Impact of discontinuation of telestroke: the Nelson experience
Annemarei Ranta, Suzanne Busch

ABSTRACT

AIM: In 2016, five Central New Zealand hospitals piloted a successful telestroke service that has since transitioned to ‘business as usual’. Nelson Hospital elected to opt out of the service after completion of the pilot. This paper reports the impact of telestroke service discontinuation on service provision within a regional and national context.

METHODS: This is a sequential comparison of three time periods: six months pre-telestroke, six months during telestroke and six months post-telestroke pilot. Main outcomes were thrombolysis rate and door-to-needle time comparing the period with telestroke to the periods without.

RESULTS: Over the 18-month period the thrombolysis rate was 8.5% (6/71) over the six months pre, 23.0% (14/61) over the six months during and 7.9% (5/63) over the six months post the use of telestroke support. The odds ratio (95% CI) of being thrombolysed with versus without telestroke support was 3.33 (1.41–7.86); p=0.006. Patients receiving thrombolysis within 60 minutes of arrival were 50% before, 64% during and 20% after telestroke (OR (95%CI) 3.15 (0.61–16.3); p=0.16). Other hospitals that continued with telestroke maintained their rates and door-to-needle times between pilot and post-pilot periods.

CONCLUSION: These findings indicate that the transient implementation of telestroke was insufficient to upskill provincial hospital generalist clinicians to sustain high thrombolysis rates.

Stroke thrombolysis with intravenous alteplase reduces post-stroke disability and is cost-effective.1,2 In New Zealand, treatment rates of 20–25% of ischaemic strokes are achieved in some centres. Nationally, the rate continues to rise, however, some centres continue to struggle achieving the national target of 8% (due to increase to 10% in 2018/19).3 This inter-hospital variation in treatment rates has been attributed, in part, to limited access to stroke expert physicians, especially out of hours.3

The American Stroke Association recommends telestroke as the best alternative to face-to-face expert assessments if access barriers exist.4 Telestroke involves the provision of remote expert decision support using videoconferencing equipment. The remote stroke expert uses modern technology to connect with the patient and the front-line clinical team virtually. The benefit of using videoconferencing is that the remote expert can directly engage with the entire team, patient and family, observe or conduct a neurological examination, appraise the situation holistically including continuous view of vital sign monitors and medication preparation to avoid drug errors, and is able to personally obtain treatment consent from the patient. It very much simulates the expert being on site at the time when he or she has to make important treatment decisions.

In 2016, the first regional New Zealand telestroke service was piloted involving Wellington Hospital as the ‘hub hospital,’ ie, the service provider of telestroke, and Palmerston North, Hawke’s Bay, Nelson and Wairau Hospitals as the service recipient or ‘spoke’ hospitals. The service only operated during the vulnerable out-of-hour periods and was associated with an increase in thrombolysis rate from 10/68 (7.1%) to 33/161 (20.5%) (OR 4.07 (95% CI 1.93–8.58; p=0.0001) across the region.5
Following the six-month pilot period, the participating DHBs developed a regional business case and received funding approval for the continuation of a regional telestroke service. Since that time, two additional centres decided to join the network with Wairarapa Hospital joining in early 2017 and Whanganui Hospital in April 2018.

One pilot site, Nelson Hospital, elected to opt out of continued participation after the completion of the pilot. They intended to test whether important learnings and gained experience by the local team during the telestroke pilot could be maintained without ongoing remote expert support.

This paper presents the impact of the discontinuation of the telestroke service to Nelson Hospital and places the Nelson experience in both a regional and national context.

Methods

Service description
The telestroke service consists of on-call Wellington neurologists using 4G iPads® or their desktops or laptops to link into the patient-end battery powered, Wi-Fi Polycom videoconferencing (VC) units using Polycom RealPresence®. The neurologists use Citrix® remote desktop to log into their work computers to view radiological images, record clinical/technical data in a secure hospital based Microsoft Access® database, and generate patient reports emailed via secure DHB emails to the provincial hospitals. The network is provided by Vivid Solutions. The remote support is limited to out-of-hour periods (ie, Monday through Friday 4pm to 7:59am and all weekends and public holidays). During regular working hours, the local teams manage patients with on-site support from their local stroke specialist.

The Nelson thrombolysis service without telestroke support consists of a stroke physician who is available part-time during regular hours and who is one of nine general physicians on the out-of-hour roster. All stroke patients are managed by one of these nine general physicians on call. All involved physicians have experience with the provision of stroke care as would be usual for general physicians, however, due to the low patient volumes, each individual has only thrombolysed a handful of patients (on average one per year). The single stroke physician is the only doctor to have attended formal thrombolysis training. The others have had exposure to in-house teaching sessions from the stroke physician and one other has participated in some online training.

Study methods
This is an observational study using a sequential comparison design looking at pre-telestroke (December 2015 through May 2016), telestroke (June 2016 to November 2016) and post-telestroke (December 2016 to May 2017) service performance. The pre-specified main outcome variables were Nelson Hospital thrombolysis rate of ischaemic stroke patients and door-to-needle times with versus without support from the telestroke service.

Patient data were captured prospectively in the National Thrombolysis register. Data captured and analysed included: patient age, treatment rates, arrival time, door-to-CT time, door-to-needle time and rate of intracerebral haemorrhage. Data was supplemented with MoH data capturing stroke discharges to calculate a thrombolysis rate. Denominator figures for MidCentral and Hawke’s Bay DHB for the post-pilot period were only available by quarter and are thus offset by one month.

The denominator for thrombolysis rate uses all admissions coded as ischaemic (ICD-10-AM code I63) and unspecified stroke (I64) as is standard practice in New Zealand. Unspecified strokes are included as the vast majority of these have been found to be ischaemic strokes when audited.

Data analysis was completed in Stata® 13.0. Variables were analysed using linear and logistic regression. For time frames, medians (interquartile range) are reported. National and regional figures from the National Thrombolysis Register are reported for comparison purposes.

Results
Over the 18-month period, 25 of 195 admitted ischemic stroke patients were thrombolysed at Nelson Hospital. Patient age was similar between study groups (mean age 71.5 pre, 73.3 during, and 72.3 years post). The majority of patients presented
out-of-hours during and after telestroke (71% and 80% respectively) with 50% presenting out-of-hours before telestroke. There were no reported symptomatic intracerebral haemorrhages on post-thrombolysis CT scans over the 18-month study period, although some patients did not undergo post-thrombolysis imaging.

The thrombolysis rate was 8.5% (6/71) over the six months pre-telestroke, 23.0% (14/61) over the six months during the telestroke pilot, and 7.9% (5/63) over the six months immediately after discontinuation of telestroke support from Wellington Hospital. The odds of being thrombolysed while telestroke remote expert support was in place was 3.33 (95% Confidence Interval (CI) 1.41–7.86); p=0.006). During the same time period, hospitals that continued to receive out-of-hour support through telestroke experienced continued increases in treatment rates (Figure 1).

Door-to-needle times also fluctuated across the three study periods. Of those thrombolysed, 50% of patients received thrombolysis within 60 minutes or less pre-telestroke, 64% during the telestroke pilot and 20% after telestroke was discontinued. The odds of achieving thrombolysis within the target time frame of 60 minutes from arrival in hospital was 3.15 (95% CI 0.61–16.3; p=0.16) in the setting of telestroke support compared with periods when there was no expert support via telestroke. Door-to-needle and door-to-CT time are depicted in Table 1.

Careful review of patients not treated

**Table 1:** Time delays to CT imaging and treatment initiation.

<table>
<thead>
<tr>
<th></th>
<th>Door-to-CT time</th>
<th>Door-to-needle time</th>
<th>Treated within 60 minutes of arrival</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Median (IQR)</td>
<td>Median (IQR)</td>
<td>%</td>
</tr>
<tr>
<td>Pre-telestroke</td>
<td>26 (23, 29)</td>
<td>61 (51, 77)</td>
<td>50</td>
</tr>
<tr>
<td>During telestroke pilot</td>
<td>27 (14, 34)</td>
<td>61.5 (43, 74)</td>
<td>64</td>
</tr>
<tr>
<td>Post-telestroke</td>
<td>37 (30,41)</td>
<td>92 (65, 116)</td>
<td>20</td>
</tr>
</tbody>
</table>

*IQR=Inter-quartile range*
after discontinuation of telestroke by two stroke experts revealed that nine additional patients met inclusion criteria and would have likely been treated had a stroke specialist been involved in the decision-making process. Had these nine patients been treated, the post-telestroke thrombolysis rate would have been 22% (14/63).

Nationally the thrombolysis rate continues to rise with a rate of 8.4% in 2015/16 that has risen to 9.5% in 2016/17. At the same time, door-to-needle times continue to gradually reduce (Figure 2) with 43% treated within 60 minutes nationally in 2016/17. This compares with a thrombolysis rate of 13% and a rate of 30% of patients treated under 60 minutes in Australia during the 2017 Australian stroke audit. It is noteworthy that the Australian audit is voluntary and captures data from only 78.5% of eligible and self-selected services compared with the New Zealand registry data, which is mandatory with all 20 DHBs contributing.

Treatment rates vary by region with the Central Region showing the highest rates and most significant increases over the last three years (Figure 3).

Figure 2: National door-to-needle times depicted by quarter.

![Door-to-needle time, median (minutes)](image)

Figure 3: Regional thrombolysis rates over the past three years.
Discussion

The greatest predictors of improved patient outcomes in the setting of stroke thrombolysis are higher treatment rates and reduced door-to-needle times. 7,8

Telestroke has been proposed to improve patient access to stroke thrombolysis, and the thrombolysis rate at Nelson Hospital rose from 8.5% to 23% after the initiation of an out-of-hour telestroke service with remote expert support from Wellington neurologists. Similar increases were seen at other telestroke ‘spoke’ hospitals during the Central Region telestroke pilot.

The transient expert support at Nelson Hospital may have helped upskill the local team to be able to sustain this rise in treatment rate even after discontinuation of expert support. The findings presented here, however, indicate that this was not the case as the rate reverted to 7.9% following the discontinuation of telestroke support.

This strongly supports the notion that ongoing telestroke support helps to maintain optimal thrombolysis rates as measured by international standards. It is reassuring that the complication rate was low even in the setting of higher treatment rates.

Furthermore, treatment delays increased after telestroke discontinuation. It may be initially surprising that time delays were worse after telestroke than before, but it is likely that this is attributable to the disproportionately higher number of patients who presented out-of-hours after the pilot compared with before. This is likely random, but does affect time delays. When patients present out-of-hours, fewer staff are on site and CT technicians have to drive in from home. However, it is noteworthy that out-of-hour patients were also very frequent during the telestroke pilot, yet reasonable door-to-needle times were achieved. The reduced door-to-needle time in the setting of expert care is likely attributable to faster decision making, focus on a parallel rather than sequential approach to managing required steps before treatment can be safely started and greater experience with prioritising some essential tasks over others.

It is overall encouraging that across New Zealand, treatment rates and speed of access have improved, which seems largely to have been driven by the implementation of telestroke in the central region although other initiatives including the National FAST campaigns, the launch of a national ambulance destination protocol and individual DHB efforts to streamline ED processes all have contributed.

New Zealand is keeping up internationally with treatment rates and door-to-needle times and is one of the only countries in the world that collects national census data on stroke reperfusion intervention rates as part of the National Thrombolysis Register. However, more progress has to be made and to that end a telestroke sub-pilot has been completed in the Midland Region with results awaited, and the South Island is starting an implementation project for telestroke there as well. Nelson is now considering rejoining the Central network.

These efforts will link into regional clot retrieval services to help optimise patient selection and help achieve timely access to the best available reperfusion options for all New Zealanders experiencing a stroke.
Competing interests:
Nil.

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