Evaluation of a rural primary-referred cardiac exercise tolerance test service

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Abstract

Aim To describe the feasibility, clinical impact and cost-effectiveness of a rural generalist-led cardiac exercise tolerance test (ETT) service for primary care patients in two different rural communities.

Method For 12 months, from Sept 2011, a generalist-led ETT service was provided in two rural hospitals in New Zealand: Dunstan in Central Otago and Rawene in Northland. Data was collected to describe the patient outcomes of this service. An audit of ETT reports and financial and rural-urban analyses were undertaken.

Results The cost per test of the local ETT service at Dunstan, ($132.50), and Rawene, ($200.00), was less than the national price ($281.13 in 2012). The majority of patients (83% at Dunstan and 70% at Rawene) were not referred to specialist services; the ETT result allowing the GP to continue to manage the patient in primary care. Where the ETT indicated specialist treatment, this was subsequently provided in a timely manner.

Conclusion ETT can be provided cost-effectively in a variety of rural settings. Improved access to ETT for rural communities may help address inequities across New Zealand in terms of access to cardiac investigations and early and appropriate treatment.

Cardiac exercise tolerance test (ETT) is often the first step when investigating a patient with suspected ischaemic heart disease (IHD) or risk stratifying a patient with known IHD. The results of ETT often determine whether or not a patient proceeds to more complex cardiology investigations and treatment.

In New Zealand public ETT services are generally provided in urban and provincial hospitals with specialist oversight. Few rural hospitals (only five in New Zealand at the time of this study, including the two in this study), offer ETT services.

There is little information on the impact of distance on the utilisation of urban based secondary services in NZ. This is in contrast to primary care where inequalities are acknowledged and there is both research and policy aimed at improving access for rural communities.1

Published evidence (both NZ and international), suggests rural patients have inferior access to cardiovascular diagnostic investigations including ETT compared with urban patients and have poorer outcomes as a result.2-4 Despite a significantly higher prevalence of IHD in Māori vs non Māori, intervention rates for Māori are low.10,11 Combinations of rurality, Māori ethnicity, and socioeconomic deprivation reflect groups with increasingly poor access to services including coronary angiography.1,12-15

ETT is a relatively low-cost, non-invasive diagnostic test that has the potential to be widely available at a community level. A recent Australian study looking at the utility of ETT in a remote setting concluded that ETT is a particularly useful tool for the diagnosis of IHD in areas where onsite specialist cardiology services are limited.16

Using Ministry of Health (MOH) Rural Innovation Funding we provided an ETT service for two different rural communities (Central Otago and Hokianga), from their respective rural hospitals for 12 months.

The tests were conducted by specifically trained local medical and nursing staff for patients referred directly by their GP.
The aim of the MoH-funded ETT service project was to improve access to ETT for these communities in a way that was cost-effective and did not compromise standards of care.

**Methods**

**Background**

The catchment population of Dunstan Hospital is approximately 25,000, encompassing Central Otago District and the Wanaka part of the Queenstown Lakes District. It is classified as rural/remote, (Rural Ranking Score (RRS) between 55 and 90). Six percent of the population is Māori. It has deprivation indices ranging from 2 to 7. Dunstan Hospital is operated by Central Otago Health Services Ltd (COHSL). Services include a generalist inpatient unit and a range of visiting specialist outpatient clinics. Base hospital and interventional cardiology services are provided 200 km away at Dunedin Public Hospital, Southern District Health Board (SDHB).

Prior to this project, patients needing an ETT were referred to the visiting cardiology clinic or, if necessary, admitted acutely to Dunstan Hospital. ETTs were conducted as part of the cardiology clinic and occasionally for in-patients. Local staff supervised the tests, all of which were then read by a Dunedin based visiting cardiologist.

The Hokianga area is rural/remote with a RRS of 65. The population is 6500, 74% of the population is Māori and the deprivation index is 10. The Hokianga Health Enterprise Trust (HHET) provides integrated health services for the area, including the hospital in Rawene. Base hospital services are provided 130 km away at Whangarei Hospital, Northland District Health Board (NDHB). The nearest interventional cardiology centre is 280 km away in Auckland. With the exception of emergency transfers, there is no direct referral pathway from Rawene Hospital to Auckland.

Visiting medical clinics (every second month) are part of the small range of outpatient clinics provided at Rawene Hospital by specialists from Whangarei Hospital. There is no on-site ETT equipment at Rawene Hospital. Prior to this project, Hokianga patients needing an ETT were first referred to a specialist outpatient clinic either at Rawene or Whangarei and would then have to travel to Whangarei Hospital, (or occasionally to Kaitaia), for the ETT. Those requiring an ETT acutely were transferred to Whangarei Hospital.

**Description of the service**

Clinical protocols were drawn up by the rural hospitals with input from the participating specialists, according to established guidelines. General Practitioners were advised of the referral process by letter. A standardised clinical record form was completed by the generalist for each ETT.

ETT clinics were held once a week at Dunstan Hospital using on site equipment.

ETT clinics were held every 6–8 weeks in Rawene coinciding with the visiting general physician’s outpatient clinics. The same physician bought portable ETT equipment from his practice and made it available to Hokianga Health to use on this project, free of charge, in conjunction with an onsite treadmill. At both sites the tests were supervised by local generalist doctors and nurses.

Testing commenced in September 2011 and continued through to November 2012 (Dunstan) and September 2012 (Rawene).

At Dunstan Hospital tests were read by a rural hospital generalist. The generalist provided a report for those tests where he felt confidently able to do so. Equivocal tests were sent on to the cardiologist for reporting.

At Rawene Hospital, all reporting was done by the rural hospital generalist and each report verified by the physician on the day.

All reports were sent to the patient’s GP and to the referring doctor, (if these were not the same.)

In both Dunstan and Rawene, the majority of patients were referred back to their GP to discuss their results and for ongoing management. On occasions, where clinically indicated, the patient was referred directly for specialist care from the ETT clinic.

With clinics only possible every 6–8 weeks in Rawene, any referrals which were deemed more urgent were referred to Whangarei Hospital.
Study design

In this study we documented the patient outcomes [ongoing GP management, referral to cardiologist, percutaneous intervention (PCI), Coronary Artery Bypass Grafting (CABG)]; audited the reporting of ETT by generalist doctors; determined the tangible costs and attempted to determine whether or not there was any rural - urban difference in the utilisation of ETT.

Ethics committee approval was obtained from the Lower South Regional Ethics committee with respect to the reading of the tests LRS/11/EXP/002.

Data was collected from the standardised clinical record form including the reason for referral, test result, patient disposition post-ETT and basic demographic data. We categorised each test result using conventional Criteria.17,18 These data were then collated, reviewed and tabulated.

An audit was undertaken of the ETT reports generated at the Dunstan site. In cases where the rural generalist did not feel confident about finalising the report, a provisional local report and the test were sent to the cardiologist for formal reporting. The provisional report and the cardiologist’s report were compared.

An additional 25 tests where only a local report had been generated were sent to the cardiologist for formal reporting at the end of the study. The tests were ordered according to the day and time they were performed and every sixth test was selected. The cardiologist report was then compared to the locally generated one. The cardiologist was blinded to the local report.

A simple financial analysis was undertaken to determine the tangible costs of the service.

We planned to collect data from the relevant DHB’s on the utilisation of ETT one year prior to and during the project. The intention was to identify any rural urban disparities and the impact this study had on these disparities.

Results

Patient demographic, referral and outcome data

Over a period of 12 months, 202 ETTs were carried out at Dunstan Hospital and 33 at Rawene Hospital. Three (1.4%) of the Dunstan patients and 22 (67%) of the Rawene patients identified as Māori.

The most common reason for the ETT was for diagnosis in patients with suspected IHD. A smaller number were referred because of arrhythmia or risk assessment in a patient with known IHD.

At Dunstan, 31 patients (15%) had a positive test result. Eighteen out of these 31 patients were referred directly to the public cardiology clinic (one was admitted acutely to Dunstan Hospital first), and another 7 were referred to a private cardiologist. The remaining 6 were returned to GP care following a discussion between the rural hospital doctor and the cardiologist.

Seventeen of the patients with positive tests proceeded to angiography and of these five had PCI, four had CABG and eight had angiograms with no flow-limiting stenoses (NFLS). Four patients (3%) with negative tests were also subsequently seen by cardiologists and one went on to have an angiogram with NFLS. Five of the 12 patients with equivocal tests were referred to cardiologists (two public and three private). Only one of these patients went on to have angiography (the result showed NFLS). All the remaining patients returned to their GP for follow up.

At Rawene, two patients (6%) had positive tests; both were seen by the visiting physician on the same day as the ETT and referred directly to Auckland for angiography. One was referred urgently and subsequently underwent CABG. The other was referred semi-urgently; the angiogram showed NFLS.

Of the 21 negative tests, (63%), all but one were returned to GP care. One patient with a negative ETT at full workload was referred to cardiology in view of a suspicious history despite the negative ETT, was referred on for angiography and went on to have PCI.

Two patients had an arrhythmia during the ETT, were seen by the physician on the same day and referred for further investigations. Six tests (18%) were suboptimal, where the patient was unable to
exercise long enough to get to their target heart rate. Three of these were referred on for further testing after discussion with the physician. Please refer to Table 1 below.

Table 1. ETT and patient outcomes in Rawene and Dunstan Hospitals

<table>
<thead>
<tr>
<th>Dunstan Hospital</th>
<th>N</th>
<th>GP</th>
<th>Private cardiologist</th>
<th>Public cardiologist</th>
<th>Admit ward</th>
<th>Urgent</th>
<th>Angiography / Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test result</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Routine</td>
</tr>
<tr>
<td>Negative</td>
<td>153</td>
<td>149</td>
<td>4</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive</td>
<td>28</td>
<td>3</td>
<td>7</td>
<td>18</td>
<td>1</td>
<td>1</td>
<td>16</td>
</tr>
<tr>
<td>Symptom positive</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equivocal</td>
<td>12</td>
<td>7</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Arrhythmia</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suboptimal</td>
<td>4</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>202</td>
<td>167</td>
<td>10</td>
<td>24</td>
<td>2</td>
<td>2</td>
<td>17</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rawene Hospital</th>
<th>N</th>
<th>GP</th>
<th>Physician</th>
<th>Urgent/ semi-urgent</th>
<th>Routine</th>
<th>No FLS</th>
<th>PCI</th>
<th>CABG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test result</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative</td>
<td>21</td>
<td>20</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Symptom positive</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Equivocal</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arrhythmia</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suboptimal</td>
<td>6</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exercise capacity</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>33</td>
<td>23</td>
<td>10</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Audit – reporting of test results

The generalist doctor reporting the Dunstan tests felt confident in providing a final report for 149 (74%) of the tests. For 53 tests (26%), (which were predominantly equivocal tests), the generalist wrote a preliminary report before the test was sent on to the cardiologist for definitive reporting. For the majority of these 53 tests (39 tests, 73%), there was no variation between the rural hospital generalist’s preliminary report and the cardiologist’s final one. For 11 tests (23%) the cardiologist downgraded the test (changed the result from equivocal to negative or positive to negative). For three tests (6%) the cardiologist upgraded the report.

There was 100% agreement between the local report and the cardiologists review for the 25 locally generated final reports that were randomly selected for audit at the end of study.

Rural – urban differences in ETT utilisation

We asked for domicile data on all patients receiving publicly funded ETTs in the year preceding the project and for the 12 months of the project. The SDHB was unable to retrieve this data from their systems because the ETT data is not collected in their main patient management system. Limited data was obtained from the NDHB from which an estimated ETT rate for Hokianga residents and urban Whangarei residents for 2010/11 and 2011/12 was extracted (see Table 2). This does not include the ETTs done at Rawene during this project. The utilisation rate for the urban Whangarei population was more than 1.5 times that of the rural Hokianga population.
Table 2. Accessibility

<table>
<thead>
<tr>
<th>District</th>
<th>Distance to ETT (km)</th>
<th>Closest ETT</th>
<th>ETT/1000 pop (2010–11)</th>
<th>ETT/1000 pop (2011–12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whangarei central</td>
<td>0–15 km</td>
<td>Whangarei Hospital</td>
<td>5.9</td>
<td>7.1</td>
</tr>
<tr>
<td>Hokianga</td>
<td>60–160 km</td>
<td>Whangarei or Kaitaia Hospital</td>
<td>3.8</td>
<td>4.4</td>
</tr>
</tbody>
</table>

Financial analysis

We calculated the direct costs of the service including doctor and nurse time, equipment costs, consumables, and cardiologist/physician oversight. The cost per test at both Dunstan ($132.50) and Rawene ($200) was considerably less than the national price of $281.13 (community referred tests-cardiology; purchase unit code MS00045 in the National Non Admitted Patient Collection [NCPAC] 2015).

The estimated real cost at Rawene was higher than at Dunstan due to the lower volume, the cost of loaning portable ETT equipment, and the specialist’s reading of every ETT test. The actual cost during the project was lower in Rawene because the specialist provided his services free of charge.

Nearly all of the patients referred to these rural services would otherwise have been referred to specialist cardiology services. The national price for a cardiology First Specialist Assessment (FSA) in 2012 was $429.49.

Comparing the cost the system would have incurred for these patients had they all been referred to a specialist cardiology service and undergone ETT (using the national prices), we can demonstrate a potential savings of over $125,000 for this small cohort of patients. Please see Tables 3 and 4 below for a summary of this information.

Table 3. Estimated cost – rural generalist ETT followed by FSA if required

<table>
<thead>
<tr>
<th>Rural generalist ETT followed by FSA if required</th>
<th>No. of patients</th>
<th>Dunstan ETT</th>
<th>Rawene ETT</th>
<th>Referred to FSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>202</td>
<td>$132.50 per patient</td>
<td></td>
<td>$200.00 per patient</td>
<td>$429.49 per patient</td>
</tr>
<tr>
<td>33</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 (18 patients)</td>
<td></td>
<td></td>
<td></td>
<td>$429.49 per patient</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$8,589.80</td>
</tr>
<tr>
<td>Total cost to system</td>
<td></td>
<td>$26,765.00</td>
<td></td>
<td>$8,589.80</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$41,954.80</td>
</tr>
</tbody>
</table>

Table 4. Direct referral for ETT/FSA estimated cost

<table>
<thead>
<tr>
<th>Direct referral to FSA for ETT using national prices</th>
<th>No. of patients</th>
<th>Dunstan ETT</th>
<th>Rawene ETT</th>
<th>Referred to FSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>202</td>
<td>$281.13 per patient</td>
<td></td>
<td>$429.49 per patient</td>
<td>$143,545.24</td>
</tr>
<tr>
<td>33</td>
<td></td>
<td></td>
<td>$429.49 per patient</td>
<td>$23,450.46</td>
</tr>
<tr>
<td>Total cost to system</td>
<td></td>
<td></td>
<td></td>
<td>$166,995.70</td>
</tr>
</tbody>
</table>
Discussion

Over a period of 12 months we provided a cost effective local generalist ETT service for two rural communities. Though the organisation of the service at the two hospitals necessarily differed to fit existing local services and available resources, the essence of both was an easily accessible service provided by local clinicians.

Central to both was collaboration between the DHB and the local trust-operated rural hospital, and integration between primary and secondary care. This, along with the option to refer to private cardiology services (Dunstan), and an innovative link-in from private practice (Rawene), resulted in a more seamless patient journey and shifted care ‘closer to home’.

Testing at both sites showed that the majority of patients did not require onward referral to specialist services, providing instead, useful information for the GP to continue to manage these patients in the community.

For example the information from the ETT report could support intensified medical management of IHD or a non-cardiac cause.

Clinical judgment about a patient’s ongoing symptoms over-rules an ETT result because of the test’s limited sensitivity as was the case here for one Rawene patient.

Our negative ETT rate is consistent with that reported elsewhere.\(^{18}\)

Our outcomes agree with previous findings that an appropriately trained and experienced generalist doctor is capable of safely reporting the majority of ETTs. They are also able to recognise those tests where the reporting is less straightforward and send them on to a cardiologist for further assessment and reporting.\(^{19}\)

Cost

ETT is no more costly to the health system overall when run in a rural area, and significantly less costly for the patient.

Travel to a distant hospital for the patient (and their support networks), means not only direct travel and often accommodation costs but also time off work and other duties. Further, public transport is sparse or absent in rural areas. For the Hokianga community there is added meaning to cost of travel from a cultural perspective: Māori have intrinsic relationships with whenua (land and identity), their whanau (family contribution to their health), and tupuna (elders who provide security, wisdom and guidance) which are generationally driven and is how Māori value their living environment which itself sustains life. Maintaining these values through kaitiakitanga (caring) sustains the people, therefore being moved from a trusted health service to distant health services causes anxiety in regard to Kaitiaki o te kainga (caring for home and land) and can further impact on health outcomes.

Our financial comparison of specialist delivered ETT vs. generalist delivered ETT is subjective. When DHBs fund providers they may use the purchase unit price, or the actual cost of delivering the test. Whilst this may be subject to negotiation with the provider, the difference is not material. We can identify no additional costs to the District Health Boards by providing this service rurally.

Rural vs urban differences in ETT utilisation

We were not able to obtain data to assess the geographic variation in the utilisation of ETT in the SDHB region or the impact that this study may have had on this. The data obtained from the NDHB was limited. We also noted that the way rural residents’ addresses are recorded in hospital systems is frequently not a good indicator of where the person actually lives, but instead often is their postal address—e.g. the closest store which could be several tens of kilometers away.

A recent NZ study identified large ‘rural versus urban’ disparities in the utilisation of computed tomography.\(^{20}\) Good data is needed if the urban vs rural disparities in access to services are to be identified and corrected; DHBs should be encouraged to collect this data.
Implications for rural services

Though we looked at only two rural areas and access to a single diagnostic test, this project illustrates the complexity and variation in systems within NZ in which rural clinicians and patients are required to operate. It suggests that the degree to which services are integrated across primary, secondary and tertiary care at the presenting rural facility has an important role in the delivery of downstream health care for that specific community.

Not only do these services and pathways seem fragmented and poorly co-ordinated, as has been noted elsewhere, they do not appear to be related in any way to patient need.

An integrated regional approach to the provision of ETT services is needed if disparities in access are to be remedied. A collaborative approach that involves local health service providers in clinical pathway development from the earliest stages will help ensure the service is locally appropriate and sustainable.

Transferability

We believe this is a sustainable way of delivering ETT services to rural communities that provides savings to the health system, improves access for rural patients and may help overcome some of the disparities in access to cardiac investigations faced by rural patients.

This service is capable of being replicated at other rural sites pending small investments in rural generalist training and equipment.

Competing interests: Nil.

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