



Canadian Stroke Network

Réseau canadien contre
les accidents cérébrovasculaires

The Quality of Stroke Care in Canada

Canadian Stroke Network

2011

The Quality of Stroke Care in Canada

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- Funds high quality stroke research that will improve the lives of Canadians;
- Trains new researchers with a focus on stroke;
- Ensures health care professionals are aware of the latest clinical practices in stroke; and,
- Promotes access to excellent stroke care and services for all Canadians.

The Canadian Stroke Network would like to thank everyone who participated in the audit, including those who sat on the national steering committee. Their commitment to this effort was significant. We hope the information collected through the national stroke audit provides value to participants and can be used at local, regional and national levels to improve stroke care.

Patrice Lindsay, PhD, Director of Performance and Standards at the Canadian Stroke Network, oversaw the audit and worked with a national steering committee, chaired by McGill University professor and neurologist Dr. Robert Côté, to manage and analyze the aggregate data. Other members of the steering committee include Dr. Michael Hill of the University of Calgary, Dr. Moira Kapral of the Institute for Clinical Evaluative Sciences, Janusz Kaczorowski, PhD, of the University of British Columbia, Nicol Korner-Bitensky, PhD, of McGill University, Katie Lafferty of the Canadian Stroke Network, Neala Gill and Katie White of Cardiovascular Health Nova Scotia, and Elizabeth Woodbury of the Canadian Stroke Strategy.

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The Quality of Stroke Care in Canada

EXECUTIVE SUMMARY

Stroke is a leading cause of death¹ and adult disability². Of all chronic diseases in Canada, stroke is among the most impactful. Sixty per cent of people who have a stroke report that they need help afterwards and 80% have restrictions to their daily activities.³ In 2005, the Canadian Stroke Strategy⁴ set out to ensure every province in Canada was organized to deliver the best possible stroke care. Over six years, progress has been achieved nation-wide (Appendix A).

Despite the impact of stroke on Canadians and the progress to date, there has never been a comprehensive pan-Canadian report on the quality of stroke care. For this reason, the Canadian Stroke Network collected data representing 38,210 patients admitted with stroke from 295 hospitals across Canada over the period 2008-2009. This data, supplemented with data from national health databases, resulted in *The Quality of Stroke Care in Canada*. The purpose of this report is to describe the quality of stroke care being provided to Canadians and to make recommendations on how it may be improved. Key findings and recommendations from *The Quality of Stroke Care in Canada* are described below.

KEY FINDINGS:

- **The risk factors for stroke need to be better controlled:** 64% of patients with stroke have hypertension, and more than one-third have experienced a previous stroke or transient ischemic attack (TIA).
- **“Time is brain” yet many don’t consider stroke a medical emergency:** Two thirds of the people who have an ischemic stroke do not arrive in time at an appropriately prepared hospital to receive optimal care.
- **When patients arrive at hospital, they are not treated quickly enough:** Only 40% of patients who arrived within 3.5 hours of symptom onset received a CT or MRI scan within an hour of arrival. The median door-to-needle (arrival to administration) time for tPA was 72 minutes.
- **Telestroke could save lives, but it is not being widely used:** Telestroke presents an opportunity for those who live in rural settings or who are admitted to smaller hospitals, yet less than 1% of stroke patients are benefiting from this service.
- **Patients need greater access to stroke units:** Only 23% of stroke patients in Canada are treated in a specialized stroke unit while in hospital. This number is substantially lower than in other countries⁵.
- **Other areas of stroke care could be improved:** Of concern is the low level (50%) of documented dysphagia screening to assess swallowing difficulties and the fact that only 22% of the audited hospitals were affiliated with a secondary prevention clinic.
- **Access to appropriate rehabilitation is vital, yet not well monitored:** Patients with moderate to severe stroke (30-40% of all cases) benefit most from rehabilitation in a specialized facility. However, only 37% of all moderate to severe stroke cases are discharged to a rehabilitation facility. In general, there is a lack of reliable information on the quality of inpatient and outpatient rehabilitation.
- **Canada must improve its stroke services to reduce death, disability and health-care costs:** The economic analysis conducted in conjunction with this report estimated that the benefits of improvement in four key areas (secondary prevention, thrombolysis, stroke units, and early supported

¹ Statistics Canada, CANSIM Table 102-0529: Deaths, by cause, Chapter IX: Diseases of the circulatory system (I00 to I99), age group and sex, Canada, annual (number), 2000 to 2006. Released May 4, 2010.

² Hootman J, Helmick CG, Theis KA, Brault MW, Armour BS. Prevalence and most common causes of disability among adults—United States, 2005. *MMWR Morb Mortal Wkly Rep.* 2009;58:421–426.

³ 2009 *Tracking Heart Disease and Stroke in Canada*, Public Health Agency of Canada

⁴ A joint initiative of the Canadian Stroke Network and the Heart and Stroke Foundation of Canada

⁵ 2009/2010 Australian Stroke Report reported 50% of patients are treated on a stroke unit and the UK Sentinel Report (2010) reported 74% of patients are treated on a stroke unit.

The Quality of Stroke Care in Canada

discharge) would result in total cumulative costs avoided between 2010 and 2031⁶ of \$36.1 billion (\$15.4 billion in direct costs avoided and \$20.7 billion in indirect costs avoided).⁷

KEY RECOMMENDATIONS:

Patients/Public:

- Lower your stroke risk by reducing the amount of sodium in your diet, regularly eating fruits and vegetables, reducing the amount of fat in your diet, quitting smoking, and maintaining an active lifestyle.
- Be aware of the signs and symptoms of stroke: sudden weakness, sudden trouble speaking, sudden vision problems, sudden and severe headache, and sudden dizziness especially when associated with other symptoms. If you suspect a stroke CALL 9-1-1 and have an ambulance bring you IMMEDIATELY to the hospital.
- Learn what to expect and what questions to ask while you are in the hospital and afterwards. The *Patient's Guide to the Canadian Best Practice Recommendations for Stroke Care* is a good place to start (www.strokebestpractices.ca).

Care Providers:

- Assess your patients' blood pressure regularly at all appropriate visits. Encourage and support patients to adopt healthier lifestyles and follow-up with them regularly. Use risk assessment tools to educate your patients on their risk of stroke.
- Ensure emergency protocols for stroke are in place within your health region and organize the emergency room to achieve door-to-needle times of less than one hour for all those eligible for tPA.
- Take advantage of existing Telestroke initiatives within your province or health region. If the technology exists, use it.
- Ensure that all hospitals that provide tPA have a stroke unit. If a stroke unit exists, ensure it has the necessary capacity to handle the volume of strokes within the hospital or region.
- Work with patients to develop personalized rehabilitation plans. Document rehabilitation practices including timeliness and type of rehabilitation therapy offered. Be aware of the community services available for patients upon discharge.
- Have your hospital assessed by Accreditation Canada for Stroke Distinction, based on best practices and defined standards of care practices.

Policymakers:

- Continue to encourage healthy lifestyles and risk factor reduction with policies that promote healthy food choices, a smoke-free environment and physical activity.
- Implement on-going public awareness campaigns that encourage people to recognize and react to the signs of stroke, and to treat it as a medical emergency.
- Support the national implementation of Telestroke by eliminating the barriers associated with cross-provincial consultations. Encourage the use of existing Telehealth networks and use existing Telestroke networks as case studies.
- Monitor quality of stroke care in Canada with the data provided in this report serving as a benchmark.

Far fewer Canadians should die or be disabled from stroke when we know how to prevent, treat, and enhance recovery. The knowledge exists – we need to use it.

⁶ The time frame 2010-2031 was selected as population projections from Statistics Canada only go to 2031

⁷ Source: Cost-Avoidance Associated with Optimal Care in Canada, April 2011, Prepared for The Canadian Stroke Network by H. Krueger & Associates Inc.

The Quality of Stroke Care in Canada

TABLE OF CONTENTS

Chapter 1: Introduction and Objectives

1.1	Objectives of the Report	Page 6
1.2	What is a Stroke?	Page 6
1.3	Canadian Stroke Strategy	Page 7
1.4	Canadian Best Practice Recommendations	Page 8

Chapter 2: Approach

2.1	Data Sources	Page 10
2.2	Audit Scope	Page 10
2.3	Data Collection	Page 11
2.4	Data Analysis	Page 11
2.5	Audit Limitations	Page 11

Chapter 3: Patient and Hospital Characteristics

3.1	Characteristics of Audit Hospitals	Page 14
3.2	Characteristics of Patients in the Audit	Page 15

Chapter 4: Comparing Current Practice to Best Practice: Pre-hospital

Page 18

Chapter 5: Comparing Current Practice to Best Practice: Early Assessment and Treatment

5.1	Emergency Department Assessment and Diagnostic Imaging	Page 20
5.2	Acute Thrombolytic Therapy	Page 21
5.3	Antiplatelet Therapy	Page 22
5.4	Telestroke	Page 23

Chapter 6: Comparing Current Practice to Best Practice: Acute Management

6.1	Stroke Units	Page 24
6.2	Dysphagia Screening	Page 26
6.3	Secondary Prevention	Page 27

Chapter 7: Comparing Current Practice to Best Practice: Rehabilitation

Page 30

Chapter 8: Key Messages and Recommendations

Page 32

Appendix A: Provincial Information

Appendix B: Economic Analysis

Glossary



The Quality of Stroke Care in Canada

Chapter 1

INTRODUCTION AND OBJECTIVES

1.1 Objectives of the Report

Stroke is a leading cause of death⁸ and adult disability⁹. Stroke has serious consequences for the individual, families, and society. Within Canada, 7.1% of people between the ages of 65 and 74 report living with the effects of a stroke¹⁰. Every year, patients with stroke spend more than 639,000 days in acute care in Canadian hospitals and 4.5 million days in residential care facilities. Despite a decline in hospitalization rates for acute stroke over the past 10 years, the aging population, along with increasing prevalence of risk factors, will likely cause an increased absolute number of strokes over the next 20 years¹¹.

Despite the impact of stroke on Canadians, there has never been a comprehensive report on the quality of stroke care. For this reason, the Canadian Stroke Network conducted an audit of a representative/random sample of hospital records of patients with stroke, supplemented with data from national health databases, to produce the first-ever report on *The Quality of Stroke Care in Canada*. The objectives of this report are:

- To compare the current practice with best practice recommendations for stroke care;
- To identify gaps in stroke care including coordination of care;
- To highlight economic and societal impacts of improved stroke care delivery; and
- To make recommendations for improving stroke care.

1.2 What is a Stroke?

Stroke is the result of either an interruption in blood supply to the brain (ischemic stroke) or bleeding into or around the brain due to a ruptured artery (intracerebral or subarachnoid hemorrhage, ICH or SAH). Approximately 80% of strokes are ischemic¹².

Preceding a major stroke, many people experience fleeting stroke symptoms, called transient ischemic attack, or a TIA. A person who has had one or more TIAs is almost 10 times more likely to have a stroke than someone of the same age and sex who has not¹³. Unfortunately, TIAs are often undiagnosed and unreported. Studies in Canada have shown that rapid assessment and follow-up of an individual experiencing a TIA can prevent a major stroke¹⁴.

⁸ Statistics Canada, CANSIM Table 102-0529: Deaths, by cause, Chapter IX: Diseases of the circulatory system (I00 to I99), age group and sex, Canada, annual (number), 2000 to 2006. Released May 4, 2010.

⁹ Hootman J, Helmick CG, Theis KA, Brault MW, Armour BS. Prevalence and most common causes of disability among adults—United States, 2005. *MMWR Morb Mortal Wkly Rep.* 2009;58:421–426.

¹⁰ *2009 Tracking Heart Disease and Stroke in Canada*, Public Health Agency of Canada

¹¹ *2009 Tracking Heart Disease and Stroke in Canada*, Public Health Agency of Canada: “Nine out of ten individuals over the age of 20 years have at least one of the following risk factors: smoking, physical inactivity during leisure time, less than recommended daily consumption of vegetables and fruit, stress, overweight or obesity, high blood pressure, or diabetes. Two in five have three or more of these risk factors”.

¹² Source: Heart and Stroke Foundation of Canada

¹³ American Stroke Association www.strokeassociation.org

¹⁴ Source: Stroke Trials Registry (www.strokecenter.org/trials): *Fast Assessment of Stroke and Transient ischemic attack to prevent Early Recurrence - Pilot Study*

The Quality of Stroke Care in Canada

Until the late 1990s, there were no effective acute therapies for ischemic stroke. However, in 1999 a thrombolytic, or clot-dissolving drug, called tissue plasminogen activator (tPA) was approved for use in Canada. For the first time, ischemic stroke became a potentially treatable emergency. New emphasis was placed on ensuring that people arrived at hospital quickly in order to receive a brain scan that would indicate if tPA was an appropriate treatment option. The drug itself is not without risks and must be administered by trained professionals. For example, a key concern during tPA administration is the potential for bleeding in the brain after the ischemic stroke (i.e., an intracerebral hemorrhage after tPA administration).

The first guidelines recommended a maximum 3-hour time window from symptom onset to tPA administration. Recent studies have reported that this window can be extended to 4.5 hours¹⁵. Studies have also shown that the effectiveness of tPA decreases with time (i.e. the earlier tPA is administered, the better)¹⁶.

Research on the optimal management of patients after the acute phase of stroke shows that patients who receive care on a specialized stroke unit versus on a generalized medical unit are significantly more likely to survive and to have better functional outcomes¹⁷. All people with stroke should be assessed to determine the severity of stroke and their early rehabilitation needs. Rehabilitation therapy within an active and complex stimulating environment should be started as early as possible. After leaving hospital, people with stroke must have access to specialized stroke care and rehabilitation services appropriate to their needs. As the majority of people with stroke will return home, it is important that families and caregivers are provided with the appropriate information, education, emotional support, and access to community services¹⁸.

1.3 Canadian Stroke Strategy

In 2005, a national initiative to improve stroke care was launched by the Canadian Stroke Network and the Heart and Stroke Foundation of Canada. Modeled on a successful provincial effort in Ontario, the Canadian Stroke Strategy mobilized key stakeholders in every province to ensure the best stroke research findings were being moved into practice in the health system.

At a national level, working groups focused on developing tools and programs that could be used across Canada to help improve the quality of care. These efforts led to the creation of the *Canadian Best Practice Recommendations for Stroke Care* (described below), new training programs for health professionals, key performance measures to monitor quality of care, and public campaigns to raise awareness of the signs and symptoms of stroke.

With the benefit of these resources, each province and territory was able to create its own unique approach to improving stroke care by customizing its resources and priorities. Appendix A describes in more detail the achievements of each province and priorities for the years ahead. Despite significant progress in improving the quality of stroke care across Canada, there is still work to be done. *The Quality of Stroke Care in Canada* could not be timelier. Ultimately, the hope is that the results of this report will be used to prioritize investments in stroke care and improve and monitor the quality of stroke care for all Canadians.

¹⁵ Thrombolytic therapy for acute ischemic stroke beyond three hours. J Emerg Med. 2011 Jan;40(1):82-92. Epub 2010 Jun 25.

¹⁶ Time to treatment with intravenous alteplase and outcome in stroke: an updated pooled analysis of ECASS, ATLANTIS, NINDS, and EPITHET trials. Lancet. 2010 May 15;375(9727):1695-703.

¹⁷ Stroke Unit Trialists' Collaboration. Organised inpatient (stroke unit) care for stroke. Cochrane Database Syst Rev 2007;(4):CD000197.

¹⁸ Canadian Best Practice Recommendations for Stroke Care 2010

The Quality of Stroke Care in Canada

1.4 Canadian Best Practice Recommendations for Stroke Care

The *Canadian Best Practice Recommendations for Stroke Care* (www.strokebestpractices.ca) describe optimal care for stroke patients that have been proven to reduce death and disability and to save health-care costs.

The Canadian Best Practice Recommendations for Stroke Care provide a set of evidence-based best practices for stroke prevention, medical care, rehabilitation and recovery. Developed by a national working group of stroke experts, best practices address topics such as blood pressure management, brain imaging, inpatient rehabilitation and more.

The initial recommendations were released in 2006, then updated in 2008 and again in 2010 when, for the first time, a dedicated website was developed to provide easy access to the latest critically appraised research evidence and to allow for more timely updates.

Today, the *Canadian Best Practice Recommendations for Stroke Care* are used across the country. In 2010, Accreditation Canada and the Canadian Stroke Network announced the rollout of the Stroke Services Distinction accreditation, awarded to health centres that comply with *Canadian Best Practice Recommendations for Stroke Care*.

For the purposes of *The Quality of Stroke Care in Canada*, current Canadian practices were compared to the best practices described in the *Canadian Best Practice Recommendations for Stroke Care*.



The Quality of Stroke Care in Canada

CHAPTER 2 APPROACH

2.1 Data Sources

The Quality of Stroke Care in Canada is based upon information from three key sources:

1. **A national review of hospital records (or “audit”) of patients admitted with stroke.** Data were collected from a random sample of all adult stroke cases admitted to an acute care hospital from April 1st, 2008 to March 31st, 2009. Sections 2.2 to 2.5 describe the audit methods and approach in more detail.
2. **Canadian Institute for Health Information (CIHI):** CIHI is an independent, not-for-profit corporation that provides essential information on Canada’s health system and the health of Canadians. *The Quality of Stroke Care in Canada* includes some data obtained from the Discharge Abstract Database for acute inpatient care and the National Rehabilitation Reporting System for inpatient rehabilitation care.
3. **A cost avoidance economic analysis:** Dr. Hans Krueger of H. Krueger & Associates Inc. conducted an analysis to assess the economic impact if specific aspects of stroke care were delivered optimally. The results of this analysis are referred to throughout *The Quality of Stroke Care in Canada* and a summary is provided in Appendix B.

The majority of data presented in *The Quality of Stroke Care in Canada* are a result of the national patient chart audit. Where data have been derived from other sources, it has been appropriately referenced and noted. For example, as the audit data focused primarily on acute care, some of the information presented related to rehabilitation (Chapter 7) was derived from the National Rehabilitation Reporting system.

2.2 Audit Scope

The national audit was based on a random sample of all adult (18 years or older) patients admitted with a stroke or TIA to an acute care hospital in Canada between April 1st, 2008 and March 31st, 2009. To obtain this sample, each provincial department of health provided a list of all hospitals within the province and the volume of patients with stroke admitted to these hospitals during 2008-2009. Hospitals that admitted fewer than 20 stroke cases per year and specialized pediatric and mental health hospitals were excluded from the audit. The hospitals in the three Canadian territories were not included in the audit due to low stroke volumes.

A simple random sample of approximately 20% of all patients with stroke was drawn for each participating hospital. Oversampling was done at smaller hospitals so that at least 10 charts were audited at any one hospital. In provinces where the annual provincial stroke admission volume was less than 1,500, all eligible patients who were admitted to hospital were included in the audit.

The Quality of Stroke Care in Canada

2.3 Data Collection

A team of 51 specially trained healthcare providers, most of whom were stroke nurses or rehabilitation professionals who had worked with stroke patients, collected data for the audit. All abstractors audited charts only within the province where they resided.

Data were specifically collected in order to be able to calculate key performance measures defined through the work of the Canadian Stroke Strategy. This included data such as time of stroke symptom onset, timeliness of emergency medical system access, treatment received in the emergency department, acute inpatient care and information related to patient discharge from the acute care hospital.

The data were entered directly into a custom designed Microsoft Access stroke audit program developed by the Registry of the Canadian Stroke Network (www.rcsn.org). The program includes range and logic checks to ensure data accuracy. The data were anonymized and encrypted before being transferred electronically to a central computer server at the Canadian Stroke Network national office.

To ensure the audit complied with applicable ethics and privacy requirements, provincial, regional and local administrative and research ethics approvals were obtained from all hospitals that participated. Privacy Impact Assessments and privacy reviews were conducted within each province, health region and, in some cases, within the individual participating hospitals to ensure that the audit met all privacy requirements specific to that province or jurisdiction.

2.4 Data Analysis

Within each province a random sample of at least 10 charts was re-entered to evaluate data entry quality. Cases where more than 30% of data were missing were eliminated from the dataset, as well as any case where the most responsible diagnosis was not documented. Once this procedure was completed, 9,588 cases of the original 10,130 remained available for analysis.

National quality of care measures were calculated as well as overall rates and proportions. Key performance measures were calculated for the provinces, but did not involve a statistical comparison between provinces (as explained in Appendix A). Provincial analyses were based on location of the treating hospital, and not the province of residence for patients.

A statistical weighted adjustment was applied to the audit results, based on hospital stroke volumes and the number of charts sampled. The weight assigned to a record was inversely proportional to the probability of that record being selected for inclusion in the study. This weighting was done to avoid potential bias resulting from unequal sampling and to ensure that the results were representative of stroke care across Canadian hospitals.

All analyses were completed using SAS statistical software version 9.2.

2.5 Audit Limitations

- The audit data and the data acquired from CIHI contain information on stroke cases admitted to hospital. This will result in potentially significant underestimates of the true incidence of stroke and TIA in Canada, as many patients with TIAs and milder stroke may be treated in the emergency department or referred to community health services without being admitted to a hospital.

The Quality of Stroke Care in Canada

- In Manitoba, only 2 out of 11 health regions participated in the audit. The two participating regions included Winnipeg Regional Health Authority and Brandon Health Authority. Therefore, audit results for Manitoba are an underestimate of stroke patients treated and most results should be interpreted with caution due to data being included from the largest regional academic centres only.
- Only hospitals that admitted 20 or more stroke cases per year were included in the audit. As a result, the quality of stroke care in small rural and remote hospitals was not evaluated as part of this initiative.
- Pediatric stroke cases were not included in the audit.
- This is the first stroke audit completed on a national level, and as such, historical data are not available for comparison. It is hoped that the results of *The Quality of Stroke Care in Canada* will provide a baseline for future monitoring and improvement of the quality of stroke care in Canada.



The Quality of Stroke Care in Canada

Chapter 3

HOSPITAL AND PATIENT CHARACTERISTICS

3.1 Characteristics of Audited Hospitals

Of the 624 potentially eligible hospitals (i.e. those that admitted stroke patients in 2008-2009), 295 were included in the audit (Table 1). The majority of hospitals were excluded because of small patient volumes. It should be reiterated that nine eligible hospitals in Manitoba did not participate in the audit, as data collection was limited to only two health regions.

From the 624 eligible hospitals, there were 43,651 admitted cases of stroke in Canada in 2008-2009. Of these, 22% (9,588 patients) were included in the audit sample. After applying weighting¹⁹, the total audit sample represented 38,210 cases (88% of the 43,651 total stroke cases in Canada).

Table 1. Total Number of Hospitals with Stroke Admissions, Participating Audit Hospitals, and Audit Patients by Province 2008-2009

	Total Hospitals that Admitted Patients with Stroke	Participating Audit Hospitals	Weighted Sample of Patients with Stroke in Audit
BC	81	46	5446
AB	88	22	3194
SK	61	13	1385
MB ²⁰	57	7	1030
ON	145	103	15076
QC	101	66	8773
NB	22	12	1293
NS	32	12	1108
PE	7	4	239
NL	30	10	666
Total	624	295	38,210

For the purpose of this audit, hospitals were categorized as a Stroke Centre or as a Non-Stroke Centre. A Stroke Centre is a hospital with all of the following three capabilities:

1. Brain imaging technology²¹;
2. Ability to administer tPA; and
3. A stroke unit.

¹⁹ A statistical weighting was applied to avoid potential bias resulting from unequal sampling and to ensure all estimates were representative of the Canadian population.

²⁰ Note: nine eligible hospitals in Manitoba did not participate in the audit

²¹ computed tomography or magnetic resonance imaging

The Quality of Stroke Care in Canada

If a hospital did not offer one of these services, it was classified as a Non-Stroke Centre. Of the hospitals included in the audit, 52 (18%) were classified as Stroke Centres (Table 2). Overall, 41% of the patients included in the audit were admitted to Stroke Centres (Table 2).

Table 2. Number of Audited Stroke Centres and Percentage of Patients Admitted by Province 2008-2009

	# of Audit Hospitals	# Stroke Centres Among Audit Hospitals	% of Audit Patients Admitted to Stroke Centres
BC	46	6	33%
AB	22	6	75%
SK	13	1	23%
MB ²²	7	0	0%
ON	103	23	48%
QC	66	7	28%
NB	12	4	62%
NS	12	4	56%
PE	4	0	0%
NL	10	1	15%
Total	295	52 (18%)	41%

3.2 Characteristics of Patients in the Audit

The sample of stroke patients in the audit was evenly divided between men and women (Table 3). The ratio of women to men experiencing different types of stroke was consistently balanced with the exception of subarachnoid hemorrhage, which occurred more often in women than men (60% vs. 40%). Two-thirds of strokes occurred in people over the age of 70, with earlier onset of stroke in men (Figure 1). People over the age of 60 were more likely than those of younger age groups to experience a transient ischemic attack (Figure 1). Almost two-thirds (63%) of patients in the audit sample experienced an ischemic stroke (Table 4). In a small number of cases (4%) auditors were unable to determine the type of stroke based on documentation in the chart.

Table 3. Stroke Type by Gender in Audit Patients, Canada 2008/2009

	Ischemic Stroke	Transient Ischemic Attack	Intracerebral Hemorrhage	Subarachnoid Hemorrhage	Unable to Determine	Total
Number of Patients	24191	6510	4035	1944	1530	38210
% of Total Strokes	63%	17%	11%	5%	4%	100%
% Occurring in Women	49%	51%	47%	60%	51%	50%
% Occurring in Men	51%	49%	53%	40%	49%	50%

²² Note: Nine eligible hospitals in Manitoba did not participate in the audit

The Quality of Stroke Care in Canada

Figure 1. Stroke Occurrence by Age and Sex in Audit Patients, Canada 2008/2009

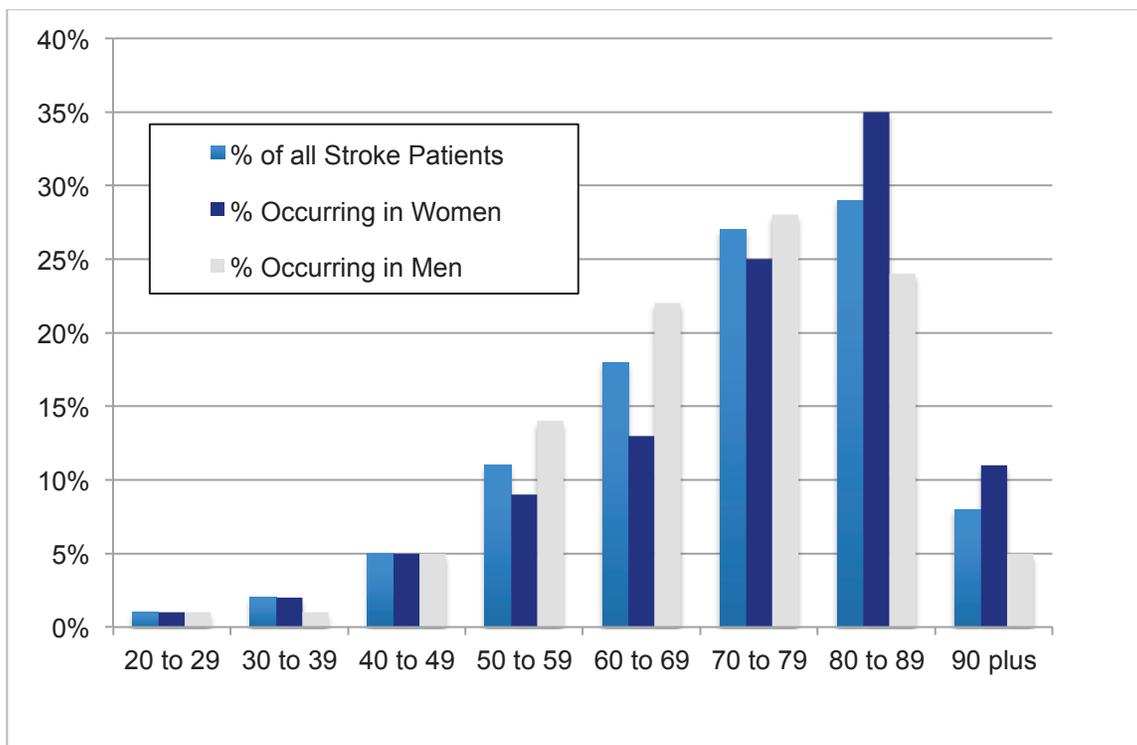


Table 4. Stroke Occurrence by Age and Stroke Type in Audit Patients, Canada 2008/2009

Stroke Type	Age Group								
	Total	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90+
Ischemic Stroke	63%	56%	54%	54%	56%	61%	66%	66%	68%
Transient Ischemic Attack	17%	7%	7%	12%	14%	17%	18%	19%	18%
Intracerebral Hemorrhage	11%	17%	16%	11%	12%	12%	10%	10%	7%
Subarachnoid Hemorrhage	5%	16%	19%	20%	15%	6%	2%	1%	1%
Unable to Determine	4%	4%	4%	3%	3%	4%	4%	4%	6%
	100%	100%	100%	100%	100%	100%	100%	100%	100%

The Quality of Stroke Care in Canada

The majority of patients in the audit had a documented diagnosis of hypertension, more than one-quarter were smokers, almost one-quarter had diabetes mellitus, and more than one-third had experienced a previous stroke or transient ischemic attack (Table 5).

Table 5. Medical History of Audit Patients, Canada 2008/2009

Medical History	% of Audit Patients with Risk Factor
Previous Stroke	22%
Previous Transient Ischemic Attack	13%
Hypertension	64%
Diabetes mellitus	24%
Current and Lifelong Smoker ²³	27%
Atrial Fibrillation	16%
Coronary Artery Disease	25%

²³ It should be noted that information on smoking status was missing for 25% of patients; this risk factor is often under-reported.

The Quality of Stroke Care in Canada

Chapter 4

Comparing Current Practice to Best Practice: PRE-HOSPITAL

KEY FINDINGS

30% of stroke patients did not arrive at the hospital by ambulance.

39% of all patients arrived at the hospital more than 12 hours after symptom onset.

Two-thirds of ischemic stroke patients admitted to hospital did not arrive in time to receive optimal care.

BEST PRACTICE

Canadians need to be aware of the signs and symptoms of stroke. Stroke is a brain attack - it occurs suddenly and the symptoms may be temporary. The primary warning signs are the sudden onset of: (1) difficulty with or loss of speech; (2) sudden loss of vision in one eye or on one side of the visual field; (3) sudden weakness or loss of strength or power in the face, arm or leg. Other symptoms include a sudden loss of sensation in the face, arm or leg, a sudden, severe and unusual headache, and sudden loss of balance or sense of vertigo, especially if accompanied by one of the other warning signs.

The severity of brain damage associated with a stroke is time-dependent. Time is brain. There is a very narrow time window (4.5 hours) from the first signs of ischemic stroke to the time that people can be successfully treated to reduce the amount of brain damage. In that interval, the likelihood of successful treatment decreases as time elapses.

People who suddenly experience the warning signs of stroke should treat those signs as a medical emergency and immediately call 9-1-1. They should not wait to see a family doctor, they should not “sleep it off” and they should not drive themselves to the hospital. Calling emergency medical services is imperative because it may increase the speed of arrival to hospital. In addition, calling an ambulance increases the likelihood that patients will be taken to a hospital that is equipped to provide emergency stroke care (such as brain-scanning equipment and tPA) and that the hospital is notified and prepared for the patient’s arrival.

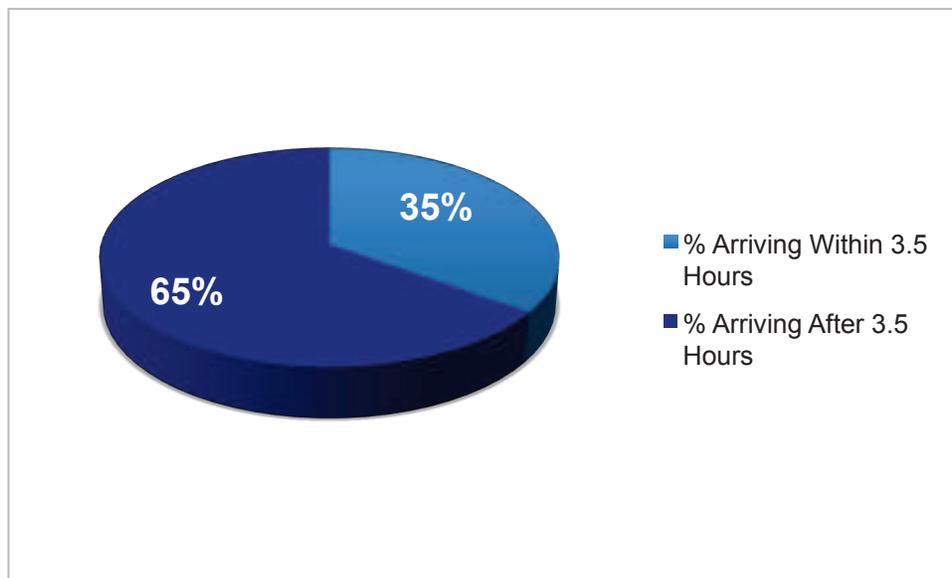
CURRENT PRACTICE

Overall, only 70% of patients arrived at the hospital by ambulance, meaning 30% were not able to benefit from potential emergency protocols routing them to the appropriate facility.

The median arrival time to hospital was 7 hours after symptom onset. This puts most patients outside the time window for treatment. Overall, 39% of all patients arrived at the hospital more than 12 hours after symptom onset. Only 35% of patients arrived at hospital within 3.5 hours (Figure 2).

The Quality of Stroke Care in Canada

Figure 2. Time from Symptom Onset to Arrival at Hospital for Audit Patients (N=38,210), Canada 2008/2009



The Quality of Stroke Care in Canada

Chapter 5

Comparing Current Practice to Best Practice: EARLY ASSESSMENT AND TREATMENT

5.1 Emergency Department Assessment and Diagnostic Imaging

KEY FINDINGS

Only 22% of all stroke patients received a scan within an hour of arrival.

For those patients arriving within 3.5 hours of symptom onset, 40% were scanned within an hour.

BEST PRACTICE

When a patient arrives at the emergency department, he/she should be rapidly assessed, receive a brain scan (MRI or CT²⁴ scanning of the brain) to determine the type and nature of the stroke, and be evaluated for treatment options, including eligibility to receive tPA. This process should be completed within 60 minutes of hospital arrival.

CURRENT PRACTICE

Overall, 22% of all patients received a brain scan within one hour of hospital arrival (Table 6). Even among those patients who arrived within 3.5 hours of symptom onset (N=13,533), where receiving a timely brain scan is most important, only 40% received a scan within one hour.

At 24 hours, approximately one-third of all patients had not yet received a scan and only 45% of those with subarachnoid hemorrhage (SAH) had received a scan (Table 6). This is sub-optimal care and is somewhat unexpected in the Canadian context, where scanners are widely available at major hospitals. This may be explained by poor documentation of scan times or delays in considering the diagnosis. It should be noted that, by the time of discharge, nearly all (97%) of patients had received a brain scan.

Table 6. Time from Arrival at Hospital to CT or MRI Scan for Audit Patients, Canada 2008/2009

	Scan Within 1 Hour of Arrival at Hospital	Scan Within 24 Hours of Arrival at Hospital	Scan Before Discharge from Hospital
All Patients with Stroke or Transient Ischemic Attack	22%	69%	97%
Ischemic Stroke	25%	72%	99%
Intracerebral Hemorrhage	29%	69%	99%
Subarachnoid Hemorrhage	16%	45%	99%
Transient Ischemic Attack	13%	69%	94%

²⁴ CT=Computerized Tomography and MRI = Magnetic Resonance Imaging

The Quality of Stroke Care in Canada

5.2 Acute Thrombolytic Therapy

KEY FINDINGS

Overall, 8% of all ischemic stroke patients received tPA.

30% of ischemic stroke patients were admitted to a hospital that doesn't provide tPA.

Only 12% of ischemic stroke patients admitted to a hospital with tPA capability were treated with tPA.

In two-thirds of the cases, it took longer than one hour to administer tPA from the time of a patient's arrival at hospital.

BEST PRACTICE

After the initial assessment, patients diagnosed with ischemic stroke and who can be treated within 4.5 hours of symptom onset should be evaluated to determine their eligibility for treatment with tPA²⁵. It should be noted that some patients will be ineligible for tPA due to other clinical considerations. For example, they may be taking medications that would prevent them from receiving tPA.

CURRENT PRACTICE

Overall, 8% of patients identified to have an ischemic stroke received tPA. Of those with an ischemic stroke arriving within 3.5 hours of symptom onset (34% of ischemic stroke patients), 22% received tPA.

Overall, 151 (51%) of the hospitals in the audit provided tPA. Seventy percent of patients with ischemic stroke were admitted to a hospital capable of providing tPA, and the overall rate of tPA administration in these patients was 11.8%.

In those who received tPA, the vast majority received it within the recommended time of 4.5 hours from symptom onset (Figure 3). Complications rates were comparable to those reported in the literature.

In two-thirds of the cases where tPA was administered, the door-to-needle (arrival to administration) time was greater than one hour, with a median time of 72 minutes (Table 7).

The economic analysis indicates that an improved rate of thrombolysis administration would result in fewer hospitalizations, an annual direct cost-avoidance of \$13.6 million, and an annual indirect saving of \$5.2 million.

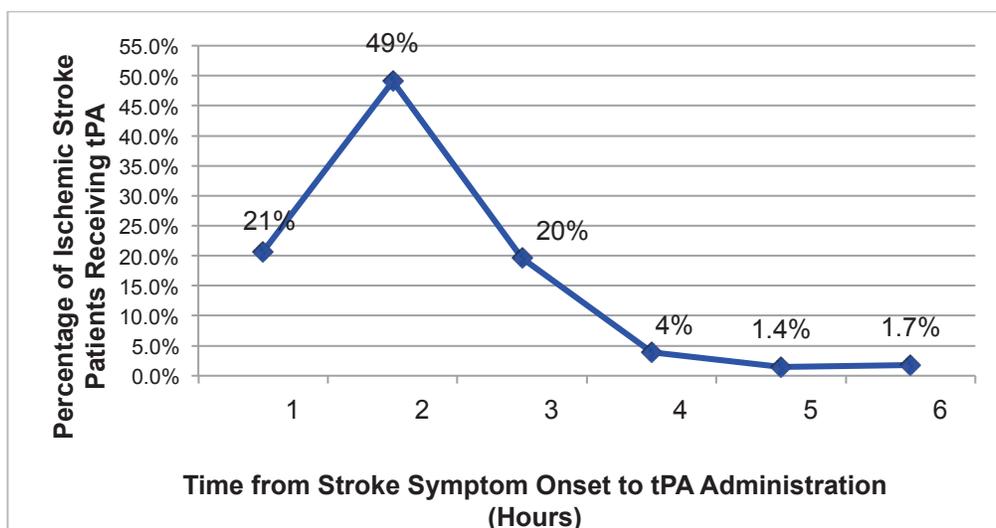
Table 7. tPA Door (Arrival) to Needle (tPA Administration) Times for Audit Patients with Ischemic Stroke who Received tPA, Canada 2008/2009

Door to Needle Time	% of Treated Patents (N=2009)
≤ 1 Hour	34%
> 1 Hour	66%
Median Time (Minutes)	72

²⁵ tPA includes thrombolysis of any kind including via an intra-arterial device or injection device, or intravenously.

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Figure 3. Time from Stroke Symptom Onset to tPA Administration for Audit Patients with Ischemic Stroke who Received tPA (N=2,009)



5.3 Antiplatelet Therapy

KEY FINDINGS

Almost one-third of patients with confirmed diagnosis of ischemic stroke and transient ischemic attack do not receive antiplatelet therapy.

BEST PRACTICE

All patients with acute ischemic stroke and TIA should receive antiplatelet therapy (usually acetylsalicylic acid - ASA or Aspirin™ - or PLAVIX™) immediately after stroke onset, once brain imaging has excluded intracranial hemorrhage. Antiplatelet therapy given within the first 48 hours of stroke onset is recommended because it reduces the risk of early recurrent ischemic stroke. In addition, long-term antiplatelet therapy reduces the risk of ischemic stroke, myocardial infarction, and vascular death.

CURRENT PRACTICE

Antiplatelet therapy was prescribed for only 70% of patients with ischemic events within 48 hours of arrival at hospital (Table 8). As mentioned earlier, only 69% of patients had received a brain scan after 24 hours, and a brain scan is recommended prior to administering antiplatelet therapy. This could partially explain why 100% of patients with ischemic stroke did not receive antiplatelet therapy within the first two days.

Table 8. Audit Patients Receiving Antiplatelet Therapy within 48 hours of Hospital Arrival, Canada 2008/2009

	% Receiving Antiplatelet Therapy within 48 Hours of Hospital Arrival
All Patients with Ischemic Stroke or Transient Ischemic Attack	70%
Ischemic Stroke	66%
Transient Ischemic Attack Patients	82%

The Quality of Stroke Care in Canada

5.4 Telestroke

KEY FINDINGS

Telestroke capability was concentrated in Ontario, Alberta and British Columbia.

Less than 1% of patients in the audit received a Telestroke consultation, indicating that this technology is being under-utilized.

BEST PRACTICE

Telestroke is the use of telecommunication technology to link referring and consulting healthcare sites for real-time assessment and management of stroke patients. It is used primarily to extend access to thrombolytic treatment in healthcare facilities that do not have 24/7 on-site stroke expertise. Telestroke networks should be implemented wherever acute care facilities do not have on-site stroke care expertise to provide continuous access to acute stroke assessment and treatment with tPA in accordance with current treatment guidelines. Telestroke can also be used in the post-acute period to provide access to healthcare experts such as rehabilitation professionals.

CURRENT PRACTICE

In Canada, only 24% (72 of the 295) of hospitals included in the audit reported that they had Telestroke capability, with the vast majority (59 sites) being in Ontario, Alberta and British Columbia. An early adopter of Telestroke in 2002, Ontario marked the treatment of more than 1,000 patients using Telestroke in June 2009. Within the audit sample, only 0.9% (n=343) of admitted patients received a Telestroke consultation during the acute phase; 91% of these were in Ontario or Alberta.

The Quality of Stroke Care in Canada

Chapter 6

Comparing Current Practice to Best Practice: ACUTE MANAGEMENT

6.1 Stroke Units

KEY FINDINGS

77% of stroke patients do not receive treatment in a stroke unit.

Even in those centres with stroke units, 47% of stroke patients are not admitted to the stroke unit.

Optimal use of stroke units could result in an annual cost avoidance of \$216.7 million.

BEST PRACTICE

When a patient with a stroke is admitted to hospital it is important that the care he/she receives is focused on recovering from the stroke, preventing complications, and preventing a recurrent stroke. An effective way of achieving this is by providing treatment on a stroke unit staffed by an inter-professional team with expertise in stroke care. A stroke unit is a specialized, geographically defined hospital unit dedicated to the management of stroke patients. Stroke unit care reduces the likelihood of death and disability by as much as 30% for people with mild, moderate, or severe stroke²⁶.

CURRENT PRACTICE

Only 23% of the stroke patients in the audit were admitted to a stroke unit at any time during their hospital stay (Table 10). Within Stroke Centres (which by definition offer a stroke unit), only 53% of patients were admitted to a stroke unit. Of these, 77% were patients with an ischemic stroke, 10% were patients with an ICH, and 13% were patients with a TIA. SAH patients are typically cared for on a neurosurgical ward or an intensive care unit.

The economic analysis indicates that providing access to stroke units to 80% of patients with stroke in Canada would result in 79,000 fewer acute care days and 132,000 fewer days in residential care. This increase in stroke unit use would result in an annual direct cost-avoidance of \$117.7 million and an annual indirect cost avoidance of \$99.0 million²⁷.

The median length of stay for all stroke patients in acute care was 7 days, with a longer stay for those with an intracerebral hemorrhage (11 days) (Table 9). Stroke mortality rates are shown in Figure 4. As would be expected, the mortality rates were higher for the more severe stroke types (ICH and SAH).

While in the hospital, the type of physician treating the individual was most often (in 71% of cases) a general practitioner or a specialist in internal medicine.²⁸

²⁶ Stroke Unit Trialists' Collaboration. Organised inpatient (stroke unit) care for stroke. Cochrane Database Syst Rev 2007;(4)

²⁷ Cost-Avoidance Associated with Optimal Care in Canada, May 2011, Prepared by H. Krueger & Associates Inc.

²⁸ Canadian Institute of Health Information, Discharge Abstract Database 2004 - 2009

The Quality of Stroke Care in Canada

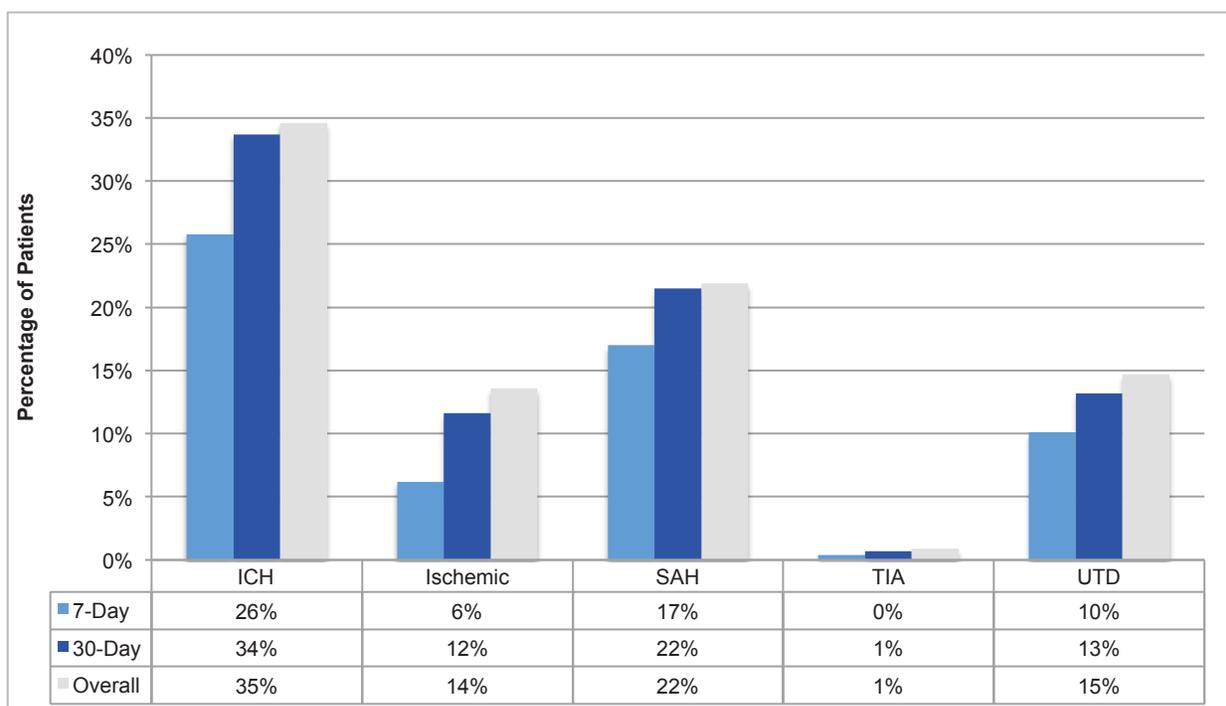
Table 9. Length of Hospital Stay in Acute Care for All Audit Patients Alive at Discharge, Canada 2008/2009

	Average Length of Stay (Days)	Median Length of Stay (Days)
All Patients with Stroke or Transient Ischemic Attack	16	7
Ischemic Stroke	18	9
Intracerebral Hemorrhage	23	11
Subarachnoid Hemorrhage	18	11
Transient Ischemic Attack	7	2
Unable to Determine	10	2

Table 10. Audit Patients Admitted to a Stroke Unit by Stroke Type (N=34,735)²⁹, Canada 2008/2009

	% of Patients Admitted to a Stroke Unit
All Patients of All Stroke Types	23%
Ischemic Stroke	25%
Intracerebral Hemorrhage	20%
Transient Ischemic Attack	16%

Figure 4. In-Hospital Mortality Rates of Audit Patients by Stroke Type, Canada 2008/2009



²⁹ Patients with SAH are usually admitted to an intensive care unit under the supervision of neurosurgery.

The Quality of Stroke Care in Canada

6.2 Dysphagia screening

KEY FINDINGS

Only 50% of patients were documented to have received a swallowing screen to test for dysphagia.

BEST PRACTICE

After a stroke, dysphagia (a difficulty in swallowing) occurs in 55% of patients³⁰. Early identification of dysphagia reduces complications, such as poor nutrition, and dehydration. Dysphagia can also contribute to aspiration pneumonia that results from swallowing of food and liquids into the lungs. Patients with stroke should have their swallowing ability screened using a simple, valid, reliable bedside screening protocol as part of their initial assessment, and before initiating oral intake of medications, fluids or food.

CURRENT PRACTICE

Amongst the audit sample, only 50% of all patients had documentation of a swallowing screen (Table 11). This rate is sub-optimal; however, it is known that documentation of what is a routine assessment may be deficient meaning that the low rate of screening found may be an underestimate. However, 5.7% of all patients were diagnosed with aspiration pneumonia, a condition that should be largely preventable with careful assessment and management of swallowing.

Table 11. Audit Patients with Documentation of a Swallowing Screen, Canada 2008/2009

	% of Patients with a Documented Swallowing Screen
All Patients with Stroke or Transient Ischemic Attack	50%
Ischemic Stroke	59%
Intracerebral Hemorrhage	43%
Subarachnoid Hemorrhage	12%
Transient Ischemic Attack	29%

³⁰ Martino R, Foley N, Bhogal S, et al. Dysphagia after stroke: incidence, diagnosis, and pulmonary complications. *Stroke* 2005;36:2756-63.

The Quality of Stroke Care in Canada

6.3 Secondary Prevention

KEY FINDINGS

One third of patients with ischemic stroke had experienced a prior TIA or stroke.

Optimal use of secondary prevention clinics would result in an annual cost avoidance of \$354.8 million, yet less than a quarter of hospitals are affiliated with such clinics.

The prescribed usage of antithrombotics for ischemic stroke patients is close to optimal.

BEST PRACTICE

Individuals who have experienced a TIA or stroke should receive appropriate timely care in order to reduce the risk of a recurrent vascular event. This is called secondary prevention and it addresses risk factor management through a variety of therapeutic interventions including lifestyle changes, medications, or surgery. In order to prevent recurrent stroke, all patients with ischemic stroke or TIA should be prescribed antithrombotic medications to prevent blood from clotting unless there is a specific contraindication. If a patient is diagnosed with atrial fibrillation, a heart rhythm disturbance that increases the risk of first or recurrent stroke, he/she should be prescribed anticoagulant therapy such as warfarin. Medications for the management of high blood pressure and cholesterol levels are also important and should be addressed before a patient leaves the hospital. For patients with ischemic stroke and TIA, physicians should also recommend further investigation to determine eligibility for a surgical procedure called carotid endarterectomy. Carotid endarterectomy is a surgical opening in one of the main neck arteries (the carotid arteries) that is performed when the artery is partially blocked by plaque. The procedure helps prevent a first ischemic stroke or reduces the risk of recurrent ischemic strokes.

CURRENT PRACTICE

One-third of patients with ischemic stroke in the audit sample had experienced a prior TIA or ischemic stroke (Figure 5). This supports the importance of secondary prevention. Only 22% of the hospitals in the audit indicated that they had an affiliated secondary prevention clinic.

Overall, 91% of patients with ischemic stroke or TIA were prescribed antithrombotic medications at discharge from hospital³¹. In addition, 72% were prescribed an anti-hypertensive medication and 59% were prescribed a lipid-lowering medication (Table 12). For those with atrial fibrillation, only 66% were prescribed oral anticoagulant therapy (Table 13).

During admission for the acute stroke event, fewer than 1% of all ischemic stroke and TIA patients underwent carotid endarterectomy at the same hospital and during the same admission. Of these, 60% of the procedures were done at Stroke Centres. This is likely an underestimate, as patients discharged to another facility or readmitted to the same institution at a later time for the carotid surgery would not be captured through the audit data.

The economic analysis indicated that if 80% of the people who are not receiving optimal secondary prevention were to receive optimal care, the impact would be significant. This would result in fewer hospitalizations for stroke and an annual direct cost-avoidance of \$45.2 million and an annual indirect cost-avoidance of \$309.6 million³².

³¹ It should be noted that this rate applies to admitted patients only and it is unknown if rates would be as high amongst patients who are not admitted (ie.g. those who are discharged from Emergency or attend an outpatient clinic).

³² Cost-Avoidance Associated with Optimal Care in Canada, May 2011, Prepared by H. Krueger & Associates Inc.

The Quality of Stroke Care in Canada

Figure 5. Audit Patients with a Past History of Ischemic Stroke or TIA Who Experience a New Stroke by Type, Canada 2008/2009

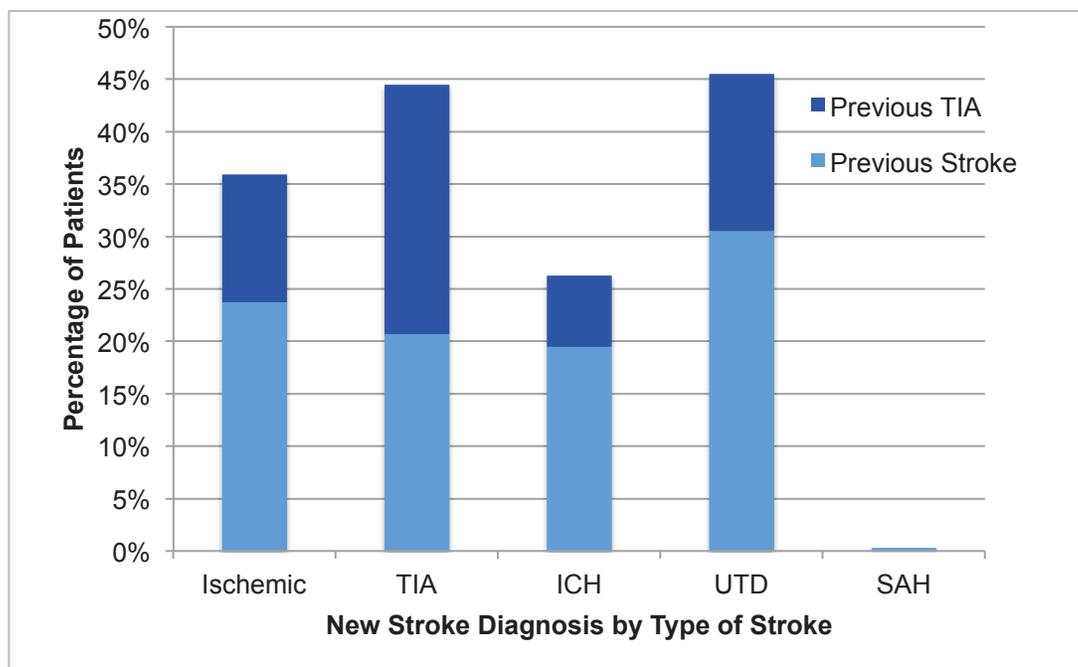


Table 12. Discharge Medications Prescribed to Audit Patients by Stroke Type, Canada 2008/2009

	% Prescribed an Antidepressant	% Prescribed an Antihypertensive	% Prescribed a Lipid Lowering Agent
All Patients with Stroke or Transient Ischemic Attack	9%	71%	59%
Ischemic Stroke	10%	76%	66%
Transient Ischemic Attack	10%	73%	60%
Intracerebral Hemorrhage	9%	68%	33%
Subarachnoid Hemorrhage	0%	0%	0%

Table 13. Antithrombotic Therapy for Audit Patients with Ischemic Stroke/TIA and Atrial Fibrillation, Canada 2008/2009

	% of Audit Patients with Ischemic Stroke/TIA and Atrial Fibrillation (n=5,229 patients)
% Receiving Antiplatelet Therapy	50%
% Receiving Anticoagulant Therapy	66%
% Receiving Either Antithrombotic Therapy	92%



The Quality of Stroke Care in Canada

Chapter 7

Comparing Current Practice to Best Practice: REHABILITATION AND TRANSITIONS

KEY FINDINGS

Upon discharge from acute hospital care, the majority (58%) of patients return home.

Only 19% of all patients are discharged from acute stroke care to a rehabilitation facility.

Rehabilitation assessment in acute care was not well documented in most cases.

Stroke patients who are admitted to inpatient rehabilitation stay for 5-6 weeks and two-thirds return home afterwards with substantial functional recovery.

BEST PRACTICE

Following a stroke, patients must have prompt access to rehabilitation programs, services and facilities. This contributes to decreased complication rates and improved functional outcomes. Individuals should be assessed within 24 to 48 hours after a stroke to determine the type of rehabilitation they require and consider the program or facility that best meets their needs. All patients with stroke should have a personalized rehabilitation plan that reflects their needs and goals. Early supported discharge and active community-based rehabilitation programs are encouraged for eligible individuals.

CURRENT PRACTICE

The type of rehabilitation required and the discharge destination from acute care is largely determined by stroke severity. Stroke severity varies according to stroke type but overall the majority of strokes are classified as mild (Figure 6).

In the audit sample the majority of patients (58%) returned home upon discharge from acute care while 19% were transferred to an inpatient rehabilitation facility and 10% to long-term care. Almost 90% of those with mild stroke were discharged directly home from acute care. Patients with moderate to severe stroke benefit most from rehabilitation but only 37% of this group were discharged to a rehabilitation facility (Figure 7).

The audit revealed that rehabilitation assessments in acute care were not well documented. This makes it difficult to assess the extent to which the discharge destinations from acute care were appropriate (Figure 7).

This audit did not collect information on inpatient and outpatient rehabilitation practices and outcomes in stroke. However, the Canadian Institute of Health Information's National Rehabilitation Reporting System (NRS) provided some clinical information for patients with stroke treated at inpatient rehabilitation institutions. Stroke patients who are admitted to inpatient rehabilitation have a median length of stay of 35 days and experience clinically significant functional recovery during their stay³³. Seventy-one percent of patients with stroke return home after inpatient rehabilitation, 30% with no services and 38% with some in-home services³⁴.

³³ Canadian Institute of Health Information, National Rehabilitation System 2008-2009

³⁴ Canadian Institute of Health Information, National Rehabilitation System 2008-2009

The Quality of Stroke Care in Canada

Figure 6. Audit Patients' Stroke Severity (based on the Canadian Neurological Scale, CNS), Canada 2008-2009

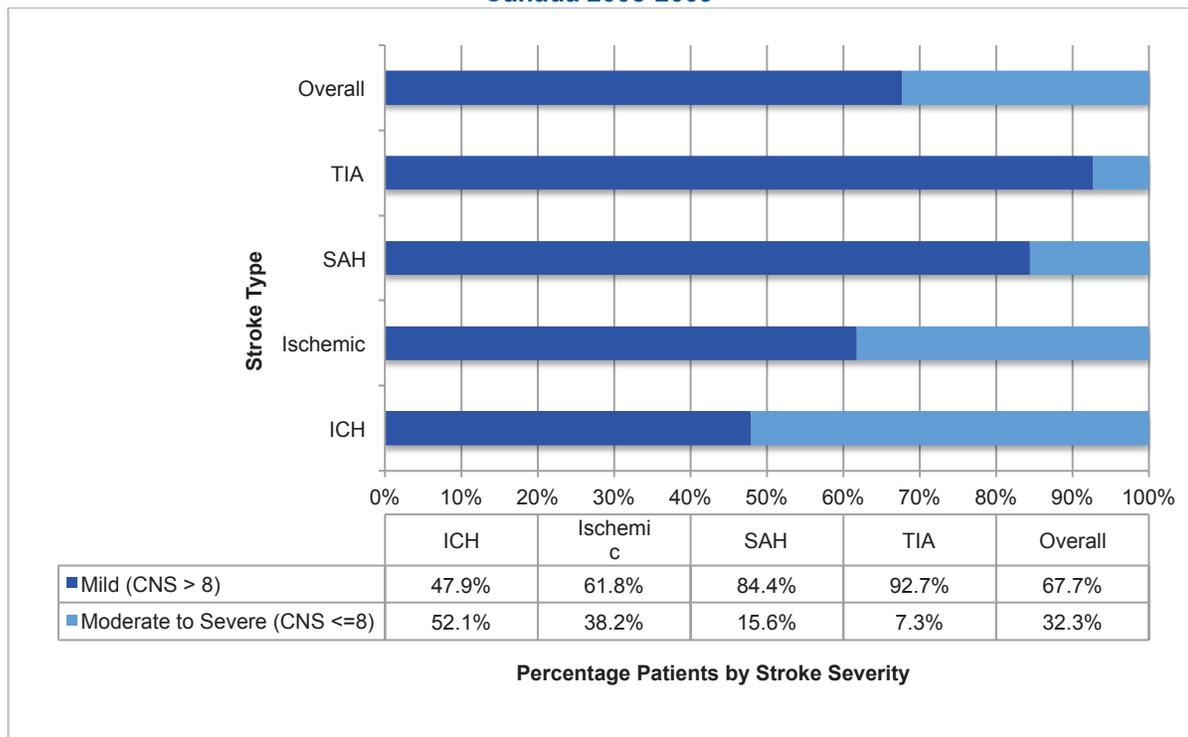
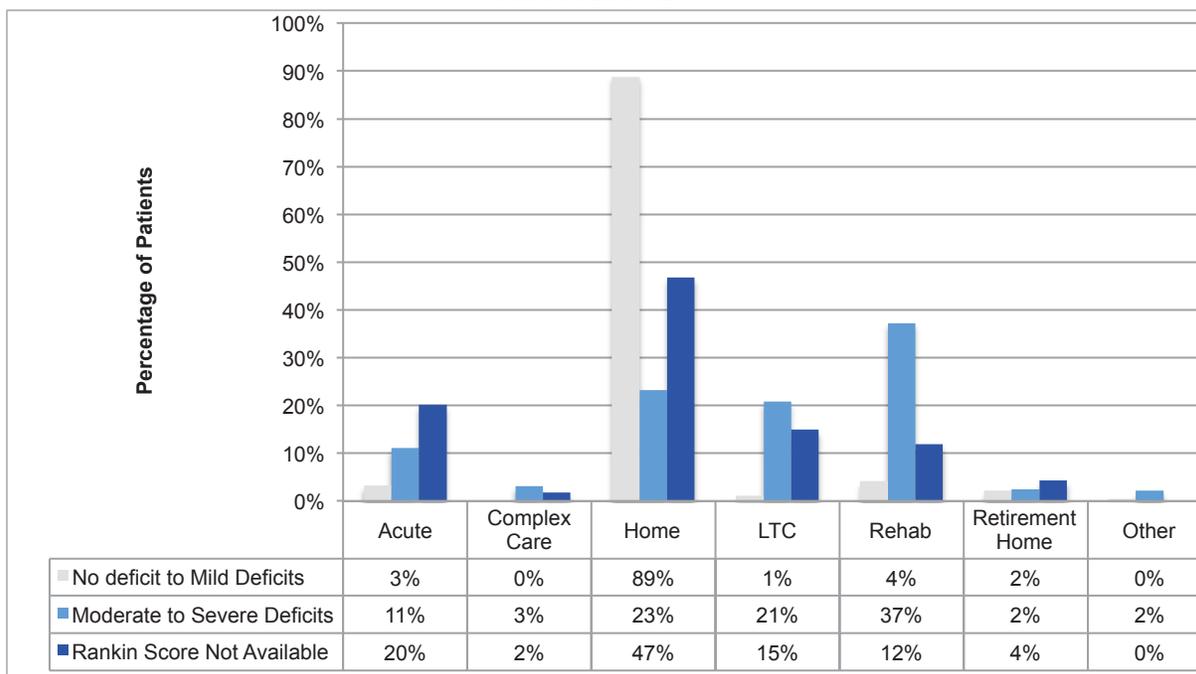


Figure 7. Audit Patients' Discharge Destination by Stroke Severity (based on Rankin Scale), Canada 2008-2009



The Quality of Stroke Care in Canada

Chapter 8: KEY MESSAGES AND RECOMMENDATIONS

The risk factors for stroke need to be better controlled

The national audit estimated that 43,651 people were admitted to hospital with a stroke in Canada in 2008-2009. This number underestimates the actual number of stroke cases in Canada. It does not include individuals who have strokes but are not admitted to hospital, such as those who are seen in physicians' offices or emergency departments without hospital admission. The report also does not capture strokes in people under the age of 18 or people who have "covert" or silent strokes. It is estimated that for every symptomatic or clinically evident stroke, there are 5 silent or asymptomatic strokes³⁵. Many of the patients with stroke had a past medical history that involved risk factors such as hypertension, smoking, and diabetes. These risk factors continue to be sub-optimally managed in the Canadian population and require the application of population-level approaches to reduce prevalence of risk factors such as efforts to reduce sodium in the food supply to reduce blood pressure levels.

RECOMMENDATIONS

- **Patients/Public:** Learn about your risk for stroke and ways to lower it by reducing the amount of sodium in your diet, regularly eating fruits and vegetables, reducing the amount of fat in your diet, quitting smoking, and maintaining an active lifestyle.
- **Care Providers:** Assess your patients' blood pressure regularly at all appropriate visits. Encourage and support patients to adopt healthier lifestyles and follow-up with them regularly. Use risk assessment tools to educate your patients on their risk of stroke.
- **Policymakers:** Continue to encourage healthy lifestyles and risk factor reduction with policies that promote healthy food choices, smoke-free environment and physical activity.

"Time is brain" yet many don't consider stroke a medical emergency, a brain attack

Two thirds of the people who have a stroke do not arrive at an appropriately prepared hospital within the treatable window. When a stroke occurs, it must be treated as a medical emergency. The recommended window for receiving thrombolytic treatment for an ischemic stroke is 4.5 hours from the time of symptom onset, but chances of recovery are much improved with earlier therapy. An ambulance serves several purposes well beyond the speed of arrival. It also allows emergency medical service providers to route patients to a hospital equipped to treat stroke, to initiate initial treatment and assessment, and to alert the hospital that a stroke patient is coming. Even when stroke symptoms resolve en route, the situation remains urgent. Even patients with a TIA must have same-day assessment and investigation so that they do not suffer a major stroke in the ensuing hours to days. The audit data indicated that those who arrive by ambulance are more likely to receive timely brain scans. Despite these benefits, 30% of stroke

³⁵ Prevalence and risk factors of silent brain infarcts in the population-based Rotterdam Scan Study. Vermeer SE, Koudstaal PJ, Oudkerk M, Hofman A, Breteler MM. Stroke. 2002 Jan;33(1):21-5.

The Quality of Stroke Care in Canada

patients made their own way to the hospital and similarly 30% of ischemic stroke patients were treated in hospitals that did not have tPA capability. This points to an urgent need for improved awareness amongst the public not only about the signs and symptoms of stroke, but also about the appropriate actions when these occur. Ongoing awareness campaigns that are bold, innovative, and yield sustained changes in public perceptions and behaviour are required.

RECOMMENDATIONS

- **Patients/Public:** Be aware of the signs and symptoms of stroke: sudden weakness, sudden trouble speaking, sudden vision problems, sudden and severe headache, and sudden dizziness especially with other symptoms. If you suspect a stroke CALL 9-1-1 and have an ambulance bring you IMMEDIATELY to the hospital.
- **Care Providers:** Ensure emergency protocols for stroke are in place within your health region, including pre-notifications and priority MRI/CT scanning access for all stroke patients.
- **Policymakers:** Implement on-going public awareness campaigns that encourage people to recognize and react to the signs of stroke, and to treat it as a medical emergency.

When patients arrive at hospital, they are not treated fast enough

The burden for timely treatment falls not only on the patient's response to the stroke but also on the health system for responding quickly once the patient arrives at the hospital. Once patients arrive at the hospital, they must be assessed and treated as quickly as possible, especially if they are still within the therapeutic window for tPA administration. However, the audit found that only 40% of patients who arrived within 3.5 hours of symptom onset received a CT or MRI scan within an hour of arrival. The median door-to-needle (arrival to administration) time for tPA was 72 minutes. Simply stated, this is not acceptable and needs urgent improvement. Despite these challenges, Canada's tPA administration rate (8% of all ischemic stroke patients and 22% of those arriving within the 3.5 hour window) is relatively high compared to other countries³⁶. While one would never expect the rate of tPA to be 100%, there is still considerable room for improvement. Based upon tPA rates at some of Canada's top stroke centres, target numbers are estimated to be 20% of all ischemic stroke and 50% of those ischemic strokes that arrive within the 3.5 hour window. In addition to the timely arrival and assessment of stroke patients, medical professionals (including nurses and emergency physicians) need to receive the appropriate professional training to feel comfortable in delivering this treatment.

RECOMMENDATIONS

- **Patients/Public:** When you arrive at the hospital, know that you should be assessed to determine the nature of your stroke. This means receiving a brain scan within 60 minutes.
- **Care Providers:** Organize the emergency room to achieve door-to-needle times of less than one hour for all those eligible for tPA. Ensure all health professionals in the emergency department are trained in how to manage acute stroke.
- **Policymakers:** Monitor tPA rates and other key indicators with existing administrative systems and future stroke audits.

³⁶ 2009/2010 Australian Stroke Report reported a tPA rate for all ischemic stroke patients of 3% and the Paul Coverdell Registry in the USA reported a tPA rate of 2.4% in 2009

The Quality of Stroke Care in Canada

Telestroke could save lives, but it is not being widely used

Telestroke presents an opportunity for those who live in rural settings with smaller hospitals, yet less than 1% of stroke patients are benefiting from this service. Telestroke can be effectively used for both acute care and rehabilitation consultations. Provinces with established Telestroke systems (Ontario, British Columbia, and Alberta) could serve as models for the expansion of this service across Canada. Issues around cross-provincial consultations, physician reimbursement, technological interfaces, and availability of CT scanners in smaller hospitals should be examined at a national level with a view towards a coordinated nation-wide system of Telestroke.

RECOMMENDATIONS

- **Care Providers:** Take advantage of existing Telestroke initiatives within your province or health region. If the technology exists, use it.
- **Policymakers:** Support the national implementation of Telestroke by eliminating the barriers associated with cross-provincial consultations. Encourage the use of existing Telehealth networks and use existing Telestroke networks as case studies.

Patients need greater access to stroke units

Once a patient is admitted, best practice would dictate that they be admitted to a stroke unit serviced by an interdisciplinary team. The audit indicated that only 23% of stroke patients in Canada are treated in a stroke unit. This number is lower than in other countries³⁷. In fact, only 18% of the hospitals in the audit sample were classified as Stroke Centres, meaning they offered brain scanning, thrombolysis, and a stroke unit. Within hospitals that had stroke units, only 53% of stroke patients were admitted to the stroke unit. These numbers indicate both a need for the establishment of more stroke units in Canada, and increased capacity and/or better utilization of existing stroke units.

RECOMMENDATIONS

- **Patients/Public:** When in an ambulance, ask if you are being taken to a Stroke Centre. When admitted to hospital after a stroke, ask if there is a stroke unit.
- **Care Providers:** Ensure that all hospitals that provide tPA have a stroke unit. If a stroke unit exists, ensure it has the necessary capacity to handle the volume of strokes within the hospital or region.
- **Policymakers:** Continue to monitor the availability and access by patients to stroke units. Canada should strive to achieve stroke unit admission rates comparable to other countries (i.e. between 50-70% of all patients with stroke).

³⁷ 2009/2010 Australian Stroke Report reported 50% of patients are treated on a stroke unit and the UK Sentinel Report (2010) reported 74% of patients are treated on a stroke unit.

The Quality of Stroke Care in Canada

Patients receive good care in hospital but several aspects of care could be improved

The median length of stay for stroke patients is 7 days yet the average length of stay is 16 days, nearly double the average length of hospital stay for all conditions in Canada³⁸. The majority of patients with stroke are primarily attended to in hospital by a general practitioner or specialist in internal medicine, which makes it extremely important to provide the appropriate stroke training and continuing medical education to these health care providers. While in hospital, the vast majority of patients are prescribed the appropriate medications, such as antithrombotic and anti-hypertensive medication. Of concern is the low level (50%) of documented dysphagia screening to assess swallowing difficulties. An effective way of preventing a recurrent stroke is through the application of secondary prevention measures. While most patients are prescribed the appropriate medications upon discharge, there should ideally be a formal process for monitoring the patient after discharge. Secondary prevention clinics are being piloted and established in certain provinces, yet at the time of the audit only 22% of the audited hospitals were affiliated with a secondary prevention clinic.

RECOMMENDATIONS

- **Patients/Public:** Learn what to expect and what questions to ask while you are in the hospital and afterwards. The *Patient's Guide to the Canadian Best Practice Recommendations for Stroke Care* is a good place to start (www.strokebestpractices.ca).
- **Care Providers:** Follow the clinical recommendations in the 2010 updated *Canadian Best Practice Recommendations for Stroke Care* (www.strokebestpractices.ca). Use the associated implementation tools to ensure all members of the stroke care team are trained in the latest stroke practices.
- **Policymakers:** Monitor the quality of care on a regular basis using the key performance measures used in *The Quality of Stroke Care in Canada*. Use the national numbers from the current report as benchmarks for improvement.

Access to appropriate rehabilitation is vital, yet not well monitored

Specialized interdisciplinary inpatient rehabilitation can substantially improve how well a patient recovers after a stroke. Patients with moderate to severe stroke (30-40% of all cases) benefit most from rehabilitation in a specialized facility. However, only 37% of all moderate to severe stroke cases are discharged to a rehabilitation facility. For those who receive inpatient rehabilitation services two thirds will return home after experiencing a clinically significant level of functional recovery. Upon returning home, more than half of the patients with stroke will require on-going care or in-home services. Despite these facts, there is a lack of information on rehabilitation assessment in acute care and on the quality of both inpatient and outpatient rehabilitation care provided to Canadians. In general, this information is inconsistently documented or not collected. Given the potential impact that appropriate rehabilitation can have on functional outcome and the large proportion of all stroke cases that could benefit, this gap needs to be addressed in order to properly evaluate the most efficient and effective models of service delivery.

³⁸ Average length of stay in Canadian Hospitals is 7 days, Canadian Institutes of Health report 2004-2005

The Quality of Stroke Care in Canada

RECOMMENDATIONS

- **Patients/Public:** Your rehabilitation team should involve you in deciding what kind of rehabilitation you need and develop a plan just for you. Know what your continued rehabilitation needs are. Get involved.
- **Care Providers:** Work with patients to develop personalized rehabilitation plans. Document rehabilitation practices including timeliness and type of rehabilitation therapy offered. Be aware of the community services available for patients upon discharge.
- **Policymakers:** Collect more robust information related to stroke rehabilitation. The existing databases of Canadian Institute of Health Information should be expanded to capture indicators for both inpatient and outpatient rehabilitation.

Canada must improve its stroke services: the benefits are significant

Clearly, there is room for improvement across the continuum of stroke care. While Canada may be performing better than some other countries in certain aspects of care delivery, there is a need for consistency in quality of service Canada-wide. The economic analysis conducted in conjunction with this report estimated that the benefits of improvement in four key areas (secondary prevention, thrombolysis, stroke units, and early supported discharge) would result in total cumulative costs avoided between 2010 and 2031³⁹ of \$36.1 billion (\$15.4 billion in direct costs avoided and \$20.7 billion in indirect costs avoided).⁴⁰

RECOMMENDATIONS

- **Patients/Public:** Demand equal access to excellent stroke care for all Canadians.
- **Care Providers:** Have your hospital assessed by Accreditation Canada for Stroke Distinction, based on best practices and defined standards of care practices. Advocate for change in how your hospital or region manages stroke from prevention through to rehabilitation. Get involved in provincial efforts to improve stroke systems.
- **Policymakers:** Ensure all Canadians have access to the best possible stroke care regardless of where they live. Continue to monitor quality of stroke care in Canada with *The Quality of Stroke Care in Canada* serving as a benchmark.

³⁹ The time frame 2010-2031 was selected as population projections from Statistics Canada only go to 2031

⁴⁰ Source: Cost-Avoidance Associated with Optimal Care in Canada, April 2011, Prepared for The Canadian Stroke Network by H. Krueger & Associates Inc.



The Quality of Stroke Care in Canada

Appendix A: PROVINCIAL INFORMATION

The goal of the Canadian Stroke Strategy has been to help support an integrated approach to stroke prevention and treatment in every province and to ensure that people get the best possible care, no matter where they live. Through sharing and adapting national tools – such as training and education programs, best practices, awareness efforts and evaluation and monitoring systems – provinces are developing their own unique approaches to improving stroke services. Significant progress has been made in each province in Canada, yet more work remains to be done. Below, provinces have provided their 5 Key Achievements to date and set out 3 Top Priorities for the future. Members of the Canadian Stroke Strategy's Provincial-Territorial Roundtable provided the information presented. Finally, the key performance indicators are presented for each province.

KEY ACHIEVEMENTS AND TOP PRIORITIES

British Columbia

Population: 4.4 million

The provincial government has invested \$5 million in the B.C. Stroke Strategy since 2006.

KEY ACHIEVEMENTS

- Developed, disseminated and reinforced clinical practice guidelines for primary care physicians to improve stroke/TIA prevention and management.
- Increased access to TIA Rapid Assessment by developing new clinics (and adding capacity to existing clinics) in all five health authorities.
- Implemented two Telestroke systems (one on Vancouver Island and one in the lower mainland) to aid in the diagnosis and treatment of stroke patients.
- Developed a comprehensive stroke/TIA registry and a robust cost avoidance model.
- Developed, implemented and embedded hospital stroke/TIA emergency department protocols and attained a commitment from the provincial government to make stroke a strategic long-term priority.

TOP PRIORITIES

1. TIA Rapid Assessment – Build further capacity and improve performance of existing clinics to ensure people are seen in secondary stroke prevention clinics within 48 hours of a TIA.
2. Hyperacute Stroke – Make focused improvements on care delivered within first 48 hours post stroke, e.g. hospital designations, EMS bypass protocols, paramedic training, emergency department protocols, Telestroke, tPA administration, acute care pathways, stroke units, etc.
3. Training, Education and Measurement – Deliver ongoing education to the full spectrum of health care providers with respect to *Canadian Best Practice Recommendations for Stroke Care* and measure, evaluate and report on progress using performance indicators, standardized data collection systems, quality improvement plans, reporting protocols.

The Quality of Stroke Care in Canada

Alberta

Population: 3.7 million

In 2005, the Alberta government committed \$20 million over a two-year period to the Alberta Provincial Stroke Strategy and renewed its commitment to improving stroke care with a further \$22.5 million in 2008 over the next three years.

The Alberta Provincial Stroke Strategy is a successful network of stroke services, knowledge dissemination and information sharing.

KEY ACHIEVEMENTS

- The proportion of patients with ischemic stroke who received tPA increased from 8.6% to 11.3% between 2004/05 and 2007/08.
- The proportion of patients treated on a stroke unit increased by 16% in absolute terms between 2004/05 and 2007/08.
- The number of stroke centres across the province capable of giving tPA increased from 5 to 16 between 2005 and 2010.
- The number of stroke prevention clinics across the province increased from 3 to 12 between 2005 and 2010. Over 15,000 patients have been seen in such clinics since mid- 2007 when tracking began.

- The 30-day in-hospital mortality decreased by 27% for ischemic stroke and 28% for hemorrhagic stroke between 2004/05 and 2008/09.

TOP PRIORITIES

1. The proportion of patients treated in stroke unit beds should increase further.
2. In addition to further increasing use of tPA, the province should strive to reduce door to treatment times to less than one hour province-wide.
3. The province should increase efforts to promote primary prevention of stroke and should make maximum use of timely secondary prevention services to reduce stroke occurrence.

Saskatchewan

Population: 1 million

A pilot evaluation is under way in Saskatchewan. Once completed in February 2012, the plan is to move towards a fully-funded provincial stroke strategy.

KEY ACHIEVEMENTS

- Direct transfer protocol: New protocol developed by Ministry of Health and implemented by all SK health regions.
- Rural Stroke Prevention Clinic with Regina neurology support via Telehealth, part of a \$1.7-million investment in a rural regional stroke pilot.
- Successful recruitment of full-time Physiotherapy, Occupational Therapy, Speech Language Pathology, Clinical Nurse Coordinator and Social Worker for in-patient and out-patient rehabilitation in rural regional stroke pilot.
- Stroke Prevention Clinic established in Saskatoon.

- Telestroke -- from emergency treatment to rehabilitation -- established as priority for Telehealth Saskatchewan.

TOP PRIORITIES

1. Province-wide implementation of a fully-funded and integrated stroke strategy in Saskatchewan following completion of pilot evaluation in February 2012.
2. Designation of Ministry of Health leadership to ensure successful implementation and integration within and between regions.
3. Funding to enable continued leadership by the Saskatchewan Integrated Stroke Strategy Steering Committee.

The Quality of Stroke Care in Canada

Manitoba

Population: 1.2 million

Manitoba has developed a draft comprehensive 5-year provincial stroke strategy. However, funding has not yet been secured to ensure realization of all activities required.

KEY ACHIEVEMENTS

- Funding for the Stroke Strategy Educator position and for professional education and conferences.
- Establishment of a 30-bed stroke rehabilitation program unit in Winnipeg in 2006 and creation of the Winnipeg Regional Health Authority Home Care Program Community Stroke Care Service in 2005 to provide case coordination, home-based rehabilitation and homecare support.
- Awareness campaign of the warning signs of stroke and the need to seek immediate medical attention, conducted by Heart and Stroke Foundation of Manitoba. Included in this campaign were ads created specifically for the Aboriginal population. Polling shows 76% of Manitobans can name 2 or more warning signs of stroke.
- Establishment of four stroke prevention clinics in Manitoba – one at each of the two teaching hospitals in Winnipeg and two in rural hospitals. In its first two years, the Steinbach stroke prevention clinic has held 85 clinics, scheduled a total of 862 patient visits and saw 626 new clients. Last year, the Brandon clinic had 532 patient visits and received 315 new referrals.

- Hiring of four new regional stroke coordinators to work with the regional health authorities.

TOP PRIORITIES

Implementation of the Manitoba Health Stroke Strategy over the next 5 years by:

1. Supporting capacity building within the regional health authorities to enable expansion of stroke acute care sites in northern and rural Manitoba.
2. Improving access and primary care service delivery for stroke prevention and TIA management.
3. Developing innovative models of care for stroke rehabilitation to improve service delivery across the province.

The Quality of Stroke Care in Canada

Ontario

Population: 13 million

In 2000, the Ontario government developed the first provincial stroke strategy in partnership with the Heart and Stroke Foundation of Ontario. The strategy, a \$30M annual investment, has evolved into the Ontario Stroke Network. Significant progress has been possible through a combination of system change, research, evaluation and knowledge management. Highlights include widespread public awareness efforts; province-wide emergency medical system protocols and redirect procedures; and Telestroke services to increase access to acute stroke therapy in rural and remote communities. There are 17 Telestroke sites across the province.

KEY ACHIEVEMENTS

- In 2008-09, tPA was administered to 8.4% of all patients with ischemic stroke, a significant increase compared to 3.2% in 2002-03.
- Compared to 2003, there are 23% fewer stroke admissions, significantly reduced in-hospital mortality rates and shorter wait times (15 vs. 41 days) for surgical procedures; the proportion of patients who are prescribed anti-thrombotic/coagulant, anti-hypertensive and anti-lipid drug therapy at discharge, as appropriate, has increased significantly from 19.9% in 2002/2003 to 52.1% in 2008/2009.
- In 2008/2009, 26 out of 142 acute care hospitals in Ontario had a stroke unit, and the proportion of patients with a stroke or TIA being admitted to these stroke units has increased 8-fold since 2002/2003. More people are receiving inpatient rehabilitation and there are fewer admissions of stroke patients to long-term care.
- The number of Stroke Prevention Clinics (SPC) in the province has increased from seven in 2002/2003 to 34 by 2008/2009. Fifty-seven per cent of patients seen in the ER but not admitted were referred to a SPC in 2008/2009, compared to 14% in 2002/2003.

- Responding to the needs of Local Health Integration Networks, Stroke Report Cards have been developed and implemented.

TOP PRIORITIES

1. Rehabilitation: Working with the Ministry of Health and Long Term Care and Local Health Integration Networks (through the "ER/ALC" initiative) to provide recommendations to develop provincial rehabilitation standards and support implementation.
2. Vascular Health Strategy: The Heart and Stroke Foundation of Ontario, Cardiac Care Network and Ontario Stroke Network have formed a tripartite working group to act as a catalyst for the creation of an Integrated Vascular Health Strategy for Ontario. The purpose of this strategy is "To reduce the incidence, prevalence and consequences of vascular disease."
3. Program Sustainability: Ensure sustainability of the Ontario stroke program at the provincial and regional levels including Ontario Stroke Network and stroke centre operational funding, Telestroke, the Ontario evaluation program and the research program.

The Quality of Stroke Care in Canada

Quebec

Population: 7.8 million

Development of a stroke strategy for Quebec began in January 2005 with a think-tank involving the Heart and Stroke Foundation of Quebec and provincial government officials.

In 2010, the provincial health minister announced 4 provincial Tertiary Stroke Centres.

KEY ACHIEVEMENTS

- Heart and Stroke Foundation of Quebec has organized three stroke summits (September 2008, 2009 and 2010) to identify areas for improvement in stroke services in Quebec, and to educate health professionals about improvements in stroke services.
- HSFQ has organized three advocacy days (May 2009 and 2010, April 2011) at the Québec National Assembly to increase awareness about stroke among MNAs.
- The Quebec Health Minister has approved the recommendations put forward by stroke experts and HSFQ on the implementation of the QC stroke strategy. The implementation committee has now been at work for the past 2 years.
- HSFQ has developed an 80-page booklet for stroke survivors, to help them understand the disease, its effects, and how to approach rehabilitation and life after stroke.
- Professional education sessions were organized with health professionals, and specially the nursing community, to share the *Canadian Best Practice Recommendations for Stroke Care*.

TOP PRIORITIES

1. Implementation of the QC stroke strategy, along all the continuum of stroke care:
 - continuity of the advisory committee work with the outcome of a document "AVC 1" from the Institut national d'excellence en santé et en services sociaux (INESS)
 - appointment and evaluation of the four tertiary level centers - 1 per Réseau Universitaire Intégré de Santé (RUIS)
 - Implementation of the Quebec stroke registry
 - Improvement of the transitional process (between the different parts of the continuum)
 - 5 partners involved: universities (faculty of medicine, nursing care and other health professionals), college and professional associations, agences de la santé et des services sociaux, 4 RUIS
2. Develop an education resource in the format of a 'flipchart' that Health Professionals can use to better inform patients and persons at risk.
3. Organize the 4th Stroke Summit in collaboration with the QC Vascular Sciences Society to continue educating health professionals about stroke and stroke care.

The Quality of Stroke Care in Canada

New Brunswick

Population: 752,000

Following the release of the New Brunswick Integrated Stroke Strategy in 2006, the New Brunswick Stroke Network was formed, along with regional networks to explore stroke services in each health zone.

KEY ACHIEVEMENTS

- *Canadian Best Practice Recommendations for Stroke Care* have been adopted as the standard across the province.
- A public awareness campaign has been put in place to educate people on the signs and symptoms of stroke and the importance of calling 9-1-1 in the event of emergency.
- Hypertension clinics have been established in health zones across the province in addition to hypertension education and awareness initiatives.

- Stroke patients are treated within designated care areas in New Brunswick hospitals.
- Professional stroke education has been enhanced.

TOP PRIORITIES

1. Implementation of a provincial Telestroke thrombolytic strategy.
2. Identification and monitoring of provincial indicators.
3. Analysis of community reintegration strategy and development of a comprehensive action plan.

Nova Scotia

Population: 943,000

Cardiovascular Health Nova Scotia, a provincial program of the Nova Scotia Department of Health, is accountable for facilitating the rollout of the stroke strategy in Nova Scotia. The stroke strategy has been funded through a \$3 million annual government commitment made in 2007.

KEY ACHIEVEMENTS

- Hired stroke coordinators to implement the stroke strategy in seven stroke programs across the province, and to monitor and evaluate care.
- Enhanced rehabilitation staff on the stroke unit.
- Supported a province-wide stroke public awareness campaign.
- Ensured delivery of best practices, focused on pre-hospital care, acute care, and early rehab, as well as secondary prevention initiatives.
- Provided education and opportunities to network and collaborate for health care providers across the province to improve stroke care for all Nova Scotians.

TOP PRIORITIES

1. Implement a provincial stroke surveillance and monitoring strategy, focused on strategic indicators and building on national performance measurement documents.
2. Continue to support those health districts that have not yet fully implemented their stroke program and protocols across the district or districts.
3. Leverage opportunities to address primary and secondary prevention through collaboration on common risk factors, such as hypertension.

The Quality of Stroke Care in Canada

Prince Edward Island

Population: 142,000

The provincial Department of Health, Island EMS and the Heart and Stroke Foundation of Prince Edward Island jointly launched a provincial stroke strategy in 2006. The province is making a \$3-million investment.

KEY ACHIEVEMENTS

- Availability of the clot-busting drug tPA (2006).
- Implementation of Emergency Medical Services protocols for direct transport of patients with a suspected stroke (2007).
- Provincial Stroke Coordinator hired (2009).
- Provincial Acute Stroke Unit and Stroke Rehabilitation Unit opened at the Queen Elizabeth Hospital (April 2010)
- Secondary Stroke Prevention Clinic pilot opened at Prince County Hospital (October 2010).

TOP PRIORITIES

1. Continued implementation of stroke rehabilitation services, including early supportive discharge at the QEH, and intensive interdisciplinary ambulatory rehabilitation available at the QEH and PCH.
2. Provincial rollout of integrated stroke prevention services.
3. Development of the components of community re-integration services and their implementation.

Newfoundland and Labrador

Population: 510,000

Newfoundland and Labrador has developed provincial emergency protocols for stroke, established three stroke units and one secondary prevention clinic.

KEY ACHIEVEMENTS

- Creation of a Provincial Stroke Medical Consultant Position within the Department of Health and Community Services.
- Development of Provincial emergency and acute protocols.
- Establishment of 3 Stroke Units.
- Establishment of 1 Secondary Stroke Prevention Clinic.
- Ongoing Stroke education teleconferences for health care providers based on stroke best practices (3 annually).

TOP PRIORITIES

1. Designation and activation of Adult Stroke Centre sites by each of the Health Authorities.
2. Establishment of Adult Stroke Inpatient Units within each Health Authority where necessary critical mass exists.
3. Establishment of additional Secondary Stroke Prevention Clinics.

The Quality of Stroke Care in Canada

PROVINCIAL KEY INDICATORS

When the Canadian Stroke Strategy was launched in 2005, all provinces were at very different stages in terms of the stroke services provided, and while progress has been made across Canada, a direct comparison between provinces would be unfair. For this reason, no statistical comparative analysis was conducted. The following indicators provide an overview of stroke care across Canada for the time period of 2008-2009. Since that time frame, some provinces have made significant progress in improving their stroke systems, as noted in the provincial progress updates. For example, at the time of the audit, Prince Edward Island did not have a stroke unit. This has since changed. It should be noted that only 2 health regions were sampled in Manitoba and thus the Manitoba sample is not representative of the entire province. For this reason, the Manitoba data have been denoted with an “*” throughout.

Table 1. Audit Patients by Stroke Type and by Province, Canada 2008/2009

	Ischemic Stroke	Transient Ischemic Attack	Intracerebral Hemorrhage	Subarachnoid Hemorrhage	Unable to Determine
BC	60%	18%	12%	6%	4%
AB	62%	20%	10%	6%	3%
SK	61%	25%	10%	4%	0%
MB*	71%	12%	7%	9%	1%
ON	65%	14%	11%	5%	6%
QC	63%	19%	11%	5%	2%
NB	57%	27%	6%	3%	8%
NS	70%	13%	8%	6%	3%
PE	61%	24%	5%	1%	9%
NL	55%	29%	8%	4%	4%
National	63%	17%	11%	5%	4%

The Quality of Stroke Care in Canada

Table 2. Past Medical History of Audit Patients by Province, Canada 2008/2009

	Previous Stroke	Previous TIA	Hypertension	Diabetes	Current and Lifelong Smoker	Atrial Fibrillation	Coronary Artery Disease
BC	23%	13%	57%	22%	27%	19%	20%
AB	18%	12%	66%	25%	29%	15%	22%
SK	25%	18%	60%	20%	31%	18%	27%
MB*	21%	14%	59%	24%	35%	13%	21%
ON	23%	13%	66%	24%	29%	18%	26%
QC	21%	11%	66%	24%	22%	13%	29%
NB	24%	20%	70%	27%	23%	17%	27%
NS	22%	12%	67%	25%	34%	17%	23%
PE	32%	20%	80%	22%	20%	22%	30%
NL	19%	17%	67%	32%	33%	15%	24%
National	22%	13%	65%	24%	27%	16%	25%

Table 3. Percentage of Audit Patients Arriving by Ambulance by Province, Canada 2008/2009

	% of Admitted Patients of All Stroke Types and All Centres Arriving by Ambulance
BC	73%
AB	75%
SK	69%
MB*	69%
ON	69%
QC	70%
NB	67%
NS	71%
PE	50%
NL	62%
National	70%

The Quality of Stroke Care in Canada

Table 4. Stroke Symptom Onset to Hospital Arrival by Timeframe for Audit Patients with Ischemic Stroke by Province, Canada 2008/2009

	% Arriving in Less Than or Equal to 3.5 Hrs	% Arriving in Less Than or Equal to 6 Hrs Ischemic	% Arriving in Less Than or Equal to 12 Hrs All Strokes
BC	40%	47%	65%
AB	38%	48%	63%
SK	28%	39%	61%
MB*	20%	29%	51%
ON	32%	42%	60%
QC	36%	45%	60%
NB	34%	42%	57%
NS	35%	43%	59%
PE	30%	43%	62%
NL	37%	52%	66%
National	34%	44%	61%

Table 5. Audit Patients Who Receive a CT or MRI Scan Within Specific Timeframes by Province, Canada 2008/2009

	Received Scan Within 1 Hour of Arrival	Received Scan Within 24 Hours of Arrival	Received Scan before Hospital Discharge
BC	20%	63%	96%
AB	32%	79%	98%
SK	16%	40%	91%
MB*	20%	61%	98%
ON	25%	75%	98%
QC	18%	66%	98%
NB	17%	56%	96%
NS	28%	76%	97%
PE	14%	68%	90%
NL	13%	61%	95%
National	22%	69%	97%

The Quality of Stroke Care in Canada

Table 6. Audit Patients with Ischemic Stroke Receiving tPA by Province, Canada 2008/2009

	% of Patients with Ischemic Stroke Receiving tPA
BC	9%
AB	12%
SK	10%
MB*	11%
ON	8%
QC	11%
NB	3%
NS	8%
PE	5%
NL	8%
National	8%

Table 7. Audit Patients with Stroke Admitted to a Stroke Unit, Canada 2008/2009

	% of Patients Admitted to a Stroke Unit
BC	4%
AB	52%
SK	17%
MB*	0.1%
ON	31%
QC	10%
NB	42%
NS	40%
PE	0.5%
NL	10%
National	23%

The Quality of Stroke Care in Canada

Table 8. Audit Patients Discharged from Acute Care to Various Destinations by Province, Canada 2008/2009

	Acute	Complex Continuing Care	Home	Long Term Care	Rehabilitation Facility	Retirement Home	Other
BC	10%	0%	67%	13%	8%	1%	1%
AB	8%	0%	64%	9%	13%	4%	2%
SK	19%	1%	51%	12%	16%	2%	1%
MB*	2%	11%	57%	4%	24%	1%	1%
ON	6%	2%	52%	9%	27%	2%	1%
QC	6%	0%	60%	12%	17%	4%	1%
NB	4%	1%	72%	11%	10%	3%	0%
NS	11%	1%	63%	8%	16%	1%	0%
PE	3%	0%	66%	13%	16%	2%	0%
NL	6%	0%	70%	9%	13%	1%	1%
National	7%	2%	58%	10%	19%	2%	1%

The Quality of Stroke Care in Canada

Appendix B: ECONOMIC ANALYSIS

Stroke is the result of either a disruption in blood supply to the brain (ischemic stroke) or bleeding into the brain due to a ruptured blood vessel (hemorrhagic stroke). Permanent brain damage is often a consequence, and death within a year occurs in over one-third of hospitalized stroke patients. A transient ischemic attack (TIA) is a short-term reduction in the flow of blood to the brain. While most TIAs do not cause permanent brain damage and the symptoms that are experienced may pass quickly, a person who has had a TIA is at an increased risk of having another TIA or a full stroke. Both stroke and TIA are included under the term acute cerebrovascular syndrome (ACVS).

Because of the significant economic and health burden of stroke, initiatives to reduce the incidence of stroke and to improve care for stroke patients have become a priority in many jurisdictions around the world. It is well-recognized that any attempt to optimize stroke management and care should include a focus on the entire care pathway. The Canadian Stroke Strategy (CSS), for example, has outlined initiatives for developing and improving the ACVS care pathway, including the enhancement of key individual components along the continuum of care.

The purpose of this document is to assess key components along the care pathway with a view to estimating the potential for cost-avoidance in Canada if services are provided in a comprehensive and optimal fashion.

Current Stroke Care in Canada

Estimating the potential for cost-avoidance in Canada if services are provided in a comprehensive and optimal fashion requires an understanding of the current state of stroke care in the country. Data from a number of sources were utilized to paint this picture, including:

- Five years (2004/05 to 2008/09) of summary data provided by the Canadian Institute of Health Information (CIHI) for every province with the exception of Quebec.
- Canadian Stroke Network audit data for 2008/09 accessed from 295 hospitals across Canada representing 89% of all stroke hospitalizations.
- 2002/03 to 2008/09 data from the province of British Columbia ACVS Registry.
- In the absence of available data from the above sources, evidence from the literature or expert opinion was garnered to estimate certain aspects of the current state of stroke care in Canada.

The “current state” served as the starting point for the cost-avoidance model. Results are summarized in the table below.

	Current Status of Stroke Care in Canada		
	Type of Stroke		
	Ischemic	Hemorrhagic	Combined
Hospitalized Stroke Cases	26,275	5,806	32,081
Acute Care Days	520,840	118,613	639,453
Total Residential Care Days	3,801,199	663,027	4,464,226
Deaths in Hospital	4,782	2,329	7,111
Quality-Adjusted Life Years Lost	214,018	72,171	286,188

The Quality of Stroke Care in Canada

Each year there are an estimated 32,081 hospitalizations for stroke care, 28,345 for incident stroke, 493 for readmissions, and 3,243 for recurrence. This cohort of stroke patients is associated with the use of over 639,000 acute care days and almost 4.5 million residential care days. In addition to this use of direct health care resources, the cohort is associated with 7,111 deaths in hospital and approximately 286,000 quality-adjusted life years (QALYs) lost.

Opportunities for Cost Avoidance

Opportunities for optimizing stroke care in the country, and thus the potential for cost avoidance, will be assessed for four major areas as outlined below. A summary table of the annual benefits of optimal stroke care in each of these areas is included at the end of this section.

TIA Rapid Assessment Clinics

Ensuring that a patient with a TIA is diagnosed and treated as quickly as possible is a key step in reducing the risk of converting from a TIA to a full stroke. Due to the high incidence of stroke following a TIA, there can be a substantial economic burden related to TIA that reflects both hospitalization and inpatient rehabilitation rates.

In the model, the following assumptions were made:

- 10% of the estimated 38,034 incident TIA/non-hospitalized stroke cases in Canada annually are receiving optimal care (assessment and treatment within 72 hours of symptom onset). That is, 27,384 patients are **not** receiving optimal care.
- The annual conversion rate from TIA/non-hospitalized stroke to hospitalized stroke could be reduced by 70%.
- 80% of the 27,384 patients would eventually receive optimal care.

Overall, the result of providing optimal care in this area would mean 899 fewer hospitalizations for stroke, 17,821 fewer acute care days, and 130,063 fewer residential care days, resulting in an annual direct cost-avoidance of \$45.2 million. In addition, 164 premature deaths would be avoided each year with 7,323 quality-adjusted life years saved, resulting in an annual indirect cost-avoidance of \$309.6 million.

Thrombolysis for Acute Ischemic Stroke

Prompt treatment of stroke with thrombolytic therapy can restore blood flow before major damage occurs. One such therapy, recombinant tissue plasminogen activator (tPA) thrombolysis, is only effective within 4.5 hours of stroke onset. The strict inclusion/exclusion criteria and delays in arriving at an Emergency Department mean that few patients actually receive tPA. Increasing the use of this therapy among eligible patients may be achieved by implementing Telestroke, and ensuring early arrival of the patient at the emergency department followed by an accurate and timely diagnosis.

In modeling the effect of optimal care in this area, the following assumptions were made:

- Optimal care in this area would be achieved if the proportion of incident ischemic stroke patients receiving tPA reached 10% (from the current 7.4%).
- Patients given tPA would, on average, have a 12.3% shorter ALOS in hospital.
- 11 out of every 100 (11%) patients given tPA would benefit.
- The patients who benefit from tPA would have a 50% reduced risk of re-admission or recurrence.
- Of the 11 patients who benefited, five would have had an mRS score of 3 and six an mRS score of 4. All of the patients with an mRS score of 4 and 50% of patients with an mRS score of 3 would have required residential care.
- All patients who benefit from tPA would be discharged home.

The Quality of Stroke Care in Canada

Overall, the result of providing optimal care in this area would mean 163 fewer hospitalizations, 4,351 fewer acute care days, and 43,902 fewer residential care days, resulting in an annual direct cost-avoidance of \$13.6 million. In addition, 46 premature deaths would be avoided each year. Given that patients who benefit from tPA would move into the minor stroke category with an improved quality of life, there would be a net increase of 122 quality-adjusted life years, resulting in an annual indirect cost of \$5.2 million.

Comprehensive Stroke Units

A comprehensive stroke unit is a multi-disciplinary, specialized hospital unit dedicated to stroke care and management. Navigation of the stroke care system is best accomplished when a care pathway is in place for the patient, directing the patient's treatment within and between the various stages of the stroke care continuum. Research comparing organized stroke unit care to care provided in a general medical unit has uniformly pointed to the effectiveness of stroke units; care in an organized stroke unit has been associated with a significant reduction in death, institutional care, dependency, and shorter length of stay.

In Canada, an estimated 23% of stroke patients receive care in a stroke unit.

In modeling the effect of optimal care in this area, the following assumptions were made:

- There would be a 20.7% reduction in acute care ALOS.
- There would be a 15% reduction in death.
- There would be a 5% reduction in institutional care.
- The 20% reduction in death and dependency reflects patients that would instead be discharged home.
- A maximum of 80% of stroke patients would be treated in a comprehensive stroke unit.

Overall, the result of providing optimal care in this area in the country would mean 79,000 fewer acute care days and 132,000 fewer residential care days resulting in an annual direct cost-avoidance of \$117.7 million. In addition, 638 premature deaths would be avoided each year with 2,341 quality-adjusted life years saved, resulting in an annual indirect cost-avoidance of \$99 million.

Early Home-supported Discharge

Patients with a mild-to-moderate stroke can be discharged from hospital early provided that appropriate supports are available in the home. On average, patients in an early supported discharge (ESD) program have a shorter length of hospital stay, and such a program is associated with reduced death or institutionalization and reduced death or dependency.

In modeling the effect of optimal care in this area, the following assumptions were made:

- That 3% of hospitalized stroke patients are currently receiving ESD in Canada (there are currently programs in Calgary, Winnipeg and parts of Ontario).
- That 37% of hospitalized stroke patients would be eligible to receive ESD.
- For patients receiving ESD, there would be a 26.7% reduction in acute care ALOS, a 10% reduction in death, and a 16% reduction in institutional care.
- The 26% reduction in death and dependency reflects patients that would instead be discharged home.

Overall, the result of providing optimal care in this area in the country would mean almost 65,000 fewer acute care days and 226,000 fewer residential care days resulting in an annual direct cost-avoidance of \$125.9 million. In addition, 213 premature deaths would be avoided each year with 782 quality-adjusted life years saved, resulting in an annual indirect cost-avoidance of \$33.1 million.

The Quality of Stroke Care in Canada

Summary of Annual Benefits

The benefits estimated for the four focal areas of improvement along the stroke care continuum are summarized in the following tables. The combined result of providing optimal care in these four areas in the country would mean approximately 166,000 fewer acute care days and 532,000 fewer residential care days, with an estimated annual direct cost-avoidance of approximately \$302 million (see following table). The estimated change in utilization of acute and residential care reflects a reduction of 432 and 1,444 beds, respectively.⁴¹

The estimated annual **direct costs** avoided associated with acute and residential care services, if optimal care is implemented throughout the country, are substantial. **Indirect costs** avoided, however, are also considerable. Not only would there be 1,061 fewer premature deaths in the country each year, but optimal care is associated with over 10,324 quality-adjusted life years saved. The quality-adjusted life years saved are associated with the early deaths avoided in stroke patients, the shorter life expectancy generally if an individual has a stroke, and the reduction in quality of life for stroke survivors. The associated annual indirect cost-avoidance is estimated at approximately \$436 million.

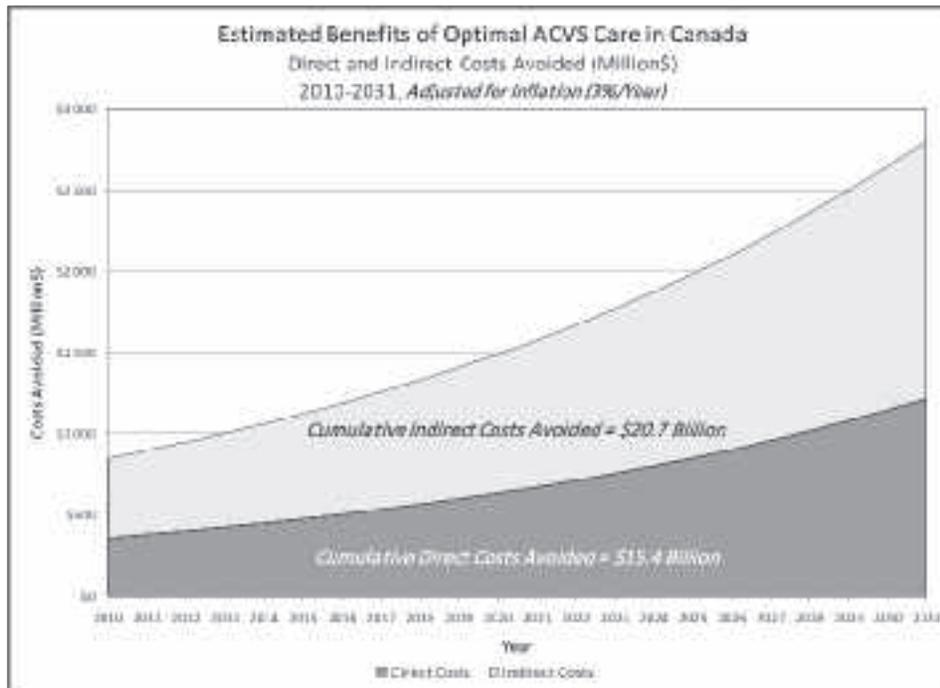
Estimated Annual Benefits of Optimal ACVS Care in Canada					
By Area of Focus					
	TIA Rapid Assessment & Treatment (1)	Increased Utilization of tPA (2)	Stroke Unit (3)	Early Supported Discharge (4)	Total
Hospitalized Stroke Cases	(899)	(163)	0	0	(1,062)
Acute Care Days	(17,821)	(4,351)	(78,711)	(64,993)	(165,876)
Acute Care Costs (\$million)	(\$17.45)	(\$4.26)	(\$89.58)	(\$77.76)	(\$189.04)
Residential Care Days	(130,063)	(43,902)	(132,140)	(226,202)	(532,307)
Residential Care Costs (\$million)	(\$27.70)	(\$9.35)	(\$28.15)	(\$48.18)	(\$113.38)
Direct Costs (\$million)	(\$45.15)	(\$13.61)	(\$117.73)	(\$125.94)	(\$302.42)
Deaths in Hospital	(164)	(46)	(638)	(213)	(1,061)
QALYs Lost	(7,323)	122	(2,341)	(782)	(10,324)
Indirect Costs (\$million)	(\$309.57)	\$5.17	(\$98.98)	(\$33.05)	(\$436.44)
<i>Percent of Total</i>					
Hospitalized Stroke Cases	84.7%	15.3%	0.0%	0.0%	100.0%
Acute Care Days	10.7%	2.6%	47.5%	39.2%	100.0%
Residential Care Days	24.4%	8.2%	24.8%	42.5%	100.0%
Direct Costs	14.9%	4.5%	38.9%	41.6%	100.0%
Deaths in Hospital	15.4%	4.4%	60.1%	20.1%	100.0%
Life Years Lost	70.9%	-1.2%	22.7%	7.6%	100.0%
Indirect Costs	70.9%	-1.2%	22.7%	7.6%	100.0%
<i>Notes on Key Assumptions</i>					
(1) 80% of patients not receiving optimal care will ultimately receive optimal care.					
(2) tPA utilization will increase from 7.40% of hospitalized ischemic stroke patients in 2008/09 to 10%.					
(3) 80% of patients not receiving optimal care will ultimately receive optimal care.					
(4) 37% of patients will ultimately receive optimal care.					

⁴¹ The potential reduction in beds was calculated assuming a 95% occupancy rate for acute care beds and a 99% occupancy rate for residential care beds.

The Quality of Stroke Care in Canada

Estimated Annual Benefits of Optimal ACVS Care In Canada				
	Current State	Optimal Care	Variance	% Var
Hospitalized Incident Stroke	28,345	27,551	(794)	-2.8%
Readmissions	493	458	(35)	-7.2%
Recurrent Stroke Admissions	3,243	3,011	(232)	-7.2%
Average Length of Hospital Stay	19.93	15.27	(4.67)	-23.4%
Total Acute Care Days	639,453	473,577	(165,876)	-25.9%
Discharges Home	12,228	13,389	1,161	9.5%
% Discharged Home	38.1%	43.2%	5.0%	13.2%
Total Deaths in Hospital	7,111	6,050	(1,061)	-14.9%
% Deaths in Hospital	22.5%	19.8%	-2.7%	-12.1%
Discharges to Residential Care Facility	8,404	7,398	(1,006)	-12.0%
% Discharges to Residential Care Facility	26.2%	23.8%	-2.3%	-9.0%
Total Residential Care Days	4,464,226	3,931,919	(532,307)	-11.9%
Quality Adjusted Life Years Lost	286,188	275,864	(10,324)	-3.6%
Direct Care Costs (\$million)				
Acute Care	\$724.24	\$535.19	(\$189.04)	-26.1%
Residential Care	\$950.88	\$837.50	(\$113.38)	-11.9%
Indirect Costs (\$million)				
	\$12,098.61	\$11,662.17	(\$436.44)	-3.6%

Cumulative Benefits between 2010 and 2031



The Quality of Stroke Care in Canada

Between 2010 and 2031, the implementation of optimal stroke care across Canada would mean 6.2 million fewer acute care days and 18.2 million fewer residential care days, with an estimated cumulative direct care cost-avoidance of approximately \$10.7 billion (in 2010 constant \$).

In addition to 37,000 fewer premature deaths in the country, optimal stroke care between 2010 and 2031 is also associated with 341,000 quality-adjusted life years saved. The associated cumulative indirect cost-avoidance is estimated at approximately \$14.4 billion.

Total cumulative costs avoided between 2010 and 2031 are an estimated \$25.2 billion.

If future costs avoided are adjusted for inflation at an annual rate of 3%, then the total cumulative costs avoided between 2010 and 2031 would increase to \$36.1 billion (\$15.4 billion in direct costs avoided and \$20.7 billion in indirect costs avoided).

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GLOSSARY

Anticoagulant

A medication that stops blood from clotting. Heparin and warfarin are examples of anticoagulants. Newer medications that do not require blood testing and dose adjustments are also now available.

Antiplatelet

A drug that interfere with the blood's ability to clot. Aspirin is an example of an antiplatelet.

Antithrombotic

Anticoagulants and antiplatelets are two classes of antithrombotics, preventing the formation of blood clots.

Atrial fibrillation

Rapid, irregular beating of the heart that greatly increases the chance of a stroke.

Canadian Best Practice Recommendations for Stroke Care

Guidelines for optimal care of stroke patients. Produced by an expert panel in 2006, updated in 2008 and 2010 and made available at www.strokebestpractices.ca

CSN

Canadian Stroke Network, a national research network headquartered at the University of Ottawa.

Carotid Endarterectomy

Surgical opening in one of the main neck arteries (the carotid arteries) that is performed when the artery is partially blocked by plaque. The procedure helps prevent a first ischemic stroke or reduces the risk of recurrent ischemic strokes.

CT

Computerized tomography is a method of scanning the brains of people suspected of having strokes.

Dysphagia

Difficulty in swallowing or inability to swallow.

Early Supported Discharge

Early supported discharge services aim to shorten hospital stay, as well as to provide a more continuous process of rehabilitation spanning both the period in hospital and the first few weeks at home. In these two ways, early supported discharge alters the conventional pathway of care to ensure more amenable services for patients undertaking rehabilitation.

Emergency Department

A hospital or primary care department that provides initial treatment to patients with a broad spectrum of illnesses and injuries, some of which may be life-threatening and require immediate attention.

Emergency Medical Services

The most common and recognized type of emergency medical service is an ambulance or paramedic organization.

FIM™

The FIM score is a measurement of level of disability following a stroke. Scores range from 1 (total assistance required) to 7 (complete independence). Scores below 6 indicate that an individual requires another person for supervision or assistance.

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Hemorrhagic Stroke

Includes two different entities:

- 1) **Intracerebral Hemorrhage (ICH)**: A stroke caused by the rupture of a small artery within the brain, usually associated with hypertension.
- 2) **Subarachnoid Hemorrhage (SAH)**: A stroke caused by the rupture of an artery around the brain but within the skull.

Hypertension

High blood pressure, defined as a repeatedly elevated blood pressure exceeding 140/90 mm Hg. Hypertension is the most important modifiable risk factor for stroke or transient ischemic attack.

Ischemic stroke

A stroke caused by the interruption or blockage of the blood flow to one part of the brain.

Length of Stay

A measure of the duration of a single hospitalization.

Median

The median is the middle point of a data set; half of the values are below this point, and half are above this point.

MRI

Magnetic resonance imaging is a non-invasive method of imaging the brain in stroke patients.

Recovery

The process whereby the person regains body function, activity and participation. (Not time limited)

Rehabilitation

Restoration of optimal physical and psychological functional ability.

Residential Care

A living arrangement in which people with special needs reside in a facility that provides help with everyday tasks.

Risk Factor

A characteristic of a person (or group of people) that is positively associated with a particular disease or condition

Secondary Prevention

Measures to prevent the recurrence of the same illness.

Stroke Centre

For the purposes of the audit, a Stroke Centre is defined as a hospital that offers brain scanning (MRI or CT scans), administers thrombolysis (tPA) and provides care to stroke patients in a dedicated stroke unit.

Stroke Unit

A specialized hospital unit geographically defined with a dedicated stroke team and stroke resources (e.g., care pathway, educational material, monitored beds).

The Quality of Stroke Care in Canada

Stroke Prevention Clinic

A clinic providing comprehensive stroke prevention services to patients who are not admitted to the hospital at the time of their emergency department visit or who require follow-up after their discharge from hospital.

Telestroke

Use of electronic communication to exchange medical information from one site to another to educate the patient or the healthcare provider and to improve patient care.

Thrombolysis

Refers to the process where a drug (tPA for example) is used to break up a blood clot.

TIA

Transient Ischemic Attack, often called a mini-stroke, occurs when blood supply to one part of the brain is temporarily interrupted. Symptoms are transitory and the individual does not suffer from any longstanding deficit.

tPA

Tissue plasminogen activator, a drug that breaks up clots when administered to eligible patients following an ischemic stroke. An intravenous drug, tPA can help reverse stroke damage if administered within 4.5 hours of the onset of stroke symptoms.