Appropriateness of general practitioner imaging requests for transient ischaemic attack patients: secondary analysis of a cluster randomised controlled trial

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ABSTRACT

AIMS: Many transient ischaemic attack (TIA) patients receive initial assessments by general practitioners (GPs). In a randomised controlled trial (RCT) we showed that BPAC Inc. TIA/stroke electronic decision support (EDS) for GPs improves patient outcomes and guideline adherence. This secondary analysis assesses the impact of trial associated enhanced GP access to radiological investigation.

METHODS: Post-hoc analysis of a multi-centre, single blind, parallel group, cluster RCT comparing TIA/stroke EDS guided GP management with usual care to assess whether imaging requests and their appropriateness differed between study groups.

RESULTS: GPs requested 15/291 (5.2%) carotid ultrasounds and 19/291 (6.5%) computed tomography (CT) head scans. Scans were obtained more frequently in the intervention group (ultrasound cluster adjusted OR (95% CI) 1.41 (0.44 to 4.49), \( P = 0.56 \) and CT 13.8 (1.7 to 110.7), \( P < 0.001 \)). All CTs were clinically appropriate. More ultrasounds were appropriate in the EDS group (cluster adjusted OR (95% CI) of 8.4 (0.39 to 92.3), \( P = 0.18 \)). Overall investigation costs did not differ between groups (\( P = 0.83 \)). Some apparent avoidable imaging duplication occurred where patients were subsequently assessed by secondary services.

CONCLUSION: In the setting of a RCT assessing GP electronic decision support, frequency of GP initiated imaging requests was low and largely appropriate especially in the setting of EDS use. Thus enhanced GP imaging access as part of the EDS tool did not result in inappropriate or excessive GP imaging requests. However, some duplication occurred and practitioners need to ensure that test referrals and results are adequately communicated between sectors.

KEYWORDS: Stroke; Transient Ischemic Attack; Electronic Decision Support; Health Service Research; Imaging

A Transient Ischaemic Attack (TIA) is a medical emergency as it can herald imminent disabling stroke. Most patients present for initial assessment and management to non-neurologists such as general practitioners (GPs). However, most GPs see patients with TIAs infrequently so they may lack confidence in making a correct diagnosis, or defer specialist referral or initiation of early medical management due to unfamiliarity with the condition.1–3

The FASTEST trial tested whether an electronic decision support (EDS) tool improved non-specialist diagnosis, triage, initial management, and subsequent outcomes for patients with TIA or minor stroke in primary care, compared with...
usual care. With the use of this tool 90-day stroke, vascular event, and/or death was reduced from 11.9% to 3.5% (OR 0.27, 95% CI 0.09 to 0.78, \( P = 0.016 \)), and guideline adherence improved from 41.2% to 76.2% (4.57 (2.39 to 8.71), \( P < 0.001 \)).

An incentive for GP uptake of the EDS tool was that it offered rapid access to Computed Tomography (CT) head scans and carotid ultrasound imaging after the tool was completed and if it recommended these investigations. However, radiology and other secondary service providers expressed concern that more liberal GP access to such investigations might result in excessive and inappropriate requests for diagnostics. The potential resultant overload of radiology services could then lead to worsening access for patients more appropriately referred for these investigations by secondary stroke specialists. In addition, inappropriately requested tests could unnecessarily increase healthcare costs.4

The aim of the secondary analysis of the FAST-EST trial was to assess the effect of enhanced GP imaging access on frequency and clinical appropriateness of imaging requests following TIA or minor stroke.

Methods

The trial plan and primary results of the FASTEST trial have been described previously.5,6 In brief the FASTEST trial was a multi-centre, single blind, parallel group, cluster randomised controlled trial comparing TIA/stroke EDS guided primary care management with usual care. Clusters were determined by practice so that all GPs in a particular practice were randomised to the EDS intervention. All GP participants were offered a 90 min pre-trial education session covering TIA and stroke management principles and 79/181 (43.7%) of participating GPs attended the training, which included information on appropriate imaging selection. In accordance with the New Zealand (NZ) Stroke Guidelines, CT head imaging was recommended for all patients with high suspicion for TIA (ie typical TIA symptoms as per NZ Guideline such as sudden onset hemibody weakness, but not syncope) to rule out intracranial bleeding and other TIA mimics especially before initiation of anticoagulation. Carotid ultrasound was recommended for patients who were potential surgical candidates and presented with anterior circulation TIA symptoms, ie carotid territory (eg language dysfunction, limb weakness, but not diplopia or isolated ataxia).

The trial recruited GPs and patients from the catchment populations of four of the twenty NZ district health boards (DHBs). Usual GP imaging access arrangements differed by DHBs. In two DHBs imaging services were provided directly through the secondary health care services, in the third imaging was provided by a private provider with partial funding from a Primary Health Care Organisation, and for the fourth DHB imaging was provided through a private provider only. For the purposes of the trial where imaging was usually provided by the secondary health care service, trial funding paid for the imaging if the DHB identified potential overutilisation, with a pre-nominated threshold for extra payment of between two and four scans a month. Imaging provided by a private provider was completely funded by the trial budget.

GPs randomised to the EDS intervention could access rapid CT and carotid imaging by ultrasound if the EDS tool was used as part of the assessment and only if the tool recommended these investigations based on the clinical data entered by the GP. In three DHBs, consistent with local DHB imaging access policies, GPs had access to carotid ultrasound in the usual care arm of
the trial as well. Here imaging requests were not vetted and solely depended on the clinical judgement of the GP without the aid of the EDS.

Whether a particular investigation was ‘appropriate’ was determined by a blinded study stroke specialist based on clinical documentation. The cost of the investigations was determined for each study patient by assigning standard published prices for each obtained test as part of the TIA/stroke work-up whether requested by a primary or secondary care clinician.8

The default recommendation of the EDS tool was for GPs to refer likely TIA patients to rapid access specialist TIA service rather than promoting primary care management consistent with international guidelines. Access to investigations was primarily intended for settings where patients either refused to see a specialists or could not access a specialist due to geographic or other factors. As a result, it was anticipated that most TIA investigations would be completed in secondary care.

Statistical methods

Differences between the proportions of participants who had investigations, and who had appropriate investigations, were assessed by generalized mixed linear models using logistic regression with and without adjustment for cluster randomization as a random effect expressed as OR with 95% confidence intervals. Cost data were analysed using a mixed linear model adjusting cluster as a random effect. This was a post hoc analysis and carries an associated risk of potential type I error. Analyses were conducted in Stata 12.1.

The study received national ethics approval and was funded through the NZ Health Research Council, University of Otago, and Neurological Foundation of New Zealand. The clinical trial registration was: ACTRN126110007921/www.anzctr.org.au.

Results

GPs requested carotid ultrasound for 15/291 (5.2%) and CT head for 19/291 (6.5%) study patients. This was an average of 0.26 ultrasounds and 0.34 CT scans per DHB per month which was substantially less than the trigger threshold nominated by the DHBs for extra funding for imaging from the trial budget on the basis of ‘over-utilisation.’ The requests and their appropriateness are summarised by treatment arm in Table 1.

Although more carotid ultrasounds were requested in the EDS arm there was no statistically significant difference between study groups cluster adjusted OR (95% CI) 1.41 (0.44 to 4.49), \(P = 0.56\). More CT head scans were requested in the EDS arm which was statistically significant, although with the single head scan requested in the usual care arm the confidence intervals are very wide; cluster adjusted OR (95% CI) 13.8 (1.7 to 110.7), \(P < 0.001\).

As expected, the rate of imaging requests was higher among patients managed in the community than patients referred to secondary services. Community managed patients had 8/74 (10.8%) CTs and 7/74 (9.5%) carotid imaging requests, while patients referred to secondary services had 8/217 (3.7%) GP initiated CT and 6/217 (2.8%) carotid imaging referrals; cluster adjusted \(P = 0.025\) for CT and \(P = 0.052\) for carotid imaging. When limiting the analysis to EDS patients this difference was more pronounced with 8/46 (17.4%) GP initiated CT requests for community managed and 7/126 (5.6%) secondary referred patients; OR 3.6 (95% CI 1.25–9.50); \(P = 0.01\). The same was observed for carotid imaging requests with 5/46 (10.9%) requests among community managed patients and 3/126 (2.4%) of those referred to secondary care; OR 5.0 (95% CI 1.01–24.7); \(P = 0.049\).

Regarding appropriate imaging, overall 14/15 (93%) of patients referred for ultrasound had a final diagnosis of cerebrovascular disease and 12

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<th>Electronic Decision Support</th>
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<td></td>
<td>N/172 (%)</td>
<td>N/119 (%)</td>
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<td>All requests</td>
<td>Ultrasound</td>
<td>CT head</td>
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<td>10 (5.8)</td>
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<td>Appropriate requests</td>
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Table 1. Imaging requests and appropriateness by study arm
(80%) had symptoms consistent with anterior circulation ischaemia. For the five control patients, three (60%) had symptoms consistent with anterior circulation distribution and the other two (40%) had posterior circulation symptoms and probably did not require an ultrasound. Overall 9/10 (90%) of intervention patients referred for carotid ultrasound had anterior circulation symptoms and one (10%) had posterior circulation symptoms and probably did not require an ultrasound. With the small number of events the generalised linear model did not converge appropriately so that a cluster random effect could not be fitted. The cluster-unadjusted OR (95% CI) for an appropriate US for EDS compared to usual care was 8.4 (0.39 to 92.3), \( P = 0.18 \).

All 19 patients sent for head CT were reasonable candidates for CT based on the initial general practitioner documented symptoms and 14/19 (74%) received a final diagnosis of TIA or stroke from a specialist. There were no patients with a 90-day stroke event following TIA in the cohort of patients who underwent GP imaging requests. The remainder of the patients who required imaging achieved this via secondary stroke services, which was the preferred access pathway where feasible.

Investigation-related costs were similar in both groups; mean (standard deviation) and median (Inter-Quartile Range): $537 (530) and $517 (0 to 930) in the EDS patients; $524 (500) and $517 (0 to 851) per control patient; cluster-adjusted difference (95% CI), –13.0 (–106 to 133); \( P = 0.83 \).

We identified three patients who had duplicate investigations. One patient underwent two ultrasounds, one patient two CT head scans, and one patient had two ultrasound and CT head scans. It is not clear from available data whether these duplications were clinically indicated although it seems more likely than not that the duplications were unnecessary and likely the result of inadequate communication between primary and secondary care teams.

**Discussion**

The TIA/Stroke EDS tool aims to optimise initial patient management to reduce the risk of recurrent stroke and associated disability, where rapid referral to specialist services, especially for high-risk patients, has been shown to have the most significant positive impact on 90-day stroke risk.\(^9\) Some patients cannot or will not access secondary stroke services and in such situations it may be useful for GPs to have publically-funded access to the guideline-recommended investigations to allow a comprehensive community based work-up. Partly for this purpose and partly as a built in incentive for GPs to use the EDS tool the FASTEST trial offered GPs access to required imaging if this was nominated as appropriate by the EDS tool.

The EDS tool use was associated with enhanced imaging access and did not result in excessive imaging requests. Overall, the number of requests was low. The study lacked statistical power to detect important differences in the proportions of patients with carotid ultrasound requests and although more ultrasounds were requested in the EDS group and more inappropriate ultrasounds were requested in the usual care group, the confidence intervals for the differences in proportions were very wide and these differences were not statistically significant. More GP initiated CT head scans were requested in the EDS group and all of these were clinically appropriate. Especially among EDS patients, GP imaging requests were significantly more frequent among community managed patients. This suggests that EDS support for imaging selection and access increases GP confidence and ability to manage patients in the community when this approach is required. The lack of access to especially CT imaging for community managed patients clearly risks that some patients miss out on relevant investigations if they cannot access secondary services for whatever reason. While the tool offers advice on test interpretation, it is advisable for secondary services to be accessible for telephone advice as needed and this is currently in place in several NZ districts.

Overall similar cost of diagnostic testing in the trial supports the notion that guideline-directed EDS tool access to imaging did not increase health care costs. The presumed unnecessary duplication of investigations was an unexpected finding as in the context of the trial we had an-
ticipated better communication between primary and secondary care because of the trial. Duplication will lead to excess costs through injudicious use of health care resources and avoidable radiation exposure to patients. With now wide-spread availability of this EDS tool in NZ primary care (www.beehive.govt.nz/release/tool-help-gps-diagnose-manage-tia-strokes), and for that matter other tools and health pathways promoting cross-sector integration, an essential component that will need to be addressed is that results are properly communicated between sectors to avoid such duplication.

This study was a post-hoc analysis of a secondary outcome variable and besides the noted issue with power to detect important differences, this study is also vulnerable to Type I error rate inflation, so that statistically significant results should be interpreted cautiously. With the small number of events we were also unable to fit a cluster random effect to some of the analyses. ‘ Appropriateness’ of imaging is based on NZ TIA Guideline criteria applied to written documentation and while a systematic approach was used that mimics imaging selection by stroke experts, it is possible that some allocation errors occurred. We do not have comparison data of appropriateness of tests requested in secondary care, but do know from prior work that secondary clinicians also at times request inappropriate investigations.7 The BPAC Inc. TIA/Stroke EDS tool improves guideline adherence, reduces 90-day vascular event rates, and reduces overall per patient treatment costs. Costs are reduced partly through reduced readmissions for secondary vascular events, but also due to reduced inappropriate specialist referrals. The EDS tool is now available for GP use nationally in NZ albeit with variable GP diagnostic access to relevant imaging investigations. In light of the demonstrated low frequency of EDS use associated imaging requests, high degree of appropriateness of requests, and no increase of imaging related treatment cost, we suggest that all DHBs include this feature as part of the TIA/stroke EDS tool to improve patient access to early imaging especially where specialist access is challenging and serve as an incentive for GPs to use this effective tool. However, if imaging is requested by GPs the information needs to be effectively communicat-ed to secondary care teams and services should regularly audit for such duplication.

References

COMPETING INTERESTS/CONFLICTS OF INTEREST
Dr Anna Ranta created the logic algorithm behind the BPAC TIA/Stroke Electronic Decision Support tool, but has no financial interest in the sale of the product. Dr John Gommans co-authored the NZ TIA and Stroke Guidelines that informed the logic algorithm. Dr Murray Tilyard is the executive director of BPAC Inc. A not-for-profit organisation, BPAC Inc. is a joint venture between the University of Otago and South Link Health. Any proceeds from the tool are reinvested into development of further patient management modules.