



# BC Stroke Strategy

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## Evaluation of TIA Rapid Assessment Clinics

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Ministry  
of Health



PARTNERS IN  
RECOVERY



Stroke Recovery  
Association of  
British Columbia

## TABLE OF CONTENTS

<b>1.0</b>	<b>BACKGROUND</b> .....	<b>1</b>
1.1	Definition .....	1
1.2	The Need for a Rapid Response .....	1
1.3	The Benefits of a Rapid Response .....	2
1.4	TIA / Non-hospitalized Stroke in B.C. ....	3
1.5	Conversion Rates in B.C.....	5
<b>2.0</b>	<b>EVALUATION</b> .....	<b>6</b>
2.1	Introduction .....	6
2.2	Evaluation Methods.....	7
2.3	Evaluation Results .....	7
	Quantitative.....	7
	Qualitative – Key Issues Raised .....	10
2.4	A Focus on the South Vancouver Island Clinic.....	11
<b>3.0</b>	<b>CONCLUSION</b> .....	<b>13</b>
<b>4.0</b>	<b>APPENDICES</b> .....	<b>14</b>
4.1	Codes Used in the ACVS Registry .....	14
4.2	Statistical Modeling - Trend Analyses for Conversion Proportions.....	15

## 1.0 BACKGROUND

### 1.1 Definition

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). A transient ischemic attack (TIA) is a short-term reduction in the flow of blood to the brain. Most last less than 10 minutes, but they can last as long as 24 hours. Most TIAs do not cause permanent brain damage, and the symptoms may only last a short time, but a person who has experienced a TIA is at an increased risk of having another TIA or a full stroke.

### 1.2 The Need for a Rapid Response

A rapid response to TIA assessment and interventions has emerged as the international gold standard since an Oxford-based study group led by Rothwell demonstrated the potential for an 80% reduction in the rates of “conversion” from TIA to early stroke (in the EXPRESS study).<sup>1</sup> A summary of the results of their study are included in the following table.

Risk of Recurrent Stroke During the 90 Days After First Seeking Medical Attention for a TIA / Minor Stroke							
	Study Population		Recurrent Stroke		% Recurrence		p-value
	Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2	
<b>Outpatient Care (predominantly the Express Clinic)</b>							
Presented with TIA	165	172	16	1	9.70%	0.58%	0.0001
Presented with Stroke	158	125	17	5	10.76%	4.00%	0.037
Total	323	297	33	6	10.22%	2.02%	<0.0001
<b>All Other (predominantly Hospital-based care)</b>							
Presented with TIA	68	80	13	10	19.12%	12.50%	NS
Presented with Stroke	243	267	17	11	7.00%	4.12%	NS
Total	311	347	30	21	9.65%	6.05%	NS
<b>Total</b>							
Presented with TIA	233	252	29	11	12.45%	4.37%	0.0015
Presented with Stroke	401	392	34	16	8.48%	4.08%	0.0077
Total	634	644	63	27	9.94%	4.19%	<0.0001

Table modified based on Table 3 in Rothwell et al. *Lancet*, 2007

In Phase 1 of their study (without a rapid response), 10.2% of patients who sought medical attention for a TIA/minor stroke had a “recurrent stroke”. This decreased to 2.0% in Phase 2 with rapid assessment and treatment. A “recurrent stroke” was defined by the authors as “any new acute neurological event with symptoms lasting >24 hours occurring after the initial ictus of the incident stroke (i.e., definite acute worsening of an established nonprogressive deficit) that was not attributable to edema, brain shift, haemorrhagic transformation, intercurrent illness, hypoxia, or drug toxicity. Sudden worsening was required for consideration as a potential

<sup>1</sup> Rothwell PM, Giles MF, Chandratheva A et al. Effect of urgent treatment of transient ischaemic attack and minor stroke on early recurrent stroke (EXPRESS study): a prospective population-based sequential comparison. *Lancet*. 2007; 370(9596): 1432-42.

recurrent event, and gradual progression of an acute deficit was excluded.”<sup>2</sup> In an effort to capture all recurrent stroke events, patients were contacted at 1, 6, 12, and 24 months post-clinic visit by a research nurse. Patients with a suspected recurrent stroke event were assessed by a neurologist. The results of this initial assessment were confirmed by an independent neurologist blinded to the phase of the study.

A key variable in the EXPRESS study is the time between the first clinical signs of the TIA and the assessment of the condition and initiation of treatment. If the delay between the TIA and initiation of treatment is more than 48-72 hours, the 90-day risk of recurrent stroke increases from 2.0% (with minimal delay) to 10.2% (with a longer delay). The 90-day risk of recurrent stroke of 10.2% with a delayed response to TIA is similar to that of patients that are not seen at all in a clinic. This suggests that not only does a patient with a TIA need to be seen in a rapid assessment clinic, but that this must occur shortly after the first signs of the TIA; furthermore, there must be an immediate treatment response once the assessment of TIA has been confirmed.

The 2008 Canadian Best Practices for Stroke Care included a new recommendation for the acute management of TIAs, stating that “patients who present with symptoms suggestive of minor stroke or [TIA] must undergo a comprehensive evaluation to confirm the diagnosis and begin treatment to reduce the risk of major stroke as soon as is appropriate to the clinical situation”.<sup>3</sup> Guidelines for diagnostic and treatment procedures for patients with suspected TIAs are outlined; these include brain imaging, blood tests, assessment for functional impairment, and antiplatelet therapy. Another important aspect of TIA patient management involves addressing risk factors for cerebrovascular disease, such as blood pressure, cholesterol, and smoking, through both pharmacologic and non-pharmacologic means.

### 1.3 The Benefits of a Rapid Response

The key benefit of a rapid response is the 80% reduction in the rate of “conversion” from TIA to early stroke as noted by Rothwell and colleagues.

As noted earlier, the Rothwell study contacted patients in an effort to capture all recurrent strokes, not just those recurrent strokes severe enough to be hospitalized. This is a key difference from what we are able to observe from the B.C. ACVS Registry. It is impossible to apply the definition of recurrence used in the Rothwell study to the B.C. population based on information in the ACVS Registry. We have thus used another term (“conversion”) to identify incident TIA/minor (non-hospitalised) stroke patients who are subsequently hospitalized for a stroke. This approach underestimates the true early “recurrence” (as defined by Rothwell et al.) by missing patients who experience a recurrent stroke but are not hospitalized. While the current approach is an underestimate of early recurrence, the identification and tracking of

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<sup>2</sup> Coull AJ, Rothwell PM, Giles MF, Chandratheva A et al. Effect of urgent treatment of transient ischaemic attack and minor stroke on early recurrent stroke (EXPRESS study): a prospective population-based sequential comparison. *Lancet*. 2007; 370(9596): 1432-42.

<sup>3</sup> Lindsay P, Bayley M, Hellings C et al. Canadian best practice recommendations for stroke care (updated 2008). *Canadian Medical Association Journal*. 2008; 179(12): S1-S25.

patients whose “recurrence” or “conversion” is severe enough to require hospitalization would, from a resource use perspective, capture the majority of costs associated with treating this population. In the same manner, changes in the “conversion” rate associated with optimal care would capture the majority of costs avoided.

Due to the high incidence of stroke following a TIA, there can be a substantial economic benefit associated with a reduction in both hospitalization and inpatient rehabilitation rates.<sup>4</sup> This is one of the factors that contribute to the favourable cost-effectiveness analysis of interventions applied in TIA clinics, including aspirin and antiplatelet therapy.<sup>5</sup>

Most critically, effective response to TIA can lead to fewer days in hospital and thus reduced direct medical costs, an outcome that has been confirmed in a follow-up analysis based on the EXPRESS study.<sup>6,7</sup> An estimated £624 (\$1,090 in Cdn\$) per patient is saved by timely referral to a TIA clinic with a concomitant aggressive intervention, as indicated by Phase 2 results in the following table:

Total Days in Hospital and Total Costs per Patient For Admissions for TIA, Stroke or Other Vascular Disease			
	Phase 1	Phase 2	Difference
Number of Patients	310	281	
Total Days in Hospital	1365	427	(938)
Total Cost	£327,474	£121,506	-£205,968
Days in Hospital / Patient	4.40	1.52	(2.88)
<b>Cost / Patient</b>	<b>£1,056</b>	<b>£432</b>	<b>-£624</b>
<b>Can \$ Equivalent</b>	<b>\$1,845</b>	<b>\$755</b>	<b>-\$1,090</b>

Source: Luengo-Fernandez, et al. *Lancet Neurology*, 2009

## 1.4 TIA / Non-hospitalized Stroke in B.C.

In B.C., all patients who are hospitalized and assigned one of the relevant Acute Cerebrovascular Syndrome (ACVS) codes (see Appendix 4.1), or have two Medical Service Plan (MSP) visits on different days within a moving 30-day period with the relevant codes, are included in the ACVS Registry. All patients in the Registry are then grouped into one of the following four categories:

1. Hospitalized ischemic stroke
2. Hospitalized hemorrhagic stroke
3. Hospitalized TIA

<sup>4</sup> Kessler C, Thomas KE. An examination of economic outcomes associated with misdiagnosis or undertreatment of TIA. *American Journal of Managed Care*. 2009; 15(6 Suppl): S170-6.

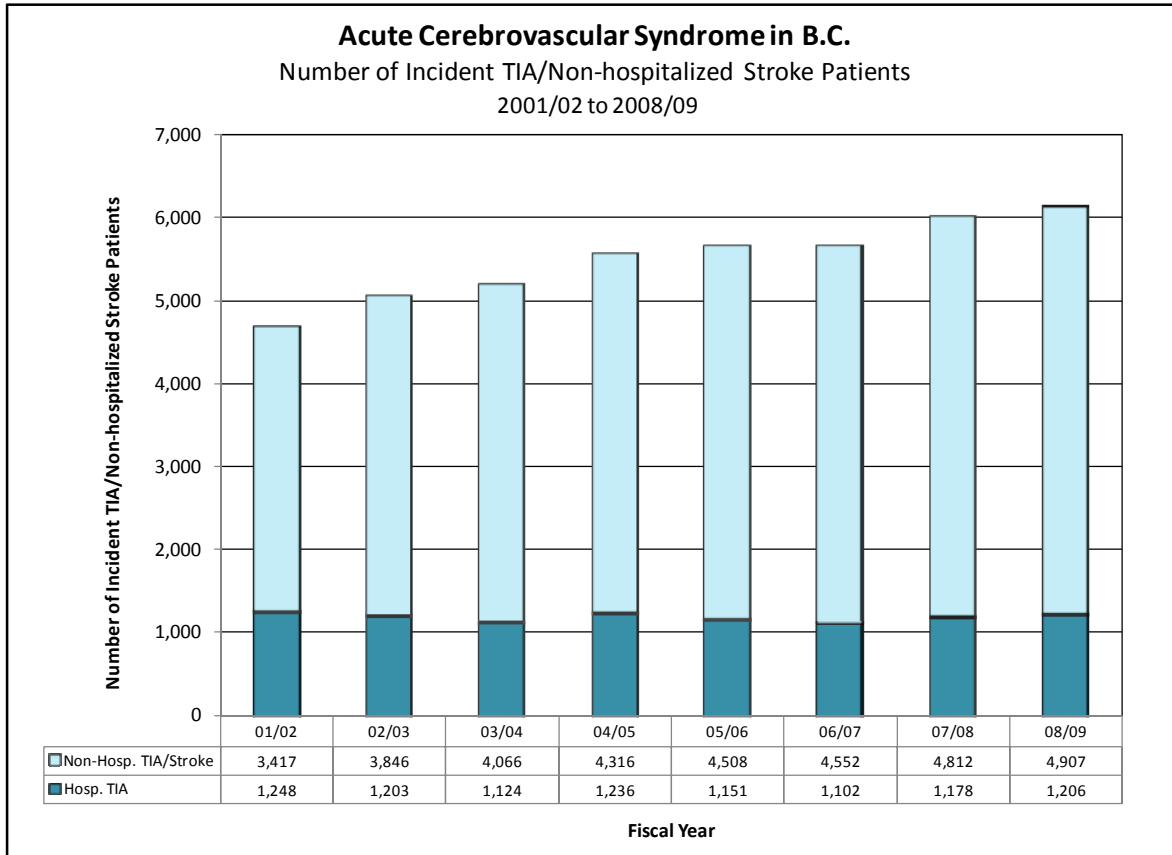
<sup>5</sup> Dunn JD. Managed care considerations. *American Journal of Managed Care*. 2008; 14(6 Suppl 2): S227-37.

<sup>6</sup> Luengo-Fernandez R, Gray AM, Rothwell PM. Effect of urgent treatment for transient ischaemic attack and minor stroke on disability and hospital costs (EXPRESS study): a prospective population-based sequential comparison. *Lancet Neurology*. 2009; 8(3): 235-43.

<sup>7</sup> Jackson D, Moshinsky J, Begg AJ. Addressing shortfalls in TIA care in the UK: an economic perspective. *Journal of Medical Economics*. 2009; 12(4): 331-8.

#### 4. Non-hospitalized TIA/ stroke

The following figure indicates that the number of diagnosed incident TIA/Non-hospitalized stroke patients in B.C. has increased from 4,665 in 2001/02 to 6,113 in 2008/09. This is arguably the cohort of patients who would benefit the most from access to a TIA Rapid Assessment Clinic.



## 1.5 Conversion Rates in B.C.

As noted earlier, a key goal of rapid response and treatment following a TIA or minor stroke is to reduce the proportion of individuals who convert to a full stroke. In the ACVS Registry, conversion rates are calculated based on moving from the TIA/non-hospitalized stroke category to either the hospitalized ischemic or hospitalized hemorrhagic stroke categories. In B.C., conversion rates within 90 days of a TIA/non-hospitalized stroke have declined from 3.79% in 2001/02 to 2.27% in 2007/08. Conversion rates within one year (365 days) have declined from 5.77% to 3.86% during that same time frame (see following table).

<b>Acute Cerebrovascular Syndrome in British Columbia</b>						
<b>Conversion from TIA/Non-hospitalized Stroke to Hospitalized Stroke</b>						
	<b>Incident TIA/Non-hospitalized Stroke</b>		<i>Within 90 Days</i>		<i>Within 365 Days</i>	
	<b>#</b>	<b>% Increase</b>	<b>#</b>	<b>Rate</b>	<b>#</b>	<b>Rate</b>
2001/02	4,665		177	3.79%	269	5.77%
2002/03	5,049	8.2%	137	2.71%	209	4.14%
2003/04	5,190	2.8%	125	2.41%	212	4.08%
2004/05	5,552	7.0%	152	2.74%	234	4.21%
2005/06	5,659	1.9%	166	2.93%	258	4.56%
2006/07	5,654	-0.1%	151	2.67%	228	4.03%
2007/08	5,990	5.9%	136	2.27%	231	3.86%
2008/09	6,113	2.1%				

## 2.0 EVALUATION

### 2.1 Introduction

In 2008/09, the BC Stroke Strategy provided funding of \$607,000 to the health authorities to enhance and expand TIA rapid assessment services in the province (see following table). This was followed by a further \$574,000 in 2009/10 and a projected \$750,000 in 2010/11.

<b>BCSS Funding For Expansion of TIA Rapid Assessment Services 2008/09 to 2010/11</b>					
<b>Health Authority</b>	<b>Actual</b>		<b>2-Year Total</b>	<b>Projected 2010/11</b>	<b>3-Year Total</b>
	<b>2008/09</b>	<b>2009/10</b>			
FHA	\$146,000	\$219,000	<b>\$365,000</b>	\$100,000	<b>\$465,000</b>
VCHA	\$89,736	\$89,735	<b>\$179,471</b>	\$230,000	<b>\$409,471</b>
VIHA	\$181,389	\$95,611	<b>\$277,000</b>	\$220,000	<b>\$497,000</b>
IHA	\$110,000	\$90,000	<b>\$200,000</b>	\$110,000	<b>\$310,000</b>
NHA	\$80,000	\$80,000	<b>\$160,000</b>	\$90,000	<b>\$250,000</b>
<b>Total</b>	<b>\$607,125</b>	<b>\$574,346</b>	<b>\$1,181,471</b>	<b>\$750,000</b>	<b>\$1,931,471</b>

Each Health Authority used this funding to adapt an implementation process based on available resources, particularly access to Neurologists. Ongoing planning and implementation occurred in the context of a team consisting of membership from all Health Authorities guided by a Neurologist. All Health Authorities developed standard algorithms, protocols, information sheets and worked to increase GP referrals from the community. The following 3 models emerged, with several variations.

1. **The Clinic Model** - Suspected TIAs/minor strokes are referred for Neurology follow-up from EDs or GPs to a stand-alone outpatient clinic. Clinics can take different approaches to diagnostic imaging, either requiring it prior to the visit or having it done as part of the clinic visit. The Fraser Health Authority established 3 such stand-alone clinics but utilized a central intake system and assigned the patient to the next available appointment, regardless of the patient's residence.
2. **The ED Work-Up Model** - In this model the patient is admitted to a 12-hour holding/observation area in the Emergency Department, diagnostic testing is ordered, and the Neurology consult occurs on-site before discharge. Any further follow-up is handled in a TIA clinic or in the Neurologist's office.
3. **The Triage Model** – This model is more prevalent in rural areas with limited access to a Neurologist. Standard protocols have been developed to guide a TIA/minor stroke follow-up process. Patients are identified in EDs or by GPs and referred to a central triage/navigator nurse who does the initial follow-up, confers with the patient and the available neurologist, orders tests, and sets up an appointment with the available Neurologist.

## 2.2 Evaluation Methods

Each 'clinic' in the province was asked to collect and submit the following information on a quarterly basis:

- # of new patient and follow-up visits
- # of new patients ultimately diagnosed with a TIA/minor stroke, allowing for the calculation of the mimic rate
- The patient's referral source (GP, ED or other)
- The mean time from the event to the first appointment
- The proportion of patients seen within 48 hours
- The mean time from referral to appointment

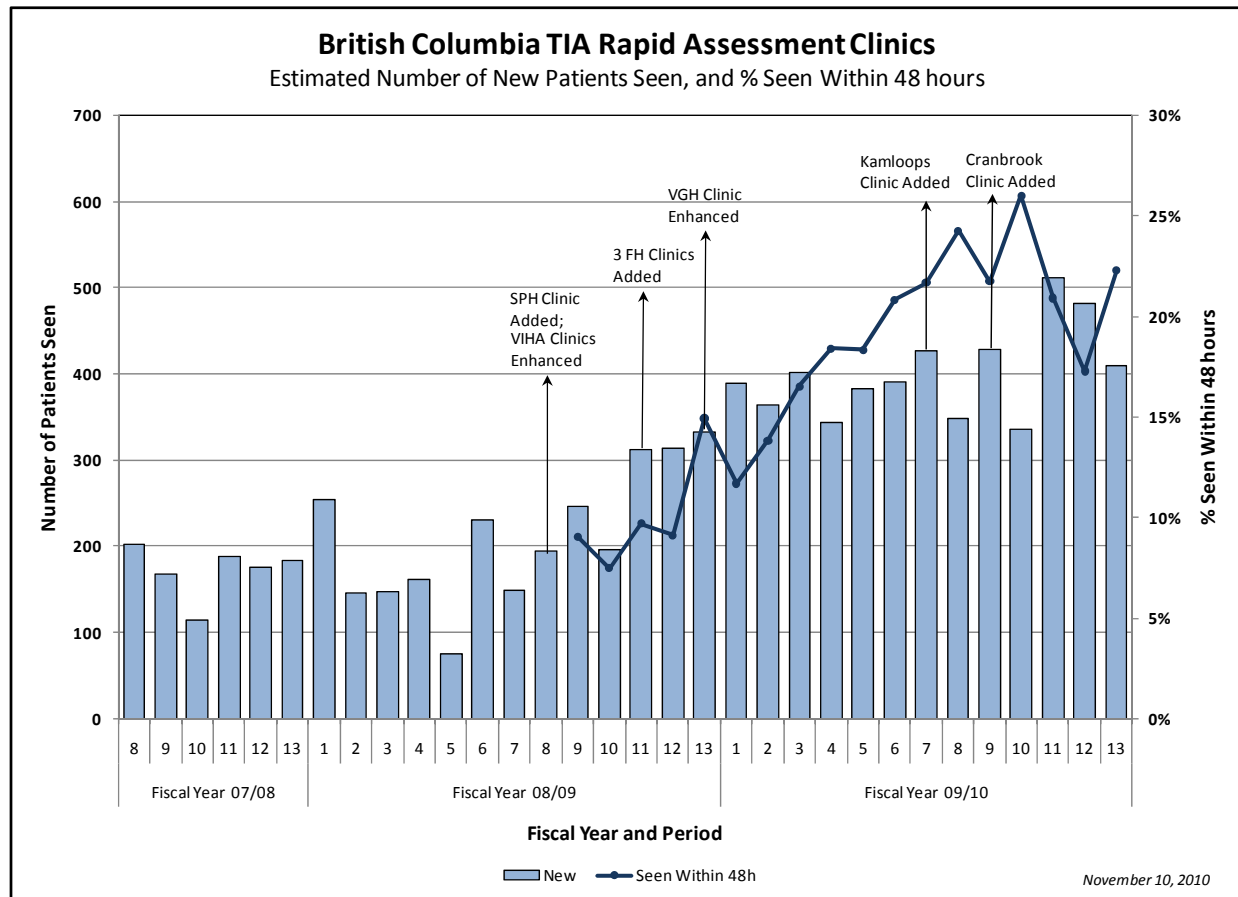
The focus of the quantitative evaluation is on the data submitted from 'clinics' for a number of reasons. First, a developmental delay in setting up access to these services in the more rural regions of the province has meant that appropriate data was not available for these services until recently (post- March 31, 2010). The establishment of the ED work-up model is also more recent with appropriate data not available as of March 31, 2010.

In addition, each health authority provided a qualitative assessment of progress and issues encountered, also on a quarterly basis.

## 2.3 Evaluation Results

### Quantitative

The additional funding provided by the BCSS resulted in a doubling of clinic capacity between 2007/08 and 2009/10, as indicated in the following figure. In 2007/08, less than 200 patients with a suspected TIA or minor stroke were being treated in British Columbia's TIA Rapid Assessment Clinics in each fiscal period. This increased to an average of over 400 per fiscal period by the end of 2009/10.



In addition, the proportion of new patients seen within 48 hours increased from less than 10% to approximately 20%.

Between 2008/09 and 2009/10, the number of new patients increased from 2,757 to 5,215 (by 89% or 2,458 patients), as seen in the following table. At the same time, the mimic rate decreased from 56% to 47%. Approximately 40% of patients were referred to the clinics by their physician or via the hospital emergency departments.

The overall time between the first signs of the TIA/minor stroke and the first clinic appointment decreased by 24% while the time between referral and first appointment decreased by 28%. The proportion of patients seen within 48 hours increased from 10.4% to 18.8% while the actual number of new patients seen within 48 hours increased from 281 in 2008/09 to 980 in 2009/10.

<b>TIA Rapid Assessment Clinics In British Columbia 2008/09 and 2009/10 Estimated</b>				
	<b>2008/09</b>	<b>2009/10</b>	<b>Variance</b>	<b>% Var</b>
<b>New Patients Seen</b>	2,757	5,215	2,458	89.2%
<b>TIA/Stroke Patients Seen</b>	1,211	2,749	1,538	127.0%
<b>Mimic Rate</b>	56.1%	47.3%	-8.8%	-15.7%
<b>Referral Source</b>				
GP/Specialist	43.8%	39.1%	-4.7%	-10.7%
Emergency Department	41.7%	42.9%	1.2%	2.8%
Other	18.0%	17.9%	0.0%	-0.1%
<b>Mean Wait Time</b>				
From Event to 1st Appointment (in days)	6.93	5.26	(1.67)	-24.1%
From Referral to 1st Appointment (in days)	6.15	4.44	(1.71)	-27.9%
# of Patients Seen Within 48 Hours	281	980	699	248.8%
% Seen Within 48 Hours	10.4%	18.8%	8.4%	80.3%

Information on results by Health Authority for 2009/10 is shown in the following table.

<b>TIA Rapid Assessment Clinics In British Columbia by Health Authority 2009/10 Estimated</b>					
	<b>VIHA</b>	<b>VCHA</b>	<b>FHA</b>	<b>IHA</b>	<b>BC Total</b>
<b>New Patients Seen</b>	1,589	2,118	1,364	144	5,215
<b>TIA/Stroke Patients Seen</b>	1,031	760	854	104	2,749
<b>Mimic Rate</b>	35.1%	64.1%	37.4%	27.8%	47.3%
<b>Referral Source</b>					
GP/Specialist	44.4%	44.6%	23.2%	47.9%	39.1%
Emergency Department	46.0%	19.9%	72.9%	47.2%	42.9%
Other	9.6%	35.6%	3.9%	4.9%	17.9%
<b>Mean Wait Time</b>					
From Event to 1st Appointment (in days)	4.77	6.28	4.40	3.72	5.26
From Referral to 1st Appointment (in days)	3.71	5.75	3.18	1.38	4.44
# of Patients Seen Within 48 Hours	373	191	349	67	980
% Seen Within 48 Hours	23.5%	9.9%	25.6%	46.8%	18.8%

*Note: Does not include data from LGH*

The mimic rate ranges from a low of 28% in Interior Health (IH) to a high of 64% in Vancouver Coastal Health (VCH). The higher mimic rate in VCH may be related to a broader spectrum of neurological patients seen at this established clinic.

The proportion of new patients seen within 48 hours also varies from 10% in VCH to 47% in IH.

Data from the ACVS Registry indicates that a total of 6,031 individuals in B.C. had an incident TIA/minor stroke in 2008/09 (the last year of available data; see following table). In 2009/10, a total of 2,749 patients with a confirmed TIA/minor stroke were treated in TIA Rapid Assessment

Clinics, or just under half of the 6,000+ individuals with an incident TIA/minor stroke. An estimated 584 of the 2,749 patients were treated within 48 hours of their symptom onset. These 584 patients would be receiving optimal care, or just 9.7% of the 6,000+ individuals in B.C. each year with an incident TIA/minor stroke.

<b>TIA/Non-Hospitalized Stroke and Rapid Assessment Clinics In British Columbia by Health Authority</b>						
	<b>VIHA</b>	<b>VCHA</b>	<b>FHA</b>	<b>IHA</b>	<b>NHA</b>	<b>BC Total</b>
<b>Incident TIA/Non-hospitalized Stroke in 2008/09</b>	1,401	1,268	1,889	1,162	237	6,031
<b>New Patients Seen in 2009/10</b>	1,589	2,118	1,364	144	NA	5,215
% Seen Within 48 Hours	23.5%	9.9%	25.6%	46.8%	NA	18.8%
# of Patients Seen Within 48 Hours	373	191	349	67	NA	980
<b>TIA/Stroke Patients Seen</b>	1,031	760	854	104	NA	2,749
% Seen Within 48 Hours	23.5%	9.9%	25.6%	46.8%	NA	21.3%
# of Patients Seen Within 48 Hours	242	75	219	49	NA	584
<b>Proportion of Patients Receiving Optimal Care</b>	17.3%	5.9%	11.6%	4.2%	NA	9.7%

### Qualitative – Key Issues Raised

- In the fall of 2009, Vancouver Island Health implemented a triage process at their South Island clinic. Early triage phone calls by the clinic RN appear to have made a significant difference in assisting with the triage process, reducing patient anxiety and reducing the mimic rate.
- Health Authorities identified the need to enhance data collection processes.
- Availability of appropriate specialist physician resources, especially in rural/remote regions of B.C., remains an ongoing challenge.
- A stroke lead in each Health Authority with a strong clinical background and excellent communication skills was considered a key success factor.
- The ongoing planning and expansion of TIA Rapid Assessment Services occurred in the context of a team consisting of membership from all Health Authorities guided by a Neurologist. The resulting cooperation between Health Authorities was seen as being highly valuable.
- The term 'exceeded expectations' appeared regularly in the qualitative reports from Northern and Interior Health.

## 2.4 A Focus on the South Vancouver Island Clinic

The Stroke Rapid Assessment Unit (SRAU) located at Victoria General Hospital has been in operation since 2004. This unit is most likely to provide services for individuals with a TIA/minor stroke living within the geographic boundaries of the South Vancouver Island Health Services Delivery Area (HSDA). Trend analysis based on information in the ACVS Registry indicates that the 90-day conversion rate has indeed decreased for individuals living within this HSDA and the change in trend appears to take place in 2004/05 (see following table). Prior to 2004/05, the 90-day conversion rate averaged 3.48%; this decreased to an average of 1.66% in the following years. The result is a reduction in the number of conversions (i.e. hospitalizations) within 90 days after an incident TIA/minor stroke from an annual average of 23 to an annual average of 11.

<b>Acute Cerebrovascular Syndrome</b>									
<b>Adults* Residing in Interior HA and South Vancouver Island HSDA</b>									
<b>2001/02 to 2008/09</b>									
Fiscal Year									
	<u>2001/02</u>	<u>2002/03</u>	<u>2003/04</u>	<u>2004/05</u>	<u>2005/06</u>	<u>2006/07</u>	<u>2007/08</u>	<u>2008/09</u>	
<i>Study Group (TIA Rapid Assessment &amp; Treatment Clinic Implemented in 2004)</i>									
<b>South Vancouver Island HSDA</b>									
Number of Incident Hospitalized Ischemic Stroke Patients	379	377	345	366	277	331	356	335	
Age-Standardized Incidence / 1,000 Population	0.847	0.832	0.728	0.769	0.567	0.641	0.680	0.642	
Conversion Rate from TIA/Non-hospitalized Stroke to Hospitalized Stroke									
Number of Incident TIA/Non-Hospitalized Stroke Patients	506	542	589	652	640	640	655	678	
Conversions to Hospitalized Stroke within 90 Days	24	14	19	11	13	8	11		
90-Day Conversion Rate	4.74%	2.58%	3.23%	1.69%	2.03%	1.25%	1.68%		
Conversions to Hospitalized Stroke within 365 Days	31	23	23	17	23	15	22		
Conversions to Hospitalized Stroke within 91-365 Days	7	9	4	6	10	7	11		
91-365-Day Conversion Rate	1.45%	1.70%	0.70%	0.94%	1.59%	1.11%	1.71%		
<i>Control Group (No Access to TIA Rapid Assessment &amp; Treatment Clinic)</i>									
<b>Interior Health Authority</b>									
Number of Incident Hospitalized Ischemic Stroke Patients	756	712	740	738	729	694	733	695	
Age-Standardized Incidence / 1,000 Population	0.994	0.911	0.912	0.885	0.849	0.781	0.788	0.732	
Conversion Rate from TIA/Non-hospitalized Stroke to Hospitalized Stroke									
Number of Incident TIA/Non-Hospitalized Stroke Patients	881	939	1,028	1,120	1,107	1,056	1,095		
Conversions to Hospitalized Stroke within 90 Days	35	30	28	33	33	26	26		
90-Day Conversion Rate	3.97%	3.19%	2.72%	2.95%	2.98%	2.46%	2.37%		
Conversions to Hospitalized Stroke within 365 Days	58	44	44	46	51	41	53		
Conversions to Hospitalized Stroke within 91-365 Days	23	14	16	13	18	15	27		
91-365-Day Conversion Rate	2.72%	1.54%	1.60%	1.20%	1.68%	1.46%	2.53%		

\* Age 20 and older

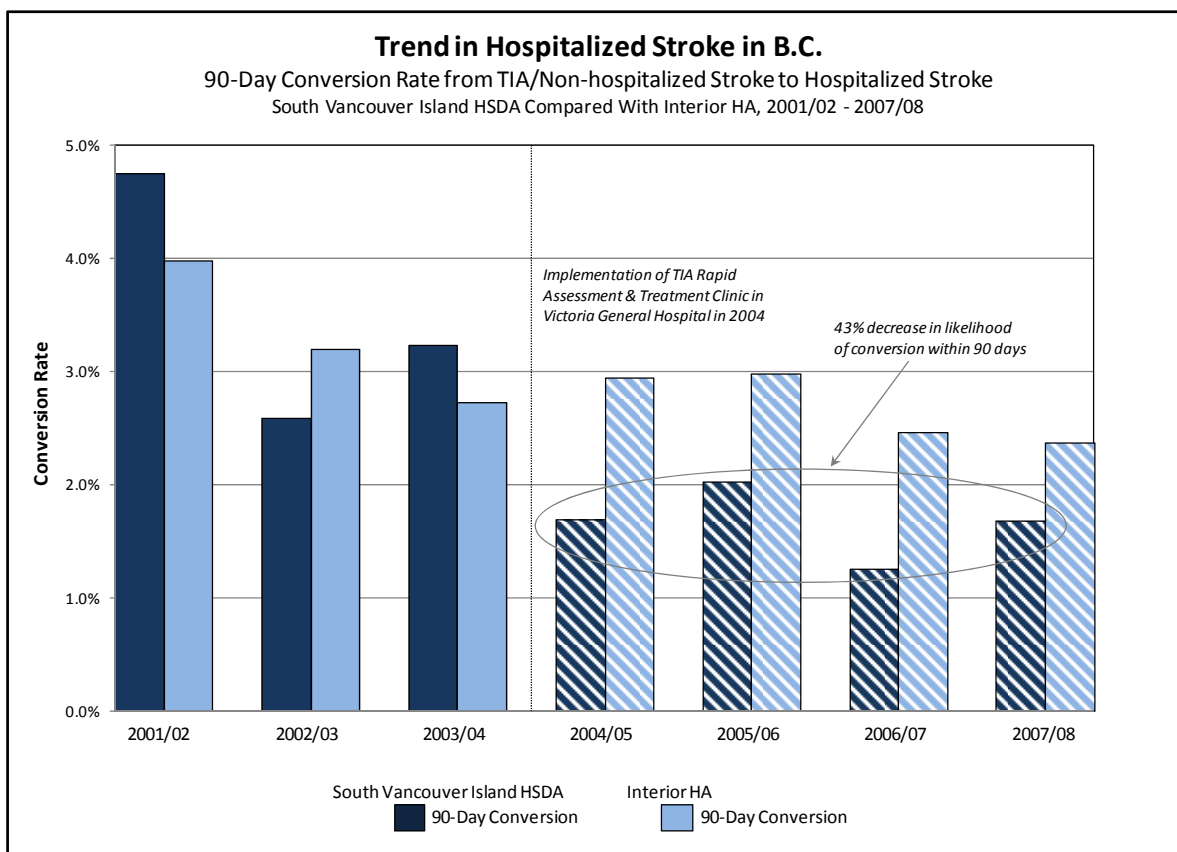
Two key questions arise in assessing the validity of this change:

1. Is the observed change in trend statistically significant or more likely due to random variation?
2. Is the observed change in trend associated with the implementation of the SRAU in 2004 or due to ongoing historical trends?

In an attempt to address these questions, we compared changes in trends over time in the South Vancouver Island HSDA compared to changes in trends over time for individuals living in the Interior Health Authority (IHA – see following figure). The IHA was chosen as a ‘control group’ since access to TIA/Rapid Assessment and Treatment services did not exist in that health authority prior to their recent implementation as part of the BCSS, and the population age structure is reasonably similar to that of the South Vancouver Island HSDA.

Statistical modeling (see Appendix B for details) suggests that individuals living within the South Vancouver Island HSDA in 2004/05 and later had a significantly lower probability of converting to a full stroke in the 90 days following an incident TIA/minor stroke than individuals living in the same HSDA prior to 2004/05 or to individuals living within the IHA either before or after 2004/05. Further modeling with individual-level data would allow for a more precise examination of the possible effects of other factors such as age and sex on these results.

The 43% decrease in the likelihood of conversion within 90 days observed in the South Vancouver Island HSDA is lower than the 80% reduction observed by Rothwell and colleagues. This difference is to be expected, as not all individuals with an incident TIA/minor stroke are being assessed and treated at the SRAU, while Rothwell’s results are based only on patients seen and treated at their clinic in a timely fashion.



## 3.0 CONCLUSION

A rapid expansion of an effective and cost-effective intervention is possible, given the appropriate funding, leadership, and co-operation between regional health authorities. Members of the TIA/Rapid Assessment Team found the opportunity to learn from and share with other health authorities to be very helpful.

Despite limited funding, health authorities were able to double access to TIA Rapid Assessment and Treatment services within the province. Analysis of the South Vancouver Island clinic suggests that even though not all patients with a TIA/minor stroke are assessed and treated in a timely fashion, the existence of the clinic is associated with a significant reduction in the likelihood of conversion within 90 days from a TIA/minor stroke to a hospitalized stroke. It is therefore likely that increased timely access for all patients with a TIA/minor stroke would further reduce the 90-day conversion rate, not only for individuals living in South Vancouver Island but for individuals throughout the province.

For this to happen, however, there are several outstanding issues that need to be addressed.

The length of time between the TIA event and the clinic appointment is an ongoing issue. In 2009/10 just one out of five (18.8%) patients were seen within 48 hours. An important barrier is the limited number of days that many of the clinics are operational. One strategy being considered is to provide access 7 days per week in at least several of the clinics. A further strategy is to implement a central intake and triage system, which could enhance timely access when more than one clinic exists within a geographic region.

In addition, despite the doubling in the number of TIA/minor stroke patients treated in these clinics, a further doubling would be required to treat all 6,000 incident TIA/minor strokes that occur annually in the province.

Finally, this assessment and evaluation of the expanded TIA Rapid Assessment and Treatment services in B.C. was only possible as a result of the data collection system set up for the prototype evaluation. The BC Stroke Strategy will continue to collect a minimum data set until the end of March 31, 2011. For longer term tracking, assessment and evaluation, however, this information will need to be incorporated into regular health authority reporting systems and repositories. At this time, there is no mandatory provincial requirement or central collection responsibility for this data.

## 4.0 APPENDICES

### 4.1 Codes Used in the ACVS Registry

Proposed ICD Acute cerebrovascular Syndrome Codes to be Used in B.C.				
ACVS Type	ICD-9 Code	Definition	ICD-10 Code	Definition
Acute Ischemic Stroke	362.3	Retinal vascular occlusion	H34.1	Central retina artery occlusion
	433.x1	Occlusion and stenosis of precerebral arteries	I63.x	Cerebral infarction
	434.x	Occlusion cerebral arteries	I64.x	Stroke, not specified as hemorrhage or infarction
	436.x	Acute, but ill-defined cerebrovascular disease		
Intracerebral Hemorrhage	431.x	Intracerebral hemorrhage	I61.x	Intracerebral hemorrhage
Subarachnoid Hemorrhage	430.x	Subarachnoid hemorrhage	I60.x	Subarachnoid hemorrhage
Transient ischemic attack	435.x	Transient cerebral ischemia	G45.x	Transient cerebral ischemic attacks and related syndromes (exclude G45.4 - transient global amnesia)

## 4.2 Statistical Modeling - Trend Analyses for Conversion Proportions

*The following statistical analysis was prepared by Dr. Bob Prosser, PhD on October 28, 2010.*

### Statistical Modeling

Multinomial logistic regression models were fitted to cell counts using a 3-category outcome variable. The 3 categories were “didn’t convert”, “converted within 90 days” and “converted in 91 to 365 days”. This type of model is closely related to ordinary logistic regression. In the latter, a linear model relating the outcome’s probabilities to explanatory variables ( $X_1$ ,  $X_2$ ) has the following form:

$$\text{Log}(\text{Prob}(\text{event occurring}) / \text{Prob}(\text{event not occurring})) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 \dots$$

The effects of the explanatory variables on the probability of the outcome are usually expressed in terms of odds ratios— $\exp(\beta_1)$ ,  $\exp(\beta_2)$ , etc.

A multinomial logistic regression model involving a k-category outcome variable consists of k-1 such equations. The models fitted in the trend analyses had the following form:

$$\text{Log}(\text{Prob}(\text{converted within 90 days}) / \text{Prob}(\text{didn't convert})) = \beta_{01} + \beta_{11} X_1 + \beta_{21} X_2 \dots$$

$$\text{Log}(\text{Prob}(\text{converted in 91-365 days}) / \text{Prob}(\text{didn't convert})) = \beta_{02} + \beta_{12} X_1 + \beta_{22} X_2 \dots$$

The double subscripts on the  $\beta$ s reflect the fact that the effects of the explanatory variables could be different for the different categories of the outcome variable. The effects are again expressed in terms of odds ratios.

“Didn’t convert” was chosen as the base category for model fitting because the primary concern is with the trends of the two types of conversion. This choice is arbitrary, however. Similar models could be fitted using, say, “converted within 90 days” as the base category. Such a reformulation would permit examination of the effects of the explanatory variables on the probability of converting in 91 to 365 days relative to converting within 90 days.

The two explanatory variables available for modeling were Group (Vancouver Island South and Interior Health Authority) and Time (fiscal year). An additional binary variable, Pre-Post, was derived from Time. This was coded 1 for the years 2001/2, 2002/3 and 2003/4 and 0 for the other years. Finally, an interaction variable was created from Group and Pre-Post. Pre-Post was used to test the hypothesis that the probability of conversion decreased after 2003/4 when the intervention started in Vancouver Island South. The interaction term was used to examine the hypothesis that the two groups differed in terms of any change that occurred after 2003/4.

### Findings

In the discussion of the findings, conversion within 90 days will be referred to as C1, and conversion in 91 to 365 days will be called C2.

### Main Effects Model Using Group and Time

The explanatory variables were coded so that the reference category for Year was 2000/1, and the reference category for Group was Interior Health Authority.

The goodness-of-fit tests indicate that this model fit the data.

Table 1 shows the parameter estimates. The odds ratios are in the Exp(B) column, and their 95% confidence intervals are in the rightmost two columns.

Table 1

		Parameter Estimates					95% Confidence Interval for Exp(B)		
outcome <sup>a</sup>		B	Std. Error	Wald	df	Sig.	Exp(B)	Lower Bound	Upper Bound
converts in <= 90 days	Intercept	-3.016	.139	471.600	1	.000			
	[region=1]	-.217	.123	3.111	1	.078	.805	.632	1.024
	[region=2]	0 <sup>b</sup>	.	.	0	.	.	.	.
	[year_r1=1]	-.379	.203	3.488	1	.062	.685	.460	1.019
	[year_r1=2]	-.405	.199	4.141	1	.042	.667	.451	.985
	[year_r1=3]	-.568	.203	7.863	1	.005	.567	.381	.843
	[year_r1=4]	-.503	.200	6.305	1	.012	.605	.409	.896
	[year_r1=5]	-.783	.219	12.830	1	.000	.457	.298	.702
	[year_r1=6]	-.720	.213	11.424	1	.001	.487	.321	.739
	[year_r1=7]	0 <sup>b</sup>	.	.	0	.	.	.	.
converts in 91 - 365 days	Intercept	-3.660	.191	366.938	1	.000			
	[region=1]	-.322	.164	3.853	1	.050	.725	.526	.999
	[region=2]	0 <sup>b</sup>	.	.	0	.	.	.	.
	[year_r1=1]	-.351	.280	1.576	1	.209	.704	.407	1.218
	[year_r1=2]	-.583	.291	4.016	1	.045	.558	.315	.987
	[year_r1=3]	-.731	.296	6.124	1	.013	.481	.270	.859
	[year_r1=4]	-.323	.265	1.478	1	.224	.724	.430	1.218
	[year_r1=5]	-.541	.283	3.645	1	.056	.582	.334	1.014
	[year_r1=6]	-.016	.247	.004	1	.948	.984	.606	1.597
	[year_r1=7]	0 <sup>b</sup>	.	.	0	.	.	.	.

a. The reference category is: no conversion.

At the 95% confidence level there was a (barely) significant overall difference between the regions with respect to the probability of C2, but not with respect to C1. South Vancouver Island’s odds of C2 (overall) were 27.5% lower than those in Interior Health. Although the Group odds ratio for C1 (0.805) was not significantly different from 1, its value suggests that Vancouver Island South’s conversion probability was lower than that of Interior Health.

The Year coefficients for C1 were all significant after 2001/2. The odds ratios were < 1 indicating that overall, C1 conversion was less likely in later years than in 2000/01. The odds ratios tend to decrease with time suggesting that there may be an overall downward trend in the likelihood of C1 conversion.

The story is different for C2 conversion. While the odds ratios for Year are all < 1—indicating lower likelihood of conversion after 2000/1—they are not all significant and do not decrease in

value over time progressively. The lack of significance is partly a function of the relative rarity of C2 events.

*Pre-Post Main Effects Model*

This model used the binary Pre-Post variable in place of Year. The coding of Pre-Post made the earliest three years the reference time period.

The goodness-of-fit tests showed that this simplified model fit the data adequately.

**Table 2**

Parameter Estimates									
outcome <sup>a</sup>		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
converts in <= 90 days	Intercept	-3.272	.092	1266.005	1	.000			
	[region=1]	-.218	.123	3.140	1	.076	.804	.632	1.023
	[region=2]	0 <sup>b</sup>	.	.	0	.	.	.	.
	[year_r2=0]	-.380	.115	10.880	1	.001	.684	.546	.857
	[year_r2=1]	0 <sup>b</sup>	.	.	0	.	.	.	.
converts in 91 - 365 days	Intercept	-3.961	.128	961.149	1	.000			
	[region=1]	-.321	.164	3.829	1	.050	.726	.526	1.001
	[region=2]	0 <sup>b</sup>	.	.	0	.	.	.	.
	[year_r2=0]	-.068	.153	.196	1	.658	.934	.692	1.261
	[year_r2=1]	0 <sup>b</sup>	.	.	0	.	.	.	.

a. The reference category is: no conversion.  
 b. This parameter is set to zero because it is redundant.

The findings from this model, shown in Table 2, are quite consistent with those from the previous model. The C1 and C2 odds ratios for Group show that there is a tendency for Vancouver Island South to have lower probabilities of conversion than Interior Health, although neither odds ratio is significantly different from 1 at the 95% confidence level.

For C1, the overall odds of conversion in the later years are 32% lower than in the early years, and this decrease is significant. For C2, there is a non-significant 7% decrease.

*Model to Test Group Differences in Trend*

The third model included Pre-Post and the interaction variable described earlier. The coding of this variable was designed to test whether there was an additional change in conversion probability for Vancouver Island South in the post-intervention period over and above the overall changes attributed to time and location.

The goodness-of-fit tests indicate that the model fit the data. The AIC and BIC statistics suggest that this model is a clear improvement over the first model, but the comparison with the second model is not as definitive; the AIC statistic suggests adding the interaction improved fit, but the BIC suggests the opposite.

Table 3

		Parameter Estimates						95% Confidence Interval for Exp(B)	
outcome <sup>a</sup>		B	Std. Error	Wald	df	Sig.	Exp(B)	Lower Bound	Upper Bound
converts in <= 90 days	Intercept	-3.369	.105	1020.532	1	.000			
	[region=1]	.060	.171	.122	1	.727	1.062	.759	1.485
	[region=2]	0 <sup>b</sup>	.	.	0	.	.	.	.
	[year_r2=0]	-.200	.141	2.015	1	.156	.819	.621	1.079
	[year_r2=1]	0 <sup>b</sup>	.	.	0	.	.	.	.
	[interaction=0]	-.558	.248	5.040	1	.025	.573	.352	.932
	[interaction=1]	0 <sup>b</sup>	.	.	0	.	.	.	.
converts in 91 - 365 days	Intercept	-3.931	.139	803.427	1	.000			
	[region=1]	-.425	.264	2.588	1	.108	.654	.389	1.097
	[region=2]	0 <sup>b</sup>	.	.	0	.	.	.	.
	[year_r2=0]	-.118	.182	.418	1	.518	.889	.622	1.270
	[year_r2=1]	0 <sup>b</sup>	.	.	0	.	.	.	.
	[interaction=0]	.173	.337	.263	1	.608	1.189	.614	2.301
	[interaction=1]	0 <sup>b</sup>	.	.	0	.	.	.	.

a. The reference category is: no conversion.  
 b. This parameter is set to zero because it is redundant

Table 3 shows that the C1 odds ratios for Group and Pre-Post were not significantly different from 1, but the odds ratio for the interaction term (0.573) is. This indicates that adding the interaction term has incorporated some of the overall impact of Group and Pre-Post. The significant odds ratio for the interaction suggests that the Vancouver Island South patients in the intervention years had a lower probability of C1 conversion than that region's patients in the pre-intervention period and Interior Health patients in either period.

Adding the interaction term renders all three odds ratios non-significant for C2 conversion.

**Conclusion**

The results from fitting these models to the aggregated data available provide preliminary evidence that the probability of a C1 conversion during the intervention years was lower than in the pre-intervention years, particularly in the group that had the intervention. There was no trend for C2 conversion although there may have been a lower overall probability of C2 in Interior Health patients. Further modeling with individual level data appears to be warranted to facilitate the examination of possible effects of other factors such as age and sex.