in these surveys, much of the information was gleaned from a proxy responder. This may affect the accuracy of the data. For this survey, those living in institutions or nursing homes, employed in the foreign services or living in remote areas did not participate and therefore the results may be skewed. The OHS and NPHS are also limited in that the smallest geographic area that can be captured are the Public Health Unit and Ministry of Health planning regions respectively.

Ontario Home Care Administration System (OHCAS)

Home care consists of health and support services within the home. These services are coordinated through Community Care Access Centres (CCACs), funded by the Ministry of Health. Based on patients' eligibility and individual needs, CCAC intake workers develop and monitor service plans that may consist of nursing, physiotherapy, social work and/or homemaking services. The Ontario Home Care Administration System (OHCAS) is the database associated with Ontario home care provision. Every time a service is provided, a claim is issued indicating the type of services rendered, and clinical and demographic information. The main limitation of OHCAS is that the diagnostic information is not coded into the database by trained personnel. Therefore, there is limited standardization of diagnostic coding across CCACs. As well, OHCAS is only reliable in determining whether an individual received services but is less informative as to the intensity (e.g. the number of services). Chapter 17 focuses on home care use in Ontario and links CIHI data to home care data to avoid the problem of inconsistent coding in OHCAS.

Ontario Myocardial Infarction Database (OMID)

The OMID was created by ICES researchers with support from the Medical Research Council of Canada to study population-based quality and patterns of care, readmissions, drug use and short and long-term mortality for those who had an acute myocardial infarction between fiscal 1994/95 and 1996/97. The OMID links all of Ontario's major administrative databases (CIHI, OHIP, ODB, RPDB). Please refer to the Methods Appendix for Chapter 5 for more detail. Chapters 5, 8, 11 and 14 used the OMID.

Registered Persons Database (RPDB)

The Registered Persons Database was developed and is maintained by the Ministry of Health. It consists of the health card number, date of birth, sex, postal code and death date (where applicable) associated with the carrier of each valid Ontario health card. The RPDB was used to confirm in-hospital deaths that were recorded in the CIHI data and to capture deaths that occurred up to one year out-of-hospital in Chapters 2, 5, 7, 8 and 14. It was also used in the creation of OMID.

Southam Database on Physician Human Resources

This proprietary database provides recent information about the supply, distribution and migration patterns of physicians in Canada. The database contains demographic information including specialty type, hospital affiliation, university and year of graduation. Chapter 16 uses this information in combination with the National Physicians Database to describe physician services and expenditures as they relate to cardiac procedures.

Vital Statistics

The Metro Toronto Ambulance Study in Chapter 15 uses vital statistics data in the analysis of emergency services in Ontario. These statistics include events such as births, deaths, marriage, stillbirth, divorce, parentage, adoption and change of name occurring in the province of Ontario and are recorded by the Office of the Registrar General, a division of the Ministry of Consumer and Commercial Relations of Ontario. Accompanying demographic information is also collected. In this Atlas, the death statistics were used in concert with other databases. A death certificate is completed by the physician attending to the death; the Statement of Death is completed at the time of death by the family and the funeral director. The cause of death is reviewed by a trained medical coder. The information on the certificates may be missing or incorrect if there are no relatives of the deceased present to verify the collected data.

The Changing Environment: Analysis by District Health Councils, Major Municipalities and Hospitals

District Health Councils/Major Municipalities

As we stated in the section "A General Introduction for Readers," most of our geographic analyses are by District Health Council (DHC). We chose to use these areas because in most cases, they are large enough to provide stable rates. From a policy perspective, presentation of data by DHC also made sense because of the DHCs' planning responsibilities. We have presented the data according to current DHC boundaries. A list of the current and past DHC names can also be found in the introductory section of the first volume of this set.

We also present data for large municipalities versus other areas within Ontario DHCs. We did this because some DHCs have distinct urban/rural components that are masked by presenting the DHC rates as a whole. Therefore, we performed two analyses—one by DHC and one by major municipality versus other areas. To break out the major municipal areas, we used the 1996 Canadian Census to flag all the municipalities with populations of 100,000 or more and calculated rates accordingly. Because the populations for rate denominators are different between the DHC-level and the municipality level analysis there may be apparent inconsistencies in the presented rates (DHC-level analyses use intercensal populations, while the major municipality-level analyses use 1996 Census data for rate denominators). In the major municipality tables, we only present DHCs that have both large urban and rural areas; we do not include Toronto because it does not have a rural component.

Area variations are also shown graphically. We created the DHC-specific maps using a geographic program called MapInfo Professional.[2] A natural break function in MapInfo allows the rates to be partitioned into five parts so that each part has as small a standard deviation as possible. Therefore, the rates are presented graphically in so-called quintiles; however, the number of DHCs in each of the five parts are not equal, as would be if we used "true" quintiles. As well, MapInfo supplies the cutoff points for each of the so-called quintiles. The last rate in a quintile range appears to be equal to the first rate in the next quintile range. However, if a rate is on a quintile cusp, MapInfo assigns it to the next highest quintile group.

Hospitals

In 1996, the Health Services Restructuring Commission (HSRC) was given a three-year mandate with specific responsibilities for restructuring the way hospital care was delivered in the province. After intensive research, the HSRC gave directives for many hospital mergers and closures. Many of these hospital changes occurred during the time frame that is portrayed in this book.

Chapters 5, 6, 8 and 9 present information organized by hospital. As with most of the other analyses, the hospital-specific information that we present draws on hospital discharge abstracts obtained from CIHI. To reconcile the changing hospital environment in our data tables, we looked at the names that the affected hospitals used in submitting their data to CIHI, before and after their effective merger date. If a hospital continued to submit information under its original name, we report it that way. If after the effective merger date a hospital submitted its data under the new merged name, we present the data under the new hospital name. Technical Appendix TA.2 provides a cross-reference listing of hospital names before and after their effective merger dates. This Appendix is assumed to be accurate as of December, 1998. For more information on hospital closings and mergers, please refer to the Ontario Hospital Association website (www.oha.com).

The hospital-specific tables are categorized into teaching, large, medium and small hospitals according to a measure called the Resource Intensity Weight (RIW —see Glossary). This measure assesses the clinical and financial resources used for each diagnosis or procedure. A large hospital was defined by an RIW greater than 1328.93, a medium hospital was defined by an RIW between 396.11 and 1328.93 and a small hospital, by an RIW of less than 396.11.

References

1. Williams JI and Young W. A Summary of Studies on the Quality of Health Care Administrative Databases in Canada. In: Goel V, Williams JI, Anderson GM, Blackstien-Hirsch P, Fooks C, Naylor CD (eds). *Patterns of Health Care in Ontario, The ICES Practice Atlas. 2nd edition.* Ottawa: Canadian Medical Association, 1996:339-345.
2. MapInfo Professional [computer program]. Version 4.5 Supplement. Troy (NY): MapInfo Corporation; 1997.

TECHNICAL APPENDIX TA.1 Data Sources and Years Used for Analyses in the Cardiovascular Atlas by Chapter

Chapter	Data Sources	Years
Chapter 1: Burden of Cardiac Disease	Ministry of Consumer and Commercial Relations, Annual Report Statistics Canada, Life Tables Statistics Canada, Cardiovascular Mortality National Population Health Survey	1997 1995 1981/82 - 1996/97 1994
Chapter 2: Common Reasons for Hospitalization for Cardiovascular Medical Diagnoses	Canadian Institute for Health Information Statistics Canada Registered Persons Database	1992/93 - 1996/97 1991; 1996
Chapter 3: Area Variation in Heart Disease Mortality Rates	Statistics Canada, Cardiovascular Mortality	1991/92 - 1996/97
Chapter 4: Risk Factors for Cardiovascular Disease	Ontario Health Survey Statistics Canada, Cardiovascular Mortality	1990 1991/92 - 1996/97
Chapter 5: Acute Myocardial Infarction Outcomes in Ontario	Canadian Institute for Health Information Registered Persons Database Ontario Myocardial Infarction Database	1994/95 - 1997/98
Chapter 6: Congestive Heart Failure Outcomes in Ontario	Canadian Institute for Health Information Registered Persons Database	1993/94 - 1997/98
Chapter 7: Procedures for Abdominal Aortic Aneurysm and Peripheral Vascular Disease	Canadian Institute for Health Information Statistics Canada Registered Persons Database	1992/93 - 1996/97 1991; 1996
Chapter 8: Use of Coronary Angiography, Angioplasty and Bypass Surgery After Acute Myocardial Infarction in Ontario	Canadian Institute for Health Information Ontario Health Insurance Plan Registered Persons Database Ontario Myocardial Infarction Database	1993/94 - 1997/98 1993/94 - 1997/98
Chapter 9: Patterns of Revascularization	Canadian Institute for Health Information Cardiac Care Network, Annual Report	1994/95 - 1997/98 1997/98
Chapter 10: Outcomes of Coronary Artery Bypass Surgery in Ontario	Cardiac Care Network Registry Database Canadian Institute for Health Information	1994 - March 1997 1994 - March 1997
Chapter 11: Secondary Prevention After Acute Myocardial Infarction, Congestive Heart Failure and Coronary Artery Bypass Graft Surgery in Ontario	Canadian Institute for Health Information Ontario Drug Benefit Program Ontario Myocardial Infarction Database	1994/95 - 1997/98 1994/95 - 1997/98
Chapter 12: Waiting Lists for Cardiac Surgery	Cardiac Care Network Registry Database Cardiac Care Network, Annual Report Cardiac Care Network, Statistical Summary Report Cardiac Care Network, Rolling Quarterly Reports	1993/94 - 1997/98 1997/98 1997/98 October - December 1996 to March - May 1998
Chapter 13: Non-invasive Cardiac Diagnostic Testing	National Physician Database Canadian Institute for Health Information	1989/90 - 1996/97 1989/90 - 1996/97
Chapter 14: Ethnoracial Origins and Heart Disease	Canadian Institute for Health Information Canadian Census SHARE Database Registered Persons Database Ontario Drug Benefit Program Ontario Myocardial Infarction Database	1991/92 - 1996/97 1991; 1996 1997
Chapter 15: Cardiac Arrest Care and Emergency Medical Services	Ontario Prehospital Advance Life Support Study Data Peel Base Hospital Program Metropolitan Toronto Ambulance Database Canadian Institute for Health Information Base Hospital Survey Data Statistics Canada, Vital Statistics	1995 - 1997 1996 1992 1992; 1997 1998 1992
Chapter 16: Access to Physician Services and Patterns of Practice	Ontario Health Insurance Plan Canadian Institute for Health Information National Physician Database Statistics Canada, Vital Statistics Southam Physician Database Intercontinental Medical Statistics	1991/92 - 1996/97 1994/95 - 1996/97 1991/92 - 1996/97 1991/92 - 1996/97 1995 -1996
Chapter 17: Home Care Utilization Following Hospitalization for Cardiovascular Disease	Ontario Home Care Administration System Canadian Institute for Health Information	1994/95 - 1996/97 1994/95 - 1996/97
Chapter 18: Women and Heart Disease	Compilation of all of the above data sources	All of the above

TECHNICAL APPENDIX TA.2 The Changing Hospital Environment in Ontario, 1992 - Present (as of December, 1998)

Hospital Names in Italics = Location No Longer In Operation Under This Name

All Hospitals from 1992 to Present	Effective Name Change/City/Site	Effective Name Change/ Merge/Close Date
Ajax and Pickering General Hospital	Rouge Valley Health System, Ajax and Pickering	04/99
Alexandra Hospital, Ingersoll		
Alexandra Marine and General Hospital, Goderich		
Algonquin Health Services, Huntsville		12/98
Almaguin Health Centre, Burk's Falls	Closed	02/92
Almonte General Hospital		
Anson General Hospital, Iroquois Falls	MICS Group of Hospitals, Iroquois Falls	Pending
Arnprior and District Memorial Hospital (The)	Ottawa Valley Hospital Alliance, Arnprior	Pending
Atikokan General Hospital		
Belleville General Hospital		
Bancroft		
Bingham Memorial, Matheson	MICS Group of Hospitals, Matheson	Pending
Brantford General Hospital		
Brockville General Hospital		
Bruce Peninsula Health Services, Wiarton	Grey Bruce Health Services, Wiarton	04/99
Bruce Penisula Health Services, Lions Head	Grey Bruce Health Services, Lions Head	04/99
Cambridge Memorial Hospital		
Campbellford Memorial Hospital		
Carleton Place and District Memorial Hospital	Ottawa Valley Hospital Alliance, Carleton Place Site	Pending
Centenary Health Centre, Scarborough	Rouge Valley Health System, Scarborough	04/99
Central Hospital, Toronto	Wellesley-Central Hospital, Toronto; now St. Michael's Hospital, Toronto	04/96; 04/99
Centre Grey General Hospital, Markdale	Grey Bruce Health Services, Markdale	04/99
Chapleau Health Services		
Charlotte Eleanor Englehart Hospital, Petrolia		
Chatham-Kent Health Alliance		04/96
Public General Campus, Chatham		
St. Joseph's Campus, Chatham		
Sydenham District Campus, Wallaceburg		
Chedoke-McMaster Hospital, Hamilton	Hamilton Health Sciences Corporation, Chedoke-McMaster Division	04/98
Chedoke-McMaster Hospital - Paediatric Program, Hamilton	Hamilton Health Sciences Corporation, Chedoke-McMaster Division	04/98
Chesley and District Memorial Hospital	South Bruce Grey Health Centre, Chesley	04/98
Children's Hospital of Eastern Ontario, Ottawa		
Children's Hospital of Western Ontario, London	London Health Science Centre	04/97
Clinton Public Hospital		
Cobourg District General Hospital	Northumberland Health Care Corporation, Cobourg	04/97
Collingwood General and Marine Hospital		
Community Memorial-Port Perry Hospital, Scugog	Lakeridge Health Corporation, Port Perry	04/99
Cornwall General Hospital		
Cottage Hospital, Uxbridge	Lakeridge Health Corporation, Uxbridge	04/99
County of Bruce General Hospital, Walkerton	South Bruce Grey Health Centre, Walkerton	04/98
Credit Valley Hospital (The), Mississauga		
Deep River and District Hospital Corporation		
Doctors Hospital (The), Toronto	Closed	08/97
Douglas Memorial Hospital, Fort Erie		
Dryden District General Hospital		
Dufferin Area Hospital, Orangeville	Dufferin-Caledon Health Care Corporation, Orangeville	04/93
Dufferin-Caledon Health Care Corporation, Orangeville		
Durham Memorial Hospital	South Bruce Grey Helath Centre, Durham	04/98
Englehart and District Hospital		
Espanola General Hospital		
Etobicoke General Hospital	Northwest GTA Hospital Corporation, Etobicoke	04/99
Four Counties General Hospital, Newbury	Four Counties Health Services, Newbury	04/99
General Hospital of Port Arthur, Thunder Bay	Thunder Bay Regional Hospital, Port Arthur	06/96
Georgetown and District Memorial Hospital	Northwest GTA Hospital Corporation, Georgetown	04/99

TECHNICAL APPENDIX TA.2 Cont'd.

Hospital Names in Italics = Location No Longer In Operation Under This Name

All Hospitals from 1992 to Present	Effective Name Change/City/Site	Effective Name Change/ Merge/Close Date
Geraldton District Hospital		
Glengarry Memorial Hospital, Alexandria		
Grand River Hospital Corporation, Kitchener		
Greater Niagara General Hospital, Niagara Falls		
Grey Bruce Health Services		04/99
Lions Head		
Markdale		
Meaford		
Owen Sound		
Southhampton		
Wiarton		
Grey Bruce Regional Health Centre, Owen Sound	Grey Buce Health Services, Owen Sound	04/99
Groves Memorial and Community Hospital, Fergus		
Guelph General Hospital		
Haldimand War Memorial Hospital, Dunnville		
Haliburton General Hospital	Haliburton Highlands Health Services Corporation, Haliburton	04/96
Haliburton Highlands Health Services Corporation		04/96
Haliburton		
Minden		
Halton Healthcare Services Corporation		04/99
Milton		
Oakville		
Hamilton Civic Hospitals (General Division)	Hamilton Health Sciences Corporation, Hamilton Civic General Division	04/98
Hamilton Civic Hospitals (Henderson Division)	Hamilton Health Sciences Corporation, Hamilton Civic General Division	04/98
Hamilton Health Sciences Corporation		04/98
Chedoke-McMaster Division		
Hamilton Civic General Division		
Hamilton Civic Henderson Division		
Hanover and District Hospital		
Hôpital General de Hawkesbury and District General Hospital Inc.		
Hôpital Montfort, Ottawa		
Hôpital Notre Dame, Hearst		
Hornepayne Community Hospital		
Hospital for Sick Children (The), Toronto		
Hôtel Dieu Hospital, Cornwall		
Hôtel Dieu Hospital, Kingston		
Hôtel Dieu Hospital, St. Catharines		
Hôtel Dieu Grace Hospital, Windsor		04/95
Grace Site		
St. Joseph's Site		
Hôtel Dieu St. Joseph's Hospital, Windsor	Hôtel Dieu Grace Hospital, Windsor	04/95
Humber Memorial Hospital, Weston	Humber River Regional Hospital, Church Street	04/98
Humber River Regional Hospital		04/98
Church Street		
Finch Avenue		
Keele Street		
Huntsville District Memorial Hospital	Algonquin Health Services, Huntsville	12/98
Huronia District Hospital, Midland	North Simcoe Hospital Alliance, Huronia	04/92
James Bay General Hospital		
Attawapiskat		
Fort Albany		
Moosonee		
Joseph Brant Memorial Hospital, Burlington		
Kemptville District Hospital	Ottawa Valley Hospital Alliance, Kemptville	Pending

TECHNICAL APPENDIX TA.2 Cont'd.

Hospital Names in Italics = Location No Longer In Operation Under This Name

All Hospitals from 1992 to Present	Effective Name Change/City/Site	Effective Name Change/ Merge/Close Date
Kincardine and District General Hospital	South Bruce Grey Health Centre, Kincardine	04/98
Kingston General Hospital		
Kirkland and District Hospital		
Kitchener-Waterloo Hospital	Grand River Hospital Corporation, Kitchener	04/95
L' Hôpital Regional de Sudbury Regional Hospital,		Pending
Laurentian Site		
Memorial Site		
St. Joseph's Health Centre		
Lady Dunn Hospital, Wawa	North Algoma Health Organization, Wawa	06/95
Lady Minto Hospital (The), Cochrane	MICS Group of Hospitals, Cochrane	Pending
Lake of the Woods District Hospital, Kenora		
Lakeridge Health Corporation		04/99
Bowmanville		
Oshawa		
Port Perry		
Uxbridge		
Whitby		
Laurentian Hospital, Sudbury	L' Hôpital Regional de Sudbury Regional Hospital, Laurentian Site	Pending
Leamington District Memorial Hospital		
Lennox and Addington County General Hospital, Napanee		
Listowel Memorial Hospital		
London Health Science Centre		04/97
Children's Hospital of Western Ontario Campus		
University Campus		
Victoria Campus		
Louise Marshall Hospital, Mount Forest		
Manitoulin Health Centre		
Little Current		
Mindemoya		
Manitouwadge General Hospital, Mattawa		
Markham Stouffville Hospital		
Mattawa General Hospital		
McCausland Hospital (The), Terrace Bay		
McKellar General Hospital, Thunder Bay	Thunder Bay Regional Hospital, McKellar Site	04/96
Meaford General Hospital	Grey Bruce Health Services, Meaford	04/99
Memorial Hospital, Bowmanville	Lakeridge Health Corporation, Bowmanville	04/99
Metropolitan General Hospital, Windsor	Windsor Regional Hospital, Metropolitan Campus	04/96
MICS Group of Hospitals		Pending
Cochrane		
Matheson		
Iroquois Falls		
Milton District Hospital	Halton Healthcare Services Corporation, Milton	04/99
Minden Hospital	Haliburton Highlands Health Services Corporation, Minden	04/96
Mount Sinai Hospital, Toronto		
Niagara-on-the-Lake General Hospital		
Nipigon District Memorial Hospital		
Norfolk General Hospital, Simcoe		
North Algoma Health Organization, Wawa		
North Bay Civic Hospital	North Bay General Hospital, McLaren Site	04/95
North Bay General Hospital	North Bay General Hospital, Scollard Site	04/95
North Bay General Hospital		04/95
McLaren Site		
Scollard Site		
North Durham Health Services, Port Perry, Uxbridge	Lakeridge Health Corporation, Port Perry and Uxbridge	04/99

TECHNICAL APPENDIX TA.2 Cont'd.

Hospital Names in Italics = Location No Longer In Operation Under This Name

All Hospitals from 1992 to Present	Effective Name Change/City/Site	Effective Name Change/ Merge/Close Date
North York Branson Hospital	North York General, Branson Site	04/97
North York General Hospital		04/97
North Simcoe Hospital Alliance		
Huronia		
Penetanguishene		
Northumberland Health Care Corporation		04/97
Cobourg District General Hospital		
Port Hope and District Hospital		
Northwest GTA Hospital Corporation		04/99
Brampton		
Etobicoke		
Georgetown		
Northwestern General Hospital, Toronto	Humber River Regional Hospital, Keele Street	04/98
Oakville-Trafalgar Memorial Hospital	Halton Healthcare Services Corporation, Oakville	04/99
Orillia Soldiers' Memorial Hospital		
Orthopaedic and Arthritic Hospital, Toronto	Sunnybrook and Women's College Health Sciences Centre	04/99
Oshawa General Hospital	Lakeridge Health Corporation, Oshawa	04/99
Ottawa Civic Hospital	The Ottawa Hospital, Civic Divison	Pending
Ottawa General Hospital	The Ottawa Hospital, General Division	Pending
Ottawa Valley Hospital Alliance		Pending
Arnprior		
Carleton Place		
Kemptville		
Nepean		
Palmerston and District Hospital		
Parry Sound District Hospital	West Parry Sound Health Centre	04/95
Peel Memorial Hospital, Brampton	Northwest GTA Hospital Corporation, Brampton	04/99
Pembroke Civic Hospital	Closed	12/97
Pembroke General Hospital		
Penetanguishene General Hospital	North Simcoe Hospital Alliance, Penetanguishene	Pending
Perth and Smiths Falls District Hospital		04/95
Perth		
Smiths Falls		
Perth Great War Memorial Hospital	Perth and Smiths Falls District Hospital, Perth	04/95
Peterborough Civic Hospital		
Plummer Memorial Public Hospital, Thessalon		
Plummer Memorial Public Hospital, Sault Ste. Marie	Sault Area Hospitals, Plummer Memorial	Pending
Plummer Memorial Public Hospital, Richard's Landing	Sault Area Hospitals, Richard's Landing	Pending
Porcupine General Hospital, South Porcupine	Closed	11/93
Port Colborne General Hospital		
Port Hope and District Hospital	Northumberland Health Care Corporation, Port Hope	04/97
Prince Edward County Memorial Hospital, Picton		
Public General Hospital, Chatham	Chatam-Kent Health Alliance, Public General Hospital Campus	04/96
Queensway General Hospital, Etobicoke	Trillium Health Centre, Queensway	04/98
Queensway-Carleton Hospital, Nepean	Ottawa Valley Hospital Alliance, Nepean	Pending
Red Lake Margaret Cochenour Memorial Hospital		
Renfrew Victoria Hospital		
Riverside Health Care Facilities		
Emo		
Fort Frances		
Rainy River		
Riverside Hospital of Ottawa (The)	The Ottawa Hospital, Riverside Division	Pending
Ross Memorial Hospital, Lindsay		
Rouge Valley Health System		04/99

TECHNICAL APPENDIX TA.2 Cont'd.

Hospital Names in Italics = Location No Longer In Operation Under This Name

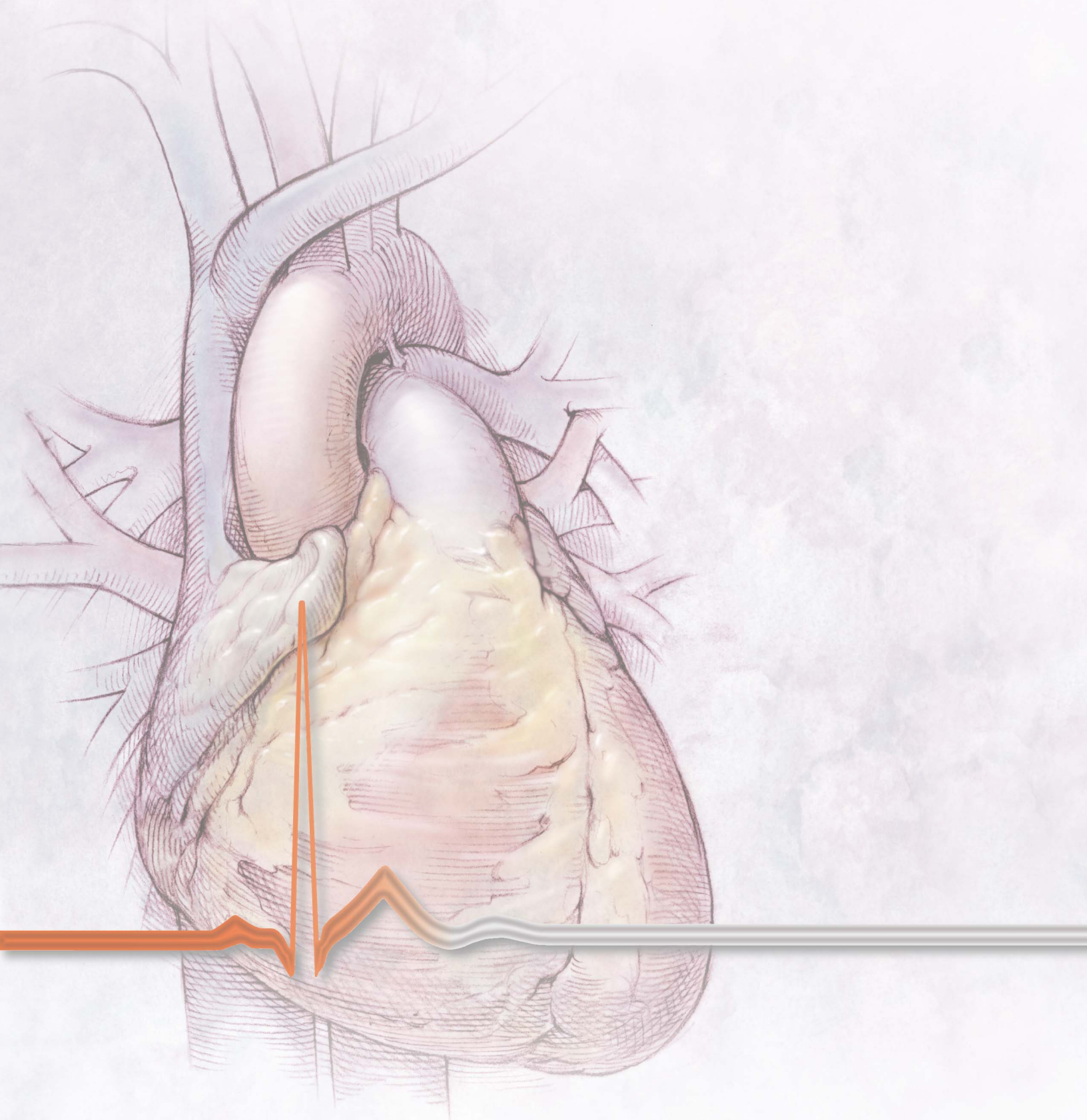
All Hospitals from 1992 to Present	Effective Name Change/City/Site	Effective Name Change/ Merge/Close Date
Scarborough		
Ajax and Pickering		
Royal Victoria Hospital, Barrie		
Salvation Army Scarborough Grace Hospital		
Salvation Army Grace Ottawa Hospital	Closed	07/98
Salvation Army Grace Hospital, Windsor	Hôtel Dieu Grace Hospital, Grace Site	04/95
Sarnia General Hospital		
Saugeen Memorial Hospital, Southamptom	Grey Bruce Health Services, Southampton Site	04/99
Sault Area Hospitals		Pending
General Site		
Plummer Memorial Site		
Richard's Landing Site		
Sault Ste. Marie General Hospital	Sault Area Hospitals, General Site	Pending
Scarborough General Hospital		
Seaforth Community Hospital		
Sensenbrenner Hospital, Kapuskasing		
Shelburne District Hospital	Chronic Care	04/93
Sioux Lookout District Health Centre		
Sioux Lookout Zone Hospital		
Smiths Falls Community Hospital	Perth and Smiths Falls District Hospital, Smiths Falls	04/95
Smooth Rock Falls Hospital		
South Bruce Grey Health Centre		04/98
Chesley		
Durham		
Kincardine		
Walkerton		
South Huron Hospital Association, Exeter		
South Muskoka Memorial Hospital, Bracebridge		
St. Catharines General Hospital		
St. Francis Memorial Hospital, Barry's Bay		
St. Joseph's Hospital, Chatham	Chatham-Kent Health Alliance, St. Joseph's Campus	04/96
St. Joseph's General Hospital, Elliot Lake		
St. Joseph's Hospital and Home, Guelph		
St. Joseph's Hospital, Hamilton		
St. Joseph's Hospital and Health Centre of Peterborough		
Haliburton		
St. Joseph's General Hospital, Thunder Bay	Chronic Care	04/97
St. Joseph's General Hospital of North Bay	North Bay General Hospital, McLaren Site	04/95
St. Joseph's Health Centre, Toronto		
St. Joseph's Health Centre, Blind River		
St. Joseph's Health Centre of London		
St. Joseph's Health Centre of Sarnia		
St. Joseph's Hospital, Brantford		
St. Mary's General Hospital, Kitchener		
St. Mary's General Hospital, Timmins	Closed	11/93
St. Mary's Memorial Hospital, St. Mary's		
St. Michael's Hospital, Toronto		04/99
Bond Street		
Central Hospital		
Wellesley Hospital		
St. Thomas Elgin General Hospital		
St. Vincent de Paul Hospital, Brockville	Chronic Care	10/98
Stevenson Memorial Hospital, Alliston		
Stratford General Hospital		

TECHNICAL APPENDIX TA.2 Cont'd.

Hospital Names in Italics = Location No Longer In Operation Under This Name

All Hospitals from 1992 to Present	Effective Name Change/City/Site	Effective Name Change/ Merge/Close Date
Strathroy-Middlesex General Hospital, Strathroy		
Sudbury General Hospital of the Immaculate Heart of Mary	L' Hôpital Regional de Sudbury Regional Hospital, St. Joseph's Health Centre	Pending
Sudbury Memorial Hospital	L' Hôpital Regional de Sudbury Regional Hospital, Memorial	Pending
Sunnybrook Health Science Centre, North York	Sunnybrook and Women's College Health Sciences Centre, Sunnybrook Site	04/99
Sunnybrook and Women's College Health Sciences Centre, Toronto		04/99
Orthopaedic and Arthritis Hospital		
Sunnybrook Hospital		
Women's College Hospital		
Sydenham District Hospital, Wallaceburg	Chatham-Kent Health Alliance, Sydenham District Campus	04/96
Temiskaming Hospital, New Liskeard		
The Mississauga Hospital	Trillium Health Centre, Mississauga	04/98
The Ottawa Hospital		Pending
Civic Division		
General Division		
Riverside Division		
Trillium Health Centre		04/98
Mississauga Hospital		
Queensway Hospital		
Thunder Bay Regional Hospital		04/96
McKellar		
Port Arthur		
Tillsonburg District Memorial Hospital		
Timmins and District Hospital		
Toronto East General and Orthopedic Hospital		
Toronto Hospital Corporation (The)		04/93
General Division		
Western Division		
Toronto General Hospital	The Toronto Hospital Corporation, General Division	04/93
Toronto Western Hospital	The Toronto Hospital Corporation, Western Division	04/93
Trenton Memorial Hospital		
University Hospital, London	London Health Sciences Centre, University Campus	04/97
Victorial Hospital Corporation, London	London Health Sciences Centre, Victoria Campus	04/97
Weeneebayko General Hospital, Moose Factory		
Welland County General Hospital		
Wellesley-Central Hospital	St. Michael's Hospital	04/98
Wellesley Hospital, Toronto	Was Wellesley-Central Hospital, Wellesley; now St. Michael's Hospital, Wellesley	04/96;04/98
West Haldimand General Hospital, Hagersville		
West Lincoln Memorial Hospital, Grimsby		
West Nipissing General Hospital, Sturgeon Falls		
West Parry Sound Health Centre		
Whitby General Hospital	Lakeridge Health Corporation, Whitby	04/99
Willett Hospital, Paris		
Wilson Memorial General Hospital, Marathon		
Winchester District Memorial Hospital		
Windsor Regional Hospital		
Metropolitan Campus		04/96
Western Campus		
Windsor Western Hospital Centre Incorporated	Windsor Regional Hospital, Western Campus	01/96
Wingham and District		
Women's College Hospital, Toronto	Sunnybrook and Women's College Health Sciences Centre, Women's College	04/99
Woodstock General Hospital		
York Central Hospital, Richmond Hill		
York Central Hospital, Newmarket		
York-Finch General Hospital, North York	Humber River Regional Hospital, Finch Avenue	04/98

Methods Appendix



METHODS APPENDIX
Chapter 1

METHODS APPENDIX MA1.1 Definition of Cardiovascular Disease

Statistics Canada Disease Code[1]	ICD-9 Code[2]	Disease Name
Acute Myocardial Infarction		
136	410	Acute myocardial infarction
Other Coronary Heart Disease		
137	411	Other acute and subacute forms of ischemic heart disease
138	413	Angina pectoris
139	414	All other forms of chronic ischemic heart disease
Other Cardiovascular Disease		
127-131	390-398	Rheumatic fever and rheumatic heart disease
132-135	401-405	Hypertensive disease
140	415-417	Disease of pulmonary circulation
141-148	420-429	Other forms of heart disease
156-158	440-448	Diseases of arteries, arterioles and capillaries
159-160	451-459	Diseases of veins and lymphatics and other disease of circulatory system

[1] Used by the Ontario Ministry of Consumer and Commercial Relations for mortality statistics.
[2] International Classification of Diseases, World Health Organization.

Data Source: Ministry of Consumer and Commercial Relations, Statistics Canada

Methods for Defining Prevalence of Cardiovascular Disease and Cardiovascular Disease—Related Disability from the National Population Health Survey, 1994/95

An individual respondent was deemed to have cardiovascular disease if he/she answered **yes** to the question:

"Do you have heart disease diagnosed by a health professional?"

For the purpose of this analysis, we did not examine responses to the question "Do you have high blood pressure diagnosed by a health professional?"

An individual was deemed to have cardiovascular disease-related disability if he/she met the following criteria:

- the patient had a restriction of activity
- the main health problem which caused the activity limitation was ischemic heart disease, other heart condition or other circulatory disease

METHODS APPENDIX MA1.2 Data Sources for Direct Costs

Direct Costs Category	Items Included	Methods for Allocating Portion of Costs to Cardiovascular Disease	Data Source for Cost Allocation Calculations	Main Limitations
Acute Care Hospitals	All related expenses (e.g. staff, supplies, drugs, overhead, administration); excludes physician fee-for-service claims for hospital services	% of total weighted cases that had a cardiac diagnosis or were assigned to Major Clinical Category 05, excluding stroke and amputations without vascular surgery	Discharge Abstract Database, Canadian Institute for Health Information	Case weighting based on resource-intensity weights derived in US
Rehabilitation and Chronic Care Hospitals	Rehabilitation and chronic care - stand-alone hospitals and wards of acute care hospitals	% of patients that were transferred to a rehabilitation institution or to a chronic institution that had a cardiac diagnosis	Discharge Abstract Database, Canadian Institute for Health Information	No resource-intensity weights available
Residential Care	Nursing homes, homes for the aged	% of patients that transferred to a chronic institution that had a cardiac diagnosis	Discharge Abstract Database, Canadian Institute for Health Information	No utilization data by diagnosis available, % attributable to cardiovascular disease assumed same as for chronic
Physician and Other Health Professional Services	Physician services, other fee-for-service health professionals, non-hospital-based lab services, community health centres, independent health facilities, underserviced area program, Northern travel grant program	% of physician expenditures	Ontario Health Insurance Plan	Diagnostic data not subject to quality assurance measures
Drugs	Professional (dispensing) fees and drug expenditures for out-patients and residential care patients	% of prescriptions, volume of drugs prescribed for cardiovascular disease cost/drug	% prescriptions: Canadian Diagnostic and Therapeutic Index database, Intercontinental Medical Statistics Dispensing fees: Canadian Pharmaceutical Association Volume of drugs: Canadian Diagnostic and Therapeutic Index database, Intercontinental Medical Statistics Cost/drug: Compuscript	Canadian Diagnostic and Therapeutic Index database, Intercontinental Medical Statistics based on survey of physicians with small sample size
Research	National cardiovascular disease research expenditures with portion allocated to Ontario based on relative population size	% of grants attributable to cardiovascular disease	Operating Grant and Personnel Award Database, Medical Research Council	Allocation of portions of grants to cardiovascular disease requires some clinical judgement
Home Care Services	Nursing, other health professional and home making services	% of total home care days	Ontario Home Care Registration data	Diagnostic data not subject to quality assurance measures
Emergency Health Services	Ambulance services and related infrastructure	% of hospital admissions by ambulance with primary diagnosis of cardiovascular disease	Discharge Abstract Database, Canadian Institute for Health Information	% of ambulance calls for cases not requiring hospitalization which are attributable to cardiovascular disease not known
Other Community Services	Community-based long-term care services	Average of % of expenditures for chronic care and % for home care	Discharge Abstract Database, Canadian Institute for Health Information Ontario Home Care Registration data	No diagnosis-specific utilization data for this category available

METHODS APPENDIX MA1.3 Assumptions for Low, Baseline & High Estimates of Cost of Disease

Cost Category	Low	Baseline	High
Hospitals	Baseline - 15%	Based on cardiovascular disease % calculated for acute institutions	Baseline +15%
Other Institutions	Baseline - 15%	Based on cardiovascular disease % calculated for rehabilitation and chronic care institutions	Baseline +15%
Physicians, Lab Services, Other Professionals	Baseline - 15%	Cardiovascular disease % calculated from Ontario Health Insurance Plan data on physician service by diagnosis	Baseline +15%
Drugs	Baseline - 15%	Based on Intercontinental Medical Statistics audit	Baseline +15%
Research	Baseline - 15%	Based on % of grants attributable to cardiovascular disease	Baseline +15%
Home Care	Baseline - 15%	Cardiovascular disease % calculated from provincial database	Baseline + 15%
Emergency Health Services	1/3 of high estimate	1/2 of high estimate	% of ambulance admissions with cardiovascular disease diagnosis
Other Community Support Services	Cardiovascular disease % for chronic care	Average of high and low estimates	Cardiovascular disease % for home care
Lost Productivity, Disability	Disability payment method	Average of high and low estimates	Reduction in earned household income due to cardiovascular disease, based on National Population Health Survey
Lost Productivity, Premature Mortality	No adjustment for household labour	0.4 weight adjustment for household labour	0.6 adjustment for household labour

References

Data sources for Exhibits 1.1 to 1.4

1. 1996 Annual Report: Office of the Registrar General. Thunder Bay: Ministry of Consumer and Commercial Relations, 1997.
2. Statistics Canada. Life Tables, Canada and Provinces, 1990-1992. First ed. Ottawa: Statistics Canada, 1995.

Data sources for Exhibits 1.5 to 1.6

3. National Population Health Survey, Public use file, 1994. Ottawa: Statistics Canada.

Data source for Exhibit 1.7

4. Public Accounts of Ontario, 1996-7, volume 1. Toronto: Ontario Ministry of Treasury and Economics.
5. Discharge Abstract Database, 1996-7. Ottawa: Canadian Institute for Health Information.
6. Ontario Health Insurance Plan Database, 1996-7. Kingston: Ontario Ministry of Health.
7. Canadian Drug Therapeutic Index, 1996. Mississauga: Intercontinental Medical Statistics.
8. Canadian Compuscript Index, 1996. Mississauga: Intercontinental Medical Statistics.
9. Report of the President, 1996. Ottawa: Medical Research Council of Canada.
10. Ontario Home Care Administration System, 1996. Toronto: Ontario Ministry of Health.
11. Earnings of Men and Women, 1996. Ottawa: Household Surveys Division, Statistics Canada. Cat no 13-217 XPE.
12. Canada Pension Plan/Old Age Security Statistical Bulletin. Ottawa: Human Resources Development Canada, April 1997.

Data sources for Exhibits 1.8 to 1.9

13. Vital Statistics for 1981. First ed. Ottawa: Statistics Canada, 1982. (and subsequent editions up to Vital Statistics for 1990.)
14. 1991 Annual Report. Office of the Registrar General. Thunder Bay: Ministry of Consumer and Commercial Relations, 1992. (and subsequent editions up to the 1996 Annual Report.
15. Ontario Ministry of Finance, County Population Projections, April, 1995.

METHODS APPENDIX
Chapter 2

All cases of adults with a calculated age of 20 years and over admitted to an Ontario acute care hospital with a valid Ontario Health Information Number and an Ontario postal code were considered. Cases which had been transferred from another acute care hospital were excluded from the analysis.

Patient residence was ascertained by linking the patient's postal code to Statistics Canada enumeration areas. Lengths of stay (LOS) were calculated from the admission and discharge hours and dates. Acute LOS was calculated as the duration of acute hospitalization minus coded alternate level of care days. In addition, very long LOS cases were trimmed at each diagnosis' 97.5 percentile LOS among cases not transferred and discharged alive.

Cases with a discharge date between April 1, 1992 and March 31, 1997 were eligible. Transfers were ascertained from the initial hospital separation record and readmission to another acute care hospital within 12 hours of discharge.

For readmission analyses, only the first 10 months of 1996/97 fiscal year data were utilized to identify incident cases in order to enable identification of readmissions within 30 days of discharge. Incident cases were recorded only for the first hospitalization in a chain of inter-hospital transfers.

Each hospitalization was linked to the Registered Persons Database (RPDB) to identify mortality after hospitalization. The accuracy of the RPDB death dates was verified by cross checking the Canadian Institute for Health Information coding of in-hospital death for all hospital separations during the study period with the RPDB database.

Readmissions are non-elective readmission to the same or another acute care hospital, or out-of-hospital death, within 30 days. In-hospital mortality is excluded from both numerator and denominator.

Population counts were grouped by five-year age groups for each sex. Intercensal population data for each census subdivision and year were calculated to provide a yearly eligible population for the calculation of annual population-based hospitalization rates. Standardized rates generally utilized the average population classification over the five-year study period.

Income quintiles were developed for each diagnostic group. For each enumeration area, the expected number of hospitalizations, based on the Ontario average hospitalization rates by age and sex, was calculated for the study period. Weighted income quintiles were calculated based on these expected caseloads for each area.

Expected growth of caseloads for each geographic area (county and District Health Council) was calculated based on the overall Ontario hospitalization rates by age and sex and the projected population numbers and distribution in the year 2003. While these provincial average rates arguably do not account for the systematic differences in hospitalization rates by area income, the relative annual projected growth will be much less affected by the use of a single set of expected hospitalization rates than would be projections of absolute hospitalization rates.

For acute myocardial infarction (AMI), cases with a prior admission for AMI within the previous eight weeks were excluded, as were cases with a calculated LOS of less than four days.

METHODS APPENDIX **Chapter 3**

Mortality data due to cardiovascular disease were obtained from Statistics Canada. Yearly data was obtained for the six year period 1991/92 to 1996/97. Counts for two causes of death were defined: general cardiovascular disease (ICD-9: 390-459) and ischemic heart disease (ICD-9: 410-414). The counts were supplied by county of residence, sex and 10-year age groupings.

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. County age- and sex-adjusted death rates were calculated for two three-year periods, 1991/92 to 1993/94 and 1994/95 to 1996/97. Standardization was performed using the direct method. Census projection figures for 1992 were used as the standard population for the earlier three-year period and 1996 census figures for the later time period. Overall province-wide age- and sex-adjusted death rates were also calculated for each of the years.

METHODS APPENDIX **Chapter 4**

Most statistical analyses were performed using the Public Use Datafile for the Ontario Health Survey 1990 (OHS, 1990[1,2]). In the OHS 1990, six risk factor variables were examined: hypertension, diabetes, daily smoking, BMI greater than 27.0 kg/m2, 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 were 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 is 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 as provided in an existing derived variable.

One new derived variable was created indicating respondents who reported three or more of these risk factors. This percentage was calculated using only those respondents who were not missing information on any of the other six risk factor questions. In total, 30% were missing information on any one or more of these questions. This analysis assumes that the responses among people with some missing information would be proportionately the same as people who answered all of the questions.

For each of these risk factors, age- and sex-adjusted estimates were calculated by first obtaining the age- and sex-specific percentages, using sample weights provided with the public use data file (which accounts for the representativeness of the survey sample). Age- and sex-adjusted estimates for each region were then obtained by direct standardization. The weights reflected the proportion of all people in that age and sex category in the whole provincial sample

Tests of statistical significance were performed for differences in risk factor prevalence by socio-demographic variables and by health planning regions (Exhibit 4.1 through 4.3). However, no tests of statistical significance were calculated for analysis by smaller geographical areas (i.e., District Health Councils or Public Health Units). For differences by age, sex, household income, education and urban versus rural location, statistical tests were performed as follows. A series of regression models were used which are analogous to logistic regression but which take into account the complex sampling design of the survey and design effect.[3] In each instance, the risk factor variable in question (dichotomous in all cases) was treated as the outcome variable and the appropriate demographic variable was treated as the independent variable. Significance was assessed using the Wald statistic.

No statistical test is readily available to address possible differences by region (tests of statistical significance for differences in percentages which are both drawn from a complex sampling survey and which are subsequently age- and sex-adjusted). However, statistical tests were performed which produce a reasonable approximation of such a test. The same regression analysis, described above, was used. This time, one regression model was fitted for each of the risk factor variables as the dependent variable. Region was included as a categoric variable with Toronto indicated as the reference category. Age and sex were also controlled with a 16 category variable. The Wald statistic was used to assess whether each of the other regions was significantly different from Toronto after controlling for age and sex. Only differences which were statistically significant ($p<0.05$) are discussed in the text.

METHODS APPENDIX MA4.1 1992 Ontario Heart Health Survey: Risk Factor Findings

Risk Factor Findings	• **4.7 million Ontarians (62%) had at least ONE of the three major risk factors — hypertension, total cholesterol >5.2 mmol/L or smoking.**	• **Both men and women in the lower education group had a higher prevalence of hyperlipidemia and smoking; however, hypertension was more prevalent among men and women with higher education.**
Hypertension	**1.3 million Ontarians (18%) aged 18-74 have been diagnosed with hypertension:** • 33% were not aware they were hypertensive. • 66% found to have hypertension did not have their blood pressure under control.	
Lipids	**3 million Ontarians (42%) aged 18-74 had a total serum cholesterol >5.2 mmol/L.** • 12% (1 in 8) had a total serum cholesterol >6.2 mmol/L.	
Smoking	**1.6 million Ontarians (23%) aged 18-74 are regular smokers; more men (25%) smoke than women (21%).** • average number of cigarettes smoked daily is 18.	
Diabetes	**Almost 300,000 Ontarians (4%) reported having been told they had diabetes.**	
Diet	• 86% of individuals surveyed knew diet was related to hypertension; only 46% recognized salt consumption is a component. • 98% of surveyed individuals had heard about cholesterol; 97% knew it was found in food and >50% knew its relationship to myocardial infarction (MI). More than two-thirds knew cholesterol levels can be reduced by eating food with less cholesterol. However, only 16% identified the value of low-fat dairy products and only 10% identified weight reduction as a way of reducing cholesterol.	
Alcohol Consumption	• 16% of individuals reported no alcohol consumption in the previous year • 7% reported taking on average ≥20 drinks per week	• 19% reported taking on average ≥7 drinks per week • Overall men were heavier drinkers than women.
Body Mass Index	**One third of individuals surveyed had a body mass index ≥27.** • Prevalence of obesity: 35% men, 30% women.	
Sedentary Lifestyle	**Prevalence is 39%.** • Lowest prevalence of sedentary lifestyle is among younger men and women.	
Family History	• About one-half (49%) had a family history of hypertension. • 28% had a family history of coronary artery disease before the age of 60 in one or more parents or siblings.	

Data Source: Ontario Health Survey, 1992 (adapted)

Finally, the text of Chapter 4 discusses the degree to which observed differences in risk factors by region correlate with observed regional differences in the prevalence of reported heart disease and with mortality from all cardiovascular causes and from ischemic heart disease (as presented in Chapter 3). Combining the 43 former PHUs (which in some instances comprised several counties) and county-level mortality data resulted in 38 comparable areas. For these 38 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 above. The degree of association, at the regional level, between risk factor prevalence and CHD rates was assessed using both Pearson's correlation coefficients and Spearman's correlation for ranked data. As both correlation techniques produced similar results, only Pearson's coefficients are discussed. Text referring to the percentage of variation in disease rates that can be 'predicted' from regional differences in risk factor levels refers to the R-square statistic. The joint influence of all of the risk factors studied was estimated with the adjusted R-square statistic using multiple linear regression models.

References

1. Ontario Ministry of Health. Ontario Health Survey 1990. User's Guide Volume 1. Documentation. Toronto: Ontario Ministry of Health, 1992.
2. Ontario Ministry of Health. Ontario Health Survey 1990. User's Guide Volume 2. Microdata Manual. Toronto: Ontario Ministry of Health, 1992.
3. StataCorp. Stata Statistical Software. Release 5.0 ed. College Station, TX: Stata Corporation, 1997.

METHODS APPENDIX
Chapter 5

Creation of the Acute Myocardial Infarction Outcomes Cohort

A cohort of all patients hospitalized with a most responsible diagnosis of an acute myocardial infarction (AMI) in Ontario (International Classification of Disease-9th revision [ICD-9] code 410.0) in the Canadian Institute for Health Information (CIHI) hospital discharge database between fiscal 1994/95 and 1996/97 (April 1, 1994 to March 31, 1997) was constructed for inclusion in our analysis. A series of nine exclusion criteria were applied to this cohort (Methods Appendix MA5.1) to maximize the likelihood that these patients had an AMI when they were admitted to hospital. For example, we excluded patients with a total length of stay less than four days under the assumption that an AMI had been ruled out for these patients. Patients with an AMI in the year preceding an index admission were also excluded so that our cohort was made up of only patients with new AMIs. Patients who were transferred to a second acute hospital were included in our analysis but had their outcomes attributed to the originating hospital to avoid biasing the results against hospitals with a large referral base. AMIs which occurred after a patient had been admitted to hospital or which occurred after a patient was admitted to a surgical service were also excluded, because these AMIs have a different prognosis than those presenting acutely to a hospital emergency room.

Acute Myocardial Infarction Coding Accuracy

Previous multicentre audits of AMI coding accuracy have shown a sensitivity of 95% and a specificity of 88% for the coding of a most responsible diagnosis of AMI in Ontario's CIHI database.[1] To improve the specificity in our AMI outcomes cohort, we applied the nine exclusion criteria shown in Methods Appendix MA5.1.

METHODS APPENDIX MA5.1 Inclusion/Exclusion Criteria for Creation of Acute Myocardial Infarction Outcomes Cohort

INCLUSION CRITERIA	Number of Patients
All Patients Discharged from Hospital in Ontario with a Most Responsible Diagnosis of Acute Myocardial Infarction (International Classification of Diseases - 9th Revision code 410) Between Fiscal 1994/95 and 1996/97	70,220

EXCLUSION CRITERIA	Number of Patients
Not Admitted to an Acute Care Hospital	139
Age <20 or Age >105	10
Non-Ontario Resident	1,230
Invalid Ontario Health Card Number	1,212
Admitted to a Non-cardiac Surgical Service	300
Transferred from Another Acute Care Facility	3,944
Acute Myocardial Infarction Coded as a Hospital Complication	1,762
Acute Myocardial Infarction Admission Within Past Year	7,910
Discharged Alive with Total Length of Stay<4 Days	815
Miscoded Based on Hospital's Chart Review	282
Final Cohort	**52,616**

METHODS APPENDIX MA5.2 Inclusion/Exclusion Criteria for Creation of Acute Myocardial Infarction Cardiac Readmission Cohort

INCLUSION CRITERIA	Number of Patients
All Patients in Ontario Satisfying the Inclusion/Exclusion Criteria for the Acute Myocardial Infarction Outcomes Cohort (Methods Appendix MA5.1)	52,616

EXCLUSION CRITERIA	Number of Patients
Died During Index Hospital Stay	6,888
Final Cohort	**45,728**

In order to further improve the accuracy of the AMI coding for the patients in our cohort, we sent each hospital in Ontario a list of the AMI patients that would be included in our analysis, so that they could independently verify the accuracy of AMI coding for the patients at their institution. Hospitals with very large numbers of AMI patients were asked to randomly verify a sample of their patients (most hospitals validated between 50 and 100 patients); only if problems were discovered, were they asked to validate their entire sample. In general, most hospitals found extremely high accuracy rates with false positive rates of less than 5%. Any patients noted as not having an AMI based on their hospital's independent chart review were excluded from our final AMI outcomes cohort.

Primary Diagnosis of Acute Myocardial Infarction

During the process of validating hospital AMI coding, it was brought to our attention that some patients may have been coded as having a primary diagnosis of AMI (i.e. a diagnosis present at the time of hospital admission) without having it as a most responsible diagnosis (i.e. the diagnosis most responsible for a patient's total length of stay). For example, a patient may have had congestive heart failure (CHF) as the most responsible diagnosis but also had an AMI as a primary diagnosis in one of the secondary diagnosis fields, or a patient may have had a most responsible diagnosis of unstable angina with a primary diagnosis of query or rule-out AMI. Because we could not be certain about the timing of these AMIs and whether they were accurately coded, we elected to exclude these patients from our final AMI outcomes cohort. However, we also conducted sensitivity analyses where we included patients who had a primary diagnosis but not a most responsible diagnosis of AMI and met our other exclusion criteria.

Overall, there were 5,466 patients who had only a primary diagnosis of AMI, with an average 30-day mortality rate of 28.7%. The most common, most responsible diagnoses in these patients were congestive heart failure (ICD-9 code 428) 24%, angina (ICD-9 code of 411 or 413) 10%, and coronary atherosclerosis (ICD-9 code 414) 10%. We conducted hospital-specific sensitivity analyses in which we included these primary diagnosis patients with those in our final AMI outcomes cohort based on most responsible diagnoses. In general, this increased the volume of AMI cases at hospitals and the associated mortality rate, but it did not alter the 30-day mortality rates at any hospital by more than 4%. Most hospital's 30-day mortality rates with and without these patients were similar.

METHODS APPENDIX MA5.3 Risk Factors Included in the Ontario Acute Myocardial Infarction 30-day and One-year Mortality Prediction Models, 1994/95 - 1996/97

Risk Factor	International Classification of Diseases - 9th Revision Code	Prevalence	30-day Mortality (%)	One-year Mortality (%)
Age				
50 - 64	-	27.2	5.7	9.3
65 - 74	-	28.9	13.9	22.2
75+	-	32.8	27.3	42.0
Female	-	36.9	19.3	29.7
Shock	785.5	2.5	78.6	82.7
Diabetes with Complications	250.1 - 250.9	2.0	21.8	40.3
Congestive Heart Failure	428.x	20.7	24.7	43.4
Malignancy	140.0 - 208.9	1.9	29.6	54.7
Cerebrovascular Disease	430.0 - 438.x	4.1	30.9	46.6
Pulmonary Edema	518.4, 514.x	1.3	30.1	47.2
Acute Renal Failure	584.x, 586.x, 788.5	1.5	53.2	70.4
Chronic Renal Failure	585.x, 403.x, 404.x, 996.7, 394.2, 399.4, v451	2.4	28.0	52.5
Cardiac Dysrhythmias	427.0 - 427.9	14.7	21.8	33.3

Note: Chi-square statistic $p<0.001$ for all values

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

Mortality

The 30-day and one-year mortality status of all patients were determined by linking the cohort using scrambled health card numbers (anonymized to protect patient confidentiality) to the Ontario Registered Person Database (RPDB) and subsequent hospital admissions associated with deaths in the CIHI database. The mortality status of these patients was cross-validated by linking the data directly to the Ontario vital statistics database at Cancer Care Ontario. A 99.6% agreement rate was found between the two data sources, confirming the accuracy of the mortality data.

Logistic Regression Models

To facilitate 30-day and one-year mortality comparisons across various health care institutions, two logistic regression statistical models were constructed to predict 30-day and one-year mortality after an AMI using the demographic and comorbidity data contained in the 15 secondary diagnosis fields of the CIHI database. The process began with a review of the risk factors used as predictors of short-term mortality after AMI in two recent AMI "report card" projects in California (1997) and Pennsylvania (1996).[2,3] The investigators in both of these projects have conducted exhaustive reviews of the medical literature to identify those factors that best predict short-term AMI mortality. They have also conducted extensive testing of potential AMI risk factors in their hospital discharge databases, which are similar to the CIHI database in Ontario. The risk factors they have included in their AMI risk-adjustment models were tested for possible inclusion in an Ontario AMI mortality prediction model. A total of 40 risk factors were considered for inclusion in the Ontario AMI mortality models.

The prevalence of each of these risk factors was identified using the ICD-9 codes used in the Pennsylvania and California reports by searching the 15 secondary diagnosis fields in the CIHI database for these codes, excluding comorbidities reported as a Type 2 (in-hospital complication) diagnosis. A series of univariate analyses were conducted to determine the association between each of the risk factors and 30-day mortality after an AMI in Ontario. Risk factors which were significant in the univariate analysis at the $p<0.05$ level were then entered into a multivariate logistic regression model. Several variables were excluded which were not felt to be clinically plausible predictors of short-term AMI mortality. A backwards stepwise regression was conducted with all variables significant at the $p<0.05$ level kept in the final model. This final model contained 10 variables as shown in Methods Appendices MA5.3 and MA5.4. These tables show the overall prevalence of the risk factors, the ICD-9 codes used to identify them, the 30-day and one-year mortality rates, and the regression coefficients associated with each factor.

For the one-year mortality prediction model, the same risk factors were used as those identified for predicting 30-day mortality but new one-year specific regression coefficients for each of those risk factors (Methods Appendix MA5.4) were modelled. Both the 30-day and one-year mortality models were evaluated by calculating the area under the receiver operating characteristic (ROC) curve, which is a measure of the predictive power of the models.[4] For the 30-day model, the area was 0.776 and the area for the one-year model was 0.793, showing both models predicted mortality very well. Their calibration was also evaluated using a Hosmer-Lemeshow statistic.[5] For both models, the p-value of this test was <0.001, suggesting the models are not well calibrated, although this may be just a function of the very large sample size.

Risk-adjusted Mortality Rates

To calculate an individual institution's risk-adjusted mortality rate (RAMR), the observed mortality rate at that institution was divided by the expected mortality rate, then the ratio was multiplied by the overall provincial average mortality rate. Ninety-nine per cent (99%) confidence intervals around the RAMR were calculated using methods developed by Hosmer and Lemeshow.[6] The RAMR can be interpreted as the mortality rate that would have occurred, had that institution's case-mix been similar to the provincial average. Hospital-specific mortality rates for institutions treating thirty or fewer patients over the three-year study period are not reported because the small numbers of patients render particularly statistically unstable RAMRs.

Comorbidity Coding Differences Across Hospitals

Although it was not possible to validate the accuracy of the comorbidities recorded in the CIHI database, the extent to which differences in the frequency with which comorbidities were recorded was determined across institutions affected the overall results. First, the frequency of each of the eight comorbidities included in our mortality prediction model was compared, (Methods Appendix MA5.3) across institutions; generally, similar prevalence levels were found. Next, each institution's 30-day age- and sex-adjusted mortality rate was calculated using age and sex in a logistic regression model. This model had an area under the ROC curve of 0.72. Each institution's fully adjusted 30-day RAMR was then

METHODS APPENDIX MA5.4 Logistic Regression Model for Predicting 30-day and One-year Mortality After an Acute Myocardial Infarction in Ontario, 1994/95 - 1996/97

Risk factors	30-day Mortality			One-year Mortality		
	Regression Coefficient	Odds Ratio	95% Confidence Interval	Regression Coefficient	Odds Ratio	95% Confidence Interval
Age						
50 - 64	0.8811	2.41	1.99 - 2.93	0.9412	2.56	2.19 - 3.00
65 - 74	1.7217	5.59	4.65 - 6.74	1.7846	5.96	5.12 - 6.93
75+	2.5045	12.24	10.18 - 14.71	2.6226	13.77	11.86 - 16.00
Female	0.1607	1.17	1.11 - 1.24	0.1386	1.15	1.10 - 1.20
Shock	3.1050	22.31	19.30 - 25.79	2.7540	15.71	13.43 - 18.37
Diabetes with Complications	0.3467	1.41	1.20 - 1.67	0.6571	1.93	1.67 - 2.23
Congestive Heart Failure	0.3231	1.38	1.30 - 1.47	0.7659	2.15	2.04 - 2.26
Cancer	0.7279	2.07	1.78 - 2.40	1.3105	3.71	3.22 - 4.26
Cerebrovascular Disease	0.6776	1.97	1.78 - 2.18	0.7705	2.16	1.96 - 2.38
Pulmonary Edema	0.4272	1.53	1.27 - 1.85	0.6587	1.93	1.63 - 2.29
Acute Renal Disease	1.3005	3.67	3.14 - 4.29	1.3564	3.88	3.28 - 4.59
Chronic Renal Disease	0.3826	1.47	1.27 - 1.69	0.8529	2.35	2.06 - 2.67
Cardiac Dysrhythmias	0.2858	1.33	1.24 - 1.42	0.2776	1.32	1.24 - 1.40
Intercept	- 4.0128			-3.5965		
Area under the Receiver Operator Curve = 0.775 Hosmer and Lemeshow Goodness-of-fit Statistic = 120.71; p = 0.0001				Area under the Receiver Operator Curve = 0.793 Hosmer and Lemeshow Goodness-of-fit Statistic = 154.07; p = 0.0001		

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

calculated and the results compared with the 30-day age- and sex-adjusted mortality rate. In general, there were only minor differences between the two rates with a maximum difference of 3% for over 95% of the hospitals in our study. The overall correlation between these two mortality rates was also extremely high (r=0.95). Although there may be minor differences in the accuracy with which comorbidities were coded across institutions, the impact of any differences on the overall results would appear to be small.

Hospital Classification

Hospitals were classified as "teaching" if they belonged to the Ontario Council of Teaching Hospitals. Non-teaching hospitals were divided into "large," "medium," and "small," based on their total resource intensity weights (RIW) for cardiovascular care (Major Clinical Category 5) in the fiscal 1994/95 CIHI database. See the Technical Appendix for more detail.

Cardiac Readmissions

The incidence of cardiac readmissions after an AMI in Ontario in the CIHI database was also studied with a focus on the three most common cardiac causes for readmission after an AMI: reinfarction, angina and congestive heart failure. Readmissions for a subsequent AMI were identified by a most responsible ICD-9 diagnosis code of 410 (and a length of stay >4 days if a patient survived the admission), angina readmissions by a most responsible ICD-9 diagnosis

code of 411 or 413, and congestive heart failure readmissions by a most responsible ICD-9 diagnosis code of 428. All readmissions from the time of hospital discharge until a total of one-year after the index admission date were included in determining the rate of cardiac readmissions. Only survivors of the index hospitalization were included in these analyses. Elective readmissions where an invasive cardiac procedure was performed (i.e. coronary angiography, percutaneous transluminal coronary angioplasty [PTCA] or coronary artery bypass graft [CABG] surgery) were not included. Similarly, admissions where a patient was admitted as a transfer from another institution, admissions to a non-cardiac surgical service and admissions coded as an in-hospital complication were not included in determining readmission rates. All readmission rates at the DHC, major municipality and hospital level were statistically adjusted for age and sex differences across regions and institutions. Ninety-five per cent confidence intervals were calculated around hospital readmission rates.

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METHODS APPENDIX
Chapter 6

METHODS APPENDIX MA6.1 Inclusion/Exclusion Criteria for Congestive Heart Failure Outcomes Cohort

INCLUSION CRITERIA	Number of Patients
All Patients Discharged from Hospital in Ontario with a Most Responsible Diagnosis of Congestive Heart Failure (ICD-9 code 428) for fiscal 1994/95 - 1996/97	75,642

EXCLUSION CRITERIA	Number of Patients
Not Admitted to an Acute Care Hospital	713
Age <20 or Age >105	273
Non Ontario Resident	660
Invalid Ontario Health Card Number	927
Transferred from Another Acute Care Facility	1,626
Congestive Heart Failure Coded as a Hospital Complication	493
Not the First Congestive Heart Failure Admission in Fiscal 1994/95 - 1996/97	23,268
Previous Congestive Heart Failure Admission in Fiscal 1991/92 - 1992/93	7,968
Final Cohort	**39,714**

METHODS APPENDIX
Chapter 7

All cases of adults with a calculated age of 50 years and over admitted to an Ontario acute care hospital with a valid Ontario Health Information Number, and an Ontario postal code were considered.

Abdominal aortic aneurysm (AAA) cases were defined by matching the primary procedure code to one of Canadian Classification of Procedures (CCP) codes 50.24, 50.34, 50.36, 50.54, 51.25, 51.29 and most responsible diagnosis International Classification of Diseases, 9th Revision (ICD) codes 441.3, 441.4, 441.5 and 441.6. Emergent and urgent non-ruptured AAA were differentiated from elective nrAAA by the CIHI admission category code.

Peripheral vascular disease surgery cases were identified by matching primary procedure CCP codes 51.25 and 51.29 in the absence of the most responsible ICD diagnosis code indicating aortic aneurysm (441.3, 441.4, 441.5 and 441.6).

Patient residence was ascertained by linking patient postal code to Statistics Canada enumeration areas. Lengths of stay (LOS) were calculated from the admission and discharge hours and dates. Acute LOS was calculated as the duration of acute hospitalization minus coded Alternate Level of Care days. In addition, very long LOS cases were trimmed at each diagnosis' 97.5 percentile LOS among cases not transferred and discharged alive.

Cases with a discharge date between April 1, 1992 and March 31, 1997 were eligible. Transfers were ascertained from the initial hospital separation record and readmission to another acute care hospital within 12 hours of discharge.

Population counts were grouped by five-year age groups for each sex. Intercensal population data for each census subdivision and year were calculated to provide a yearly eligible population for the calculation of annual population-based hospitalization rates. Standardized rates generally utilized the average population classification over the five-year study period.

Income quintiles were developed for each diagnostic group. For each enumeration area, the expected number of hospitalizations, based on the Ontario average hospitalization rates by age and sex, was calculated for the study period. Weighted income quintiles were calculated based on these expected caseloads for each area.

Expected growth of caseloads for each geographic area (county and District Health Council) were calculated based on the overall Ontario hospitalization rates by age and sex and the projected population numbers and distribution in the year 2003.

METHODS APPENDIX
Chapter 8

All patients with codes in either Canadian Institute for Health Information or Ontario Health Insurance Plan for coronary angiography, angioplasty or coronary artery bypass surgery were flagged (Exhibit MA8.1). All patients having revascularization procedures required a record for coronary angiography. Accordingly, 0.18% of the cohort had revascularization procedures after AMI without having a record for coronary angiography and were therefore excluded from the analysis. These patients may have represented a coding error, or alternatively, may have received coronary angiography prior to acute myocardial infarction (AMI) and could have already been awaiting revascularization when presenting with a myocardial infarction. The Hospital of National Defence was also excluded from the analysis. Hospital level data were aggregated to reflect hospital mergers. Hospitals in Thunder Bay and Windsor remained separate to distinguish institutions with angiographic facilities from those without.

Significance levels were derived from statistical models that examined whether hospital grouping, type of facility, and geographical factors predict procedure use and waiting times. Patient-level data were used to generate multiple logistic (i.e. the likelihood of having an invasive cardiac procedure) and linear (i.e. examining the waiting time to the invasive cardiac procedure) regression models. Covariates examined included age, sex and institutional characteristics. First-order statistical interactions were not examined. Appropriate adjustments for multiple testing were made by evaluating pair-wise comparisons only after ensuring statistical significance of the overall model. Exhibits MA8.2 to MA8.5 illustrate the levels of statistical significance for comparisons across hospital group (teaching, large, medium and small), hospital type (services provided), and distances to hospitals with revascularization services. These tables correspond with Exhibits 8.9, 8.10 and 8.11 in the chapter.

The probability and the factors associated with receiving certain cardiac procedures within a year of having an AMI and the associated waiting times were calculated using logistic and linear models (least square estimation method). The models were derived according to hospital type (the cardiac services that they provide) rather than combining institutional characteristics together with patient-level characteristics. The models are calculated according to the type of hospital that a person was first treated with an AMI–those that provide revascularization (Exhibits MA8.6 to MA8.9), those that provide catheterization only (Exhibits MA8.10 to MA8.13) and hospitals without invasive services (Exhibits MA8.14 to MA8.17). These models examined all possible first-order statistical interactions. Only those variables that remained statistically significant were kept in the models.

METHODS APPENDIX MA8.1 Coding Definition of Invasive Cardiac Procedures

Procedure	Canadian Institute for Health Information Code	Ontario Health Insurance Plan Code
Coronary Angiography	489.2 - 489.8, 499.6, 499.7	Z442, G297
Percutaneous Transluminal Coronary Angioplasty	480.2, 480.3, 480.9	Z434
Coronary Artery Bypass Surgery	481.0 - 481.9	R742, R743

METHODS APPENDIX MA8.2 Significance Levels for Comparisons Across Hospital Groups in Exhibit 8.9

Hospital Group Comparisons	Probability of Receiving Cardiac Procedure (p-value)			Waiting Times for Cardiac Procedure (p-value)		
	Coronary Angiography	Angioplasty	Bypass Surgery	Coronary Angiography	Angioplasty	Bypass Surgery
Small vs Teaching	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0048
Small vs Large	<0.0001	0.0007	<0.0001	<0.0001	0.2757	0.0543
Small vs Medium	<0.0001	0.0043	<0.0001	0.0199	0.4905	0.1276
Medium vs Teaching	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0240
Medium vs Large	0.0759	0.4783	0.0004	0.0060	0.4175	0.5535
Large vs Teaching	<0.0001	<0.0001	0.0068	<0.0001	<0.0001	0.0329

METHODS APPENDIX MA8.3 Significance Levels for Comparisons Across Hospital Types in Exhibit 8.10

Hospital Type Comparisons	Probability of Receiving Cardiac Procedure (p-value)			Waiting Times for Cardiac Procedure (p-value)		
	Coronary Angiography	Angioplasty	Bypass Surgery	Coronary Angiography	Angioplasty	Bypass Surgery
Other vs Revascularization	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.7038
Catheterization Only vs Revascularization	<0.0001	<0.0001	0.8133	<0.0001	<0.0001	0.4590
Other vs Catheterization Only	<0.0001	0.9659	0.0055	<0.0001	0.0466	0.0384

METHODS APPENDIX MA8.4 Significance Levels for Comparisons Across Distances to Hospitals with Revascularization Services in Exhibit 8.11

Distance to Hospital with Revascularization Services	Probability of Receiving Cardiac Procedure (p-value)			Waiting Times for Cardiac Procedure (p-value)		
	Coronary Angiography	Angioplasty	Bypass Surgery	Coronary Angiography	Angioplasty	Bypass Surgery
>50 km vs. 0-10 km	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0303
10-50 km vs. 0-10 km	<0.0001	<0.0001	<0.0001	<0.0001	0.0540	0.1247
>50 km vs. 10-50 km	<0.0001	0.0090	<0.0001	0.0243	0.0625	0.4332

Note: Hospitals with catheterization only (non-invasive services) were excluded for this analysis.

METHODS APPENDIX MA8.5 Significance Levels for Comparisons Across Distances to Hospitals with No-invasive Cardiac Services

Distance to Hospital with Non-invasive Cardiac Services	Probability of Receiving Cardiac Procedure (p-value)			Waiting Times for Cardiac Procedure (p-value)		
	Coronary Angiography	Angioplasty	Bypass Surgery	Coronary Angiography	Angioplasty	Bypass Surgery
>50 km vs. 0-10 km	<0.0001	<0.0001	<0.0001	<0.0001	0.0624	0.0080
10-50 km vs. 0-10 km	<0.0001	<0.0001	0.0006	<0.0001	0.7028	0.0410
>50 km vs. 10-50 km	<0.0001	0.0090	<0.0001	0.0243	0.0625	0.4332

Note: Hospitals with invasive services were excluded for this analysis.

METHODS APPENDIX MA8.6 Probability of Coronary Angiography in Hospitals with Revascularization Services in Exhibit 8.12

Variable	Parameter Estimate	Odds Ratio	Wald Confidence Interval
Intercept	**5.0503**		
Age	**- 0.0833**	**0.9200**	**0.910 - 0.929**
Sex (Male)	**- 1.3478**	**0.2600**	**0.118 - 0.572**
Age* Male Sex	**0.0224**	**1.0230**	**1.011 - 1.034**

Log Odds of receiving coronary angiography for an individual patient = 5.0503 - 0.0833 (age) - 1.3478 (male sex) + 0.0224 (age* male sex)
Hosmer and Lemeshow chi-square = 101.17 with 8 DF ($p < 0.0001$); c statistic = 0.74

Note: The poor statistical fit of this model may be attributable to lack of severity adjustments for patients undergoing coronary angiography.

METHODS APPENDIX MA8.7 Probability of Revascularization in Hospitals with Revascularization Services in Exhibit 8.12

Variable	Parameter Estimate	Odds Ratio	Wald Confidence Interval
Intercept	**0.0482**		
Age	**- 0.0056**	**0.9940**	**0.987 - 1.002**
Sex (Male)	**0.5254**	**1.6910**	**1.134 - 2.522**
RQ	**- 0.0056**	**0.9940**	**0.989 - 1.000**
Age* Male Sex	**- 0.0875**	**0.9910**	**0.985 - 0.998**

Log Odds of receiving revascularization for an individual patient = 0.9482 - 0.0056 (age) + 0.5254 (male sex) - 0.00555 (RQ) - 0.00875 (male sex* RQ)

Hosmer and Lemeshow chi-square test = 9.989 with 8 DF ($p = 0.2658$); c statistic = 0.602

RQ = Angiography waiting time as a % rank statistic within any given institution-type used as an estimate of severity of illness.

METHODS APPENDIX MA8.8 Waiting Times for Coronary Angiography in Hospitals with Revascularization Services in Exhibit 8.13

Variable	Parameter Estimate	Odds Ratio
Age	**- 0.0029**	**0.9646**
Sex (Male)	**1.5959**	**0.3710**

Waiting time for coronary angiography for an individual patient = 19.577387 - 0.002934 (age) + 1.595925 (male sex); 2 DF ($p = 0.6524$); R-square = 0.0004

Note: The poor predictive capacity reflects the inability to include other potentially important predictive variables such as clinical illness severity.

METHODS APPENDIX MA8.9 Waiting Times for Revascularization in Hospitals with Revascularization Services in Exhibit 8.13

Variable	Parameter Estimate	Odds Ratio
Intercept	**15.6690**	
Age	**- 0.1038**	**0.4469**
Sex (Male)	**- 3.1097**	**0.6526**
RQ	**0.2115**	**0.0516**
Male Sex* RQ	**0.3744**	**0.0026**

Waiting time for revascularization for an individual patient = 15.668973 - 0.103829 (age) - 3.109651 (male sex) + 0.211521 (RQ) + 0.374427 (sex* RQ); 4 DF ($p<0.0001$); R-square = 0.0771

RQ = Angiography waiting time as a % rank statistic within any given institution-type used as an estimate of severity of illness.

METHODS APPENDIX MA8.10 Probability of Coronary Angiography in Hospitals with Catheterization Services Only in Exhibit 8.12

Variable	Parameter Estimate	Odds Ratio	Wald Conference Interval
Intercept	**5.9130**		
Age	**- 0.1015**	**0.9040**	**0.887 - 0.920**
Sex (Male)	**- 3.0114**	**0.0490**	**0.012 - 0.198**
Age* Male Sex	**0.0467**	**1.0480**	**1.026 - 1.070**

Log Odds of receiving coronary angiography for an individual patient = 5.9130 - 0.1015 (age) - 3.0114 (male sex) + 0.0467 (age* male sex)

Hosmer and Lemeshow chi-square test = 39.733 with 8 DF (p<0.0001); c statistic = 0.74

Note: The poor statistical fit of this model may be attributable to lack of severity adjustments for patients undergoing coronary angiography.

METHODS APPENDIX MA8.11 Probability of Revascularization in Hospitals with Catheterization Services Only in Exhibit 8.12

Variable	Parameter Estimate	Odds Ratio	Wald Conference Interval
Intercept	**- 0.7755**		
Age	**0.0241**	**1.0240**	**1.010 - 1.040**
Sex	**0.0350**	**1.0360**	**0.723 - 1.484**
RQ	**- 0.1220**	**0.9880**	**0.982 - 0.993**

Log Odds of receiving revascularization for an individual patient = - 0.7755 + 0.0241* (age) + 0.035* (male sex) - 0.0122 (RQ)

Hosmer and Lemeshow chi-square test = 6.0593 with 8 DF (p = 0.6406); c statistic = 0.62

RQ = Angiography waiting time as a % rank statistic within any given institution-type used as an estimate of severity of illness.

METHODS APPENDIX MA8.12 Waiting Times for Coronary Angiography in Hospitals with Catheterization Services Only in Exhibit 8.13

Variable	Parameter Estimate	p-value
Intercept	**33.1110**	
Age	**0.0589**	**0.7054**
Sex (Male)	**1.8795**	**0.6288**

Waiting time for coronary angiography for an individual patient = 33.110981 + 0.058872 (age) + 1.879526 (male sex); 2 DF (p = 0.8461); R-square = 0.0005

Note: The poor predictive capacity reflects the inability to include other potentially important predictive variables such as clinical illness severity.

METHODS APPENDIX MA8.13 Waiting Times for Revascularization in Hospitals with Catheterization Services Only in Exhibit 8.13

Variable	Parameter Estimate	p-value
Intercept	**36.2556**	
Age	**- 0.4282**	**0.1157**
Sex (Male)	**2.5573**	**0.6854**
RQ	**0.7029**	**<0.0001**

Waiting time for revascularization for an individual patient = 36.255624 - 0.428154 (age) + 2.557313 (male sex) + 0.702925 (RQ); 3 DF (p-value < 0.0001); R-square = 0.1384

RQ = Angiography waiting time as a % rank statistic within any given institution-type used as an estimate of severity of illness.

METHODS APPENDIX MA8.14 Probability of Coronary Angiography in Hospitals with No Invasive Services in Exhibit 8.12

Variable	Parameter Estimate	Odds Ratio	Wald Conference Interval
Intercept	**3.7850**		
Age	**- 0.0766**	**0.9260**	**0.923 - 0.930**
Sex	**- 1.0026**	**0.3670**	**0.278 - 0.485**
Age* Male Sex	**0.0184**	**1.0190**	**1.014 - 1.023**

Log Odds of receiving coronary angiography for an individual patient = 3.785 - 0.0766 (age) - 1.0026 (male sex) + 0.0184 (age* male sex)
Hosmer and Lemeshow chi-square test = 588.14 with 8 DF ($p < 0.0001$); c statistic = 0.735

Note: The poor statistical fit of this model may be attributable to lack of severity adjustments for patients undergoing coronary angiography.

METHODS APPENDIX MA8.15 Probability of Revascularization in Hospitals with No Invasive Services in Exhibit 8.12

Variable	Parameter Estimate	Odds Ratio	Wald Conference Interval
Intercept	**- 0.2413**		
Age	**0.0139**	**1.0140**	**1.011 - 1.017**
Sex	**0.2082**	**1.2310**	**1.129 - 1.343**
RQ	**- 0.0092**	**0.9910**	**0.990 - 0.992**

Log Odds of receiving revascularization for an individual patient = - 0.2413 + 0.0139 (age) + 0.2082 (male sex) - 0.00916 (RQ)

Hosmer and Lemeshow chi-square test = 18.566 with 8 DF ($p = 0.0174$); c statistic = 0.59

RQ = Angiography waiting time as a % rank statistic within any given institution-type used as an estimate of severity of illness.

METHODS APPENDIX MA8.16 Waiting Times for Coronary Angiography in Hospitals with No Invasive Services in Exhibit 8.13

Variable	Parameter Estimate	p-value
Intercept	**58.4202**	
Age	**- 0.1757**	**<0.0001**
Sex (Male)	**4.5185**	**<0.0001**

Waiting time for coronary angiography for an individual patient = 58.42017 - 0.175734 (age) + 4.518497 (male sex);
2 DF (p-value <0.0001); R-square = 0.004

Note: The poor predictive capacity reflects the inability to include other potentially important predictive variables such as clinical illness severity.

METHODS APPENDIX MA8.17 Waiting Times for Revascularization in Hospitals with No Invasive Services in Exhibit 8.13

Variable	Parameter Estimate	p-value
Intercept	**27.1980**	
Age	**- 0.2641**	**<0.0001**
Sex (Male)	**0.9270**	**0.7709**
RQ	**0.5891**	**<0.0001**
Male Sex* RQ	**0.1477**	**0.0127**

Waiting time for revascularization for an individual patient = 27.197986 - 0.264139 (age) + 0.927015 (male sex) + 0.589056 (RQ) + 0.147747 (male sex* RQ); 4 DF (p-value <0.0001); R-square = 0.113

RQ = Angiography waiting time as a % rank statistic within any given institution-type used as an estimate of severity of illness.

METHODS APPENDIX
Chapter 9

Angioplasty

The Canadian Institute for Health Information (CIHI) collects information on all hospital discharges routinely in Ontario, including patient demographics, health card insurance number, admission and discharge dates, diagnoses associated with the admission (coded according to the International Classification of Diseases [ICD-9])[1] and surgical procedures performed (classified according to the Canadian Classification of Procedures [CCP]).[2]

In the CIHI database, three Canadian procedure codes are used for angioplasties: 48.02 percutaneous transluminal coronary angioplasty (PTCA) without thrombolytic agent; 48.03 PTCA with thrombolytic agent (CCP code 48.03); and 48.09 other (in 1997 used with a suffix for PTCA with stent). For purposes of this analysis, we included all records with one of the above procedure codes listed as one of the first procedure codes on the CIHI abstract. We excluded all records with suffix code of 8 (cancelled surgery), 9 (previous surgery) or 0 (out of hospital) or cases with missing residence codes, or procedures found in institutions not performing angioplasty. Persons less than 20 years of age were excluded. Age groupings used were: 20 to 34, 35 to 49, 50 to 64, 65 to 74 and 75+. It is important to note that the number of procedures will not be equivalent to number of people since individuals can have more than one angioplasty. Data for a period of four years (1994/95 to 1997/98) were analyzed for age- and sex-specific rates over time and age- and sex-adjusted rates over time; two small area variation analyses were performed for comparison—1994/95 to 1995/96 and 1996/97 to 1997/98. Comparison was made to all men and women in Ontario 20 years and over in 1996 as determined by Census Canada by similar age groupings and by county for total provincial rates, and for the small area analysis. DHC specific rates for angioplasty have been adjusted for age and sex differences using the direct method of standardization.

This process was complicated by the following: two hospitals used coding systems for angioplasty and stenting that differed from the usual coding instructions in the Canadian Code Source Book. As stated above, we identified angioplasties using codes 48.02 (PTCA without mention of thrombolytic agent); 48.03 (PTCA with thrombolytic agent); or 48.09 (other removal of coronary artery obstruction).

Most hospitals do not use 48.09 (other removal of coronary artery obstruction). The code book instructions about coronary stenting required the joint occurrence of 48.02 (PTCA without mention of thrombolytic agent) or 48.03 (PTCA with thrombolytic agent) with 48.09. For hospitals that code using ICD-9 Clinical Modification (CM), stenting was identified by the joint occurrence of 36.01 (single vessel percutaneous transluminal coronary angioplasty or coronary atherectomy without mention of a thrombolytic agent) or 36.02 (single vessel percutaneous transluminal coronary angioplasty or coronary atherectomy with mention of a thrombolytic agent) with 36.06 (insertion of a coronary artery stent[s]).

In ICD-9, 36.06 is a unique code. One hospital developed internal policies to identify stented patients, not using the usual coding instructions in the Canadian Code Source Book. This hospital reasoned that the coding of the angioplasty provided redundant information and used a procedure code space on the abstract. Staff were concerned that if they used both codes, the other procedures might be dropped off the abstract. This internal policy did not appear to be a problem for them as the insertion of a coronary artery stent (CM code 36.06) is used by the CIHI grouper to assign patients to an angioplasty CMG. The problem only appears when CIHI converts the new code 36.06 to 48.09, the code for "other removal of coronary artery obstruction", a code already in use and not unique to stenting.

The second hospital pulled and re-abstracted charts to tease out the discrepancies in numbers, and found that in 1994/95, cases coded as 48.01 (removal of coronary artery obstruction unqualified) should have been coded as 48.04 (open chest coronary artery angioplasty). These cases coded 48.04 should not have been included as angioplasty procedures. Based on a sample of their 1996 charts, health records personnel concluded that the 93 patients coded as 48.09 without 48.02 or 48.03 were angioplasty plus stent patients. As before, the 48.02/48.03 cases had not been coded. Unfortunately, the Health Records staff had not been informed about the introduction of stents and therefore were not coding them. Appropriate adjustments to the numbers were made for both institutions.

Coronary Artery Bypass Graft Surgery

In the CIHI database, Canadian procedure codes 48.11 to 48.19 are used for CABG. For purposes of this analysis, we included any patient with one of the above procedure codes listed as one of the first procedure codes on the CIHI abstract. We excluded all records with a suffix code of 8 (cancelled surgery), 9 (previous surgery) or 0 (out of hospital) or cases with missing residence codes or procedures found in institutions not performing bypass surgery. Persons less than 20 years of age were excluded. Age groupings used were: 20 to 34, 35 to 49, 50 to 64, 65 to 74 and 75+. Data for the period 1991/92 to 1997/98 were analyzed for age- and sex-specific rates over time and age- and sex-adjusted rates over time; 1991 to 1993, 1994 to 1996 and 1997 were analyzed for small area rate variation. Comparison was made to all men and women in Ontario 20 years and over in 1996 as determined by Census Canada by similar age groupings and by county for total provincial rates, and for small area analysis. District Health Council specific rates for angioplasty have been adjusted for age and sex differences using the direct method of standardization.

References

1. World Health Organization. Manual of international statistical classification of diseases, injuries and causes of death. 9th revision [ICD-9]. Geneva: World Health Organization; 1977.
2. Statistics Canada. Canadian classification of diagnostic, therapeutic, and surgical procedures. 2nd edition. Ottawa: Ministry of Industry, Science and Technology, 1993.

METHODS APPENDIX
Chapter 10

As noted, the risk factors derived from the Cardiac Care Network (CCN) data include: age, sex, urgency category, previous coronary artery bypass graft surgery (CABG), left ventricular function (LVF), anatomical pattern of coronary obstructions, recent myocardial infarction (MI) and Canadian Cardiovascular Society angina (CCS) class.

Information on in-hospital mortality, discharge dates and non-cardiac comorbidity was taken from the Canadian Institute for Health Information (CIHI) database, where non-cardiac comorbidity was derived using the method of Deyo et al[1]. The following risk factors were derived from the diagnoses codes in CIHI: peripheral vascular disease (PVD), cerebrovascular disease, chronic obstructive pulmonary disease (COPD) and diabetes mellitus.

When sex and age variables were not available in CCN, they were taken from CIHI. Post-operative length of stay was calculated using the surgery date in CCN and the discharge date in CIHI. When this value was negative, we used the discharge date in CCN. There were no missing values for either of the two outcomes.

Missing data were uncommon. For example, in fiscal 1996/97, the most frequently missing variables in CCN were recent MI status (n=103) and LV function (n=87). The mortality rates for those with missing recent MI status and those with recent MI status="No" were nearly identical so they were grouped together. This was not the case for those with missing LV function and they were analyzed separately throughout. The numbers of missing values for the other variables were trivial: disease anatomy (n=6), CCS class (n=4), previous CABG (n=3), and urgency rating score (n=5). We grouped unknown values with the lowest category for each variable after affirming that the two groups had similar mortality rates.

We summarize the steps involved in data linkage briefly below. In fiscal 1994/95 and 1995/96, we excluded patients with a missing discharge date or those with a discharge date outside the fiscal year of interest. For 1996/97, we restricted the analysis to procedures performed between April 1, 1996 to March 1, 1997 inclusive because at the time of analysis we only had CIHI hospital records to the end of March 1997. If we included procedures that occurred later in March, we would run the risk of missing CIHI records for people who had longer lengths of stay and were discharged after March 31.

In all three years we excluded a small number of duplicate records, i.e. those identifying a second procedure during the same admission as another record. These second operations occurred very shortly after the first operation, had high urgency scores, and were almost certainly undertaken in response to an immediate and serious post-operative complication. While we excluded these second operations from the analysis, we did retain the initial record because the second procedure and any associated excess mortality or prolonged length-of-stay should be seen as complications of the first procedure and attributed accordingly.

We used the linkage program Automatch® to perform the matching between the CCN and CIHI databases. In the first steps, we matched records with identical health care numbers and similar chart numbers, institution, admission date, procedure date, discharge date, date of birth, sex and postal code. Matching by health care numbers captured the majority of in-province patients and the addition of the admission date helped to identify the specific CIHI record we were looking for since many patients had more than one. These steps matched well over 90% of records. We next accepted records with an identical chart number, and with similar health care numbers, institution, admission date, procedure date, discharge date, date of birth, sex and postal code.

The total matches for 1994/95 and 1995/96 were 98% and 97% respectively. However, Ottawa had a lower-than-expected proportion of matches (90-93%) because it served a moderate number of Quebec residents. In 1996/97, we took extra steps to link patients with missing health card numbers, making allowance for similar rather than identical chart numbers, so long as the match was perfect for institution, procedure date, and sex and similar chart number, admission date, discharge date, date of birth and postal code. With this approach, we brought the match rate up to 99.7%, and resolved the previously low rate of matching for Ottawa (now linked for 99.6% of records).

Earlier ICES score-cards for CCN relied on our published 1991 surgical risk index as the basis for risk-adjustment.[2] However, this risk index was developed for both isolated CABG surgery as well as valve surgery. While adding large numbers of new risk factors has small marginal returns,[3] our ongoing work has shown that somewhat better discrimination and much improved calibration are possible when new models are derived and fitted to each year's isolated CABG data.[4] Thus, results for 1994/95 and 1995/96 in the Atlas will vary somewhat from the preceding unpublished reports to CCN. Data for 1996/97 are new.

Logistic regression was used to model the probability of in-hospital mortality (Methods Appendix MA10.1) and Poisson regression (Methods Appendix MA10.2) was used to model post-operative length of stay.

The models were developed in the following fashion: First, all risk factors were analyzed at the univariate level. Each factor with a p-value less than 0.25 was included in the multivariate analysis. Factors with the highest p-values greater than 0.10 were dropped one by one from the multivariate model and the model was recalculated between each step until the final model was reached with all factors having p-values less than 0.10. The final model was compared to the full model using a likelihood ratio test to ensure that the fit of the reduced model was not significantly different than the full model.

When modelling mortality we found a significant interaction between Canadian Cardiovascular Society angina class and urgency classification due to the high collinearity between the two variables. Since urgency category had the better predictive ability (higher area under the ROC [receiver operating characterisic] curve) and gave the model a better fit (larger value for the Hosmer-Lemeshow goodness-of-fit statistic), we dropped CCS class from the models for mortality and retained urgency.

METHODS APPENDIX MA10.1 Logistic Regression Models for In-hospital Mortality

Risk Factor*		Fiscal Year							
		1994/95**		1995/96***		1996/97†		Aggregate††	
		Odds Ratio	p-value	Odds Ratio	p-value	Odds Ratio	P-Value	Odds Ratio	p-value
Age	65 - 74	1.57	.014	2.05	<.001	1.76	.004	1.74	<.001
	≥75	3.07	<.001	3.90	<.001	2.76	<.001	3.11	<.001
Sex	Female	1.52	0.023	1.39	.099	1.70	.004	1.54	<.001
Urgency	Urgent	1.33	0.156	1.88	.006	1.01	.959	1.32	.021
	Emergency	4.32	<.001	4.33	<.001	2.87	<.001	3.61	<.001
Repeat Operation	Yes	3.12	<.001	3.87	<.001	2.06	.006	2.86	<.001
Left Ventricular Function	Grade 2	1.36	0.158	0.99	.954	1.53	.069	1.30	.056
	Grade 3	1.98	.003	2.11	.003	2.71	<.001	2.23	<.001
	Grade 4	3.87	<.001	5.54	<.001	5.65	<.001	4.83	<.001
	Unknown	1.53	.582	5.83	<.001	2.30	.145	3.31	<.001
Cerebro-vascular Disease	Yes	2.11	.006	4.52	<.001	6.15	<.001	4.04	<.001
Chronic Obstructive Pulmonary Disease	Yes					1.74	.061		
Constant	(Coefficient)	-4.99	<.001	-5.68	<.001	-5.39	<.001	-5.28	<.001

* Reference group is age <65, male, elective urgency rating, no previous CABG, LVF of grade 1, no CVD and no COPD (1996/97 only)

** Used for longitudinal comparisons of Ontario mortality, as well as institutional comparisons of 1994/95 mortality

*** Used for institutional comparisons of 1995/96 mortality

† Used for institutional comparisons of 1996/97 mortality

†† Used for institutional comparisons of 1994/95 - 1996/97 mortality

Data Source: Cardiac Care Network, Canadian Institute for Health Information

The areas under the ROC curve and p-values for the Hosmer-Lemeshow (H-L) goodness-of-fit tests for the annual mortality models follow: 1994: ROC = 0.76; H-L p = 0.94; 1995: ROC = 0.81; H-L p = 0.36; and 1996: ROC = 0.81; H-L p = 0.31. All models therefore showed reasonable discrimination and were adequately calibrated.

To compare across institutions for each fiscal year, we used the risk factor weights for each year's mortality model to calculate the expected probability of mortality for each person in that year. We then calculated the expected mortality rate for each institution. The risk-adjusted mortality rate, which was calculated as the observed rate over the expected rate in that institution, multiplied by the observed rate for the province in the year of interest. The chapter shows the risk-adjusted mortality rates for each institution in each year. Below we show the crude mortality rates for reference purposes only.

Using the mortality model, we also categorized patients into low-, medium- and high-risk based on provincial tertiles of risk where risk is calculated as a person's predicted probability of mortality. Methods Appendix MA10.4, compiled using a three-year aggregate mortality model built in the same way as the yearly models, confirms that there was relatively little interhospital variability in overall risk profiles in this period.

METHODS APPENDIX MA10.2 Poisson Regression Models for Post-operative Length of Stay

Risk Factor*		Fiscal Year					
		1994/95**		1995/96***		1996/97†	
		Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
Age	65 - 74	0.2158	<.001	0.1658	<.001	0.1914	<.001
	≥75	0.3378	<.001	0.2913	<.001	0.2934	<.001
Sex	Female	0.1183	<.001	0.1268	<.001	0.0987	<.001
Urgency	Emergency	0.3364	<.001	0.2070	<.001		
Repeat Operation	Yes	0.1725	<.001	0.1369	<.001	0.1109	<.001
Left Ventricular Function	Grade 2	0.0193	.073	0.0248	.025	0.0469	<.001
	Grade 3	0.1611	<.001	0.0491	<.001	0.1383	<.001
	Grade 4	0.2468	<.001	0.2055	<.001	0.1045	<.001
	Unknown	0.0709	.159	0.1527	<.001	0.1298	<.001
Disease Anatomy	3 vessel/2 vessel + Proximal Left Anterior Descending Artery			0.0577	.002	0.0579	<.001
	Left Main			0.0466	.029	0.1046	<.001
Recent Myocardial Infarction	Yes	0.0315	.020	0.0575	<.001		
Canadian Cardio-vascular Society Class	Class 3	0.0067	.632	0.0417	.005	0.0353	.021
	Class 4a	0.0755	<.001	0.0728	<.001	0.0872	<.001
	Class 4b	0.0860	<.001	0.0703	<.001	0.1383	<.001
	Class 4c	-0.1709	<.001	-0.0437	.416	0.2674	<.001
Peripheral Vascular Disease	Yes	0.1220	<.001			0.1336	<.001
Cerebro Vascular Disease	Yes	0.3522	<.001	0.4043	<.001	0.4531	<.001
Chronic Obstructive Pulmonary Disease	Yes	0.0333	.064	0.1108	<.001	0.1404	<.001
Diabetes	Yes	0.0855	<.001	0.0847	<.001	0.0639	<.001
Constant		1.84	<.001	1.73	<.001	1.61	<.001

* Reference group is age <65, male, elective or urgent urgency rating (1994/95 and 1995/96 only), no previous coronary artery bypass graft, left ventricular function of grade 1, 1-vessel disease or 2-vessel disease without proximal left anterior descending artery involvement (1995/96 and 1996/97 only), no recent myocardial infarction (1994/95 and 1995/96 only), Canadian Cardiovascular Society Class 1 or 2, no peripheral vascular disease (1994/95 and 1996/97 only), no cerebral vascular disease, no chronic obstructive pulmonary disease and no diabetes.

** Used for institutional comparisons of 1994/95 length of stay.

*** Used for institutional comparisons of 1995/96 length of stay.

† Used for institutional comparisons of 1996/97 length of stay.

Data Source: Cardiac Care Network, Canadian Institute for Health Information

We calculated risk-adjusted post-operative length of stay in a similar fashion. We did not do longitudinal analyses of post-operative length of stay. For each year, we used the risk factor weights from the length of stay model to calculate the expected length of stay for each person in that year and the expected mean length of stay by institution. The risk-adjusted post-operative length of stay for an institution was calculated as the observed mean length of stay over the

METHODS APPENDIX MA10.3 Crude In-hospital Coronary Artery Bypass Graft Surgery Mortality Outcomes by Hospital, 1994/95 - 1996/97

Hospital	Crude In-hospital Mortality Rate (%)		
	1994/95	1995/96	1996/97
Kingston General Hospital	1.25	0.27	3.52
Sudbury Memorial Hospital	1.33	1.60	1.62
The Toronto Hospital	2.80	2.26	1.92
Sunnybrook Health Science Centre	2.06	2.31	2.90
Hamilton Civic Hospital (now Hamilton Health Science Centre)	2.23	2.52	2.71
University of Ottawa Heart Institute	3.57	1.61	2.12
St. Michael's Hospital	4.39	3.28	3.75
Victoria Hospital (now Victoria Campus, London Health Sciences Centre)	3.27	2.87	2.18
University Hospital (now University Campus, London Health Sciences Centre)	2.64	4.33	1.89
Overall	**2.75**	**2.32**	**2.41**

Data Source: Cardiac Care Network, Canadian Institute for Health Information

METHODS APPENDIX MA10.4 Mortality Risk Distribution for Isolated Coronary Artery Bypass Graft Surgery by Hospital, 1994/95 - 1996/97

Hospital	Low Risk Patients (%)	Medium Risk Patients (%)	High Risk Patients (%)
Kingston General Hospital	34.59	31.02	34.39
Sudbury Memorial Hospital	33.51	35.25	31.24
The Toronto Hospital	33.06	31.39	35.55
Sunnybrook Health Science Centre	37.42	33.50	29.07
Hamilton Civic Hospital (now Hamilton Health Science Centre)	34.18	34.80	31.02
University of Ottawa Heart Institute	32.24	30.51	37.25
St. Michael's Hospital	30.33	35.70	33.97
Victoria Hospital (now Victoria Campus, London Health Sciences Centre)	37.09	33.50	29.42
University Hospital (now University Campus, London Health Sciences Centre)	37.33	33.80	28.88
Overall	**34.05**	**32.92**	**33.03**

Data Source: Cardiac Care Network, Canadian Institute for Health Information

expected mean length of stay for that institution, multiplied by the overall mean length of stay in the province in the year of interest.

For longitudinal analysis, we compared the provincial mortality rates across the three years of study, using the 1994/95 model weights to calculate the expected probability of mortality for each person in every year of data. From this we calculated the expected mortality rate for each fiscal year. The risk-adjusted mortality rate for each year was calculated as the observed rate over the expected rate in that year, multiplied by the observed rate in 1994/95. Thus, each year could be compared to the 1994/95 rate. (The risk-adjusted 1994/95 rate is accordingly identical to its observed rate).

METHODS APPENDIX MA10.5 Distribution of Surgical Risk Factors Among Cardiac Surgery Hospitals in Ontario, 1994/95 - 1996/97

		Kingston General Hospital	Sudbury Memorial Hospital	The Toronto Hospital	Sunnybrook Heath Science Centre	Hamilton Civic Hospital (now Hamilton Health Science Centre)	University of Ottawa Heart Institute	St. Michael's Hospital	Victoria Hospital (now Victoria Campus, London Health Sciences Centre)	University Hospital (now University Campus, London Health Sciences Centre)	Overall
Age	<65	55.78	57.54	54.62	53.61	49.87	53.24	52.32	54.08	53.42	53.65
	65 - 74	36.61	35.86	35.71	36.00	40.13	37.25	39.99	37.82	38.13	37.35
	≥75	7.61	6.60	9.67	10.39	10.00	9.51	7.69	8.10	8.45	9.00
Sex	Men	77.84	75.74	78.21	79.56	75.87	79.15	78.25	75.03	78.77	77.75
	Women	22.16	24.26	21.79	20.44	24.13	20.85	21.75	24.97	21.23	22.25
Urgency	Elective	48.55	64.67	51.88	49.97	48.13	46.79	61.74	47.99	33.58	50.40
	Urgent	36.51	24.94	35.64	37.48	38.76	40.49	27.00	44.15	47.98	37.10
	Emergency	14.93	10.39	12.48	12.55	13.11	12.71	11.26	7.86	18.44	12.50
Repeat Operation	No	96.72	93.10	93.47	96.93	93.87	90.57	93.56	96.10	94.86	93.93
	Yes	3.28	6.90	6.53	3.07	6.13	9.43	6.44	3.90	5.14	6.07
Left Ventricular Function	Grade 1	44.32	28.51	28.59	44.01	40.62	46.20	26.04	36.42	57.90	37.78
	Grade 2	34.68	40.11	43.46	34.01	40.93	22.14	37.78	37.27	30.57	36.24
	Grade 3	15.61	21.00	23.23	18.11	14.80	19.34	25.33	17.84	9.33	19.17
	Grade 4	3.95	8.19	4.52	3.58	3.64	9.87	5.66	6.52	2.06	5.46
	Unknown	1.45	2.20	0.21	0.28	0.00	2.43	5.18	1.95	0.15	1.35
Disease Anatomy	Left Main Disease	27.75	17.06	15.70	14.71	17.69	18.28	16.98	18.45	17.85	17.55
	3 vessel/ 2 vessel + Proximal Left Anterior Descending Artery	63.29	67.40	74.06	73.71	62.71	66.62	66.69	72.72	69.07	69.23
	1 vessel/ 2 vessel - Proximal Left Anterior Descending Artery	8.96	15.54	10.24	11.58	19.60	15.11	16.33	8.83	13.08	13.22
Recent Myocardial Infarction	No Recent	83.53	89.54	83.34	87.17	83.96	84.19	84.33	80.15	76.78	83.69
	Recent	16.47	10.46	16.66	12.83	16.04	15.81	15.67	19.85	23.22	16.31
Canadian Cardio-vascular Society Class	Class 1 - 2	17.44	35.25	19.80	12.15	4.36	12.16	13.11	18.70	6.69	15.29
	Class 3	37.57	29.95	28.56	37.88	49.24	34.56	44.46	35.57	27.77	35.59
	Class 4A	15.32	13.57	17.66	15.50	11.69	22.59	22.94	10.35	24.17	17.33
	Class 4B	15.32	10.69	21.24	21.75	22.18	21.11	8.28	27.59	22.19	19.73
	Class 4C	14.35	10.54	12.73	12.72	12.53	9.58	11.20	7.80	19.18	12.06
Peripheral Vascular Disease	No	95.76	98.56	92.97	98.13	97.96	98.23	99.34	97.81	98.97	96.92
	Yes	4.24	1.44	7.03	1.87	2.04	1.77	0.66	2.19	1.03	3.08
Cerebro-vascular Disease	No	90.27	96.44	93.41	96.20	96.58	96.76	96.25	96.65	96.91	95.43
	Yes	9.73	3.56	6.59	3.80	3.42	3.24	3.75	3.35	3.09	4.57
Chronic Obstructive Pulmonary Disease	No	89.50	96.51	88.68	94.32	98.40	96.54	95.35	93.85	98.46	94.04
	Yes	10.50	3.49	11.32	5.68	1.60	3.46	4.65	6.15	1.54	5.96
Diabetes	No	83.24	84.23	76.73	76.38	93.56	88.84	80.87	79.05	91.11	83.18
	Yes	16.76	15.77	23.27	23.62	6.44	11.16	19.13	20.95	8.89	16.82

Data Source: Cardiac Care Network, Canadian Institute for Health Information

The distribution of surgical risk factors across institutions for the three-year period under study, is shown in Methods Appendix MA10.5. We remain concerned about potential interinstitutional disparities in coding practices. For example, two variables with large coefficients in the mortality models are presence of a grade 4 ventricle and cerebrovascular disease. As Methods Appendix MA10.5 shows, the prevalence of these risk factors does vary considerably by hospital. However, their overall prevalence is sufficiently low in both cases that the risk-adjusted outcomes should be reasonably robust in spite of any coding inconsistencies.

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METHODS APPENDIX
Chapter 11

METHODS APPENDIX MA11.1 Inclusion and Exclusion Criteria for Acute Myocardial Infarction Secondary Prevention Cohort

INCLUSION CRITERIA	Number of Patients
All patients in Ontario satisfying the inclusion/exclusion criteria for the Acute Myocardial Infarction outcomes analysis between fiscal 1994/95 and 1996/97 (Appendix 5.1)	52,616

EXCLUSION CRITERIA	Number of Patients
Age 64 or Younger	20,115
Discharged to Chronic Care Facility	335
Died in Hospital	6,112
Final Cohort	**26,054**

METHODS APPENDIX MA11.2 Inclusion and Exclusion Criteria for Congestive Heart Failure Secondary Prevention Cohort

INCLUSION CRITERIA	Number of Patients
All patients in Ontario satisfying the inclusion/exclusion criteria for the Congestive Heart Failure outcomes analysis between fiscal 1994/95 and 1996/97 (Appendix 6.1)	39,714

EXCLUSION CRITERIA	Number of Patients
Age 64 or Younger	6,075
Missing Institution	0
Discharged to Chronic Care Facility	635
Died in Hospital	3,491
Final Cohort	**29,513**

METHODS APPENDIX MA11.3 Inclusion and Exclusion Criteria for Coronary Artery Bypass Graft Secondary Prevention Cohort

INCLUSION CRITERIA	Number of Patients
All patients in Ontario satisfying the inclusion/exclusion criteria for the Coronary Artery Bypass Graft surgery Canadian Classification of Procedures code 48.1 between fiscal 1994/95 and 1996/97	21,585

EXCLUSION CRITERIA	Number of Patients
Patient From Out-of-Province	890
Missing Residence Code, Age or Invalid Institution	11
Died in Hospital	630
Age 64 or Younger	10,462
Missing Health Card Number	31
Final Cohort	**9,561**

METHODS APPENDIX MA11.4 Cardiac Drugs Available through the Ontario Drug Benefit Program that were Included in the Secondary Prevention Analysis

Drug Type	Drug Name
Angiotension Converting Enzyme Inhibitors	Benazepril, Captopril, Cilazapril, Enalapril, Fosinopril, Lisinopril, Perindopril, Quinapril, Ramipril
Beta-blockers	Acebutolol, Atenolol, Labetalol, Metroprolol, Nadolol, Oxprenolol, Pindolol, Propranolol, Timolol
Calcium Channel Blockers	Amlodipine, Diltiazem, Felodipine, Nifedipine, Verapamil
Loop Diuretics	Furosemide
Statins	Fluvastatin, Lovastatin, Pravastatin, Simvastatin

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This chapter features only descriptive statistics. Some are taken from previously published material, while others were derived for this document.

Exhibit 12.1: From the Cardiac Care Network (CCN) Statistical Summary for 1997/98. Includes Ontario residents only. Time scale has been shifted to correspond to fiscal quarters rather than calendar quarters as in the CCN report.

Exhibit 12.2: From CCN Statistical Summary for 1997/98. Includes Ontario residents only. Time scale has been shifted to correspond to fiscal quarters, rather than calendar quarters as in the CCN report. The Recommended Mean Waiting Time (RMWT) is a function of the Urgency Rating Score (URS), a score for prioritizing coronary artery bypass surgery (CABG) patients. Please note Interpretive Caution about the change in the URS calculation in April 1997. This change will affect both the urgent/semi-urgent/elective categorization and the calculation of the RMWT.

Exhibit 12.3: From CCN Statistical Summary for 1997/98. Includes Ontario residents only.

Exhibit 12.4i-viii: Data taken from CCN quarterly reports. Each value represents a monthly average of three months.

Exhibit 12.5: Produced from CCN data at the Institute for Clinical Evaluative Sciences (ICES). Includes patients waiting for isolated CABG, who either received isolated CABG or died while waiting 1995/96-1997/98. Urgency categories are defined on the basis of the Urgency Rating Score (URS) as follows: Urgent: URS≤4; Semi-urgent: URS>4 and URS<5; Elective: URS≥5.

Exhibit 12.6i-iii: Produced from CCN data at ICES. Includes patients waiting for isolated CABG, who either received isolated CABG or died while waiting within the specified time period. Urgency categories are defined on the basis of the Urgency Rating Score (URS) as follows: Urgent: URS≤4; Semi-urgent: URS>4 and URS<5; Elective: URS≥5.

Exhibit 12.7: Produced from CCN data at ICES. Includes patients waiting for isolated CABG, who either received isolated CABG or died while waiting within the specified time period. Urgency ranges include the upper limit of the range—for example, URS 3-4 includes patients with URS>3 or URS≤4.

Exhibit 12.8: Produced from CCN data at ICES. Includes patients waiting for isolated CABG, who either received isolated CABG or died while waiting within the specified time period.

Exhibit 12.9: Information of backlog from CCN 1997/98 Annual Report. Information on Targets from Waits and Rates document. Details of calculation in Appendix 12.1.

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The Role of non-invasive cardiac diagnostic testing

Electrocardiogram (ECG). The minute electrical current discharged by the specialized conducting cells of the heart to initiate contraction can be recorded from the surface of the body.[1] The recording device is an electrocardiograph and the tracing obtained is an electrocardiogram. Clinical electrocardiography provides two categories of diagnoses: (1) absolute diagnoses, which relate to cardiac rhythm and conduction; and (2) relative or "correlative," diagnoses, which involve abnormalities of the contour of the ECG.[2] In the latter instance, diagnosis is based on the probability that the electrocardiographic abnormality correlates to an anatomic, physiologic, or metabolic abnormality, which in turn

depends on the clinical setting.[2] As a consequence, ordering an ECG for the purpose of establishing a correlative diagnosis (e.g., presence of ischemia or of left ventricular hypertrophy) should only be undertaken in individuals with a reasonable prior likelihood of having the abnormality in question.[2,3] Furthermore, it is useful to remember that the ECG is a static and indirect representation of what may be dynamic processes (e.g., cardiac ischemia). Often patterns are nondiagnostic, with the potential for causing diagnostic uncertainty and error, while even supposedly "diagnostic" findings, such as Q-waves, may have limited specificity.[4] Nevertheless, with these caveats in mind, the ECG is still a useful diagnostic and even prognostic tool.[5-7]

Ambulatory electrocardiography (Holter monitoring). Ambulatory electrocardiography monitors cardiac rhythm and conduction over an extended period of time (e.g., 24 hours), and is used most commonly to identify arrhythmias. This procedure has also been employed to detect silent ischemia, which manifests itself as a transient, often asymptomatic ST-segment depression.[8] Silent ischemia may occur with ordinary daily activity at significantly lower heart rates than during exercise testing,[9-12] is three to four times more prevalent than symptomatic ischemia,[12-17] and is associated with a higher frequency of subsequent cardiac events.[12-19] Hence, ambulatory ECG complements other diagnostic procedures for evaluating ischemic heart disease, as it carries additional prognostic information beyond clinical assessment, exercise stress test results, or level of ejection fraction measured with radionuclide angiocardiography.[12,17,18,20]

Exercise stress test (EST). This test is used routinely to assess patients with suspected ischemic heart disease. It can help to diagnose coronary artery disease, determine functional capacity, evaluate the effects of therapy and estimate prognosis.[21-24] The predictive value of the EST depends on the prevalence of disease.[21-23] This feature may limit its use as a screening tool in high- or low-risk groups, including women, especially if young and presenting with atypical symptoms.[25-32] In addition to various relative and absolute contraindications, stress test results are limited by such confusing electrocardiographic variables as left ventricular hypertrophy, left bundle branch block or digitalis effect.[21,33]

Myocardial perfusion scintigraphy. Scintigraphic assessment of myocardial perfusion, in conjunction with exercise or pharmacologic stress, has become widely used in the diagnosis and prognosis of patients with known or suspected ischemic heart disease.[34-37] Thallium-201 is a potassium analog that, following intravenous administration, is almost 90% extracted by the myocardium.[24,34,35,38] Other radionuclide agents used include technetium-99m sestamibi. Uptake of thallium-201 or similar agents within the heart is proportional to myocardial blood flow across much of its physiological range.[34-36] With exercise or pharmacologic stress (as, for instance, with dipyridamole), coronary flow increases. However, blood flow and hence radionuclide uptake is less than normal distal to a functionally significant coronary stenosis. Thus, regional heterogeneity of radionuclide distribution reflects underlying myocardial blood flow abnormality and is manifested as "defects" on the scintigram. Redistribution of thallium radionuclide occurs with a four to eight hour half-life, but is slower than normal in areas of hypoperfused myocardium.[35,36] A defect that is reversible on re-imaging two to four hours later suggests the presence of ischemic but viable tissue while a fixed defect generally implies a nonviable scar.[34-37] Technetium-99m sestamibi

does not redistribute and hence reinjection of compound is required prior to re-imaging. Advantages of myocardial perfusion scintigraphy over EST include a higher sensitivity and specificity for detecting coronary artery disease,[34,37-40] utility for localizing regional flow abnormalities,[41,42] preserved reliability even in populations with a low prevalence for coronary artery disease (hence potentially more useful than the standard exercise stress test in women),[43,44] powerful prognostic ability,[34,37,45,46] and limited ability to distinguish reversible from irreversible myocardial injury.[34,35,38,47,48]

Radionuclide angiocardiography (RNA). Radionuclide techniques can also be used to assess ventricular function. A small sample of the patient's own red blood cells are labelled with technetium-99m and then reinjected into the circulation. A conventional scintillation camera uses a physiologic indicator, such as the electrocardiogram, to synchronize ("gate") serial static images of the cardiac blood pool relative to the cardiac cycle.[34,49,50] In this fashion, images can be related to key phases of the cardiac cycle such as end-systole and end-diastole. RNA can be performed during exercise, generally using supine or semi-supine bicycle ergometry. The procedure permits reproducible quantitative assessment of right and left ventricular ejection fractions, measurement of ventricular size and volume, assessment of regional ventricular function and analysis of diastolic filling parameters.[34,49,50] By quantifying left ventricular ejection fraction, the procedure also provides important prognostic insights.[38,50-53] RNA is of limited value in the diagnostic evaluation of women with suspected ischemic heart disease[26] while the presence of atrial fibrillation or frequent premature beats may reduce the accuracy of, or even invalidate, results.[49,54]

Echocardiography refers to a family of tests that utilize ultrasound to examine cardiac structure and function, as well as patterns of blood flow within the heart.[55,56]

M-mode echocardiography uses pulsed ultrasound waves to obtain one-dimensional anatomic information (ice-pick view) which is displayed in a time graph. Although M-mode displays lack spatial information, they lend themselves well to the measurement of cardiac structures and chambers.

Two-dimensional echocardiography uses sequentially-directed, pulsed ultrasound waves to create two-dimensional images of anatomic structures which are displayed in real-time on a video screen. Standard tomographic views are obtained of the entire heart including pericardium, chambers, valves and great vessels.

Doppler echocardiography assesses blood flow by detecting frequency shifts of ultrasound waves reflected back from moving blood cells. These shifts are instantaneously processed, converted to flow velocity by an on-line computer and are displayed spectrally on a time graph. Pulsed wave Doppler analyses Doppler signals at a selected depth (sample volume) within a cardiac chamber to localize and map abnormal blood flow within that chamber. However, pulsed wave Doppler cannot sample quickly enough to identify very rapid blood flow. Therefore, continuous-wave Doppler, which analyses blood flow along the entire length of the ultrasound beam, is most commonly used for detecting high-flow velocities (e.g., resulting from large pressure gradients as with aortic stenosis). Unfortunately, it is more difficult to determine the tissue depth at which signals are originating with this method. Colour flow imaging (or

Colour Doppler) selects Doppler information from multiple sample volumes in a given two-dimensional area and displays these in a colour encoded fashion. By convention, flow toward the transducer is displayed in red and flow away from the transducer in blue. Turbulent flow appears as an admixture, usually green or a mosaic of colours. This technique allows the real-time visualization of intracardiac flow to be superimposed on the two-dimensional echocardiographic display and is a powerful visual aid to the detection of flow abnormalities.

Two dimensional echocardiography provides easily obtained and reproducible information on cardiac structure and function.[55-57] It can be readily used to obtain qualitative and quantitative assessments of left ventricular thickening,[58] systolic function, and is sensitive to regional wall motion abnormalities resulting from ischemia or infarction.[59,60] Prognostic information can be derived from the functional data.[61] More recently, the diagnostic and prognostic utility of the echocardiogram in the assessment of the patients with known or suspected ischemic heart disease has been enhanced by its combination with exercise or pharmacologic stress.[62-65] Application of stress echocardiography may be especially useful for the detection of ischemic heart disease in women.[66] Newer Doppler echocardiographic techniques have permitted assessment of left ventricular diastolic dysfunction.[67-71] Echocardiography (including two-dimensional and Doppler studies) is the procedure of choice for assessing congenital heart disease[57] and is commonly used to identify and evaluate problems with both native and prosthetic heart valves.[55-57] Gradients derived by Doppler echocardiography correlate highly with those obtained at cardiac catheterization, particularly for aortic stenosis.[55]

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METHODS APPENDIX
Chapter 14

Coronary Artery Bypass Surgery and Percutaneous Angioplasty

For this analysis, we obtained from the Canadian Institute for Health Information (CIHI) all data on Ontario patients who had coronary artery bypass surgery (CABG) code 48.1 and percutaneous transluminal coronary angioplasty (PTCA) codes 48.02 or 48.03 for fiscal 1991/92 to 1996/97. If patients were noted to have had PTCA or CABG in hospitals which do not provide this service, they were excluded.

Area-based Ethnicity

Ethnicity information for the area of residence of the patient was obtained from Part B of the 1991 census. Those who claimed a single ethnic origin whereby the nationality of their ancestors was French, British, German, Italian, Portuguese, Ukrainian, Dutch, Jewish, Greek, non-Aboriginal Canadian, Hungarian, Spanish, Norwegian, Yugoslavian, Croatian, Polish, Swedish, Danish and Finnish, were designated as Caucasian (Jewish Ontarians are predominantly Ashkenazi, and thus were considered Caucasian). The proportion of Caucasians was determined for each area, designated by the first three digits of the postal code of residence. Each area was then ranked from the lowest to highest proportions of Caucasians with population quintiles created. The population for each quintile was age- and sex-specific such that slightly different quintiles were created for six different categories: women age 40 to 64, 65 to 74 and 75+ years, and men age 40 to 64, 65 to 74 and 75+ years.

METHODS APPENDIX MA14.1 Age/Sex-specific Angioplasty Rates per 100,000 Population by Surname Ethnicity in Ontario, 1991/92 - 1996/97

Age Group (Years)	Sex	Ethnicity	Number per Year	Population	Rate per 100,000
20 - 64	Women	Chinese	3	113,775	2.9
		South Asian	13	103,477	12.4
		Other	609	2,989,776	20.4
	Men	Chinese	17	110,865	15.3
		South Asian	64	100,703	63.9
		Other	2,105	2,916,100	72.2
>65	Women	Chinese	4	25,985	14.2
		South Asian	7	23,743	28.2
		Other	552	680,416	81.1
	Men	Chinese	6	18,794	29.3
		South Asian	10	17,198	56.4
		Other	880	491,569	178.9

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, Census 1991 and 1996, ICES-modified SHARE Database

METHODS APPENDIX MA14.2 Age/Sex-specific Coronary Artery Bypass Rates per 100,000 Population by Surname Ethnicity in Ontario, 1991/92 - 1996/97

Age Group (Years)	Sex	Ethnicity	Number per Year	Population	Rate per 100,000
20 - 64	Women	Chinese	3	113,775	2.2
		South Asian	18	103,477	16.9
		Other	567	2,989,776	18.9
	Men	Chinese	24	110,865	21.4
		South Asian	106	100,703	105.0
		Other	2,684	2,916,100	92.0
>65	Women	Chinese	5	25,985	17.3
		South Asian	12	23,743	48.4
		Other	823	680,416	120.9
	Men	Chinese	16	18,794	84.1
		South Asian	28	17,198	164.6
		Other	2,043	491,569	415.6

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, Census 1991 and 1996, ICES-modified SHARE Database

For the statistical analysis of the rate of CABG involving socioeconomic status (SES), urban Ontario patients who had surgery between fiscal 1991/92 and 1995/96 were included. For the denominator of rates in this detailed analysis, the rural population was excluded and thus the absolute rates would not be deflated, as in the overall analysis which excluded SES. For SES, Part B of the 1991 census was used to obtain the corresponding sex-specific, mean individual income for an area represented by the first three digits of the postal code of residence. Each area was ranked from lowest to highest average income with population quintiles created. The population for each quintile was age- and sex-specific such that slightly different quintiles were created for four different categories: women age 40 to 64, women age 65+, men age 40 to 64 and men age 65+ years. Over the years 1992 to 1995, we obtained projections from Statistics Canada in the age- and sex-specific subpopulation growth, which was used for the denominator for the rates. We assumed that each income quintile grew by the same amount over the five year period.

For the statistical analysis of the rate of CABG or PTCA compared to area ethnicity that excluded SES, we performed logistic regression analysis separately for the fiscal years 1991/92 to 1993/94 and 1994/95 to 1996/97. In both models for each procedure, the independent categorical variables were age (under and over age 65), sex (female/male) and area ethnicity quintile (five categories, with reference to the lowest quintile or lowest proportion of Caucasians in an area). The dependent variable was the rate of CABG or PTCA. For PTCA for fiscal 1991/92 to 1993/94 inclusive, all independent variables were statistically significant at $p<0.0001$, except for quintile 2 ($p=0.0002$) and age ($p>0.05$). For fiscal 1994/95 to 1996/97, all independent variables were significant at $p<0.0001$ except for quintile 4 ($p>0.05$). For CABG for fiscal 1991/92 to 1993/94, all were significant at $p<0.0001$ except quintile 4 ($p=0.0444$), quintile 5 ($p=0.0043$) and quintiles 2 and 3 (both $p>0.05$). For fiscal 1994/95 to 1996/97, all were significant at $p<0.001$ except for quintile 3 ($p=0.0157$) and quintiles 2, 4 and 5 (latter three $p>0.05$).

METHODS APPENDIX MA14.3 Ethnicity-Socioeconomic Status Regression Model

Independent Variable	Incidence Rate Ratio*	95% Confidence Interval**	p-value
Income			0.0001
Income Quintile 1[1]	0.78	0.27 - 2.24	0.6405
Income Quintile 2[1]	0.87	0.30 - 2.52	0.8037
Income Quintile 3[1]	0.86	0.30 - 2.48	0.7750
Income Quintile 4[1]	0.88	0.29 - 2.64	0.8185
Proportion of Caucasians			0.0002
Ethnic Quintile 1[2]	0.72	0.25 - 2.08	0.5392
Ethnic Quintile 2[2]	0.84	0.29 - 2.42	0.7460
Ethnic Quintile 3[2]	0.72	0.25 - 2.08	0.5439
Ethnic Quintile 4[2]	0.59	0.20 - 1.76	0.3449
Sex			0.0001
Male[3]	3.53	1.29 - 9.66	0.0138
Age			0.0001
40 to 64 Years[4]	0.26	0.19 - 0.35	0.0001
Year			0.0001
1991[5]	0.70	0.44 - 1.10	0.1216
1992[5]	0.80	0.52 - 1.23	0.3077
1993[5]	0.66	0.42 - 1.04	0.0746
1994[5]	0.82	0.53 - 1.25	0.3528

Overall model goodness-of-fit: deviance/df = 0.95 (deviance/df<1 = very good fit)

Final model includes interactions of sex-age, age-year, income-sex, income-age, income-ethnicity, income-ethnicity-age (all p<0.0001), income-ethnicity-sex (p<0.0031) and income-ethnicity-year (p<0.0045)

* IRR: incidence rate ratio (~relative risk) $=e^{\text{coefficient}}$

** 95% CI: 95% confidence interval $=e^{\text{coefficient} \pm 1.96 \times \text{standard error}}$

[1-5] reference subgroup i.e. coefficient values compared to subgroup "x" where "x" =
[1]income: quintile 5 [2]ethnicity: highest % Caucasians (quintile 5)
[3]sex: female [4]age: 65 and over
[5]year: 1995

For the analysis of the rate of CABG compared to area ethnicity that included SES, we performed regression analysis based on the Poisson distribution, because of the anticipated very low rates for each SES-ethnicity group. The dependent continuous variable was rate of CABG. The independent categorical variables were age (40 to 64 versus 65+), sex, year of CABG, ethnicity and SES. Interaction terms were left in the model if each demonstrated $p<0.05$. All analyses were performed using SAS.[1]

Surname-based Ethnicity

As outlined previously, we modified the surname list provided by the SHARE group, using the Registered Persons Database (RPDB) as a guide. Specifically, we first scanned the list to put names into several categories: definitely a given ethnicity, moderate specificity for an ethnic group, low specificity for an ethnic group, definitely not specific for an ethnic group but a common surname in the RPDB (e.g. Wilson for South Asian), definitely not specific for an ethnic group but a rare surname. We were guided in the selection of the specificity for the Chinese surnames by a study conducted by Choi et al.[2] In order to circumvent undercounting, especially for non-specific surnames, such as DeSouza for

South Asians and Lee for Chinese, we individually assessed all such names for first and/or middle names that were likely to be associated with a given ethnicity. This may actually cause some over-counting of people, whose first and/or middle names may not be clearly identifiable. For example, some Korean given names may be indistinguishable from Chinese ones, and thus some Koreans with the last name "Lee" would be counted as Chinese, thus over-representing Chinese (given that the population in the denominator of the rate would be self-identified Chinese from the census). Accepting all names that fell into the definite and moderate categories, we achieved ethnic population proportions from the RPDB very similar to the known Ontario population proportions.

For the denominator of the rate of CABG or PTCA, the population sizes by ethnicity were obtained from the 1991 and 1996 census. In the two census years, ethnic population sizes were determined differently. The 1991 census provided information only for single ethnic origin whereas for 1996, the census provided information on multiple ethnic origins. We speculated that the 1991 census would thus undercount the actual ethnic populations because multiple origins were not considered. Thus, for the 1991 population for both the Chinese and South Asian ethnic groups, we multiplied the population size by a correction factor. This factor was a ratio of the 1996 census total population for a given ethnic origin (multiple or single), to the number that responded as declaring only a single ethnic origin. We then added the population totals for both census years together, and then divided by two, to determine the average population size. For the numerator of the rate, because there were data on six years of procedures, the total number of procedures over the six years were divided by six, to determine the average rate.

For the statistical analysis of the rate of PTCA or CABG compared to surname ethnicity, we performed logistic regression analysis. The independent categorical variables were age (under and over age 65), sex (female/male) and ethnicity (three categories, with reference to the "other" group). The dependent variable was the rate of CABG. All independent variables in the final models were found to be significant at $p<0.0001$, except for South Asians in the CABG model ($p=0.0008$). All analyses were performed using SAS.[1]

Post-MI Cohort

For this section of this chapter, please refer to Methods Appendix for Chapters 5 and 11.

References

1. SAS (Sas Institute Inc., Cary, North Carolina).
2. Choi BCK, Hanley AJG, Holowaty EJ, Dale D. Use of surnames to identify individuals of Chinese ancestry. *Am J Epidemiol* 1993;138:723-734.

METHODS APPENDIX
Chapter 15

METHODS APPENDIX MA 15.1 Components of The Chain of Survival: Availability in Selected Communities in Ontario, 1998 *

Community	Presence of 911 System	Public Cardiopulmonary Resuscitation Training Programs Available	Firefighters Provide Cardiopulmonary Resuscitation Training; Written-tiered Response Agreement	Police Provide Cardiopulmonary Resuscitation Training; Written-tiered Response Agreement	Firefighter Defribrillation Program Instituted	Police Defribrillation Program Instituted	Ambulance Defribrillation Program Instituted	Ambulance ALS (PII Level) for All Cardiac Arrest Patients
Barrie								
Huntsville	■	■	■				■	
Bracebridge	■	■	■				■	
Port Carling	■	■	■				■	
Bala	■	■	■				■	
Gravenhurst	■	■	■				■	
Orillia	■	■	■		■		■	
Midland	■	■	■				■	
Penetang	■	■	■				■	
Wasaga Beach	■	■	■				■	
Collingwood	■	■	■				■	
Barrie	■	■	■				■	
Angus	■	■	■				■	
Innis - FN	■	■	■		■		■	
Mnjikaning - FN	■	■	■		■		■	
Ramera Township	■	■	■		■		■	
Alliston	■	■	■				■	
Beeton	■	■	■				■	
Bradford	■	■	■				■	
Christian Island	■	■	■					
Cambridge								
Cambridge	■	■	■		■		■	■
Kitchener	■	■	■		■		■	■
Waterloo	■	■	■		■		■	■
Wilmot Township	■	■	■		■		■	■
Woolwich Township	■	■	■				■	■
Wellesley Township	■	■	■		■**		■	■
North Dumphries Township	■	■	■		■		■	■
Cambridge-Wellington Perth County								
Town of Listowel	■	■					■	
Grey Township	■	■					■	
Wellesley Towhship	■	■					■	
Ellice Township	■	■					■	
Morris Township	■	■					■	
Howick	■	■					■	
Dufferin County								
Orangeville	■	■					■	
Shelburne	■	■					■	
Melancthon Township	■	■					■	
Mulmur Township	■	■					■	
Mono Township	■	■					■	
Amaranth Township	■	■					■	
East Garafraxa Township	■	■					■	
Adjala Township	■	■					■	
Ospry Township	■	■					■	
Wellington County								
Guelph	■	■	■		■		■	
Fergus	■	■					■	
Arthur	■	■	■		■		■	
Mount Forest	■	■					■	
Palmerston	■	■					■	
West Garafraxa Township	■	■					■	
Pilkington Township	■	■					■	
Nichol Township	■	■					■	

METHODS APPENDIX MA 15.1 Cont'd

Community	Presence of 911 System	Public Cardiopulmonary Resuscitation Training Programs Available	Firefighters Provide Cardiopulmonary Resuscitation Training; Written-tiered Response Agreement	Police Provide Cardiopulmonary Resuscitation Training; Written-tiered Response Agreement	Firefighter Defibrillation Program Instituted	Police Defibrillation Program Instituted	Ambulance Defibrillation Program Instituted	Ambulance ALS (PII Level) for All Cardiac Arrest Patients
Guelph Township	■	■					■	
Eramosa Township	■	■					■	
Erin Township	■	■					■	
Puslinch Township	■	■					■	
Arthur Township	■	■					■	
West Luther Township	■	■					■	
Peel Township	■	■					■	
Maryborough Township	■	■					■	
Minto Township	■	■					■	
Halton/Mississauga								
Burlington	■	■	■	■	■		■	■
Oakville	■	■	■	■	■		■	■
Mississauga	■	■	■	■	■		■	■
Milton	■	■		■			■	
Halton Hills	■	■		■			■	
Hamilton								
Hamilton	■	■	■		■		■	■
Flamborough-Dundas	■	■	■		■		■	■
Ancaster	■	■	■		■		■	
Brantford	■	■					■	
Delhi	■	■					■	
Hagersville	■	■					■	
Dunnville	■	■					■	
Port Rowan	■	■					■	
Simcoe	■	■					■	
Langton	■	■					■	
Kingston								
Perth		■					■	
Smiths Falls		■					■	
Brockville	■	■					■	
Gananoque	■	■					■	
North Leeds	■	■	■		■		■	
Parham		■	■		■		■	
Wolfe Island	■	■					■	
Kingston	■	■	■		■		■	■
North Brook	■						■	
Bancroft	■	■					■	
Madoc	■	■	■		■		■	
Trenton	■	■					■	
Belleville	■	■	■				■	
Picton	■						■	
Napanee	■	■					■	
London								
London	■	■	■		■		■	■
Woodstock	■	■	■				■	
Ingersoll	■						■	
Stratford	■	■	■				■	
St. Mary's	■	■					■	
Lucon	■						■	
Parkhill							■	
Strathroy	■	■					■	
Rodney							■	
Dutton							■	
St. Thomas		■	■				■	

METHODS APPENDIX MA 15.1 Cont'd

Community	Presence of 911 System	Public Cardiopulmonary Resuscitation Training Programs Available	Firefighters Provide Cardiopulmonary Resuscitation Training; Written-tiered Response Agreement	Police Provide Cardiopulmonary Resuscitation Training; Written-tiered Response Agreement	Firefighter Defibrillation Program Instituted	Police Defibrillation Program Instituted	Ambulance Defibrillation Program Instituted	Ambulance ALS (PII Level) for All Cardiac Arrest Patients
Aylmer							■	
Tillsonburg							■	
Markham/Stouffville								
Markham	■	■	■		■		■	
Richmond Hill	■	■	■		■		■	
Vaughan	■	■	■		■		■	
Whitchurch-Stouffville	■	■	■				■	
Aurora	■	■	■		■		■	
Newmarket	■	■	■		■		■	
Township of King	■	■	■				■	
East Gwillimbury	■	■	■		■ †		■	
Georgina	■	■	■				■	
Niagara Falls								
St. Catharines	■	■	■		■		■	■
Niagara Falls	■	■	■		■		■	■
Port Colborne	■	■	■		■		■	■
Welland	■	■	■		■		■	■
Thorold	■	■	■		■		■	■
Niagara-on-the-Lake	■	■	■				■	
West Lincoln (Grimsby)	■	■	■				■	■
Lincoln (Beamsville)	■	■	■				■	
Fort Erie	■	■	■				■	
Smithville	■	■	■				■	
Pelham	■	■	■		■		■	
North Bay								
North Bay	■	■	■				■	
Callander	■	■	■				■	
Powassan	■	■	■				■	
Redbridge	■		■				■	
Thorne							■	
Mattawa	■	■	■				■	
Sturgeon Falls	■	■	■				■	
Verner			■				■	
Loring	■	■	■				■	
South River	■	■	■				■	
Trout Creek	■		■				■	
Temagami		■	■				■	
Bear Island		■	■				■	
Latchford							■	
Haileybury		■	■				■	
New Liskeard		■	■				■	
Englehart		■	■				■	
Elk Lake			■				■	
Kirkland Lake		■	■		■		■	
Virginiatown			■				■	
Larder lake			■				■	
Nipissing	■	■	■				■	
Oshawa								
Pickering	■	■	■				■	
Ajax	■	■	■		■		■	
Whitby	■	■	■		■		■	
Oshawa	■	■	■				■	■
Bowmanville	■	■	■		■		■	
Port Perry	■	■					■	

METHODS APPENDIX MA 15.1 Cont'd

Community	Presence of 911 System	Public Cardiopulmonary Resuscitation Training Programs Available	Firefighters Provide Cardiopulmonary Resuscitation Training; Written-tiered Response Agreement	Police Provide Pulmonary Resuscitation Training; Written-tiered Response Agreement	Firefighter Defibrillation Program Instituted	Police Defibrillation Program Instituted	Ambulance Defibrillation Program Instituted	Ambulance ALS (PII Level) for All Cardiac Arrest Patients
Uxbridge	■	■					■	
Beavertown	■	■					■	
Ottawa								
Ottawa	■	■	■		■		■	■
Nepean	■	■	■		■		■	■
Kanata	■	■	■		■		■	■
Orleans	■	■	■		■		■	■
Osgoode	■	■	■		■		■	■
Richmond	■	■	■		■		■	■
Almonte	■	■					■	
Carlton Place	■	■					■	
Arnprior	■	■	■		■		■	
Kemptville	■	■					■	
Casselman	■	■					■	
Rockland	■	■					■	
Embrum	■	■					■	
Cornwall (Associate)								
Cornwall	■	■					■	
Alexandria	■	■					■	
Winchester	■	■					■	
Morrisburg	■	■					■	
Finch	■	■					■	
Prescot	■	■					■	
Alfred		■					■	
Hawkesbury		■					■	
Owen Sound								
Chesley	■	■	■				■	
Durham	■	■	■	■ ††			■	
Hanover	■	■	■				■	
Kincardine	■	■	■	■ ††			■	
Markdale	■	■	■	■ ††			■	
Meaford	■	■					■	
Owen Sound	■	■	■	■	■		■	
Port Eglin	■	■		■	■		■	
Walkerton	■	■	■	■ ††			■	
Wiarton	■	■	■	■			■	
Wingham		■	■	■			■	
Tobermory	■	■	■				■	
Pary Sound – West Parry Sound								
Parry Sound	■	■		■			■	
McDougall	■	■	■	■			■	
Carling	■	■	■	■			■	
Archipelago	■	■		■			■	
Seguin	■	■	■	■			■	
McKellar	■	■	■	■			■	
Hagerman		■	■	■			■	
Ferguson	■	■	■	■			■	
Wasauksing - FN	■	■	■	■			■	
Shawanaga - FN		■	■	■			■	
Henvey Inlet - FN		■	■	■			■	
Magnetawan - FN		■	■	■			■	
Peel Memorial (Associate BHP)								
Brampton	■	■	■	■	■		■	
Streetsville	■	■	■	■	■		■	■
Caledon	■	■	■	■			■	

METHODS APPENDIX MA 15.1 Cont'd

Community	Presence of 911 System	Public Cardiopulmonary Resuscitation Training Programs Available	Firefighters Provide Cardiopulmonary Resuscitation Training; Written-tiered Response Agreement	Police Provide Cardiopulmonary Resuscitation Training; Written-tiered Response Agreement	Firefighter Defibrillation Program Instituted	Police Defibrillation Program Instituted	Ambulance Defibrillation Program Instituted	Ambulance ALS (PII Level) for All Cardiac Arrest Patients
Pembroke (Renfrew County Associate BHP)								
Pembroke		■				■		
Petawawa		■				■		
Deep River		■				■		
Barry's Bay		■				■		
Eganville		■				■		
Denbigh						■		
Renfrew		■				■		
Peterborough								
Peterborough	■	■	■		■	■	■	
Lindsay	■	■	■		■	■	■	
Cobourg/Port Hope	■	■	■		■	■	■	
Colbourne	■		■			■		
Campbellford	■	■	■			■		
Apsley	@		■			■		
Bobcaygeon	■	■	■		■	■		
Fenelon Falls	■	■	■			■		
Haliburton/Minden		■	■			■		
Sarnia								
Brigden	■	■	■			■		
Corunna	■	■	■			■		
Forest	■	■				■		
Petrolia	■	■				■		
Sarnia	■	■	■		■	■	■	
Thedford	■	■				■		
Watford	■	■	■		■	■		
Warwick	■	■	■		■	■		
Clinton						■		
Dashwood						■		
Zurich						■		
Goderich						■		
Seaforth						■		
Glencoe	■					■		
Bothwell	■					■		
Point Edward	■	■	■		■	■	■	
Blythe			■		■	■		
Courtright	■	■	■			■		
Sault Ste. Marie								
Blind River		■				■		
Thessalon		■				■		
Richards Landing		■				■		
Sault Ste. Marie	■	■	■	■	■	■		
Chapleau		■				■		
Wawa		■				■		
Dubreuilville		■				■		
White River		■				■		
Homepayne		■				■		
Sudbury								
Espanola	■	■				■		
Manitoulin Island	■	■				■		
Elliot Lake	■	■	■			■		
Killarney	■	■				■		
Noelville	■	■				■		
Sudbury	■	■	■		■	■	■	

METHODS APPENDIX MA 15.1 Cont'd

Community	Presence of 911 System	Public Cardiopulmonary Resuscitation Training Programs Available	Firefighters Provide Cardiopulmonary Resuscitation Training; Written-tiered Response Agreement	Police Provide Pulmonary Resuscitation Training; Written-tiered Response Agreement	Firefighter Defibrillation Program Instituted	Police Defibrillation Program Instituted	Ambulance Defibrillation Program Instituted	Ambulance ALS (PII Level) for All Cardiac Arrest Patients
Valley East	■	■					■	@@
Chelmsford	■	■					■	@@
Hagar	■	■					■	
Lively/Walden	■	■					■	
Onaping Falls	■	■	■			■	#	
Capreol	■	■	■			■	##	
St. Charles	■	■	■			■	$	
Thunder Bay & Sioux Lookout								
Thunder Bay	■	■	■		■		■	■
Nipigon/Red Rock		■					■	
Beardmore		■					■	
Geraldton		■	■				■	
Nakina		■					■	
Longlac		■					■	
Terrace Bay		■					■	
Schreiber		■					■	
Marathon		■					■	
Manitouwadge		■					■	
Shuniah	■ $$						■	
Shabaqua							■	
Armstrong		■						
Upsala		■					■	
Ignace		■	■	■			■	
Atikokan		■		■			■	
Fort Frances		■	■				■	
Emo		■	■				■	
Rainy River		■	■				■	
Nester Falls		■	■				■	
Sioux Narrows		■	■				■	
Kenora		■	■				■	
Ear Falls		■	■				■	
Red Lake		■	■				■	
Dryden	■	■	■				■	
Sioux Lookout		■	■				■	■
Pickle Lake		■	■				■	
Timmins							■	
Timmins	■	■					■	
Shining Tree							■	
Gogama							■	
Foleyet							■	
Matheson							■	
Iroquois Falls							■	
Cochrane							■	
Smooth Rock Falls							■	
Kapuskasing							■	
Hearst							■	
James Bay							■	
Attiwapiskat							■	
Toronto								
Toronto	■	■	■		■		■	■

METHODS APPENDIX MA 15.1 Cont'd

Community	Presence of 911 System	Public Cardiopulmonary Resuscitation Training Programs Available	Firefighters Provide Cardiopulmonary Resuscitation Training; Written-tiered Response Agreement	Police Provide Cardiopulmonary Resuscitation Training; Written-tiered Response Agreement	Firefighter Defibrillation Program Instituted	Police Defibrillation Program Instituted	Ambulance Defibrillation Program Instituted	Ambulance ALS (PII Level) for All Cardiac Arrest Patients
Windsor								
Windsor	■	■	■		■		■	■
County of Essex	■	■	■		■		■	
County of Chatham/Kent	■	■					■	
Tecumseh	■	■	■		■		■	■
LaSalle	■	■	■		■		■	■
Leamington	■						■	
Amherstburg	■						■	
Harrow	■						■	
Essex	■		■		■		■	

■ Component present

* Data was compiled from a survey of all base hospital programs in Ontario - 1998

** 1/3 of the fire brigades are equipped to provide first responder defibrillation

FN First Nation

† Discussions currently ongoing to institute defibrillation program

†† Agreement with Ontario Provincial Police (OPP) to provide tiered response

@ Scheduled to be operational in Spring 1999

@@ Scheduled to be operational within one year

No ambulance station present, PI level of care provided by Chelmsford Ambulance Service

No ambulance station present, PI level of care provided by Valley East Ambulance Service

$ No ambulance station present, PI level of care provided by Noelville Ambulance Service

$$ Partial coverage only

METHODS APPENDIX
Chapter 16

METHODS APPENDIX MA16.1 Ontario Health Insurance Plan Diagnostic Codes Used to Identify and Classify Patient Visits for Exhibit 16.2

Diagnostic Code	Disease Name
Hypertensive Disease	
401	Essential, Benign Hypertension
402	Hypertensive Heart Disease
403	Hypertensive Renal Disease
Diseases of Peripheral Vessels	
440	Generalized Arteriosclerosis, Atherosclerosis
441	Aortic Aneurysm (non-syphilitic)
443	Raynaud's Disease, Buerger's Disease, Peripheral Vascular Disease, Intermittent Claudication
446	Polyarteritis Nodosa, Temporal Arteritis
447	Other Disorders of Arteries
451	Phlebitis, Thrombophlebitis
452	Portal Vein Thrombosis
454	Varicose Veins of Lower Extremities with or without Ulcer
455	Hemorrhoids
457	Lymphangitis, Lymphedema
459	Other Disorders of Circulatory System
Chest Pain not yet Diagnosed	
785	Chest Pain, Tachycardia, Syncope, Shock, Edema, Masses
Ischemic and Other Forms of Heart Disease	
390	Rheumatic Fever without Endocarditis, Myocarditis or Pericarditis
391	Rheumatic Fever with Endocarditis, Myocarditis or Pericarditis
392	Chorea
394	Mitral Stenosis, Mitral Insufficiency
398	Other Rheumatic Heart Disease
410	Acute Myocardial Infarction
412	Old Myocardial Infarction, Chronic Coronary Artery Disease of Arterioschlerotic Heart Disease, without Symptoms
413	Acute Coronary Insufficiency, Angina Pectoris, Acute Ischemic Heart Disease
415	Pulmonary Embolism, Pulmonary Infarction
426	Heart Blocks, Other Conduction Disorders
427	Paroxysmal Tachycardia, Atrial or Ventricular Flutter or Fibrillation, Cardiac Arrest, Other Arrythmias
428	Congestive Heart Failure
429	All Other Forms of Heart Disease

Calculation of Full-time Equivalents for Exhibit 16.1

To evaluate the level of activity of individual physicians, we used a modified version of Health Canada's definition of full-time equivalents (FTEs),[1] given by the following formula:

$$FTEj = \log (B_j / B_{60}) \text{ if } B_j > B_{60}$$
$$= 1 \text{ if } B_{60} \geq B_j > B_{40}$$
$$B_j / B_{40} \text{ if } B_{40} \geq B_j$$

where B_j = the billings of the j-th physician

B_{60} = the 60th percentile of billings for the specialty of the j-th physician

B_{40} = the 40th percentile of billings for the specialty of the j-th physician

The calculation of the 40th and 60th percentiles was based on Ontario fee-for-service physician billings in 1996/97.

METHODS APPENDIX MA16.2 OHIP Fee Codes Used to Define Different Types of Visits for Exhibit 16.2

Type of Visit	Fee Codes Used	Description
General and Family Practice Office Visit	A001	Minor Assessment
	A007	Intermediate Assessment
		These services must not have billed in conjunction with an emergency department special visit code (see below)
Cardiology Consultations	A605	Consultation
	A675	Limited Consultation
	A606	Repeat Consultation
Internal Medicine Consultations	A135	Consultation
	A435	Limited Consultation
	A136	Repeat Consultation
Emergency Department Visits	Urban Emergency Departments:	
	H101, H103, H104	Daytime Emergency Visits
	H121, H123, H124	Night Emergency Visits
	H151, H153, H154	Weekend Emergency Visits
	Rural Emergency Departments:	
	K990 - K997	Special visits to the emergency department were identified; then, the corresponding assessment code (e.g. A001, A007) appearing on the same day as the special visit was identified

METHODS APPENDIX MA16.3 Fee Code Groupings Used to Define the Procedures Analyzed in Exhibit 16.7

Procedure	Fee Code	Description
Transplantation	R870	Orthotopic Cardiac Transplantation
	R874	Cardiopulmonary Transplantation
Coronary Artery Bypass	R742	Coronary Artery Repair - one
	R743	Coronary Artery Repair - two
Valve Surgery	R724	Pulmonary Valvotomy
	R725	Pulmonary Valvotomy and Infundibular Resection
	R772	Pulmonary Valve Replacement
	R726	Tricuspid Valvotomy
	R727	Tricuspid Annuloplasty
	R728	Tricuspid Valve Replacement
	R729	Mitral Valvotomy
	R730	Mitral Valvotomy - Restenosis
	R734	Mitral Annuloplasty
	R735	Mitral Replacement
	R733	Mitral Valvuloplasty
	R930	Aortic Valvuloplasty
	R736	Aortic Valvotomy
	R737	Aortic Infundibular Resection
	R738	Aortic Valve Replacement
	R863	Replacement of Aortic Valve, Replacement of Ascending Aorta, and Reimplantation of Coronary Arteries
Abdominal Aortic Aneurysm	R802	Arteries - Abdominal Aorta - Aneurysm
	R816	Arteries - Abdominal Aorta - Aneurysm and Unilateral Common Femoral Repair
	R817	Arteries - Abdominal Aorta - Aneurysm and Bilateral Common Femoral Repair
	R783	Aorta-Iliac Repair - Including Common Iliac Repair (Unilateral/Bilateral)
	R784	Aorta-Iliac Repair - Plus Unilateral Common Femoral Repair
	R785	Aorta-Iliac Repair - Plus Bilateral Common Femoral Repair
	R814	Aorta-Iliac Repair - Embolectomy/Thrombectomy of Bifurcation
Carotid Endarterectomy	R792	Arteries - Carotid - Endarterectomy
	N220	Carotid - Endarterectomy
Pacemaker Procedures	R752	Atrio-ventricular Sequential Pacemaker/Permanent Endocardial Electrodes
	Z412	Heart and Pericardium - Replacement/Repair Pacemaker Lead
	Z433	Heart and Pericardium - Replacement of Pack
	Z435	Heart and Pericardium - Insertion Permanent Endocardial Electrode(s)
	Z436	Heart and Pericardium - Expose Vein and Implant Pack
	Z444	Heart and Pericardium - Insertion Permanent Electrodes and Pack Includes Insertion of Temporary Transvenous Lead At Same Surgical Procedure by Same Surgeon
	Z445	Heart and Pericardium - Repositioning Permanent Endocardial Electrode (as separate procedure)
Peripheral Vascular Disease Procedures	R787	Femoro-anterior/Posterior Tibial/Peroneal Bypass Graft - with Saphenous Vein
	R780	Femoro-anterior/Posterior Tibial/Peroneal Bypass Graft - with Prosthetic Graft
	R797	In-situ Saphenous Vein Arterial Bypass - Popliteal
	R804	In-situ Saphenous Vein Arterial Bypass - Tibial
	R809	Femoral - Popliteal Endarterectomy
Major Varicose Vein Procedures	R868	High Ligation and Stripping Long Saphenous Vein With Groin Dissection
	R869	Veins - Stripping Short Saphenous Vein With Popliteal Dissection
	R837	Veins - Multiple Ligation and Avulsion
	R842	Veins - Extra Fascial/Subfascial Incompetent Perforators Full Fascial Technique
	R844	Veins - Recurrent Varicose Veins - Multiple Ligation and/or Stripping

References

1. Full-time equivalent physicians report, Canada. 1989/90 to 1993/94. Ottawa: Canadian Institute for Health Information, 1998.

METHODS APPENDIX
Chapter 17

We included all patients who: (1) were discharged from an acute care institution during 1994/95 to 1996/97; (2) were identified as having a problem that related to the circulatory system (diagnostic code 390 to 459) or had cardiac surgery or syncope and collapse 78.02 and chest pain 78.65 as defined by C.D. Naylor in Methods Appendix MA17.1. We excluded patients who were non-Ontario residents, had missing residence code, age, sex or health care number; who were reported to have had a CABG or PTCA in a non-designated institution, who were transferred to a chronic or rehabilitation institution, and heart attack patients who had a length of stay less than four days (see Methods Appendix MA17.2). We did not delete transfers from another institution, as we were interested in a post-acute outcome.

We classified each admission, using the most responsible diagnosis and procedure code, in a hierarchy of 19 categories. There were six surgical/procedural groups and 13 medical groups. The six surgical groups were: Coronary Artery Bypass Surgery, PTCA, Open Heart Valve Procedures, Pacemakers, Aortic and Peripheral Vascular Surgery, Varicose Vein Procedures. The 13 medical groups were: Acute Myocardial Infarction (AMI), Angina, Other Forms of Chronic Ischemic Heart Disease, Hypertension, Cardiac Dysrhythmias, Congestive Heart Failure, Phlebitis and Thrombophlebitis, Syncope and Collapse, and Chest Pain, Other Forms of Heart Disease, Diseases of Arteries, Arterioles and Capillaries, Diseases of Veins and Lymphatics and Other Circulatory System, and Miscellaneous. Any cardiac procedure took precedence over any diagnostic code. Any bypass surgery procedure code took precedence over any angioplasty. Any angioplasty took precedence over any surgical procedure.

All non-surgical cases with Ischemic Heart Disease (AMI [diagnostic code 410], Angina [diagnostic code 411 or code 413], and Other Forms of Chronic Ischemic Heart Disease [diagnostic codes 414.0, 414.1, 414.8 or 414.9]) were assigned to one of three mutually exclusive categories based on the most responsible diagnosis. The inclusion criteria used for Ischemic Heart Disease are consistent with those used throughout this Atlas.

The non-surgical cardiac patients without Ischemic Heart Disease were first assigned to diagnostic groups discussed in other chapters (such as Congestive Heart Failure and Chest Pain) or to diagnostic groups that were high volume (Hypertension, Cardiac Dysrhythmias, Phlebitis and Thrombophlebitis; and Syncope and Collapse).

These six surgical groups and nine medical groups accounted for 91.9% of the cases. Seven per cent of the remaining eight per cent of cases were assigned to one of three diagnostic groups using the World Health Organization's Classification of Diseases (Other Forms Of Heart Diseases, diagnostic codes 420 to 429 with 427 and 428 excluded; Diseases of Arteries, Arterioles and Capillaries, diagnostic codes 440 to 448; and Diseases of Veins and Lymphatics, and Other

METHODS APPENDIX MA17.1 Procedures/Diagnoses and Canadian Classification of Procedure (CCP) and International Classification of Diseases Diagnosis Codes - 9th Revision (ICD-9)

SURGICAL

Procedure/Diagnosis	CCP/ICD-9 Codes	Description
Coronary Artery Bypass Graft Surgery	48.1	Bypass Anastomosis of Heart Revascularization
Percutaneous Transluminal Coronary Angioplasty	48.02	Percutaneous Transluminal Coronary Angioplasty without Thrombolytic Agent
	48.03	Percutaneous Transluminal Coronary Angioplasty with Thrombolytic Agent
	48.09	Other Removal of Coronary Artery Obstruction
Open Heart Valve Procedures	47.12	Open Heart Valvuloplasty of Mitral Valve
	47.23	Other Replacement of Mitral Valve
	47.24	Replacement of Aortic Valve with Tissue Graft
	47.25	Other Replacement of Aortic Valve
Pacemakers	49.71	Pacemaker Implantation Not Otherwise Specified
	49.72	Implantation of Myocardial Electrodes
	49.73	Implantation of Endocardial Electrodes
	49.74	Implantation of Automatic Cardioverter/Defibrillator
	49.82	Replacement of Endocardial Electrodes
	49.83	Replacement of Pulse Generator
	49.88	Replacement or Removal of Automatic Cardioverter/Defibrillator Leads
Aortic and Peripheral Vascular Surgery	50.18	Endarterectomy of Lower Limb Vessels
	50.24	Resection of Aorta with Anastomosis
	50.34	Resection of Aorta with Replacement
	50.35	Resection of Other Thoracic Vessels with Replacement
	50.36	Resection of Abdominal Arteries with Replacement
	50.38	Resection of Lower Limb Vessels with Replacement
	51.25	Aorta-iliac-femoral Bypass
	51.29	Other (Peripheral) Shunt or Bypass
	51.49	Other Revision of Vascular Procedure
	51.52	Other Repair of Aneurysm
	51.57	Repair of Blood Vessel with Synthetic Patch Graft
	51.59	Other Repair of Blood Vessel not Elsewhere Coded
Varicose Vein Procedures	50.48	Ligation and Stripping of Varicose Veins of Lower Limb Vessels

MEDICAL

Ischemic Heart Disease		
Acute Myocardial Infarction	410.0	Acute Myocardial Infarction
Angina	411.0	Other Acute and Subacute Forms of Ischemic Heart Disease
	413.0	Angina Pectoris
Other Forms of Chronic Ischemic Heart Disease	414.0	Coronary Atherosclerosis
	414.1	Aneurysm of Heart
	414.8	Other Specified Forms of Chronic Ischemic Heart Disease
	414.9	Chronic Ischemic Heart Disease, Unspecified
Non-ischemic Heart Disease		
Hypertension	401.0	Essential Hypertension
Cardiac Dysrhythmias	427.0	Paroxysmal Supraventicular Tachycardia
	427.1	Paroxysmal Ventricular Tachycardia
	427.2	Paroxysmal Tachycardia Unspecified
	427.3	Atrial Fibrillation and Flutter
	427.4	Ventricular Fibrillation and Flutter
	427.5	Cardiac Arrest
	427.6	Premature Beats

METHODS APPENDIX MA17.1 Cont'd.

MEDICAL

Procedure/Diagnosis	CCP/ICD-9 Codes	Description
Non-ischemic Heart Disease (cont'd)		
	427.8	Other Specified Cardiac Dysrhythmias
	427.9	Cardiac Dysrhythmia, Unspecified
Congestive Heart Failure	428.0	Congestive Heart Failure
	428.1	Left Heart Failure
	428.9	Unspecified Heart Failure
Phlebitis and Thrombophlebitis	451.0	Phlebitis/Thrombophlebitis Superficial Vessels of Lower Extremities
	451.1	Phlebitis/Thrombophlebitis Deep Lower Extremities
	451.2	Phlebitis/Thrombophlebitis Lower Extremities Not Otherwise Specified
	451.8	Phlebitis/Thrombophlebitis Other Sites
	451.9	Phlebitis/Thrombophlebitis Unspecified Sites
Syncope and Collapse	78.02	Syncope and Collapse
Chest Pain	78.65	Chest Pain

OTHER

Other Forms of Heart Disease	420	Acute Pericarditis
	421	Acute and Subacute Endocarditis
	422	Acute Myocarditis
	423	Other Diseases of Pericardium
	424	Other Diseases of Endocardium
	425	Cardiomyopathy
	426	Conduction Disorders
Diseases of Arteries, Arterioles and Capillaries	440	Atherosclerosis
	441	Aortic Aneurysm
	442	Other Aneurysm
	443	Other Peripheral Vascular Disease
	444	Arterial Embolism and Thrombosis
	446	Polyarteritis Nodosa and Allied Conditions
	447	Other Disorders of Arteries and Arterioles
	448	Diseases of Capillaries
Diseases of Veins and Lymphatics and Other Circulatory System	452	Portal Vein Thrombosis
	453	Other Venous Embolism and Thrombosis
	454	Varicose Veins of Lower Extremities
	455	Hemorrhoids
	456	Varicose Veins of Other Sites
	457	Noninfectious Disorders of Lymphatic Channels
	458	Hypotension
	459	Other Disorders of Circulatory System
Miscellaneous	390-392	Acute Rheumatic Fever
	393-398	Chronic Rheumatic Heart Disease
	402	Hypertensive Heart Disease
	403	Hypertensive Renal Disease
	404	Hypertensive Heart and Renal Disease
	405	Secondary Hypertension
	415	Acute Pulmonary Heart Disease
	416	Chronic Pulmonary Heart Disease
	417	Other Diseases of Pulmonary Circulation

METHODS APPENDIX MA17.2 Excluded Cases and Missing Data for Home Care Cohort by Procedure/Diagnosis for Ontario, 1994/95 - 1996/97

SURGICAL

	Number of Procedures	Out of Province	Number of Eligible Procedures	Missing Residence	Ineligible or Missing Age	Missing Sex	Deaths	Consistency Criteria*	Remaining Records	Hierarchy*	Index Admission*
Coronary Artery Bypass Graft Surgery	7,195	297	6,898	1	1	0	210	262	6,440	6,440	6,436
Percutaneous Transluminal Coronary Angioplasty	4,990	266	4,724	1	5	0	47	210	4,481	4,384	3,965
Open Heart Valve Procedures	1,575	71	1,504	0	25	0	77	84	1,327	877	876
Pacemakers	4,071	52	4,019	3	61	0	223	440	3,399	3,393	3,158
Aortic and Peripheral Vascular Surgery	6,634	90	6,554	1	178	0	726	1,218	4,916	4,899	4,634
Varicose Vein Procedures	2,028	11	2,017	1	6	0	0	42	1,969	1,969	1,942

MEDICAL

	Number of Procedures	Out of Province	Number of Eligible Procedures	Missing Residence	Ineligible or Missing Age	Missing Sex	Deaths	Consistency Criteria*	Remaining Records	Hierarchy*	Index Admission*
Ischemic Heart Disease											
Acute Myocardial Infarction	23,387	396	22,991	15	11	0	3,624	2,575	17,497	16,664	15,584
Angina	24,280	397	23,883	8	4	0	140	439	23,300	22,125	18,132
Other Forms of Chronic Ischemic Heart Disease	21,420	673	20,747	4	9	0	791	532	19,507	10,968	9,887
Non-ischemic Heart Disease											
Hypertension	2,106	27	2,079	0	28	0	7	58	1,989	1,986	1,877
Cardiac Dysrhythmias	14,730	229	14,501	8	336	0	537	449	13,393	12,115	10,491
Congestive Heart Failure	25,214	218	24,996	8	121	0	2,593	1,080	21,377	21,253	16,358
Phlebitis and Thrombophlebitis	3,676	40	3,636	1	30	0	27	139	3,443	3,432	3,221
Syncope and Collapse	4,299	51	4,248	3	154	0	10	127	3,960	3,906	3,771
Chest Pain	14,770	182	14,588	8	89	0	5	256	14,236	14,230	13,346
Other											
Other Forms of Heart Disease	46,836	621	46,215	22	685	0	3,461	1,789	40,632	3,878	3,447
Diseases of Arteries, Arterioles and Capillaries	9,576	105	9,471	2	241	0	825	1,413	7,306	2,813	2,493
Diseases of Veins and Lymphatics and Other Circulatory System	11,929	112	11,817	3	137	0	110	3,488	8,181	2,729	2,598
Miscellaneous	76,536	1,578	74,958	29	155	0	4,373	8,133	64,458	1,811	1,658
Total	**305,251**	**5,415**	**299,836**	**117**	**2,277**	**0**	**17,783**	**22,733**	**261,810**	**139,874**	**123,875**

* See Methods Appendix text for details of these exclusion criteria

Data Source: Canadian Institute for Health Information, Ontario Home Care Administration System

Diseases of Circulatory System, diagnostic codes 451-459 with 451 excluded).

For completeness the remaining 1% of cases were assigned to Miscellaneous.

Using scrambled health care numbers, we linked the cardiac inpatient discharges to the OHCAS database for 1994/95-1996/97. All patients receiving home care within 30 days of discharge from the acute care institution were identified as home care recipients.

We then generated a unique patient-level file by selecting only the first occurrence of a discharge within each of the 19 groups. Some individuals with multiple admissions for different diagnoses/procedures in a year may be counted several times. For each District Health Council, the total number of discharges and the total number of home care recipients for each of the 19 groups was determined. For each DHC, 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 outlined in Chapter 9. The denominator is not the usual post-censal population estimates but the number of records within the cohort.

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