Ontario Stroke Network

Regional Economic Overview – North East LHIN

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Regional Economic Overview –

North East LHIN

Background/ Rationale

Stroke is a significant contributor to mortality and morbidity in Ontario and represents an enormous economic burden to the healthcare system annually. Every year approximately 20,000 Ontarians arrive at an emergency department with stroke or transient ischemic attack (TIA) and ~13,000 are admitted to an acute hospital for care[1]. Upon discharge, ~3,200 go to inpatient rehabilitation and ~900 each to Complex Continuing Care (CCC) and Long-Term Care (LTC) to meet their ongoing needs. Under this burden, the Ontario Ministry of Health and Long-Term Care (MoHLTC) is actively seeking opportunities to improve the cost-effectiveness with which these patients receive their care.

In 2011, as part of its involvement with the MoHLTC's Rehabilitation and Complex Continuing Care Expert Panel (RCCCEP) the Ontario Stroke Network (OSN) established the Stroke Reference Group (SRG); a panel of regional experts in stroke care. The SRG was asked to make best-practice recommendations for stroke care that could help facilitate smoother flow of patients through the healthcare system. The SRG recommendations released in November 2011[2] included the following:

- Timely transfer of appropriate patients from acute facilities to rehabilitation
  - Ischemic strokes to rehabilitation by day 5 on average
  - Hemorrhagic strokes to rehabilitation by day 7 on average
- Provision of greater intensity therapy in inpatient rehabilitation
  - 3 hours of therapy per day
  - 7-day a week therapy
- Timely access to outpatient/community-based rehabilitation for appropriate patients
  - Early Supported Discharge with engagement of Community Care Access Centres (CCAC) and allied health professionals (contracted through their rehabilitation and nursing provider agencies)
  - Mechanisms to support and sustain funding for interprofessional outpatient (e.g. day rehabilitation) and/or community-based rehabilitation
  - 2-3 outpatient or Community-based allied health professional visits/ week (per required discipline) for 8-12 weeks
  - In-home rehabilitation provided as necessary

In 2012, the OSN released a report that assessed the potential economic impact of achieving full adherence to the best-practice stroke rehabilitation recommendations across Ontario[3]. This report noted that in addition to improving patient care, better application of best-practice principles could

allow Ontario's healthcare system to make available up to $20M annually for re-investment elsewhere in the system. However, this report also included results from focus groups across the province identifying a number of important challenges that must be overcome before adoption of these recommendations will be possible.

In parallel with this work, in 2012/13 the MoHLTC began implementation of the Health System Funding Reform strategy designed to promote more efficient and patient-centered healthcare spending[4]. As part of this initiative, stroke was chosen to undergo funding reform beginning in 2013 through implementation of a Quality-Based Procedures (QBP) funding structure. The QBP payment system is designed to promote efficient, high quality care with smooth transitions between care settings by providing a "bundled payment" for patient care that is tied to quality indicators. Under this reformed system, the LHINs (and facilities within them) will be forced to re-evaluate their stroke care delivery model and those regions with coordinated stroke systems will be in the best position to manage the change.

In advance of the QBP funding reform implementation, Health Quality Ontario and the MoHLTC released the Quality-Based Procedures Clinical Handbook for Stroke in January 2013[4]. In this document, a summary of recommended practices developed in coordination with the stroke episode of care expert panel are reported. These recommendations, informed largely by the Canadian Best-Practice Recommendations for Stroke Care, will formulate the standards by which healthcare providers will be measured under the QBP system. Notable recommendations include:

Acute Care
- access to stroke thrombolysis for eligible patients
- provision of acute stroke care on a specialized, geographically defined stroke unit with a suggested minimum annual volume of 165 ischemic stroke admissions
- 5 day LOS for ischemic stroke patients and 7 day for hemorrhagic

Inpatient Rehabilitation
- 7-day a week admissions to inpatient rehabilitation
- 1:6 therapist to bed ratios for PT and OT in inpatient rehabilitation and 1:12 for SLP
- 3-hours of direct task-specific therapy per day for at least six days a week

While the details of the QBP funding reform remain uncertain, the information contained in the clinical handbook provides insight into the direction in which the stroke system is heading and can serve to inform regional dialogue about stroke care.

Objective

This report is designed to replicate portions of the provincial economic evaluation noted above from the perspective of the North East Local Health Integration Network (NE LHIN). It is not designed as a comprehensive economic evaluation, but rather to present contextual information in a way that will help guide regional discussion about local stroke care. It is our hope that this will support regional

representatives in assessing their stroke system, identifying areas where improvements are possible and informing discussions with local healthcare providers regarding system reform. Data and analyses performed here can (and should) be challenged and updated as appropriate.

Regional Context

The Northeastern Ontario Stroke Network (NEOSN) is responsible for the implementation of stroke best practice across the continuum of care in the North East LHIN. Part of the Ontario Stroke System since 2003, NEOSN includes District Stroke Centres in North Bay, Timmins and Sault Ste. Marie in addition to a Regional Stroke Centre in Sudbury. Each of these designated centres houses a Telestroke Program (for assistance with delivery of thrombolysis), an Acute Stroke Unit, a Stroke Prevention Clinic and dedicated inpatient rehabilitation beds. Inpatient acute stroke care is currently provided at all 24 hospitals in the North East LHIN with an additional Telestroke Program available at the Temiskaming Hospital. Inpatient rehabilitation is current provided at each of the four designated stroke centre hospitals in addition to the West Parry Sound Health Centre.

Regional Stroke Review

NEOSN, under the guidance of the North East LHIN is currently completing a review of the regional model of stroke care delivery. The *North East LHIN Regional Stroke Care Review* began in January of 2013 and is planned to be completed by December 31st, 2013. Specifically, this review will include an impact analysis of the following proposed changes to the regional model:

a. Post-emergency department inpatient stroke care (acute + rehabilitation phases) will be consolidated to the LHIN's four designated stroke centre hospitals at Health Sciences North | Horizon Santé-Nord (HSN), Sault Area Hospital (SAH), Timmins and District Hospital (TDH) and North Bay Regional Health Centre (NBRHC). As part of stroke care consolidation in the North East LHIN, it is also recommended that the inpatient stroke patient volume at the West Parry Sound Health Centre (approximately 44 acute and 15 rehabilitation admissions/year) be transferred to the Huntsville District Memorial Hospital Site (part of Muskoka Algonquin Healthcare), as part of the North Simcoe Muskoka LHIN stroke care restructuring. This consolidation of care will allow all stroke patients in the North East LHIN to access care within a dedicated inpatient stroke unit.

b. Outpatient post-stroke interdisciplinary follow-up and community navigation services will be provided across the entire LHIN via a regionalized program. Interdisciplinary Stroke "Re-Check" clinics will be available at each designated stroke centre with community navigation services and outpatient or home based rehabilitation services provided locally in each community.

c. A regional anticoagulation program will be implemented to ensure all stroke patients that require this service can receive it.

Each of the above stated changes to the current model of stroke care are targeted at decreasing the gap between current practice and the published Canadian Best Practice Recommendations for Stroke Care.

Review Process
The impact of each change on stroke care stakeholders (including patients/families, EMS, hospitals, CCC, CCAC, community agencies), in addition to the related resource implications (both financial and human) will be identified as part of the review. Meetings are scheduled to be held monthly from February to December 2013.

Methods

In the spirit of providing a regional "economic overview", current data were explored with the goal of identifying opportunities for improved care, potential for cost reductions relative to current expenditure and estimates of the need for re-investment or re-allocation of funding. The following areas were addressed:

Potential EMS impact

Estimate mean annual stroke/TIA incidence (based on ED arrivals) and the proportion of patients transferred to hospital by ambulance annually

In order to estimate annual incidence, it was assumed that all patients with stroke or TIA would arrive at an emergency department. We acknowledge that this may not always be true, but felt that the resulting estimate was reasonable. Data were retrieved from the 2012 Stroke Evaluation Report for ED arrivals and averaged over fiscal years 2008-2010[1].

Estimate mean travel times and distances between regional hospitals

Distances and travel times between hospitals were retrieved from Google maps. Times account only for estimated driving times and do not account for drop off or pick-up times, traffic, weather, nor any additional time staff require (eg. breaks).

Potential Acute Care impact

Estimate annual admissions to acute care by hospital and stroke type (TIA, Isch, Hem, Not Specified)[l]

Data were retrieved from IntelliHealth by a member of the North Simcoe Muskoka Decision support team for all LHINs. The initial data pull included information on all patients with most responsible diagnosis of stroke (ICD-10 codes H34.1, G45 (not G45.4), I60 (not I60.8), I61, I63 (not I63.6), or I64) who were 18 years or older and were either a resident of the NE LHIN or received some acute medical care in the LHIN in fiscal years 2007-2011. Patients were divided by stroke type using the following criteria:

Hemorrhagic (ICD-10 = 160 & I61)

Ischemic (ICD-10 = H341 & I63)

Stroke Not Specified (ICD-10 = I64)

TIA (ICD-10 = G45)

The number of discharges was summed for each hospital to infer the number of stroke admissions annually. For planning purposes, the following steps were used to ensure that patients were not double counted in the estimated number of annual admissions. Among LHIN residents, records of patients transferred from another acute care hospital were eliminated and only the sentinel admission was used. Non-resident patients transferred from an acute site outside of the LHIN remained.

To generate the final table, resident and non-resident data were combined and summed. For calculation of LOS and resource intensity weight (RIW), the sum of all within-LHIN hospital stays was combined regardless of site or number of admissions. Five-year averages were generated by summing all data across all 5 years and then dividing each cell by five. Mean RIW per patient was generated by dividing the total RIW sum for each group by the number of total discharges.

Estimate current annual acute stroke budget

Mean annual acute admissions and resource intensity weight (RIW) averaged over fiscal years 2007-11 were multiplied by the estimated 2013/14 mean cost per weighted case provided by the MoHLTC ($4380)[a]. This represents an estimate of the annual direct cost of acute hospital care for stroke patients across the entire LHIN.

Project mean LOS under best-practice model and estimate annual need for acute care beds regionally

[a] Interim Quality-Based Procedure list for stakeholder consultation, MoHLTC 2012

The current best-practice recommendation is for ischemic stroke patients to be transferred to the appropriate rehabilitation setting by day 5 on average and hemorrhagic patients by day 7 [2]. However, using this information to project the need for acute beds is difficult. In order to achieve these aggressive LOS targets, substantial system change would be required including improved access to outpatient and community-based rehabilitation programs, greater acute care efficiency, and readily available access to long-term care beds when necessary. While we believe this ideal state to be possible, it is likely not imminent. Still, Ontario data suggest tremendous opportunity for improved efficiency even within the current structure of services.

Due to the challenging nature of projecting resource need, data were presented in this section in two ways to help inform planning discussion. First, a mean 10-day acute LOS was assumed for all stroke patients (ischemic, hemorrhagic and stroke type not specified (NS)). This estimate was felt to be a conservative target to allow for the fact that some patients being discharged to settings other than rehabilitation (palliative care or LTC) may require a longer acute stay than the 5 and 7 day targets under the constraints of the current system. These data are presented to represent a reasonable interim target. Second, estimates were generated based on the assumption of full achievement of the best-practice recommendations (mean 5 day and 7 day LOS for ischemic and hemorrhagic stroke patients respectively) in order to infer the impact of achieving an "ideal" scenario. Bed estimates were then derived assuming a 90% occupancy rate to allow for natural variation in stroke incidence.

Mean LOS for patients with TIA is generally shorter than 5 days and consensus opinion is that many of these patients do not require acute admission at all. However, no reliable estimate for the proportion of TIA patients who require admission exists currently. Therefore, in all cases the current mean LOS occupied by TIA patients, or 5 days (whichever is lower) was considered sufficient in system modeling and separate estimates for the potential reduction in TIA admissions were calculated.

Estimate the opportunity for annual acute cost reduction

As in the previous section, there are several ways in which cost reduction estimates could be generated. We chose to present three scenarios. First, *per diem* cost estimates (Appendix B) reported in a previous report[3] were used to generate an estimate of the impact that a single day reduction in mean LOS would have on direct stroke costs in the region. Second, the same *per diem* estimates were used to infer the potential cost savings that would accompany achievement of both the 10-day and the "ideal" LOS targets for ischemic and hemorrhagic patients compared to the current average LOS.

Expert opinion suggests that many of the TIA patients currently admitted to acute care could be better managed in a secondary prevention clinic. However, no reliable estimate of the proportion of TIA patients for whom an acute admission is appropriate exists currently. Regional data were used to estimate the incremental direct acute care cost savings that would accompany each TIA admission avoided. These were generated by multiplying the mean RIW of TIA patients admitted to acute care within the LHIN by the MoHLTC cost per weighted case ($4,380).

Estimate staffing model required for proposed bed number

Staffing ratios for each discipline included in the recommended interdisciplinary stroke team were drawn from the CSS "Guide to the Implementation of Stroke Unit Care"[5]. The ratios recommended in the CSS guide were used to estimate the total staffing requirement that would be needed to provide best-practice stroke care to all patients across the region under both the 10-day and "ideal" systems.

Potential Inpatient Rehabilitation Impact

Identify LHIN-level annual admissions to rehabilitation by rehabilitation patient group (RPG) and mean LOS

Data requested from the National Rehabilitation Reporting System (NRS) from fiscal years 2008-2010 were used to estimate the mean number of stroke patients (Rehabilitation Client Group-1) admitted to a designated inpatient rehabilitation bed (by RPG) annually.

Estimate current annual rehabilitation stroke budget

The mean number of rehabilitation admissions annually was multiplied by their mean LOS and then by the *per diem* cost estimate of $603[3] (Appendix B) to generate a regional estimate of the cost of inpatient rehabilitation annually. Similarly, the mean number of CCC admissions for rehabilitation was inferred. Provincially, approximately 30% of patients who enter CCC post stroke are ultimately discharged home[1]. This value was used in combination with the number of annual acute discharges to CCC[1] to infer the number of patients discharged to CCC for rehabilitation purposes. This estimate was multiplied by the *per diem* cost estimate for CCC of $561 (Appendix B) and the provincial mean LOS in CCC[1] (93.5 days) to estimate current expenditure on rehabilitation in CCC annually. It is recognized that use of CCC beds for rehabilitation varies significantly within and across LHINs due to a lack of standardized policy for rehabilitation in this setting. The inference made regarding rehabilitation in CCC is a methodology limitation that will benefit from local interpretation.

Anticipate number of inpatient rehabilitation admissions annually under best-practice model and number of rehabilitation beds needed

Current data limitations make it difficult to identify the proportion of patients admitted to inpatient rehabilitation who could have been cared for in an outpatient setting or the number of patients currently admitted to complex continuing care beds who would have been more appropriately cared for in inpatient rehabilitation. Therefore, the Ontario benchmark for stroke patients alive at acute discharge who are candidates for inpatient rehabilitation (42.3%)[1] was used to estimate the number of patients who would require inpatient rehabilitation annually. A 30-day mean LOS was used to derive an estimate of the need for rehabilitation beds, assuming 90% occupancy.

Estimate rehabilitation staffing model for proposed bed number

The estimate is based on provision of PT, OT and SLP services as indicated in the clinical handbook for Quality Based Procedures. Other rehabilitation disciplines were not included in the model due to the lack of recommendations around appropriate staffing ratios in rehabilitation.

The rehabilitation staffing model required to care for the expected number of rehabilitation admissions was based on the assumptions that 1) a single therapist was capable of providing 6 hours of direct therapy per day, 5 days a week, for 46 weeks a year (1380 hours total assuming 6 weeks for vacation and illness) and 2) a 2:1 registered therapist to assistant ratio was assumed to be appropriate.

Two estimates of staffing compliments were generated. Best-practice recommendations suggest therapy 7-days a week, while the HQO clinical handbook made a more conservative recommendation of at least 6-days a week. Assuming that each patient would require 1 hour of direct therapy per day from PT and OT, the anticipated number of rehabilitation bed days occupied by stroke patients was assumed to equal the number of rehabilitation sessions required by each of these disciplines under the 7-day model. A 6-day model was then generated by multiplying the estimated number of bed days occupied by stroke patients by 6/7 to infer the total number of PT and OT rehabilitation sessions required annually. In both models, 1/2 as many sessions were assumed to be necessary for SLP based on the assumption that only 50% of patients require this care.

The total number of sessions in both models was then divided by 1380 (the number of direct therapy hours provided by 1 FTE annually) to infer the total number of FTEs needed to provide the appropriate number of sessions. The estimated FTEs were then calculated for the therapist to assistant ratio (2:1) and multiplied by the estimated annual salaries used previously (Appendix B) to estimate the annual direct cost of best-practice rehabilitation in the region under both a 7-day and 6-day model of care.

Potential Outpatient/Community-based Rehabilitation Impact

Estimate "best-practice" annual need

As done in the OSN report[3], it was assumed that 13% of stroke patients discharged alive from acute care, and all patients discharged from inpatient rehabilitation, require additional outpatient or community-based rehabilitation. Between 2008 and 2010, approximately 12% of stroke patients died in hospital[1]. To estimate the number of patients who require additional rehabilitation, 12% of the annual admissions were removed along with all TIAs and all patients discharged to inpatient rehabilitation. Of the remaining patients, 13% were assumed to require additional rehabilitation. This number was then added to the estimated number of admissions to inpatient rehabilitation to derive an estimate of the total number of patients requiring outpatient or community-based rehabilitation annually. Each patient

was assumed to require a best-practice recommended 2.5 sessions per week (an average of 2-3 visits per patient) for 10 weeks (the average of 8-12 weeks duration)[2].

Estimate annual direct costs for outpatient and community-based rehabilitation programs

Results of the previous OSN report found that 88% of patients in Ontario live within a 30-minute drive of an outpatient rehabilitation program[3]. However, these analyses have not been performed for each LHIN individually. Cost estimates were generated by multiplying the per-session rehabilitation costs reported previously for outpatient and community-based rehabilitation (Appendix B) by the number of sessions required annually. This allowed for generation of an estimated direct cost for provision of ALL rehabilitation sessions by each of outpatient and community-based rehabilitation programs, separately. This was done for illustrative purposes and the true cost is anticipated to lie somewhere in between these estimates.

The estimates provided here require local interpretation given the high variance in rurality and population across LHINs. The balance of outpatient versus CCAC service provision will vary by region based on a) the presence or absence of outpatient programs in various communities and on b) how rurality affects access. LHIN profiles providing information on the percent rural residency can be found at Statistics Canada.

Results

Potential EMS impact

Estimate mean annual stroke/TIA incidence (based on ED arrivals) and the proportion of patients transferred to hospital by ambulance annually

Ontario's stroke evaluation report indicates that between fiscal years 2008 to 2010, an average of 1071 stroke or TIA patients arrived at an emergency department in the NE LHIN annually (range 1099 to 1021)[1]. Approximately 53.3% of these patients were transferred to hospital by EMS[1]. This estimate is lower than the annual number of admissions retrieved from Intellihealth (presented in table 5) and, therefore, likely represents an underestimate of incidence.

Estimate mean travel times and distances between regional hospitals and the proposed stroke sites

In order to infer the potential impact of stroke system reform on EMS services, estimates of the additional distances and travel times covered by EMS annually from each hospital to the proposed stroke center were generated and totaled (tables 1-4). This crude analysis suggests that the proposed stroke system would result in an additional 73,052 kms (round trip) for EMS crews or an additional 893.4 driving hours to transport patients to the appropriate stroke centers in the NE region.

In addition, an average of 44 patients per year from the Parry Sound region would be transferred to Hunstville for care. At approximately 87 kms (68 mins) per trip, this would result in 7656 kms round trip (100 hours) for EMS annually.

These estimates do not account for additional considerations including patients already transferred by EMS, between hospital transfers, weather, traffic, or EMS staff time during pick-up and drop off. Verification and discussion with local EMS providers should be pursued.

Table 1. Estimated annual impact on EMS transfers to proposed North Bay stroke unit

Facility	Mean Annual Stroke Admissions	Current Annual EMS Transfers (estimated)	Approx. Distance in KMs (travel time in minutes)	Estimated Annual Impact on EMS in KMs (drive time in hours)
Englehart	12	6	196 (130 mins)	2352 (26 hrs)
Mattawa	10	5	65 (46 mins)	650 (7.6 hrs)
Temiskaming	30	15	151 (101 mins)	4530 (50.5 hrs)
West Nipissing	27	14	35 (27 mins)	945 (12.2)
				8477 (96.3 hrs)

Table 2. Estimated annual impact on EMS transfers to proposed Sault Ste. Marie stroke unit

Facility	Mean Annual Stroke Admissions	Current Annual EMS Transfers (estimated)	Approx. Distance in KMs (travel time in minutes)	Estimated Annual Impact on EMS in KMs (drive time in hours)
Blind River	7	4	147 (109 mins)	1029 (12.7 hrs)
Hornepayne	3	2	410 (310 mins)	1230 (15.5 hrs)
Wawa	4	2	224 (164 mins)	896 (10.9 hrs)
				3155 (39.1 hrs)

Table 3. Estimated annual impact on EMS transfers to proposed Sudbury stroke unit

Facility	Mean Annual Stroke Admissions	Current Annual EMS Transfers (estimated)	Approx. Distance in KMs (travel time in minutes)	Estimated Annual Impact on EMS in KMs (drive time in hours)
Elliot Lake	41	22	165 (119 mins)	6765 (81.3 hrs)
Espanola	15	8	78 (57 mins)	1170 (14.3 hrs)
Manitoulin Island	32	17	164 (129 mins)	5248 (68.8 hrs)
				13183 (164.4 hrs)

Table 4. Estimated annual impact on EMS transfers to proposed Timmins stroke unit

Facility	Mean Annual Stroke Admissions	Current Annual EMS Transfers (estimated)	Approx. Distance in KMs (travel time in minutes)	Estimated Annual Impact on EMS in KMs (drive time in hours)
Chapleau	3	2	104 (86 mins)	312 (4.3 hrs)
Cochrane	10	5	105 (85 mins)	1050 (14.2 hrs)
Hearst	10	5	261 (193 mins)	2610 (32.2 hrs)
Iroquois Falls	6	3	77 (65 mins)	462 (6.5 hrs)
Kapuskasing	21	11	165 (127 mins)	3465 (44.5 hrs)
Kirkland Lake	22	12	139 (97 mins)	3058 (35.6 hrs)
Matheson	5	3	70 (52 mins)	350 (4.3 hrs)
Moose Factory/ Moosonee	5	3	--	--
Smooth Rock Falls	4	2	101 (80 mins)	404 (5.3 hrs)
				11711 (146.9)

Potential Acute Care impact

Identify mean annual admissions to acute care by hospital and stroke type (TIA, Isch, Hem, NS)

Due to the large number of hospitals in the NE LHIN, detailed results are presented in Appendix A. Regional summary of the total number of admissions is presented in table 5.

Table 5. Summary data for mean annual stroke admissions, LOS and resource intensity weight among hospitals in the NE LHIN between fiscal years 2007 and 2011.

Stroke Type	Mean Annual Admissions	Mean Annual ALOS	Mean Annual ALOS ALC	Mean Annual Total ALOS	Mean Patient RIW
Hemorrhagic	117.2	1183.2	775.4	1958.6	3.1989
Ischemic	313.8	3015.0	2120.0	5135.0	2.4888
Not Specified	344.8	3291.6	2814.0	6105.6	2.3554
TIA	311.6	1296.6	378.4	1675.0	0.8150
Total	**1087.4**	**8786.4**	**6087.8**	**14874.2**	**2.0434**

Estimate current annual acute stroke budget

Using the 2013/14 "Interim Quality-Based Procedures list for Stakeholder Consultation" direct cost per weighted case of $4380, the estimated *direct cost* of acute stroke care in the NE LHIN is $9,732,330 annually.

Anticipate mean LOS under best-practice model and estimate annual need for acute care beds regionally

Assuming a mean 10 day LOS for all stroke patients and no change in the LOS of TIA patients, a total of 9433 bed days can be anticipated to be occupied by stroke/TIA patients annually. Assuming 90% occupancy in stroke unit beds, this would require 28.7 acute beds to care for these patients.

Were the best-practice recommendations of mean 5-day and 7-day LOS attained for ischemic and hemorrhagic stroke patients respectively, a total of 5788 bed days would be occupied by patients with stroke or TIA. Care of patients under this "ideal" system would require 17.6 acute care beds.

Estimate the opportunity for annual acute cost reduction

Based on the number of admission, the mean LOS and the MoHLTC cost per weighted case, the average *per diem* direct acute care cost for stroke and TIA in the NE LHIN is $654 per day. This means that across the region, a single day reduction in mean LOS could free up $711,496 annually for re-investment elsewhere in the system.

Attainment of a 10-day mean LOS for all ischemic, hemorrhagic and stroke not specified patients (with no change in TIA LOS) in the NE LHIN would result in the elimination of 5441 acute care bed days annually. Using the previously reported *per diem* ALC cost estimates of $577 for hemorrhagic patients and $592 for ischemic and stroke not specified patients (Appendix B), these 5441 days could result in $3,209,391 made available annually. Interestingly, the proposed 5441 bed day reduction could entirely be achieved through elimination of ALC bed days in the region (see table 5).

Were the "ideal" targets of 5 and 7 days met for all ischemic and hemorrhagic stroke patients across the region, 9086 fewer acute bed days would be occupied by stroke patients annually compared to current LOS. This would result in an estimated $5,361,907 made available annually; more than halving current direct acute-care expenditure in the region.

In addition to the potential cost reductions among stroke patients, data also suggest tremendous opportunity for acute cost reductions associated with avoiding TIA admissions. Every TIA admission avoided in the NE LHIN would make available approximately $3,570 for spending elsewhere. Based on

this incremental estimate, if even half of the TIA admissions were avoided annually, $556,159 could be made available to care for these patients elsewhere.

Estimate staffing model required for proposed acute bed number

Based on the CSS Stroke Unit guidelines[5], regional best-practice staffing compliments are presented in table 6 for a model with a 10-day acute stroke LOS and the "ideal" best-practice target model. Note that these estimates are only for acute care and do not account for care at multiple sites. The suggested acute staffing ratios would remain constant at each facility, but may result in different region-wide values. Estimates are provided to generate local discussion around staffing and to allow for regional estimates of staff costs to be performed.

Table 6. Estimate of the best-practice staffing compliments required to care for stroke patients in the NE LHIN for both the 10-day and "ideal" models.

Team Member	NE 10-day Requirement For 28.7 acute beds	NE "ideal" Requirement For 17.6 acute beds
RN**	26.8	16.4
RPN**	13.4	8.2
PT†	3.2	2.0
OT†	3.2	2.0
SLP††	1.6	1.0
PT/OT Assistants$^{\pi}$	3.2	2.0
CDA$^{\pi}$	0.8	0.5
SW‡	1.4	0.9
Dietitian‡‡	2.3	1.4

**Estimates based on assumed need of 1.4 nursing FTE/bed at a 2RN:1RPN ratio

†Estimates based on assumption of 1:6 therapist:bed ratio[3]

††Estimate based on assumption of 1:12 therapist:bed ratio[3]

$^{\pi}$Assistant calculations based on 1:2 assistant:registered therapist ratio.

‡Assuming 1 FTE/ 20 bed ratio

‡‡Assuming 0.8FTE/10 bed ratio

Potential Inpatient Rehabilitation Impact

Identify LHIN-level annual admissions to rehabilitation by functional level (RPG) and mean LOS

According to the NRS, between 2008 and 2010 an average of 189 patients from the NE LHIN (range 153 - 207) were admitted to a designated inpatient rehabilitation bed annually. On average these patients

remained in inpatient rehabilitation for a mean of 39.6 days. The distribution of patients by RPG and their mean LOS are presented in table 7.

Table 7. Mean number of annual admissions to inpatient rehabilitation in the NE LHIN by RPG and their corresponding mean LOS from 2008-2010.

RPG	Mean Annual Admissions	Mean LOS (days)
1100	26	63.7
1110	42	55.5
1120	28	40.9
1130	34	29.9
1140	22	25.0
1150	22	27.1
1160	15	12.5
Total	**189**	**39.6**

Estimate current annual rehabilitation stroke budget

Previous estimates suggest that, on average, a single day in inpatient rehabilitation costs $603 (Appendix B). Based on this estimate, the annual cost of inpatient rehabilitation in the NE LHIN is approximately $4,508,953. Of this total cost, approximately $113,163 is spent on rehabilitation of patients in RPG 1160; a group that current best-practice recommendations suggest could be cared for in an outpatient or community-based rehabilitation setting to avoid an inpatient rehabilitation admission.

Between 2008 and 2010, on average, 29 patients a year were discharged to CCC from acute care post stroke in the NE LHIN[1]. Assuming that 30% of these patients were rehabilitation candidates, approximately 9 patients a year were admitted to CCC for rehabilitation. Based on the provincial average LOS of 93.5 days[1] at $561/day (Appendix B), these patients would cost $472,082 to care for in this setting. Were these patients to have been admitted to inpatient rehabilitation and achieve a mean LOS of 64 days (that of the most severe RPG group, 1100), their care would have cost $347,328; an annual cost reduction of $124,754.

Anticipate number of inpatient rehabilitation admissions annually under best-practice model and number of rehabilitation beds needed

Using data currently available, it is difficult to estimate the proportion of patients currently in inpatient rehabilitation unnecessarily, as well as the proportion of patients currently admitted to “slow-stream” rehabilitation or CCC who should instead should have been admitted to inpatient rehabilitation. Therefore, the current best-practice provincial benchmark of 42.3%[1] of acute stroke patients discharged alive requiring rehabilitation was felt to be a better approximation of regional rehabilitation need.

Based on this estimate (42.3% x 683), approximately 289 patients from the NE LHIN would require inpatient rehabilitation annually after stroke. Assuming 90% bed occupancy, management of these patients would require 26.4 inpatient rehabilitation beds annually.

Estimate rehabilitation staffing model for proposed bed number

In order to provide inpatient rehabilitation (PT, OT and SLP) services at the level of intensity noted in the QBP clinical handbook for stroke (3-hours daily, 6 days a week), a combined regional therapy staffing complement of 13.5 dedicated FTEs would be required at an estimated annual salary of $1,178,876**.** Were the best-practice recommended model of 7-day a week therapy for PT, OT, and SLP achieved, 15.7 FTEs would be required at an estimated $1,375,356 (or an additional $196,479). These are estimates of the entire PT, OT and SLP staffing compliment required, which would include staff currently employed in the region. Estimates of the need for FTEs and the corresponding cost for each rehabilitation discipline are presented in table 8.

Table 8. Estimates of the need for inpatient rehabilitation FTEs in the NE LHIN, under 6 and 7 day a week therapy models, and an estimate of the corresponding cost.

Discipline	Number of FTEs 6-Day model	Estimated Annual Salary 6-Day model	Number of FTEs 7-Day model	Estimated Annual Salary 7-Day model
PT*	3.6	$373,292	4.2	$435,507
OT*	3.6	$373,292	4.2	$435,507
SLP**	1.8	$197,313	2.1	$230,198
PT/OT Assistant†	3.6	$186,831	4.2	$217,969
CDA††	0.9	$48,150	1.0	$56,175
Total	**13.5**	**$1,178,876**	**15.7**	**$1,375,356**

*PT/OT estimates based on an annual salary of $104,057

**SLP estimates based on an annual salary of $110,004

†PT/OT assistant estimates based on an annual salary of $52,080

††CDA estimates based on an annual salary of $53,688

Potential Outpatient/Community-based Rehabilitation Impact

Estimate "best-practice" annual need

It was assumed that 13% of patients with stroke discharged alive from acute care and all patients discharged from inpatient rehabilitation require additional rehabilitation services from OT and PT, and that half would require SLP. Each patient was assumed to require 2.5 rehabilitation sessions per week

for 10 weeks (both averages of the current best-practice recommendations). Based on these assumptions, patients in the NE LHIN are anticipated to require 8378 sessions of both PT and OT, and 4189 sessions of SLP annually.

Estimate annual costs for outpatient and community-based rehabilitation programs

Assuming an outpatient clinic cost of $94.33 per session for PT and OT and $97.80 for SLP (includes direct costs and a portion of overhead; Appendix B), provision of all rehabilitation sessions in an outpatient clinic would cost approximately $1,990,352. Were all sessions provided by a community-based program (estimated costs of $117.13 PT, $139.98 OT and $141.12 SLP including overhead and travel; Appendix B), the cost of care would rise to $2,745,321. These estimates do not account for current programs and staff available in the region and represent a high and low boundary for the estimate. Given that much of the NE LHIN geography is rural, it is likely that many patients would benefit from rehabilitation in the community setting rather than travelling to a hospital outpatient rehabilitation department. The actual proportion of candidates for each service cannot be estimated at this time and the potential unmet need cannot be estimated due to a lack of outpatient data.

Summary/ Recommendations

The Northeastern Ontario Stroke Network envisions a coordinated system of care that ensures all stroke patients in the region have access to best practice care across the healthcare continuum. This report highlights not only the system redesign and investments required to move towards providing best practice care but also the opportunity to free up health funding through the adoption of these practices. Currently at its mid-way point, the *North East LHIN Regional Stroke Care Review* has met with multiple stakeholder groups to discuss several proposed changes to the current regional model of care. There appears to be general support for the consolidation of inpatient acute and rehabilitation care at the region's designated stroke centres while maintaining delivery of post-hospital outpatient/community based services as "close to home" as possible. Key to the success of this more regionalized stroke system of care will be ensuring adequate patient flow through both the hospital and community care sectors. The second half of the review will look at the more logistical issues related to care provision and patient flow throughout the entire care continuum. In addition, the impact of the Quality Based Procedure funding models on the regional stroke care model will also be analyzed.

Reference List

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Appendix A

Summary data for annual admissions, LOS and RIW by stroke type for each hospital in the NE LHIN averaged across fiscal years 2007-2011.

Hospital	Stroke Type	Admit	ALOS	ALOS ALC	ALOS Tot	RIW
BLIND RIVER DISTRICT HEALTH CENTRE	Total	6.6	122.0	20.0	142.0	2.8505
	Hem	0.8	50.8	6.2	57.0	9.1120
	Isch	2.2	52.0	1.4	53.4	3.3025
	NS	1.4	7.0	0.0	7.0	0.8307
	TIA	2.2	12.2	12.4	24.6	1.4069
SERVICES DE SANTE DE CHAPLEAU HEALTH SERVICES	Total	3.4	90.0	30.0	120.0	4.4034
	Hem	0.0	0.0	0.0	0.0	0.0000
	Isch	0.4	35.8	0.0	35.8	12.7893
	NS	2.0	42.8	8.8	51.6	3.0611
	TIA	1.0	11.4	21.2	32.6	3.7339
LADY MINTO HOSPTIAL (Cochrane)	Total	9.6	102.0	99.4	201.4	2.4721
	Hem	0.6	2.2	0.0	2.2	0.9060
	Isch	0.6	3.2	0.8	4.0	1.5438
	NS	5.2	80.6	91.4	172.0	3.6168
	TIA	3.2	16.0	7.2	23.2	1.0797
ST. JOSEPH'S GENERAL HOSPITAL (Elliot Lake)	Total	40.6	479.2	419.8	899.0	2.9290
	Hem	2.8	17.4	29.8	47.2	3.1452
	Isch	7.4	110.4	91.6	202.0	3.5518
	NS	20.6	301.2	278.8	580.0	3.5996
	TIA	9.8	50.2	19.6	69.8	0.9871
ENGLEHART AND DISTRICT HOSPITAL	Total	11.8	206.8	224.0	430.8	4.3972
	Hem	0.6	17.6	58.6	76.2	16.5901
	Isch	5.4	94.4	91.6	186.0	4.1418
	NS	3.6	84.8	73.8	158.6	5.0829
	TIA	2.2	10.0	0.0	10.0	0.5768
ESPANOLA GENERAL HOSPITAL	Total	15.4	178.8	295.6	474.4	3.6672
	Hem	0.2	0.4	0.0	0.4	1.2279
	Isch	2.2	26.6	14.0	40.6	3.0039
	NS	9.2	136.8	281.6	418.4	5.1159
	TIA	3.8	15.0	0.0	15.0	0.6724
NOTRE DAME HOSPITAL (Hearst)	Total	10.4	166.0	91.0	257.0	2.9824
	Hem	0.2	0.6	0.0	0.6	1.4548
	Isch	1.0	8.6	0.0	8.6	1.5999
	NS	7.0	145.0	26.2	171.2	3.0096
	TIA	2.2	11.8	64.8	76.6	3.6631
HORNEPAYNE COMMUNITY HOSPITAL	Total	2.6	8.2	9.6	17.8	1.2352
	Hem	0.4	1.8	0.0	1.8	1.2064
	Isch	0.0	0.0	0.0	0.0	0.0000

	NS	1.8	6.0	9.6	15.6	1.4722
	TIA	0.4	0.4	0.0	0.4	0.1977
ANSON GENERAL HOSPITAL (Iroquois Falls)	Total	6.2	118.4	79.4	197.8	3.4623
	Hem	0.4	15.4	0.0	15.4	5.0687
	Isch	2.2	28.4	53.8	82.2	3.9416
	NS	2.2	69.6	25.6	95.2	4.5533
	TIA	1.4	5.0	0.0	5.0	0.5359
LADY DUNN HEALTH CENTRE (Wawa)	Total	4.2	33.2	60.8	94.0	3.1694
	Hem	0.6	2.6	0.0	2.6	1.0799
	Isch	1.0	15.8	0.0	15.8	2.4125
	NS	1.8	11.8	60.8	72.6	5.4014
	TIA	0.8	3.0	0.0	3.0	0.6608
SENSENBRENNER HOSPITAL (Kapuskasing)	Total	21.0	195.2	111.8	307.0	1.8987
	Hem	0.6	5.6	0.0	5.6	1.7212
	Isch	1.2	11.8	1.8	13.6	1.2312
	NS	10.8	140.4	105.0	245.4	2.9392
	TIA	8.4	37.4	5.0	42.4	0.6690
KIRKLAND AND DISTRICT HOSPITAL	Total	22.4	226.2	189.2	415.4	2.4096
	Hem	2.2	42.0	31.6	73.6	4.0970
	Isch	5.0	67.6	54.6	122.2	3.0111
	NS	9.0	90.4	103.0	193.4	2.8431
	TIA	6.2	26.2	0.0	26.2	0.6964
BINGHAM MEMORIAL HOSPITAL (Matheson)	Total	5.4	48.4	0.0	48.4	1.2796
	Hem	0.0	0.0	0.0	0.0	0.0000
	Isch	1.2	15.2	0.0	15.2	1.7652
	NS	3.0	29.2	0.0	29.2	1.2997
	TIA	1.2	4.0	0.0	4.0	0.7438
MATTAWA GENERAL HOSPITAL	Total	10.2	140.0	74.4	214.4	2.6480
	Hem	1.0	22.0	0.0	22.0	3.1427
	Isch	0.4	9.4	0.0	9.4	3.5509
	NS	4.8	99.2	74.4	173.6	4.2272
	TIA	4.0	9.4	0.0	9.4	0.5389
MANITOULIN HEALTH CENTRE	Total	32.4	235.2	106.6	341.8	1.5958
	Hem	1.2	15.4	13.2	28.6	4.5322
	Isch	1.4	11.8	5.2	17.0	1.3124
	NS	15.6	162.8	62.6	225.4	2.0542
	TIA	14.2	45.2	25.6	70.8	0.8719
SMOOTH ROCK FALLS HOSPITAL	Total	4.0	48.0	34.2	82.2	2.5153
	Hem	0.2	0.4	0.0	0.4	1.4367
	Isch	0.0	0.0	0.0	0.0	0.0000
	NS	1.2	39.2	34.2	73.4	6.9960
	TIA	2.6	8.4	0.0	8.4	0.5303
JAMES BAY GENERAL HOSPITAL	Total	0.2	0.2	0.0	0.2	0.4397
	Hem	0.0	0.0	0.0	0.0	0.0000
	Isch	0.0	0.0	0.0	0.0	0.0000

	NS	0.0	0.0	0.0	0.0	0.0000
	TIA	0.2	0.2	0.0	0.2	0.4397
WEST NIPISSING GENERAL HOSPITAL	Total	26.8	156.0	136.8	292.8	1.3764
	Hem	1.0	5.8	7.8	13.6	2.0444
	Isch	1.0	7.4	0.0	7.4	1.2813
	NS	14.8	98.2	116.4	214.6	1.7614
	TIA	10.0	44.6	12.6	57.2	0.7493
TEMISKAMING HOSPITAL	Total	30.4	253.2	212.8	466.0	2.0661
	Hem	3.0	29.6	0.0	29.6	1.5707
	Isch	5.8	62.0	10.8	72.8	1.9504
	NS	13.2	139.8	202.0	341.8	3.1870
	TIA	8.4	21.8	0.0	21.8	0.5616
TIMMINS AND DISTRICT GENERAL HOSPITAL	Total	79.0	386.2	331.0	717.2	1.6387
	Hem	6.6	42.6	36.6	79.2	2.0489
	Isch	29.2	167.4	165.6	333.0	2.1547
	NS	22.0	118.4	121.2	239.6	1.7997
	TIA	21.2	57.8	7.6	65.4	0.6334
WEST PARRY SOUND HEALTH CENTRE	Total	43.6	355.8	157.8	513.6	1.6986
	Hem	6.8	57.8	11.4	69.2	1.7363
	Isch	17.6	165.6	99.2	264.8	2.2057
	NS	8.6	79.4	40.6	120.0	1.7499
	TIA	10.6	53.0	6.6	59.6	0.7905
SUDBURY HOPITAL REGIONAL	Total	322.2	2926.0	1889.4	4815.4	2.4192
	Hem	50.6	573.8	402.0	975.8	4.2283
	Isch	124.2	1317.2	897.4	2214.6	2.7214
	NS	79.0	672.6	558.2	1230.8	2.1631
	TIA	68.4	362.4	31.8	394.2	0.8281
SAULT AREA HOSPITAL	Total	209.4	1322.0	844.0	2166.0	1.6846
	Hem	25.0	192.2	131.0	323.2	2.3882
	Isch	52.6	427.8	313.2	741.0	2.4030
	NS	61.2	426.2	279.2	705.4	1.7211
	TIA	70.6	275.8	120.6	396.4	0.8686
WEENEEBAYKO AREA HEALTH AUTHORITY (Moose Factory)	Total	4.8	33.0	1.8	34.8	1.3556
	Hem	0.2	1.8	1.8	3.6	4.0732
	Isch	0.8	2.8	0.0	2.8	1.4670
	NS	1.8	15.0	0.0	15.0	1.4120
	TIA	2.0	13.4	0.0	13.4	0.9886
NORTH BAY REGIONAL HEALTH CENTRE	Total	164.8	956.4	668.4	1624.8	1.4359
	Hem	12.2	85.4	45.4	130.8	1.5701
	Isch	51.0	373.8	319.0	692.8	1.9199
	NS	45.0	295.2	260.6	555.8	1.7688
	TIA	56.6	202.0	43.4	245.4	0.7061

Appendix B

Summary of cost estimates, sources and adjustments copied from the 2012 OSN Impact of Moving to Stroke Rehabilitation Best-Practices in Ontario report.

Data Point	Value	Source	Adjustments
Acute care bed day – Ischemic Stroke (ICD-10 codes I63,I64)	$591.52	Ontario Case Costing Initiative CAT tool	Inflation
Acute care bed day – Hemorrhagic Stroke (ICD-10 codes I61,I62)	$576.64		
Acute care bed day – TIA (ICD-10 code G45.9)	$656.58		
Inpatient rehabilitation bed day	$603	RPG stroke values (2008)	Inflation
Inpatient rehabilitation salary (PT)	$104,057	2014 OPSEU central collective agreement wage grid	None
Inpatient rehabilitation salary (OT)	$104,057		
Inpatient rehabilitation salary (SLP)	$110,004		
Inpatient rehabilitation salary (PT/OTa)	$52,080		
Inpatient rehabilitation salary (CDA)	$53,688		
CCC rehabilitation bed day	$561	Estimate provided by Elisabeth Bruyere Hospital, Ottawa	None
Outpatient rehabilitation visit (PT or OT)	$94.33	Parkwood Hospital Outpatient Rehabilitation Program (2010)	None
Outpatient rehabilitation visit (SLP)	$97.80		
CCAC in-home rehabilitation visit (PT)	$117.13	CCAC MIS comparative reports 2011/12	None
CCAC in-home rehabilitation visit (OT)	$139.98		
CCAC in-home rehabilitation visit (SLP)	$141.12	SE LHIN CCAC cost estimate (2010)	None