

Final Pilot Evaluation Report

Endovascular Thrombectomy in Hyperacute Stroke Care: improving outcomes for those with severe stroke across Southeastern Ontario

August 2017

**Kingston Health Sciences Centre (KHSC)
Kingston General Hospital (KGH) Site**



Submitted by:

The KHSC-KGH Stroke Endovascular Thrombectomy (EVT) Workgroup - membership list in Appendix A

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1.0 Executive Summary

Background

Five landmark trials supporting Endovascular Thrombectomy were published in 2015 supporting this treatment as a new standard of care and included in the Canadian Best Practice Recommendations for stroke care in July 2015. This had significant regional implications for KHSC-KGH as one of Ontario's nine designated Regional Stroke Centres (RSCs). KHSC-KGH did not participate in the research trials because, despite significant supra-aortic experience, the KGH body interventional radiologists were not neuro-trained. This treatment consists of arterial catheterization and mechanical removal of large clots occluding brain vessels using a micro-catheter and retrieval stent thus promoting reperfusion of the circulation by recanalization of the artery. The evidence supports significant improvement in functional outcomes for select patients with large proximal clots. The outcomes for these select patients are poor with IV thrombolysis alone. The endovascular treatment can be given with or without IV thrombolysis and is the only treatment available for patients with contraindications to IV tPA (e.g. due to bleeding risk). EVT also has a longer time window of 7.3 hours versus 4.5 hours for thrombolysis; however, the sooner treatment is delivered the better the outcomes. Cases transported to Ottawa or Toronto have arrived too late to benefit. Eligibility for treatment is based on clinical presentation combined with specific brain and vascular imaging (CT head and multiphase CT angiography).

KHSC EVT Pilot

Approval: In June 2015 the Senior Leadership Team at KGH supported the formation of an inclusive multi-disciplinary and interprofessional EVT Workgroup to assess the feasibility of EVT delivery at KGH. The Workgroup mapped the process flow for EVT patients from pre-hospital care, through ED, DI, IVR, and Kidd 2 Critical Care to the Kidd 7 Acute Stroke Unit. A business case for EVT delivery at KGH was developed for both daytime and 24/7 service delivery. In Dec 2015, a presentation was made to the KGH Planning and Performance Committee asking for senior leadership approval to plan and implement a Pilot of 10 EVT cases at KGH over the 2016/17 fiscal year. Given EVT was not yet publicly funded, a funding source was identified through a deferred stroke project fund. The Pilot was approved for daytime cases 8am to 4pm with the understanding that if successful, learning would be applied to planning 24/7 service delivery. It was understood that 24/7 service delivery would require significant resources from the IVR suite.

A project plan was delivered. Education was provided, care processes and order sets were developed and an innovative mentorship model was established with Hamilton using Tele-fluoroscopy. The Pilot was launched May 2016. Indicators were monitored; debriefs were held on every case and informed continuous improvements. Workflow improvements were made; for example, median thrombolysis Door-to-Needle time was reduced from 41 to 19 minutes. Ten 10 anterior circulation cases were completed by May 2017.

Regional Access: The Pilot included several patients on EMS bypass to KGH for thrombolysis from community hospitals (e.g. Napanee, Brockville). The Pilot was extended to the QHC-Belleville site and transfer algorithms for QHC were implemented in December 2016. QHC delivers thrombolysis for patients in that catchment so a protocol had to be developed to allow QHC to initiate thrombolysis and then transport EVT eligible candidates to KGH. This required Belleville to implement provincially recommended CT/CTA imaging to select eligible patients and a "drip and ship" protocol/algorithm for transport to KGH via land ambulance with a nurse escort. QHC worked effectively with KGH to enable access and flow, bearing referral costs that are not covered by QBP (imaging, nurse escorts). Regional stroke repatriation agreements had been in place since 2004 and continued to apply to EVT cases; however, several cases did well enough to be discharged straight home within a week.

KHSC Pilot Outcomes:

An interim Pilot Report and presentation were circulated in January 2017 with a final report in August 2017. The EVT Stroke team received the prestigious KGH Board *Team Award for Care* in January 2017. Cases were treated from across the region. Both process times and outcomes from the 10-case Pilot compared favorably with those of the Canadian ESCAPE trial (53% with Modified Rankin Scale MRS score of ≤ 2 at 90 day follow-up i.e., minimal to no disability). Process times for picture to puncture to reperfusion were well ahead of trial targets.

Pilot Outcomes:

- All cases had severe disability on presentation.
- 8/10 cases showed improved function at acute discharge:
 - 6/10 cases had minimal to no disability, MRS ≤ 2 at 90 day follow-up;
 - 2/10 cases had moderate disability, best MRS ≥ 3 by 90 day follow-up.
- Two deaths – technically challenging - one procedure had to be aborted, one case with severe vessel tortuosity.

Stroke EVT Funding

Interim results were already demonstrating feasibility of daytime service delivery so KGH began to discuss plans for 24/7 delivery given the ministry had announced QBP EVT funding in 2017/18 only for sites that delivered 24/7 service. In May 2017, KHSC learned that it would be funded for 14 cases in 2017-18 at a QBP price of \$29,633 per case. Although there was no explanation for the volumes, reference was made to service delivery requirements that included 24/7 service.

A QBP memo was released in March 2017 indicating that EVT had been added to the Stroke QBP Clinical Handbook, effective April 1st 2017. QBP Intervention codes were identified (1.JE.57.GQ; 1.JW.57.GP-GX.; 1.JX.57.GP-GX). Exclusions included patients under 18 years, cases at non 24/7 EVT Centres, and strokes occurring as a post-admission complication. Case-costing included both emergent and inpatient costs, covering the full episode of care. The EVT treating centre receives the QBP price of \$29,633 for funded EVT procedures. The sending facility does not receive funding when selecting or transferring a patient to KHSC.

Pilot Conclusions and Outcomes since Pilot Completion

- a) The Pilot has demonstrated feasibility.
- b) KGH has demonstrated that it has the operational capacity and technical ability to perform EVT safely and effectively with successful outcomes in line with published trials.
- c) Many patients will stand to benefit from the service; EVT should be made available 24/7.

Since Pilot Completion, process times and patient outcomes have continued to be in line with the ESCAPE trial sustaining the 60% favorable Pilot outcome rate. This procedure can be feasibly performed between Ottawa and Toronto, an urgent necessity for our region given the time dependency of stroke treatment. This treatment has dramatically improved outcomes for individuals with very large strokes who previously had limited treatment options and embodies KHSC's role as a specialty acute centre for the region. The KHSC-KGH EVT team delivers this innovative, outstanding care despite having more limited resources than larger tertiary centres. KHSC has received public funding for EVT and has entered a new era in outstanding stroke care in this region thanks to the passion and commitment of a collaborative care team.

24/7 EVT Delivery at KHSC-KGH site

The pilot demonstrated that this complex procedure required added interventional radiology staff (RNs and techs) as well as interventional radiologists and neurologists. There was a need to build an adequate staffing pool for call-back. An agreement facilitated by the Office of the Chief of Staff was signed with the interventional radiologists on July 7th, 2017. This agreement supported increased staffing and provision for education. New staff were hired and trained with the plan to launch 24/7 service delivery on Sept 29th, 2017.

Summary and Recommendations:

EVT is a new standard of practice in stroke care that saves lives and improves outcomes for citizens of our region. The EVT service at KHSC is now well established and is demonstrating consistent process times and positive outcomes. Patients from across the region have received this treatment, the majority returning home with no disability, often within a week. Recommendations on page 9 of the report include planning for 24/7 volume growth and for expansion of IVR space, equipment and staff over the long term. Ongoing evaluation, CQI and regional communication will continue to be overseen by the KHSC EVT Workgroup. Further advocacy with the MOHLTC will be needed to ensure adequate volume-based funding and to reconsider funding of EVT for inpatients who sustain strokes as a post-admission complication.

2.0 Project Summary

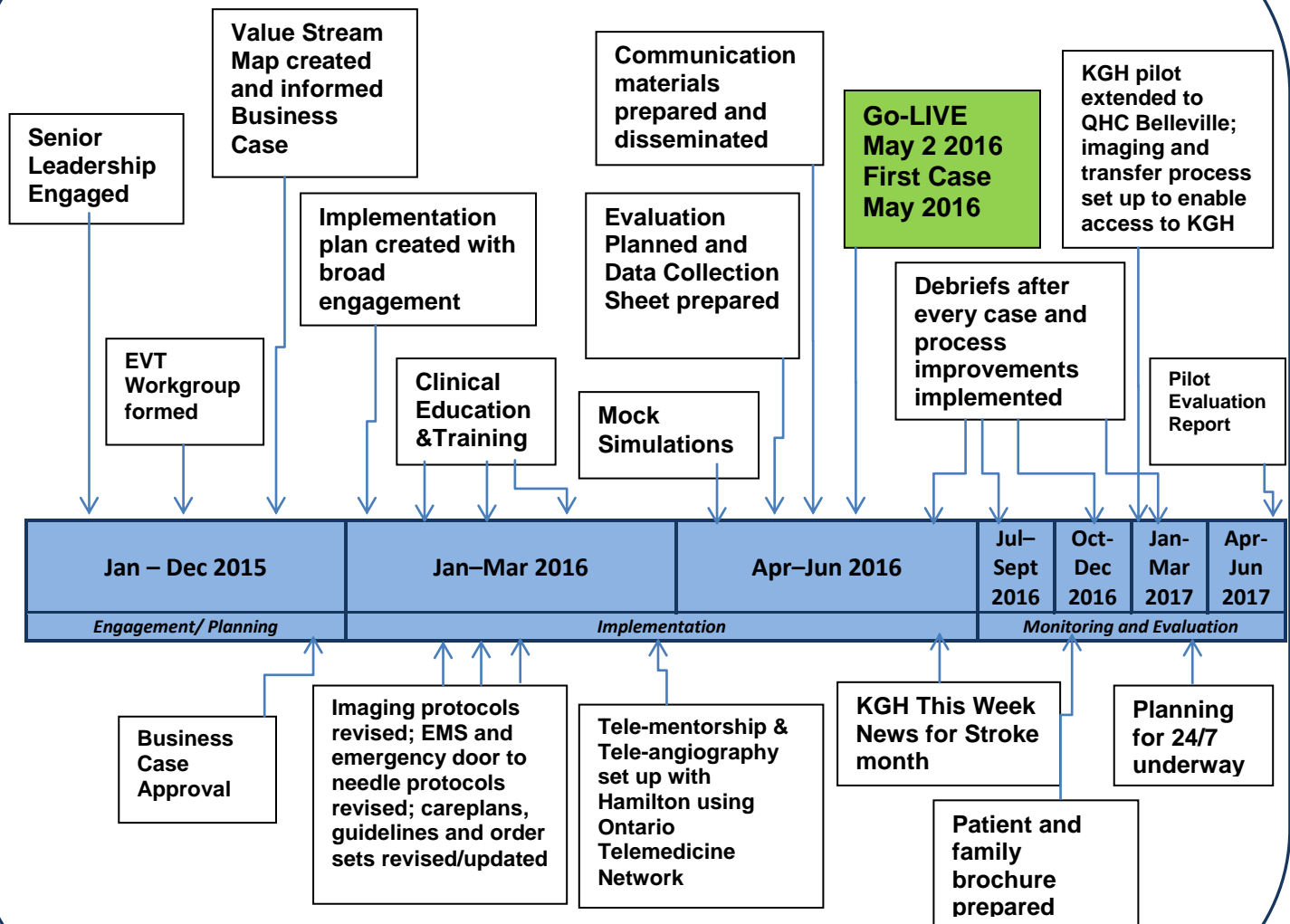
KHSC-KGH site is one of Ontario's nine designated Regional Stroke Centres (RSCs), the only acute tertiary care centre between Toronto and Ottawa. Five landmark trials were released in 2015 supporting strong evidence for endovascular mechanical clot retrieval (thrombectomy) in hyperacute stroke care. These trials led to the identification of this treatment as a new standard of hyperacute stroke care in the July 2015 update of the [Canadian Best Practice Recommendations for Stroke Care](#) (Heart and Stroke Canada). The evidence supports significant improvement in functional outcomes and reduced mortality for select patients that otherwise tend to respond poorly to IV thrombolysis. Selection criteria include patients with large proximal clots and adequate collateral circulation evident on imaging. This new treatment can be given with or without IV tPA. It is highly time dependent and as such, travel to Ottawa or Toronto negates the possibility of quality outcomes.

Given this new evidence, a KGH Stroke EVT Workgroup was formed in August 2015 bringing together interprofessional representatives from neurology/neurosciences, emergency, interventional radiology, neuroradiology, critical care and anesthesiology. This group developed a value stream map to inform a business case that was presented to the KGH Planning and Performance Committee in Dec 2015. This Committee approved a Pilot Project to deliver Endovascular Thrombectomy (EVT) using mechanical clot retrieval for ten acute ischemic stroke patients who met specific selection criteria. The EVT Workgroup delivered on a project plan and launched a weekday service on May 2nd 2016. The intent of the Pilot was to learn what would be required to deliver the service 24/7. Between May 2016 and May 2017, eleven individuals received the treatment, ten of which fit anterior circulation inclusion criteria for the Pilot (one being a posterior circulation case). Process and outcome data were collected for every case. Debriefs were held and minuted following every case in order to learn and make process improvements. Costs were tracked for IVR supplies used for each case. Three- month follow-up visits were set up to track functional outcomes. The Pilot Project demonstrated that the KGH EVT team can feasibly and effectively deliver the service during weekdays with positive outcomes of minimal to no disability in 6 of 10 cases and moderate instead of severe disability in two cases. One case had to be aborted due to technical limitations and one very complex case died as a result of complications. Recommendations include planning to deliver the service 24/7 with attention to IVR staffing and call demands, and to ongoing monitoring.

2.0 Project Implementation Overview

Figure 1 - Project Plan Overview	Apr – June 2015	July – Sept 2015	Oct – Dec 2015	Jan – Mar 2016	Apr – June 2016	July – Sept 2016	Oct – Dec 2016	Jan – Mar 2017	Apr – June 2017
Engagement, Business Case Approval									
Communication Plan									
Evaluation Plan									
Resource Planning - Staff, Space and Equipment									
Clinical Pathway Implementation and Related Education/Training									
Process Review and Improvement									
Regional Planning to create Belleville telestroke access									
Pilot Report and Planning for 24/7									

Figure 2 - Project Implementation Summary

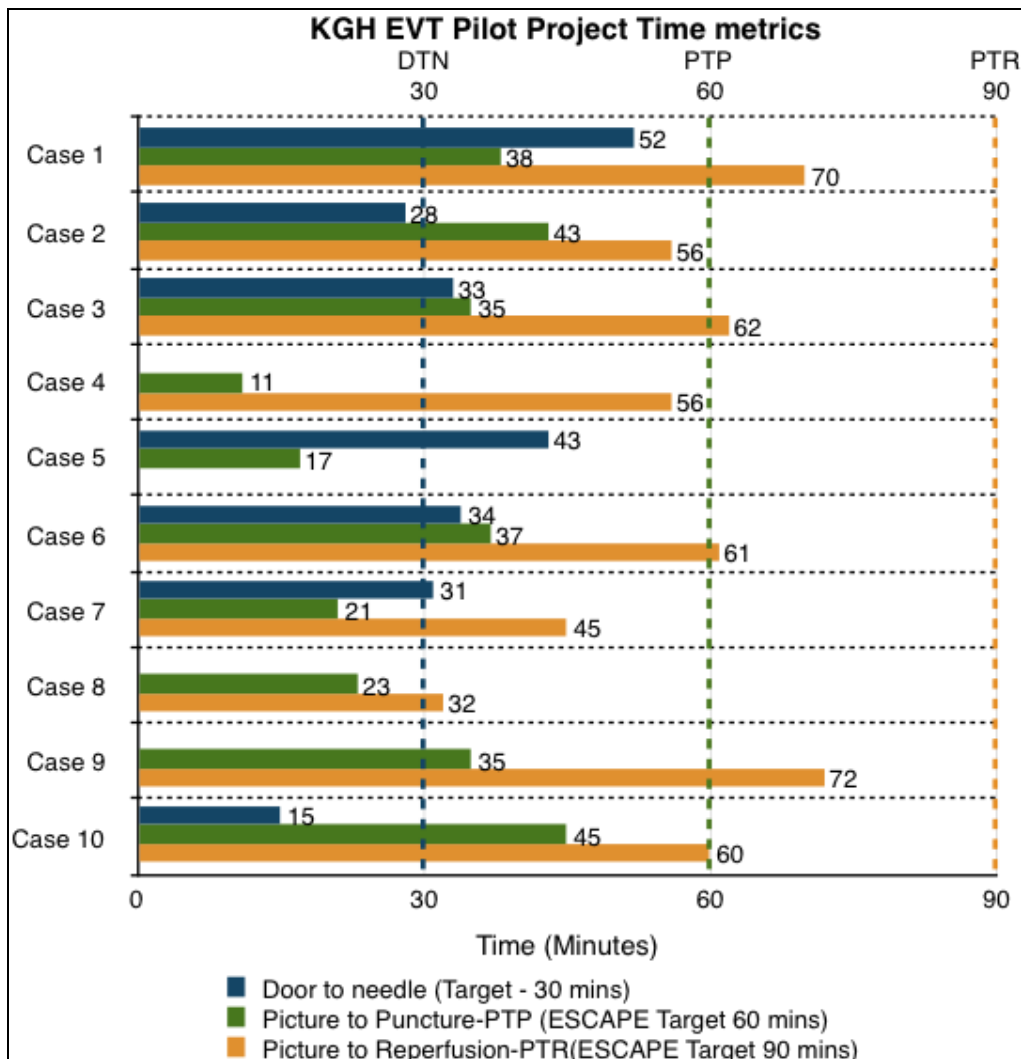


A project plan was developed with the input of the full Workgroup (summarized in Figures 1 and 2 and Appendix B). The CT suite obtained the multi-phase imaging protocol from the Calgary EVT team and adopted it at KGH. The interventional radiology team attended an EVT workshop in Banff delivered by the leaders of the Calgary ESCAPE trial. Telementorship was set up with Hamilton and their protocols were obtained. Mock simulations of the emergency and imaging process were held, followed by simulations of the entire procedure; these included paramedic providers. Patient selection criteria were established. Care plans and order sets were revised and stroke packages updated. Protocols and guidelines are listed in Appendix C. Education and communication materials on best practices were prepared and disseminated. The evaluation was planned, indicators established and data collection sheets prepared. The pilot was launched May 2nd and the first case took place in May. Debriefs informed process improvements (e.g. checklists, flow, data collection). Weekday volumes were as anticipated with an average of one case per month although some months were busier than others. Twenty evening and weekend missed cases were also tracked. Work began with Belleville in September to include telestroke cases due to six added missed cases from that area. Belleville developed imaging and transfer protocols in discussion with the Regional Stroke Program. A process for Belleville transfers launched Dec 21st 2016 and CitiCall added KGH to its Call Centre for weekday cases in early January. Process improvements continued with planning for 24/7 delivery.

3. Process Indicators: Time is Brain

Outcomes of this procedure are known to be extremely time sensitive. For this reason, time metrics were tracked and are represented graphically below (Figures 3, 4). Debriefs were held after every case and ensuing actions were documented. The feedback from staff, reflections, learning and follow up actions from each debrief are summarized below (Table 1). Full documentation of debrief actions is included in Appendix D. Many challenges were overcome. The process is complex and involves many resources with players working collaboratively in a time sensitive manner. The time graphs indicate the success of the team in surpassing ESCAPE trial time targets.

Figure 3: DTN, CT to Puncture & CT to Perfusion Time Metrics, KGH EVT Pilot Project



Notes:

Some cases did not receive thrombolysis for medical reasons; door to needle time was not applicable for these cases
Some were in-hospital at the time of the stroke; one case was aborted for medical and technical reasons

At the start of the project, patients were treated from the central and eastern parts of the region but not from Belleville/Hastings & Prince Edward Counties. The Belleville area patients seen in the QHC ED use the provincial telestroke consultation process. Belleville patients were initially transported to Toronto EVT centres from Feb to July 2016. The outcomes of these cases were varied and none received EVT. The time sensitivity of this treatment offset the chances of positive outcomes given the travel time to Toronto. As such, transfer algorithms and imaging selection processes were established within the region to enable Belleville participation in the weekday KGH Pilot. These followed recommended provincial processes. As of Dec 2016, Belleville began to transfer patients to KGH and jointly debriefed on transferred cases in order to apply learning to future transfers. The transfer process was a success and continues to be used. The hours were adjusted once plans were made for 24/7 service delivery. At that time, Belleville also put 24/7 CT/CTA imaging selection processes into place.

Figure 4: KGH EVT Pilot Time Metrics versus ESCAPE Trial Target Time Metrics

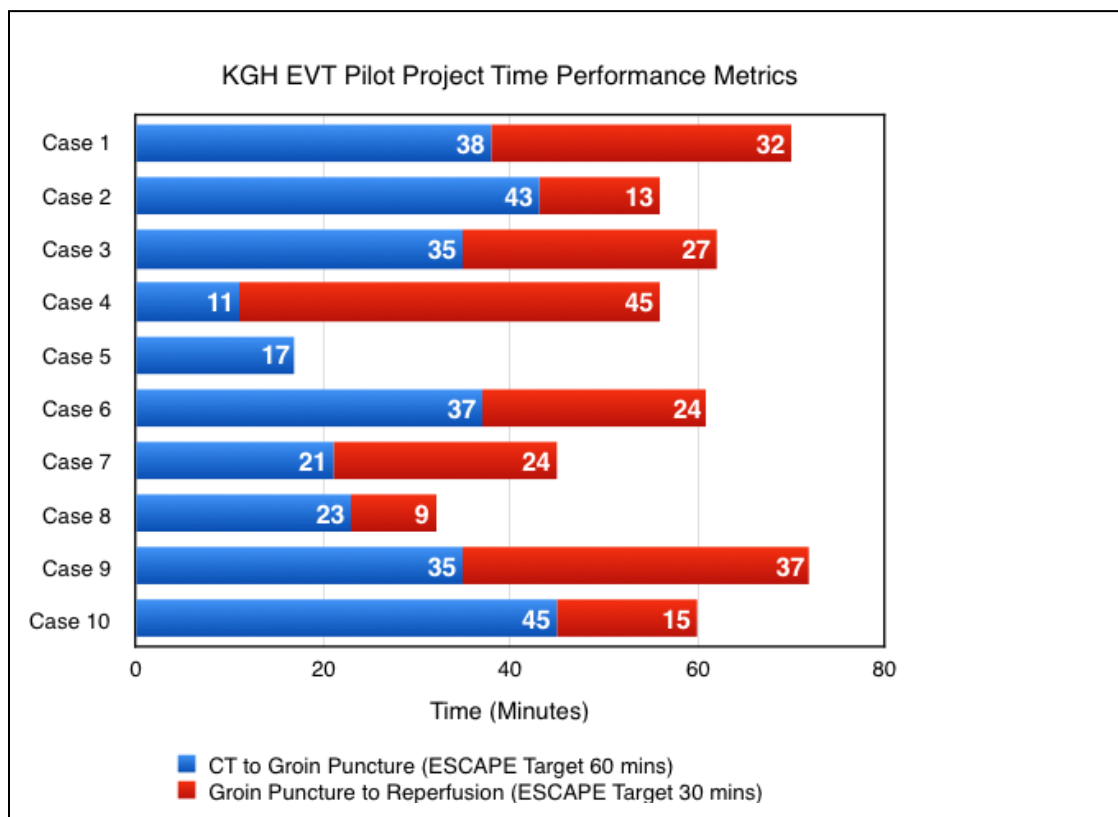


Table 1: Summary of Debrief Concerns and Actions Taken (full documentation in Appendix D)

Debrief Themes	Actions taken
Case Selection	2 Interventional Radiologists make the decision to proceed; Inclusion & Exclusion Selection/Safety Checklist Created and available in CT suite.
ED workflow and door to needle times	Patient registration included in pre-notification; Processes for Point of Care testing devices and communication about bloodwork protocols; Patient remaining on EMS stretcher and use of EMS monitor to CT suite; consideration for tPA to be given in CT suite; stroke recognition for cases not arriving on "stroke protocol"
Imaging protocol – delays in imaging reconstruction	CT tech practice; new CT Scanners now in place; faster reconstruction times; MOCK simulations reviewed roles and processes as noted above.
Communication, patient flow, bed management,	From ED to IVR and back; from neuro and IVR to ICU; from ICU to Kidd 7 Stroke Unit; clarity on who communicates when to facilitate planning; updated in roles and responsibilities chart; use of IVR stretcher vs ICU bed; communication on when using indwelling urinary catheters
Consent	Use of the standard IVR consent form; emergency consent added to checklist
Family information	Use of family brochure; use of IVR family room
Procedural Sedation	IVR nurses are trained in procedural sedation and provide the sedation; Neurology advises based on clinical presentation; use of minimal sedation
IVR Technical Concerns & Equipment	Check re opening stent devices; use of aspiration, J-curve; equipment availability for intra-arterial tPA; restraints; C-Arm; use of stretcher; MOCK simulations - neurology role in IVR suite; radiation safety training for neurology
Order sets	EVT order Set available in Entry Point; tPA orders to be entered in EDIS
Discharge planning and follow-up with regional partners	Repatriation to stroke units at home hospitals; follow up by KGH or local Stroke Prevention Clinic with Modified Rankin score at 90 days.
Regional access	Algorithms, drip and ship protocols for Belleville, joint workgroup
Data Collection and Time Capture	Ongoing refinements to time capture and data collection processes; addressing missing information; use of electronic record PCS and a data sheet in IVR
In- hospital stroke – EVT processes	Revision of process to allow for thrombolysis to be given in CT suite

4. Outcome Indicators

Positive outcomes are indicated by reperfusion scores of TICI 2b or 3 and a 90 day Modified Rankin Scale (MRS) score of ≤ 2 indicating minimal to no disability. Table 2 outlines the Pilot data. Average age was 69.4 years with a range from 43 to 83 years, 6 female and 4 male. Eight of ten cases (80%) showed significant improvement in function at acute discharge with six of ten having a MRS ≤ 2 at 90-days and two with a best MRS score of 3-4. This compares favorably with the ESCAPE trial outcomes of 53% with a MRS ≤ 2 at 90 days. Of note: two cases died. These involved technically challenging cases with significant vessel tortuosity or difficulties in passing the aortic arch precluding intervention. Well after acute discharge, one further case died of other stroke complications.

Table 2: Outcomes Indicators, KGH EVT Pilot

Case #	NIHSS Stroke Scale		tPA given	CT APECTS on arrival	Collateral score/ Clot on arrival	Reperfusion Score	KGH Length of Stay	MRS at 90 days
	arrival	day 1						
<u>1</u>	7	8	y	8	4 L M1 - FMD	TiCi 2b	5	6
<u>2</u>	23	0	Y	10	4 LMCA	TiCi 3	4	0
<u>3</u>	23	13	Y + IA	9	4 L M2	TiCi 2b	19	2
<u>4</u>	20	0	N	8	4 RMCA	TiCi 3	4	0
<u>5</u>	20	N/A	Y	9	1 RMCA & M1	aborted	1	6
<u>6</u>	22*	4	Y	9	4 R MCA	TiCi 2b	2	0
<u>7</u>	16	4	Y	9	3 RMCA & M1	TiCi 2b	6	0
<u>8</u>	16	9	N	7	3-4 RMCA & M1	TiCi 3	14	3* (*best score at acute discharge)
<u>9</u>	15	0	N	7	5 L MCA, M1	TiCi 3	6	0
<u>10</u>	12	8	Y	10	4 R MCA, M1	TiCi 3	18	4

*15 on arrival and 22 by time of CT

Note: a posterior circulation case with a vertebro-basilar blockage also was transferred via CritiCall to KGH. Recanalization was successful however, the 7-hour delay to arrival at KGH in this younger individual with severe stroke resulted in significant infarction. The door to reperfusion time was 40 minutes (door to CT 6 mins, CT to puncture 21 mins, puncture to reperfusion 13 mins). Return home was possible following a long course of rehabilitation and strong family support despite an outcome of ongoing severe disability. Posterior circulation cases do not align with ESCAPE selection criteria so these were not included in the Pilot data. Outcomes for posterior circulation cases continue to be tracked separately.

Missed Cases: An effort was made to track known missed cases. Twenty potential EVT cases were missed during the timeframe of the Pilot, the majority presenting to the KGH ED on evenings and weekends. The limited weekday hours of EVT service were of significant concern. In addition, six cases presenting at the district stroke centre, QHC-Belleville were transported to Toronto during the same timeframe but did not receive EVT. Regional volumes were predicted to be up to 40 cases in the first year of 24/7 service delivery with growth expected up to 60 cases in the following year, possibly more given the plans for expansion of the EMS time window for bypass to 6 hours.

5. Story-telling; the Lived Experience

The outstanding outcomes are best described by these stories:

- a) A person arrived on bypass from a community hospital presenting with complete right sided weakness and inability to speak: *"Within minutes of the procedure being completed, the patient was talking and shaking hands with the doctors and nurses who were in the room. People on the team were ecstatic as we'd never seen anybody recover this quickly from this type of big stroke before"* KGH this Week 2016
- b) A person was visiting family and experienced a sudden onset of right-sided weakness and complete loss of speech. EVT was delivered and the individual was able to return home, able to walk and speak despite ongoing difficulties swallowing.
- c) A young woman and her family all arrived by EMS. She had severe movement abnormality throughout her left side. She received EVT and was discharged home in a few days, able to care for her baby. She continues to live at home without deficits, caring for her family.
- d) A woman was brought to KGH by ambulance, bypassing a community hospital. She had severe right sided weakness and inability to speak. She was able to return to the local acute stroke unit in 3 days and returned home to 2 days later, functioning independently.
- e) A man arrived by ambulance bypassing a community hospital. He had severe left sided weakness, visual field loss and neglect of his left side. His wife came with him in the ambulance. He received EVT and recovered well, returning to the local acute stroke unit for follow up in relation to his mild remaining deficits; he was discharged home within a week, functioning independently.
- f) A person experienced a stroke as an in-hospital complication three days following cardiac surgery. Although not a candidate for thrombolysis, this person received EVT and was able to return home the same week, fully independent with no brain infarction on repeat CT and much improved cardiac function.

6. Case-Costing

Supply Costs

Pilot funds were made available for the first 10 cases and further cases were supported until MOHLTC funds were received. Upon transitioning to 24/7 service, KGH qualified for public Quality Based Procedure funding. Case costing on the IVR equipment costs for the 10 Pilot cases is outlined below:

Case #1 - \$13,006 (2 stents)
Case #2 - \$7,405
Case #3 - \$8,385
Case #4 - \$7,926
Case #5 - \$808 (no stent deployed)
Case #6 - \$8,373
Case #7 - \$7,944
Case #8 - \$8,175
Case #9 - \$8,415
Case #10- \$7,944

Total: \$78,381

Average supply cost per anterior circulation case = **\$7,838.81**

In addition, the posterior circulation case supply cost was: \$8,831

Human resource costs:

Two of the daytime cases required some overtime due to arrival late in the day. Given the positive Pilot outcomes, and following an interim report, 24/7 planning began. It was determined that an increased resource pool would be needed for IVR techs and nurses in order to prevent staff burnout from excessive call. The EVT team revisited processes to enable 24/7 delivery. This estimate was used to re-visit the original Business Case created for the Planning and Performance Committee in Dec 2015. A revised plan for the expected 24/7 delivery was made available to the Senior Executive Team and included two additional 0.5 FTE part time RNs and two added 0.5 FTE part times MRTs. In May 2017, the hospital received word from the MOHLTC and LHIN that it would receive public funding of \$29,633 per case for 14 cases in FY 2017-18 on the condition that it moved to 24/7 service delivery.

7. Recommendations (impact, sustainability and spread)

- 1) Continue to deliver EVT services and plan to move to 24/7 delivery by Sept 2017;
- 2) Ensure staff continue to be recognized for their significant contribution to innovation in best practice;
- 3) Communicate and profile the Pilot findings within KHSC, externally with Queen's University, regional and provincial partners; specifically, with Queen's Faculty of Health Sciences, the University Hospitals Kingston Foundation; regional health care providers; the SE LHIN; other regions, CorHealth Ontario and MOHLTC.
- 4) Until a CIHI EVT administrative database becomes available, continue to monitor process times and outcomes using a reduced manual data collection sheet (Appendix E) focused on:
 - a. Collection of the recommended national indicators;
 - b. Use of embedded and reliable data sources such as EDIS, PACS, PCS, IVR and ICU flow sheets;
- 5) Transition data collection to CIHI administrative EVT data sources when these become available (anticipated in 2018-19).
- 6) Adopt a communication tool for the EVT team outlining process times against targets modeled after Hamilton's, for use with those within the circle of care;
- 7) Discontinue scheduled interprofessional debriefs on each case. Debrief immediately after each case as needed with those involved in the case. Regional Stroke Office will schedule full debriefs as needed at the request of EVT Workgroup Members.
- 8) Continue to hold EVT Workgroup meetings every 3 to 6 months as needed to review processes and outcomes; frequency to be determined by the Workgroup based on need.
- 9) Implement the KHSC plan for 24/7 service delivery by Sept 2017 as follows:
 - a. Continue to engage paramedics, ED, diagnostic imaging, IVR, critical care, Kidd 7 and neurology teams in providing collaborative input on workflow processes, staffing and equipment needs to support 24/7 best practice;
 - b. Refine the EVT workflow process for 24/7 service delivery based on input from MOCK simulations;
 - c. Continue to track stroke protocol volumes by time of day to inform ongoing planning;
 - d. Build the annual EVT budget using the revised 24/7 business case, with approval from senior leadership;
 - e. Hire new IVR staff and provide necessary training;
 - f. Communicate with CorHealth Ontario and the SE LHIN the plan to launch 24/7 service delivery by September 2017.
- 10) Implement the Regional Stroke plan for access to 24/7 EVT including:
 - a. Support QHC to implement 24/7 multiphase CTA protocols, refine drip-and-ship protocols and decrease door-to-needle and door-in-door transfer times;
 - b. Support Paramedic Services to implement the revised paramedic prompt card when mandated by the MOHLTC (arrival at ED within 6 hours instead of 3.5);
 - c. Revise the transfer guideline for walk-in protocols from community hospitals to 6 hours by Sept 2017 and remove unnecessary exclusions;
 - d. Continue to assess telestroke readiness with Brockville General.
- 11) Inform CorHealth Ontario of predicted volumes and advocate with the MOHLTC for adequate volume-based funding given anticipated growth.
- 12) Support EVT team participation in ongoing learning opportunities to sustain and build competencies;
- 13) Inform long-range planning for expansion of interventional radiology space and staffing at KHSC in relation to Stroke EVT needs and growth in the endovascular field;
- 14) Given KGH's academic role, facilitate knowledge translation of Pilot findings:
 - a. Deliver presentations, posters and publications about how centres of this size can successfully deliver EVT;
 - b. Collaborate with other research teams;
 - c. Share KHSC's experience as a prototype for innovative approaches to building EVT access and capacity at other stroke centres; include tele-angiography as an innovative mentorship model.

8. Discussion

The Pilot has validated the original premise of the Business Case.

The benefits are:

1. Significantly improved outcomes for stroke patients, particularly for those with severe stroke:
 - a. decreased mortality
 - b. decreased morbidity/disability: improved level of functional recovery
 - c. improved quality of life;
2. Decreased length of stay in acute care;
3. Decreased long term costs of stroke care:
 - a. reduced inpatient rehabilitation stay
 - b. reduced need for community rehabilitation and reintegration supports
 - c. decreased long term care requirements;
4. Informed planning for regional hyperacute EVT delivery systems
5. Regional access to new hyperacute stroke care standards; demonstrated role as a Regional Stroke Centre.

The impacts if the service is not continued are:

1. Cost to the patient and family:
 - a. greater mortality
 - b. greater long term disability and dependence; decreased level of functional recovery
 - c. decreased quality of life
2. Increased length of stay in acute care
3. Increased long term costs of stroke care
 - a. increased inpatient rehabilitation stay
 - b. increased need for community rehabilitation and reintegration supports
 - c. increased long term care requirements
4. No access to this evidence based approach for the citizens of Southeastern Ontario; given the limited time window eligible SE residents have not been able to access this treatment elsewhere.
5. Risk of losing ministry designation as Regional Stroke Centre and associated regional funding.
6. Risk of losing Accreditation Canada Stroke Distinction Status.

9. Conclusions

- a) The Pilot has demonstrated feasibility for delivery of EVT at KHSC-KGH site.
- b) KGH has demonstrated that it has the operational capacity and technical ability to perform EVT safely and effectively with successful outcomes in line with published trials.
- c) Many patients will stand to benefit from the service; EVT should be made available 24/7.

This procedure can now feasibly be performed between Ottawa and Toronto, an urgent necessity for our region given the time dependency of stroke treatment. This complex service was put in place within one year of the release of evidence-based publications. This treatment has dramatically improved outcomes for individuals with very large strokes who previously had limited treatment options. This embodies KHSC's role as a specialty acute centre for the region. The KHSC-KGH EVT team now delivers innovative, outstanding care despite having more limited resources than larger tertiary centres. KHSC is now eligible for public funding for EVT and has entered a new era in outstanding stroke care in this region thanks to the passion and commitment of a collaborative care team. Planning for 24/7 delivery will take staff concerns and needs into account so that the service can be safely delivered and sustained at KGH.

The EVT Stroke team received the prestigious KGH Board *Team Award for Care* in January 2017. At the Award presentation, the Board Chair commented on the success of the broad collaboration required to implement this service. Dr Al Jin, Regional Stroke Medical Leader and Stroke Neurologist remarked *"Getting this successful service started required a great deal of time and energy from many staff. The benefit to the patient is immediate and one of the greatest advances in stroke therapy in the past 30 years, an enormous step forward. Many will be helped by the procedure; building capacity for 24/7 delivery is essential for our region given our population has no other way of receiving this time sensitive treatment."*

Bibliography

Landmark Endovascular trials

1. Berkhemer, O.A., Fransen, P.S.S., Beumer, D., van den Berg, L.A., Lingsma, H.F., Yoo, A.J., et al. for the [MR CLEAN](#) Investigators. A Randomized Trial of Intraarterial Treatment for Acute Ischemic Stroke. *N Engl J Med*. 2015 Jan; 372(1):11–20.
2. Campbell, B.C.V., Mitchell, P.J., Kleinig, T.J., Dewey, H.M., Churilov, L., Yassi, N., et al. for the [EXTEND-IA](#) Investigators. Endovascular Therapy for Ischemic Stroke with Perfusion-Imaging Selection. *N Engl J Med*. 2015 Feb 11; 372 (2):1009-18.
3. Jovin T.G., Chamorro A., Cobo E. et al for the [REVASCAT](#) Trial Investigators. “Randomized Trial of Revascularization with Solitaire FR Device versus Best Medical Therapy in the Treatment of Acute Stroke due to Anterior Circulation Large Vessel Occlusion presenting within 8 Hours of Symptom Onset”. *N Engl J Med* 2015; April 17
4. Saver J., M. Goyal, A. Bonafé, H. Diener, E. Levy, V. Mendes-Pereira, G. Albers, C. Cognard, D. Cohen, W. Hacke, O. Jansen, T. Jovin, H. Mattle, R. Nogueira, A. Siddiqui, D. Yavagal, T. Devlin, D. Lopes, V. Reddy, R. du Mesnil de Rochemont and R. Jahan for the [SWIFT PRIME](#) Investigators, “Solitaire with the Intention for Thrombectomy as Primary Endovascular Treatment for Acute Ischemic Stroke Trial: Protocol for a Randomized Controlled, Multicentre Study Comparing the Solitaire Revascularization Device with IV tPA alone in Acute Ischemic Stroke” *Int J. Stroke* 2015; 10; 439
5. Goyal, M., Demchuk, A.M., Menon, B.K., Eesa, M., Rempel, J.L., Thornton, J., Hill, M. et al. for the [ESCAPE Trial](#) Investigators. Randomized Assessment of Rapid Endovascular Treatment of Ischemic Stroke. *N Engl J Med* 2015; 372:1019-1030 March 12, 2015

Economic analyses

6. Mittmann, N., Seung, S.J., Hill, M.D., Phillips, S. J., Hachinski, V., Cote, R., Buck, B.H., MacKey, A., Gladstone, D. J., Howse, D. C., Shuaib, A., Sharma M. BURST study: Impact of Disability Status on Ischemic Stroke Costs in Canada in the First Year. *The Canadian Journal of Neurological Sciences* 2012; 39:6: 793 - 800.
7. Leppert, MH; Campbell JD; Simpson JR; Burke, JF; cost effectiveness of Intra-arterial Treatment as an Adjunct to Intravenous Tissue-Type Plasminogen Activator for Acute ischemic Stroke. *Stroke* 2015; 46: 1-7 July 2015
8. Gandesalingam, J; Pizzo, E; Morris, S et al; Cost Utility Analysis of Mechanical Thrombectomy using Stent Retrievers in Acute Ischemic Stroke. *Stroke* 2015; 46: 2591-2598 Sept 2015
9. Health Quality Ontario; Mechanical Thrombectomy in Patients with Acute Ischemic Stroke: A Health Technology Assessment; Ontario Health Technology Assessment Series; Vol 15; Sept 2015

EMS/ Hospital Protocols/Process

10. McTaggart RA; Ansari SA; Goyal M et al; Initial Hospital Management of Patients with Emergent Large Vessel Occlusion: report of the standards and guidelines committee of the Society of NeuroInterventional Surgery; *J Neurointervent. Surg* 2015; 0:1-9, Oct 2015
11. ESCAPE trial website - for clinical guidelines, protocols and resources:<http://www.ucalgary.ca/dcns/ESCAPE>

List of Appendices

- A. KHSC-KGH Stroke Endovascular Workgroup Members
- B. Project Plan One-page Implementation Summary
- C. List of KGH EVT Processes, Guidelines and Protocols
- D. Debriefing Notes: Stroke EVT ACTION Items
- E. Kingston General Hospital Stroke EVT Data Flow Sheet 2017

APPENDIX A

KHSC-KGH Stroke Endovascular Workgroup 2015-2017

Medicine (Neurology, Neurosciences, Stroke Network of SEO)
Dr. Ramana Appireddy, Stroke Neurologist
Darlene Bowman/Anne Dubé, Stroke Specialist Case Manager
Sharen Chapman, Program Manager, Neurosciences
Richard Jewitt/Cynthia Phillips, Program Operational Director, Medicine
Dr. Al Jin, Stroke Neurologist, Medical Director, Stroke Network SEO (Co-Chair)
Cally Martin, Regional Director, Stroke Network SEO (Co-Chair)
Colleen Murphy, Regional Stroke Best Practice Coordinator, Stroke Network SEO
Jennifer Rogers, Clinical Learning Specialist
Emergency Department
Jacquie Donaldson, Program Manager
Katherine Dowker/Krista Brisbin/Jenilee Feddema, Clinical Learning Specialists
Julie Caffin/Carol McIntosh Program Operational Director, ED
Dr. Terry O'Brien and Dr Karen Graham, Program Medical Directors, Emergency
Diagnostic Imaging Services and Interventional Radiology (IVR)
Brenda Beattie, Charge RN, IVR
Kelly Bodie, Program Manager, IVR
Barb Delaney, Senior CT Technologist, Diagnostic Imaging Services
Dr. Omar Islam, Neuroradiologist
Dr. Annette McCallum, Head, Radiology
Dr. Alex Menard, Interventional Radiologist
Dr. Ben Mussari, Interventional Radiologist
Karen Pearson, Director, Imaging Services
Lesa Thom, Imaging Services Senior IVR Technologist
Dr. Douglas Walker, Interventional Radiologist – IVR Department Chair
Anesthesiology
Dr. Imelda Galvin, Anesthesiologist and Intensivist (cross appointed to critical care)
Critical Care
Dr. Gord Boyd, Neurologist and Intensivist (cross appointed to neurology)
Julie Caffin/Leanne Wakelin, Program Operational Director, Critical Care
Rebecca Gill, Clinical Learning Specialist
Christina Panopoulos-Rowe, Program Manager, D4ICU
Nicole Valade/Donna Leybourne, Program Manager, K2ICU
Clinical Laboratories
Anne Vincent, Senior MLT, Point of Care Testing
Information Analysis & Distribution (IAD)
Rod Albrough, Senior Data Management Coordinator
Patient Safety, Quality & Risk
Dana MacPhail, Patient Experience Specialist

With ad-hoc support from Patient Registration, Switchboard, Paramedic Services

Appendix B

Project Plan One-page Implementation Summary (preparing for launch)

March 2016

- Complete signing of "*Terms of Pilot Project*" (A12)
- Finalize communications & key best practice messages (B3, E10)
- Confirm communication plan - who, when (B2)
- Confirm evaluation indicators; prepare data collection sheet (C1,2)
- Complete updates of Thrombolysis/Thrombectomy Rationale /Guidelines, Roles and Responsibilities Document, Stroke/CC Order Sets, Collaborative Care Plan (E1,6) and IVR Policies, Order Sets (E5)
- Follow up on DTN strategies from meeting held March 11 - set date for trial of patient staying on EMS stretcher through to CT (E2,3)
- Complete documentation of new KGH EVT imaging protocol (E4)
- Continue work on OTN telementorship between IVR and Hamilton (E5)

April 2016

- Patient and Family Education Resource Ready for Use (B4)
- Order equipment needed (D2)
- Deliver Key Messages to stakeholders (B5)
- Deliver Best Practice Education to staff in ED, IVR, CC using document on key Best Practices (E3,5,6,7)
- Trial of patient staying on EMS stretcher through to CT- early April (E2,3)
- April 7/8 - IVR and Neurology training - simulation with Dr Van Adel (E5,E8)
- Finalize OTN technical arrangements for IVR mentorship with Hamilton (E5)
- Communication with EMS, ED, DI, IVR, CC, K7 and neurology confirming roles and responsibilities (E3,4,5,6,7)
- Ensure clear communication plan for transitions from ED, IVR, CC, K7 (E1)
- Ensure clear protocol for notifying anesthesiology (E9)
- April 14th meeting with all EMS Chiefs re processes for DTN time (E2,3)
- MOCK trial of EVT process and debrief April 27 9:30 to 11:30 -use data collection sheet to simulate tracking times; use telementoring - (E11)
- Confirm date of launch based on MOCK (E12)

May 2016

- Launch - tentatively May 2nd (E12)
- Debrief process ready to implement (early May) (E13)
- Prepare draft evaluation reporting template (C3)
- Follow up on each debrief to improve processes (E13)

Appendix C

List of KGH EVT Processes, Guidelines and Protocols

The Following EVT Processes, Guidelines and Protocols have been developed and adopted for use at KGH:

- EVT Process Workflow Map
- EVT Business Case – Dec 2015 and updated March 2017
- KGH EVT Implementation Project Plan and One-page Summary used to prepare for launch
- Rationale and Guidelines for use of Thrombolysis and EVT
- Acute Stroke Protocol Roles and Responsibilities Chart for Thrombolysis and EVT
- ED RN Door to Needle Guide with Checklist for use in ED
- EVT Best Practice Key Messages Communiqué
- CT/mCTA Imaging Protocol and Emergency Consent form
- Safety Inclusion Exclusion Checklist for Physician use in Patient Selection
- IVR Consent Form
- IVR Prep Sheet
- KGH Adult Procedural Sedation Policy and related documents (RAMSAY Score)
- IVR Procedure Order Set
- IVR Post Procedure Order Set
- Angiography Sheath Removal Order Set
- EVT Critical Care Order Set
- Acute Ischemic Stroke Collaborative Care Plan
- Patient and Family EVT Education Brochure
- Pilot and Post Pilot Data Collection Sheet
- Excel Data Tracking Record
- Standard Repatriation Transfer Form
- OTN-KGH-Hamilton Tele-mentorship Guideline

Guidelines developed and adopted for Regional Access:

- Regional Algorithm for EVT Referral and Access
- Imaging Protocol for use at Telestroke Site
- EVT Transfer Guide Poster for use by Telestroke Site
- EVT Drip and Ship Protocol for use by Telestroke Site
- South East Project Plan for Regional Access to EVT

Provincial Processes adopted for use in the region:

- CT/mCTA Minimum Imaging Set for use at Telestroke Sites
- Regional EVT Implementation Framework and Action Plan
- CritiCall Process for Referral and Transport
- Repatriation to Acute Stroke Unit Guideline
- QBP Handbook for Stroke – April 2017

Appendix D

Debriefing Notes: Stroke EVT ACTION Items

ISSUE	ACTION	MRP	STATUS √= complete
Case #1			
Case selection; Fibromuscular Dysplasia (FMD)	<ul style="list-style-type: none"> Consensus among 2 IRs to go forward with a case. Reflect as a team (IVR and neurology) before proceeding and before completing, especially if complex case Exclude FMD cases from Pilot Debrief images with mentor 	IVRads and Stroke Neurologists	√
2 stent retriever packages opened but only one needed	<ul style="list-style-type: none"> Ensure there is a check with physician and amongst team before opening stent package- check not already open 	IVR techs	√
CT images not fully reconstructed by the time of groin puncture	<ul style="list-style-type: none"> Monitor CT image reconstruction and transmission time and ensure all images available before proceeding 	IVRads	√
Debrief held too early	<ul style="list-style-type: none"> Debrief at 3 to 4 days to allow time to know outcome but not to lose valuable process information. 	Dr. Jin and C. Martin	√
Case #2			
ED Flow to CT – timing of bloodwork, use of POCT; keeping patient on EMS monitor until in CT	<ul style="list-style-type: none"> Neuro to let RN know the plan re timing of blood work Case Manager Stroke Specialist and POCT MLT to set up process for stroke team training and access to POCT- [June 2016] Keep patient on EMS monitor until CT: communicate with 5 EMS services and update documents [June 2016] nurses to let neurology know when they need to gain access to patient; collaboration is key 	A. Vincent, D. Bowman	√
		C. Martin & C. Murphy	√
		RN and Neurologists	√
Communication between IVR, ED and ICU	<ul style="list-style-type: none"> IVR Charge nurse to call ED unit clerk - ext 2335 when suite ready IVR Charge also let ICU know to plan for bed for EVT case 	IVR Charge nurse	√
IVR Suite- technical and equipment	<ul style="list-style-type: none"> use mentor's suggestion re use of J curve 	IVRads	√
Significant staffing required for the procedure	<ul style="list-style-type: none"> discuss future finances and HR with leadership team- if moving to 24/7 the resources will be stretched – need further funding 	EVT Workgroup	√
Critical Care order sets not yet ready	<ul style="list-style-type: none"> Continue to move through Critical Care order set approval process; keep printed, paper copy for reference in ICU. 	Dr Boyd	√
Flow to Kidd 7 Acute Stroke Unit	<ul style="list-style-type: none"> Meet with manager of Admin Coordinators to provide support and ensure they are aware of the need for EVT cases to get to Acute Stroke Unit. In future, neurology will work with Case Manager Stroke Specialist and Kidd 7 Charge Nurse to plan ahead re possible bed moves in stroke unit and on Kidd 7 to make space. 	D. Bowman, C. Martin	√
		Neurology, D. Bowman, S. Chapman D. Tuppenay	√
3- month follow up in Stroke Prevention Clinic (SPC)	<ul style="list-style-type: none"> Let SPC know to watch for follow-up SPC referral 	C. Martin K. Gray	√

Case #3			
ED- delay in arrival of neuro team on call; Dr Jin covered	<ul style="list-style-type: none"> Inform Neurology team best to arrive 10 mins before ETA 	Dr Jin	✓
IVR – technical & equipment	<ul style="list-style-type: none"> Order smaller catheters to be prepared for IA 	L. Thom	✓
IVR- identification of groin site	<ul style="list-style-type: none"> Take time to use US to identify best groin puncture site to avoid hematoma especially when thrombolysis running 	IVRads	✓
IVR- waiting on table for ICU bed	<ul style="list-style-type: none"> Move patient off IVR table to a stretcher to make patient more comfortable while awaiting ICU team arrival 	B. Beattie	✓
K2 ICU – mix up of charts	<ul style="list-style-type: none"> Follow-up with manager 	Dr Jin N. Valade	✓
K7 Discharge Planning for out of province case	<ul style="list-style-type: none"> Dr Jin to connect with out of province neurologist 	Dr Jin	✓
IVR Procedure – technical & equipment	<ul style="list-style-type: none"> Ensure balloon catheter aspiration functioning well 	IVRads & techs	✓
Case #4			
Communication with Kidd 2 ICU and within Kidd 2 ICU - Could ICU be called sooner?	<ul style="list-style-type: none"> Neurologist to notify Kidd 2 Intensivist (who notifies ICU charge nurse) as soon as suspect need for EVT Stroke Specialist Case Manager to notify Kidd 2 Charge as back up and reminds neurologist to let ICU physician know if not already informed Ensure communication about EVT processes <u>within</u> critical care unit 	Neurology and D. Bowman	✓
Procedural Sedation process	<ul style="list-style-type: none"> Follow KGH procedural Sedation policy: Sedation is given by RNs in IVR suite; normally one RN in IVR suite would give the sedation while the other RN documents 	IVR RNs	✓
ICU EVT order set not yet approved, not in Entry Point-delays?	<ul style="list-style-type: none"> until orders approved either Dr Boyd or Dr Jin will help ICU residents write out orders using draft hard copy as guide C. Martin asked to follow up with Dr.Drover and S. Hall re delays with the order set approval process 	Dr Boyd, Dr Jin	✓
		C. Martin	✓
Consent process	<ul style="list-style-type: none"> It is necessary to have written consent for EVT procedure. Continue with neurologist completing part A and Interventional Radiologist completing part B of IVR consent form. If family not available, emergency consent process used. 	IVRads and Neurology	✓
IVR technical and equipment: during EVT, straps and C-Arm	<ul style="list-style-type: none"> Use strap at head, waist, thighs – noted that this then requires skin checks and need to document Keep C-arm at the side 	IVRads, RNs and techs	✓
Family kept informed?	<ul style="list-style-type: none"> Generally best if family brought to IVR waiting room if a procedure is to take place in IVR. This facilitates consent, ongoing information and being brought up to ICU. Finish revisions on Patient Family Handout and then consider translation into French. 	Neuro and IVR team C. Murphy	✓ Translation TBD
Missing info on chart	<ul style="list-style-type: none"> ICU flow sheet missing – action: Darlene to follow up IVR procedure sheet missing – action: Kelly to follow up 	D. Bowman K. Bodie	✓
3 month Follow up	<ul style="list-style-type: none"> Ensure Stroke Prevention Clinic Follow-up booked 	K. Gray	✓

Case #5			
EVT Criteria Checklist	<ul style="list-style-type: none"> Colleen to forward EVT Criteria Checklist from tPA/EVT Guidelines to stroke neurologists for revised checklist. Printed copies to be made available in CT Department in pink folder labelled <i>Stroke EVT Checklist</i> Dr Jin to follow up with lit review/ discussions 	C. Murphy Dr. Appireddy C. Martin Dr Jin	✓ ✓ ✓
Direct carotid puncture	<ul style="list-style-type: none"> Decision: will not be performed 	All	✓
Access for QHC patients, Build EVT volumes and competency at KGH	<ul style="list-style-type: none"> Initiate planning for EVT transfers from Belleville. KGH approval received. Quinte Belleville General site and EMS invited to participate in a joint workgroup to develop a process for transferring EVT candidates from QHC. 	C. Martin	✓ Regional protocol in place Dec 21st
Process if no ICU bed available?	<ul style="list-style-type: none"> Kelly Bodie to follow up at next bed meeting to ensure this situation is reviewed; Inform Admitting Manager. Usual corporate process to be used. 	K. Bodie, N. Valade	✓
For in-hospital strokes, administration of IV tPA in CT prep room	<ul style="list-style-type: none"> In-hospital stroke if EVT case- give tPA in CT prep room. Kelly to discuss with CT Techs re in-hospital stroke patients who proceed to EVT Revise in-hospital stroke protocol 	K. Bodie D. Bowman	✓ ✓
Process for In-hospital Stroke- Internal Acute Stroke Protocol?	<ul style="list-style-type: none"> Follow up with Richelle Kartye regarding the internal stroke protocol process and education to D3 Colleen to send Dr. Appireddy the Internal Stroke Protocol for review 	D. Bowman R. Kartye C. Murphy	✓ ✓
Case #6			
Consent: Part A / B	<ul style="list-style-type: none"> Neurologist to document consent, if not using full form; document as emergency procedure 	Dr Jin to let neuro know	✓
Communication	<ul style="list-style-type: none"> Page Stroke Specialist Case Manager if not present 	Neuro team	✓
Handover to K2 ICU	<ul style="list-style-type: none"> Stroke team (attending neurologist and residents) to follow the patient to ICU and ensure admission orders are written 	Neuro team	✓
Follow up in Stroke Prevention Clinic	<ul style="list-style-type: none"> F/Up at 90 days by Dr. Appireddy in Stroke Prevention Clinic –let SPC know 	C. Martin K. Gray	✓
Time capture if Darlene away; CT data capture / IVR data capture	<ul style="list-style-type: none"> Discuss back up for data collection with IVR Manager Follow up with Senior CT Tech regarding collecting CT times in similar way - specific times Create an IVR data collection sheet for use in IVR to be faxed to regional stroke office - fax number to be included on the form [IVR data collection sheets kept in pink folder] 	D. Bowman Dr. Appireddy D. Bowman Dr. Appireddy C. Martin L Thom	✓ ✓ ✓
Imaging MOCK	<ul style="list-style-type: none"> Set up MOCK ED to CT (considering new CT installations) 	C. Martin and K. Bodie	✓
Sedation and anesthesiology?	<ul style="list-style-type: none"> Follow-up with neurology to be clear on when to involve anesthesiology 	Dr Jin and Dr Boyd	✓
Patient Selection - EVT inclusion/exclusion checklist	<ul style="list-style-type: none"> Revise the EVT Inclusion/Exclusion check list and replace the current with the new in CT Suite- add instructions FAX to Stroke Office. 	Dr Appireddy C. Martin	✓
tPA orders not written	<ul style="list-style-type: none"> Neurologists to write on green order sheet; add reminder to EVT check list 	Dr Appireddy to add to list	✓
Consent re: emergency procedure?	<ul style="list-style-type: none"> Neurologists to ensure consent is received and to ensure this is documented; add reminder to EVT check list 	Dr Appireddy to add to list	✓

Case #7			
POCT device unplugged so not charged	<ul style="list-style-type: none"> follow up to troubleshoot to prevent the POC INR machine from being unplugged 	C. Martin A. Vincent	✓
First case using new CT Scanner	<ul style="list-style-type: none"> Follow up with technologists re how things are going with modifications to imaging protocol with new CT scanners 	K. Hubbard	✓
Workflow in IVR when bed not immediately available	<ul style="list-style-type: none"> IVR charge RN and tech to encourage patient be transferred to recovery area if ICU bed not ready 	B. Beattie and L. Thom	✓
Neurology Staff and senior resident did not get paged.	<ul style="list-style-type: none"> Follow up with Switchboard/Communications re notification issues with attending neurologists (fixed on-line call list provided by neurology) Neurologists to inform Cally when there are issues regarding pre-notification and each time provide a CR# - she will follow up with EMS and ED 	C. Martin with Switchboard and neurology	✓
		Neurologists and C. Martin	✓
Stroke Clinic 3 mo. Follow up	<ul style="list-style-type: none"> F/Up at 90 days in Stroke Prevention Clinic - inform SPC 	C. Martin K. Gray	✓
Consideration for administration of tPA in CT Suite rather than in ED	<ul style="list-style-type: none"> EVT workgroup to discuss consider administering tPA in CT scan department - as part of the future recommendations and a consideration for 24/7 expansion (beyond pilot phase) 	EVT workgroup	✓
Sedation delivered by neurology resident (also an anesthesiologist)	<ul style="list-style-type: none"> Neurologists to convey to colleagues to rely on IVR team to deliver sedation in IVR suite; neurologists to follow up with Residents regarding EVT protocol 	Dr. Jin	✓
Orders taking too long due to lack of order entry/order set	<ul style="list-style-type: none"> Dr Boyd to inform the Group when the orders go live in EntryPoint – (went live the following week) 	Dr Boyd	✓
Case #8			
Stroke recognition for patient arriving without stroke protocol activation	<ul style="list-style-type: none"> Explore whether education is required for ED staff about activating ASP for walk-ins. Education to highlight need for establishing an IV. Follow up with paramedics services about pre-notification 	K. Brisbin and D. Bowman	✓
		C. Martin	✓
Patient transferred via stretcher instead of bed. Stretcher much easier to push/pull	<ul style="list-style-type: none"> Use stretcher instead of ICU bed to transfer EVT patient from IVR 	B. Beattie to follow up with Rebecca Gill	✓
90-day Follow – up in SPC	<ul style="list-style-type: none"> F/Up at 90 days by Dr. Jin in Stroke Prevention Clinic 	C. Martin to inform K. Gray	✓
Workflow in IVR <ul style="list-style-type: none"> Clarity on how neuro can help in IVR Handling cases that go straight from CT to IVR idea of stroke bucket MOCK CT to IVR 	<ul style="list-style-type: none"> Get staff feedback on new workflow - cases that come directly from CT to IVR, those that get tPA in CT suite Inquire about the EVT stroke package that HHS uses during EVT procedure—all equipment located in one package/bucket Dr Appireddy to provide list EVT “stroke bucket” contents used in Calgary Organize a MOCK involving CT to IVR 	K. Bodie, Dr Appireddy, C. Martin	✓
POCT charge	<ul style="list-style-type: none"> Re-group about POCT machine- keeping it charged, batteries, plugging it in etc. 	A. Vincent	✓

Case #9- in-hospital stroke			
Contact made with IR who was not on service	<ul style="list-style-type: none"> Consult with IR working in IR Suite 	Neurologists	✓
In-hospital stroke - limited info to IVR RN	<ul style="list-style-type: none"> Address flow of communication within the suite and ensure RN is given report 	Neurologists and IR	✓
Uncertain whether indwelling urinary catheter to be used	<ul style="list-style-type: none"> Ensure communication is clear regarding use of indwelling urinary catheter; normally prefer use 	Neurologists and IR	✓
IVR Workflow and roles; desire for more practice	<ul style="list-style-type: none"> Set up mini-MOCKs in IR suite 	K. Bodie	✓
Delayed call to Intensivist re ICU bed	<ul style="list-style-type: none"> Reminded to call ICU from CT suite – as soon as know EVT is proceeding. Neurology to call Intensivist; Charge IVR RN to call Charge ICU RN. 	Neurologist and Charge IVR RN	✓
90-day Follow up in Stroke Prevention Clinic	<ul style="list-style-type: none"> F/Up at 90 days in Stroke Prevention Clinic 	C. Martin to inform K. Gray	✓
Case #10			
First case performed on a Saturday; IVR team was already in hospital	<ul style="list-style-type: none"> Plan for 24/7 delivery Review of expected volumes Meetings to discuss flow, staff requirements Hire and train new staff 	EVT Workgroup	✓ 24/7 began Sept 2017
Radiation Safety training needed for neurologists	<ul style="list-style-type: none"> Set up radiation safety training given that neuro team helps in the suite. Order more goggles, universal size aprons. 	K. Bodie M. Bollen	✓

Appendix E

Kingston General Hospital Stroke EVT Data Flow Sheet 2017 (rev June 30 2017)

Name: _____ Recorder: _____
 Chart Record Number: _____ Age: _____ Intubated? Y / N
 Arrival by Transfer or Bypass? _____
 Hospital bypassed or transferred from _____
 Neurologist(s): MRP _____ back-up _____
 Interventional radiologist(s): MRP _____ assisting _____

Element:	Recordings:	Observations
Date:		
Stroke Onset (hhmm)		
Modified Rankin Scale prior to Stroke Onset		
Part A: From ER arrival to CT to IVR to K2ICU		
ER Arrival Time ("Door Time", hhmm)		
NIH Stroke Scale Score		
Time of CT First Slice ("CT first slice Time", hhmm)		
Door to CT first slice time (hhmm) (derived from CT first slice minus ED Door time)		
CT Findings – provide ASPECTS Score for MCA stroke		
Clot Location		
Collateral Score for anterior circulation strokes (0 to 5)*		
*Good=4,5; Moderate=3; poor = 1,2		
Time of IV tPA bolus ("Needle Time", hhmm)		
Door-Needle time (hhmm) (derived from tPA bolus minus door time) – TARGET<30 mins		
Time of Groin Puncture (hhmm)		
CT to Groin Puncture time (hhmm) (derived groin puncture time minus time of CT first slice) – TARGET<60 mins		
Procedure aborted (Y/N)?		
Time of First Reperfusion (hhmm) when TICl 2b/3 achieved		
CT to First Reperfusion (hhmm) (derived from first reperfusion to CT first slice) – TARGET<90 mins		
Reperfusion grade (TICl scale) - TARGET TICl 2b or 3		
Number of stent-retrievers used		
Number of passes done		
Carotid stent used		
Any procedural complications? Y/N? - specify		
Time of Completion of EVT (hhmm) - groin closure		
Part B: K2ICU Arrival to ASU:		
Date and time of arrival in K2ICU (yyyymmddhhmm)		
Door-K2ICU Arrival Time (hhmm) Derived - ED to K2 arrival		

Date of arrival in Acute Stroke Unit		
Days in Critical Care		
NIHSS score on Day 1		
Follow-up CT ASPECTS		
Part C: ASU Arrival to Hospital Discharge		
LOS in Hospital (KGH)		
Discharge destination		
CNS Complications- indicate Y/N for each	Yes	No
• Hemorrhagic transformation/Intracranial hemorrhage		
• Post stroke seizure		
• Craniectomy		
• Other		
Other stroke complications – indicate Y/N for each	Yes	No
• MI/Cardiac Complications		
• Pneumonia		
• UTI		
• PE/DVT		
• Skin ulcer		
• GI Bleed		
Part D1: Hospital Discharge to 90 days- From SPC Clinic follow up visit		
LOS in other hospital if available		
Where living at time of stroke?		
Where living now?		
Modified Rankin Scale score at 90 days		
Total number of days living at home between Stroke Onset and 90 days		
No Show – did patient die before 90 days? Date? Cause?		

Through Decision Support:

Part D2: Hospital Discharge to 90 days- From CIHI data	
Readmission to hospital within 30 days? and MRDx	
Readmission to hospital within 90 days? and MRDx	
Recurrent stroke or TIA within 90 days?	
ED visits over 90 days – dates/times, causes	